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IMPROVING STRATEGIC TRANSPORT ENCOMPASSING CORRIDORS FROM M4 JUNCTION 34 TO THE A48 | HIGHWAY LINK STUDY

WelTAG Stage Two Plus | Impacts Assessment Report

CONSULTATION DRAFT

SEPTEMBER 2020

Improving Strategic Transport Encompassing Corridors from M4 Junction 34 to the A48 | Highway Link Study

WelTAG Stage Two Plus | Impacts Assessment Report

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1 Introduction

1.1 Purpose of the Study

1.1.1 Arcadis Consulting (UK) Limited has been commissioned by the Vale of Glamorgan Council to develop and appraise potential options for improving the strategic transport network encompassing corridors from M4 Junction 34 to the A48 (Five Mile Lane), including the Pendoylan Corridor (or alternative). The appraisal of options has been undertaken in accordance with the Welsh Government's latest version of WelTAG (December 2017[1]) including advice on the appraisal in relation to the Future Generations of Wales (2015) Act Well-being Goals[2]. The WelTAG Stage Two Plus report presents the development and proportionate appraisal of highway route options between the M4 Junction 34 and A48.

1.1.2 This WelTAG Stage Two Plus Impacts Assessment Report details the supporting evidence, data and analysis underlying the statements made in the WelTAG Stage Two Outline Business Case report (10028657-ARC-XX-XX-RP-TP-0001). As noted within the WelTAG guidance, the Impacts Assessment Report *'is a live document that builds up during the five WelTAG stages. It contains the analysis underlying each stage and is written for a technical audience. It presents detailed evidence on the anticipated impacts of each option under consideration and underpins the summaries of those impacts presented in the WelTAG stage document.'*

1.1.3 Furthermore, *'Where further evidence is required in future WelTAG stages, the WelTAG Impacts Assessment Report sets out the details of the proposed methodology for collecting this evidence and then, when it has been collected, presents the results of that work. The recommendations for future work in the next stage of the appraisal process should be presented in the Stage report.'*

1.2 Case for Change

1.2.1 The 'Case for Change' is set out in the Peter Brett Associates report contained in Appendix A.

1.3 Report Structure

1.3.1 The structure of this report is as follows:

- Chapter 2 presents a summary of the policy framework at the local, regional and national level.
- Chapter 3 presents the transport baseline conditions of the study area.
- Chapter 4 summarises the social context.
- Chapter 5 summarises the cultural context.
- Chapter 6 summarises the environmental context.
- Chapter 7 summarises the economic context.
- Chapter 8 provides the data source references.

[1] https://beta.gov.wales/sites/default/files/publications/2017-12/welsh-transport-appraisal-guidance.pdf

[2] https://beta.gov.wales/sites/default/files/publications/2017-12/WelTAG-2017-supplementary-guidance-the-well-being-of-future-generations-wales-act-2015.pdf

2 Policy, Legislation and Background Documents

2.1 Overview

2.1.1 This section provides a summary of the policy and legislative framework and background studies and documents which provide the context for this study.

2.2 National Legislation

Active Travel (Wales) Act (2013)

2.2.1 The Active Travel (Wales) Act came into force in 2013 and places a legal duty on local authorities to continuously improve infrastructure and routes for pedestrians and cyclists. The Act symbolises a landmark shift in policy direction to encourage and prioritise walking and cycling. The Act requires all local authorities to prepare maps of current access and identify potential future routes for use for active travel. The Act places a requirement upon all new road schemes and improvement schemes to consider the needs of pedestrians and cyclists at every stage, in particular during design. The Act aims to promote active travel by securing new and improved active travel routes and related facilities to enable people to partake in sustainable travel. The relevant base maps and Integrated Network Maps to this study are presented on each of the local authority websites.

Well-being of Future Generations (Wales) Act (2015)

2.2.2 The Act strives to improve the social, economic, environmental and cultural well-being of Wales. The vision is *'in 2050, Wales will be the best place to live, learn, work and do business.'* The Act makes the public bodies listed in the Act consider the longer-term perspective; engage with people and communities and each other; prevent problems; and to deliver a joined-up approach. The goals to represent what the long-term economic, social and environmental well-being of Wales are shown in Figure 2.

Figure 2 Well-being of Future Generations (Wales) Act – Well-being Goals

Goal	Description of the Goal
A prosperous Wales	An innovative, productive and low carbon society which recognises the limits of the global environment and therefore uses resources efficiently and proportionately (including acting on climate change); and which develops a skilled and well-educated population in an economy which generates wealth and provides employment opportunities, allowing people to take advantage of the wealth generated through securing decent work.
A resilient Wales	A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).
A healthier Wales	A society in which people's physical and mental well-being is maximised and in which choices and behaviours that benefit future health are understood.
A more equal Wales	A society that enables people to fulfil their potential no matter what their background or circumstances (including their socio-economic background and circumstances).
A Wales of cohesive communities	Attractive, viable, safe and well-connected communities.

Goal	Description of the Goal
A Wales of vibrant culture and thriving Welsh language	A society that promotes and protects culture, heritage and the Welsh language, and which encourages people to participate in the arts, and sports and recreation.
A globally responsible Wales	A nation which, when doing anything to improve the economic, social, environmental and cultural well-being of Wales, takes account of whether doing such a thing may make a positive contribution to global well-being.

2.2.3 The five ways of working as set out within the Act are shown in Figure 1[3]. The latest WelTAG guidance has been developed in such a way to ensure that public funds are invested in a way that maximises contribution to the well-being of Wales, as set out in the Well-being of Future Generations (Wales) Act. The onus is specifically focused upon the delivery of sustainable development, of which will in turn contribute to the achievement of the well-being goals.

Figure 1 Well-*being of Future Generations (Wales) Act – Five Ways of Working*

Planning (Wales) Act 2015

2.2.4 The Planning (Wales) Act became law in July 2015 and is a set of provisions that provide a modern legislative framework for the operation of the planning system. The key purposes of the Act are to:

- Strengthen the plan-led approach to planning, by the introduction of the National Development Framework and Strategic Development Plans.
- Providing a modernised framework for the delivery of planning services, by enabling some planning applications to be made directly to Welsh Ministers.

[3] http://futuregenerations.wales/about-us/future-generations-act/

- Make provision for pre-application consultation, and to require local planning authorities to provide pre-application services.
- Reform the development management system to streamline procedures, to ensure that applications are dealt with promptly.
- Improve enforcement and appeal procedures.

Environment (Wales) Act 2016

2.2.5 The Environment (Wales) Act 2016 puts in place the legislation needed to plan and manage Wales' natural resources in a more proactive, sustainable and joined-up way. It delivers the Programme for Government commitment to introduce new legislation for the environment. This positions Wales as a low carbon, green economy, ready to adapt to the impacts of climate change.

2.2.6 The act has been carefully designed to support and complement work to help secure Wales' long-term well-being, so that current and future generations benefit from a prosperous economy, a healthy and resilient environment and vibrant, cohesive communities. The key parts of the act of relevance to the study are:

- **Part 1 |** Sustainable management of natural resources – enables Wales' resources to be managed in a more proactive, sustainable and joined-up way. It also helps to tackle the challenges faced and is focused on the opportunities Wales' resources provide.
- **Part 2 |** Climate change – provides the Welsh Ministers with powers to put in place statutory emission reduction targets, including at least an 80% reduction in emissions by 2050 and carbon budgeting to support their delivery. This is considered vital within the context of existing UK and EU obligations and sets a clear pathway for decarbonisation. It also provides certainty and clarity for business and investment.
- **Part 7 |** Flood and Coastal Erosion Committee and land drainage – clarifies the law for other environmental regulatory regimes including flood risk management and land drainage.

Public Transport (Wales) Bill

2.2.7 The Welsh Government published a White Paper in December 2018 which sets out proposals to improve the legislative framework in Wales for how local bus services are planned and delivered, together with reform of the licensing regime for taxis and private hire vehicles[4].

2.2.8 A ministerial statement was issued in July 2019[5]. Consultation took place on the White Paper between December 2018 and March 2019. Following the consultation and engagement, work has been underway to build on the White Paper and develop the proposals for a Bill. In the First Minister's legislative statement on 16 July 2019, it was confirmed that the Public Transport (Wales) Bill would be included in year 4 of the current legislative programme.

2.2.9 Building on the wider bus reform agenda and Welsh Government's partnerships with local authorities and bus operators, the Bill will put in place enabling provisions that will provide a suite of tools for local authorities to consider using when planning and delivering bus services, including enhanced partnership working, franchising and local authority run bus services.

2.2.10 The Bill will put in place new information management and sharing arrangements, so that information to the public will be more accessible and reliable, and local authorities will be in a better position to make arrangements to address changes in service provision. The Bill will also amend the eligibility age for the mandatory concessionary fares scheme so that over time it will align with a person's state pension age.

[4] https://gov.wales/sites/default/files/consultations/2018-12/improving-public-transport_0.pdf

[5] https://gov.wales/written-statement-update-public-transport-wales-bill-and-wider-bus-reform-agenda

The Equality Act 2010 (Statutory Duties) (Wales) Regulations 2011

2.2.11 The Act came into force in April 2011 and requires public authorities to publish 'equality objectives' and a statement that sets out the steps intended to be taken in order to achieve the objectives and the time frame for doing so. The Equality Act 2010 (Statutory Duties) (Wales) Regulations 2011 is a key piece of legislation that must be taken into account throughout the WelTAG process.

Welsh Language (Wales) Measure 2011

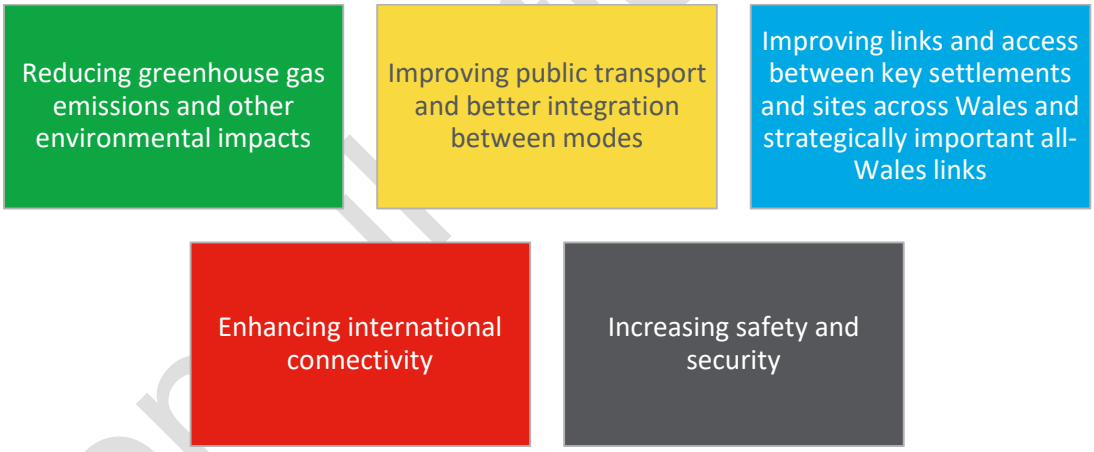
2.2.12 The Welsh Language (Wales) Measure was given royal assent in February 2011 and gives the Welsh language official status in Wales, meaning Welsh should be treated no less favourably than the English language in Wales. The measure also established the role of the Welsh Language commissioner to promote the Welsh language and improve the opportunities for people to use it.

2.3 National Policies and Strategies

One Wales: Connecting the Nation | Wales Transport Strategy (2008)

2.3.1 The Wales Transport Strategy (WTS) published in 2008 set out the Welsh Government's aim to improve transport. The WTS focused on the role that transport can play in delivering the wider policy agenda of integrating transport with spatial planning, economic development, education, health, social services, and environment and tourism, whilst meeting the strategic agenda and the implementation framework of the (then) Wales Spatial Plan. The vision of the WTS was *'to promote sustainable transport networks that safeguard the environment while strengthening our country's economic and social life'.*

2.3.2 The WTS set out five priorities, which provide additional strategic direction and work towards the long-term outcomes and maximise the scope for local solutions to transport challenges within a consistent national framework. The five priorities were:



2.3.3 The WTS had three key sustainable transport themes and a number of desired outcomes, which underpin the strategy. The three themes underpinning the strategy were:

- Achieving a more effective and efficient transport system.
- Achieving greater use of the more sustainable and healthy forms of travel.
- Minimising demand on the transport system.

2.3.4 The WTS notes how significant congestion exists on strategic routes such as the M4. Congestion is documented as costing businesses millions of pounds a year and hence improved transport (reliability) is a top priority of Welsh businesses.

Proposed approach to the Wales Transport Strategy replacement

2.3.5 During the past decade much has changed including the devolution of more powers to the Welsh Assembly; publication of overlapping legislation (Well-being of Future Generations (Wales) Act 2015;

Environment (Wales) Act), while further changes are anticipated arising through delivery of Prosperity for All – The National Strategy (2017), from Local Government reforms; post-Brexit funding and relationships; the recently awarded Wales and Border rail franchise and; the devolution of further transport related responsibilities.

2.3.6 It is against this background that the Welsh Government is seeking to develop a new WTS which recognises these recent changes and looks to address future opportunities and challenges. A two-tier approach to the replacement WTS is proposed, comprising an overarching policy statement supported by a number of thematic policy statements, which is due to be published in May 2020.

2.3.7 The overarching policy statement will set out how transport will work to deliver the four key themes in Taking Wales Forward and deliver against the Priority areas set out in Prosperity for All. The overarching policy statement will be underpinned by a suite of thematic policy statements which together form a new WTS. This would in turn, sit under the Economic Action Plan and the National Strategy.

Natural Resources Policy (2015)

2.3.8 Welsh Government's Natural Resources Policy (2015) is the second statutory product of the Environment (Wales) Act. The focus of the Natural Resources Policy document is the sustainable management of Wales' natural resources, to maximise their contribution to achieving goals within the Well-being of Future Generations Act. The policy set out three priorities:

- Delivering nature-based solutions.
- Increasing renewable energy and resource efficiency.
- Taking a place-based approach.

2.3.9 The Natural Resources Policy Statement states that motorised transport and industry are the main Welsh man-made sources of pollution. It is noted that levels of pollution can be lowered through measures employed in identified hotspots and through actions to drive improvements in technology and industrial practices.

2.3.10 Air and noise pollution are considered the two biggest environmental contributors to the burden of disease in the UK. There is an estimated cost of £9-19bn per year owing to fine particulate pollution[6]. It has also been estimated that in Wales in 2010, approximately 1,320 deaths could be attributed to long-term exposure to fine particles that can be inhaled deep into the lungs[7]. Noise pollution is considered the second biggest environmental contributor to the burden of disease in the UK. The estimated cost of noise pollution is at approximately £7-10bn per year[8]. The Natural Resources Policy Statement also indicates that the homes of more than 200,000 people in Wales are exposed to levels of road traffic noise exceeding World Health Organisation night noise guidelines.

Taking Wales Forward | 2016 – 2021 (2017)

2.3.11 Taking Wales Forward published in 2017, sets out how the Welsh Government will deliver within this Assembly term. The four cross-cutting strategies are:

- **Prosperous and Secure** – aim is better jobs, closer to home. We want work and secure housing for all, supported by sustainable growth in our businesses.
- **Healthy and Active** – commitment to helping improve health and well-being for all.

[6] www.gov.uk/air-quality-economic-analysis

[7] www.gov.uk/government/publications/estimating-local-mortality-burdens-associated-with-particulate-air-pollution

[8] www.gov.uk/noise-pollution-economic-analysis

- **Ambitious and Learning** – states that everyone deserves the opportunity to achieve their potential and that education changes lives and drives economic growth.
- **United and Connected** – continue to build a united and connected society, where everyone is respected and valued. The transport actions stated were:
  - Deliver an M4 relief road, and improvements to the A55, the A40 in West Wales and other trunk roads.
  - Create a South Wales Metro and advance the development of a North Wales Metro system.
  - Develop a new, not-for-profit, rail franchise and deliver a more effective network of bus services once powers have been devolved.
  - Ensure seamless ticketing arrangements and improved marketing as part of the new travel arrangements for Wales.
  - Ensure better access to active travel for all.

Prosperity for All | The National Strategy (2017)

2.3.12 The aim of Welsh Government's Prosperity for All (2017) is for *'every one of us having a good quality of life, and living in strong, safe communities.'* The strategy takes the key commitments of Taking Wales Forward 2016-2021 and sets out how these fit with the work of the wider Welsh public service.

2.3.13 The relationship between the Prosperity for All – The National Strategy (2017), Taking Wales Forward 2016-2021 (2017) and the Well-being and Future Generations Act (2015) is presented in Appendix B.

2.3.14 The Strategy aims to deliver quality health and care services, promote good health and well-being, and build healthier communities and better environments. As part of this, Welsh Government has set out that they will:

- Deliver an integrated public transport network which supports the aim to enable people to travel more actively, by combining different types of transport with walking and cycling.
- Deliver the South Wales Metro, underpinning the region's economic development, and spreading jobs and prosperity through more rapid transport, and ensuring that all new and significant developments in the region are sited within easy reach of a station.
- Build more purpose-built housing developments located close to easily accessible public transport.

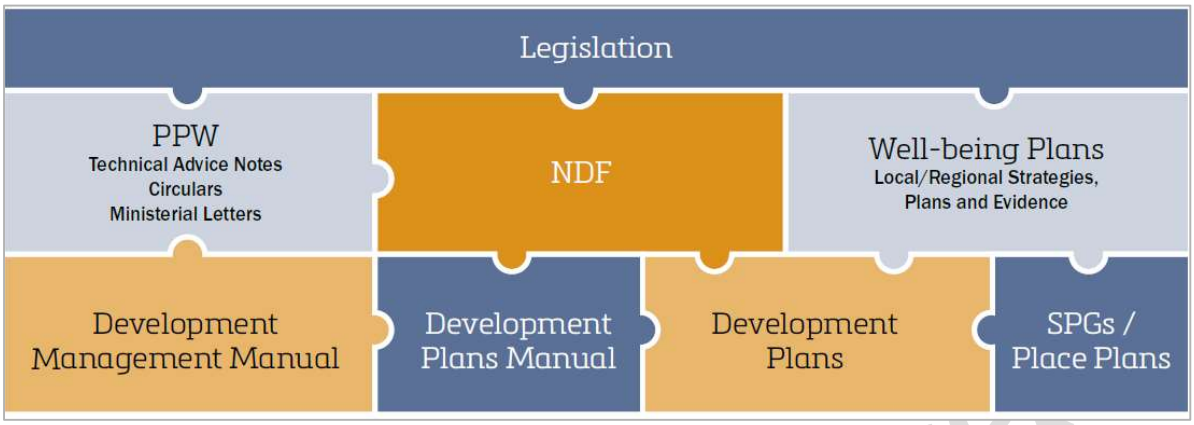
2.3.15 The Strategy acknowledges that attitudes to and expectations of transport are likely to change in ways that one cannot currently anticipate. It is anticipated that travel by private car will remain an important mode of travel for the sparse population of Wales. New powers over buses and the rail franchise also mean that Welsh Government is able to take a more joined up view across all transport modes which will enable to reduce carbon emissions, promote active travel, and get the most from public transport spending.

Planning Policy Wales | Edition 10 (2018)

2.3.16 Planning Policy Wales (PPW) (2018) aims to deliver the vision for Wales set out in the Well-being of Future Generations Act and provides the context for land use planning in Wales. The planning policies are supplemented with a series of Technical Advice Notes (TANs) and policy clarification letters, which together comprise national planning policy.

2.3.17 PPW additionally, sets out Welsh Government objectives, strategies and policies related to land use. PPW Edition 10 has been shaped around the policy themes of the well-being goals and updated to reflect the most recent Welsh Government strategies and priorities. PPW Edition 10 includes four key themes: Placemaking, Active and Social Places, Productive and Enterprising Places and lastly Distinctive and Natural Places. The Planning Framework for Wales, within which PPW Edition 10 sits is set out within Figure 2.

Figure 2 Planning Framework for Wales



Emerging National Development Framework | Draft Consultation Stage (2019)

2.3.18 The National Development Framework (NDF) will be a 20-year national spatial plan for Wales (Welsh Government, 2020 – 2040), replacing the current Wales Spatial Plan. Consultation on a draft NDF took place in Summer 2019 and the NDF is anticipated to be published in September 2020.

2.3.19 The draft vision is to *'help deliver sustainable places across Wales by 2040, by supporting positive placemaking and ensuring that our spatial choices direct development to the right places, make the best use of resources, create and sustain accessible, healthy communities, protect our environment and support prosperity for all.'*

2.3.20 The key outcomes related to the study are set out in Table 1. The NDF outcomes are overarching ambitions based on the national planning principles and national sustainable placemaking outcomes set out in Planning Policy Wales. The 11 outcomes have been identified for the next 20-year period.

Table 1 Draft National Development Framework Outcomes

Goal	Description
1	A Wales where people live and work in connected, inclusive and healthy places.
2	A Wales where people live in vibrant rural places with access to homes, jobs and services.
3	A Wales where people live in distinctive regions that tackle health and socio-econo0mic inequality through sustainable growth.
4	A Wales where people live in places with a thriving Welsh Language.
5	A Wales where people live and work in towns and cities which are a focus and springboard for sustainable growth.
6	A Wales where people live in places where prosperity, innovation and culture are promoted.
7	A Wales where people live in places where travel is sustainable.
8	A Wales where people live in places with world – class digital infrastructure.
9	A Wales where people live in places that sustainably manage their natural resources and reduce pollution.

Goal	Description
10	A Wales where people live in places with biodiverse, resilient and connected ecosystems.
11	A Wales where people live in places that are decarbonised.

Prosperity for All | Economic Action Plan (2017)

2.3.21 Welsh Government's Prosperity for All | Economic Action Plan (2017) aims to grow an inclusive economy whereby spreading opportunity and promoting well-being are central to the Plan. The Economic Action Plan aims to contribute towards the delivery of Prosperity for All – The National Strategy.

2.3.22 Within the Economic Action Plan, there is a commitment to a Regionally Focussed Model of Economic Development to develop the distinctive strengths of each region in pursuit of inclusive growth and to improve transport integration. The Economic Action Plan includes a five-year programme of transport capital funding through Transport for Wales for both transport maintenance and new projects.

2.3.23 Welsh Government's approach will be collaborative in order to ensure that efficiency of the transport network is maximised by addressing bottlenecks and pinch points. Collaboration will occur amongst the following actors in particular:

- The new Joint Governance Committee.
- The Chief Regional Officers.
- Transport for Wales.
- Local partners, including local authorities and regional transport authorities.

2.3.24 The Plan aims to deliver infrastructure capable of supporting a range of economic activities and creating attractive places to live, learn, work and invest. The National Transport Finance Plan details the transport infrastructure projects to be delivered. The EAP aims to decarbonise the transport network and improve air quality. In ten years, the aim is for all taxis and buses in Wales to have a zero-carbon footprint.

Prosperity for All | A Low Carbon Wales (2019)

2.3.25 Prosperity for All | A Low Carbon Wales (2019) outlines Welsh Government's commitment to tackling climate change. The Plan sets out *'an approach to cut emissions and increase efficiency in a way that maximises wider benefits for Wales, ensuring a fairer and healthier society. It sets out 100 policies and proposals that directly reduce emissions and support the growth of the low carbon economy.'* This latest plan continues the theme of ensuring integration across Welsh Government's strategic policies to decarbonise, including interconnectivity with Prosperity for All: The National Strategy (2017) which outlines decarbonisation as one of six cross-government priorities.

2.3.26 The plan (Part 3 – Sector Emission Pathways) outlines Welsh Government's commitment to shift towards active travel and a low carbon public transport system which is accessible to all and contributes to liveable and sustainable communities. There is an overarching aim for the transport sector to reduce emissions by 43% (from baseline levels) by the year 2030 through:

- Behavioural change measures (modal shift to more sustainable travel).
- Increasing uptake of electric vehicles.
- Reducing emissions from road and rail transport through vehicle and fuel efficiency measures.

2.3.27 The plan identifies that transport in Wales is dominated by the use of the private car, contributing to problems such as air quality issues, congestion and a significant proportion of Wales' CO2

emissions. To encourage a shift away from use of the private car, a range of proposals and supporting policies are highlighted as follows

- Proposals
  - Proposal 12 | Working to achieve a modal shift from car dependency to sustainable forms of transport
  - Proposal 13 | Significantly increasing modal share of active travel for short journeys
  - Proposal 14 | Piloting activity to promote the use of zero and ultra-low emission road vehicles
  - Proposal 15 | Promote the decarbonisation of Private Sector fleets in Wales
- Policies
  - Policy 46 | Increasing Active Travel
  - Policy 47 | Increasing travel by rail
  - Policy 48 | Increasing travel by bus
  - Policy 49 | Use planning policy to promote sustainable travel and reduce the need to travel
  - Policy 50 - Increasing the proportion of vehicles which are electric and ultra-low emission
  - Policy 51 | Plan for and invest in EV charging infrastructure
  - Policy 52 | Aiming to reduce the carbon footprint of buses to zero by 2028
  - Policy 53 | Aim to reduce the carbon footprint of taxis and private hire vehicles to zero by 2028
  - Policy 54 | Reduce transport emission

Welsh Government: Climate Emergency (2019)[9]

2.3.28 In April 2019, following the publication of Prosperity for All: A Low Carbon Wales, the Minister for Environment, Energy and Rural Affairs, on behalf of the Welsh Government, declared a climate emergency in Wales. The announcement drew attention to the significance of evidence from the Intergovernmental Panel on Climate Change. The announcement stated: that Wales has *'the determination and ingenuity in Wales to deliver a low carbon economy at the same time as making our society fairer and healthier.'*

Partnership for Growth | Strategy for Tourism 2013 to 2020

2.3.29 The Partnership for Growth strategy published in 2013, drives the tourism industry across Wales. The strategy published by the Welsh Government has a target of a 10% growth in real tourism earnings in Wales during the plan period under the goal of growing tourism in a sustainable way. The strategy is built round five pillars: promoting the brand; product development; people development; profitable performance; and place building.

2.3.12 The strategy has the following vision for tourism in Wales *'Wales will provide the warmest of welcomes, outstanding quality, excellent value for money and memorable, authentic experiences to every visitor.'* The strategy additionally, has the goal for *'Tourism to grow in a sustainable way and to make an increasing contribution to the economic, social and environmental well-being of Wales'* and the ambition to *'Grow tourism earnings in Wales by 10% or more by 2020.'*

Cymraeg 2050 | A Million Welsh Speakers (2017)

2.3.30 The Welsh Government has a strategic vision outlined in the Cymraeg 2050; A Million Welsh Speakers (2017) to increase the number of Welsh speakers throughout Wales, stating its vision as *'The year 2050: The Welsh language is thriving, the number of speakers has reached a million, and*

[9] https://gov.wales/written-statement-welsh-government-declares-climate-emergency

it is used in every aspect of life. Among those who do not speak Welsh there is goodwill and a sense of ownership towards the language and a recognition by all of its contribution to the culture, society and economy of Wales.' The strategy plans to achieve this vision by using three strategic themes including (1) increasing the number of Welsh speakers, (2) increasing the use of Welsh and (3) creating favourable conditions – infrastructure and context.

National Transport Finance Plan (2018 Update)

2.3.31 The National Transport Finance Plan was first published in July 2015. The purpose of the plan being to provide the timescale for financing schemes, the timescale for delivering schemes, detail the estimated expenditure, and identify the likely source of financing to enable delivery. The National Transport Finance Plan 2018 Update provides information on progress since publication and sets out a revised programme for the next three years and beyond.

2.3.32 The plan includes both revenue and capital initiatives, ranging from specific schemes to others where further investigatory and development work is required. The schemes which are stated as currently under construction include:

- (R6) M4 Junction 33 west/ A4232
- (R14) Improvements to Five Mile Lane, Vale of Glamorgan **[Note | scheme completed in 2019 and is now operational]**

2.3.33 Other relevant schemes are as shown in Table 2. Notably reference NEW 3 refers to the options being considered in this Stage Two WelTAG study.

Table 2 National Transport Finance Plan Schemes (2018 Update)

NTS Reference	Description
R32	Explore, and where practicable, apply measures to improve air quality in Air Quality Management Areas (AQMA) which relate to the WG network.
NEW 3	Five Mile Lane – Explore options from Sycamore Cross to [M4] Junction 34.
R27g	M4 J32 to J35 Corridor.
R27h	M4 J35 to J49 Corridor.
AT1b	Ensure the Active Travel (Wales) Act 2013 is delivered (Integrated Network Maps).
AT1c	Ensure the Active Travel (Wales) Act 2013 is delivered (Active Travel Schemes).
AT2	Delivering the actions set out in the Active Travel Action Plan.
AT3	Work with partners to deliver a programme of improvements to the National Cycle Network and that contribute to the objectives of the Active Travel Act.
BCT12	Work with local authorities and bus operators to identify congestion and pinch points on the network that impact on bus reliability and punctuality and ensure that solutions are integrated into wider highway improvements programme.
A1	Manage funding for the delivery of two return services a day between Anglesey Airport and Cardiff Airport.
A2	We will continue to work with Cardiff Airport and airlines to improve international connectivity to promote Wales as a destination for business and leisure, including taking forward measures to improve surface access to the airport.

NTS Reference	Description
IT1	Make grant funding available to local authorities for transport, including schemes that will help to improve access to employment sites, road safety schemes and schemes that will deliver the Welsh Government's wider priorities.
IT3	Review opportunities already identified by others to improve access between and to/ from Enterprise Zones and Local Growth Zones, and working with others, identify further opportunities. Develop and deliver an improvement programme or support others to do this.

International Connectivity through Welsh Ports and Airports (July 2012) | National Assembly Enterprise and Business Committee

2.3.34 The International Connectivity through Welsh Ports and Airports report provides recommendations for the Welsh Government, whilst acknowledging the need to engage with other stakeholders including the UK Government where appropriate. The aim of this inquiry by the National Assembly's Enterprise and Business Committee was to explore:

- How important major Welsh ports and airports are to the economy of their own regions and to Wales as a whole.
- What factors limit realisation of the potential offered by major Welsh ports and airports; what opportunities are available to develop this potential, and how these can be realised.
- How effectively Welsh Government policies support the development of major Welsh ports and airports.

2.3.35 The report notes that around 73% of passengers travel to Cardiff Airport via car whilst the remainder use public transport, in particular buses[10]. Recommendations included in the report are as follows:

- Recommendation 5: The Welsh Government should introduce an improved, dedicated express bus service between Cardiff Airport and the city centre, and explore options for funding that service with partners and other key stakeholders.
- Recommendation 8: The Welsh Government should integrate connectivity to Welsh Airports with transport and infrastructure policy for Wales as a whole and seek to negotiate the provision of better cross-border transport links and prospective electrification of rail services such as for Swansea and the Valleys.

2.4 Regional Policies and Strategies

Cardiff Capital Region | State of the Region Reports[11]

2.4.1 **Part 1: Connected |** This report brings together data on the Cardiff Capital Region's connectivity, notably highlighting key features of the region's transport and housing infrastructure. Travel to work patterns highlight the strong interdependencies that exist between the region's communities which reinforces the importance of the South Wales Metro, as does the continued evidence of the region's emphasis upon the car for commuting. The report also highlights how the region's housing infrastructure is critically linked to commuting patterns across the region.

2.4.2 **Part 2: Competitive |** The report brings together different indicators to highlight current economic performance and key trends across the Cardiff Capital Region. It is intended to present some of the

[10] Department for Transport, Record of Proceedings paragraph 138, 8 March 2012 (am)

[11] https://www.cardiffcapitalregion.wales/documents/

key data that now exists for the city region, and which can help benchmark the region's performance as the City Deal investment progresses over time. The report focuses on labour productivity utilising Gross Value Added (GVA) as a key measure of economic performance. The reports that economic performance is a key theme that emerges from the data. *'Whether it is the highly variable rates of unemployment, the number of jobs and skill levels, there is clear evidence that the CCR's goal of tackling inequalities is imperative.'*

2.4.3 **Part 3: Resilient |** The State of the Region report Part 3 notes Cardiff Capital Region's strategic goal of building a resilient regional economy. The report subsequently provides a selection of socio-economic, cultural and environmental indicators to support the region's drive towards resilience, including for example population dynamics, wealth and deprivation, health and well-being and environment, culture and heritage.

Cardiff Capital Region | Industrial and Economic Plan

2.4.4 The Regional Economic Growth Partnership was established to advise on the implementation of the Cardiff Capital Region City Deal's Wider Investment funds. The Industrial and Economic Plan is a 20-year plan setting out an ambitious and long-term vision to boost productivity and accelerate economic and inclusive growth in the region. The approach will be based on five key factors including cohesion, scale, leverage, return on investment and ecosystem development.

2.4.5 A key part of the plan is establishing infrastructure that is fit for the future, both digital and physical. The region seeks to implement infrastructure that connects the region effectively by road, rail and air and notes the following key initiatives to achieve this goal:

- Continue to work closely with the UK and Welsh Governments to further develop, enhance and implement the transport network to improve links within the region, reduce congestion and connect people.
- Embrace the Metro as a backbone to connecting CCR and shaping places on its networks.
- Develop a series of strategic employment spaces across the region to meet the needs of businesses.
- Utilities networks to ensure the region is ready for the future of electric and/ or hydrogen vehicles.

Cardiff Capital Region | City Deal Business Plan 2020/21

2.4.6 The City Deal Business Plan outlines the activities Cardiff Capital Region will progress through the Wider Investment Fund (WIF). The Annual Business Plan is prepared in the context of the overarching five-year Joint Working Agreement Business Plan, which was approved by Regional Cabinet in February 2018 and all ten Councils in and around March 2018. The report highlights the key challenges the region faces including:

- Low levels of competitiveness and productivity.
- Low levels of R&D investment and intensity.
- High growth and competitiveness areas cheek by jowl with some of the most deprived and impoverished places in the UK.
- Dependency mind-set has limited choices and eroded self-esteem.

2.4.7 Transport engineering forms one of ten priority sectors recognised with investment priorities focussed around innovation, infrastructure and challenge. The report highlights several delivery programmes including the following transport-based initiatives:

- **Metro Plus |** Schemes are now moving towards final stages of WelTAG with delegations for funding approvals to the Regional Transport Authority.
- **LEV Strategy, Taxi Strategy and Infrastructure Charging Models |** The Taxi Strategy was approved in 2019 and discussions are taking place with Transport for Wales and the UK Government's Electric Vehicle Infrastructure Investment Fund (managed by Zouk Capital) regarding development of a regional gain-share model.

- **Cardiff Metro Central Interchange |** The circa £200m Cardiff Metro Central Interchange project is underway linked to the comprehensive redevelopment of Central Square and the Southside Quay area of the City.

2.4.8 A range of priorities are presented for the years ahead including a comprehensive climate crisis response encompassing a comprehensive plan, vision and mission for energy and clean growth, and 'planning ahead' – taking longer-term view and beginning to establish plans and infrastructure proposals for the future, especially important for sustainable transport.

Network Rail Welsh Route Study (2016)

2.4.9 Network Rail published the Welsh Route Study in March 2016[12], which sets out the plans for railway in Wales that is fit for the future. The study is a key part of the rail industry's strategic planning process for the future, assessing how demand for rail will grow in response to the economy. The strategic priorities that underpin this Route Study are:

- Safety – to ensure all our customers, staff and suppliers get home safe every day.
- Economic growth – the railway is integral to the economy and thus a better railway is pivotal in delivering a better Great Britain.
- Social value – the railway is crucial in supporting local economies by providing access to employment, education and other social infrastructure as well as the retail and tourism sectors.
- Digital Railway – the rail industry's Digital Railway blueprint will revolutionise train control, ticketing, tariffs and information.
- Capacity – longer trains and increased frequency of train services to accommodate growth in passenger numbers will require the capability of the railway to be enhanced.
- Connectivity – the role rail can play in connecting communities and making interchanges easier and more reliable, both between trains and between trains and other modes.
- Punctuality – more needs to be done to get customers to their connections or destinations on time.
- Weather Resilience – future proofing the railway system from the worst effects of climate change is crucial to future plans.

2.4.10 The Route Study estimated growth in passenger peak demand for commuting to Cardiff from 2013 to 2023 and 2043. For the Vale of Glamorgan Line, it is estimated that passenger demand will grow by 80% by 2023 and 159% by 2043, based on the Prospering in Global Stability scenario (PGS).

Network Rail Wales Route Strategic Plan (2019)

2.4.11 In March 2019, Network Rail presented their Control Period 6 Strategic Business Plan. The report states that the plan focusses on four key areas encompassing safety, reliability, affordability and sustainability to support the continued forecast growth in passenger numbers during Control Period 6. In addition, the plan also considers changes in asset policy, deferrals from Control Period 5, electrification, and safety, health and environment strategies. Route enhancements that form the strategic approach to Control Period 6 encompass a range of on and off-track strategies including digital railway, telecoms and property strategies, together with enhancements to track, signalling, E&P, structures and buildings. The plan also outlines maintenance and operational strategies.

Network Rail Wales & Western Delivery Plan for 2019 – 2024 | Control Period 6

2.4.12 Network Rail has outlined its specific route enhancement work planned for Control Period 6, detailing a range of work to enhance rail travel across its Wales and Borders route. A selection of key work is outlined as follows:

[12] https://cdn.networkrail.co.uk/wp-content/uploads/2016/11/Welsh-Route-Study.pdf

- Network Rail is supporting Transport for Wales' £5bn plan to transform rail services, with increased capacity, new rolling stock and improvements to stations across the network. This will include the transfer of the Core Valley Lines infrastructure to Transport for Wales.
- Working with Network Rail's partners at Transport for Wales, they've developed joint performance measures focussed on delivering to the minute punctuality and a right time railway.
- Network Rail are investing £176m in refurbishing and replacing track across the network and £27m to meet the challenge of climate change and extreme weather in Wales.
- They'll be delivering phase two of the Port Talbot West resignalling project; improving resilience, reliability and reducing delays in South West Wales.
- In partnership with the British Transport Police they're focussed on reducing route crime and its impact on passengers. Priorities include reducing the number of bridge strikes and tackling cable theft and trespass.

The Rail Network in Wales | The Case for Investment (2018)

2.4.13 Welsh Government commissioned Professor Mark Barry to consider the strategic and economic case for investment in Wales' rail infrastructure. The output of the study suggests that there is a *'positive and compelling case for major rail investment that addresses both the Welsh Government's economic ambitions and [Wales'] broader environmental and well-being objectives.'* The report further states *'that a programme of investment in rail infrastructure in Wales is required to support a stronger, inclusive and more equitable economy, delivering prosperity for all by connecting people, communities and businesses to jobs, services and markets.'*

2.4.14 With regard to the South Wales Main Line there is a vision to support inclusive and balanced economic growth in Wales and south west England by providing faster and more frequent services through investment in the Great Western rail corridor. It is proposed that this is achieve through implementation of the following key objectives:

1. Reduce rail journey times between West Wales and London, towards targets of
   - 90 minutes between Cardiff and London Paddington
   - 30 minutes between Cardiff and Bristol Temple Meads
   - 30 minutes between Swansea and Cardiff
2. Increase service frequencies between south west Wales and London; Cardiff and Bristol Temple Meads; and Swansea and Cardiff.
3. Provide sufficient capacity and improve rail network resilience between Cardiff and Bristol to accommodate future passenger and freight demand.
4. Enhance rail connectivity to international gateways/ airports and Enterprise Zones.
5. Improve Park and Ride provision for accessing the South Wales Main Line and reduce reliance on the M4 corridor.
6. Improve integration between main line rail and the wider transport network, especially the developing south Wales and Bristol Metro systems.
7. Maximise the potential for stations to accelerate urban regeneration and major development site delivery.
8. Increase the number of trips made by public transport, focusing on commuter trips.
9. Reduce the environmental impact of transport, especially carbon emissions & air quality.
10. Improve rail network efficiency to allow a lower future subsidy requirement per passenger.

2.4.15 The report outlines several potential solutions to support this vision as follows, including the potential for a new railway station at M4 Junction 34 (Miskin):

- Line speed improvements from Severn Tunnel Junction to Swansea and beyond that enable the benefits of new trains to be realised (including consideration of electrification and more capacity).
- New services operating on a balanced pattern of fast and stopping services (4tph from Cardiff to London and 2 tph from Swansea; 4 tph Bristol Temple Meads to Cardiff and 2tph from Swansea).
- Potential for new stations at Magor, Llanwern, Cardiff Parkway, Rover Way, Miskin Junction 34, Brackla, Cockett and St Clears.
- Enhanced transport interchange and Park and Ride near the M4 in Swansea Bay.

2.4.16 The report also provides an economic and transport context for South Wales, noting an overarching challenger to increase Wales' Gross Value Add (GVA) per capita, as well as deliver its obligations on sustainability and well-being. The report notes that *'transport can only be part of a solution that requires complementary measures focussed on communities and bespoke regeneration and economic development interventions.'* Key items including highways and congestion, bus integration, active travel, rail freight and emerging technologies are also considered.

Cardiff Capital Region Metro Study (2013)

2.4.17 Welsh Government commissioned M&G Barry Consulting (with support from other stakeholders) to produce the Cardiff Capital Region Metro Study, which sets out a strategic regional plan for developing the Metro. The Metro is described as *'a turn up and go integrated transport network that will connect over 70% of the population of the Cardiff City Region, developed in a way that enables and/ or enhances developments at strategic sites, maximises economic benefits & facilitates regeneration.'* The study identified a number of relevant existing transport problems and key trends, including:

- Limited integration between rail and bus services.
- Problems many people in the region encounter in accessing work, education and healthcare because of lack of available, affordable transport.
- Limited public transport access to some of the region's major hospitals, schools and other public services
- The Vale of Glamorgan rail line generally has poor frequencies (with one train an hour).

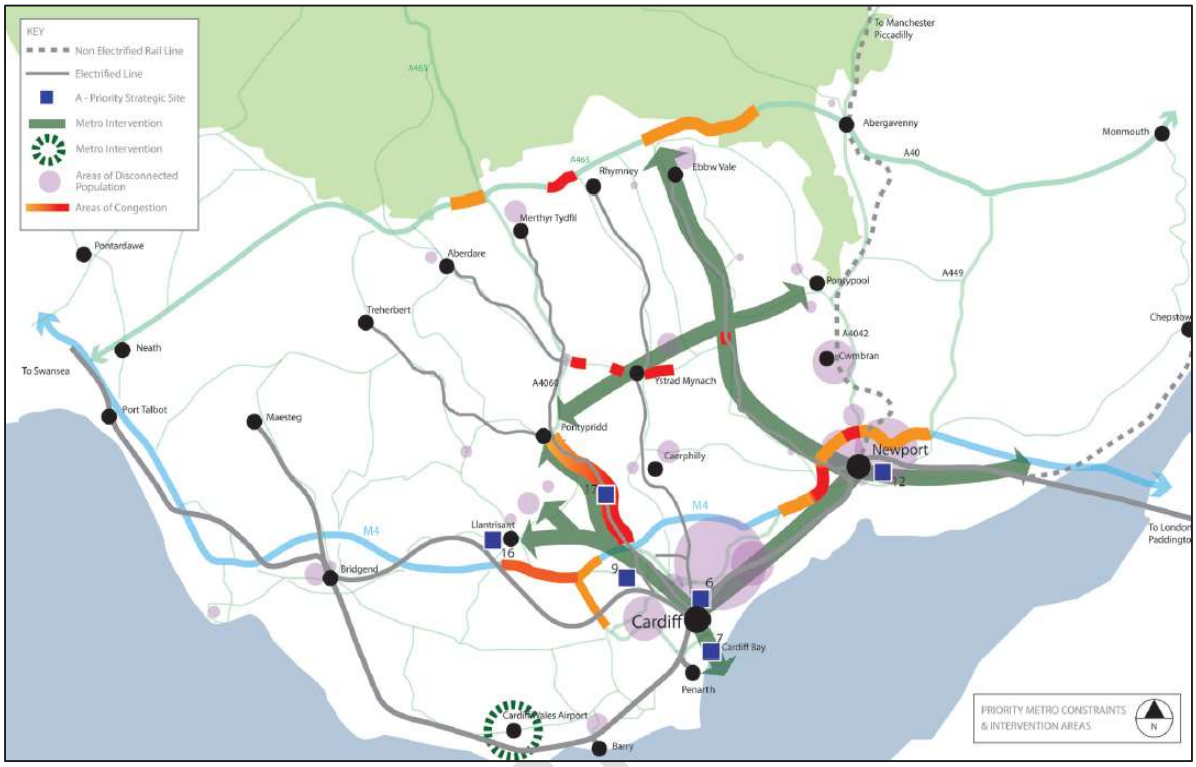
2.4.18 The Metro's extent includes routes east of Cardiff including to Cardiff Airport and Pontyclun, towards Maesteg. The study noted the need for invested improved connectivity for Cardiff Airport, stating 'There is much evidence that demonstrates a link between the economic performance of a region and its level of international connectivity. Whilst better access to Heathrow and its extensive range of long-haul flights is essential to the economy of South East Wales, so is the need to provide access to international markets from Cardiff Airport.

2.4.19 The report noted that such connectivity will support the case for inward investment to the region. Whilst Cardiff Airport has a limited natural catchment area, it can be extended with the appropriate investment in transport infrastructure. This may help the airport secure untapped demand for services to destinations in the Middle East, some European cities and locations in the US & Canada (predominantly served via Heathrow and Bristol'.

2.4.20 Cardiff Airport is noted to be a pivotal regional asset whose performance can be enhanced by increasing its catchment area by public transport. From a Metro perspective this is said to require a new or upgraded airport station - either on the current Vale of Glamorgan line or at the current airport site via a new spur. New services from across the region and from out of the region will be able to access the airport either directly or via a change at Cardiff central.

2.4.21 In line with the National Transport Plan 2010, half hourly services would then be introduced on the Vale of Glamorgan line to facilitate access to airport. M4 Junction 34 (M4 Junction 32-34) is referred to as an area experiencing congestion and as an existing transport problem that is in need of addressing. An overview of the Metro priorities is shown in Figure 3.

Figure 3 Metro Priorities[13]



Transport for Wales Rail Services | Wales & Borders Franchise Planned Future Work – South East Wales

2.4.22 Transport for Wales Rail Services is the delivery body for transport services on behalf of Welsh Government and are responsible for the Wales and Borders Franchise (run by KeolisAmey)

2.4.23 The following outlines planned future works for south east Wales[14].

- Remove Pacer trains by December 2019 (Passenger feedback has highlighted the need to improve capacity and resilience in the fleet as a key priority, TfW plan to deliver this by keeping Pacer trains for a short period during 2020).
- Introduce a Central Metro that improves journey times and increases frequency to at least four trains per hour from the head of each valley using new trains.
- Introduce new Metro Vehicles with level boarding by December 2022, which will provide a modern metro-style service to the Treherbert, Aberdare and Merthyr valleys.
- Retain the link from Penarth, Barry and Bridgend to destinations north of Cardiff Central using new tri-mode trains (overhead electric, battery and diesel) from December 2023.
- Invest in Cardiff Central station from April 2025, Abergavenny station from April 2023, Chepstow from April 2025 and Merthyr Tydfil from April 2020.
- Build new stations at Crwys Road, Loudoun Square and Cardiff Bay by December 2023, and Gabalfa by 2028. We will relocate Treforest Estate station by December 2025 to improve safety and convenience.

[13] Cardiff Capital Region Metro Study (2013)

[14] https://trc.cymru/whats-happening-south-east-wales

- Simplify the Cardiff Valley fare structure from January 2020, reducing Anytime Return fares by 12.5% and Weekly Season tickets by 14% for 33 of the outer stations.
- Develop a fleet maintenance depot at Taff's Well and a dedicated Infrastructure Management depot in the Valleys. Both will use local training and development facilities such as Coleg y Cymoedd.
- Introduce three new Community Rail Partnerships, recruiting a Community and Stakeholder Manager and nine Community and Customer Ambassadors by 2021.
- Eliminate diesel use on the Central Metro lines by 2024.
- Provide ticket machines at all South Wales Metro stations by April 2019.
- Introduce pay-as-you-go for users of smartcards by April 2020.

2.5 Local Policies & Strategies

Vale of Glamorgan Local Development Plan | 2011 – 2026 (2017)

2.5.1 The Vale of Glamorgan Local Development Plan (LDP) 2011-2026 was adopted on 28th June 2017, superseding the previous adopted Unitary Development Plan (UDP). The LDP is the basis for decisions on land use planning in the Vale of Glamorgan and will be used by the Council to guide and manage new development proposals. The plan has been written mindful of the need to regenerate and support communities and in doing so seeks to achieve a balance between economic growth, social cohesion and environmental impact.

2.5.2 Pendoylan, Bonvilston, St Nicholas and Peterston-super-Ely are identified as minor rural settlements with the LDP Settlement Hierarchy. The LDP refers to the minor rural settlements as functionally linked, emphasising the importance of safeguarding facilities as well as facilitating new development opportunities. The LDP Strategy comprises four key elements 'to promote development opportunities in Barry and the South East Zone. The St Athan area to be a key development opportunity and Cardiff Airport a focus for transport and employment investment. Other sustainable settlements to accommodate further housing and associated development.'

2.5.3 A summary the key strategic policies relevant to the study have been included within Table 3, with an applicable section of the Vale of Glamorgan LDP proposals map (2017) relevant to the study area shown in Appendix C.

Table 3 Key Strategic Policies Relevant to the Study Area

Policy	Description
Policy SP1	Delivering the Strategy (including 4. Promoting Sustainable Transport).
Policy SP2	Strategic Sites – Land is allocated for development at strategic sites including mixed use at St Athan and employment uses at land adjacent to the airport and Port Road, Rhoose, as part of the St Athan – Cardiff Airport Enterprise Zone.
Policy SP5	Employment Requirements – To ensure the continued prosperity of the Vale of Glamorgan and promote growth in the capital region.
Policy 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 (RTP) and the Local Transport Plan (LTP) will be favoured. Priority will be given to schemes that improve highway safety and accessibility, public transport, walking and cycling. Surface and public transport access to Cardiff Airport is highlighted as in need of significant improvements if the potential of the airport is to be realised.

Policy	Description
	This will include bus priority measures to the airport, a new Northern Access Road, with the latter incorporating walking and cycling infrastructure. The provision of a strategic highway network is further described as vital to the efficient movement of people and goods throughout the Vale of Glamorgan, with particular emphasis on providing improvements in access to Barry, Cardiff Airport and St Athan from the M4.
Policy 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: The architectural and/ or historic qualities of buildings or conservation areas, including locally listed buildings. Historic landscapes, parks and gardens. Special Landscape Areas (SLA). The Glamorgan Heritage coast. Sites designated for their local, national and European nature conservation importance. Important archaeological and geological features.
Policy MD7	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.
Policy MD8	Historic Environment – Development proposals must protect the qualities of the built and historic environment of the Vale of Glamorgan.
Policy MD9	Promoting Biodiversity – New development proposals will be required to conserve and where appropriate enhance biodiversity interests unless certain conditions can be demonstrated.
Policy MG9	Employment Allocations – including at Land to the South of Junction 34 M4 Hensol; Land adjacent to Cardiff Airport and Port Road, Rhoose; and Aerospace Business Park, St Athan Rhoose.
Policy MG10	St Athan – Cardiff Airport Enterprise Zone – including provision of sustainable transport infrastructure.
Policy MG11	Land to the south of Junction 34 M4, Hensol – Land is allocated to the south of Junction 34 M4 (Hensol) for employment purposes to meet local need.
Policy MG16	Transport Proposals – Land for the following transportation schemes (relevant to the study) is allocated: Walking and cycling: A4050 Port Road to Cardiff Airport. Rail: Modernisation of the Valley Lines. Highways: Northern Access Road (St Athan Enterprise Zone); Improvements to the A4226 between Waycock Cross, Barry and Sycamore Cross, A48 (Five Mile Lane); North of A48, Bonvilston Road Improvements.
Policy MG17	Special Landscape Areas – 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. The designation of SLAs is not intended to prevent

Policy	Description
	development but to ensure that where development is acceptable, careful consideration is given to the design elements off the proposal such as siting, orientation, layout and landscaping, to ensure that the special qualities and characteristics for which the SLAs have been designated are protected.
Policy MG19	Sites and Species of European Importance – Development proposals likely to have a significant effect on a European site will only be permitted under certain conditions.
Policy MG20	Nationally Protected Sites and Species – Development likely to have an adverse effect either directly or indirectly on the conservation value of a Site of Special Scientific Interest (SSSI) will only be permitted under certain conditions.
Policy MG21	Sites of Importance for Nature Conservation, Regionally Important Geological and Geomorphological Sites and Priority Habitats – Development proposals likely to have an adverse impact on sites of importance for nature conservation or priority habitats and species will only be permitted under certain conditions.
Policy MG22	Development in Minerals Safeguarding Areas – Known mineral resources of sandstone, sand and gravel and limestone are safeguarded. New development will only be permitted in any area of known mineral resource under certain conditions.

Vale of Glamorgan Local Transport Plan (2015)

2.5.4 The Vale of Glamorgan Local Transport Plan (LTP) has been established to recognise the diverse economic and social geography, and overlapping labour and housing markets that exist throughout the Capital Region (encompassing Cardiff, Blaenau Gwent, Bridgend, Caerphilly, Merthyr Tydfil, Monmouthshire, Newport, Rhondda Cynon Taf, Torfaen and the Vale of Glamorgan).

2.5.5 Whilst acknowledging the requirement for a collaborative approach for the future development of the Capital Region, the LTP seeks to identify the sustainable transport measures required to ensure Vale of Glamorgan Council adheres to current requirements and good practice, to allow for a sustainable transport environment for the period 2015 to 2020, as well as looking forward to 2030. The plan therefore seeks to secure better conditions for pedestrians, cyclists and public transport users and to encourage a modal shift away from the single occupancy car. The LTP also *'seeks to tackle traffic congestion by securing improvements to the strategic highway corridors for commuters who may need to travel by car.'* The plan highlights actions required including:

- In partnership with bus operators, negotiate expansion of current bus services, linking to key settlements and interchanges.
- Encourage use of community transport provision to sustain and entice bus operators/ community transport providers to take over once grown to acceptable sustainable level of patronage.
- To deliver existing safe routes in communities' schemes identified by schools and the public and encourage more schemes to come forward for consideration and implementation.
- In partnership with bus operators, negotiate expansion of current services, linking routes where there needs to be interchange and ensuring timings of connections are acceptable. Encourage use of integrated ticketing for services. Increase Community Transport to cater for demand.
- Deliver highway/ junction improvement schemes at key locations.
- Deliver bus infrastructure improvement schemes/ corridors.
- Provide Park & Ride/ Park & Share.

Highway Impact Assessment | Vale of Glamorgan Council Deposit LDP Background Paper (2013)

2.5.6 Capita Symonds was commissioned by Vale of Glamorgan Council to undertake a capacity assessment of the impact of possible future LDP residential development sites on the strategic highway network. This forms part of the evidence base for the deposit LDP. Table 4 presents the link and junction capacity assessment results within the appraisal area (based on Ratio of Flow to Capacity (RFC) / degree of saturation) for the base year and the future year with the LDP proposals having been implemented.

2.5.7 The table shows that one junction within the appraisal area (Sycamore Cross) was forecast to be over capacity in the future 2026 year with or without pedestrians. In 2012, the table shows that the junction is over capacity with pedestrians, but within capacity without pedestrians. Junction improvements have been made to the Sycamore Cross junction since the report was published. Sycamore Cross was previously a priority junction; however, it is now a signalised junction with turning lanes and formal pedestrian crossing facilities.

Table 4 Junction Capacity Assessment Results

Link / Junction Name	2012 AM	2012 PM	2026 AM	2026 PM
A48/ Five Mile Lane/Road to Pendoylan (Sycamore Cross)	Over Capacity with Pedestrians	Over Capacity with Pedestrians	Over Capacity with or without Pedestrians	Over Capacity with or without Pedestrians
A48 (nr the Old Post Public House) EB	Within Capacity	Within Capacity	Within Capacity	Within Capacity
A48 (nr the Old Post Public House) WB	Within Capacity	Within Capacity	Within Capacity	Within Capacity
A48 (nr St Nicholas) EB	Within Capacity	Within Capacity	Within Capacity	Within Capacity
A48 (nr St Nicholas) WB	Within Capacity	Within Capacity	Within Capacity	Within Capacity

Sustainable Transport Assessment | Vale of Glamorgan Council Deposit LDP Background Paper (2013)

2.5.8 The Sustainable Transport Assessment forms part of a series of topic papers prepared by Vale of Glamorgan Council as part of the evidence base used to inform the production of policies and site allocations for the Deposit LDP. This assessment seeks to identify the sustainable transport measures required to create and ensure a sustainable transport environment in the Vale of Glamorgan.

2.5.9 Vale of Glamorgan Council is committed to reducing the environment impact of its activities and as such seeks to provide transport infrastructure and transport services to assist the public to choose sustainable travel modes for all journeys where possible. This includes for all new developments to include off-road shared use walking/ cycling routes where possible and cycle signs on main roads where off-road facilities are not practical.

- **Walking and Cycling |** A number of walking and cycling schemes have been funded/ proposed in the appraisal area since the RTP Capital programme implementation began in April 2010. This includes NCN88 (£311,000) – Match funding European Creative Rural Communities Grant over a 3-year programme to deliver walking and cycling routes throughout the rural Vale, including around Cardiff Airport.
- **Bus |** The report notes that at the time of writing within the last five years, funding for bus services had declined. There had been a reduction of £8m of Grant throughout Wales despite the agreed objectives of increased patronage and improved services still standing.

2.5.10 The LDP supports Bus-Based Park & Ride initiatives as a transport planning tool that can be used to encourage car users to switch to public transport. Locations identified as suitable for developing Park and Ride sites include M4 Corridor Junction 34/ Hensol (of which it is noted that no land has so far been identified). It is noted that bus based Park and Ride sites need to be large enough to significantly reduce car traffic on the target corridors and that for regional sites, parking for a minimum of 500 cars will be required along with bus priority measures along the line of route. Essential factors to address in the design and implementation of Park and Ride sites include:

- Clear and conspicuous signposting.
- Ease of access to the site.
- Comparative Bus-Based Park & Ride and central area parking tariffs.
- The quality, frequency and reliability of the transit service.
- Journey time advantages over the car.
- Site facilities, such as shelter, passenger information and security measures.

Cardiff Airport 2040 Masterplan | Setting Intentions for Wales' Largest Airport

2.5.11 To support Cardiff airport's vision to be a pioneering airport business, a Masterplan has been completed in accordance with UK Government Aviation Policy Framework 2013 to outline growth plans for the next 20-year period towards becoming a key gateway to the United Kingdom. The economic significant of Cardiff Airport is highlighted, *'…both as an international gateway and as a major driver within the Welsh Economy, supporting 1,800 aviation-related jobs at the Airport as well as directly and indirectly supporting a further 2,675 jobs across the wider area.'*

2.5.12 The Masterplan subsequently recognises a number of drivers and opportunities for change including connectivity and accessibility, customer experience, technology, culture and identity, environment and sustainability, and business and economy. In addition to recognising Cardiff airport and its associated Enterprise Zones as a strategic opportunity area, it also describes the importance of the airport towards supporting Cardiff Capital Region achieving its priorities to achieve regionally and nationally significant economic growth and to attract employment opportunities and skills to the region. A number of expansion and improvement plans are subsequently outlined to help facilitate its wider vision including:

- A new passenger and cargo terminal with replacement aircraft parking stands.
- New dedicated road access to be provide for the terminal from the A4226, separating airport traffic from other users, including surface connectivity to the Enterprise Zone.
- Improvements to pedestrian and cycle access to and through the airport site, including links to Rhoose and Barry.
- Future integration with the Metro with a safeguarding bus link as well as an improved, dedicated connection between the terminal and Rhoose Cardiff International Airport railway station to improve the transfer experience.
- Open space, public realm ad landscaping improvements, safeguarded land for expansion and improved rail links.

2.5.13 The Masterplan's commentary in surface access include existing and opportunities for future transport links including M4 Junction 34 to A48 link road, Five Mile Lane improvements (since completed), Great Western mainline improvements, South Wales Main Line improvements, South Wales Metro development, rail frequency enhancements and express bus connectivity.

2.6 Supplementary Planning Guidance

2.6.1 The Vale of Glamorgan Council has produced a number of Supplementary Planning Guidance (SPG) documents in support of the adopted LDP. These are available to view on the Council's web site with the following SPGs noted for the purposes of this study:

- Planning Obligations
- Cardiff Airport and Gateway Development Zone
- Tourism and Leisure Development
- Sustainable Development
- Parking Standards
- Travel Plan
- Trees, Woodlands, Hedgerows and Development
- Biodiversity and Development
- Design in Landscape

2.7 Other Relevant Documents and Policy Guidance

2.7.1 The following background evidence is also considered relevant towards the WelTAG appraisal of the proposed options:

- Cardiff Airport and St. Athan Enterprise Zone – Strategic Plan (2015)
- St. Athan and Cardiff Airport Enterprise Zone – Draft Strategic Development Framework (2015)
- Bridgend County Borough Council LDP 2006 – 2021 (2013)
- Bridgend County Borough Council LTP 2015 – 2030 (2015)
- Rhondda Cynon Taf County Borough Council LDP 2006 – 2021 (2011)
- South East Wales Valleys Local Transport Plan (2015)
- Cardiff Council LDP 2006 – 2026 (2016)
- Cardiff LTP 2015 – 2020 (2015)
- Welsh Government | Rolling Out the Metro
- Welsh Government | Partnership for Growth: Strategy for Tourism 2013-2020
- Welsh Government | Welcome to Wales: Priorities for the Visitor Economy 2020-2025

2.8 Committed Developments

Land South of M4 Junction 34 | Hensol

2.8.1 In 2011, Renishaw plc purchased the former Bosch site and surrounding land to the south of M4 Junction 34. In June 2016, Vale of Glamorgan Council approved plans for 'development comprising class B1, B2, B8 uses; a hotel/residential training centre (class C1/ C2); and ancillary uses within class A1, A2, A3; associated engineering and ground modelling works and infrastructure, car parking, drainage and access for all uses; provision of infrastructure (including energy centre(s)); landscaping and all ancillary enabling works.' The provision of a work bus service through the day and night is noted within the Travel Plan submitted as part of the planning application package. An application for the approval of reserved matters (appearance, scale, layout, access and landscaping)

and associated works pursuant to outline permission 2014/00228/EAO was submitted in December 2019. The application is currently Awaiting Consultation Responses (Ref: 2019/01421/RES)

Land at Sycamore Cross | Pendoylan Lane and North of A48 | Bonvilston

2.8.2 Planning permission was granted on 2nd February 2017 for a 'development of 120 homes including affordable homes, new vehicle, pedestrian and cycle access, improvement works to Pendoylan Lane, regrading of site, drainage, landscape works, provision of public open space, demolition of existing modern timber stables and all associated works'. This is currently being implemented and the existing road on Pendoylan Lane has been remodelled to provide a suitable vehicle access to the site, along with pedestrian and cyclist connection on a 2.5m wide shared surface, connecting to A48. Cycle improvements were proposed to be created along the A48 between Culverhouse Cross and Bridgend. It is noted that all new transport infrastructure should be well lit and have real time information. Development is under construction.

Land to the East of Mink Hollow | St Nicholas

2.8.3 Planning was approved for a proposed residential development for 17 dwellings and associated highway and ancillary works, in November 2016. Waterstone Homes built the "St Nicholas Fields" development, with all 17 dwellings sold.[15] A new ghost island junction access arrangement has been constructed to serve the proposed 20 dwellings, as well as an additional 100 dwellings situated to the west of the site, which are currently being built. A right-turn lane with a width of 3m and through lanes with a width of 3.55m has been created.

Land to the East of St Nicholas

2.8.4 A development of 100 houses and associated open space vehicular and pedestrian access, landscaping and infrastructure, including the demolition of 'Emmaville' was approved by the Vale of Glamorgan in December 2016. The development will be accessed via a new priority T-junction with the A48. The access road will be 5.5m wide and will also provide 2m wide footways on both sides of the highway. Improvements will be made to the existing speed limit change gateway feature will include extending the red surface treatment across the whole highway as well as providing white lined channels on both edges to introduce a visual narrowing effect, thus slowing westbound traffic. Development is under construction and as of April 2019, 87 dwellings had been constructed[16].

Land to the North of Junction 33 | Creigiau

2.8.5 A planning application for a comprehensive development of 'Land to the North of Junction 33 of the M4' was approved in September 2017. Development is under construction. The proposal is to create a new community containing:

- A range of new homes, including houses, apartments and some sheltered accommodation for the elderly (Use Classes C2 and C3).
- A Park and Ride facility and transport interchange or hub community facilities including a new primary school and community centre (Use Class D1).
- A local centre including shops (Use Class A1), financial and professional (Use Class A2), food and drink (Use Class A3) and a clinic or surgery (Use Class D1).
- New offices, workshops and research and development facilities (Use Classes B1 with Ancillary B2 and B8).
- A network of open spaces including parkland, footpaths, sports pitches and areas for informal recreation new activities and requiring, site preparation.

[15] https://www.waterstonehomes.com/site/st-nicholas-fields-vale-of-glamorgan-4-5-bedroom-family-homes/

[16] LDP Annual Monitoring Report April 2018 to March 2019

- The installation or improvement of services and infrastructure.
- The creation of drainage channels improvements/ works to the highway network and other ancillary works and activities.

2.8.6 The proposed development includes 1,500 new homes and a Park and Ride facility with a maximum of 1,000 spaces. The development is designed to accommodate the aspirational Mass Rapid Transport proposal currently being investigated and included in the Cardiff Council LDP.

Land Adjacent to A4226 | Five Mile Lane

2.8.7 A proposal for on-line improvements to the existing A4226 between Waycock Cross Roundabout in Barry and the lay-by to the north of the Welsh Hawking Centre and an off line new road provision to the east of the existing A4226 to reconnect with the existing A4226 just to the south of Blackland Farm was approved on 16th December 2016. Works consisted of a new and upgraded single lane carriageway (7.3m wide with a 1m wide hard strip) making the total carriageway 9.3m wide; a cycleway/ footpath located on the west side of the on-line road comprising a 2.5m wide verge; three new junctions along the route including two priority T-junctions and one staggered junction all of which will have ghost islands; and enhancement works to the Sycamore Cross junction. Works are complete and the highway is operational.

3 Transport Baseline Conditions

3.1 Introduction

3.1.1 This chapter presents a summary of the issues and opportunities within the study area. The analysis presented here has informed the identification of problems, objectives and options.

3.2 Rail

3.2.1 There are no railway stations located within the study appraisal area. The nearest railway stations within the vicinity of the appraisal area are located north of the M4 corridor within Pontyclun (South Wales Main Line) and at Barry and Rhoose (Vale of Glamorgan Line). Pontyclun Railway Station provides one service per hour running west towards Maesteg and Bridgend, and east towards Cardiff Central and Newport stations (Table 5). Over the last five years, (2014/15 - 2018/19), significant railway station patronage increases have been observed at Pontyclun Railway Station, from 295, 778 to 365, 524 passengers (19.1% increase).

3.2.2 The Vale of Glamorgan Line was reopened between Barry and Bridgend in 2005 including new stations at Rhoose and Llantwit Major with Park and Ride facilities[17]. A dedicated shuttle bus also operates between Cardiff Airport and Rhoose Station. The stations provide one service per hour running to Bridgend and Cardiff Central, and one service every one to two hours to Aberdare. Between 2014 and 2019, there has also been a significant increase in railway station patronage observed at Rhoose Railway Station (Cardiff International Airport) from 168, 132 to 197, 434 passengers (representing a 15% increase).

Table 5 Rail Frequency (Direct Services Monday - Saturday)[18]

Railway Station	To/ Destination	Journey Time	Frequency
Pontyclun	Maesteg	38 minutes	1 per hour
	Bridgend	16 minutes	1-2 per hour
	Cardiff Central	14 minutes	1 per hour
Rhoose	Aberdare	1 hour 40 minutes	1 per hour
	Bridgend	27 minutes	1 per hour
	Cardiff Central	34 minutes	2 per hour

Table 6 Railway Station Patronage[19]

Railway Station	Patronage (2014/15)	Patronage (2018/19)	Percentage Change
Pontyclun	295,778	365,524	+19.1%
Rhoose	168,132	197,434	+15%

17 Vale of Glamorgan Deposit LDP 2011-2026 (2013)

18 National Rail

19 Office of Road and Rail – Station Usage Data

Figure 4 Map of South Wales Railway Stations[20]

3.3 Bus

Bus Connectivity within the Appraisal Area

3.3.1 Bus transport modal share for journeys to work within the area is 2% compared to 3% in the Vale of Glamorgan and 6% in South East Wales as a whole.[21] However, it is noted that the appraisal area is extensively rural with no large urban settlements. There are various bus services serving the area with the frequency of service varies with Sunday services being very sparse. There are no direct services from the appraisal area to Cardiff Airport or the St Athan area. Bus routes are as described in Table 7 with regards to the appraisal area.

Table 7 Bus Routes within the Appraisal Area (2020)

Bus Service	Description
122	Greyfriars Road to Tonypandy, including stops in Llandaff, Creigiau, Pontyclun, Tonyrefail and Penygraig.
124	Greyfriars Road to Maerdy, including stops in Pontcanna, Creigiau, Coedely, Trebanog and Ferndale.
320	Westgate Street Cardiff to Talbot Green including stops in Llandaff, Pendoylan, Hensol and Pontyclun.
X2	Wood Street Cardiff to Porthcawl including stops in Bonvilston, Tair Onen and Corntown, along the A48.

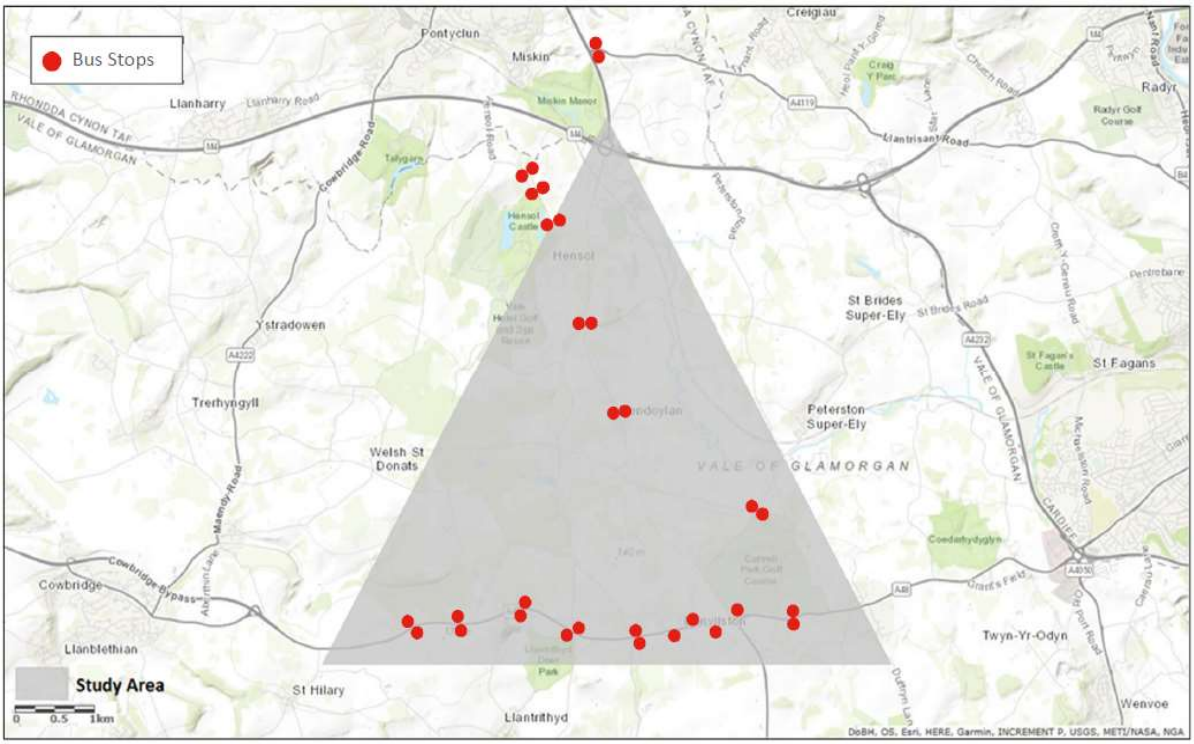
[20] National Rail Enquiries

[21] 2011 Census

3.3.2 Figure 5 shows the location of bus stops within and near to the appraisal area. Bus stops are generally equipped with timetables however there is no real-time passenger information. Within the appraisal area, there are 30 bus stops, 10 of which comprise shelters with seating, flag poles and timetable, 15 have poles with timetables and five of which have no facilities. Footway provision to bus stops is inconsistent, with many bus stops without any footway provision or very limited provision.

3.3.3 It is a regional and local aspiration to standardise bus stops to ensure well maintained infrastructure in order to deliver a fully accessible bus service[22].The existing bus network varies in provision in the region and increased pressure on budgets mean that supported services are increasingly under pressure. There are currently no direct services from the appraisal area to Cardiff Airport or the strategic employment sites in the St Athan area. There are a number of community transport operations within the Vale of Glamorgan including Greenlinks, Voluntary Emergency Services Transport (VEST), East Vale Community Transport (EVCT), The Intersensory Club, and Non-Emergency Patient Transport.

Figure 5 Local Bus Stops



3.4 Walking and Cycling

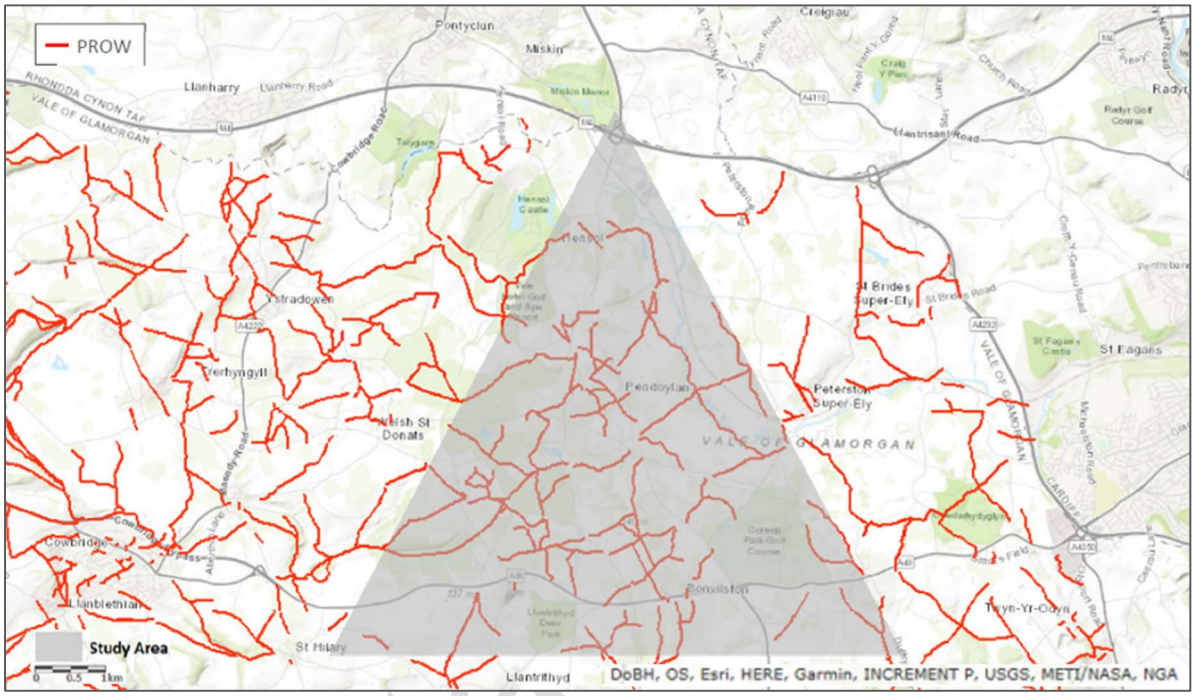
Walking

3.4.1 The provision of segregated footways throughout the appraisal area is limited given the rural nature of the area with provision in certain built up locations. There is reasonable footway provision through Pendoylan Village on at least one side of the carriageway, and to the south of the appraisal area footways are provided on at least one side of the A48. In addition, there is limited footway provision along the A4226 with the exception of footways on both sides of the carriageway on the approach of its junction with the A48, and limited provision is also evident along Redway Road.

[22] Vale of Glamorgan LDP 2011-2026 Sustainable Transport Assessment

3.4.2 A signalised pedestrian crossing comprising tactile paving and refuge island with barriers is located at the A4226/ A48 junction. A signalised crossing comprising tactile paving is also located adjacent to the Red Lion Public House along the A48 and at the Pendoylan corridor/ A48 junction. There are numerous Public Rights of Way (PRoW) within the area including a network of footpaths linking Pendoylan to Bonvilston. There are also PRoW linking Bonvilston through to Cardiff Airport. An outline of the existing local PRoW affecting the study area is as shown on 6.

Figure 6 Public Rights of Way



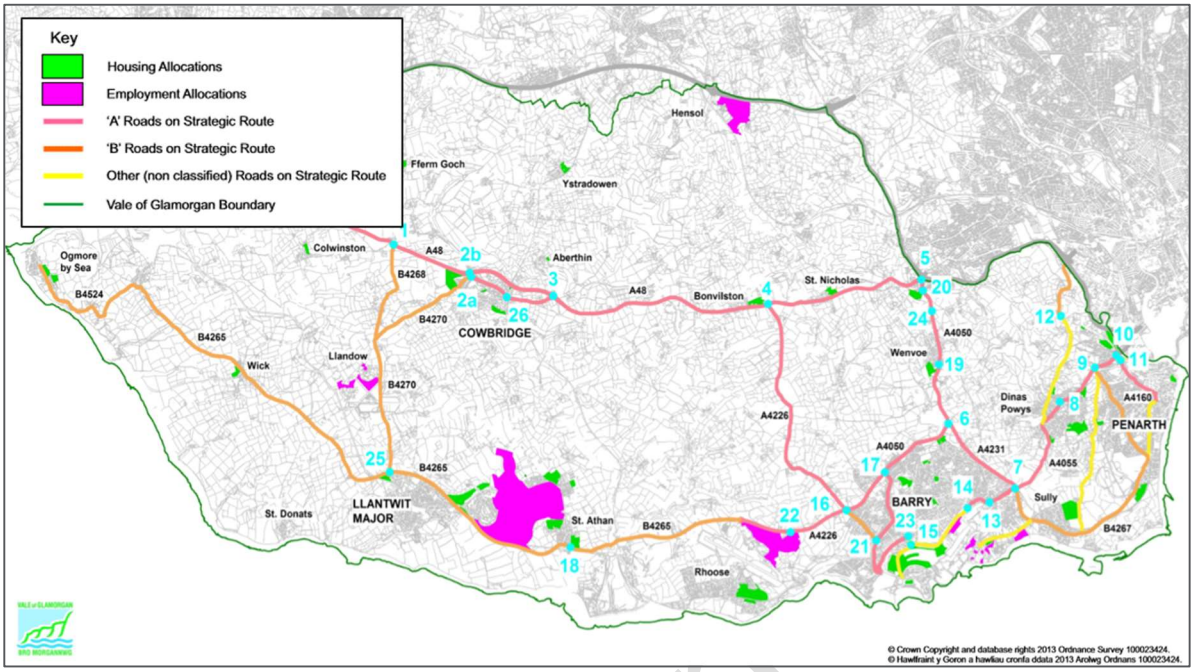
Cycling

3.4.3 There are no National Cycle Network (NCN) routes within the appraisal area. The nearest route is NCN route 88 which is situated approximately 6km south of Pendoylan Village and which interconnects from Newport to Margam Country Park along a mostly coastal route. Cycling provision between the M4 Junction 34 and A48 is very limited with no cycle markings or signs throughout the Pendoylan corridor. There are minor on-line cycle markings provided along a small section of the A48, adjacent to the Shepherds Lodge.

3.5 Local Highway Network

3.5.1 The highway network forms the principal transport network within the appraisal area predominantly encompassing the Pendoylan corridor from M4 Junction 34 through Pendoylan/ Clawdd-Coch to the A48 at the Sycamore Cross junction, Redway Road/ unnamed road (linking Clawdd-côch and the A48) as well as a section of the A48 through St Nicholas and Bonvilston. The following section assesses the key elements of the local highway network. The Vale of Glamorgan Council Deposit LDP Background Paper *Highway Impact Assessment (2013)* identifies the strategic highway network, key junctions and allocated employment and residential development allocations over the local LDP period. These are shown in Figure 7.

Figure 7 Strategic Routes and Junctions in the Vale of Glamorgan[23]



Pendoylan Corridor including Access to Renishaw

3.5.2 The southern arm of the M4 Junction 34 junction provides direct access to the Renishaw site. The road is subject to a 30mph speed limit extended c.500m between Junction 34 and the site entrance. Street lighting is provided, although there are no pedestrian footways or cycle paths adjacent to the road. The Pendoylan corridor is predominantly a narrow single carriageway connecting to M4 Junction 34 to the north and to the A48 to the south, as illustrated in a selection of photographs shown in Appendix D. In its northern section, the Pendoylan corridor is a single carriageway with standard width until the priority junction towards Hensol. The road then narrows and becomes a rural road predominantly bounded by hedgerows and woodland areas and is subject to the national speed limit (photograph 1).

3.5.3 The speed limit reduces to 30mph through the village of Pendoylan which is located approximately halfway along the route. There is some footway provision throughout the village (photograph 2 and photograph 3). The speed limit rises again to the national speed limit to the south of Pendoylan and reduces to 40mph within approximately 50m of its junction with the A48. The route is narrow in places with difficulties for two vehicles to pass and various passing bays are provided along the route (photograph 4). There are issues along the route of poor visibility at junctions and for vehicles emerging from property drives.

A48 through Bonvilston

3.5.4 The A48 is a single carriageway trunk road. Within the appraisal area, the A48 has good footway provision (shared cycle and pedestrian path) with a few pedestrian crossings and bus stops.

3.6 Existing Strategic Junctions

M4 Junction 34

3.6.1 Junction 34 is a grade separated junction with slip roads from the mainline carriageway connecting to the A4119 dual carriageway to the north and the single carriageway link to Hensol/ Pendoylan to the south. The junction has two circulatory lanes across the motorway, widening to three lanes to

[23] Vale of Glamorgan Council Deposit LDP Background Paper | Highway Impact Assessment (2013)

and from the west. The junction is partially signalised, with signals on the westbound off-slip and southbound on the circulatory section. The junction is subject to congestion, notably on the A4119 and on and off of the motorway.

Sycamore Cross Junction

3.6.2 The Capita Symonds Highway Impact Assessment LDP Background Paper (2013) identified that the A48/ Five Mile/ Pendoylan Road junction was forecast to be over capacity by 2026 during the AM and PM peak periods.Since this report junction improvements have been made to introduce traffic signals with right turning lanes, pedestrian crossing facilities and a bus lane on the north side east of the junction. During consultations, issues were highlighted with the junction that the signals may be causing a platooning effect which leads to additional issues of vehicles passing in the Pendoylan corridor to the north. Other consultees however noted that the junction was safer to use since the signals were introduced.

3.7 Baseline Traffic Flows

3.7.1 Baseline traffic data has been collated for the following junctions and is included as Appendix E:

- A48 Sycamore Cross
- Priority Junction south of the M4 Junction 34 (junction between road to Pendoylan and the Renishaws factory)

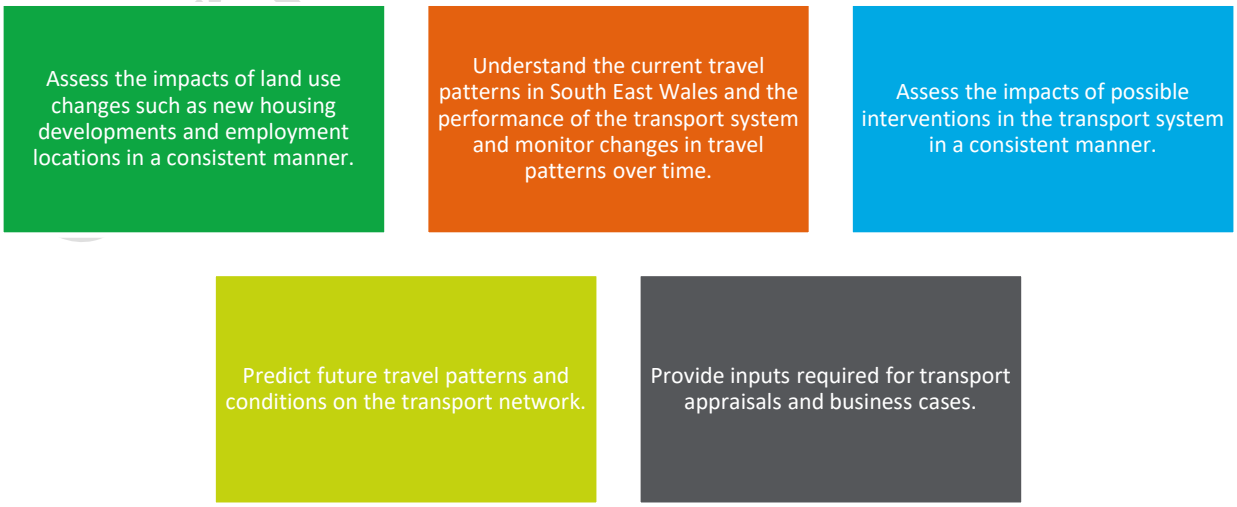
3.8 South East Wales Transport Model

Background

3.8.1 To facilitate assessment of the highway route options and quantify the anticipated economic, social and environmental impacts, Mott MacDonald (working with Arup) was commissioned by Transport for Wales to undertake strategic transport modelling for the M4 Junction 34 to A48 link using the South East Wales Transport Model (SEWTM) following a request from Arcadis and working on behalf of Vale of Glamorgan Council. A full technical summary of the commission and output traffic flow plans has been included as Appendix F.

3.8.2 The SEWTM is a multi-modal disaggregate demand model focused on South East Wales, covering the 11 unitary authority areas of Blaenau Gwent, Bridgend, Caerphilly, Cardiff, Merthyr Tydfil, Monmouthshire, Neath Port Talbot, Newport, Rhondda Cynon Taf, Torfaen, and Vale of Glamorgan.

3.8.3 The model comprises separate highway and public transport assignment models linked together with a demand model. The model was commissioned by Welsh Government in 2015 and has been developed by a team led by Mott MacDonald, and including Arup, RAND Europe and David Simmonds Consultancy. The SEWTM has been designed to achieve the following key objectives.



3.8.4 The model represents an average weekday for four time periods: an AM average hour between 07:00 and 09:30; an inter-peak (IP) average hour between 09:30 and 15:30; an average PM hour between 15:30 and 18:00 and an off-peak (OP) average hour between 18:00 and 07:00. The assignment models can also represent peak hours within the AM and PM peak periods. Peak hours are the single hours during which the highest volume of trips is undertaken; between 07:45 and 08:45, and between 16:30 and 17:30. The SEWTM base year is 2015, with forecast years of 2026 and 2036 currently available.

Approach Overview

3.8.5 An overall approach to the strategic modelling, which is proportionate to the scale of the scheme and current development stage, was agreed in advance. The commissioned model subsequently incorporated a single carriageway way, 60mph link from just south of Hensol to the Sycamore Cross junction on the A48. The longest of the two highway alignments was used as a worst case for journey times.

3.8.6 It was assumed that there would be three junctions with local roads on the route and the Sycamore Cross junction will be an improved staggered signalised junction, in line with the current proposals as part of the Five Mile Lane upgrade. The model would specifically encompass running the highway component of SEWTM only and for the 2036 forecast year only, with model outputs used to complete a single year TUBA assessment.

Output

3.8.7 Mott MacDonald/ Arup has issued the following model run outputs:

- GIS shapefiles containing modelled link vehicle flows (actual and demand for AM/ Inter-Peak/ PM) for the 2015 Base, 2036 Do-Minimum and 2036 Do-Something.
- Flow difference plots for AM, Inter-Peak, and PM time periods, comparing the 2036 Do-Minimum and 2036 Do-Something scenarios.
- Full set of TUBA 1.9.9 input and output files for a single year (2036).
- Highway hour to period factors to assist in forecasting Annual Average Daily Traffic (AADT) flows – AM (2.1977), Inter-Peak (6), PM (2.3768), and Off-Peak (13).

3.8.8 A summary of the output traffic flows for the various scenarios has been included in Appendix G.

4 Social Context

4.1 Introduction

4.1.1 The Vale of Glamorgan administrative area is situated to the west of Cardiff predominantly south of the M4 corridor and is extensively rural with a pattern of small settlements. The neighbouring local authorities are Bridgend County Borough Council to the west, Cardiff Council to the east and Rhondda Cynon Taff County Borough Council to the north, with the local authority boundary including the M4 Junction 34.

4.1.2 The deposit LDP (2013) recognises the M4 and A48 as key strategic road links within the county, connecting with to the wider south-east region and beyond. The Pendoylan corridor connects to the strategic network via M4 Junction 34 to the north and to the A48, east of Bonvilston, to the south. Redway Road/ unnamed road runs parallel to and also connects to the Pendoylan corridor, to the west. The carriageway connects to the Pendoylan corridor through Pendoylan at Clawdd-côch, to the north, and the A48 west of Bonvilston to the south.

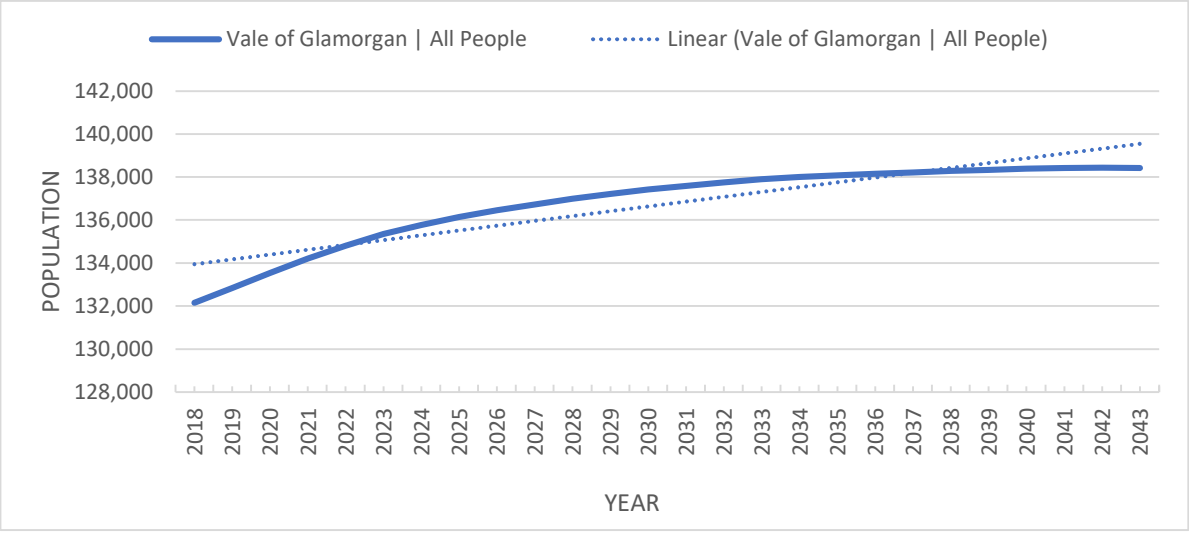
4.1.3 Bonvilston, Pendoylan and Peterston-super-Ely have been identified as minor rural settlements in the LDP Settlement Hierarchy[24]. These settlements are noted to contribute towards the special character of the rural Vale and also play an important role in underpinning sustainable rural communities.

4.1.4 This chapter summarises the social context of the study. A range of social indicators have been explored to understand the existing social situation for the study area including population and age profile. All social WebTAG assessments are included in Appendix R.

4.2 Population and Age Profile

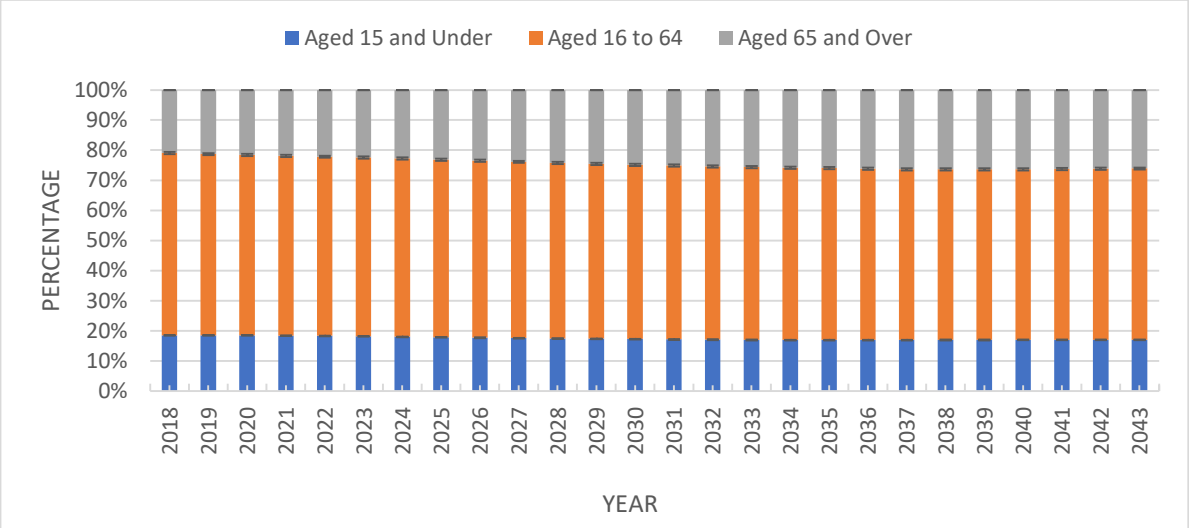
4.2.1 The number of people living in the Vale of Glamorgan is forecast to rise from circa 133,541 in 2020 to 138,432 in 2043, as outlined in Figure 8, although the forecast reveals a stabilisation in population from circa 2035 onwards. The age profile of all residents outlines an increasing number of people aged 65 and over, rising from 21.6% of the population in 2020 to 26.1% by 2043 (Figure 9). Whilst the proportion of those aged 15 and under remains broadly stagnated, there is a noticeable drop for working age adults decreasing from 60.2% to 56.0% over the same period. Existing 2020 populations and forecast population growth (up to 2043) for south east Wales local authorities is included within Appendix H.

Figure 8 Vale of Glamorgan All People Population Forecast (2018 – 2043)



[24] Vale of Glamorgan LDP 2011-2026 – Written Statement – June 2017

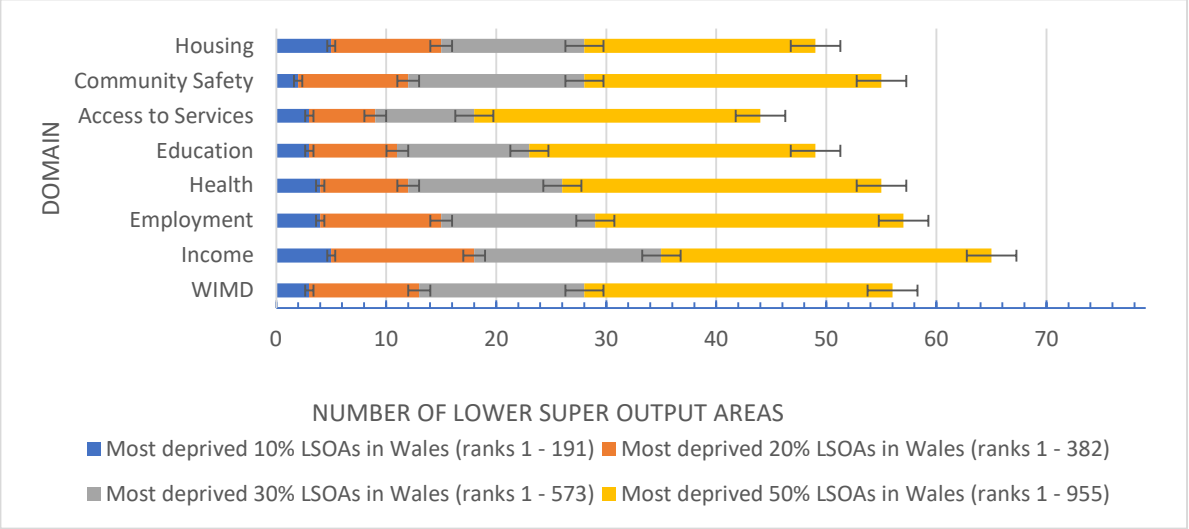
Figure 9 Vale of Glamorgan All People % Age Profile (2018 – 2043)



4.3 Welsh Index of Multiple Deprivation (WIMD) and Access to Services

4.3.1 The Vale of Glamorgan exhibits considerable socio-economic diversity containing some of the most affluent and the most deprived communities in Wales particularly in respect of employment, income, education, health and community safety. The Welsh Index of Multiple Deprivation (WIMD) 2019[25], shows that of the 79 lower super output areas (LSOA) in the Vale of Glamorgan, 29 (35%) are contained with the most deprived 50% LSOAs in Wales[26].

Figure 10 Vale of Glamorgan Welsh Index of Multiple Deprivation (2019)



[25] Welsh Government – Welsh Index of Multiple Deprivation 2019 https://statswales.gov.wales/Catalogue/Community-Safety-and-Social-Inclusion/Welsh-Index-of-Multiple-Deprivation

[26] Welsh Government – Welsh Index of Multiple Deprivation 2019 Local Authority Analysis - https://statswales.gov.wales/Catalogue/Community-Safety-and-Social-Inclusion/Welsh-Index-of-Multiple-Deprivation/WIMD-2019/localauthorityanalysis

4.4 Physical Activity

4.4.1 The benefits of increasing physical activity levels have shown to deliver cost savings for health and social care services. Low physical activity levels are associated with negative health impacts. Levels of physical activity are influenced by the physical and social environment. An appraisal of physical activity in WelTAG considers changes in participants in active travel.

4.4.2 The annual cost of physical inactivity is estimated to be some £10 billion[27], highlighting the costs associated with obesity and ill-health. Physical inactivity can be a major cost to local businesses, with ill health and contributing to absenteeism. By promoting active travel in the workplace, a healthier and more productive workforce will be created, in addition, to saving in other business areas such as car parking costs.

4.4.3 Active Travel data for 2017/18, obtained from Welsh Government, measured the amount of people who frequently walk or cycle as a mode of transport. Data was available by local authority and it is estimated that in Vale of Glamorgan, 7% of the population use a bicycle to travel more often than once a month[28]. The walking frequency for residents of the Vale of Glamorgan 2017/18 has also been reviewed, with 78% of people walking for more than 10 minutes, as a means of transport, at least once a month. Results for all Welsh local authorities have been included in Appendix I, which is illustrates that the Vale of Glamorgan recorded the highest walking rates of all authorities.

4.4.4 Sustainable transport infrastructure can assist in providing access to public transport for longer journeys, whilst encouraging activity levels, increasing the accessibility of currently socially excluded areas. This can lead to increased participation in the local community, reducing social exclusion and increasing sense of place within the region.

4.4.5 The lifestyles of adults in the Vale of Glamorgan and Wales are summarised in Table 8. It can be seen that activity levels in adults undertaking less than 30 minutes of physical activity is proportionally lower than for Wales, combined with the number of adults participating in at least 150 minutes a week of physical activity being proportionally higher in the Vale of Glamorgan. However, the number of overweight and obese is higher in the Vale of Glamorgan, both characteristics of which are slightly higher than the national average.

Table 8 Adult Lifestyles in Vale of Glamorgan and Wales[29]

Category	Vale of Glamorgan	Wales
Active <30 minutes in week	28%	33%
Active 30 to 149 minutes in previous week	12%	14%
Active 150 minutes in previous week	60%	53%
Overweight or obese (BMI 25+)	62%	60%
Obese (BMI 30+)	21%	23%

[27] Sustrans Growth market: The role of sustainable transport in boosting local economies

[28] https://gov.wales/sites/default/files/statistics-and-research/2018-12/active-travel-financial-year-2017-to-2018_1.pdf

[29] https://statswales.gov.wales/Catalogue/National-Survey-for-Wales/Population-Health/Adult-Lifestyles/adultlifestyles-by-localauthority-healthboard

4.4.6 According to the 2011 census, the percentage of people that rate their health as bad or very bad in Vale of Glamorgan is 6.4% compared with 7.2% in Wales. In total 4.2% of people living in the Vale of Glamorgan stated that their day to day activities are limited a lot. Health rating results are summarised in Table 9.

Table 9 Health by Percentage for Vale of Glamorgan and Wales[30]

Health Rating	Area	
	Vale of Glamorgan (%)	Wales (%)
Very Good Health	48%	46.6%
Good Health	32%	31.1%
Fair Health	13.6%	14.6%
Bad Health	4.9%	5.8%
Very Bad Health	1.5%	1.8%

4.5 Journey Quality

4.5.1 The DfT WebTAG guidance on social impact appraisal identifies that travellers don't normally travel for their own sake. Travel is a derived demand that arises from people's desire to engage in activities. As a result, a high-quality journey, when experienced, is often taken for granted, although a poor journey quality when experienced can be easily recognised. Journey quality can be affected both by travellers and by network providers and operators.

4.5.2 Journey quality is a measure of the real and perceived physical and social environment experienced while travelling. This includes factors such as public information provision, perceptions of safety (e.g. street lighting, CCTV cameras, segregated cycle paths away from traffic), provisions for accessibility, physical crowding on public transport services, and so on. The journey quality impacts considered here are those aspects of quality not considered elsewhere in the appraisal (such as journey times and reliability which form part of the economic appraisal).

4.5.3 Journey quality factors may be an important influence on the travel choices made by individuals. Poor quality may dissuade individuals from using certain modes and interventions that improve this quality may induce a different mode choice. For highway and active travel users, journey quality will be influenced by travellers' views, route uncertainty, stress, frustration and fear of potential accidents, whilst for public transport users, journey quality will also be influenced by the provision and quality of station facilities (such as for waiting and information) and rolling stock.

4.6 Accidents

4.6.1 Appendix J shows available personal injury accident data by severity within the appraisal area and its vicinity, between 2015 and 2019[31]. The map shows a cluster of accidents at M4 Junction 34 with seven accidents, six of which were slight in severity and one was serious. Eight accidents have been recorded along the A48 between its junction with Redway Road and Pendoylan corridor, seven of which were slight in severity and one of which was serious. A total of three accidents have been recorded along or within close proximity to Pendoylan corridor, two of these accidents were slight in severity and one of which was serious.

[30] ONS Local Area Report – 2011 Census

[31] https://www.crashmap.co.uk

4.7 Security

4.7.1 The DfT WebTAG definition of security (as set out in the social impact assessment) is that transport interventions may affect the level of security for transport users. The assessment of these impacts should reflect both changes in security and the likely numbers of users affected. According to the latest reported crime statistics for the year ending September 2019 from the Office of National Statistics (ONS), the South Wales Police area had levels of total reported crime (84.7 per 1,000 population) similar to the Wales average (84.2 per 1,000 population). These statistics do not include fraud, as offences of fraud are currently excluded from subnational breakdowns of police recorded crime.

4.8 Access to Employment

4.8.1 A summary of employment statistics for the Vale of Glamorgan has been included as Table 10 against regional and national statistics. Census data (2011) shows that there was a higher percentage of those employed within the appraisal area and also the Vale of Glamorgan as a whole (figures at 63% and 62%) compared with 58% for SE Wales and Wales as a whole. There is a significantly higher population of retired people within the appraisal area compared to the Vale of Glamorgan, South East Wales and Wales as a whole.

Table 10 Employment Statistics Census 2011

Economic Activity	Appraisal Area	The Vale of Glamorgan	South East Wales	Wales
Employed	63%	62%	58%	58%
Unemployed	2%	4%	5%	4%
Retired	21%	16%	15%	16%
Student	7%	7%	10%	9%
Other	8%	10%	13%	12%

Figures rounded

4.8.2 The appraisal area provides limited opportunities for sustainable access to employment within the appraisal area; thus, travel by car is the dominant mode. The following subsequently provides a summary of key characteristics for access to employment affecting the appraisal area. 30% of workers travel less than 10km to work from the appraisal area compared to 52% within the Vale of Glamorgan as a whole (2011 Census Distance Travelled to Work) (Figure 11).

4.8.3 The dominant distance to work from the appraisal area is between 10 and 20km, with 32% of the area travelling this distance to work, in comparison to just 19% of the Vale of Glamorgan.

4.8.4 The car (or van) is the dominant mode of travel to work across the appraisal area, as with the Vale of Glamorgan and South East Wales as a whole. 92% of those from the appraisal area drive to work (including passengers) compared with 76% of South East Wales as a whole. Only 4% of workers in the appraisal area travel to work on foot, nearly a third of the percentage of the Vale of Glamorgan as a whole (11%).[32]

4.8.5 2% of workers use bus services to travel to work, slightly lower than for the Vale of Glamorgan (3%) and only 1% of the appraisal area's workers travel by train to work compared with the average of 6%

[32] 2011 Census Journey to Work Commuter Flows by Local Authority

for the Vale of Glamorgan as a whole. 38% of workers within the Vale of Glamorgan also live in the Vale of Glamorgan.

4.8.6 More people commute out of the Vale of Glamorgan compared to those commuting into the Vale of Glamorgan. 26,715 people out-commute from the Vale of Glamorgan compared to 13,305 people who in-commute establishing a net flow of -13,410 (2011 Census Journey to Work Commuter flows by Local Authority). 12% of workers from the appraisal area work in Cardiff and 2% of workers in the appraisal area live in Cardiff.

Figure 11 Distance Travelled to Work (%)[33]

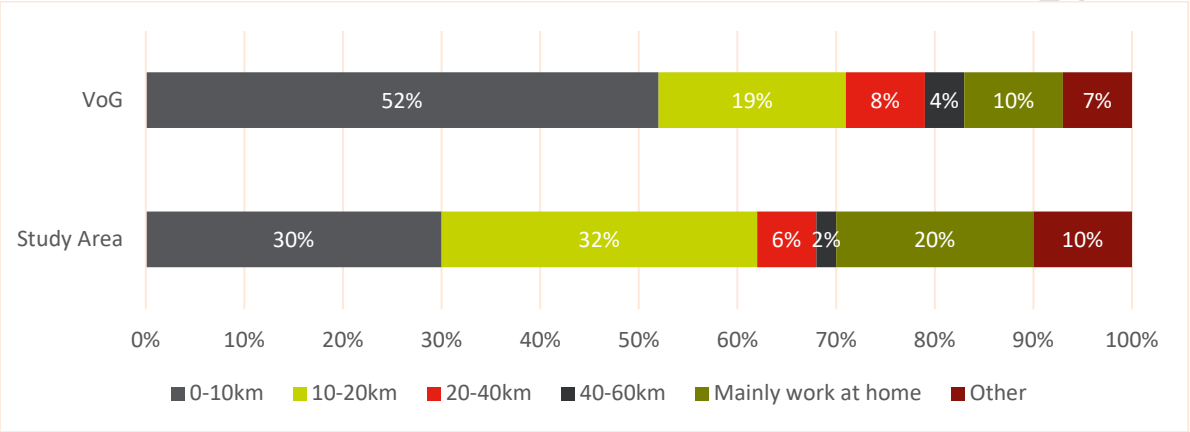


Table 11 Method of Journey to Work (2011 Census)[34]

Mode	Appraisal Area	The Vale of Glamorgan	South East Wales
Car or Van Driver	89%	72%	69%
Car or Van Passenger	3%	6%	7%
Taxi	0%	0%	1%
Motorcycle, Scooter or Moped	0%	1%	1%
Bus, Minibus or Coach	2%	3%	6%
Train	1%	6%	3%
Bicycle	1%	2%	2%
On Foot	4%	9%	11%
Other	0%	1%	1%

[33] 2011 Census

[34] 2011 Census Journey to Work Commuter Flows by Local Authority

Table 12 2011 Comparison of Census Journey to Work Commuter Flows by Local Authority[35]

Authority	Out Commuting	In Commuting	Net Flow	% Working in Own Area
Bridgend	18,040	17,256	-784	56%
Cardiff	32,845	73,126	40,281	65%
RCT	36,609	19,365	-17,244	48%
Vale of Glamorgan	26, 715	13,305	-13,410	38%

Table 13 2011 Census Location of Usual Residence and Place of Work

Currenly Residing	Place of Work	Number of People
Vale of Glamorgan	Cardiff	17,773 (Total)
Appraisal Area		367 (2%)
Cardiff	Vale of Glamorgan	5,576 (Total)
	Appraisal Area	670 (12%)

4.9 Access to Services

4.9.1 Access to services within the appraisal area are generally poor as demonstrated within Figure 12. There are a limited number of facilities and services within 5km of Pendoylan (central point), including education, healthcare, employment, retail, public transport and recreation.

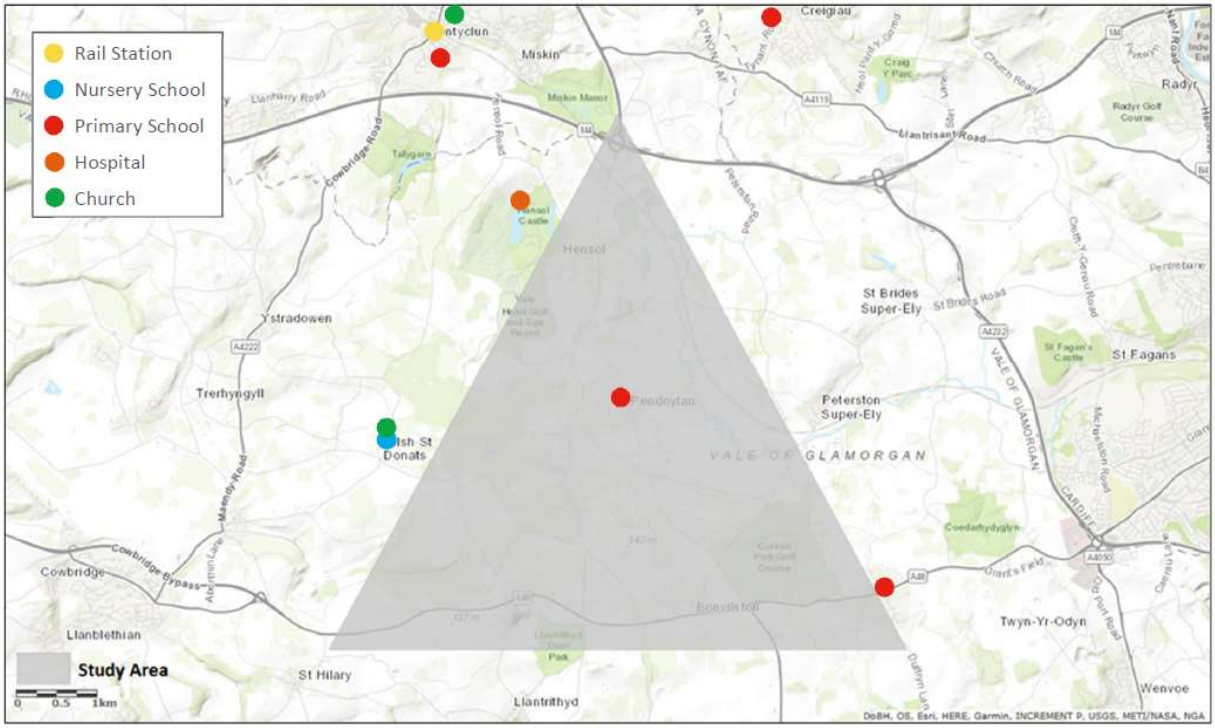
- St Athan is located within approximately 14km via a combination of rural roads and the B4265 to the south-west of Pendoylan. There are no direct bus routes from the appraisal area.
- Barry is located approximately 12km south-east of Pendoylan via Pendoylan Corridor and Five Mile Lane. There are no direct bus routes from the appraisal area.
- Cardiff is located approximately 15km to the east of Pendoylan via either the M4 of the A48. There are direct routes into Cardiff from the Red Lion Inn, Pendoylan.
- The Miskin, Pontyclun (including Pontyclun railway station) and Talbot Green area is approximately 5km to 7km to the north of Pendoylan. There are direct bus routes between this area and Pendoylan.
- Cardiff Airport is located south of the appraisal area, approximately 9.3km from Pendoylan. There is currently no direct access by rail or bus services.
- Nuffield Health (The Vale Hospital) is located west off Hensol Road approximately 3km north-west of Pendoylan. The hospital benefits from a number of bus stops close by and is also within 2.5km of Pontyclun Railway Station.
- There are several schools within the vicinity of the appraisal area encompassing:

[35] AECOM Mid and North Wales – 2011 Journey to Work Analysis (2014)

- Abracadabra Playgroup is situated along Heol Mynydd. The playgroup is located in Welsh St Donats. There are poor pedestrian facilities near to the playgroup.
- Pendoylan Church in Wales Primary School is situated along the Pendoylan corridor road passing through Pendoylan. A zebra crossing comprising tactile paving is located at the entrance of the school's car park. A bus stop is located within approximately 150m to the south of the school, with footways interlinking.
- St Nicholas Church in Wales Primary School is situated along School Lane, off the A48. There are limited pedestrian facilities near to the primary school owing to the area's rural character. A bus stop is located within approximately 250m to the south-east of the school; footway provision is limited with the exception of along the A48.

- There are limited evening and weekend bus services leading to potential difficulties in accessing essential services and leisure opportunities thus encouraging greater reliance on the private car.

Figure 12 Access to Key Local Services within the Appraisal Area



4.10 Affordability

4.10.1 The WebTAG guidance identifies there is a substantial body of research to demonstrate that the monetary costs of travel can be a major barrier to mobility for certain groups of people, with particularly acute effects on their ability to access key destinations. Access to transport and transport poverty can be barriers to employment for many people. Public transport options can assist in providing affordable access for certain groups (particularly where there is concessionary travel applicable), although the cost of rail and bus fares is important to take into account.

4.10.2 The appraisal area contains some of the least deprived areas. The average gross weekly full time pay in the Vale of Glamorgan was £619.40 in 2019, which was almost £80 a week more than the figure for Wales. Whilst at local authority level, the Vale of Glamorgan points to a higher income than other parts of Wales, at lower geographies it is evident that there is a great deal of variation. Moreover, it should be noted that transport improvements in the vicinity of the M4 Junction 34 could lead to benefits for the wider strategic area, including Rhondda Cynon Taff where average incomes

are less. The average weekly pay in 2019 within Rhondda Cynon Taff was £511.00, which is £29.70 less than the national average and significantly lower than the Vale of Glamorgan.

4.11 Severance

4.11.1 The DfT WebTAG guidance defines community severance as the separation of residents from facilities and services they use within their community caused by substantial changes in transport infrastructure or by changes in traffic flows. Severance will only be an issue where either vehicle flows are significant enough to significantly impede pedestrian movement or where infrastructure presents a physical barrier to movement.

4.11.2 Severance primarily concerns those using non-motorised modes, particularly pedestrians. To ensure a consistent approach, classification should be based on pedestrians only. The impact of severance on cyclists will differ for two reasons: they travel more quickly; and crossing facilities may not be available to them.

5 Cultural Context

5.1 Introduction

5.1.1 This chapter presents the cultural context of the study area. A range of cultural indicators have been explored to further understand the existing cultural situation for the study area. The terms cultural facilities refer to places relating to recreation, the arts and tourism.

5.2 Cultural Facilities

5.2.1 A cultural facility has been defined in this study as a place for activity associated with the arts, sport and other attractions. Cultural facilities entail a broad spectrum of facilities comprising, although not exclusive to, the following: arts and craft centres; beaches and marinas; country parks; golf courses and ranges; heritage attractions and museums; leisure centres and stadia; outdoor activities; trekking and riding centres; visitor attractions. The Future Generations of Wales Act (2015) has a well-being goal of: *'A Wales of vibrant culture and thriving Welsh language'*. It is noted that this well-being goal will be achieved through *'a society that promotes and protects culture, heritage and the Welsh language, and which encourages people to participate in the arts, and sports and recreation.'*

5.2.2 Appendix K illustrates the locations of various cultural facilities throughout the Vale of Glamorgan as well as within the vicinity of the north of the study area, including a list the cultural facilities identified. Cultural facilities have largely been identified as presented in the Vale of Glamorgan Tourism Strategy. Clusters of cultural facilities concentrate around the areas of Pontyclun to the north-west and Barry to the south. Cultural facilities are sparsely spread throughout the study area and consist largely of golf facilities and tourist attractions.

- Vale of Glamorgan Golf and Country Club
- Golf Driving Range, Hensol
- Hensol Forest
- Hendrewennol Fruit Garden
- Warren Mill Farm, Pendoylan
- Llanerch Vineyard
- Cottrell Park Golf Club, Bonvilston

5.3 Welsh Language

5.3.1 The Future Generations of Wales (2015) Act has a well-being goal of *'A Wales of vibrant culture and thriving Welsh language.'* It is noted that this well-being goal will be achieved through 'a society that promotes and protects culture, heritage and the Welsh language, and which encourages people to participate in the arts, and sports and recreation.'

5.3.2 In addition, the Welsh Government has a strategic vision outlined in the Cymraeg 2050; A Million Welsh Speakers (2017) to increase the number of Welsh speakers throughout Wales, stating its vision as *'The year 2050: The Welsh language is thriving, the number of speakers has reached a million, and it is used in every aspect of life. Among those who do not speak Welsh there is goodwill and a sense of ownership towards the language and a recognition by all of its contribution to the culture, society and economy of Wales.'* The strategy plans to achieve this vision by using three strategic themes including (1) increasing the number of Welsh speakers, (2) increasing the use of Welsh and (3) creating favourable conditions – infrastructure and context.

5.3.3 The percentage of people aged three and over able to speak Welsh in the Vale of Glamorgan was 20.4% in 2018, representing an increase of 3% since 2008. This compares to 29.9% of the Welsh population able to speak Welsh in 2018.

6 Environmental Context

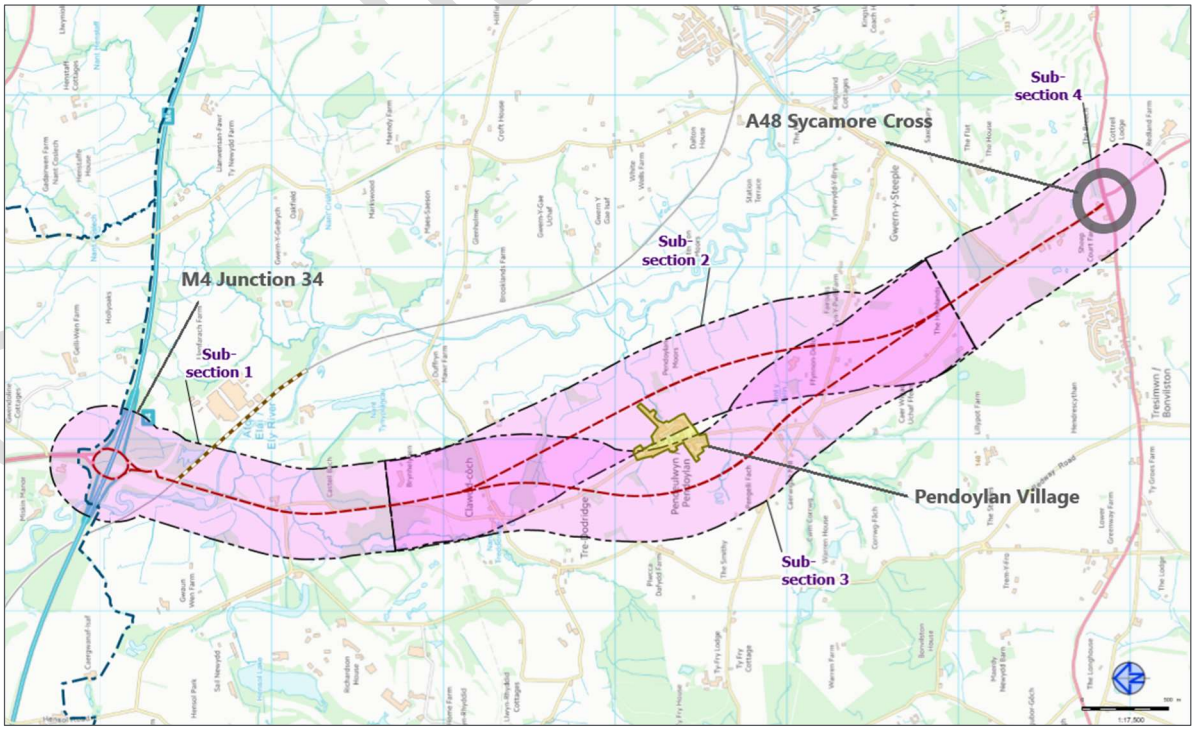
6.1 Background

6.1.1 To facilitate enhanced collation of WelTAG Stage Two baseline environmental conditions, a range of desktop studies and early environmental surveys has been completed by technical specialists to acquire a greater understanding of the potential impacts of the options and consider any requirements for further environmental studies beyond Stage Two. The scope of work completed was informed through stakeholder and public consultation, output stemming from the Review Group and subsequent endorsement by the Vale of Glamorgan Council Environment and Regeneration Scrutiny Committee and Cabinet.

6.1.2 Whilst ground condition does not form one of the specific impact assessment factors for the WelTAG Transport Case appraisal, a desk-based Geotechnical Feasibility assessment was commissioned by the Vale of Glamorgan Council as part of a the wider environmental appraisal to assess development risk and inform design progression. The output of this assessment is included herewith. The extent of the local study area has effectively been determined by the requirements of environmental surveys required to support the study encompassing a 250m radius buffer around the offline options, whilst also encompassing the online options. For the purposes of the assessment, the study area has been separated into four distinct sub-sections as follows:

- Sub-Section 1 | The route within the northernmost section southwards from the M4 Junction 34 for approximately 1.5km.
- Sub-Section 2 | The proposed Eastern route section around the settlement of Pendoylan. This is circa 3km in length and aligned north-northwest to south-southeast.
- Sub-Section 3 | The proposed Western route section around the settlement of Pendoylan. This is circa 3km in length and aligned north-northwest to south-southeast.
- Sub-Section 4 | The southernmost segment of the route aligned north-northwest to south-southeast, approximately 1.2km and interconnects with the A48 Sycamore Cross junction.

Figure 13 Highway Link Study Area



6.1.3 The environmental reports exclude specific reference to the online options, however given the existing Pendoylan road is retained within the study area, all environmental data required to inform the outline business case has been extracted to assess the online option appraisal accordingly.

6.1.4 In addition, and as a result of the timeline associated with the wider WelTAG assessment, the accompanying environmental reports include reference to a Sub-Section 5, which is associated with the now separated Vale of Glamorgan Gateway Station WelTAG appraisal.

6.1.5 All environmental WebTAG assessments are included in Appendix R.

6.2 Biodiversity

Background

6.2.1 The ecological features of importance to the proposed scheme have been presented in relation to the following two categories:

- The study area (250m radius for the highway alignment options in Sub-Sections 1-4).
- A wider 2km search area, which refers to the proposed highway alignment options, plus a 2km buffer around the alignment options, within which relevant ecological data was collated and reviewed.

Desk Study

6.2.2 A desk study was undertaken in order to identify any existing ecological information relating to the study area and the 2km search area. The following key activities were completed to inform this approach:

- The Multi-Agency Geographic Information for the Countryside (MAGIC) website5 was used to search for statutory designated nature conservation sites within the 2km search area; the search area was extended to 10km for Special Areas of Conservation (SACs) designated for bats.
- The South-East Wales Biodiversity Records Centre (SEWBReC) was consulted in February 2019 to request records of local nature conservation sites and of protected/notable habitats and species within the 2km search area. This included a request for records of Priority Habitats and Priority Species, as listed within Section 7 of the Environment (Wales) Act 20166.
- The Natural Resources Wales (NRW) Ancient Woodland Inventory Map7 was reviewed in February 2019 in order to identify areas of ancient woodland, including Ancient Semi-Natural Woodland (ASNW), Restored Ancient Woodland Sites (RAWS) and Plantation on Ancient Woodland Sites (PAWS), within the 2km search area.
- The Vale of Glamorgan GIS data set was searched for Tree Preservation Orders (TPOs) within the 2km search area.

Phase 1 Habitat Survey

6.2.3 An extended Phase 1 habitat survey was undertaken by Arcadis Ecologists in July 2019. Dominant plant species were noted, as were any uncommon species or species indicative of particular habitat types, but there was no attempt to compile exhaustive species lists. Habitats were assessed for their potential to support protected/ notable species of fauna and observation was made of any incidental signs of protected/ notable species.

6.2.4 Where access was restricted or refused by landowners, habitats were assessed using a combination of viewing from public footpaths or public roads and supported by aerial imagery. It must be noted that certain features may not have been visible (e.g. ponds in the corners of fields overtopped by trees) and areas which could not be surveyed have been identified and presented on the Phase 1 habitat survey plan.

Preliminary Ecological Appraisal Report

6.2.5 The Preliminary Ecological Appraisal report encompassing the findings of the desk study and Phase 1 habitat survey is included as Appendix L.

6.3 Water Environment

Background

6.3.1 The River Ely flows south east from Miskin outside of the appraisal area through the appraisal area and is designated as a Main River.

6.3.2 In terms of water quality, the Ely and its tributaries are WFD waterbodies and the reach in the study area in the second cycle achieved status of Bad ecological status and Fail with regard to chemical quality. The WFD groundwater body underlying the route is the South East Valleys Southern Devonian Old Red Sandstone and Triassic Mercia Mudstone. This waterbody achieves Good status in terms of both groundwater quality and quantity.

6.3.3 With regards to aquifers, there are no groundwater Source Protection Zones along the alignment or in proximity to it. Potential for effects is likely to be relatively limited, there would be some scope for impacts if the new highway was drained to ground via soakaways (rather than discharges to watercourses), or if there were sections in cut (which may trigger the need for groundwater control measures e.g. dewatering).

Water Environment | Highway Link Study

6.3.4 In consultation with NRW, a hydraulic model of the River Ely and its floodplain has been developed by Arcadis. This model has generated robust flood risk data to inform a detailed FCA and could be used to explore flood risk management measures to demonstrate whether the highway options would be free from flooding over its lifetime and would not increase flood risk to third party lands, in accordance with the requirements of TAN15.

6.3.5 The associated flood risk and drainage reports have been included for reference and are as follows:

- Improving Strategic Transport Encompassing Corridors from M4 Junction 34 to the A48 | Highway Link Study | River Ely Model Review and Proposed Approach | 10028657-ARC-XX-XX-RP-CW-00XX-01 | November 2019 (Appendix M)
- Improving Strategic Transport Encompassing Corridors from M4 Junction 34 to the A48 | Highway Link Study | River Ely Hydraulic Modelling | 10028657-ARC-XX-XX-RP-CW-00XX-02 | March 2020 (Appendix N)

6.4 Historic Environment | Cultural Heritage

Background

6.4.1 Work carried out up to WelTAG Stage Two by the Arcadis Heritage team identified a number of designated heritage assets including Scheduled Monuments, Listed Buildings, Conservation Areas, Registered Parks and Gardens and a Registered Landscape of Outstanding Historic Interest. There are also a number of non-designated heritage assets recorded on the Historic Environment Record. During the Stage Two Plus study a desk study and walkover survey were undertaken to provide further cultural heritage baseline information.

Desk Study

6.4.2 A Cultural Heritage Desk-Based Assessment was undertaken to ensure that selection of options is informed by a robust evidence base in terms of understanding the cultural heritage resource, with the aim of being able to minimise risk at an early stage, inform the design process and ensure that archaeological works are adequately addressed in the project programme. Consultation has been undertaken with Cadw, the Glamorgan Gwent Archaeological Trust (GGAT) and the Vale of Glamorgan Council Conservation Officer.

Walkover Survey

6.4.3 In addition, a walkover survey was undertaken as part of this assessment. The objectives of the survey were to:

- Assess and describe the current ground conditions within the Site.
- Identify evidence and/or potential for the survival of buried archaeological remains within the Site.
- Confirm the presence, location and condition of known above-ground archaeological remains.
- Identify any unknown above-ground built heritage assets not recorded elsewhere.
- Identify any areas where previous modern activities may already have impacted upon known and/or potential heritage assets.
- Consider the potential impact of the proposed development upon the setting of built and buried heritage assets within the study area.

Cultural Heritage Desk-Based Assessment Report

6.4.4 The Cultural Heritage Desk-Based Assessment report encompassing the findings of the desk study and walkover survey is included as Appendix O.

6.5 Landscape, Townscape and Residential Amenity

Existing Landscape Characterisation

6.5.1 The site lies in the National Landscape Character Area NLCA36 VALE OF GLAMORGAN – '*The Vale is a distinctive, gentle lowland landscape, largely comprising a rolling limestone plateau. Glacial till contributes to its undulating topography. A variety of rural land uses characterise the area, reinforced by thick hedgerows, frequent small woodlands and trees, which create a sense of enclosure and intimacy. This is despite the proximity to large towns such as greater Cardiff, Barry and Bridgend, and a number of large built features within the Vale.*

In the centre of the Vale, compact and historic settlements reinforce the area's distinctive sense of place, but with limited modern development. Yet the area has attracted many professionals, who commute to Cardiff and Bridgend, adding to the more prosperous character of places like Cowbridge and Llanblethian. The area's historic character was shaped by Anglo-Norman influences. Norman castles and medieval villages centred on churches are key features.'

6.5.2 The Vale of Glamorgan Council designation of landscape character areas – final report (August 2008) forms part of the Local Development Plan 2011 – 2026 evidence base, and together with the Vale of Glamorgan Council Designation of Special Landscape Areas - Final Report (March 2008) set out a more detailed assessment of the landscape character of the Vale.

6.5.3 The study area falls into three distinct landscape character areas identified within these assessments as outlined in Figure 14:

- 13 – Ystradowen Lowland Valleys LCA
- 15 – Ely Valley LCA
- 22 – Central Vale Ridges and Slopes

6.5.4 In addition, the Ely valley and ridge slopes were identified as a Special Landscape Area – this includes the Ely Valley LCA and parts of the Ystradowen Lowland Valleys LCA. These areas are shown on Figure 14. The accompanying impacts assessment for the Landscape is included as Appendix P.

Ystradowen Lowland Valleys

- **Description |** An area of undulating landscape with relatively good tree cover with areas of woodland. Parts of the area (Pendoylan) are formed by glacial deposits providing a complex system of small valleys and intervening hills which rise up in places to 130m AOD. Primarily an

area of lowland glacial fill which results in an irregular terrain, somewhat hummocky in places. On its Eastern edge it abuts the side slopes of the Ely valley.

- **Landscape Habitats |** A broad mixture of lowland habitats, including semi-improved neutral grasslands, hedgerows and hedgerow trees together with a number of woodlands. The valley floors have areas of wet grassland and mire.
- **Visual and Sensory Landscapes |** A complex landscape of lowland valleys and hills which form the upper reaches of the tributaries to the Thaw and Ely rivers. It is a mosaic of small to medium pastoral fields within a network of strong hedgerows, hedgerow trees and scattered woodland. These woodlands tend to be on the steeper slopes or alongside water courses. Farms and houses are scattered around the area, although the few settlements show signs of suburbanisation.
- **Historic and Cultural Landscapes |** The landscape character reflects its historic development as an agricultural area. It also includes Hensol Castle and associated parkland.

Figure 14 Landscape Character

Ely Valley

- **Description |** Large lowland valley running across the north Eastern corner of the Vale before running into the Taff complex at Cardiff Bay. The valley is one of the main river systems within the Vale. The landscape is affected by the presence of the South Wales Main Line railway.
- **Landscape Habitats |** A mosaic of lowland habitats, with a particular range of riparian features relating to the river itself. Field boundaries formed by hedgerows, with hedgerow trees, with limited areas of woodland.
- **Visual and Sensory Landscapes |** A lowland valley floor, mostly floodplain generally flat in nature. This creates a sense of openness and it contains the attractive, meandering Ely River. A mosaic of field patterns, with frequent gaps and overgrown hedges which gives a slightly uncared for feel to the area. There are a number of scattered farmsteads and houses, and the main

settlements along the river are St George's and part of Wyndham Park. Low lying wetter areas, have a characteristic rectilinear field system and associated drainage ditches.

Central Vale ridges and slopes

- **Description |** A large area of undulating hilly terrain that runs east west from Cowbridge, around the top of the Upper Waycock Valley towards the unitary authority boundary at Culverhouse Cross and including the Wenvoe area, and down to the confluence of the Thaw and Waycock at Llancadle.

  It forms an important ridgeline across the central Vale landscape, largely agricultural in land use. It affords long distance views across the wider Vale landscape. The LCA is dissected by the A48(T) road which follows the ridgeline across the area.

- **Landscape Habitats |** A largely agricultural area it exhibits a range of dry terrestrial habitats, with areas of arable cultivation and grassland, bounded by hedgerows and hedgerow trees. Woodland areas, mostly deciduous, found on the higher ground to the north.

- **Visually and Sensory Landscapes |** The LCA is an area of lowland plateau with a series of enclosed valleys created by the Thaw - Waycock river system. Its' northern portion (aspect area VS271) forms a visually important ridgeline in the Bonvilston/St Nicholas area which rises to 137m AOD at Pantylladron between Cowbridge and Bonvilston.

  This affords extensive views across the Vale. The area is a mixture of arable and pastoral farming within a matrix of hedgerows with hedgerow trees. Field sizes are medium to large, giving an extensive open feel to the area. There are a number of scattered settlements and farms, with the main settlements straddling the A48 corridor.

The Ely Valley and Ridge Slopes | Special Landscape Area

6.5.5 This was identified as a Special Landscape Area in the Local Development Plan – it includes the Ely Valley LCA and parts of the Ystradowen Lowland Valleys LCA.

- **Primary Landscape Qualities and Features |** 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 here, and drainage and agricultural improvement threatens habitats.

  To the north-west, the landscape is one of lowland valleys and hills, forming the upper reaches of various tributaries that flow into the Thaw and Ely valleys. It is a well-maintained tranquil landscape. 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.

- **Designations |** There are no specific landscape designations within the study area other than the Hensol Castle Designed landscape [grade 2] which lies to the west of the proposed route and in unaffected by either option. Lancarfan - a Registered Landscape of Outstanding and of Special Interest lies immediately to the south of A48 and is out with the study area.

Analysis – Local Landscape Character

6.5.6 The local landscape pattern of the study area is a mosaic of small to medium pastoral fields within a network of strong hedgerows, hedgerow trees and scattered woodland. The key defining landscape characteristics of the study area are:

- Undulating landform rising to the A48 ridge.
- Extensive hedgerows outlining small irregular fields – predominately managed as pasture
- Individual trees within hedgerows
- Significant number of small woodlands

6.6 Air Quality & Greenhouse Gasses

6.6.1 Based upon the 2018 Air Quality Progress (APR) Report for the Vale of Glamorgan, the APR confirms that in 2017 air quality within the Vale of Glamorgan continues to meet the relevant air quality objectives. From the 47 locations monitored throughout the Vale Borough with the use of passive diffusion tubes, no sites breach the national NO2 annual objective of 40µg/m3 or the NO2 1-hour objective (200µg/m3, not to be exceeded more than 18 times per year). Based on the 2017 datasets it can be concluded that the NO2 1-hour objective was not breached. There are no Air Quality Management Areas (AQMAs) within or near to the project's study area.[36]

6.7 Noise

6.7.1 There are no Noise Planning Priority Areas located within 2km of the study area.

6.8 Ground Conditions | Geotechnical Feasibility

Background

6.8.1 A Geotechnical Feasibility Desk Study report has been completed by Arcadis specialists for the study area and presents the findings of a high-level desk-based review of publicly available information. The report has been included as Appendix Q.

[36] Vale of Glamorgan Council Air Quality Progress Report (2018)

7 Economic Context

7.1 Introduction

7.1.1 This chapter presents the economic appraisal of the study area including setting out the economic baseline, relevant economic strategies and programmes, future growth, journey time reliability issues, transport costs and wider economic issues.

7.1.2 **Note | As a result of the COVID-19 outbreak in early 2020, economic activity is anticipated to be significantly affected beyond expected fluctuations. Information provided herewith is to inform the wider economic context beyond such extreme events, and for the purposes of the WelTAG appraisal should be viewed with this in mind.**

7.2 Economic Activity

7.2.1 In order to set the economic baseline, key economic activity statistics are presented in Table 14 for Vale of Glamorgan, Wales and United Kingdom. In summary:

- There is a higher proportion of economically active people and those in employment in the Vale of Glamorgan compared to the Wales and United Kingdom averages.
- In addition, the Vale of Glamorgan retains a lower unemployment rate that both the Wales and United Kingdom average.

Table 14 Employment and Unemployment (Oct 2018-Sep 2019)[37]

	Vale of Glamorgan (%)	Wales (%)	United Kingdom (%)
Economically Active	80.8%	76.8%	78.9%
Employed	78.4%	73.5%	75.7%
Unemployed	3.4%	4.1%	3.9%

7.3 Economic Strategies and Studies

7.3.1 See Section 2 | Policy, Legislation and Background Documents.

7.4 Future Growth

Employment and Household Growth

7.4.1 Vale of Glamorgan Council predicts future housing and employment growth, which is reflected in the adopted Local Development Plan (LDP) 2018. The LDP evidence identifies the need to deliver 9,460 new dwellings between 2011 and 2026, with provision of up to 10,408 new dwellings allocated during the plan period, including an affordable housing target of 3,252 new affordable homes. In addition, to support continued prosperity of the Vale of Glamorgan and promote growth in the capital region, 492 hectares (369 ha net) of land has been allocated within the LDP to meet regional and local employment needs.

7.5 Wider Economic Benefits

7.5.1 This section assesses potential wider economic benefits that could occur from investment in a new or enhanced highway through the Pendoylan corridor. The specifics and relevance to each option will be explored in greater detail as part of the Transport Case appraisal, however investment in highway infrastructure could establish the following:

[37] https://www.nomisweb.co.uk

- Induced investment through additional strategic development arising due to improved connectivity to the EZ (existing connections are constraining growth). Moreover, there may be benefits to those larger commercial businesses (such as the airport and Aston Martin) through transport improvements where competitive markets are imperfect. In this case, it will assist by providing an improved level of connectivity for the airport and businesses.
- There may also be beneficial labour supply impacts by improving connectivity between the employment sites and population centres, notably assisting access to employment from the Rhondda Valleys to the EZ. Whilst the EZ presents a regionally significant opportunity, the labour market catchment of the site is limited by the current transport infrastructure and services. If this issue is not resolved, it may have longer term implications for firms currently located in the Vale of Glamorgan and in terms of the business location decisions of prospective investors. The limited labour market catchment of the EZ currently is also compounded by comparatively poor business-to-business accessibility.
- The improvement in accessibility may bring a relocation of more productive jobs to the area. As the proposed link forms a connection between functioning parts of the Capital Region, there may also be productivity impacts due to agglomeration benefits for the Vale of Glamorgan in terms of linking in developments in the area to similar businesses/ clusters in the region.
- Moreover, productivity in the Cardiff Capital Region is very low compared to other UK City Regions, so improving connectivity to the Vale of Glamorgan may form part of a package of measures to address this (and in part addressing the issue of a lack of appropriate industrial premises).

7.6 Journey Time Reliability

7.6.1 The broadly qualitative assessment has been completed using DMRB 11.3.9.2 (travellers' views) and 11.3.9.3/4 (traveller stress) has subsequently been considered alongside traveller care elements noted within TAG Unit A4.1.6 (Journey Quality Impacts). It is noted that these DMRB Volume 11 Section 3 Part 9 references are now withdrawn, although the appraisal has been completed in line with the existing TAG Unit A4.1.6 guidance.

7.7 Transport Costs

7.7.1 At this stage, the WelTAG Stage Two appraisal does not include a baseline for transport costs but provides a qualitative assessment of changes based on a professional view from the interventions.

7.8 Land Ownership and Access Arrangements

7.8.1 A comprehensive land referencing exercise has been completed at WelTAG Stage Two Plus to identify land ownership and, where applicable, agree access arrangements with the Vale of Glamorgan Council to facilitate completion of environmental surveys. The latter has included consultation with key officers at the Council including the Estates and Legal teams.

7.8.2 To identify the property owners with the wider study area, a 500m metre boundary surrounding the study area was established. Arcadis then procured basic Land Registry data to acquire the following information:

- Geography of each registered title (down to parcel level)
- Registered Freeholder and registered Leaseholder (if applicable)
- Details of any charges over the land (mortgage companies etc)
- Size of land
- Any 'gaps' in land (i.e. unregistered or possible digitising errors)

7.8.3 On receipt of the data from Land Registry, a comprehensive and confidential record log of all landowners was established to inform the existing WelTAG study, as well as provide a basis from which future appraisal can be taken forward. The database has provided land parcels with unique

references that can be used to support a correspondence log, produce mailing lists, record any specific events (such as survey visits), record changes in ownership information, and to provide a basis for interface with GIS.

7.9 Capital and Revenue Costs

7.9.1 The WelTAG Stage One study includes only a high-level assessment of options and no identification of current or future capacity and revenue costs that might change with options being taken forward has been undertaken.

7.10 Value for Money Assessment

7.10.1 The impact on Public Accounts (PA) and the results of the Analysis of Monetarised Costs and Benefits (AMCB) for the highway options has been considered, based on the costs calculated by Arcadis and the benefits derived from the outputs of the SEWTM. Full discussion of the methodology and results is included in Appendix S.

8 Data Source

8.1 Overview

8.1.1 In accordance with the WelTAG guidance this section summarises the data sources used to inform the study.

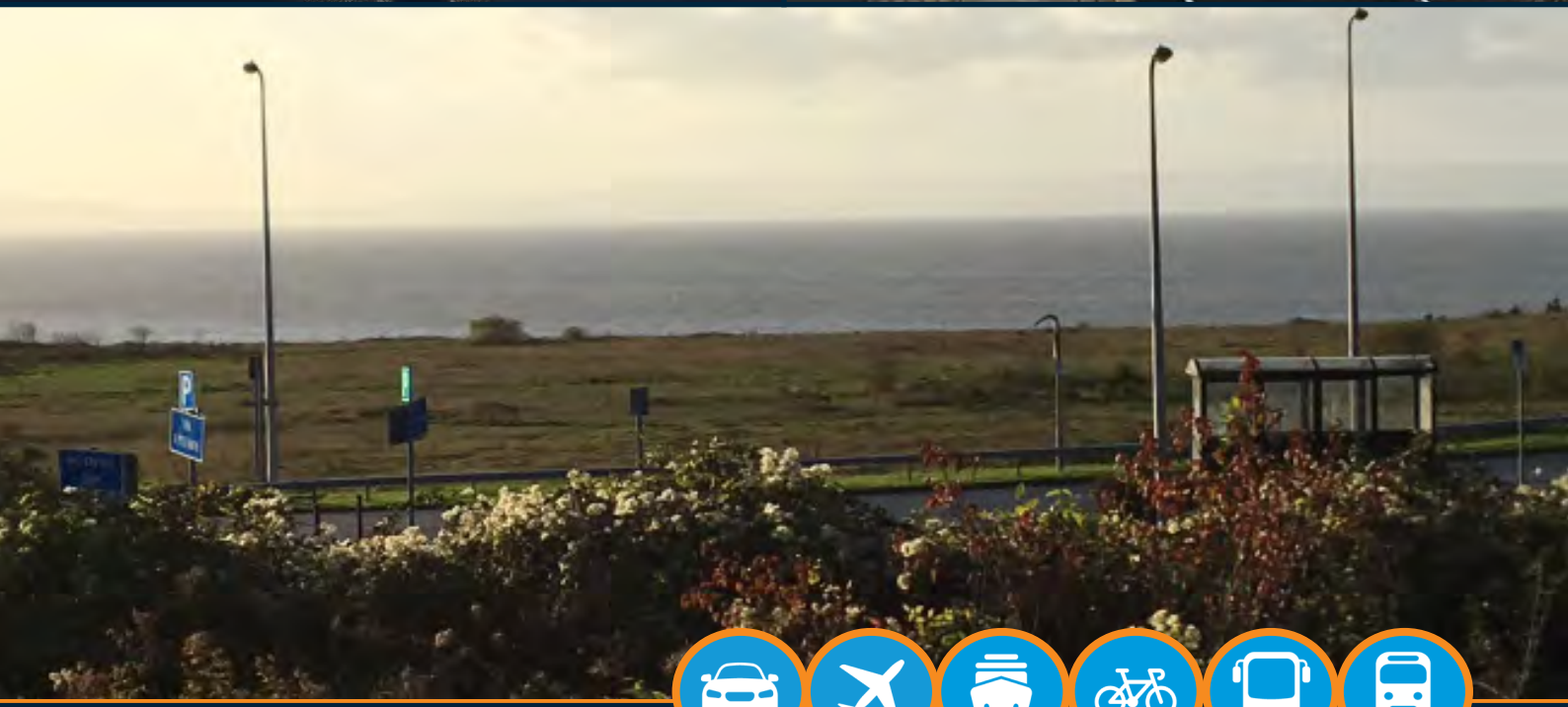
8.2 Data Sources

- Archwilio – Historic Environment Records of Wales (2017) - https://www.archwilio.org.uk/her/chi1/arch.html?county=Gwynedd&lang=eng
- Bridgend County Borough Council - LDP 2006-2021 (2011)
- Capita Symonds - Highway Impact Assessment LDP Background Paper (2013)
- Cardiff Capital Region Metro Study (2013)
- Cardiff Council - Cardiff City Region Transport Implementation Plan (2010)
- Cardiff Council - LDP 2006-2026 (adopted 2016)
- Cardiff Council - LTP (2015)
- DEFRA - Air Quality Management Areas - https://uk-air.defra.gov.uk/aqma/maps
- DEFRA - Multi-Agency Geographic Information for the Country website (MAGIC) – Magic Application (2017) - http://magic.defra.gov.uk/MagicMap.aspx
- Department for Transport – Record of Proceedings (2012)
- Google Maps (2017)
- Historic Wales – Portal for Historic Environmental Information in Wales (2017) - http://historicwales.gov.uk/
- Lle Geo-Portal – Catalogue (2017) - http://lle.gov.wales/catalogue?t=1&lang=en
- National Assembly Enterprise and Business Committee – International Connectivity through Welsh Ports and Airports, July 2012
- Natural England – Agricultural Land Classification of England and Wales 1985 (ALC009) (2013) - http://publications.naturalengland.org.uk/publication/6172638548328448
- Natural Resources Wales' Flood Risk Map Viewer – Long-term flood risk (2017) – https://naturalresources.wales/evidence-and-data/maps/long-term-flood-risk/?lang=en
- Network Rail - http://www.networkrail.co.uk/wp-content/uploads/2016/11/South-Wales-investment-map.pdf
- National Rail Enquiries – http://www.nationalrail.co.uk/
- National Transport Finance Plan (2015) and Evidence Base
- Office for National Statistics – Annual Survey of Hours and Earnings 2014
- Office for National Statistics (2011) (2001) Census
- Office of Road and Rail (2016) – Estimates of Station usage 2015-16
- One Wales: Connecting the Nation – Wales Transport Strategy (2008)
- Rhondda Cynon Taf Council – LDP up to 2021 (2011)
- RowMaps – Maps showing rights of way (2017) – http://www.rowmaps.com/
- South East Wales Transport Alliance (Sewta) Rail Strategy (2013) (Jacobs)

- South East Wales Transport Alliance (Sewta) Regional Bus and Community Transport Network Strategy (2014)
- Sustrans - http://www.sustrans.org.uk/ncn/map
- Traveline Cymru - https://www.traveline.cymru/
- Vale of Glamorgan Council – Accident Data
- Vale of Glamorgan Council – Air Quality Progress Report (2013)
- Vale of Glamorgan Council – Air Quality Progress Report (2016)
- Vale of Glamorgan Council – Adopted LDP 2011-2026 (2017)
- Vale of Glamorgan Council – Designation of Special Landscape Areas (2008)
- Vale of Glamorgan LDP Background Paper - High Impact Assessment, (2013)Welsh Government - Well-being of Future Generations (Wales) Act (2015)
- Vale of Glamorgan Council – Listed Buildings Inventory - https://www.valeofglamorgan.gov.uk/Documents/Living/Planning/Listed%20Buildings/Listed_Buildings_Inventory_October_2011.pdf
- Vale of Glamorgan Council – LDP 2011-2026 Sustainable Transport Assessment
- Vale of Glamorgan Council – LDP Proposals Map - https://www.valeofglamorgan.gov.uk/Documents/Living/Planning/Policy/LDP-2013/02-LDP-Proposals-Map-2013.pdf
- Vale of Glamorgan Council – LSV Tackling Poverty Report - https://statswales.gov.wales/Catalogue/Community-Safety-and-Social-Inclusion/Welsh-Index-of-Multiple-Deprivation/WIMD-2014/wimd2014localauthorityanalysis
- Vale of Glamorgan Council – LTP 2015-30
- Vale of Glamorgan Council – Public Rights of Way Map - http://myvale.valeofglamorgan.gov.uk/myGlamorgan.aspx?MapSource=ValeOfGlamorgan/AllMaps&StartEasting=309333.460273&StartNorthing=173932.149174&StartZoom=120000&o=1&Layers=rowFOOTPATH,rowBRIDLEWAY,rowRESTRICTEDBYWAY,Walescoastalpath
- Welsh Assembly Government (2016) Welsh Transport Planning and Appraisal Guidance (WelTAG) (draft version, June 2016)
- Welsh Government (2013) – Active Travel (Wales) Act 2013
- Welsh Government (2015) – Active Travel (Wales) Act 2013 Annual Report 2015
- Welsh Government - Noise Priority Areas (2017) http://gov.wales/topics/environmentcountryside/epq/noiseandnuisance/environmentalnoise/noisemonitoringmapping/priority-areas/?lang=en
- Welsh Government - Welsh Index of Multiple Deprivation (2014) - http://gov.wales/docs/statistics/2015/150812-wimd-2014-summary-revised-en.pdf

APPENDIX A

The Case for Change: Peter Brett Associates (February 2018)



Vale of Glamorgan Connectivity Study – The Case for Change

Welsh Government

Final Report

February 2018

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Vale of Glamorgan Connectivity Study – The Case for Change

Final Report

On behalf of **Welsh Government**

Llywodraeth Cymru
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Executive Summary

The Welsh Government (WG), in partnership with the Vale of Glamorgan County Council, is assessing the case for improving the strategic transport connectivity of key employment sites within the Vale of Glamorgan (VoG). This report is focussed on the early stages of the 'Strategic Case', which determines whether or not an investment is needed, either now or in the future. The purpose of this study is to clearly demonstrate and elaborate the 'case for change' - that is, to provide a clear rationale for making an investment, its strategic fit, and how the investment will further the aims and objectives of WG and its partners.

The study aligns with the H.M. Treasury *Green Book: Appraisal & Evaluation in Central Government*, and in particular Chapter 3, 'Justifying Action', in that it makes the 'case for change' and hence investment.

The study area includes the ten local authorities within the Cardiff Capital Region (Cardiff, Monmouthshire, Torfaen, Blaenau Gwent, Newport, Caerphilly, the Vale of Glamorgan, Merthyr Tydfil, Rhondda Cynon Taf and Bridgend) as well as three of the four members of the Swansea Bay City Region (Swansea, Neath Port Talbot and Carmarthenshire). This is shown in the figure below:

Figure S1: Study Area

Why is case for improving connectivity to the VoG being considered?

There are both regional / national and local drivers for improving connectivity to and from the VoG. From a **regional and national** perspective:

- The emergence of the Cardiff Airport – St Athan Enterprise Zone (EZ) in the VoG presents a strategically important economic development and employment opportunity for South Wales as a whole. **It is anticipated that this development will create 4,000 new jobs, with further indirect and induced employment across South Wales.**

- As part of the development of the Cardiff Capital Region and corresponding City Deal, there is a desire to improve transport connectivity across South-East Wales, safeguarding and promoting employment & investment and attracting & retaining population. It is envisaged that judicious and targeted investment will ensure that the Capital Region remains attractive and competitive.
- Through an arms-length company, WG owns and operates Cardiff International Airport. Surface access to the airport has frequently been cited as a problem and there is a desire within WG to consider options for improving connectivity to and from the airport within the boundaries of European Union (EU) State Aid rules.

From a **local** perspective:

- In partnership with neighbouring Rhondda Cynon Taf (RCT) County Council, VoG is pursuing a sub-regional development strategy intended to ensure that the area offers an appropriate and future-proofed balance of employment, commercial and residential opportunities. The current transport infrastructure is considered to be a constraint in realising these aspirations.
- The transport links, across all modes, connecting the VoG with Cardiff and the wider Capital Region are experiencing significant congestion, which is considered by the Council to be acting as a major constraint on the area in terms of attracting investment and realising development planning opportunities, whilst it is also seen to detract from resident and visitor amenity.

What is the policy fit?

The principle of improving connections to and from the VoG aligns well with national, regional and local transport, planning and socio-economic policies. In particular, the EZ has been identified as a strategic opportunity area, with the overall policy framework providing guidance as to how the potential of such developments can be realised.

Of particular relevance is the clear alignment with the headline national and regional policies, as follows:

- Improvements to the connectivity of the VoG would make an enabling contribution to the 'Themes' of **Prosperity for All – The National Strategy**. Enhancing access to a potentially major employment growth area and promoting development at the sub-regional level would support the emergence of regionally significant business and employment opportunities in the VoG, which would be of benefit to communities across South Wales.
- **Prosperity for All** is underpinned by an **Economic Action Plan (EAP)**, which sets out a vision for "inclusive growth, built on strong foundations, supercharged industries of the future and productive regions". Within the EAP, there is a commitment to both:
    - A new *regionally focussed* model of economic development, which will promote regional interests and issues in Welsh Government. In the context of this study, this can be thought of as the Cardiff Capital Region, of which the VoG is part.
    - A five-year programme of transport capital funding, linking to mandated regional land-use and planning decisions. Whilst this commitment remains at the strategic stage, it is possible that the EZ would be considered within the context of 'mandated regional land-use'.
- Investment in improved connectivity would also make a significant contribution to the outcomes and, by definition, the strategic priorities identified in the **Wales Transport Strategy**. As well as supporting access to employment, overall local and national connectivity would be improved, with resulting journey time, reliability and environmental benefits accruing.
- The regional employment opportunity presented by the EZ has the potential to contribute to the **Our Valleys, Our Future** priorities, particularly in terms of creating good quality jobs and furnishing residents with the skills to do them. However, facilitating this desired

outcome will require both transport infrastructure and services which connect the Valleys labour market to employment opportunities in the VoG.

- The proposal to enhance connectivity to and from the VoG is also well grounded within the **Wales Spatial Plan**. The outturn schemes would support access to the Vale of Glamorgan Strategic Opportunity Area and Cardiff Airport, whilst better matching labour with employment opportunities across the area through improving accessibility.
- The emerging **National Development Framework and Strategic Development Plans** are likely to support the development of key sites within the VoG, including the EZ. This would provide a firm policy basis for supporting accessibility improvements to these sites.
- **Powering the Welsh Economy**, the document underpinning much of the **Cardiff Capital Region City Deal**, emphasises the need for investment in improved transport connectivity to both promote economic development and address existing transport problems.
- **A Growth Strategy for the Swansea Bay City Region** recognises the need for improved connectivity between the City Region, the rest of Wales, the UK more generally and internationally. Access to Cardiff Airport is specifically noted as a desired outcome.

Land-Use Development Baseline

The declaration of an EZ in the VoG has facilitated a strategically important and high value economic development and employment site within the area - 78% of the total employment land allocation for the Vale of Glamorgan falls within the EZ and it is anticipated that the site will create 4,000 direct jobs. The EZ therefore represents a development of strategic importance for the Cardiff Capital Region and South Wales as a whole.

Whilst this report is focussed on the case for improving connectivity to the VoG, there is also a specific case for considering infrastructure improvements which would support the development of the sub-regional economy, combining the development potential of the EZ and strategic opportunity sites in Rhondda Cynon Taf (the Rhondda Gateway and Llanilid on the M4). The realisation of these sites and the EZ would assist in addressing an identified market failure in respect of the provision of Grade A commercial property within the Capital Region and would assist in ensuring the Region as a whole is competitive against other areas of the UK.

Ensuring that the EZ and the wider VoG maximises its development and regional economic potential (particularly in terms of the sub-region being developed in partnership with RCT) will require the provision of a safe and efficient transport network capable of meeting the needs of employees, business visitors and freight. As the subsequent sections explain, the transport infrastructure and services in their current form are likely to act as a constraint on the anticipated development of the EZ and the wider sub-regional opportunity.

Outwith the strategic land-use development issue, it is worth noting that the Inspector's Report on the VoG Local Development Plan (LDP) suggests that without intervention in the relatively short-term, transport infrastructure may start to place a longer-term constraint on land-use aspirations within the VoG, negatively affecting the economy of the County.

Socio-Economic Baseline

A comprehensive socio-economic baselining exercise has identified two key points in relation to the socio-economic profile of the study area:

- There is strong evidence of the existence of a **'two-speed economy'** with a broadly affluent rural hinterland and coastal zone encircling the Valleys, which suffer high levels of multiple deprivation (including high levels of economic inactivity and unemployment). The imbalance within the regional economy is negative for the study area as a whole.
- There is an evidenced issue with **productivity / competitiveness** within the study area as a whole and within constituent local authorities.

Participation (i.e. high levels of economic activity and employment) and **productivity** are considered to be the building blocks of a strong economy. Whilst there are variances across the study area, there is a clearly evidenced problem in respect of both of these growth factors when the area is considered as a single entity.

At the strategic level, the rationale for improving transport connections to & from the VoG is based on supporting strategic economic and land-use development within the VoG, most notably in the context of the EZ. It is anticipated that by improving connectivity (the *outcome*), there will be a positive impact in terms increased Gross Value Added (GVA), reduced unemployment, higher household incomes etc (the *impacts*).

It is also important to note the economic position of the study area is not static. Improvements to transport connectivity (e.g. improvements to the South Wales Mainline, removal of the tolls on the Severn Bridges) and other infrastructure investments outwith the study area could disadvantage both the Cardiff Capital Region and Swansea Bay City Region if other areas of the UK, and in particular the south-west of England, are deemed to be more competitive. Whilst the Metro and M4 Newport Bypass will greatly assist in supporting the economic competitiveness of South Wales, the threat of a loss of economic activity is a real one.

It is in this context that the EZ, and indeed the wider sub-regional opportunity, can be considered so important. The EZ, amongst other developments, presents a regionally significant economic growth opportunity, potentially generating a range of employment opportunities across different occupational categories, both directly and in terms of indirect and induced employment. Of critical importance is the potential creation of jobs in manufacturing (skilled and unskilled) which would be well suited to parts of the study area with high concentrations of residents in these occupational categories.

Effective transport connectivity between the VoG and the rest of the study area is however likely to be essential in ensuring the EZ is competitive in matching jobs with the labour market and facilitating business-to-business interactions.

Transport Connectivity Baseline

The land-use development and socio-economic 'cases' set out above clearly highlight the scale of the EZ and its socio-economic importance to South Wales. However, the current transport connectivity of the VoG is considered to be a constraint in the development of the EZ sites and thus the benefits associated with it. Specifically:

- Whilst the M4 provides high quality strategic access points to the VoG, the local road network within the Vale is generally of a single carriageway standard and suffers significant congestion around the primary 'gateway' of Culverhouse Cross. Accessibility analysis shows that the need to route via J33 of the M4 and the busy Culverhouse Cross does have a negative impact on both journey length and reliability.
- The most direct route from the M4 to the EZ is via J34 of the M4. However, the connecting road is of a poor quality with lengthy single track sections and poor visibility. The J34 option has become a rat run for those travelling to the VoG from the west, with negative implications for communities along the route, including Pendoylan.
- Whilst there is a reasonable public transport network connecting Cardiff City Centre with the Airport (and, to a much lesser extent, St Athan), connections from elsewhere in the Capital Region and areas to the west are limited, infrequent and generally require interchange. It is notable that those currently working in the EZ area generally travel to work by car.
- Public transport journey times to the VoG generally and the EZ specifically are well in excess of those by car.
- Freight access to and from the Vale of Glamorgan is sub-optimal, with issues associated with journey time reliability, routing through broadly residential areas and a circuitous route to West Wales. The area around Cardiff Airport has a high proportion of freight intensive industries, whilst the focus of the EZ on aerospace and manufacturing means that there is

likely to be significant growth in freight movements from the VoG in the medium-term. The provision of appropriate freight routes to the M4 is a key consideration of any future improvements to VoG connectivity.

Whilst the EZ presents a regionally significant opportunity, the labour market catchment of the site is limited by the current transport infrastructure and services. If this issue is not resolved, it may have longer term implications for firms currently located in the VoG and in terms of the business location decisions of prospective investors. The limited labour market catchment of the EZ currently is compounded by comparatively poor business-to-business accessibility. This may have an impact on business location / investment decisions and would also weaken the agglomeration benefits associated with the development of an aerospace cluster in the Vale.

Moreover, the accessibility analysis undertaken found that relatively modest reductions in journey times to / from the VoG would significantly increase the labour market and business-to-business catchment of the EZ.

The Future of Cardiff International Airport

Whilst the aspiration to improve the connectivity of the Vale of Glamorgan is predominantly focussed on unlocking the land-use development and employment potential of the EZ, any such improvement would clearly be beneficial for Cardiff International Airport. Indeed, the desk-based analysis and consultation demonstrated that the current surface accessibility of the airport is acting as a key constraint on route development, frequency and ultimately passenger numbers.

Analysis of the CAA Passenger Survey data points to the issue of Cardiff Airport being uncompetitive within its target market. There is a significant proportion of leakage – the analysis shows that 58% of South Wales residents surveyed use Bristol, Birmingham and Gatwick when taking a flight, with the overall proportion of leakage likely to be higher if e.g. Heathrow, Manchester etc were included within the analysis.

Benchmarking has also demonstrated that Cardiff is also relatively poorly served in terms of both short and long-haul routes when compared with other EU peripheral secondary airports (e.g. Glasgow & Edinburgh, Dublin, Keflavik etc).

Despite the above points, there are several opportunities within the aviation sector (e.g. low cost long haul, reforms to Air Passenger Duty etc) which could be beneficial for Cardiff. In addition, the securing of the first scheduled long-haul route to Doha with Qatar Airways from May 2018 will significantly enhance the connectivity of Wales to Asia and Australasia. This connection may also provide a template for an expansion of the long-haul market and an embryonic high value and niche freight industry at Cardiff Airport. Realising these and other opportunities will however require resolution of the evidenced problems with surface access to the airport, which is considered by consultees to be a major constraint.

Why invest in improved transport connectivity?

As explained above, improvements in transport connectivity to and from the VoG would assist in improving the accessibility of the EZ, and would better connect jobs to labour and businesses to other businesses within the study area. This concept can be encapsulated in a logic map, which is an effective way of visually presenting the linkages between the infrastructure being delivered and the potential outcomes and impacts that could be generated.

The Logic Map tells the story along the lines of that set out diagrammatically in the figure below. The Strategic Need sets out the rationale for the scheme with the evidence showing the current issues and problems. If there is investment of X (deliverables) this will then generate outputs which result in certain outcomes and then, ultimately, impacts. If the linkages are correct, these impacts should resolve the problems and issues identified under the Strategic Need / current situation.

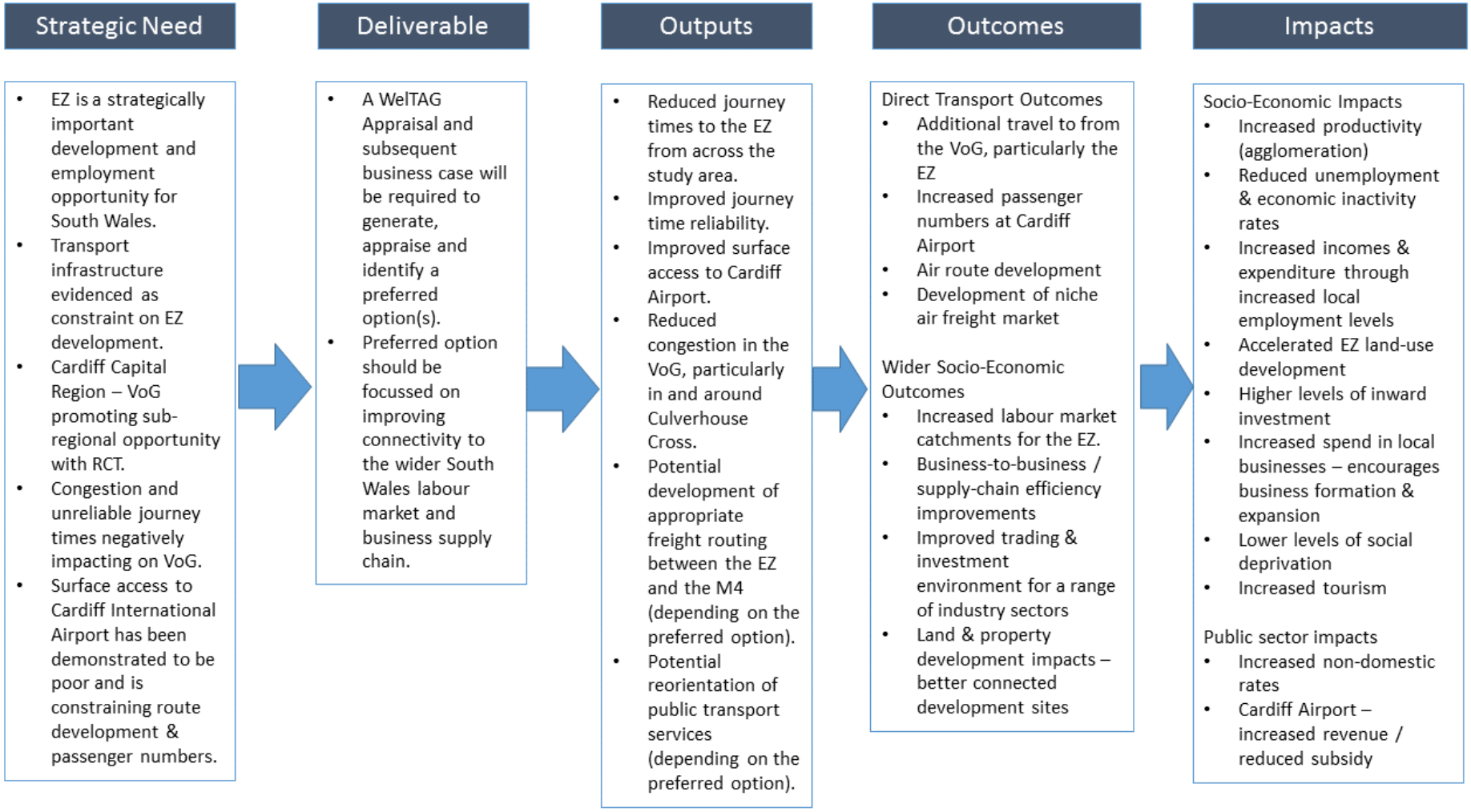


Figure S2: Logic Map

The extent to which each of the desirable outcomes and impacts, and their relative magnitude, will be realised through improving connectivity to the VoG will be dependent on the preferred option pursued.

Conclusions

A 'case for change' has been made predominantly on the basis of realising the strategic development and employment opportunities associated with the Cardiff Airport – St Athan Enterprise Zone, which will offer economic development benefits for South Wales as a whole.

Taken together, consultation and desk-based analysis has demonstrated that the current transport connectivity of the VoG, in the context of the EZ and airport, is sub-optimal in terms of journey times, journey time reliability, public transport coverage and the routing of strategic traffic. If these issues are not addressed, there is a risk that the opportunities offered by the EZ may not be fully realised.

The socio-economic baselining of the study area has clearly highlighted the multitude of problems currently being experienced in the Cardiff Capital Region and Swansea Bay City Region. These include low levels of productivity and business competitiveness, limited inward investment, high rates of economic inactivity & unemployment and concentrated areas of multiple deprivation. The EZ is part of a package of measures across the respective City Regions which could begin to tackle these issues through creating (high value) direct, indirect and induced employment opportunities, as well as wider supply-chain opportunities for Welsh businesses across the region. However, its success is dependent on connecting the employment opportunities to the labour market and ensuring that business-to-business interactions are as seamless as possible.

Moreover, with a once in a generation programme of capital investment in transport infrastructure in the Capital Region and connecting Wales with England underway, there is an opportunity for the areas to the west of Cardiff to better access a wider range of employment and business opportunities. However, this improved connectivity also presents a risk, in that by failing to address the transport problems in the VoG, the economic gravity of the area could shift to the east, with potential for economic leakage to England.

There are also a number of opportunities for Cardiff International Airport to better position itself as the gateway to Wales, particularly in terms of the long-haul market. The presence of a well-connected international airport is generally seen to be positive in promoting economic development and inward investment. However, the current surface access to the airport has been widely cited as a constraint which, if not addressed, could continue to limit the route development potential of the airport.

Finally, within the VoG itself, the current transport infrastructure is considered to be having a negative impact on the area, particularly in terms of congestion and journey time reliability. The transport issues are considered to be having a negative impact on business performance, the attractiveness of the VoG as a place to live, work and do business and, in the longer-term, land-use aspirations within the Vale.

In short, improving the transport connectivity of the VoG is considered necessary to support national, regional and local economic performance.

Next Steps

The next step in the process involves undertaking a WelTAG appraisal of options / business case which should be framed within the above logic map (updating it as necessary). The appraisal should be focussed on:

- defining a set of Transport Planning Objectives which reflect the strategic need;

- generation and appraisal of options which, through an iterative process, will define a preferred option(s) which best addresses the evidenced strategic need;
- application of available tools (e.g. the South-East Wales Transport Model (SEWTM), accessibility software, business surveys etc) to evidence the type and magnitude of outcomes and impacts which can be expected; and
- development of a robust monitoring and evaluation plan, which will create a framework for establishing the baseline position and tracking the emergence of outcomes and impacts over time (and in the long-term with relation to wider socio-economic impacts).

1 Introduction

1.1 Overview

1.1.1 The Welsh Government (WG), in partnership with the Vale of Glamorgan County Council, is assessing the case for improving the strategic transport connectivity of key employment sites within the Vale of Glamorgan (VoG). WG has commissioned Peter Brett Associates LLP (PBA) to support the initial development of the business case.

1.1.2 The study aligns with the H.M. Treasury *Green Book: Appraisal & Evaluation in Central Government*, and in particular Chapter 3, 'Justifying Action', in that it makes the 'case for change' and hence investment.

1.2 Scope of the Study

1.2.1 The *Better Business Cases* framework used by WG in assessing potential scheme or policy interventions is based predominantly on the H.M. Treasury 'Five Case Model', which provides a sequential set of steps, from demonstrating the case for change through to the ultimate delivery of an intervention.[1]

1.2.2 This report is focussed on the early stages of the 'Strategic Case', which determines whether or not an investment is needed, either now or in the future. The purpose of this study is to clearly demonstrate and elaborate the 'case for change' - that is, to provide a clear rationale for making an investment, its strategic fit, and how the investment will further the aims and objectives of the Welsh Government and its partners.

1.2.3 This report does **not** consider specific options for improving connectivity for the VoG. Providing the case for change can be satisfactorily demonstrated to the relevant investment decision makers, a subsequent Welsh Transport Appraisal Guidance (WelTAG) study will be required to consider the comparative merits of different options, with a preferred option(s) then being taken forward into a detailed business case.

1.3 What is driving this study?

1.3.1 The initial brief for this study suggested that there are both national / regional and local drivers for improving connectivity for the VoG. From a **national / regional** perspective:

- The emergence of the Cardiff Airport – St Athan Enterprise Zone (EZ) in the VoG presents a strategically important commercial development and employment opportunity for South Wales as a whole.
- As part of the development of the Cardiff Capital Region and corresponding City Deal, there is a desire to improve transport connectivity across South-East Wales, safeguarding and promoting employment & investment and attracting & retaining population. It is envisaged that judicious and targeted investment will ensure that the Capital Region remains attractive and competitive.
- Through an arms-length company, WG owns and operates Cardiff International Airport. Surface access to the airport has frequently been cited as a problem and there is a desire within WG to consider options for improving connectivity to / from the airport within the boundaries of European Union (EU) State Aid rules.

1.3.2 From a **local** perspective:

- In partnership with neighbouring Rhondda Cynon Taf (RCT) County Council, VoG is pursuing a sub-regional development strategy intended to ensure that the area offers an appropriate and future-proofed balance of employment, commercial and residential

[1] http://gov.wales/funding/wales-infrastructure-investment-plan/better-business-cases/?lang=en

opportunities. The current transport infrastructure is considered to be a constraint in realising these aspirations.

- The transport links, across all modes, connecting the VoG with Cardiff and the wider Capital Region are experiencing significant congestion, which is considered by the Council to be acting as a major constraint on the area in terms of attracting investment and realising development planning opportunities, whilst it is also seen to detract from resident and visitor amenity.

1.3.3 The evidence underpinning the above points, and the extent to which they support the overall case for change, will be explored through this study.

1.4 Developing the Case for Change

1.4.1 There were two discrete steps in developing the case for change within the context of this research:

- Baselining the study area from a land-use, socio-economic and transport perspective, with a view to identifying current and potential future opportunities and problems.
- Undertaking a structured stakeholder consultation exercise to develop the evidence base surrounding the identified problems and opportunities. A full list of the stakeholder consultees is provided in Appendix A.

1.4.2 This report draws upon the above tasks to develop the narrative surrounding the case for change, as follows:

- Chapter 2 defines the study area on which the subsequent analysis is based.
- Chapter 3 sets out the policy context, exploring the extent to which improving the strategic connectivity of the VoG aligns with national, regional and local policy.
- Chapter 4 considers the land-use development context and the potential implications of this for the transport system.
- Chapter 5 provides a socio-economic summary of the study area and explores the extent to which current transport connectivity may be acting as a constraint to realising positive outcomes.
- Chapter 6 reviews the transport network in the Vale of Glamorgan and explores the extent to which current connectivity may be acting as a constraint.
- Chapter 7 specifically considers current activity at Cardiff Airport and the extent to which the transport infrastructure is acting as a constraint.
- Chapter 8 develops a 'logic model', which summarises the case for improved transport connectivity to and from the VoG, the potential transport outcomes and wider socio-economic impacts which may be realised through improving transport connectivity.
- Chapter 9 sets out the study conclusions and identifies the next steps required in terms of developing a WelTAG-based options appraisal and subsequent business case (should the investment decision maker consider the case for change to have been satisfactorily made).

2 Study Area

2.1 Overview

2.1.1 The study area includes the ten local authorities within the Cardiff Capital Region (Cardiff, Monmouthshire, Torfaen, Blaenau Gwent, Newport, Caerphilly, the Vale of Glamorgan, Merthyr Tydfil, Rhondda Cynon Taf and Bridgend) as well as three of the four members of the Swansea Bay City Region (Swansea, Neath Port Talbot and Carmarthenshire). This is shown in the figure below:

Figure 2.1: Study Area

2.1.2 In defining the study area, consideration was given to the inclusion of Pembrokeshire. However, given the more limited flows from that area to the Capital Region, it was considered prudent to omit Pembrokeshire from the wider study area. This is also the case for the local authorities to the north e.g. Powys and Ceredigion.

3 Policy Review

3.1 Introduction

3.1.1 The first test in making the case for change in any business case is understanding the strategic fit of the proposed intervention with the wider policy context.

3.1.2 As the funding source of any future intervention is obviously undetermined at this stage, a review of the relevant transport and planning policies at the national, regional and local level has been undertaken and is summarised below. The review is intended to be succinct and identify the strategic 'fit' of any proposed interventions, rather than providing an exhaustive policy narrative. The focus can be gradually tailored in subsequent stages of the business case.

3.2 National Policy

3.2.1 Improving access to the VoG, and in particular the emerging Cardiff Airport - St Athan Enterprise Zone, could represent a regionally and potentially nationally significant investment. It is therefore essential that the 'case for change' can be demonstrated to contribute towards nationally defined outcomes. The following national policy documents have been reviewed:

- Prosperity for All – The National Strategy
- The Wales Transport Strategy – One Wales: Connecting the Nation
- Our Valleys, Our Future
- People, Places, Futures: The Wales Spatial Plan (2008 Update)
- Planning Policy Wales (November 2016)

Prosperity for All – The National Strategy

3.2.2 WG published its Programme for Government, *Taking Wales Forward 2016-21*, in 2016 and set out headline commitments to be delivered by 2021, effectively a set of measures which can be implemented within the lifetime of this Assembly. The National Strategy – *Prosperity for All* - takes those key commitments, places them in a long-term context, and sets out how they fit with the work of the wider Welsh public sector to lay the foundations for achieving prosperity for all.

3.2.3 The National Strategy stems from the ground-breaking *Wellbeing of Future Generations Act*, which sets out the need for a long-term focus to guide Welsh public services in delivering for the people. The Act is believed to be among the first of its kind, promoting a long-term and strategic focus for Wales, within which shorter-term strategies and delivery plans can be nested.

3.2.4 *Prosperity for All* sets out four key themes:

- 1) Prosperous and secure
  - Support people and businesses to drive prosperity.
  - Tackle regional inequality and promote fair work.
  - Drive Sustainable growth and combat climate change.
- 2) Healthy and active
  - Deliver quality health and care services fit for the future.
  - Promote good health and wellbeing for everyone.
  - Build healthier communities and better environments.
- 3) Ambitious and learning
  - Support young people to make the most of their potential.

- Build ambition and encourage learning for life.
- Equip everyone with the right skills for a changing world.

- 4) United and connected
  - Build resilient communities, culture and language.
  - Deliver modern and connected infrastructure.
  - Promote and protect Wales' place in the world.[2]

3.2.5 Initiatives to enhance access to and from the VoG from the wider Capital Region and Swansea Bay City Region would contribute directly to the 'Prosperous & Secure' and 'United & Connected' themes.

3.2.6 In terms of Theme 1 (Prosperous & Secure), the strategic economic opportunities emerging in the VoG around the EZ offer a regionally significant opportunity to expand the business and employment base in South Wales. In addition, there is an opportunity at the sub-regional level to connect the emerging opportunities in the VoG with those in RCT, creating a wider strategic opportunity. This in turn will assist in tackling regional inequalities, where pockets of affluence on the coast and in rural areas are juxtaposed against high levels of deprivation and inequality in the Valleys amongst other areas.

3.2.7 In addition, numerous streams of research considering the relationship between transport and economic development have highlighted the importance of air connectivity in promoting business growth and attracting inward investment. Transport improvements in the Vale of Glamorgan would either directly or indirectly (depending on the schemes progressed) support surface access to Cardiff Airport, thus improving integration between the airport and the wider Capital Region (most notably Cardiff City Centre). This point came through very strongly in the stakeholder consultation.

3.2.8 By definition, enhancing the strategic connectivity of the VoG would assist in delivering modern and connected infrastructure. In addition, the provision of infrastructure which could facilitate the development of Cardiff Airport through improving access would 'promote and protect Wales' place in the world', supporting the development of a better connected gateway to South Wales.

3.2.9 By contributing to the above two themes (particularly Theme 1), connectivity improvements would also support Theme 3 *Ambitious & Learning* by providing employment, training and apprenticeship opportunities and Theme 2 given the proven correlation between unemployment and poorer physical and mental wellbeing.

Prosperity for All – Economic Action Plan

3.2.10 Prosperity for All is underpinned by an Economic Action Plan (EAP), which sets out a vision for "inclusive growth, built on strong foundations, supercharged industries of the future and productive regions". Within the EAP, there is a commitment to both:

- A new *regionally focussed* model of economic development, which will promote regional interests and issues in Welsh Government. In the context of this study, this can be thought of as the Cardiff Capital Region, of which the VoG is part.
- A five-year programme of transport capital funding, linking to mandated regional land-use and planning decisions. Whilst this commitment remains at the strategic stage, it is possible that the EZ would be considered within the context of 'mandated regional land-use'.[3]

Key Point: Improvements to the strategic connectivity of the VoG would make an enabling contribution to all of the 'Themes' of *Prosperity for All* and the wider *Economic Action Plan*. Enhancing access to a potentially major employment growth area and promoting development at the sub-regional level would support the emergence of regionally significant business and

[2] http://gov.wales/docs/strategies/170919-prosperity-for-all-en.pdf

[3] http://gov.wales/docs/det/publications/171212-economic-action-plan-executive-summary-en.pdf

employment opportunities in the VoG, which would be of benefit to communities across South Wales.

The Wales Transport Strategy – One Wales: Connecting the Nation

3.2.11 Published in April 2008, this document aims to promote sustainable transport networks that safeguard the environment while strengthening the country's economy and social life. High-level outcomes are identified along with the steps for their delivery.

3.2.12 Long-term social, economic and environmental outcomes are set out with relevant outcomes. The table below summarises these outcomes and identifies the extent to which the proposed interventions could contribute towards their delivery.

Table 3.1: Wales Transport Strategy – Mapping Outcomes to the Proposed Interventions

Outcome	How can any potential interventions contribute?
Improving access to employment opportunities.	The EZ offers a nationally significant employment opportunity but its long-term development may be constrained by the current surface access to the VoG. Improving access to the EZ would support a range of employment opportunities across the Capital Region and Swansea Bay City Region. It would also support sub-regional development aspirations being jointly pursued by VoG and RCT.
Improving connectivity within Wales and internationally.	Access improvements to and from the VoG would improve local and regional connectivity in the study area. However, perhaps more importantly, improved access to Cardiff Airport would provide a basis for enhancing international connectivity, particularly when aligned with aspirations related to the abolition of Air Passenger Duty for long-haul flights
Improving the efficient, reliable and sustainable movement of people.	Whilst the preferred option(s) for improving connectivity in the VoG has not yet been defined, it is likely that the outturn scheme(s) will be focussed on enhancing the movement of people to, from and within the region, and in particular better connecting the employment and labour markets.
Improving the efficient, reliable and sustainable movement of freight.	Whilst the preferred option(s) for improving connectivity in the VoG has not yet been defined, it is likely that any outturn scheme(s) would enhance the movement of freight to, from and within the region. A key issue will be ensuring that current and future freight generated by the EZ is conveyed / routed in such a way that it is 1) not negatively impacted by poor journey time reliability; and 2) does not in itself impact on the journey times of non-freight users on the radial routes (road and rail) connecting into Cardiff.
Reducing the contribution of transport to greenhouse gas emissions	Access improvements to and from the Vale of Glamorgan would assist in reducing a range of negative environmental impacts. The identification of precise impacts clearly depends on the definition of the final option(s). However, it is likely that any investment will reduce congestion (thus improving air quality) and reduce the amount of through traffic (particularly freight) in urban and peri-urban areas. There is potentially a negative impact at the Wales level if aircraft movements at Cardiff Airport increased, although clearly these movements would be happening elsewhere and this would thus just be a redistribution when considered at a wider spatial level.
Reducing the contribution of transport to air pollution and other harmful emissions.	
Improving the impact of transport on the local environment.	

3.2.13 The outcomes in the Wales Transport Strategy formed the basis of a set of strategic priorities (which by definition would be delivered if the outcomes are realised). These are:

- reducing greenhouse gas emissions and other environmental impacts;
- integrating local transport;
- improving access between key settlements and sites;

- enhancing international connectivity; and
- increasing safety and security.

Key Point: Improving connectivity for the VoG would clearly make a significant contribution to the outcomes and, by definition, the strategic priorities identified in the Wales Transport Strategy. As well as supporting access to employment, overall local and national connectivity would be improved, with resulting journey time, reliability and environmental benefits accruing.

Our Valleys, Our Future

3.2.14 Building on the work of the Ministerial Taskforce for the South Wales Valleys, a high level plan has been published which outlines future priorities for the area – these are:

- good quality jobs and the skills to do them;
- better public services; and
- my local community.

3.2.15 The EZ offers a specific opportunity in respect of the first bullet in particular, offering high quality direct employment and the potential for further indirect and induced employment. However, in order to ensure that these opportunities are fully realised, the transport infrastructure and services must effectively connect the Valleys labour market to the employment opportunities in the EZ, as well as facilitating business-to-business interactions.

Key Point: The regional employment opportunity presented by the EZ has the potential to contribute to the *Our Valleys, Our Future* priorities, particularly in terms of creating good quality jobs and furnishing residents with the skills to do them. However, facilitating this desired outcome will require both transport infrastructure and services which connect the Valleys labour market to employment opportunities in the VoG.

People, Places, Futures: The Wales Spatial Plan (2008 Update)

3.2.16 Updated in 2008, the *Wales Spatial Plan* sets out the spatial planning framework for Wales as a whole. As a national plan, it is intended to guide the type and location of strategic developments, whilst providing an over-arching framework to which local development planning must pay due regard.

3.2.17 The *Wales Spatial Plan* aims to ensure that development 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 its different regions. Collaborative working is important as is the vertical and horizontal integration of policies nationally and regionally. It sets out five themes under which key issues and challenges have been identified:

- building sustainable communities;
- promoting a sustainable economy;
- valuing our environment;
- achieving sustainable accessibility; and
- respecting distinctiveness.

3.2.18 It is important to note that the *Wales Spatial Plan* was prepared prior to the full / current formulation of the City Regions concept and the designation of Enterprise Zones. Nonetheless, it provides an important strategic basis for this study. The Plan defines South-East Wales as the 'Capital Region' and notes that:

- the area will function as a networked city region, on a scale to realise its international potential, its national role and to reduce inequalities;

- a fully integrated high quality transport system is necessary for this to happen. Over the 20-year horizon of the *Wales Spatial Plan*, all the of area's key settlements should be linked to Cardiff or Newport by suitable high capacity public transport (effectively the basis of the Metro concept); and
- the success of the area relies on Cardiff developing its capital functions, together with strong and distinctive roles of other towns and cities.[4]

3.2.19 The plan specifically recognises the importance of the Vale of Glamorgan and St Athan, which is defined as a Strategic Opportunity Area (SOA), the forerunner of the Enterprise Zone. Cardiff International Airport is also recognised as making an important contribution to the region and the international visibility of Wales. It is specifically noted that there is a need to ensure good road and public transport access to the airport, whilst more clearly defining the future role and function of the airport.[5]

3.2.20 It is further noted that the Capital Region faces a big challenge to equip all of its people with the skills they will need to contribute effectively to the future of the area. It is pointed out that economic inactivity rates remain high in the Heads of the Valleys and in some wards in Cardiff and Newport.

3.2.21 The transport element of the *Wales Spatial Plan* is contained within the SEWTA *Regional Transport Plan* (discussed later in this chapter). Nonetheless, it supports the development of sustainable travel corridors and enhanced access to key settlements and development sites.

Key Point: The proposal to enhance connectivity to and from the VoG is well grounded within the *Wales Spatial Plan*. The outturn schemes would support access to the Vale of Glamorgan SOA and Cardiff Airport, whilst better matching labour with employment opportunities across the area through improving accessibility.

National Development Framework for Wales

3.2.22 It should be noted that the *Wales Spatial Plan* will soon be superseded by the new National Development Framework (NDF). The NDF will set out a 20-year land-use framework for Wales and will:

- set out where nationally important growth and infrastructure is needed and how the planning system - nationally, regionally and locally - can deliver it;
- provide direction for Strategic and Local Development Plans and support the determination of Developments of National Significance;
- sit alongside Planning Policy Wales, which sets out the Welsh Government's planning policies and will continue to provide the context for land-use planning; and
- support national economic, transport, environmental, housing, energy and cultural strategies and ensure they can be delivered through the planning system.

3.2.23 Whilst the detail of the NDF has not yet been published, the key point of note is that an additional layer of planning will be added into the system, with Strategic Development Plans (SDPs), where appropriate, acting a bridge between the NDF and Local Development Plans. It is likely that the Cardiff Capital Region and Swansea Bay City Region will benefit from a SDP, which will support the determination of 'Developments of National Significance'. From a VoG perspective, the EZ will potentially be defined as such a development within any Capital Region SDP. This would provide an added layer of policy support for improving connectivity to and from the VoG.

[4] *Wales Spatial Plan* (Welsh Government, 2008), p.97.

[5] *Wales Spatial Plan* (Welsh Government, 2008), p.111.

Key Point: The emerging National Development Framework and Strategic Development Plans are likely to support the development of key sites within the VoG, including the EZ. This would provide a firm policy basis for supporting accessibility improvements to these sites.

Planning Policy Wales (November 2016)

3.2.24 *Planning Policy Wales* (PPW) was adopted in November 2016 and sets out the land-use planning policies of the Welsh Government, focusing on the commitment to sustainable development in the planning system.

3.2.25 Chapter 8 of the document outlines the transport objectives which support sustainable development through integration within and between different types of transport; between transport measures and land-use planning; between transport measures and policies to protect and improve the environment; and between transport measures and policies for education, health, social inclusion and wealth creation (Paragraph 8.1.1). There are a number of points within the PPW which support improved connectivity to and from the VoG:

- Ways in which land-use planning can help achieve the Welsh Government's objectives for transport is through locating development near other related uses to encourage multi-purpose trips and reduce the length of journeys; promoting sustainable transport options for freight and commerce; supporting sustainable travel options in rural areas; and supporting necessary infrastructure improvements (Paragraph 8.1.5). This would tie in with supporting the development of an aerospace enterprise cluster in the EZ.
- Promoting public transport as a means to achieve environmental objectives as well as relieving congestion and encouraging social inclusion, the provision of new stations and enhanced passenger services on existing lines are two options which could be explored. Due to the fixed nature of the infrastructure, rail services can provide a focus for regeneration and new development (Paragraph 8.3.1). This may align with the proposed investment in the VoG.
- Ease of interchange between transport modes should be considered as this is an important determinant of public transport use. Local authorities should identify the need for additional interchange sites and improvements to existing interchanges in development plans and local transport plans (LTPs). (Paragraph 8.3.2). This is a key point if the VoG is to be better connected to the wider Capital Region outwith Cardiff City Centre.
- Local authorities should work to reduce the need to use trunk road and other through routes for short, local journeys with development plans specifying the primary road network including the trunk roads. These routes should be identified as corridors for movement (Paragraph 8.5.1). The evidence (expanded on later in this report) suggests that the mix of local and strategic traffic on trunk and key radial routes is a significant challenge for the VoG.
- In terms of freight, local authorities should consider which routes are most suitable for use by freight and encourage the location or relocation of distribution and operating centres to sites which have good access to these routes (Paragraph 8.5.3). This would tie in directly to the long-term transport consideration for the development of the EZ and any air freight aspirations associated with Cardiff Airport.
- Local authorities should consider potential for promoting the use of railways for additional passenger and freight traffic, identifying new infrastructure, multi-modal transfer facilities and, where appropriate, major employment sites with access to railways (Paragraph 8.5.4).
- Development at airports can bring improved facilities and economic benefits (Paragraph 8.5.5).

Key Point: Potential transport interventions in the VoG align well with the *Planning Policy Wales* Guidance.

Summary

3.2.26 The principle of improving connections for the VoG aligns well with national transport, planning and socio-economic policies. In particular, the EZ has been identified as a strategic opportunity area, with the overall policy framework providing guidance as to how the potential of such developments can be realised.

3.2.27 Whilst consistent with national policy overall, this is not in itself enough in terms of making a case for investment. There are several EZs and strategic opportunity areas around Wales, each of which could potentially make a similar case for investment. It is therefore important to explore the alignment with regional, particularly in terms of the Cardiff Capital Region, and local policy.

3.3 Regional Policy

3.3.1 Across the United Kingdom, there has been a recent trend towards devolution of central government funding and / or powers, most tangibly demonstrated through the formation of City Regions. The case for change being developed in this study is very much focussed at the regional level, and thus the fit with regional policy is key. This is particularly the case in terms of the Cardiff Capital Region (the City Region for South-East Wales), under which any emerging interventions are likely to sit. The policy documents considered include:

- Powering the Welsh Economy: Cardiff Bay & the Region Beyond
- A Growth Strategy for the Swansea Bay City Region (January 2015)
- South East Wales Transport Alliance Regional Transport Plan (March 2010)
- South East Wales Regional Strategic Framework
- South-East Wales City Region Tourism Action Framework 2014 – 2020
- Cardiff Airport and St Athan Enterprise Zone: Strategic Plan 2015

Powering the Welsh Economy: Cardiff Bay & the Region Beyond

3.3.2 This document underpins the Cardiff Capital Region City Deal, which was agreed in 2016 and will see £1.28 billion invested in the Capital Region. Published in February 2015 by the Cardiff Capital Region Board, this document focusses upon the three key themes of **'Connectivity'**; 'Skills'; and 'Innovation and Growth' for developing the economy in the region. The pressing need to better align transport with land-use planning is highlighted due to its ability to act as a catalyst for economic growth as well as providing social and environmental benefits. The efficient flow of people and goods whilst connecting key hubs (employment, residential and recreational) is noted as being paramount for a successful city region and sustained economic growth. This above rationale provides a firm basis for the Metro concept as a whole, but also supports the case for investing in improved strategic transport connectivity for the Vale of Glamorgan, stimulating the EZ and other land-uses.

3.3.3 In terms of innovation and growth, it is highlighted that the aerospace, defence and security sector should work with Bristol to develop a critical mass as Wales and the South West of England combined has the largest aerospace and defence cluster in the UK. Together these provide over 59,000 jobs, revenues of £5.5 billion as well as Cardiff Airport being home to the MoD's Defence Equipment and Support (DE&S) operations and the Government Communications Headquarters (GCHQ) at Cheltenham. This makes investment to realise the development of the EZ and associated aerospace cluster a key priority.

3.3.4 The report also notes that Cardiff Airport offers international access to Wales as well as hosting aerospace and defence companies, but it needs to be **accessible** and thriving to allow the region to be globally connected. Significant investment is ongoing to improve access to the airport as well as improve the operations and infrastructure of the airport itself.

3.3.5 According to the document, 65% of commuters to Cardiff use the car as their primary mode of transport which is seen as being unsustainable. It is noted that improvements to the Great

Western Mainline (GWML) and electrification of the Valleys lines together with emerging developments through the Metro concept, offer an opportunity to address this and other transport issues in the future. These opportunities will need to be considered in terms of making the wider case for investment in the VoG.

Key Point: *Powering the Welsh Economy*, the document underpinning much of the Capital Region City Deal, emphasises the need for investment in improved transport connectivity to both promote economic development and address existing transport problems.

A Growth Strategy for the Swansea Bay City Region (January 2015)

3.3.6 Whilst the focus in this report is predominantly on the Cardiff Capital Region, improved access for the VoG could also benefit the Swansea Bay City Region, particularly in the east (in terms of both access to employment and the international connectivity via the airport).

3.3.7 This strategy underpins the Swansea Bay City Deal and represents a framework to support South West Wales and its future economic development, which intends to stimulate and shape the work of all the stakeholders with a common vision to enhance the long-term prospects of the City Region economy, its businesses and communities.

3.3.8 Whilst generally focussed on the Swansea Bay City Region, the document notes that improved ***connectedness*** is a condition for achieving sustainable growth by which positive links are required between local knowledge-based industries and other relevant actors within and outside the area.

3.3.9 Within *Strategic Aim 5: Distinctive Places and Competitive Infrastructure*, it is noted that there is a requirement for strategic transport links to the rest of Wales and the wider UK to be upgraded to make the Swansea Bay City Region more accessible. Although the region has strong connectivity of ports, along with road and rail links to neighbouring City Regions, it is argued that the limitations of the strategic transport infrastructure has resulted in an insularity that challenges the extent to which the region can be considered an international-class 'destination'.

3.3.10 Specifically, investment is seen to be needed to enhance intra-regional connectivity between key centres of employment and areas of innovation including targeted investment in alleviating capacity restrictions of the M4. Additionally, a coherent approach is needed to support and drive transport infrastructure investment, such as road, rail and air (via Cardiff), to enhance the City Region's strategic connectivity.

3.3.11 As well as strengthening links within the City Region, there is also seen to be a need to develop relationship with partners elsewhere, be it Cardiff, the rest of the UK or internationally, to ensure economic growth in the region.

Key Point: A *Growth Strategy for the Swansea Bay City Region* recognises the need for improved connectivity between the City Region, the rest of Wales, the UK more generally and internationally. Access to Cardiff Airport is specifically noted as a desired outcome.

South East Wales Transport Alliance Regional Transport Plan (March 2010)

3.3.12 The South East Wales Transport Alliance (SEWTA) was a consortium of the Cardiff Capital Region local authorities intended to develop a regional approach to transport planning. SEWTA was disbanded in 2014 but the Regional Transport Plan (RTP) was produced in 2010 and remains current. It provides a 15-year transport strategy up to 2025. The RTP is intended to improve transport in the region as well as to help deliver the social, economic and environmental objectives of the *Wales Spatial Plan* and the *Wales Transport Strategy*.

3.3.13 The wider goals of the RTP are to develop the economy; promote social inclusion and equality; and protect the environment. In order to reach these goals, SEWTA has set objectives covering:

- Safety and Security;
- Connectivity and Accessibility;
- Quality and Efficiency;
- Environment; and
- Land Use and Regeneration.

3.3.14 As a result, the RTP aims to:

- Improve access for all to employment opportunities, healthcare, education, tourism and leisure facilities;
- Improve interchange within and between modes of transport;
- Improving the quality, efficiency and reliability of the transport system;
- Reduce traffic growth, traffic congestion and make better use of the existing road system;
- Achieve a modal shift towards more sustainable forms of transport for moving both people and freight;
- Reduce significantly the emission of greenhouse gases from transport;
- Ensure developments in South East Wales are accessible by sustainable transport; and
- Make sustainable transport and travel planning an integral component of regeneration schemes.

Key Point: Whilst now somewhat dated, the SEWTA RTP is well aligned with the proposals to enhance transport connectivity for the VoG, particularly in terms of promoting accessibility to employment, tourism etc and ensuring sustainable access to developments.

South East Wales Regional Strategic Framework, 2013

3.3.15 Delivered in October 2013, this Framework for economic development identifies the key high priority investments that the local authorities in the region wish to see implemented in order to secure sustained future prosperity in the region supported by investments to secure economic development, develop efficient and accessible transport and provide excellent connectivity. To achieve this, the South East Wales Regional Partnership is working with the Welsh Government in assessing and developing the regional transport priorities as well as using their highway and planning powers to assist with the delivery of the programme.

3.3.16 Under *Strategic Priority 1: Place*, key projects for delivering an effective and efficient cross-regional transport infrastructure include strategic road improvements; electrification of the rail network; the implementation of the South Wales Metro network; and developing an international airport of significance (i.e. Cardiff).

3.3.17 The M4 forms part of the Trans-European Transport Network (TEN-T) and therefore plays a key strategic role in connecting South Wales with the rest of Europe and Ireland. It is a significant east-west route and one of the most heavily used roads in Wales as it provides a means for transporting goods, linking people to employment as well as serving the tourism industry. The South East Wales Regional Partnership assume that with their support, the Welsh Government will lead on securing improvements to the M4 corridor; the development of Cardiff International Airport; and rail electrification. This aims to improve connectivity by 2030 within the region and beyond whilst reducing the reliance on the private car and increasing the use of public transport. It also notes the need to reduce travel times to work as well as reduce emissions. This improved connectivity is expected to unlock economic growth through increasing employment to the Enterprise Zones, such as St Athan.

3.3.18 In terms of *Strategy Priority 2: Business Support & Development*, key business clusters, such as Enterprise Zones, should be identified and exploited to allow the region to build upon

strengths and generate opportunities for investment and further employment. This involves providing the infrastructure requirements in the Enterprise Zones.

3.3.19 Additionally, *Strategic Priority 3: People and Skills* outlines the need to enable people, particularly in disadvantaged areas, to take advantage of new opportunities as they are generated.

Key Point: Any proposals to improve connectivity for the VOG (including addressing the issues in the M4 Corridor) would be closely aligned with the South-East Wales Regional Strategic Framework. The Framework recognises the need for developing intra and inter-regional connectivity in South Wales and the role of Cardiff Airport from an economic development perspective. There is also a recognition of the role that infrastructure can play in unlocking regionally significant development opportunities and better connecting labour with employment.

South-East Wales City Region Tourism Action Framework 2014 – 2020

3.3.20 The Regional Tourism Action Framework sets the future ambitions and targets, as well as priority or transformational projects to 2020. It establishes the ambition to grow the value of tourism to the South East by 15% in real terms by 2020, representing an overall estimated value of £650m of GVA and approximately 83,000 FTE jobs.

3.3.21 Key objectives include:

- attracting new tourists into the area;
- encouraging repeat visits by existing leisure tourists;
- encouraging business tourists to return on a longer duration leisure holiday; and
- linking together tourism locations and help establish a critical tourism mass for south-east Wales.

3.3.22 Cardiff Airport is clearly fundamental to this vision, acting as the international and, to some extent, domestic (i.e. from the rest of the UK) gateway to South-East Wales. The Glamorgan Heritage Coast is also an important destination in its own right and forms part of the wider tourism product in South-East Wales. There is also a strong day-tripper market to Barry Island, which places additional pressure on the local rail and road network.

Key Point: Enhancing the strategic connectivity of the VoG is an important element of the long-term development of tourism in South-East Wales (likely beyond the above strategy period). This would include supporting the development of Cardiff Airport as the point of entry for trips to Wales from current and new destinations and enhancing access to the Glamorgan Heritage Coast. There is also likely to be a strong element of business tourism associated with the EZ, and in particular the Aston Martin development, which is of international significance.

Cardiff Airport and St Athan Enterprise Zone: Strategic Plan 2015

3.3.23 Published in July 2015, this strategic plan details the framework for the Cardiff Airport – St Athan Enterprise Zone which is one of seven Enterprise Zones in Wales, each of which focuses on a key industry sector. These geographical areas aim to create new jobs and support sustainable growth.

3.3.24 The Cardiff Airport - St Athan Enterprise Zone focuses on aerospace business, offering two runways in close proximity, good airside access and large areas of land already allocated and approved for development, as well as proximity to higher education institutions in South East Wales.

3.3.25 The zone is made up of three distinct areas, as follows (more details and a map are provided in Chapter 4):

- **St Athan ABP:** a base for aerospace activity for more than half a century. The site has a 1,800m runway, with full airfield support, and is suitable for both fixed wing and rotary aircraft, up to Airbus A330 and Boeing 767-sized aircraft. Accommodation is fit for a range of civilian or military purposes, including aircraft Maintenance, Repair & Overhaul (MRO), manufacture, engine overhaul, Non-Destructive Testing (NDT) and R&D.
- **Cardiff Airport:** offers air travel to a number of short and long haul destinations. Land and facilities are available for MRO operators and supply chain operators complementary to British Airways Maintenance, Cardiff (BAMC). The proximity of the airport and runway are ideal for the fast movement of aerospace parts, as well as storage and salvage, cargo operations and freight-related businesses.
- **The Gateway Development Zone:** includes potential development land close to Cardiff airport. Currently at the concept stage, there are plans to develop an airport city, creating a business destination for local and international businesses. The plans include quality office accommodation, specialist education and training facilities and leisure developments.

3.3.26 The document notes that a total of 20% of UK aeronautical business is located in Wales including some of the world's largest aerospace and defence companies such as Airbus, British Airways and BAE Systems.

3.3.27 The vision for the Enterprise Zone is to be: "*Europe's centre of aeronautical excellence, a catalyst for growth in the Cardiff Capital Region and an international gateway with world-class facilities, opportunities and a highly skilled quality workforce."*

3.3.28 The key objectives include:

- a thriving aerospace and defence cluster built upon a strong heritage of aeronautical excellence;
- Europe's hub for aerospace education, training and R&D;
- unique and state of the art accommodation fit for a range of civilian or military aviation purposes;
- world-class office accommodation and light industrial units;
- a gateway to Wales' business, tourism and leisure destinations; and
- a quality environment in which to do business.

3.3.29 In terms of being a gateway for Wales, the EZ will support the aspiration to expand air services at Cardiff International Airport whilst also taking advantage of the Zone's existing transport links and capitalising upon the committed highways and access improvements. The Enterprise Zone will also support planned major infrastructure proposals such as Cardiff Capital Region Metro.

3.3.30 It is anticipated that the EZ will generate around 4,000 additional jobs, which could be created through the development of the Gateway Development Zone and would provide employment opportunities across the region. This would generate further indirect & induced employment and would also complement planned housing growth in the surrounding area.

3.3.31 A range of land-uses could potentially be accommodated as part of the Gateway Development Zone Framework Plan including a transport interchange to enhance accessibility to the airport as well as serve the Gateway Development Zone. This plan is flexible to allow the Enterprise Zone to adapt to, and capitalise upon, any future transport infrastructure proposals such as the Metro.

3.3.32 Further development to the Aerospace Business Park site within the Enterprise Zone was granted planning permission in 2009 including the erection of new and replacement buildings as well as infrastructure improvements.

3.3.33 With the Welsh Government owning the airport itself, it aims to increase passenger numbers and expand upon the routes and services offered (within the boundaries of EU State Aid legislation).

3.3.34 The Gateway Development Zone includes potential development land to the east of Cardiff Airport. The site has been identified as having the potential to be a destination for local and international business including office accommodation, leisure development and transport logistics. Together with the Aerospace Business Park, the Gateway Development Zone is allocated in the VoG LDP as a strategic employment site.

3.3.35 The document highlights that there are strong interdependencies and interconnectivity between the Vale of Glamorgan, Cardiff and the wider South East Wales region which have been reflected in the establishment of the Cardiff Capital Region. Through having strategic direction and collaborative working, the Region aims to be well-connected, innovative, highly-skilled and capable of supporting inclusive and sustainable communities.

3.3.36 In terms of employment, the strong heritage of St Athan as well as the existing skilled workforce of the South East Wales region creates a strong basis for delivering a key regional employment site.

Key Point: The EZ proposals represent a development of potentially national significance, creating high value employment and commercial space proximate to Cardiff. The Strategic Plan identifies the critical importance of improved transport connectivity / surface access in realising the full potential of this opportunity. Fully realising the EZ aspirations can be considered as the fundamental driver of this study.

Summary

3.3.37 The concept of improving connectivity for the VoG is strongly correlated with regional economic, land-use and transport policy. The fundamental drivers of this are the EZ and Cardiff Airport, which are development sites and a transport hub of importance across South Wales as a whole.

3.4 Local Policy

3.4.1 Finally, at the local level, there are a number of Local Transport Plans (LTPs) produced by each local authority, which are reviewed below. The following policy documents have been reviewed.

- Vale of Glamorgan Local Transport Plan 2015 – 2030
- South East Wales Valleys Local Transport Plan (2015)
- Cardiff Local Transport Plan 2015 – 2020
- Bridgend County Borough Council Local Transport Plan 2015 - 2030
- Monmouthshire County Council Local Transport Plan Draft (2015)
- Newport City Council Local Transport Plan (2015)
- Joint Transport Plan for South West Wales 2015 – 2020

Vale of Glamorgan Local Transport Plan 2015 – 2030

3.4.2 The Vale of Glamorgan LTP identified a series of strategic transport 'issues and opportunities' in the area which are relevant to this study. These include:

- The strategic highway network is congested leading to increased journey times and reduced journey time reliability.
- Employment growth areas not aligned with housing growth areas (45% of Vale residents commute out of the local authority for work purposes, the majority of which commute to Cardiff).

- Lack of provision for freight vehicles on a number of key strategic highway corridors – there is seen to be a conflict between HGVs and active travel modes, specifically cycling.
- Limited bus service provision in the rural VoG and throughout the Vale in the evenings and at weekends.
- A geographic spread of population, which brings with it challenges for public transport provision.
- Existence of Air Quality Management Areas (AQMA) in Penarth and the Eastern Vale.[6]

3.4.3 The LTP aims to identify sustainable transport measures with priority given to schemes which aim to serve the economic, social and environmental needs of the local authority area and promote the objectives of the regional plan. In this respect, there is a clear aspiration in the Plan to more effectively manage the interface between local and strategic traffic.

Key Point: The VoG LTP supports a range of transport improvements which would enhance accessibility to both Cardiff and the wider strategic transport network. The LTP succinctly defines the transport issues and opportunities at the local level, with many of these issues having a strategic element to them (at least in terms of how they are resolved).

South East Wales Valleys Local Transport Plan (2015)

3.4.4 Published in January 2015, this document brings together the five South East Wales Valleys local authorities of Blaenau Gwent, Caerphilly, Merthyr Tydfil, Rhondda Cynon Taf and Torfaen, identifying the issues and opportunities for transport in this area. This joint approach is due to the area as a whole being faced with challenges of regeneration in the north and development in the south with transport having a key role to play in achieving the economic, social and environmental objectives as well as reducing socio-economic disparities.

3.4.5 The vision for this Local Transport Plan (LTP) is to provide an integrated and sustainable transport system which increases opportunity, promotes prosperity for all and protects the environment with active travel, public transport and sustainable freight providing real travel alternatives.

3.4.6 Due to out of centre employment sites, improved public transport, particularly to employment growth areas, along with improved access to facilities such as Park & Ride and improved public transport interchange can help improve access to jobs and leisure opportunities. It is noted that these schemes could reduce economic and social disparities which are apparent between the northern and southern areas of the SE Wales Valleys. This could also assist in reducing reliance on the private car therefore increasing sustainable travel.

Key Point: Whilst the South-East Wales Valleys LTP is predominantly focussed on local transport issues, there is a commitment to improving access to current and emerging employment centres across the Capital Region, which would include the EZ.

Cardiff Local Transport Plan 2015 – 2020

3.4.7 This Local Transport Plan (LTP) identifies key transport issues relevant to Cardiff, the high level interventions needed to address these and the specific priorities for the local authority to deliver in the short- and long-term to 2030. It sets out high level interventions for developing the strategic public transport network and the active travel network as well as positively managing the highway network to support sustainable travel. One of the key challenges for Cardiff is addressing the tidal road traffic into the city in the morning and then back out in the evening

3.4.8 Proposed solutions include improved interchange facilities and Park & Ride facilities which can assist in tackling the lack of alignment between employment growth and housing growth in the city, as well as reducing congestion.

[6] Vale of Glamorgan Local Transport Plan 2015-2030 (Vale of Glamorgan County Council, 2015), pp. 13-20.

Key Point: Cardiff is the predominant trip recipient within South-East Wales, and there is therefore support within the LTP to encourage sustainable access to the City addressing both city centre congestion and the imbalance between employment and housing growth.

Bridgend County Borough Council Local Transport Plan 2015 - 2030

3.4.9 The Local Transport Plan (LTP) sets out the short, medium and long-term transport goals for Bridgend CBC for the period between 2015 and 2030.

3.4.10 Priorities include supporting economic growth; reducing economic inactivity through improving access to employment; maximising the contribution of transport for the most deprived communities; and encouraging safer, healthier and sustainable travel. Reducing emissions is also a key aim of the LTP.

3.4.11 Improved transport interchange is seen to be required to tackle the lack of alignment between employment growth and housing growth with improvements required to the strategic road network in order to reduce congestion and improve access for freight.

Key Point: Bridgend is proximate to the EZ and thus improving connectivity to the Vale of Glamorgan would support the objective of improving access to employment, particularly for the most deprived communities.

Monmouthshire County Council Local Transport Plan Draft (2015) and Newport City Council Local Transport Plan (2015)

3.4.12 Whilst there is broad support with the Monmouthshire and Newport LTPs for improved transport connections to key employment sites and transport interchanges, these areas are slightly more distant from the proposed area of intervention. There is therefore little specific information of relevance to this study in these documents.

Joint Transport Plan for South West Wales 2015 – 2020

3.4.13 The Joint Transport Plan for South West Wales 2015-20 covers the Swansea Bay City Region local authorities (i.e. Carmarthenshire, Neath Port Talbot, Pembrokeshire and Swansea). Consistent with the National Transport Plan (NTP) and the Welsh Government Programme Priority Areas, this LTP aims to support:

- economic growth;
- access to employment;
- tackling poverty;
- sustainable travel and safety; and
- access to services.

3.4.14 Additionally, the strategic road network, strategic rail network, ports and airports are seen to provide key gateways for the region, allowing it to become increasingly globalised and have good connectivity both within the region and beyond into the rest of the UK and Europe.

3.4.15 Relevant strategies for addressing these issues include:

- improving the strategic east / west road and rail links;
- improving linkages between key settlements and strategic employment sites;
- improving efficiency of the highway; and
- improving the integration of land use and transportation planning;

3.4.16 As a result, the LTP aims to improve access to employment for all, improving international connectivity, reducing congestion, reducing reliance on the private car, improving integration and improving access for freight.

Key Point: The JTP for South Wales covers the neighbouring area to the Cardiff Capital Region but nonetheless supports measures which would support improved east / west connectivity, access to strategic employment sites & Cardiff Airport and improved functioning of the M4.

3.5 Summary

3.5.1 This chapter has reviewed the policy environment in which improvements to connectivity for the VoG would be developed. It is evident from this review that strategic transport interventions, in whatever form they take, would be consistent with transport, economic development and spatial planning policy at the national, regional and local level.

3.5.2 Of particular relevance is the fit with emerging national and strategic development planning in Wales as well as the aspirations of the Cardiff Capital Region and Swansea Bay City Region.

4 Land-Use Development Baseline

4.1 Overview

4.1.1 As noted in the introductory chapter, the initial rationale for this study stemmed from ensuring that the transport infrastructure in the Vale of Glamorgan is fit for purpose in terms of delivering the needs of the EZ, the Local Development Plan and wider sub-regional aspirations. This chapter therefore establishes the anticipated development profile firstly in the VoG and then in the wider sub-region.

4.2 Vale of Glamorgan Local Development Plan 2011-2026

4.2.1 The Local Development Plan (LDP) describes the Council's land-use strategy for this 15-year period, providing guidance in terms of the type, scale and timing of development expected across the area, in addition to the policies against which new development proposals will be assessed. The Vale of Glamorgan Local Development Plan 2011-2026 was adopted by the Council in June 2017, replacing the previous Unitary Development Plan 1996-2011.[7]

4.2.2 This section identifies the employment land allocations and other plans within the VoG, which will impact upon the local transport network and so may be of relevance to proposals for improved connectivity for the VoG.

Land Allocations

4.2.3 This brief section considers the land allocations within the LDP in respect of employment and residential land. Whilst predominantly a local issue, the purpose of this section is to provide context on the overall levels of anticipated growth in the VoG.

Land Allocated for Employment

4.2.4 Policy MG9 allocates 492 hectares of land for employment uses in the VoG, with 437 hectares being allocated to address strategic need. The LDP notes that the allocated employment land could support a total of 7,610 - 10,610 jobs.

4.2.5 Strategic employment land allocations are spread across three key sites: Land South of Junction 34 of the M4, Land adjacent to Cardiff Airport and Port Road (Rhoose) and St Athan Aerospace Business Park (ABP). Table 4.1 provides further details.

Table 4.1: Strategic Employment Allocations (Vale of Glamorgan)

Site	Uses	Size Gross (Ha)	Size Net (Ha)
Land to the south of Junction 34 M4 (Hensol)	B1, B2, B8	55.2	29.6
Land adjacent to Cardiff Airport and Port Road, Rhoose (I.e. Gateway Development Zone. Forms part of the EZ)	B1, B2, B8	77.4	76.6
Aerospace Business Park, St Athan Rhoose (Forms part of the EZ)	ABP, employment and education	305.0	208.0[8]
	Total	**437.6**	**314.2**

[7] http://www.valeofglamorgan.gov.uk/en/living/planning_and_building_control/planning_policy/local_development_plan/Local-Development-Plan.aspx

[8] 22 ha of the site will be retained by the MoD for military purposes, reducing the net developable area to 208 ha.

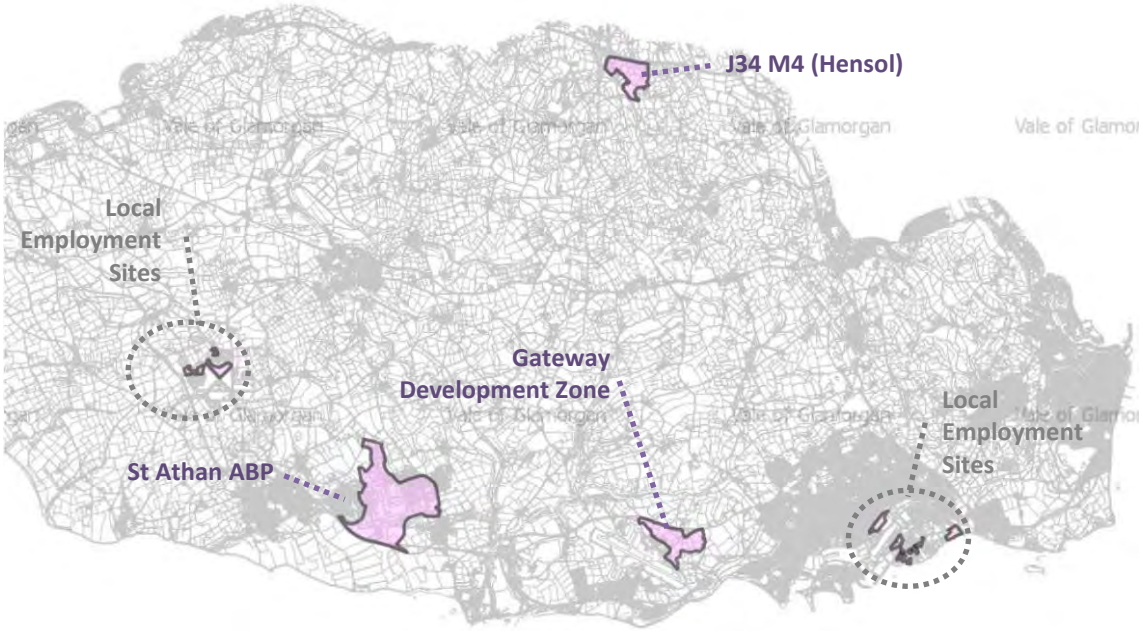


Figure 4.1: Allocated Employment Sites (Source: Vale of Glamorgan LDP Interactive Map)

4.2.6 The following sections provide greater detail on the policies specific to the strategic employment allocation sites.

Policy Mg10: St Athan - Cardiff Airport Enterprise Zone

4.2.7 Policy MG10 describes how the Council envisage the EZ being developed, and notes that a masterplan is required (which is currently under preparation by Arup on behalf of WG).

4.2.8 The St Athan ABP will support business and employment uses associated with the defence and aerospace industry, and the masterplan will include proposals for:

- the refurbishment of the existing 70,000 sqm hanger at St Athan (17.95 ha);
- an aerospace business park north and south of the runway at St Athan;
- a business park for aviation support services at Picketston (immediately north of St Athan) (11.79 ha); and
- a new northern access road at the St Athan ABP.

4.2.9 Improved transport infrastructure is noted as being critical to the successful development of the St Athan ABP site, including construction of a new Northern Access Road, and highway improvements on the B4265 between St. Athan and Aberthaw at Gileston Old Mill (to address existing road safety issues). New housing is also allocated on the site under Policy MG2.

4.2.10 Cardiff Airport and the Gateway Development Zone will support employment uses associated with aerospace and high-tech manufacturing, and the masterplan will include proposals for:

- new aerospace, education, research and development, manufacturing, office and other ancillary development at the Cardiff Airport and gateway development zone;
- a 42-hectare extension to Porthkerry Country Park;
- provision of sustainable transport infrastructure, including reservation of land to ensure that development does not compromise potential for a rail link direct to Cardiff Airport; and
- the incorporation of a sustainable energy centre at the Cardiff Airport and Gateway Development Zone.

4.2.11 This site will house an 'airport-city', which the Council envisages will take "*the form of a business destination for local and international businesses including quality office accommodation, specialist education, training facilities and leisure developments"*. General B1, B2 and B8 industrial development are not acceptable on this site.

Key Point: The proposed commercial developments at the EZ represent an investment of strategic significance in the VoG. The LDP identifies the need for transport connectivity improvements if the potential of these strategic sites is to be maximised.

Land Allocated for Residential

4.2.12 Housing allocations with the VoG LDP are as follows:

Table 4.2: Housing Allocations and Supply for Study Area (No. Dwellings)[9]

Council	LDP Period	Allocated	Committed	Other	Total Requirement	Total Supply
Vale of Glamorgan County Council	2011-2026	8,525	182	1,701	9,460	10.408

4.2.13 The housing supply within the VoG LDP is sufficient to meet the total housing requirement. However, the Inspector's Report identified a number of concerns in relation to the impact of this level of development on the VoG highway network. The Highways Impact Assessment (HIA) examined the potential increase in road use a result of the planned housing developments, specifically examining existing and future peak hour flows and capacity of the all the main arterial highway links and junctions within the Vale. It was noted that, by the end of the Plan period, the HIA anticipates that some 15 link roads and 19 junctions are projected to be above capacity.

4.2.14 The identified housing need was accepted by the Inspector and transport mitigation measures are to be put in place within the Plan period. In addition, it is considered that the growth in local employment opportunities, particularly in the EZ, will have a positive impact on reducing out-commuting. Nonetheless, the evidence from the report suggests that the current transport infrastructure in the VoG is starting to act as a constraint on its economy, a situation which may also be exacerbated by the transport needs of the EZ and any growth in the airport (notwithstanding the above point in relation to out commuting). In addition, given the lead in times for planning, consenting and constructing new transport infrastructure, current constraints may severely limit the allocations which can be made within the next LDP unless addressed in the relatively short-term.[10]

Key Point: The transport infrastructure within the VoG is capable of accommodating the anticipated levels of growth within the LDP, although not without challenges. The conclusions of the Inspector's report suggest that, without intervention in the relatively short-term**,** transport infrastructure may start to place a longer-term constraint on the VoG economy, and would also have negative implications for the competitiveness of the EZ.

4.3 Cardiff Airport – St Athan Enterprise Zone

4.3.1 The Cardiff Airport – St Athan Enterprise Zone is one of eight such sites identified by the Welsh Government, where public sector assistance will be provided to attract and support businesses and jobs. The EZ comprises three separate sites located in and around Cardiff Airport and St Athan, as shown in the figure below.

[9] Vale of Glamorgan Local Development Plan 2011-2026 (Vale of Glamorgan County Council, 2017), pp. 56-57.

[10] Report to the Vale of Glamorgan Council (The Planning Inspectorate, 2017), pp. 47-49.

Figure 4.2 - Cardiff Airport – St Athan Enterprise Zone Map (Source: Welsh Government)

4.3.2 A number of developments have already emerged in relation to the EZ:

- Work has been undertaken to improve the visitor experience at Cardiff Airport, with a view to attracting new airlines (a significant investment in the terminal facility was announced in October 2017).
- Bristow Helicopters has opened a new £5m Search and Rescue base, whilst Cardiff Aviation has opened a new training facility and FlyBe has also established a new base at the airport.
- To date, the EZ has created / safeguarded / assisted 223 jobs[11] but once fully built-out, it could deliver circa 4,000 jobs, and support over £250m of investment.

4.3.3 A Strategic Development Framework for the EZ has been established by Welsh Government, which sets out a '*vision for the future of the Enterprise Zone, to help realise that opportunity*'. It is noted that the majority of new development will be focussed on the Gateway Development Zone, which will combine the following land-uses:

- Airport expansion – space reserved for long term expansion to accommodate up to 3 x the level of current activity;
- Education, training and R&D – aerospace education, Research & Development (R&D) and training hub (64,000sqm);
- Airport / aerospace office campus (45,000sqm);
- Hotel, conference and leisure (300 bed hotel);
- Logistics hub (17,000sqm);
- Transport interchange to support future Cardiff Capital Region Metro proposals and reserve space for potential rail connection; and
- Energy park.

[11] http://www.bbc.co.uk/news/uk-wales-politics-41734208

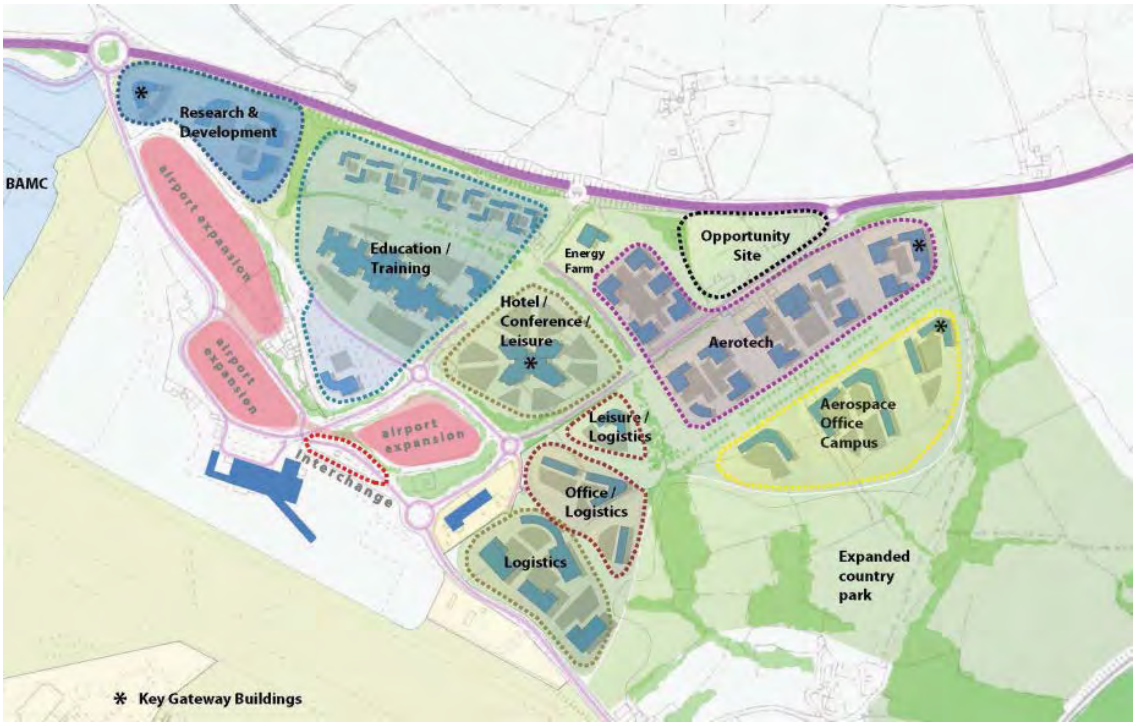


Figure 4.3: Gateway Development Zone Illustrative Masterplan (Source: Cardiff Airport – St Athan EZ SDF)

4.3.4 The EZ is subject to an extensive masterplanning exercise being undertaken by Arup on behalf of the Welsh Government, where the anticipated outputs from the sites will be defined in more detail.

Key Point: The Strategic Development Framework and masterplan further emphasise the scale of the potential developments which are anticipated to emerge in the Vale of Glamorgan. Facilitating the travel-to-work market, business-to-business interactions and freight movements will require a transport network which facilitates efficient movement to, from and within the VoG.

4.4 The Sub-Regional Opportunity

4.4.1 Whilst the EZ is a strategically important economic development opportunity in its own right, the VoG and RCT are working in partnership to develop a sub-regional proposition in the context of the Capital Region.

4.4.2 The rationale for pursuing a sub-regional solution is to address a perceived market failure in the provision of appropriate business premises in the Cardiff Capital Region. This issue was picked up in an economic baselining of South-East Wales undertaken in 2015, which found that a key weakness in the area is a lack of speculative development and little or no investment in the promotion of strategic development sites.[12] Jones Lang LeSalle (JLL) South Wales Report 2017 explained that the supply of commercial land has reduced from the 2016 level, with the availability of units over 100,000 square feet having gone down by 32% on the previous year.

4.4.3 This has been set against a 27% increase in the take up of commercial land, driving an increase in the demand for second hand property. In particular, JLL note that there is a growing demand for distribution floorspace, explaining that there is a particular requirement for business park premises in the M4 corridor at key locations such as Llantrisant.[13]

4.4.4 The sub-regional offer from VoG and RCT combines the Strategic Opportunity Areas associated with the EZ (VoG) and the Rhondda Gateway, as well as the 'Llanilid on the M4' Strategic Opportunity Corridor (see below). It is envisaged that the realisation of these opportunities as

[12] Baseline Economic Analysis for South-East Wales (AECOM, 2015), p. 86.

[13] South Wales Report (Jones Lang LeSalle, 2017), pp. 3-9.

a package would deliver significant economic benefit at the regional and indeed national level. However, transport connectivity between the VoG and RCT is limited across all modes – improving connections between the two local authorities would be integral to realising these opportunities.

Vale of Glamorgan

4.4.5 From the VoG perspective, the principal development in respect of the sub-regional opportunity is the EZ. However, the VoG LDP also includes a significant allocation of land at Hensol, just south of the M4 J34. This site comprises circa 77-hectares of brownfield and greenfield land, but development is restricted to 36.2 hectares for environmental reasons. The strategic allocation extends to 29.6 hectares and land uses will be restricted to high quality B1, B2 and B8 uses with non-employment uses restricted to small scale ancillary proposals. It is anticipated that the 6.6 ha local employment allocation will take the form of a business park.

4.4.6 In-keeping with these designations, outline planning consent was granted for the site in June 2016 for the development of 150,000sqm of Class B1, B2 and B8 land uses, in addition to a hotel / training centre, 1,300 sqm of ancillary uses (A1, A2, A3) and supporting infrastructure.

Rhondda Cynon Taf

4.4.7 The proposed developments at Hensol are mirrored by a much larger proposed development to the north of the J34 in RCT.

A4119 Corridor: Regional Rhondda Gateway – Strategic Opportunity Area

4.4.8 The A4119 corridor in Llantrisant has been identified as a key opportunity area within the region, particularly in terms of a critical mass of development opportunities proximate to the M4 Corridor. With direct access onto the M4, the A4119 trunk road corridor (which is expected to be dualled in the near-term) is considered to provide a strategic development opportunity, building on development that has already been consented and / or is in the planning pipeline. This is shown in the map below:

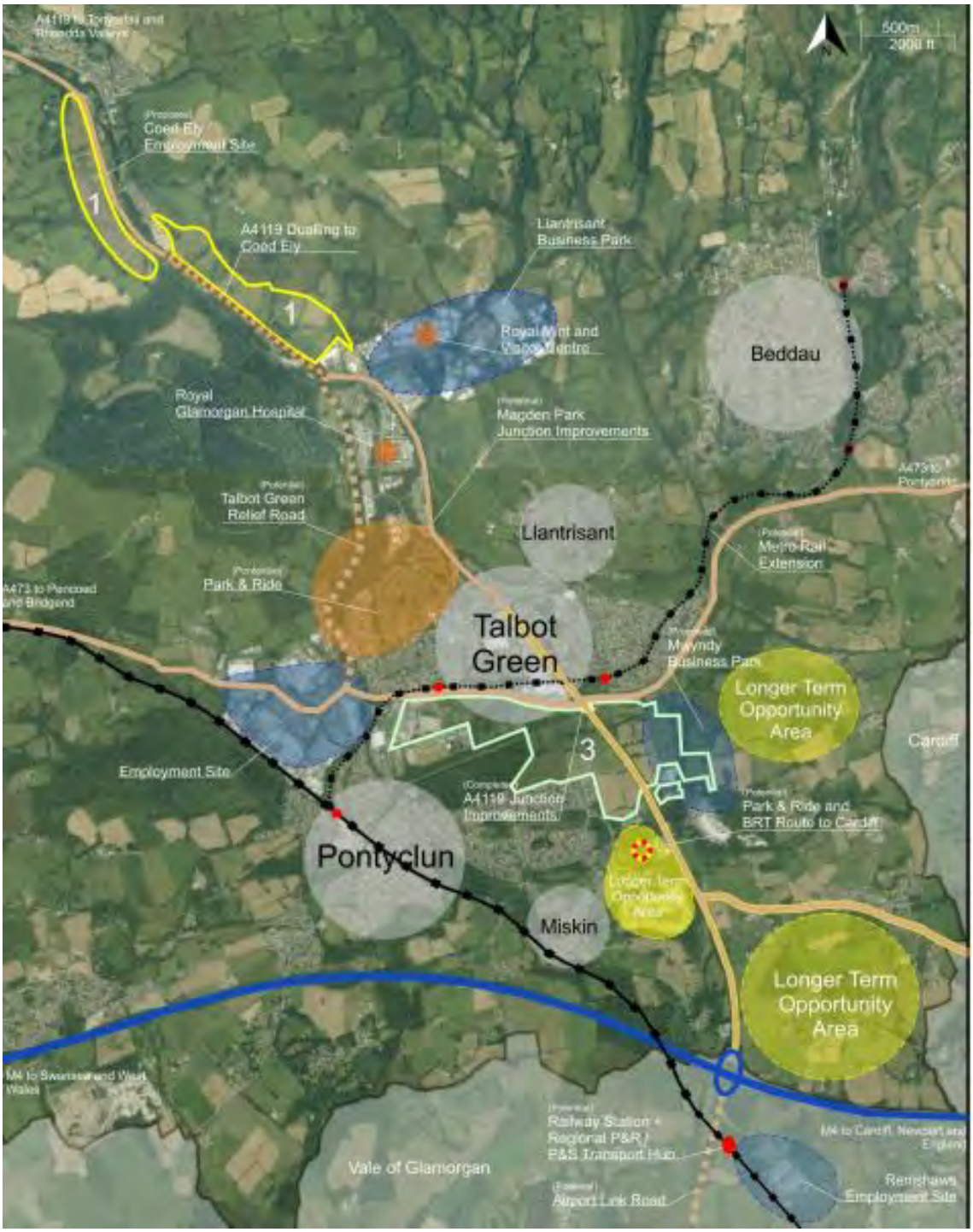


Figure 4.4: A4119 Regional Rhondda Gateway (Source: RCT County Council)

4.4.9 The two immediate opportunities are:

- Coed Ely (short-term) and land north-east of the A4119 (medium-term); and
- Mwyndy / Talbot Green Strategic Site – short / medium-term.

4.4.10 Lying approximately 4.5 miles to the north of the M4, with direct access to the A4119, the **Coed Ely** site provides over 15 hectares of allocated employment land. The site has been profiled into three development zones, with outline planning permission granted for a comprehensive development on the site. Welsh Government is investing in further site improvements. On the north-eastern side of the A4119**,** just **south of Coed Ely**, is a further opportunity for developing c33 hectares of land which is currently agricultural and in private ownership.

4.4.11 Both sites lie close to the established and buoyant Llantrisant Business Park, which has a variety of large scale occupiers. These sites offer an opportunity to build on the success of the business park, expanding the economic mass in the area. The proposed developments would also support the realisation of high specification industrial floorspace, which has been identified as a key weakness of the Capital Region from an investment perspective.

Mwyndy / Talbot Green Strategic Site

4.4.12 This site offers opportunities for major development of a mix of uses – the land is privately owned and much of the development will be delivered without direct public intervention, but there is a requirement for infrastructure investment to facilitate this. The proposed development would deliver:

- circa 500 dwellings (based on the current planning application); and
- 15 hectares of employment land, which consists of 23,400 sq m of retail floor space and 10,000 sq m of leisure floor space.

4.4.13 The development site is clearly of a significant scale and lies on both sides of the A4119, 1.5 miles north of J34 on the M4. 15 hectares of employment land lie on the eastern side of the A4119 and offer a prime development location, which again would assist in addressing the lack of high specification commercial and industrial floorspace across the region.

Llanilid on the M4 – Strategic Opportunity Corridor

4.4.14 The Llanilid / M4 corridor is noted by the Council to be the only inward investment site of this scale in the Capital Region, and is viewed as a critical opportunity for major transformational growth in the economy of the region. On the M4 between J34 and J35, this is perceived to be a major regional opportunity of circa 715 hectares in close proximity to the strategic transport network and Pencoed Technology Park. This is shown in the map below:

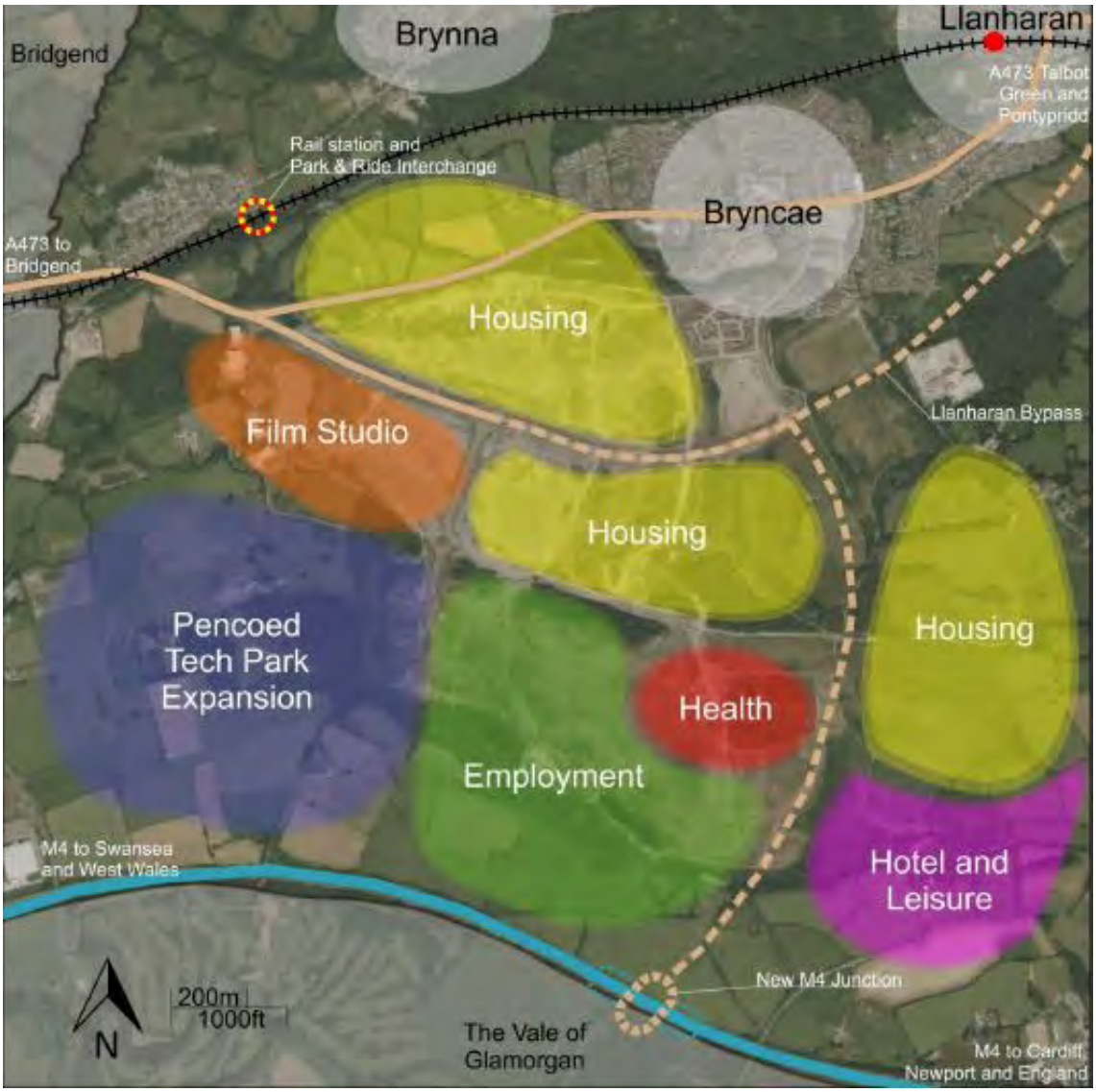


Figure 4.5: Llanilid on the M4: (Source: RCT County Council)

4.4.15 1,850 houses, a new primary school and village centre are already consented and the area is allocated for strategic development in the RCT Local Development Plan. Film studios of 40,000 sq ft have been developed on the western end of the site, but the remainder is a blank canvas for extensive development. It is noted that a new junction on the M4 between J35 and J34 (J34A) would be required to facilitate this development.

Relevance of the sub-regional opportunity

4.4.16 An obvious question in relation to the above material is why the sub-regional opportunity is relevant in the context of VoG connectivity, given that the predominant movements are from the south-east of the Vale to Cardiff City Centre. The relevance of the sub-regional opportunity is as follows (and should be considered in any subsequent options appraisal):

- A combination of the EZ, the Regional Rhondda Gateway and Llanilid on the M4 present a regional opportunity of a significant scale. If fully realised, these opportunities will assist in addressing the market failure associated with a lack of 'Grade A' commercial premises in the Capital Region. This in turn will assist in ensuring the area to the west of Cardiff will be competitive within the context of the Capital Region as a whole. More importantly, the realisation of this development will support the wider competitiveness of the Capital Region *vis a vis* other emerging City Regions in the UK.

- The development of an economic hub of this nature will create a significant demand for labour and increased need for business-to-business interactions. If the developments in the VoG and RCT could be brought 'closer' together in terms of improved transport connectivity between the two areas, this would generate agglomeration and labour market benefits for the Capital Region as a whole (which could be monetised once the options are defined).
- There is an extensive body of research, including the seminal Eddington Study, which suggests that better connecting economic clusters to international gateways, particularly airports, is beneficial in terms of economic performance (expressed in terms of business productivity). The proposed developments in RCT are focussed on attracting both domestic and inward investment, and thus improving connectivity to Cardiff Airport is considered to be beneficial in this respect.

Key Point: Whilst this report is focussed on the case for improving connectivity to the VoG, there is a specific case for considering infrastructure improvements which would support the development of the sub-regional north-south economy, combining the development potential of the EZ and strategic opportunity sites in RCT. The realisation of these sites would assist in addressing an identified market failure in respect of the provision of Grade A commercial property within the City Region and would assist in ensuring the Region as a whole has a competitive 'offer' against other areas of the UK.

4.5 Summary

4.5.1 The declaration of an EZ in the Vale of Glamorgan has facilitated a strategically important economic development and employment site within the area - 78% of the total employment land allocation for the Vale of Glamorgan falls within the EZ.

4.5.2 Ensuring that the EZ and the wider VoG maximises its development and regional economic potential (particularly in terms of the north-south sub-region being developed in partnership with RCT) will require the provision of a safe and efficient transport network capable of meeting the needs of employees, business visitors and freight. The desk-based research (see Chapter 6) and consultation suggest that the existing transport network in the area will act as a constraint if the strategic connectivity of the VoG is not improved.

4.5.3 Having set out the development context and key considerations in respect of it, the next chapter builds on this by considering the socio-economic arguments for improving the connectivity of the Vale of Glamorgan.

5 Socio-Economic Baseline

5.1 Overview

5.1.1 The development context established in the previous chapter provides part of the rationale for improving connectivity to and from the Vale of Glamorgan. The EZ, coupled with wider developments in the VoG and at the sub-regional level, will create significant opportunities in terms of employment and business-to-business opportunities. However, for these developments to be realised and successful, it is essential that the transport network facilitates access to employment and business-to-business interactions.

5.1.2 There is an extensive and constantly evolving literature evidencing the connection between transport and economic development. Of particular importance in this respect is the recent emergence and quantification of 'wider economic impacts', which capture some of the wider economic implications of transport investment that are additional to conventional transport user benefits in terms of i.e. journey time savings, reduced vehicle operating costs etc.

5.1.3 In order for the case to be made that a transport investment will have a positive impact in respect business productivity and the labour market, it is necessary to profile the socio-economic position in the study area, assessing the extent to which e.g. economic metrics trail national averages, providing evidence of sub-optimal economic performance. As far as practically possible, and drawing on the consultation, the following analysis identifies where transport connectivity is potentially a contributing factor to an identified economic problem (although it is not possible to empirically evidence this, given there are no data available which would demonstrate causality).

5.1.4 It is important to note that this chapter is not intended to provide an exhaustive profile of every socio-economic aspect of the study area, rather it is focussed on identifying where the area lags other areas and on identifying the transmission mechanisms by which improved transport connectivity could potentially assist in addressing these issues.

5.2 Data Geography

5.2.1 It is important to note that the available data and its spatial scale impacts on the type of analysis which would be undertaken. Figure 5.1 therefore provides a summary of the data used for analysis by different geographic levels:

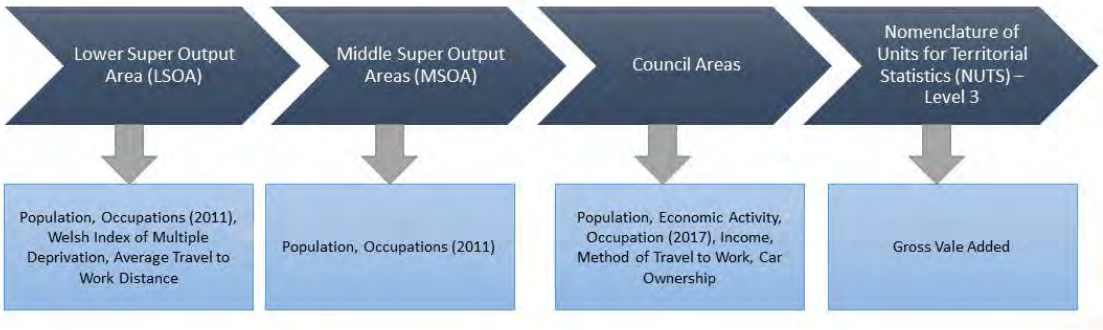


Figure 5.1: Data used for analysis by different geographic levels

5.2.2 Lower Super Output Areas (LSOA) provide the most spatially disaggregate level of data.

5.3 Demographics & Socio-Economics

5.3.1 This section considers the following issues:

- Population;
- Economic activity;
- Occupations; and
- Income.

Population

5.3.2 The figure below provides the 2016 mid-year population estimates for the study area local authorities:

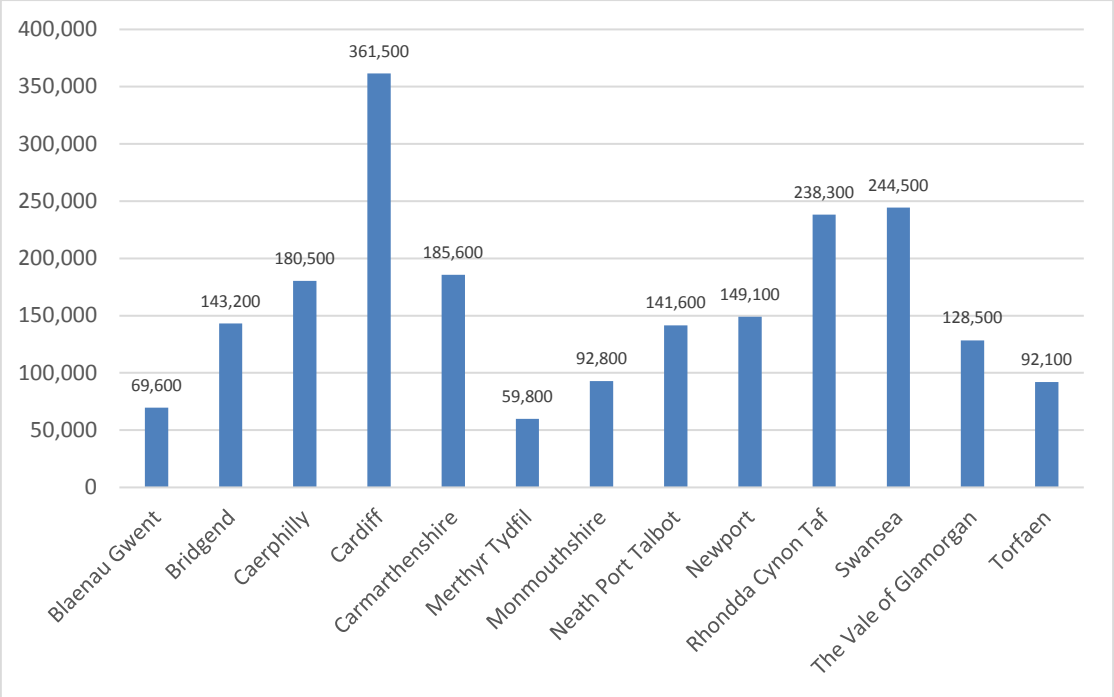


Figure 5.2: 2016 Population Estimate by Local Authority (Source: Population Estimates 2016)

5.3.3 Whilst Cardiff is evidently the economic hub of South-East Wales, the Vale of Glamorgan's neighbouring local authorities (Bridgend and Rhondda Cynon Taff) have a combined population of 381,500, or 18% of the study area total (or 19.5% if VoG is excluded). There is therefore a significant potential labour market catchment both in neighbouring authorities and beyond for the economic development sites within the VoG, and at the sub-regional level.

5.3.4 However, a key theme which emerged from the consultation is that the current transport infrastructure serving the VoG (road and public transport) is an inhibitor to the effective matching of labour and employment opportunities. In particular, representatives from a number of the Valleys local authorities explained that the journey times associated with travelling to the area of the EZ currently would be prohibitive for the majority of residents, with circuitous routing (particularly in terms of public transport) and congestion at various pinch points leading to poor journey time reliability. Culverhouse Cross was cited as a particular constraint in this respect by numerous stakeholders.

5.3.5 In the reverse direction, VoG County Council noted that transport infrastructure within the Vale is constraining access to Cardiff and, in the longer-term, the potential opportunities emerging at the sub-regional level (e.g. at Talbot Green, Llanilid etc)

Key Point: There is a significant population base within the Vale of Glamorgan and surrounding areas which would be well placed to access the development opportunities emerging in that area. However, relatively poor north-south connectivity to / from the VoG is seen by consultees

to act as a factor constraining growth (both now and in the future), particularly for those without access to a car.

Economic Activity

5.3.6 The economic activity rate is a critical indicator of the economic wellbeing of an area from a residents' perspective. The economically active are those defined as in work or actively looking for work, whilst the economically inactive are defined as those neither in work nor seeking employment (e.g. retired people, students, long-term sick, unpaid carers etc). This is a key metric in determining the relative economic health of a location – areas with comparatively lower rates of economic activity tend to perform less well.

5.3.7 The table below compares the rates of economic activity, those in employment, unemployment and economic inactivity across the study area. The 'top 3' in each category (column) are highlighted in red, with a comparison made with the Welsh and British averages as a whole.

Table 5.1: Economic Activity & Inactivity Rates (Source: Annual Population Survey)

Area	Economically active (%)	*In employment (%)*	Economically Inactive	*Unemployed (%), Model Based*
Blaenau Gwent	70.9	*66.8*	29.1	*5.8*
Bridgend	73.3	*69.6*	26.7	*4.8*
Caerphilly	75.2	*71.1*	24.8	*5.0*
Cardiff	72.0	*69.1*	28.0	*4.8*
Carmarthenshire	78.6	*75.1*	21.4	*3.8*
Merthyr Tydfil	74.0	*69.0*	26.0	*5.7*
Monmouthshire	78.5	*76.5*	21.5	*2.9*
Neath Port Talbot	74.9	*70.7*	25.1	*4.9*
Newport	76.1	*72.8*	23.1	*5.0*
Rhondda Cynon Taff	73.9	*69.1*	26.1	*5.2*
Swansea	72.0	*68.2*	28.0	*5.0*
The Vale of Glamorgan	78.4	*73.5*	21.6	*4.4*
Torfaen	76.6	*74.0*	23.4	*4.0*
Welsh Average	***74.8***	***71.4***	***25.2***	***4.4***
British Average	***78.0***	***74.2***	***22.0***	***4.7***

5.3.8 As is common across much of Great Britain, the economic activity rate is highest in the more prosperous rural areas, with Carmarthenshire, Monmouthshire and Vale of Glamorgan all having relatively high levels of economic activity and employment.

5.3.9 In contrast, economic activity rates in the Valleys tend to lag Welsh and British averages for the best part. Of those who are economically inactive, a significant proportion tend to be classified as long-term sick (for example 38% of all economically inactive residents in Blaenau Gwent are classified as such). Unemployment also tends to be higher in these areas. Moreover, much of this unemployment is likely to be 'structural', whereby the profile of the employment market has changed to such an extent that there is a skills mismatch, leading to a concentration in low-paid

and insecure jobs (a direct product of the decline of dominant industries, such as coal mining and iron & steel in Merthyr Tydfil, Blaenau Gwent, Rhondda Cynon Taf etc).

5.3.10 Cardiff and Swansea both have relatively low economic activity rates, but this is largely because of the university presence in both cities (with students being defined as economically inactive).

5.3.11 The economic activity data point to the existence of a **'two-speed economy'** (otherwise known as economic dualism) with a broadly prosperous rural hinterland and coastal zone encircling an area suffering from socio-economic deprivation. Dualism of this nature is problematic for the South Wales economy as a whole, likely acting as a drag on productivity, investment and competitiveness. This is an issue which will be revisited throughout this chapter.

Key Point: The economic activity data, whilst only part of the picture, clearly point to the existence of a dual or 'two-speed economy' within the study area, which is negative for the area as a whole. The EZ presents an opportunity in terms of direct, indirect and induced job creation and supply-chain opportunities for local businesses. However, the extent to which this opportunity materialises will, in part, be dependent on the provision of transport infrastructure and services which connect the EZ to the wider study area.

Occupations

5.3.12 The table below shows the range of occupations across the study area local authorities (by place of residence) and the Welsh and British averages. It is useful to examine occupational categories as they provide an indication of the main sectors of the economy and the broad skills base of an area. For instance, those employed within the occupational categories of managers, and senior officials; professional occupations' and associate professional and technical occupations are typically higher skilled, whereas those employed within the occupational categories of elementary occupations, and process, plant and machine operatives typically possess a lower skill level. Again the top three values in each column are shown in red.

Table 5.2: Occupational Categories for Local Authority (Source: ONS Annual Population Survey 2017)

Area	Managers, directors and senior officials	Professional occupations	Associate professional and technical occupations	Administrative and secretarial occupations	Skilled trades occupations	Caring, leisure and other service occupations	Sales and customer service occupations	Process, plant and machine operatives	Elementary occupations
Blaenau Gwent	9.8	11.0	8.9	11.1	11.1	12.5	10.5	11.4	12.3
Bridgend	10.2	17.0	11.0	11.3	13.1	10.8	8.6	7.6	10.1
Caerphilly	7.3	15.1	11.1	10.7	12.2	10.3	10.9	10.4	11.8
Cardiff	8.7	29.5	14.4	13.5	7.2	7.1	9.1	3.0	7.4
Carmarthenshire	10.5	15.3	10.0	7.3	15.0	12.2	9.0	7.1	11.9
Merthyr Tydfil	7.4	14.2	9.7	12.1	12.4	11.8	9.0	10.2	13.1
Monmouthshire	13.9	23.2	11.8	10.5	10.8	9.7	4.5	4.9	10.4
Neath Port Talbot	8.1	15.5	12.4	10.7	12.3	13.6	5.8	8.7	11.9
Newport	8.4	19.4	14.4	12.0	7.4	8.3	7.6	8.2	13.8
Rhondda Cynon Taff	8.7	18.9	14.6	9.0	11.0	10.3	9.0	7.9	10.2
Swansea	8.5	18.9	10.3	11.0	11.3	9.6	9.3	7.4	13.0

Area	Managers, directors and senior officials	Professional occupations	Associate professional and technical occupations	Administrative and secretarial occupations	Skilled trades occupations	Caring, leisure and other service occupations	Sales and customer service occupations	Process, plant and machine operatives	Elementary occupations
The Vale of Glamorgan	13.6	23.2	12.8	11.9	8.4	8.8	8.0	4.6	8.1
Torfaen	9.1	14.3	13.6	11.2	12.8	10.2	10.3	6.7	10.5
Welsh Average	***9.6***	***18.8***	***12.1***	***10.3***	***12.4***	***10.1***	***8.1***	***7.1***	***11.1***
British Average	***10.7***	***20.4***	***14.2***	***10.2***	***10.4***	***9.1***	***7.5***	***6.3***	***10.7***

5.3.13 The above table neatly summarises the broad economic geography of South Wales. The 'highest' occupational categories are dominated by the affluent rural areas in the Cardiff and Swansea Bay City Regions (i.e. Monmouthshire, Vale of Glamorgan and Carmarthenshire). The 'Professional Occupations' category broadly mirrors this, although the Cardiff Capital Region and its environs supplant Swansea to some extent given the dominance of such occupations in the Welsh capital, particularly in the city centre and Cardiff Bay. In contrast, the Valleys local authorities generally have a much smaller proportion of their population concentrated in the highest occupational categories.

5.3.14 The opportunities emerging in the Vale of Glamorgan will undoubtedly cater for an expansion in 'white collar' employment and may serve to intensify the above concentrations of activity. However, the consultation and desk-based research has suggested that, in volume terms, a significant proportion of the 'new' employment (particularly indirect employment) is likely to be concentrated in 'skilled trade occupations', 'process plant and machine operatives' and 'elementary occupations'. In this respect, the Valleys local authorities are dominant with Merthyr Tydfil, Blaenau Gwent, Caerphilly and Neath Port Talbot representing four of the 'top 5' local authorities in terms of the combined concentration of employees in these occupational categories (the other 'top 5' member being Carmarthenshire, which has a large agricultural sector), as is illustrated in the figure below:

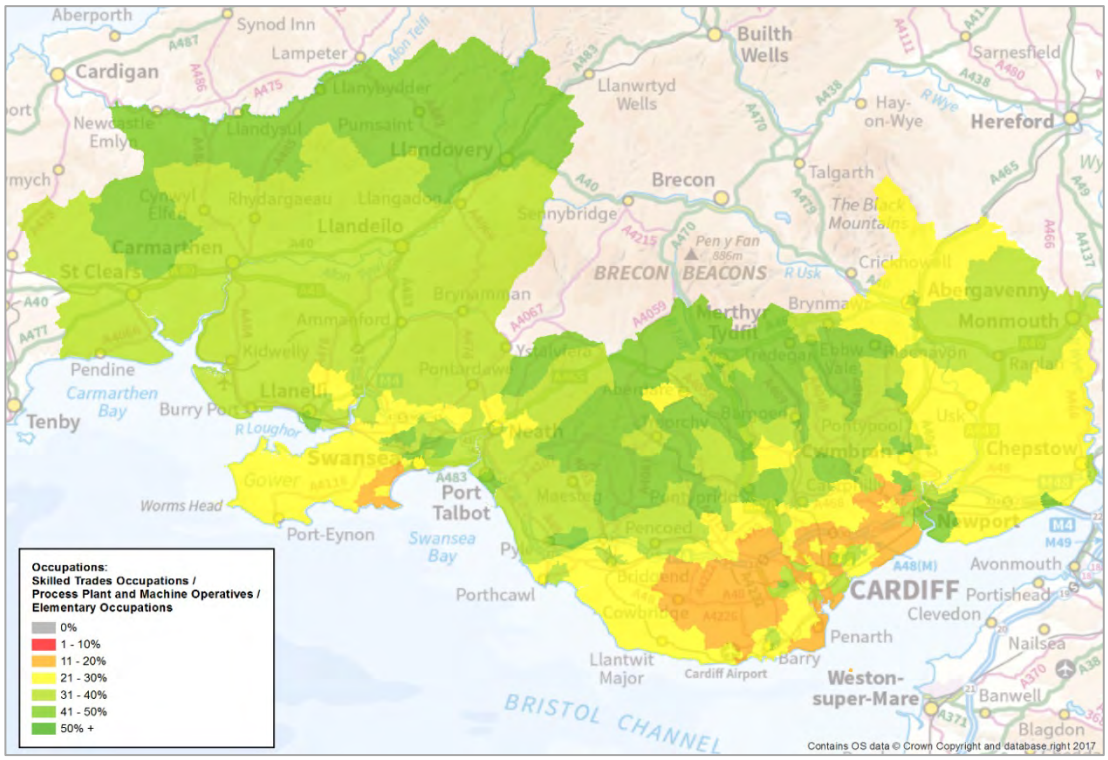


Figure 5.3: Proportion of 'Lowest' Occupational Categories (Skilled Trade Occupations, Process Plant and Machine Operators and Elementary Occupations)

5.3.15 The majority of consultees, and in particular local authorities, perceive the EZ as a regionally significant opportunity to generate new direct, indirect and induced employment opportunities within the study area, including in the above occupational categories. Indeed, consultation with a major business located in the EZ found that the availability of a 'deep' local labour market with the 'right' skills was part of their decision to locate in the area.

5.3.16 However, there was a broad consensus that current transport connections to and from the Vale are 'convoluted' & congested (by road) and either indirect or unavailable (by public transport). This view was as commonly held by neighbouring local authorities (e.g. Bridgend and RCT) as it was by more distant local authorities like Merthyr Tydfil and Blaenau Gwent.

5.3.17 High quality transport connectivity is considered essential in ensuring an effective matching of jobs with labour and promoting business-to-business interactions. This point came through strongly in the consultation, with a number of stakeholders noting that the EZ offers an important regional employment opportunity, particularly for residents in skilled trades. An interesting angle in relation to this point was raised by Blaenau Gwent CBC, which noted that the distances involved are likely to deter large scale daily commuting to the EZ. However, they explained that the creation of commutable high quality (i.e. well paid) employment would support the retention of 'middle earners' in the area, thus giving rise to induced employment and economic impacts.

5.3.18 Moreover, the EZ is seen as a significant supply-chain opportunity for firms across South Wales, with the consultation noting that journey time reliability is essential in effectively realising these opportunities (a point which will be picked up in more detail later in this chapter).

Key Point: The employment and business opportunities associated with the strategic development sites in the Vale of Glamorgan will require labour from a mix of occupational categories from across the Cardiff Capital Region and the Swansea Bay City Region. Whilst a broad generalisation, the analysis contained within this section show that there are particular concentrations of occupational categories in defined geographic clusters. Ensuring efficient connectivity between these clusters will be essential to maximising the benefits of the opportunities presented by the EZ.

Income

5.3.19 The primary objective of the UK-wide programme of City Deals is to devolve investment making powers to the regional / local level, with a view to supporting economic growth. City Deal funding has typically been used both to unlock economic development and promote transport infrastructure investment which improves access to strategic employment or economic development opportunities. In the medium to long-term, it is anticipated that this will increase income and reduce socio-economic inequality.

5.3.20 The figure below shows average annual, **resident** income (gross) of full time workers across the study area, and for Wales and the UK as a whole.

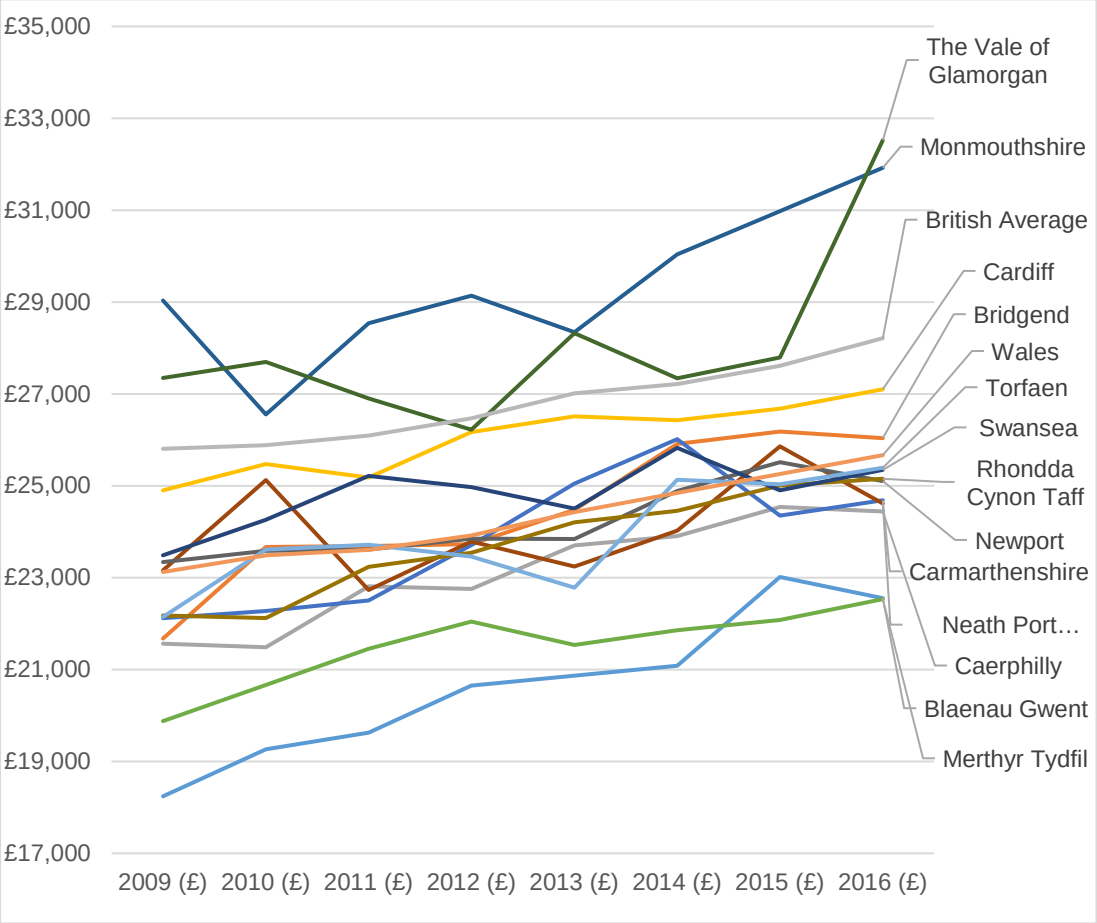


Figure 5.4: Median Gross Annual Income for Residents (Full Time) (Source: Annual Survey of Hours and Earnings, 2009-2016)

5.3.21 The key point of note from the above table is that there is significant income inequality across the Cardiff Capital Region and Swansea Bay City Region with earnings in the VoG being 44% higher than those in Merthyr Tydfil. The levels of Gross Annual Income also demonstrate a strong correlation with the analysis of occupational categories contained within the previous section. Areas with a high concentration of residents in the top three occupational categories also tend to demonstrate the highest levels of income (e.g. Monmouthshire and Vale of Glamorgan). Conversely, it is clear that the Valleys local authorities continue to suffer from below average incomes (although income growth in these areas has been relatively high in recent years, corresponding with a rebound from the economic downturn and targeted regeneration initiatives).

5.3.22 A key objective of enhancing access to and from the Vale of Glamorgan therefore has to be improving access to the strategic employment opportunities associated with the Enterprise Zone and the wider sub-regional opportunity from areas where incomes are lower, with a view to supporting balanced income growth across the two city regions.

Key Point: There is marked income inequality across the study area. Enhancing access to / from the Vale of Glamorgan will assist in connecting lower income areas to the strategic employment opportunities associated with the EZ and the wider sub-regional opportunity.

5.3.23 An alternative means of considering income is to use a **workplace**-based measure – that is, measuring the average income of an area based on those who work there rather than those who live there. The average annual, workplace income (gross) of full time workers in the study area is shown in the figure below.

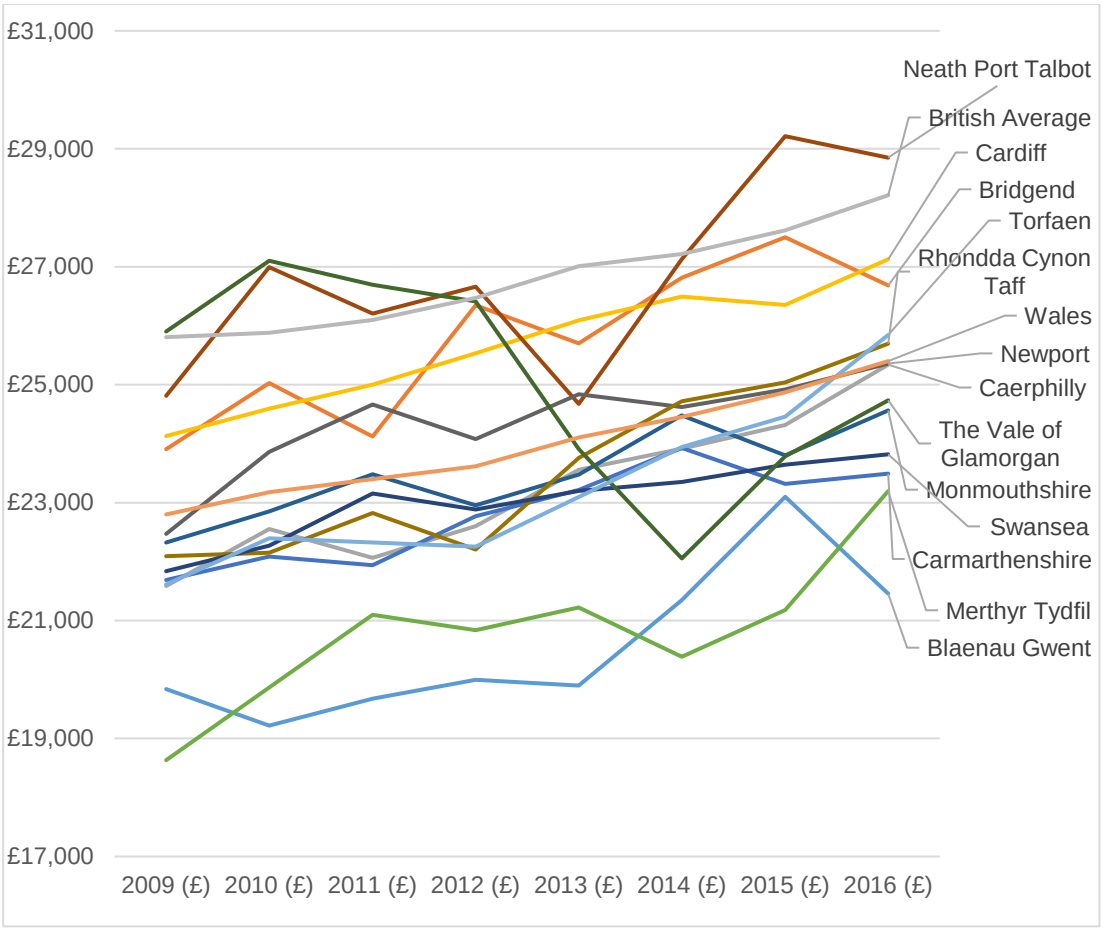


Figure 5.5: Median Gross Annual Income for Workplaces (Full Time) (Source: Annual Survey of Hours and Earnings)

5.3.24 To some extent, the workplace measure of employment presents a slightly different picture. Bridgend and Neath Port Talbot are in the 'top 3' in terms of workplace-based income, although this is likely to be almost exclusively driven by the presence of the Port Talbot steelworks (which in itself highlights the extent to which the development / maintenance of a single major employment location can support incomes at the sub-regional level).

5.3.25 It is however notable that many areas with low resident income also tend to demonstrate below average workplace income, Blaenau Gwent and Merthyr Tydfil for example. This again highlights the importance at the regional level of connecting these areas to strategic employment opportunities.

Key Point: As with the resident-based earnings measure, workplace-based earnings across sections of the Valleys tend to lag a range of averages. At the regional level, there is a case for better connecting these areas with the emerging strategic employment opportunities in the Vale of Glamorgan.

5.4 Gross Value Added

5.4.1 Gross Value Added (GVA) is a measure of economic activity in a region and is measured at current basic prices, which includes the effect of inflation, excluding taxes (less subsidies). The data geography in the context of GVA is more aggregate than other available datasets and is only collated up to and including 2015 at this point. The tables and figures below show GVA firstly per head of the (resident) population and then secondly per filled job:

Table 5.3: Workplace based GVA per head (Source: ONS)

Area	2007 (£)	2013 (£)	% Change 2007-2013
Bridgend and Neath Port Talbot	14,372	15,593	8.5%
Cardiff and Vale of Glamorgan	22,554	22,986	1.9%
Central Valleys[14]	12,309	14,291	16.1%
Gwent Valleys[15]	11,194	13,290	18.7%
Monmouthshire and Newport	19,895	20,071	0.9%
South West Wales[16]	12,949	13,715	5.9%
Swansea	15,835	17,445	10.2%
Wales	***15,572***	***16,893***	***8.5%***

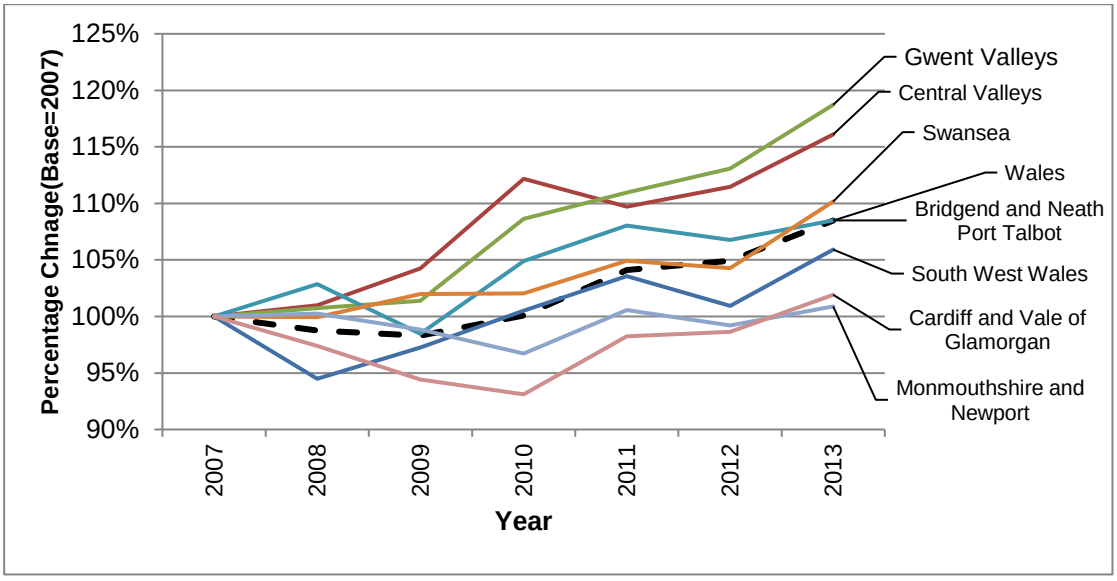


Figure 5.6: Change in workplace based GVA per head (Source: ONS)

Table 5.4: GVA per Filled Job (Source: ONS)

Area	2007 (£)	2015 (£)	% Change 2007-2015
Bridgend and Neath Port Talbot	38,400	42,531	11%

[14] Merthyr Tydfil and Rhondda Cynon Taf.

[15] Blaenau Gwent, Caerphilly and Torfaen.

[16] Carmarthenshire, Ceredigion and Pembrokeshire.

Cardiff and Vale of Glamorgan	39,697	42,363	7%
Central Valleys[17]	34,555	43,491	26%
Gwent Valleys[18]	35,304	39,274	11%
Monmouthshire and Newport	39,255	42,738	9%
South West Wales[19]	33,376	36,553	10%
Swansea	33,601	38,375	14%
Wales	36,319	40,316	11%

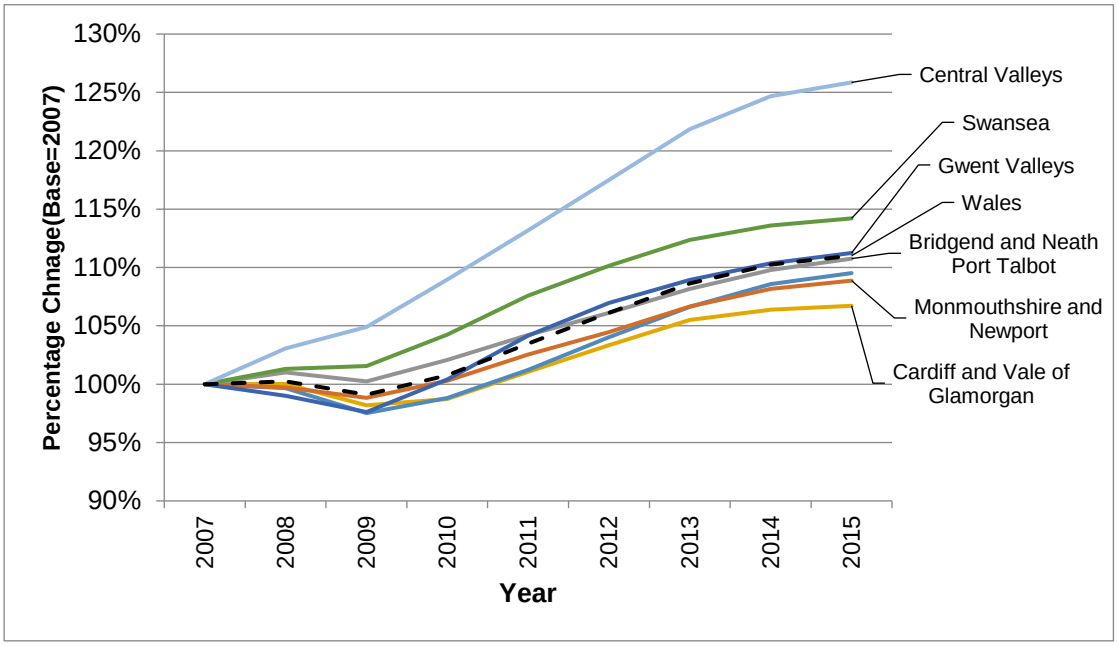


Figure 5.7: Change in GVA per Filled Job (Source: ONS)

5.4.2 The above table and figure show that GVA per head in 'Bridgend and Neath Port Talbot', 'Central Valleys', and 'Gwent Valleys' was consistently below that of the Welsh average (albeit the disparity has narrowed to some degree in recent years). However, the disparity is lessened and, in some cases reversed in terms of the GVA per filled job, which implies that, on the one hand, Valleys residents in work are in relatively high value employment but, on the other, that overall economic activity / employment is relatively lower.

Key Point: There is significant GVA disparity in South Wales, with the southern coastal strip and Monmouthshire tending to display significantly higher GVA per capita than the area as a whole. The realisation of the strategic economic development opportunities in the Vale of Glamorgan may, to some extent, widen this disparity. Nonetheless, it provides an important opportunity to increase the GVA of South Wales. Enhanced connectivity to and from the Vale of Glamorgan would assist in ensuring that the Cardiff Capital Region and Swansea Bay City Region as a whole would benefit from developments in the Vale of Glamorgan.

Business Competitiveness

[17] Merthyr Tydfil and Rhondda Cynon Taf.

[18] Blaenau Gwent, Caerphilly and Torfaen.

[19] Carmarthenshire, Ceredigion and Pembrokeshire.

5.4.3 The November 2017 UK Government Budget highlighted the challenge which the country faces in terms of **productivity** (i.e. output per worker, or GVA per head), in which the UK lags numerous international competitors. The UK Industrial Strategy published on 27th November 2017 is intended to address the productivity challenge, and highlighted investment in infrastructure as one of the key elements of the proposed approach.

5.4.4 In the context of this study, it can be argued that the success of the EZ will at least in part depend on the extent to which the local (i.e. South Wales) labour market and infrastructure supports the competitiveness of businesses within the area (i.e. their productivity). Assessing the competitiveness of any particular destination is clearly challenging given the myriad of factors which impact on business choices. However, the most consistent and commonly used measure is the UK Competitiveness Index, which defines competitiveness as "*the ability for an economy to attract and maintain firms with stable or rising market shares in an activity, while maintaining stable or increasing standards of living for those who participate in it*".

5.4.5 The Index takes into account a number of factors in terms of inputs, outputs and outcomes:

- Input factors include economic activity rates; business start-up rates; number of businesses per 1,000 people; NVQ Level 4 and qualifications; and proportion of knowledge based businesses.
- Output factors include GVA per head, output per hour worked (i.e. productivity) and employment rates.
- Outcome factors include gross weekly pay and unemployment rates.

5.4.6 There are several headlines within the UK Competitiveness Index 2016 which highlight the critical importance of raising the overall level of competitiveness and productivity in South Wales, as follows:

- Wales as a whole is deemed to be the least competitive region in the UK.[20]
- Of the 45 Local Enterprise Partnerships (LEP) / City Regions in the UK, Cardiff is ranked 34th and Swansea 45th in terms of competitiveness.[21]
- Three of the Capital Region authorities, Merthyr Tydfil, Blaenau Gwent and Caerphilly, are in the 'bottom 10' for the whole of the United Kingdom.[22]

5.4.7 The table below shows the relative competitiveness of the individual study area local authorities, together with the change in rank between 2013 and 2016.:

Table 5.5: Study Area Competitiveness Rank, 2013 and 2016 (ordered by 2016 Rank, out of 379)[23]

Area	Rank (2013)	Rank (2016)	Change 2013-2016
Cardiff City	134	128	+6
Monmouthshire	167	162	+5
Newport	232	228	+4
Vale of Glamorgan	225	253	-28
Bridgend	294	283	+11
Swansea City	319	308	+11
Torfaen	366	352	+14
Rhondda Cynon Taf	367	355	+12

[20] UK Competitiveness Index 2016 (Cardiff University & Nottingham Business School, 2016), p.23.

[21] UK Competitiveness Index 2016 (Cardiff University & Nottingham Business School, 2016), p. 26.

[22] UK Competitiveness Index 2016 (Cardiff University & Nottingham Business School, 2016), p.13.

[23] UK Competitiveness Index 2016 (Cardiff University & Nottingham Business School, 2016), pp. 43-53.

Area	Rank (2013)	Rank (2016)	Change 2013-2016
Neath Port Talbot	348	359	-11
Carmarthenshire	365	372	-7
Caerphilly	374	374	0
Merthyr Tydfil	378	376	+2
Blaenau Gwent	379	379	0

5.4.8 It is clear from the above table that the study area faces a challenge in terms of its overall competitiveness, particularly in the Welsh Valleys, almost all of which are in the 'bottom 20' for the whole of the UK. The EZ offers an important opportunity in this regard, potentially bringing a mass of high value investment and employment to the region, which will in turn have indirect and induced impacts.

5.4.9 However, in order to realise the anticipated benefits, it will be important to ensure that access to the EZ for both individuals and businesses is quick and reliable. It is notable that the VoG has suffered the biggest absolute decline in its position between the 2013 and 2016 indices, some 28 places in total. The index does not address the issue of transport infrastructure specifically, but the consultation does suggest that it is possible and indeed probable that this it is one of the key challenges faced in the area.

5.4.10 The prospective value associated with the EZ and the importance of good transport connectivity was a point raised repeatedly throughout the consultation – feedback from consultees included:

- A Central Valleys local authority noted that, due to the types of business that will be located in the EZ, predominantly large multi-nationals, improving access could provide employment for skilled labour in the local authority area. It was also noted that the EZ will provide opportunities for primary and secondary supply chain support from within the local authority boundaries.
- A Gwent Valleys local authority noted that improved access to the EZ would be beneficial in terms of the local supply-chain (e.g. supplying Aston Martin) as manufacturing (particularly niche manufacturing) accounts for a large proportion of employment in the local authority area. It is anticipated that improved connectivity would reduce the 'distance effect' associated with the VoG currently.
- Another Central Valleys local authority highlighted the potential supply-chain benefits of improved connectivity associated with the high value aerospace industry, automotive and defence industries.
- There was a generally held view amongst a number of local authorities that improving connectivity to the EZ would create agglomeration impacts and increase productivity by creating clusters in high value sectors, with spin-offs (and thus positive labour market impacts) for businesses throughout the study area.
- A business representative group highlighted the importance of fast and reliable access to the EZ for members either supplying firms within it or attending meetings in the area.

Key Point: The study area faces clearly evidenced challenges in terms of productivity and business competitiveness. The EZ, with its significant scale and concentration in high value & productive industries, is seen as presenting an important opportunity to increase productivity. However, the consultation repeatedly identified the need for fast and reliable transport connections to and from the VoG.

5.5 Deprivation

5.5.1 WG produces the Welsh Index of Multiple Deprivation (WIMD) which is the official measure of relative deprivation for small areas in Wales. The WIMD is made up of eight separate domains

(or types) of deprivation namely; income, employment; health, education, access to services, community safety, physical environment, and housing.

5.5.2 The generally accepted point at which an area is defined as deprived is when it is classified in the '20% most deprived'. The figure below shows the overall levels of deprivation in the study area in WIMD 2014 by quintile.

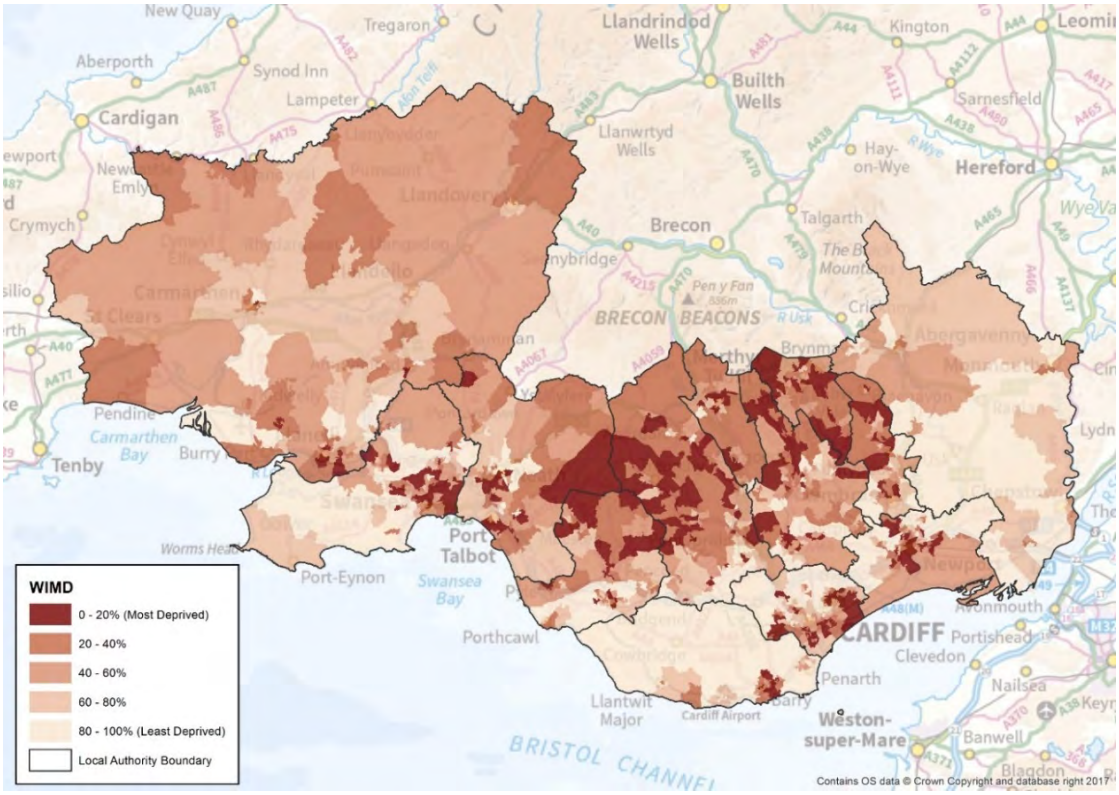


Figure 5.8: Welsh Index of Multiple Deprivation - Overall

5.5.3 The 'employment' and 'income' domains of WIMD is mapped separately below:

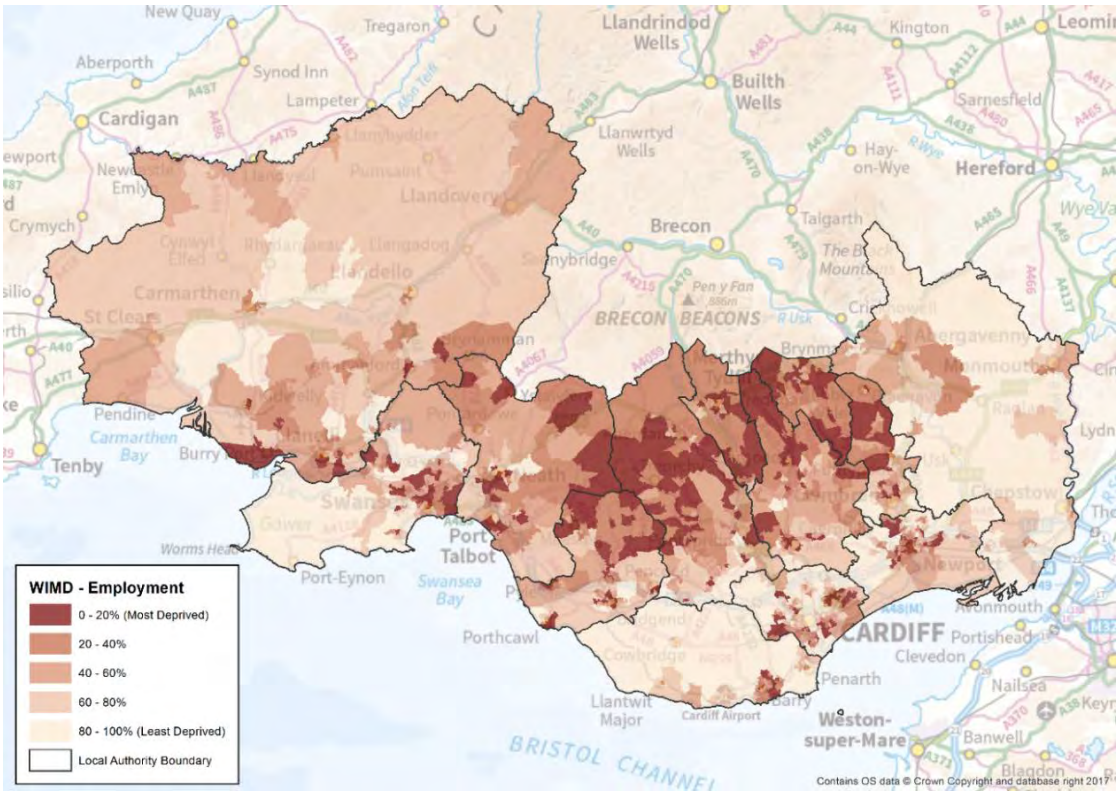


Figure 5.9: Welsh Index of Multiple Deprivation – Employment

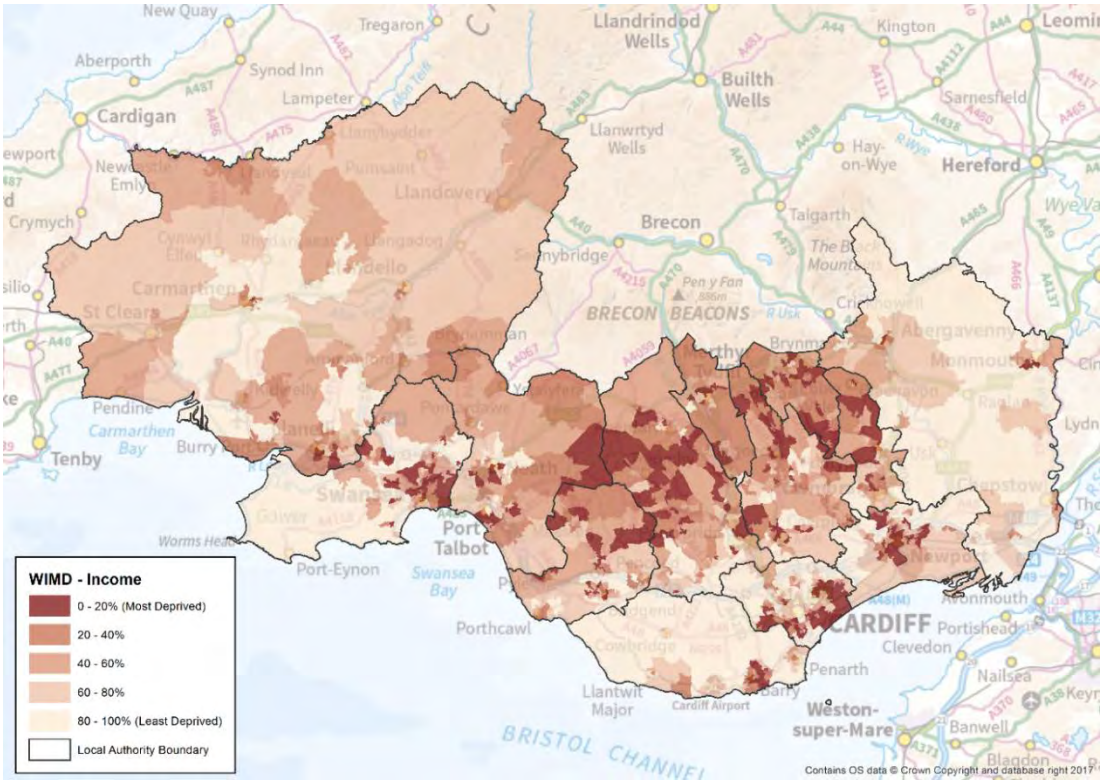


Figure 5.10: Welsh Index of Multiple Deprivation – Income

5.5.4 The above figures clearly evidence the socio-economic analysis brought out in the above sections, and reinforce the idea of a two-speed economy. There are several concentrated areas of deprivation across the Valleys, set against areas of very low deprivation in the more affluent rural areas, such as the Vale of Glamorgan and Monmouthshire.

5.5.5 This emphasises the importance of ensuring that the opportunities associated with the EZ benefit the entire Capital Region. A number of local authorities consulted as part of the study explained that the EZ and the wider sub-regional opportunity must work towards a more spatially even distribution of activity across the study area, whilst also offering benefits to the northern areas of the Valleys, which suffer the most severe deprivation.

5.5.6 It is also worth noting that there are wards within the most deprived quintile in Barry, so the EZ will also promote local employment opportunities.

Key Point: The WIMD data clearly summarises the disparities in income, employment and overall measures of deprivation within South-East Wales. The EZ represents a strategically important employment opportunity and, from a regional perspective, it will be important to ensure that these job opportunities are matched effectively with the wider South-East Wales labour market. Good connectivity is essential to this.

5.6 Census Travel-to-Work

5.6.1 Building on the above point about matching jobs to labour - one of the desired outputs of improved connectivity - this section considers the travel-to-work patterns prevalent within the study area. The Census Travel to Work (CTTW) analysis uses 2011 data to show the distances travelled to work by residents within the study area as well as the method by which they travel.

5.6.2 The figure below shows the **distance residents travel** to their place of work:

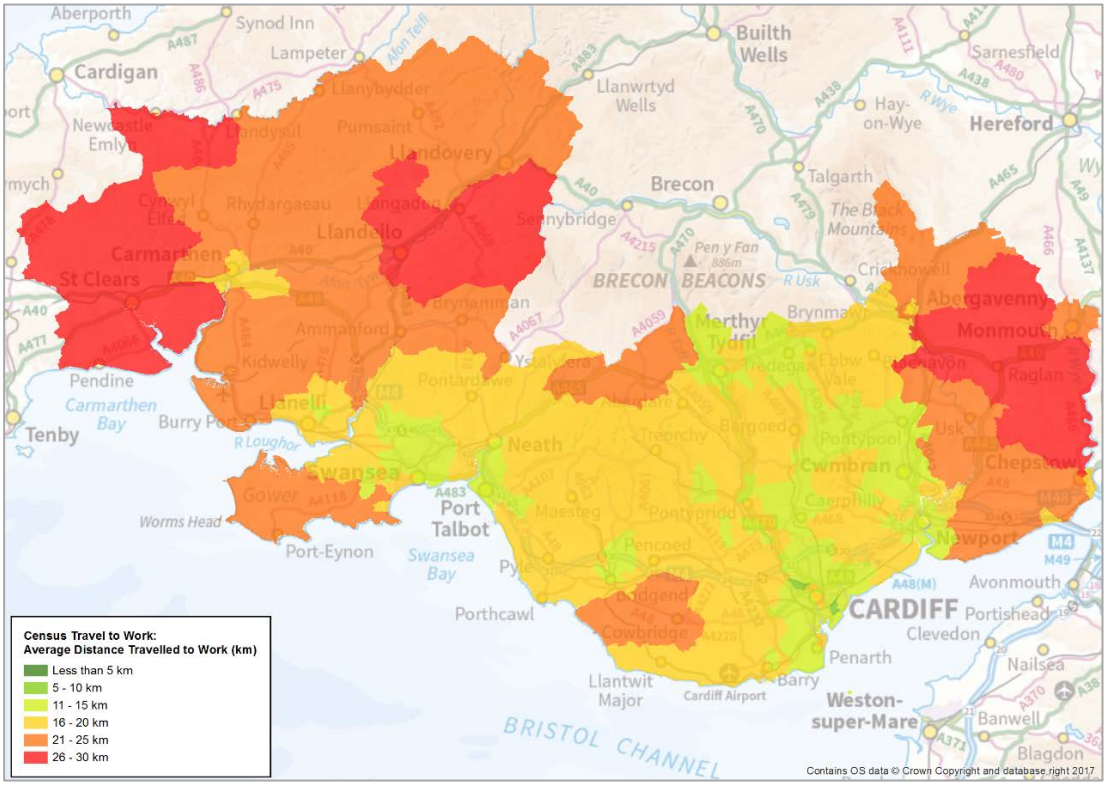


Figure 5.11: 2011 Census Travel to Work Distance (Average Distance in km) (Source: Census 2011)

5.6.3 The figure shows that those living in and around the urban centres of Cardiff and Swansea travel much shorter distances to work compared to those in the wider study area. However, there is a much greater propensity to travel a longer distance in the surrounding study area.

5.6.4 The stakeholder consultation identified a general willingness of respondents to travel longer than average distances where high value / well-paid employment is on offer.

Key Point: The travel-to-work data highlights that distance is not necessarily an impediment to taking up employment. Whilst the longer travel distances in the wider study area are likely to result from commuting to Cardiff, Swansea and, to a lesser degree, Newport, the figure suggests that residents in the study area would be willing to travel to the VoG for work if the employment opportunities are appropriate. Ensuring good connectivity is therefore essential in matching employment opportunities to the wider labour market.

5.6.5 Figure 5.12 below sets out the mode by which residents of each local authority travel to their place of work.

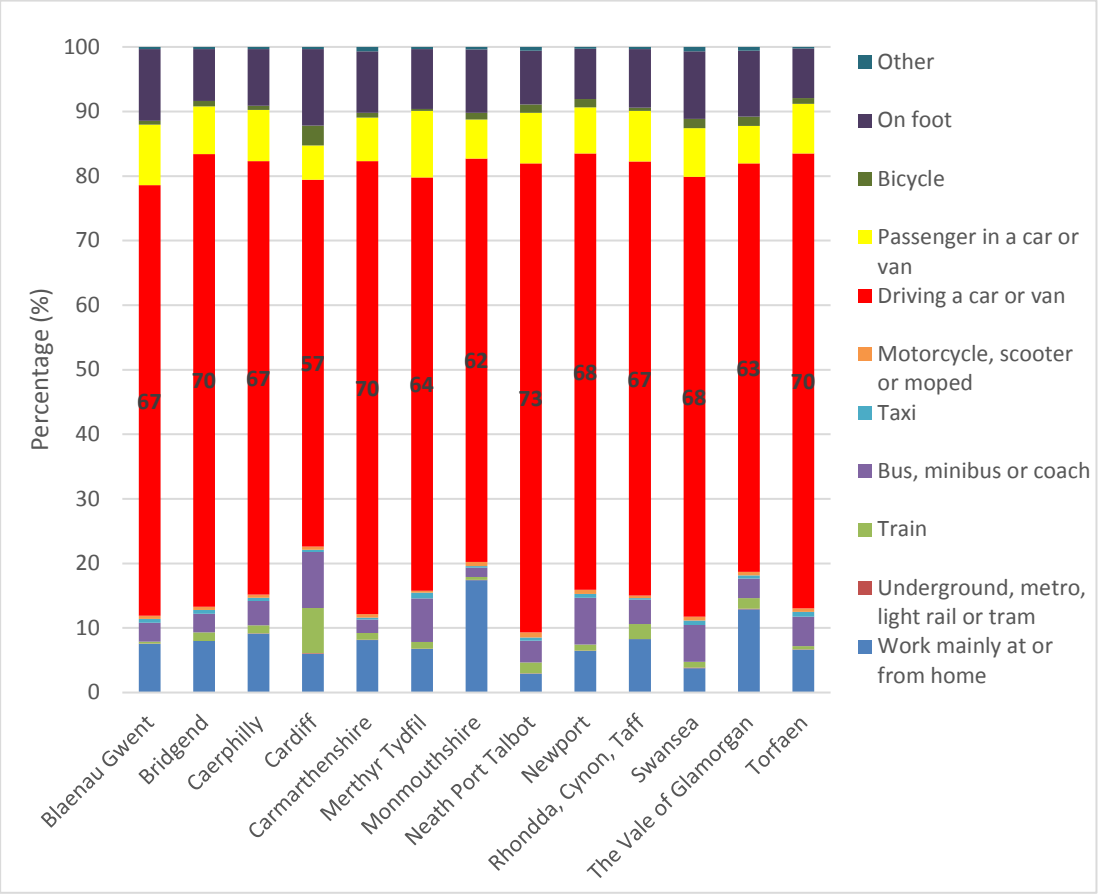


Figure 5.12: Census Travel to Work Method by Local Authority (Source: 2011 Census)

5.6.6 It is evident that the car is the most common mode of transport for all local authorities with those from Neath Port Talbot, Bridgend, Torfaen and Carmarthenshire (73%, 70%, 70% and 70% respectively) having the highest proportion of car users.

5.6.7 The figure below highlights the high proportion of residents driving a car or van to their place of work.

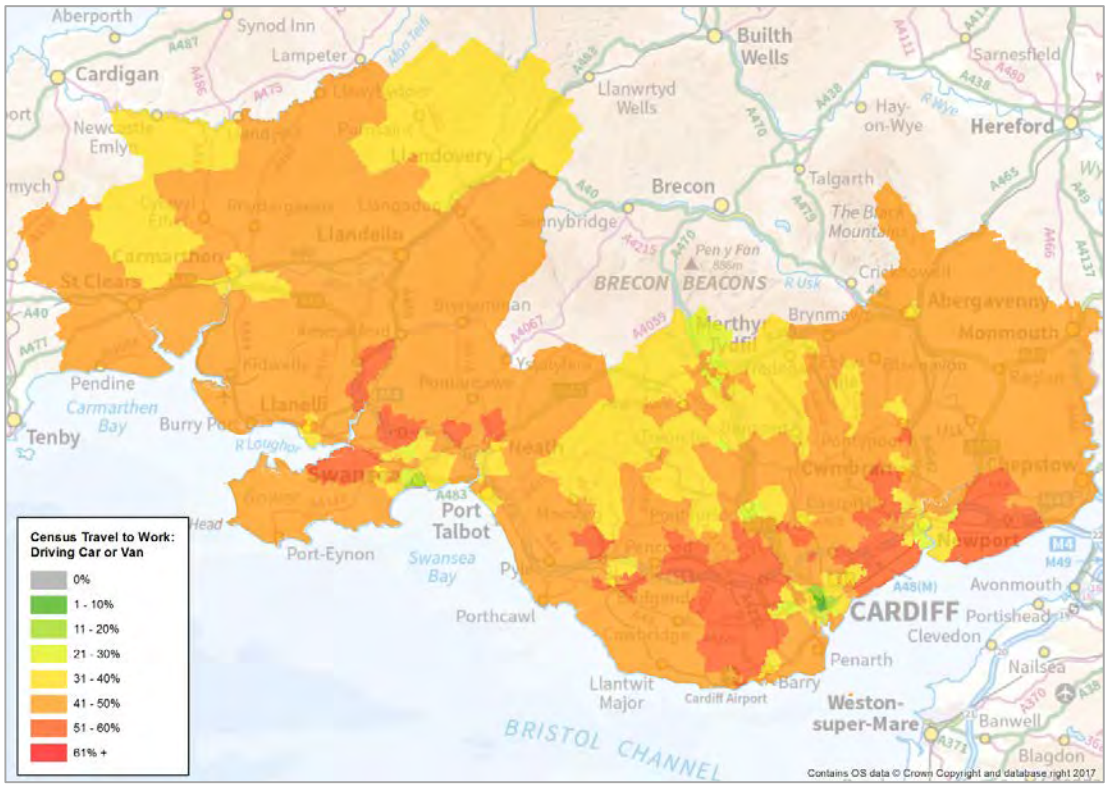


Figure 5.13: 2011 Census Travel to Work Method (Driving Car or Van) (Source: 2011 Census)

5.6.8 Whilst driving a car is the most common mode of travel-to-work overall, it is notable that several of the Valleys (particularly around the Heads of the Valleys) demonstrate a proportionally lower use of the car for travel-to-work. This may in some respects reflect the longer distances to the key employment centres as well as the relatively frequent rail services. However, low levels of car ownership are also likely to be a key issue, as discussed below. The figure below shows car or van availability by local authority:

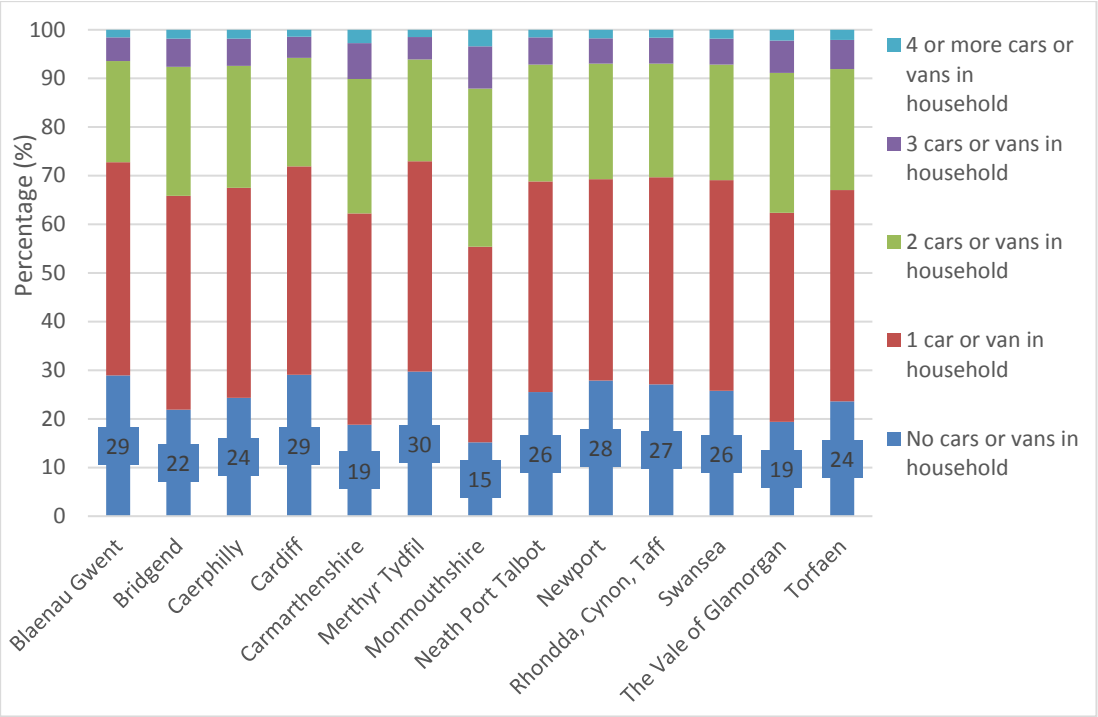


Figure 5.14: Household Car or Van Availability by Local Authority (Source: 2011 Census)

5.6.9 Car ownership varies significantly between each local authority with 30% not having access to a car in Merthyr Tydfil. Car ownership is also low in Blaenau Gwent (29%) and RCT (27%). Outwith the urban areas, low levels of car ownership correlate strongly with a range of negative socio-economic indicators including employment and income. The distribution of households without access to a car or van is highlighted in the figure below:

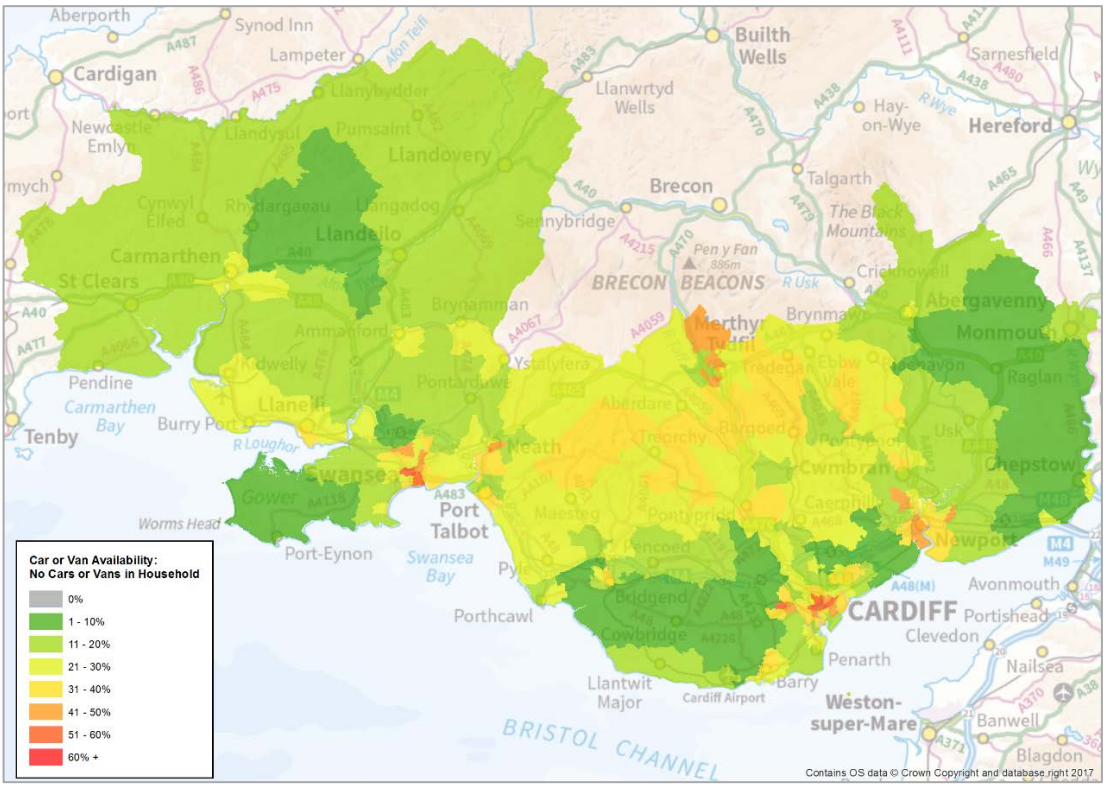


Figure 5.15: Percentage of households with no car or van (Source: 2011 Census)

5.6.10 The above figure confirms the earlier hypothesis that low car ownership in a number of the Valleys local authorities (particularly in the Heads of the Valleys area) is a contributory factor to lower than average travel-to-work by car. This is an important issue in terms of ensuring that the transport solution developed for the VoG maximises multi-modal accessibility in line with the policy context.

Key Point: Census travel-to-work data clearly highlights the dominance of the private car for accessing employment in the study area. However, low levels of car ownership in certain areas, particularly in the Heads of the Valleys, will limit car-based accessibility to the employment opportunities in the EZ. This is an important issue in terms of ensuring that any transport solution(s) developed for the VoG maximise multi-modal accessibility.

5.7 Inward Investment

5.7.1 Foreign Direct Investment (FDI) data were received from Welsh Government at the local authority level covering the period 2008-09 to 2013-14. These data cover 325 projects accounting for 34,000 jobs (split roughly evenly between new and safeguarded jobs). The breakdown of these 325 projects by local authority area is shown in the figure below:

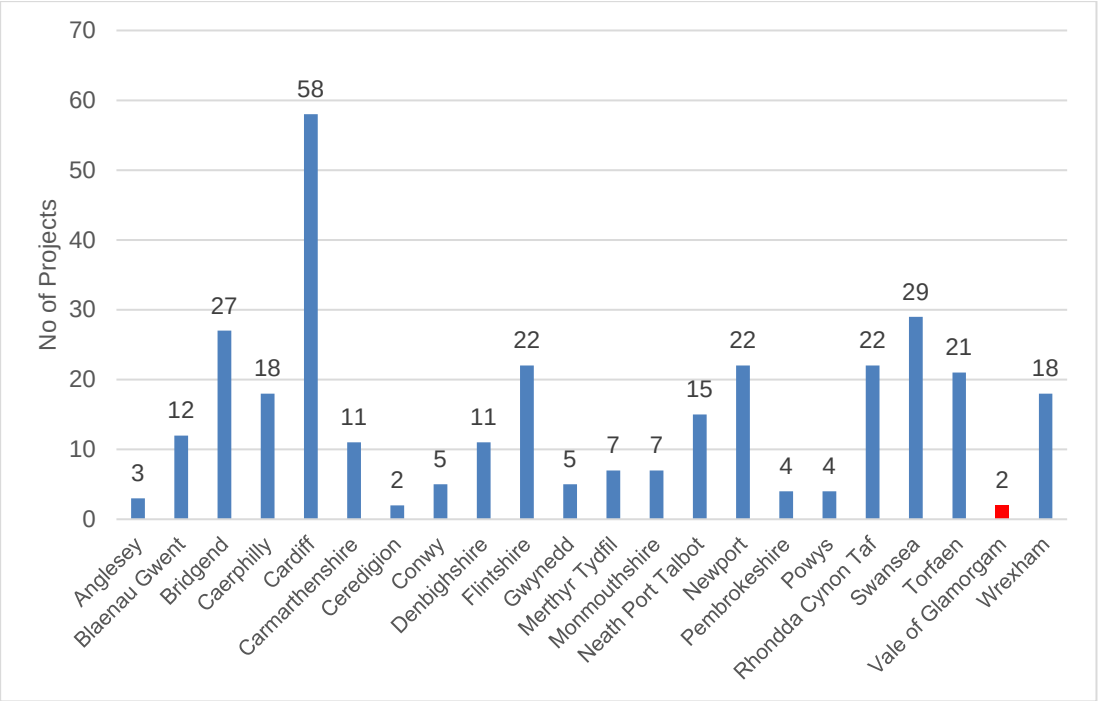


Figure 5.16: FDI Projects by Local Authority, 2008/09, to 2013/14 (Source: Welsh Government)

5.7.2 It is notable from the above chart that, despite the presence of Cardiff Airport and proximity to Cardiff itself, the level of inward investment in the Vale of Glamorgan has historically been amongst the lowest in Wales (joint lowest with rural Ceredigion). Whilst there are numerous reasons for this (including regional policy initiatives historically being focussed on areas of evidenced deprivation), the low levels of inward investment in the VoG are somewhat surprising.

5.7.3 The declaration of the EZ and the early commitment of Aston Martin to locate in the VoG is an important first step in increasing the level of inward investment. However, evidence from a range of studies assessing the locational choices of inward investors has highlighted the importance of good surface transport connectivity in this respect.

Key Point: Inward investment in the Vale of Glamorgan has historically been lower than in much of Wales. The declaration of the Enterprise Zone and the early commitment of Aston Martin to the area represents a significant opportunity to increase the level of inward investment in the VoG. Evidence from a range of studies does however suggest that high quality connectivity is an important factor in the locational decisions of inward investors, and thus improving transport connections to and from the VoG is necessary to maximise the economic development opportunities in the area.

5.8 Tourism

5.8.1 Tourism is a critical component of the Welsh economy. WG maintains tourism data using the STEAM tourism model, which highlights that, in 2013, tourism supported around 100,000 FTE jobs across Wales, generating around £6.23 billion of GVA.[24] The figure below shows the estimated number of visitors by local authority:

[24] Wales STEAM report and dataset (Welsh Government, 2013).

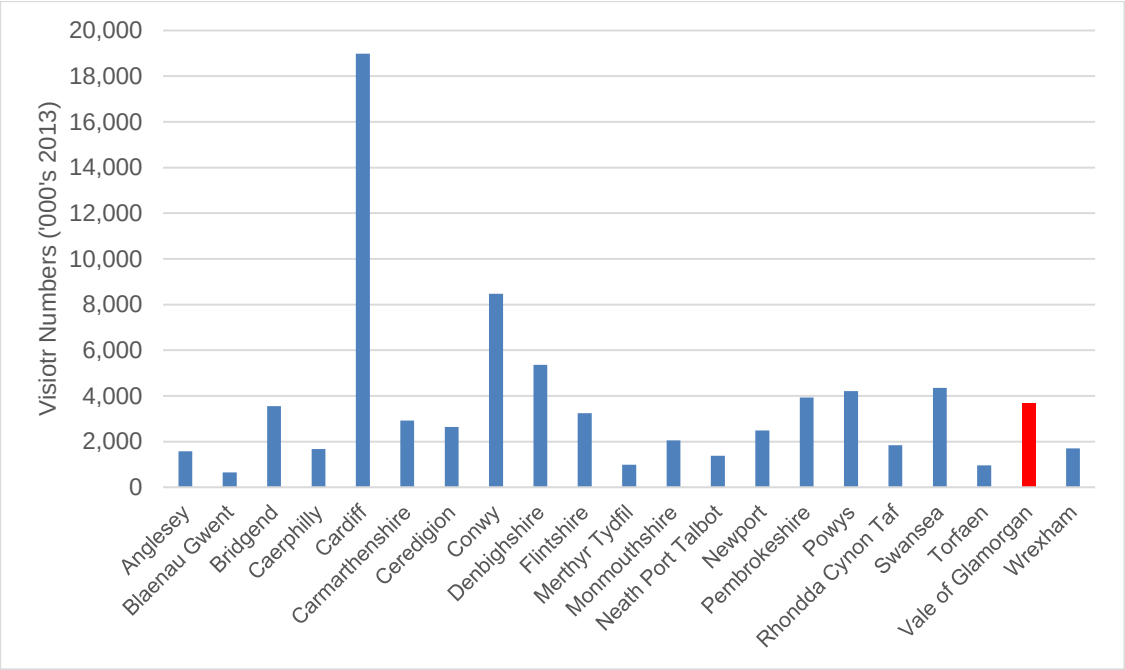


Figure 5.17: Visitor Numbers by Welsh Local Authority (STEAM, 2013)

5.8.2 The chart above picks up both Welsh domestic (approximately 51% of the total) and non-Welsh visitors. Whilst the vast majority of non-Welsh visitors are from the rest of the UK, Wales received around 884,000 overseas visits in 2013. Whilst we do not have firm evidence at present, it is highly likely that a significant proportion of these tourists entered Wales via England, partly due to the range of flights and destinations available from Cardiff Airport.

5.8.3 Improving the infrastructure and connectivity in the Vale of Glamorgan will likely deliver the by-product of improved surface access to Cardiff Airport, one of a potential package of measures which would support route and service development through the airport, thus contributing to increasing the number and duration of visits to Wales.

Key Point: Wales receives a large volume of foreign tourism. However, the limited range of flights and destinations served by Cardiff Airport means it is likely that a significant proportion of overseas visitors arrive via England. Improving surface access to the airport as part of a wider package of measures in the VoG would potentially support further development of the airport route network and thus tourism overall in Wales.

5.9 Summary

5.9.1 This chapter has developed a proportionate economic profile of the study area. Two key points emerge from the above analysis:

- There is evidence of the existence of a **'two-speed economy'** with a broadly affluent rural hinterland and coastal zone encircling the Valleys, which suffer high levels of multiple deprivation (including high levels of economic inactivity and unemployment). The imbalance within the regional economy is negative for the study area as a whole.
- There is an evidenced issue with **productivity / competitiveness** within the study area as a whole and within constituent local authorities.

5.9.2 **Participation** (i.e. high levels of economic activity and employment) and **productivity** are considered to be the building blocks of a strong economy. Whilst there are variances across the study area, there is a clearly evidenced problem in respect of both participation and productivity when the area is considered as a single entity.

5.9.3 It is also important to note that this not a static position. Improvements to transport connectivity (e.g. improvements to the South Wales Mainline, removal of the tolls on the Severn Bridges) and other infrastructure investments outwith the study area could disadvantage both the Cardiff Capital Region and Swansea Bay City Region if other areas of the UK, and in particular the south-west of England, are deemed to be more competitive. Whilst the Metro and M4 Newport Bypass will greatly assist in supporting the economic competitiveness of South Wales, the threat of a loss of economic activity is a real one.

5.9.4 It is in this context that the EZ, and indeed the wider sub-regional opportunity, can be considered so important. The EZ, amongst other developments, presents a regionally significant economic growth opportunity, potentially generating a range of employment opportunities across different occupational categories, both directly and in terms of indirect and induced employment. Of critical importance is the potential creation of jobs in manufacturing (skilled and unskilled) which would be well suited to parts of the study area with high concentrations of residents in these occupational categories.

5.9.5 Effective transport connectivity between the VoG and the rest of the study area is however likely to be essential in ensuring the EZ is competitive in matching jobs with the labour market, facilitating business-to-business interactions, and ensuring that the benefits of improved job opportunities are spread across the study area. It is to the quantification of the current transport connectivity that this report now turns.

6 Transport Connectivity Baseline

6.1 Overview

6.1.1 The previous chapter stated at various points that transport connectivity is currently acting as a constraint on the economic performance of the Vale of Glamorgan. More importantly, it was argued that, if not addressed, these connectivity issues could have a long-term negative impact on the development of the EZ and indeed the wider sub-regional opportunity.

6.1.2 This chapter therefore explores these issues further, using connectivity analysis to more accurately define and quantify the issue. Whilst the analysis does consider the VoG as a whole, the focus is predominantly on the EZ sites (i.e. the sites at the airport and St Athan) as these represent the strategic / regional opportunity which has been alluded to in previous chapters.

6.2 VoG Highways Network

6.2.1 The figure below highlights the principal highway network within the Vale of Glamorgan:

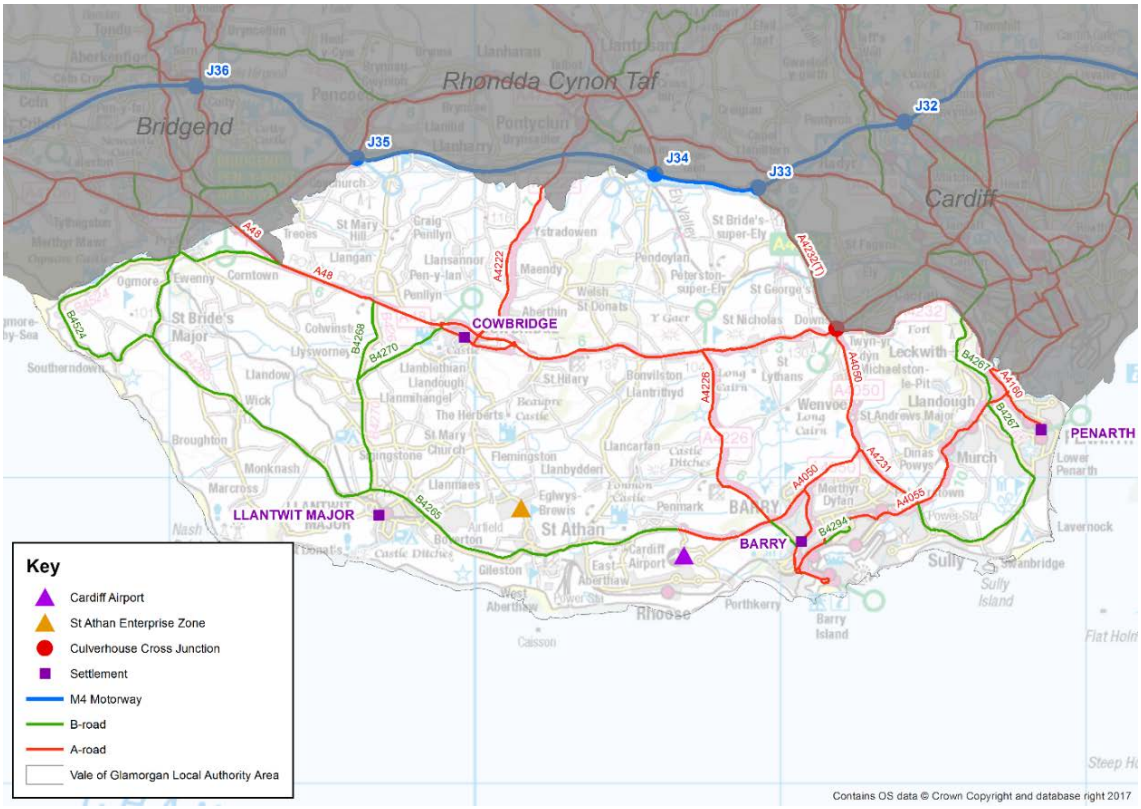


Figure 6.1: Vale of Glamorgan Highway Network

6.2.2 Strategic road access to the VOG is principally via the M4 motorway, with Junctions 33 (Cardiff West), 34 (Llantrisant) and 35 (Bridgend / Pencoed) all providing links into the County. Of these options, J33 provides the highest standard route into the Vale, providing a link to the A4232 (T) dual carriageway and connecting to Culverhouse Cross Roundabout, a major strategic junction linking Cardiff (via the A4232 south), Cowbridge (via the A48 trunk Road) and Barry (via the A4050). The A4232 is a principal route into Cardiff from the west and Culverhouse Cross Roundabout is a congestion hotspot, particularly at peak times. This has a negative impact on journey time reliability to and from destinations in the VoG, including Cardiff Airport.

6.2.3 J34 also provides southbound access into the Vale of Glamorgan. The route passes through Clawdd-coch and Pendoylan before linking to the A48 near Bonvilston. However, the route is mainly single carriageway, but with a number of very narrow single track sections from Hensol

Golf Academy southwards, and is not suitable for significant traffic volumes or larger vehicles. It has become a popular 'rat run' from the M4 to the airport, and can be heavily used when there are problems on the M4 - a function for which the road is ill-suited.

6.2.4 J35 provides a link from the M4 to the less populated west of the VoG, including St Bride's Major and the coastal areas of Ogmore-by-Sea and Southerndown.

6.2.5 As shown in the figure above, the Cardiff Airport - St Athan Enterprise Zone is located in the central southern part of the County. Given the road standard south of J34, the most appropriate strategic (and indeed the signed) route to Cardiff Airport when coming from the west is via J33 (to the east), the busy Culverhouse Cross Roundabout on the A4232, and onward via the A4050 and A4226. The A4050 passes through the residential area of Colcot to the north of Barry and has a speed limit of 40mph along much of its length while the A4226 is rural in nature with a speed limit of 50mph beyond Barry.

6.2.6 The route to the St Athan element of the Enterprise Zone continues west past the Airport along the B4265 before travelling through St Athan via Gileston Road / Cowbridge Road and then west along the northern boundary of the site.

Views of Consultees

6.2.7 As part of the consultation, we sought views on the suitability and problems associated with the current highway network from VoG County Council (the highway authority for the majority of roads within the Vale), an EZ representative and the neighbouring local authorities of Bridgend and RCT County Council. The consultation findings assist in contextualising the subsequent accessibility analysis.

Vale of Glamorgan County Council

6.2.8 Vale of Glamorgan County Council noted the following points in relation to the local highway network:

- In terms of accessing the M4, the radial routes within the eastern Vale all generally converge of Culverhouse Cross, creating a strategic bottleneck. There is also local congestion on these routes. It was noted that there is no effective separation of local and strategic traffic, further congesting radial routes in the area and making active travel options less attractive. It is anticipated that this problem will worsen with the gradual realisation of the EZ opportunities.
- More generally, there is not seen to be an appropriate strategic route for commercial vehicles or abnormal loads in the Vale. HGVs also run through or near residential areas, which is considered sub-optimal.
- There is an evidenced 'rat run' through J34 of the M4 and the village of Pendoylan when the motorway is congested. The recent construction of an offset signalised junction on the A48 at Sycamore Cross has also led to vehicle platooning on this single track road, which can be highly problematic with the limited number passing places available.
- The VoG is a popular destination for tourists, with peak period traffic (particularly day-trippers to Barry Island) layered on top of daily traffic.

Enterprise Zone Official

6.2.9 The EZ set out the following points in relation to the highway network:

- The highway network surrounding the EZ is rural in nature and is generally unsuitable for large volumes of traffic. At peak times, congestion adds significantly to road journey times. In addition, due to the nature of the roads there is limited resilience, with traffic incidents or poor weather leading to significant delays.
- Amongst those currently based at the EZ around 250-300 commute in from the north of the site, including from RCT. Jobs in the aerospace industry are well paid compared to the

Welsh average and therefore people are willing to travel to access them. The current highway infrastructure is considered to be sub-optimal in facilitating such movements.

- From a freight perspective, it was noted that poor transport connections can impact on the cost of transporting supplies which in turn impacts on the cost of doing business more generally. Within the EZ, there is a well-developed industry in Aircraft on Ground (AOG) which is aircraft maintenance, whereby a problem is serious enough to prevent an aircraft from flying. To avoid delays, the parts must be dispatched so that the aircraft can be returned to service. AOG supplies are centred around Heathrow / Gatwick which is around 2 hours from Cardiff. However, it can then be an additional 40 minutes from the M4 to Cardiff Airport. Aircraft in service costs are very high (up to £20,000 an hour) and therefore any delay in delivering parts can have a major impact in terms of cost which has an immediate knock-on impact for the industry.

Neighbouring Local Authorities

- Bridgend CBC noted that the quality of the roads into the VoG from the M4 are relatively poor. The western route via J35 is single carriageway, with the B4265 also having a relatively poor alignment and low speed limit. J34 is not considered to be an appropriate access point given the single track sections connecting to the south of the Vale, whilst the route via J33 is considered to be circuitous and subject to congestion related journey time reliability issues.
- From the perspective of RCT CBC, the most direct route into the Vale is via J34, which as previous noted is inappropriate and thus the congested J33 is generally used. From the perspective of the wider sub-regional development opportunity, addressing congestion on the M4 across the north of the VoG is considered a key priority.

Key Point: Whilst the M4 provides high quality strategic access points to the perimeter of the VoG, the local road network within the Vale is generally of a single carriageway standard and suffers significant congestion around the key 'gateway' of Culverhouse Cross. In both the short and longer-term, this is likely to constrain access to the County and, in particular, the Cardiff Airport – St Athan Enterprise Zone. The most direct route from the M4 to the EZ is via J34 of the M4. However, the connecting road is of a poor quality with lengthy single track sections and poor visibility. The J34 option has however become a rat run for those travelling to the VoG from the west, with negative implications for communities along the route.

6.3 Highway Connectivity Analysis

6.3.1 The socio-economic baseline highlighted the importance of ensuring good connectivity between the VoG and the wider study area if the employment and wider opportunities associated with the EZ are to be realised and maximised. Connectivity analysis has therefore been undertaken to baseline the existing connectivity of the VoG with respect to key locations across the study area.

Journey Times

6.3.2 In order to do this, a series of calculations were undertaken using the 'Network Analyst' software. Network Analyst calculates the quickest car drive times between sets of origins and destinations using a defined start time, car speed data (in this case INRIX data, thus providing actual observed speed and journey time data) and a range of user defined parameters.

6.3.3 The key **origins** used in the analysis are shown in Figure 6.2, with the largest settlement in each local authority being used to determine a representative accessibility measure. In addition, in order to examine the different potential access options from both Cardiff and Bridgend, additional locations were selected in these areas (namely Ely, Tongwynlais and Maesteg). All possible **destinations** within the Vale of Glamorgan are represented at the Census Output Area level (the lowest level of spatial definition):

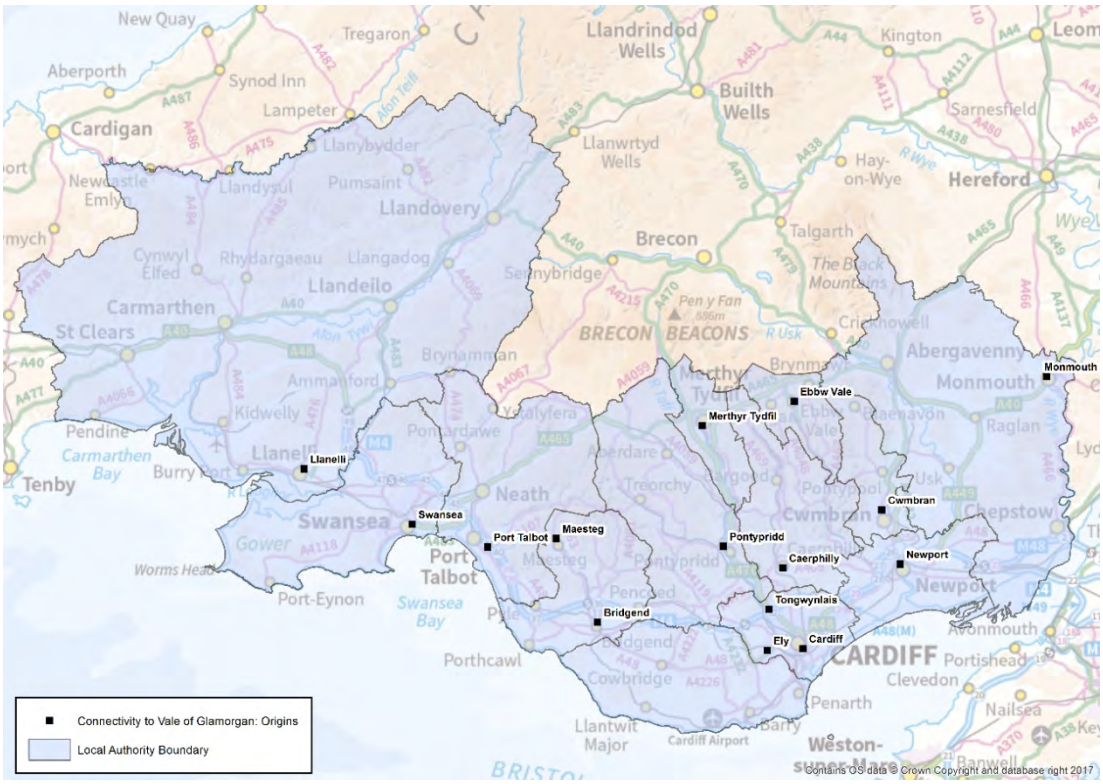


Figure 6.2: Origins Points used within Journey Time Calculations

6.3.4 Four calculations were undertaken (starting at 0630, 0700, 0730 and 0800) and the results were used to calculate an average journey between each origin and destination pair.

6.3.5 For illustrative purposes, Figures 6.3–6.6 show the highway connectivity from Caerphilly, Pontrypridd, Merthyr Tydfil, and Port Talbot to the Vale of Glamorgan (in the interests of brevity, plots for all other named settlements are provided in a stand-alone PowerPoint in Appendix B).

6.3.6 The purpose of this analysis is to show current observed road based travel times from each settlement to all parts of the VoG.

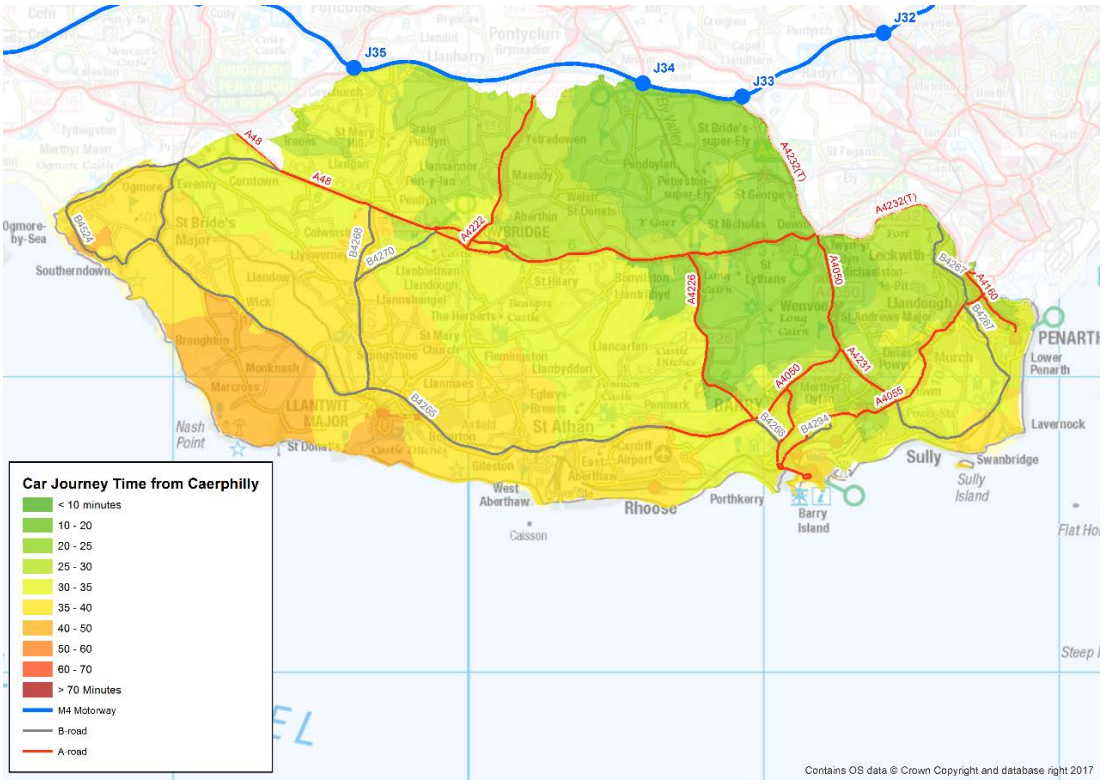


Figure 6.3: Highway Journey Time to Vale of Glamorgan from Caerphilly

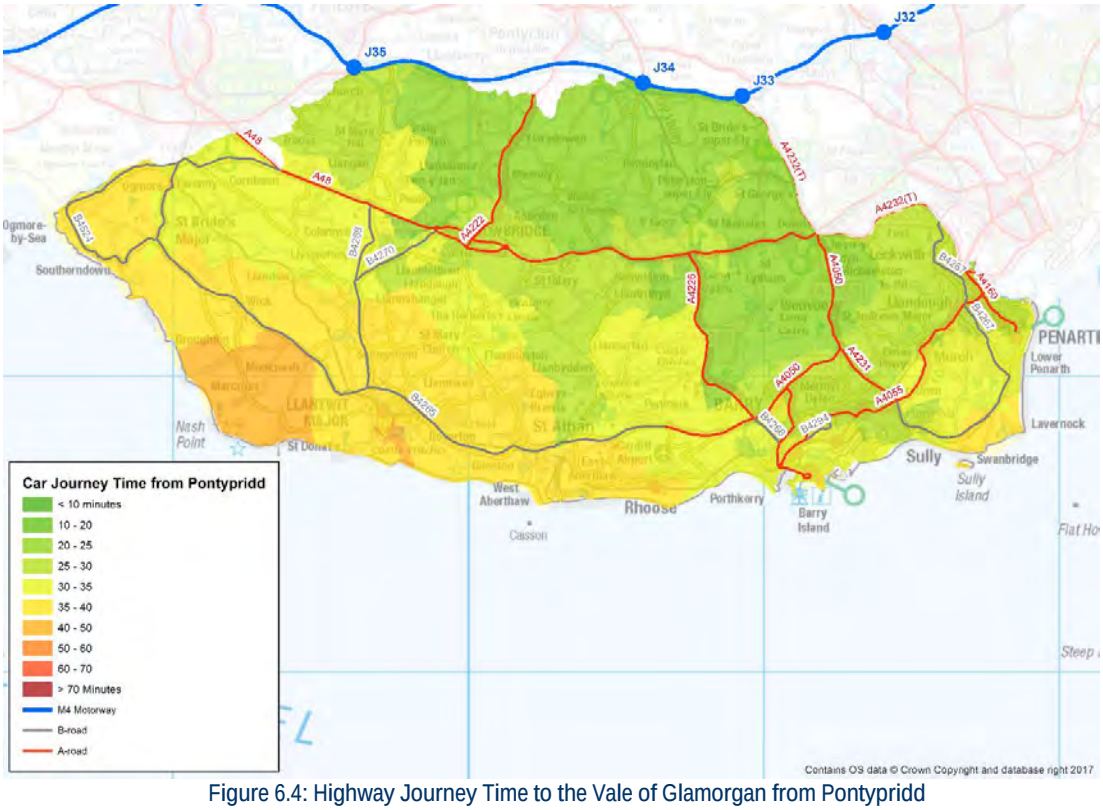


Figure 6.4: Highway Journey Time to the Vale of Glamorgan from Pontypridd

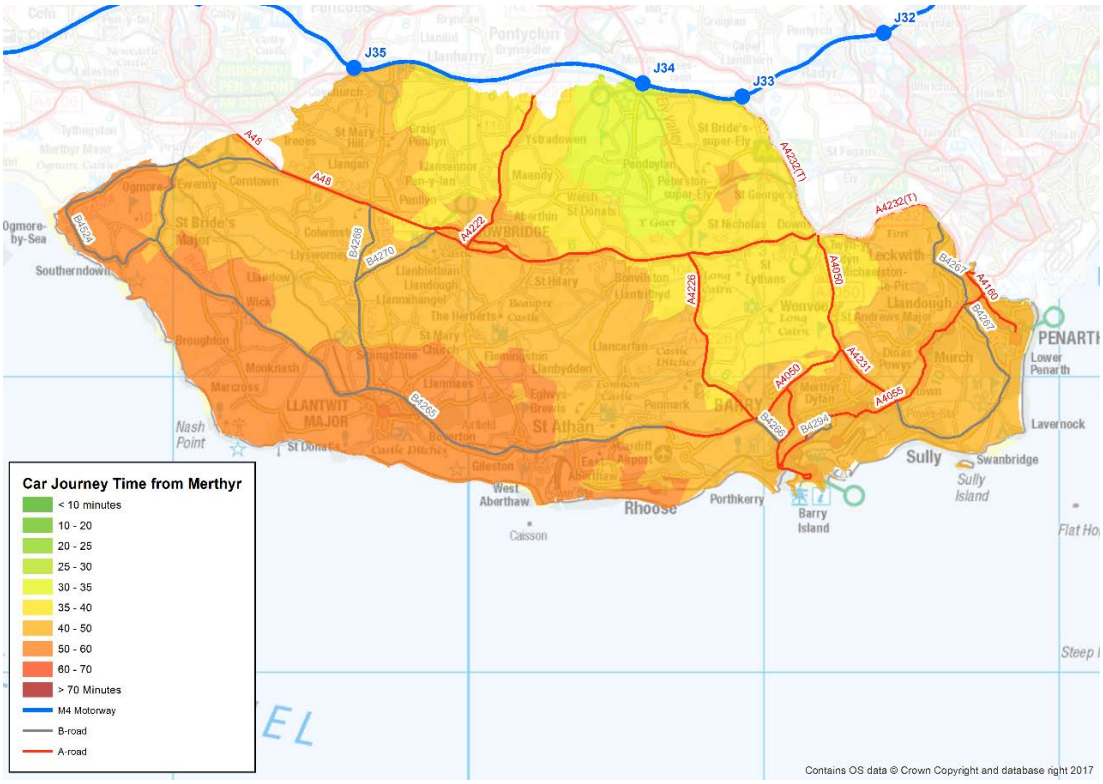


Figure 6.5: Highway Journey Time to the Vale of Glamorgan from Merthyr Tydfil

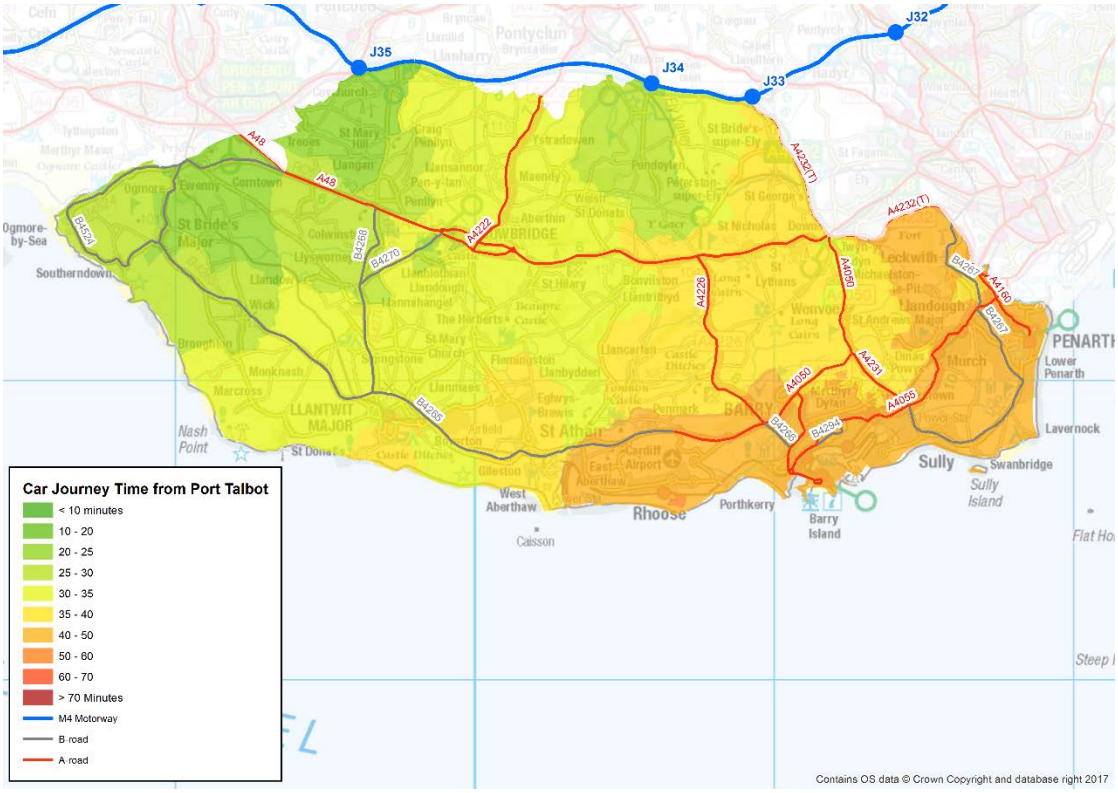


Figure 6.6: Highway Journey Time to the Vale of Glamorgan from Port Talbot

6.3.7 The above figures show that connectivity to the north-eastern end of VoG is within a reasonable journey time (circa 30 minutes or so) for settlements in the southern portion of the Valleys (e.g. Caerphilly and Pontypridd). However, access to the area of the EZ tends to display slightly longer journey times which, whilst a function of overall distance, is also likely to be partly a result of delays at Culverhouse Cross (given that peak data have been used).

6.3.8 Journey times from the northern portion of the Valleys, represented by Merthyr Tydfil, are of course longer, in the 50-70 minute band. This is likely at the upper-end of the time band at which people would generally be willing to travel for work, and thus reductions in these journey times would be desirable if the labour market catchment of the EZ is to be maximised.

6.3.9 It is notable that journeys from the west (represented by Port Talbot) to the EZ are actually only slightly shorter than those from Merthyr Tydfil (despite being closer as the crow flies). This is largely due to the need to use the M4 J33 and route via Culverhouse Cross rather than the shorter route via J34. The relatively poor current accessibility to / from areas in the west may therefore limit the potential labour market catchment of the EZ from this area.

Key Point: Overall, this analysis has provided a benchmark for road-based journey times to and from the Vale of Glamorgan, and specifically the EZ. The need to route via J33 of the M4 and the busy Culverhouse Cross does have a negative impact on both journey length and reliability. This may in turn limit the current potential labour market catchment of the EZ and the overall benefit to both the Cardiff Capital Region and Swansea Bay City Region. From this perspective, enhancing access to and from the VoG has the potential to support the overall economic development of South Wales by increasing the size of the potential labour market at these sites.

Cardiff Airport and St Athan Journey Time Catchments

6.3.10 In addition to examining journey times to the VoG from specific points, a series of calculations were also undertaken examining journey times to both Cardiff Airport and the wider EZ (denoted by the St Athan site) from all origin locations across the study area. The origin locations were represented in the analysis at the lower supper output area (LSOA) level and, as with the above, four calculations were undertaken (starting at 0630, 0700, 0730 and 0800) and an overall average calculated.

6.3.11 The figures below show the average highway journey time from the study area to Cardiff Airport and St Athan Enterprise Zone sites respectively:

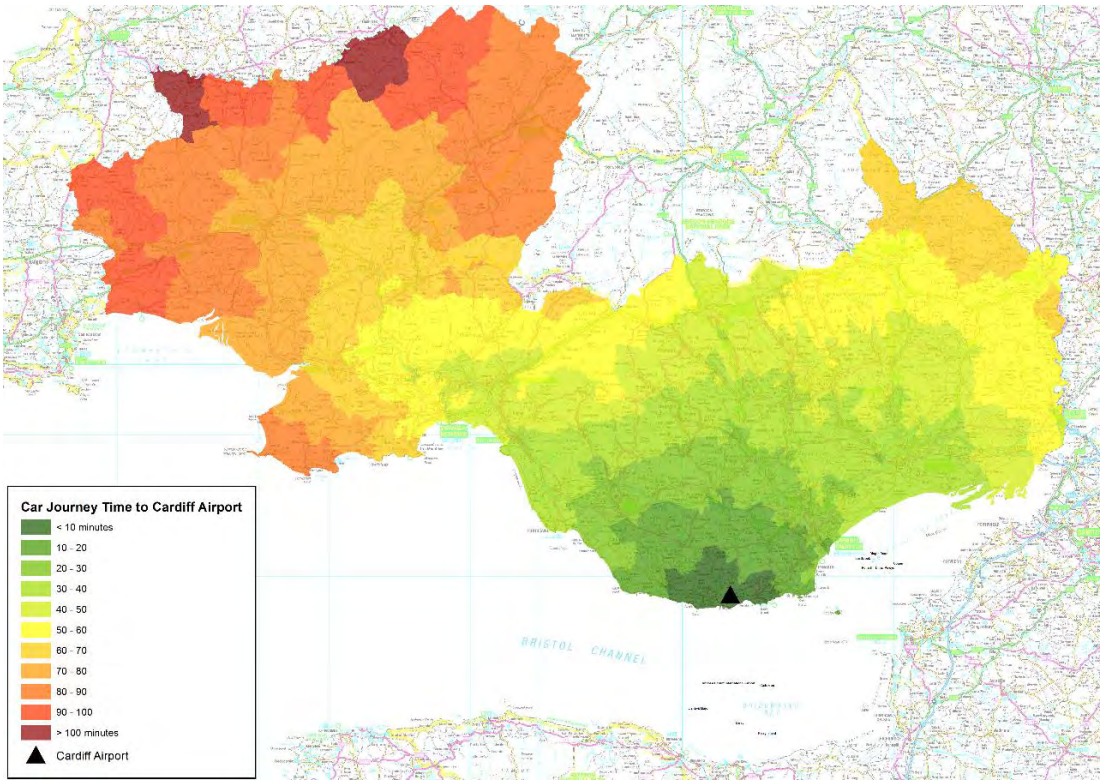


Figure 6.7: Current AM Highway Journey Time to Cardiff International Airport

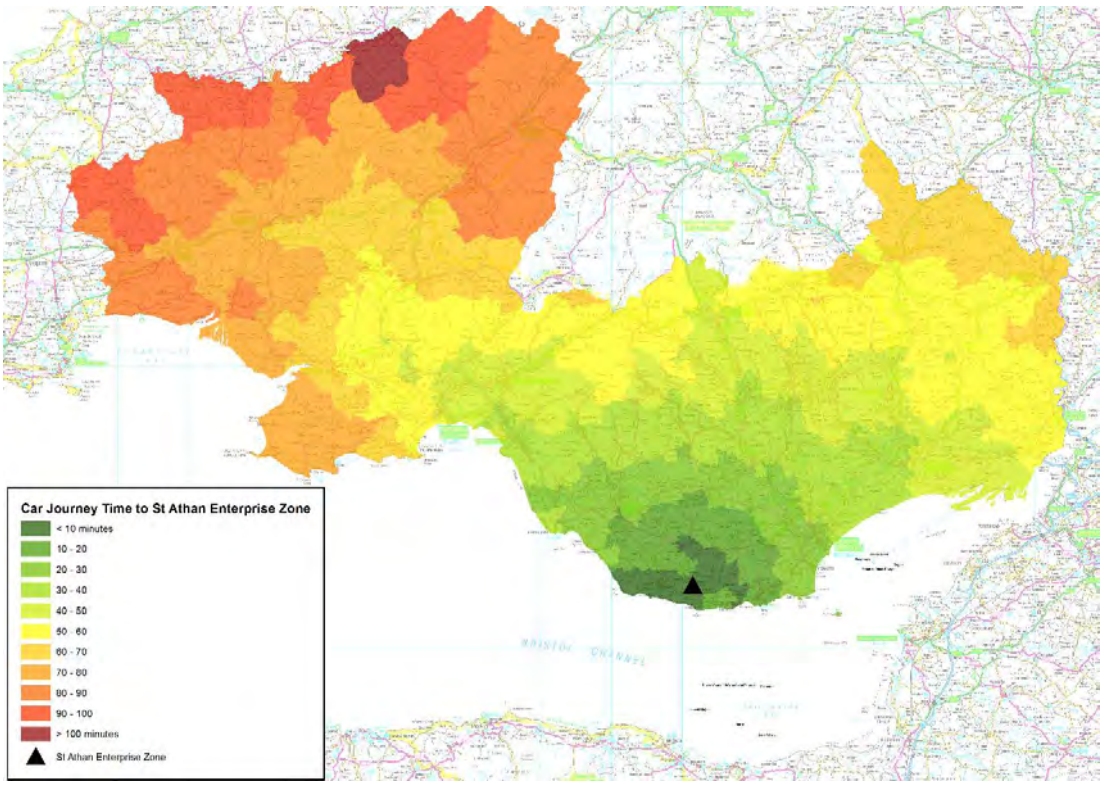


Figure 6.8: Current AM Highway Journey Time to St Athan Enterprise Zone Sites

6.3.12 In order to put the above plots into context, the following tables considers the working age population within various drive time bands from each site – this is effectively a measure of **labour market accessibility** from the perspective of an employer.

Table 6.1: Working Age Population (16-74) in 10-Minute Drive Time Bands of Cardiff International Airport

Category	Working Age Population	Percentage
< 5 minutes	3,208	0.2%
5-10	39,393	2.6%
10-20	91,194	6.1%
20-30	319,603	21.3%
30-40	335,615	22.3%
40-50	318,798	21.2%
50-60	235,743	15.7%
60-70	93,585	6.2%
70-80	38,282	2.5%
80-90	16,881	1.1%
90-100	7,468	0.5%
> 100 minutes	3,544	0.2%

Table 6.2: Working Age Population (16-74) in 10-Minute Drive Time Bands of St Athan Enterprise Zone

Category	Working Age Population	Percentage
< 5 minutes	3,307	0.2%
5-10	11,373	0.8%
10-20	57,393	3.8%
20-30	288,712	19.2%
30-40	355,438	23.6%
40-50	371,440	24.7%
50-60	270,718	18.0%
60-70	90,475	6.0%
70-80	31,567	2.1%
80-90	13,098	0.9%
90-100	8,710	0.6%
> 100 minutes	1,083	0.1%

6.3.13 The key points from the above tables are as follows:

- **Cardiff International Airport:** 30% (453,398) of the study area population are within 30 minutes' drive-time of the airport, with 89% (1,343,554) being within one-hour drive time.
- **St Athan EZ sites:** 24% (360,785) of the study area population are within 30 minutes' drive-time of the St Athan EZ sites, with 90% (1,358,381) being within one-hour drive time.

Key Point: It is notable that, for Cardiff International Airport and the St Athan EZ sites, around 45% of the study area population is within the 30-50 minutes' drive time band. Even a relatively small reduction in journey times to / from the VoG could significantly enhance the labour market catchment of the EZ.

6.3.14 These connectivity metrics can be used as a benchmark in any subsequent appraisal of options (i.e. a WelTAG appraisal) which would improve connectivity to these key site, e.g. option *x* would increase the labour market within a 40-minute drive time by *y*%.

6.4 VoG Public Transport Network

6.4.1 This section considers the public transport connectivity of the VoG and specifically the EZ sites.

Railway Network

6.4.2 The figure below shows the railway network in the Vale of Glamorgan and the surrounding counties.

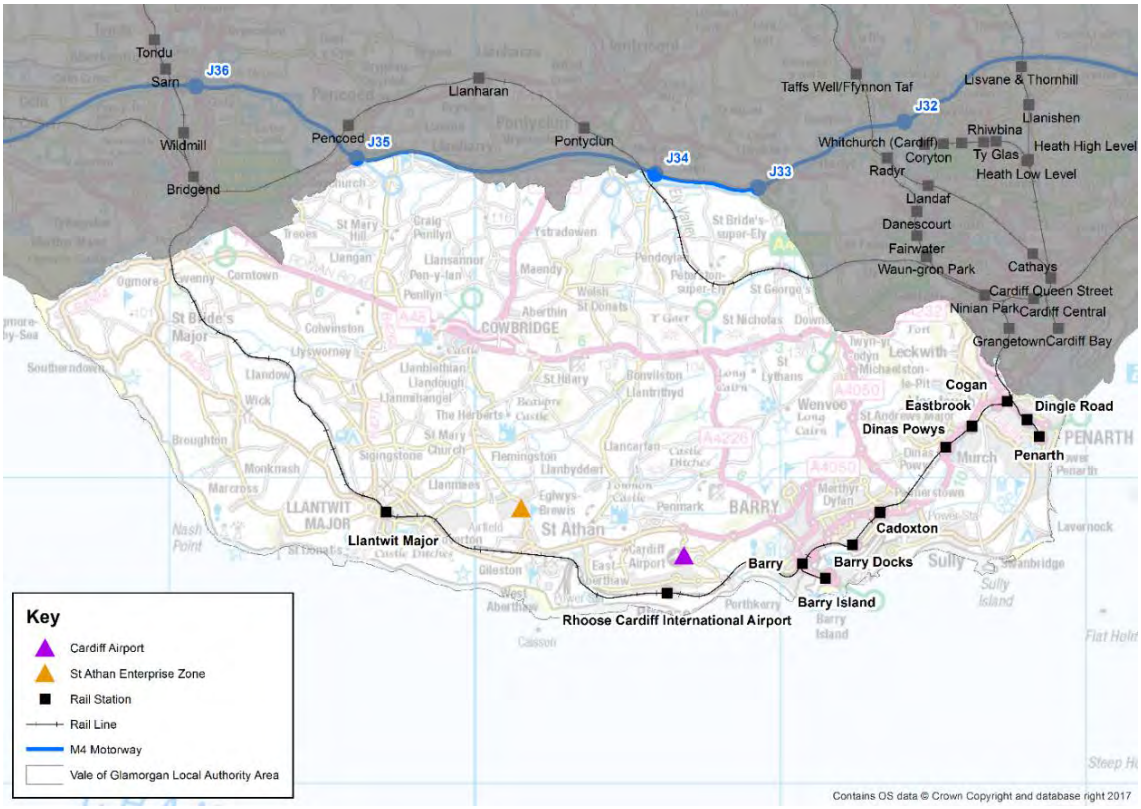


Figure 6.9: Vale of Glamorgan Rail Network

6.4.3 As shown, the Vale of Glamorgan Line (VoGL) to the south of the County is the only railway line which directly serves the principal settlements in the local authority area. The line links Cardiff to Bridgend via Barry, Rhoose and Llantwit Major and is operated by Arriva Trains Wales, although the Wales and Borders franchise is currently out to tender. The line is split into three branches:

- The Barry Branch – which runs from Cardiff West to Barry Island;
- The Penarth Branch – which links Cogan junction to Penarth; and
- The Vale of Glamorgan Branch – which connects Barry to Bridgend.

6.4.4 While there are no other railway stations within the Vale of Glamorgan, the South Wales Main Line which connects Cardiff to Swansea via Pontyclun, Llanharan, Pencoed and Bridgend runs through the north of the County.

6.4.5 The rolling stock used on the Vale of Glamorgan line is relatively old, typically consisting of 2-car Class 150 diesel multiple units, strengthened to 4-car units for certain peak services.

Rhoose Cardiff International Airport

6.4.6 Rhoose Railway Station, the closest to Cardiff Airport, is situated approximately four miles to the south of the terminal building as illustrated in the figure below:

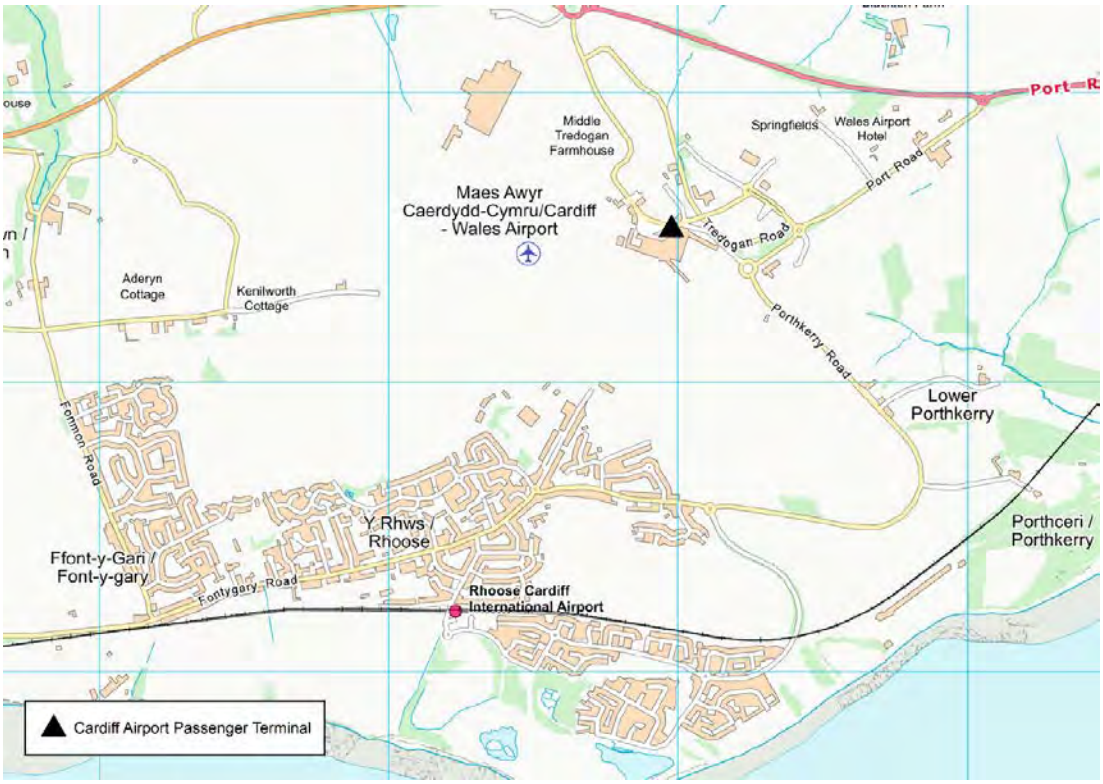


Figure 6.10: Rhoose Rail Station and Cardiff Airport

6.4.7 The station, which is located on the Vale of Glamorgan line, is of a two platform arrangement, but is somewhat unconventional in that the platforms are staggered either side of a level crossing (the 'Up' platform to the east of the crossing and 'Down' platform to the west).

6.4.8 The figure below shows combined station entries and exits for Rhoose Cardiff International Airport Station:

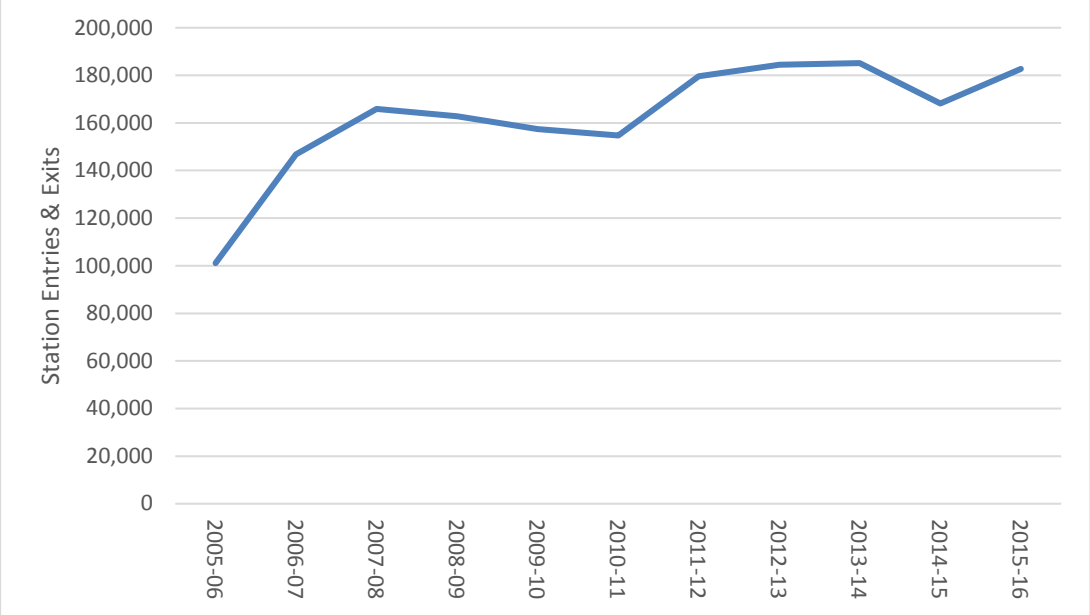


Figure 6.11: Rhoose Cardiff International Airport Station Entry & Exist (Source: ORR)

6.4.9 The table below shows the operating day, frequency and first & last departure times from Rhoose.

Table 6.3: Rhoose Railway Station First and Last Departures and Service Frequency

	To Cardiff		From Cardiff		Service Frequency
	First Departure	Last Departure	First Arrival	Last Arrival	
Monday - Friday	06:06	23:06	06:11	23:12	Hourly
Saturday	06:06	23:06	06:11	23:06	Hourly
Sunday	10:06	22:06	09:12	19:12	Every 2 hours

6.4.10 As shown, there is a reasonable service on both weekdays and Saturdays with services running between Rhoose and Cardiff Central on an hourly basis between 6am and 11pm. The Sunday service is slightly reduced however with a far shorter operating window, particularly in the westbound direction, and a lower frequency (one service every two hours).

6.4.11 There is a 66 space car park to the south of the station, with around five disabled spaces. The car park is not charged. The station is unmanned and there is no waiting room, although there are ticket vending machines and bus-stop style shelters. Step free access is provided to and from the platforms and trains. There are no public conveniences at the station.[25]

6.4.12 A complementary bus service (the 905) connects the station with Cardiff Airport for the duration of the train service (see below). Whilst broadly fit for purpose given available assets, it is a slightly cumbersome means of accessing the airport from Cardiff or the west. Users have to interchange, switching form rail to bus which is not desirable, whilst the station is fairly rudimentary (and at the end of a residential street) compared to other rail-air interchanges across the UK.

6.4.13 The table below sets out ticket prices for trips between Rhoose and Cardiff Central / Bridgend:

Table 6.4: Ticket Prices: Rhoose – Cardiff Central / Bridgend

	Off-Peak Day Return	Anytime Day Return
Rhoose – Cardiff Central	£5.90	£7.00
Rhoose - Bridgend	N/A	£3.90

6.4.14 It is worth noting that, despite the designation of Rhoose as an airport station, only day return tickets can be purchased. If the return journey is one or more days after the outbound journey, two singles have to be purchased, making the cost of a return to £9.

Bus Network

6.4.15 The figure below shows the extent of the bus network in the Vale of Glamorgan:

[25] http://www.nationalrail.co.uk/stations/RIA/details.html

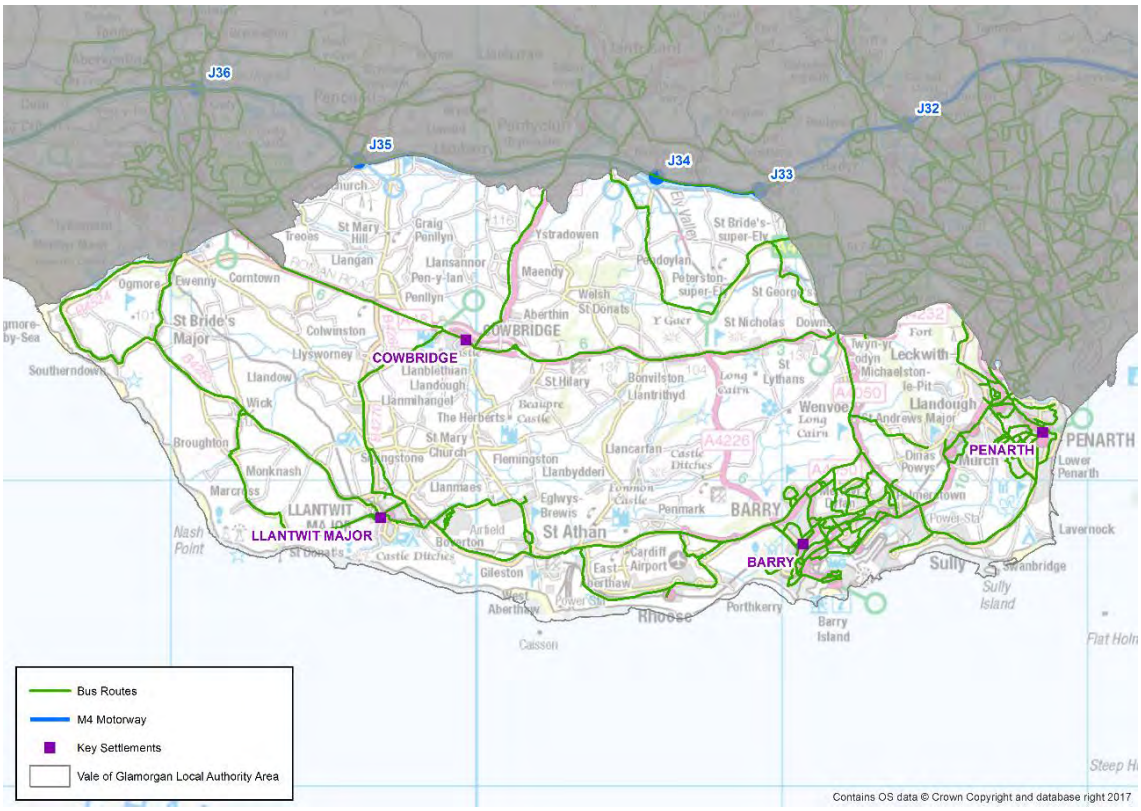


Figure 6.12: Extent of Bus Network in the Vale of Glamorgan

6.4.16 As shown, the bus routes are focussed on the key towns along the coast as well as Cowbridge in the centre. As may be expected given the rural nature of the County, there are few bus routes outside of the main A-roads and to the west of Barry, the main settlement in the VoG.

Cardiff Airport and St Athan EZ Buses

6.4.17 The table below details the bus network serving Cardiff International Airport and the EZ area.

Table 6.5: Bus Services to / from Cardiff Airport

Service Number	Origin Destination	Approximate Frequency	Nearest Stop	Fare (Adult Day Ticket)
T9 – Cardiff Airport Express Bus Service	Cardiff International Airport – Cardiff Central – Cardiff Bay	Every 20 minutes (summer); Every 30 minutes (winter)	Airport Passenger Terminal	Free on weekends; £5 single / £8 return on weekdays
905	Cardiff Airport - Rhoose Railway Station – MOD St Athan	Hourly	Airport Passenger Terminal / Camp, Cowbridge Road	£1 one way
X91	Cardiff – Llantwit Major (travelling through Rhoose)	Every 2 hours	Holiday Inn Express near Airport / East Camp, Cowbridge Road	£4.90
303	Bridgend – Barry (travelling through	Hourly	Holiday Inn Express near Airport / East	

Service Number	Origin Destination	Approximate Frequency	Nearest Stop	Fare (Adult Day Ticket)
	Llantwit Major, St Athan, Rhoose)		Camp, Cowbridge Road	

6.4.18 The T9 Airport Express Service is the key link between Cardiff Airport and Cardiff City Centre & Cardiff Bay. The service includes coach-style leather seating, climate control, WiFi, and extra luggage space, is free on weekends and costs £8 (Return) / £5 (Single) during the week, with the option to pay in Euros also available. The service operates up to every 20 minutes during the summer (April – October) and up to every 30 minutes during the winter (November – March). The end-to-end journey time is 40 minutes.

6.4.19 The figure below shows passengers numbers on the T9 Service for each year between 2014/15 and 2017/18.

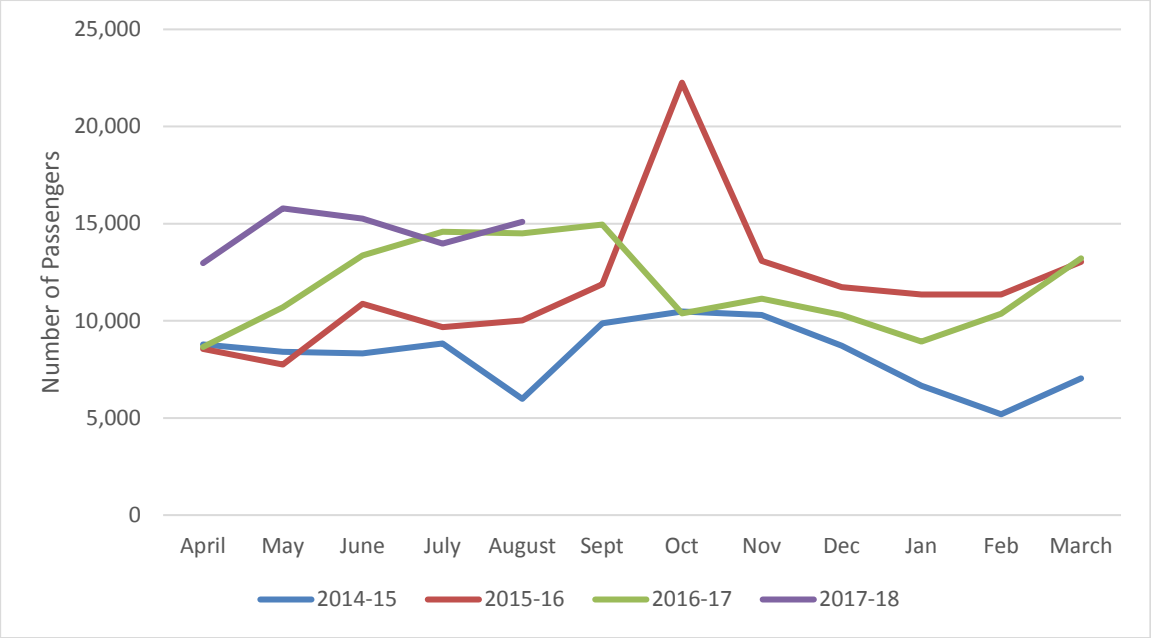


Figure 6.13: Number of Passengers on X91 Service 2014-15 – 2017-18 (Source: Welsh Government)

6.4.20 Overall, passenger numbers increased by 43% between 2014/15 and 2016/17 with data for the first five months of 2017/18 already tracking ahead of previous years suggesting that the total passenger figures for 2017/18 will be higher than 2016/17. The data suggests that passenger numbers fluctuate throughout the year although there is no clear monthly trend.

6.4.21 The remaining VoG bus services connect to both Cardiff Airport and St Athan. The 905 service is the express service between Cardiff Airport and Rhoose Railway Station which also connects to St Athan. The X91 links Cardiff to Llantwit Major via Rhoose and St Athan and Service 303 links Barry to Bridgend calling at Llantwit Major, St Athan and Rhoose. Both the X91 and 303 call close to the Airport but stop at the Holiday Inn Express rather than the passenger terminal. In all cases the nearest stop to the Enterprise Zone is East Camp which is just outside the entrance of the Business Park.

6.4.22 There are no bus services connecting direct to the airport from the north of the study area, with those wishing to travel to both Cardiff Airport and St Athan from areas such as Merthyr Tydfil, Blaenau Gwent and Rhondda Cynon Taf having to travel into Cardiff and interchange first.

Views of Consultees

6.4.23 As part of the consultation, we sought views on the suitability and problems associated with the current public transport network from VoG County Council, an EZ representative and the local authorities across the study area. As with the highway equivalent, the consultation findings will assist in contextualising the subsequent accessibility analysis.

Vale of Glamorgan County Council

- The Council noted that there is a perception that rail services from Barry towards Cardiff are seen to be capacity constrained, with relatively old rolling stock. Rail P&R sites, particularly Barry, are also evidenced to be at capacity.
- The rural (i.e. west of Barry) bus service is seen to be limited (as shown above). It was noted by the Council that improving north-south connectivity to the VoG could assist in supporting public transport services to from RCT and further afield.

Other Local Authorities

- There was a recurring theme throughout the consultation that the current public transport connections to the EZ and the VoG generally are not conducive to commuting. There are few direct routes (even from neighbouring RCT) and routes which do exist are seen to be circuitous and infrequent.
- Congestion is also seen to be a key issue impacting on bus services, particularly in the M4 corridor and arterial routes branching off from it. For example, RCT noted that one of its bus services from Tonypandy to Cardiff experiences a 24-minute timetable variation between peak and off-peak services. This is not seen to be conducive to travelling by public transport to Cardiff, let alone the VoG.
- From a rail perspective, all journeys to the VoG, except from Bridgend require interchange in Cardiff, which is seen to make this an unattractive option for accessing the Vale. This interchange issue is further compounded by capacity issues (despite service 'strengthening') and relatively long journey times considering the distance involved.

EZ Official

- It was noted that public transport access to the airport and EZ is limited, with the majority of people currently working at the EZ driving to work as public transport is not seen to provide a viable option. For example, it was explained that, if travelling from Rhondda Cynon Taf by public transport, it would be necessary to travel into Cardiff first and then take the train from Cardiff to the VoG which adds significantly to journey time and cost.
- In terms of access to the airport, it is noted that Rhoose provides an interchange but cannot be considered a substitute for a direct rail link (although it was acknowledged that there would need to be sufficient demand to build any case for investment in a rail link). In terms of leisure travellers, it was noted that the majority of people drive to the airport.

Traws Cymru

6.4.24 Traws Cymru, which is supported by the Welsh Government, operates long distance express bus routes in Wales, including the T9 airport service. They offered the following views in respect of public transport connectivity within the VoG:

- There are a number of pinch points experienced along the T9 route including Culverhouse Cross and Cardiff City Centre. Congestion within the city is often unpredictable but can occur at Callaghan Square and Lloyd George Avenue. Whilst it is noted that this does not affect patronage, it can cause dissatisfaction should there be delays when travelling to the airport.
- The T9 service depends on derived demand and can be affected by the number and frequency of flights from Cardiff Airport. Passenger numbers can also increase should there be a sport / music event being held, particularly in Cardiff.

Key Point: Whilst there is a reasonable public transport network connecting Cardiff City Centre with the Airport (and, to a much lesser extent, St Athan), connections from elsewhere in the Capital Region and areas to the west are limited, infrequent and generally require interchange. It is notable that those currently working in the EZ area generally travel to work by car. The lack of suitable public transport provision could act as an inhibitor to the growth of the EZ and the realisation of the wider sub-regional opportunity, particularly given low levels of car ownership in a number of parts of the study area.

6.5 Public Transport Connectivity Analysis

Journey Times

6.5.1 In order to quantify the existing public transport connectivity of the Vale of Glamorgan, a series of calculations were undertaken using TRACC accessibility software. TRACC calculates the quickest journey time by public transport between sets of defined locations within a defined time frame using public transport timetable data, road network information and a range of user-defined parameters.

6.5.2 The key origins used were the same as those used in the above Network Analyst calculation and the destinations were represented by Census output areas. Three calculations were undertaken in TRACC (covering the time periods 0500-0900, 0600-1000, and 0700-1100) and the results were used to calculate an average journey between each origin and destination pair.

6.5.3 Figures 6.14 – 6.17 show the public transport connectivity from Caerphilly, Pontypridd, Merthyr, and Port Talbot to the Vale of Glamorgan. Images showing the journey times from each of the other key origins are included in a standalone PowerPoint.

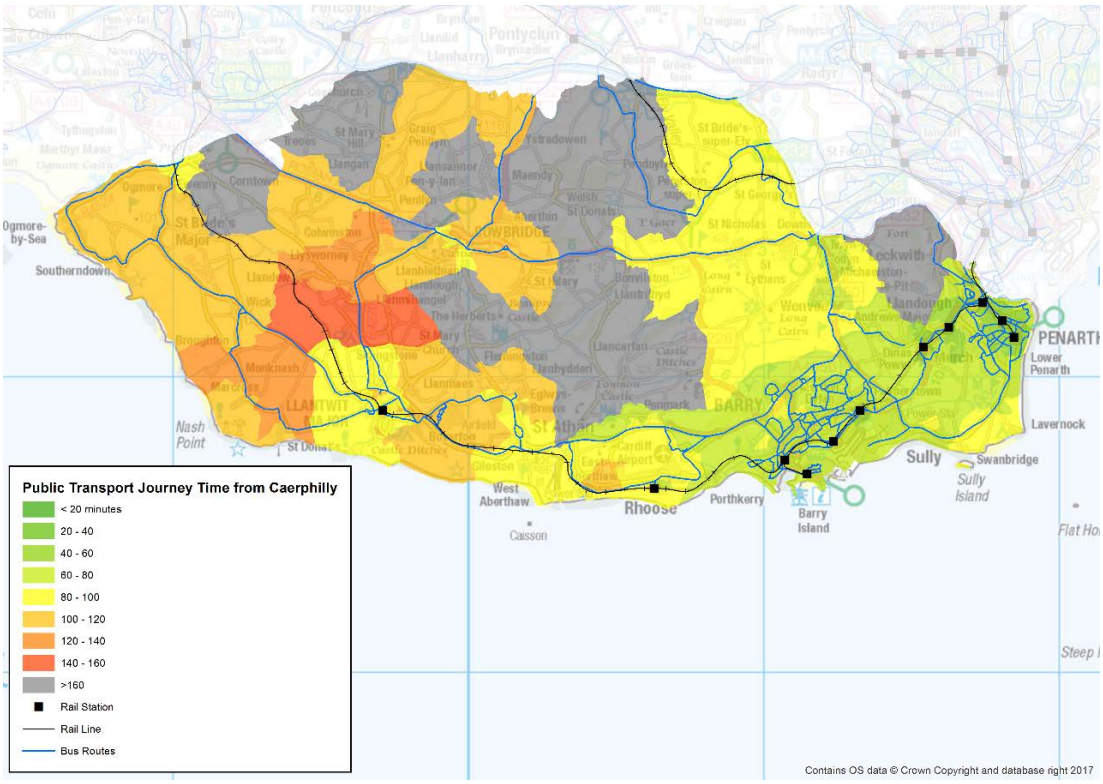


Figure 6.14: Public Transport Journey Time from Caerphilly to Vale of Glamorgan

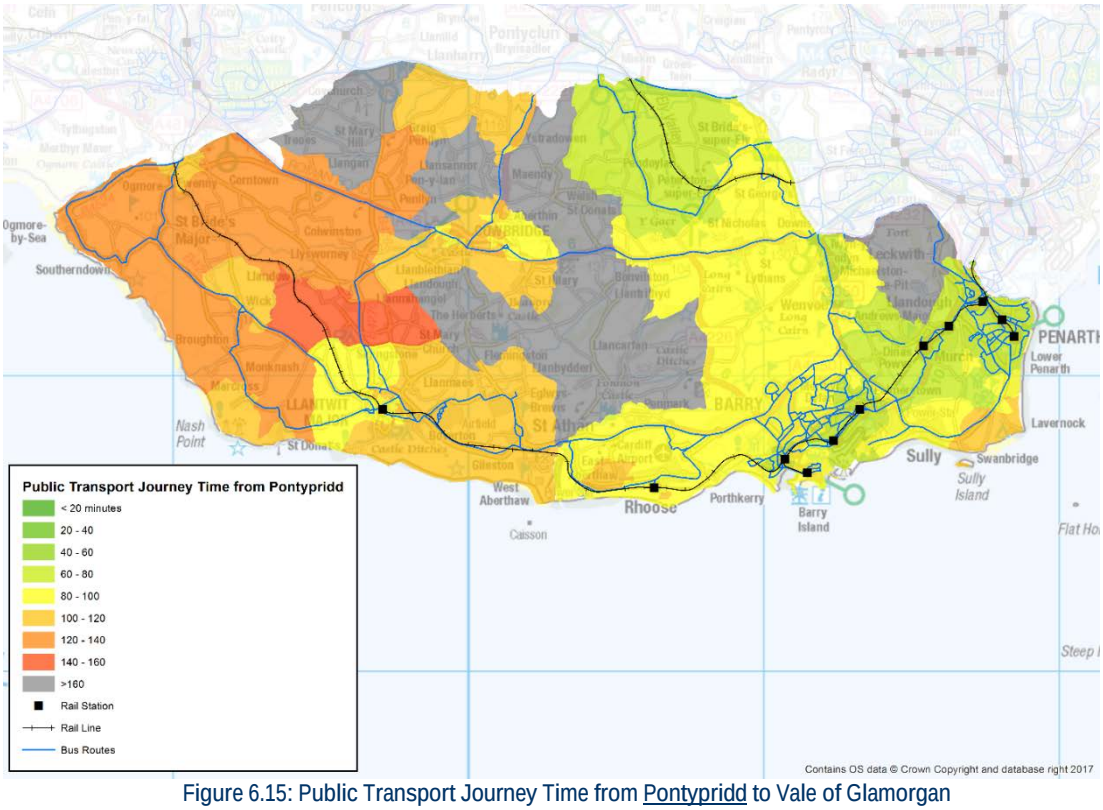


Figure 6.15: Public Transport Journey Time from Pontypridd to Vale of Glamorgan

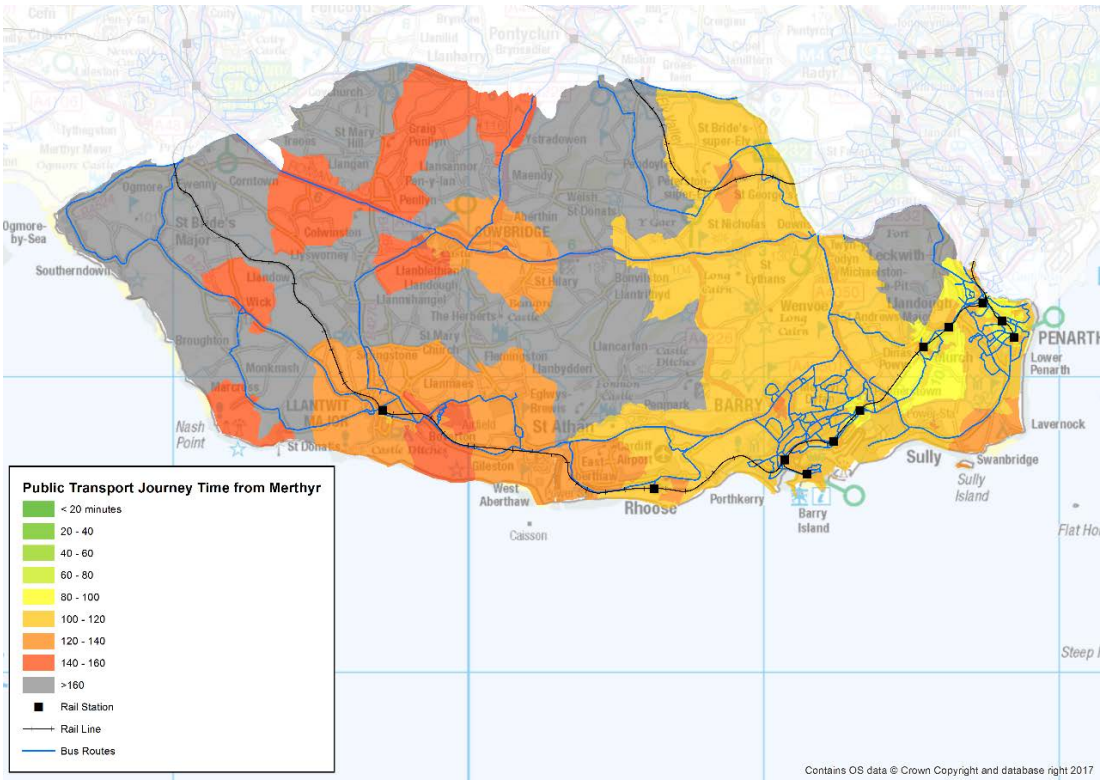


Figure 6.16: Public Transport Journey Time from Merthyr to Vale of Glamorgan

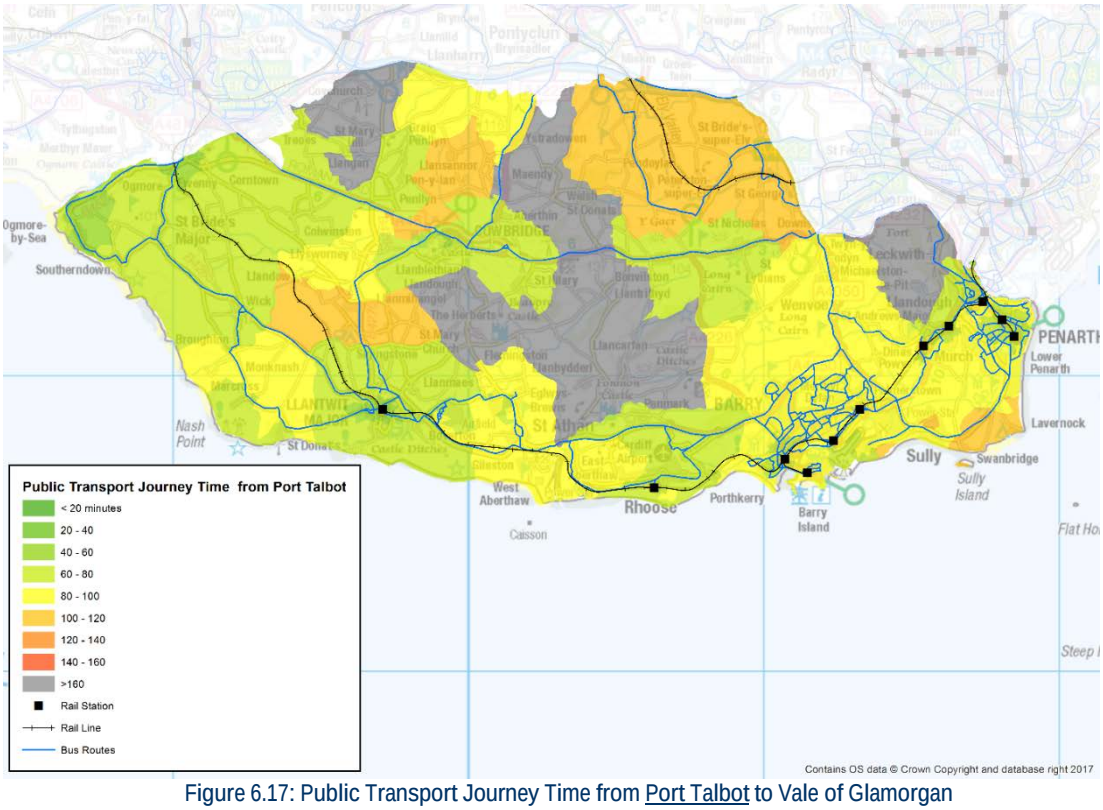


Figure 6.17: Public Transport Journey Time from Port Talbot to Vale of Glamorgan

Key Point: The main point from the above figures is that public transport journey times to the VoG generally and the EZ specifically are well in excess of those by car. Public transport is not currently a viable means of commuting to and from much of the VoG, representing a barrier to taking up employment opportunities there.

Cardiff Airport and St Athan Journey Time Catchments

6.5.4 As with the highway analysis above, a series of calculations was undertaken examining public transport journey times to both Cardiff Airport and the St Athan EZ sites from all origin locations across the study area. Origin locations were represented by Census lower super output areas and three calculations were undertaken (covering the time periods 0500-0900, 0600-1000, and 0700-1100) and an overall average calculated.

6.5.5 The figures below illustrate public transport journey times from the study area to Cardiff Airport and the St Athan EZ sites respectively.

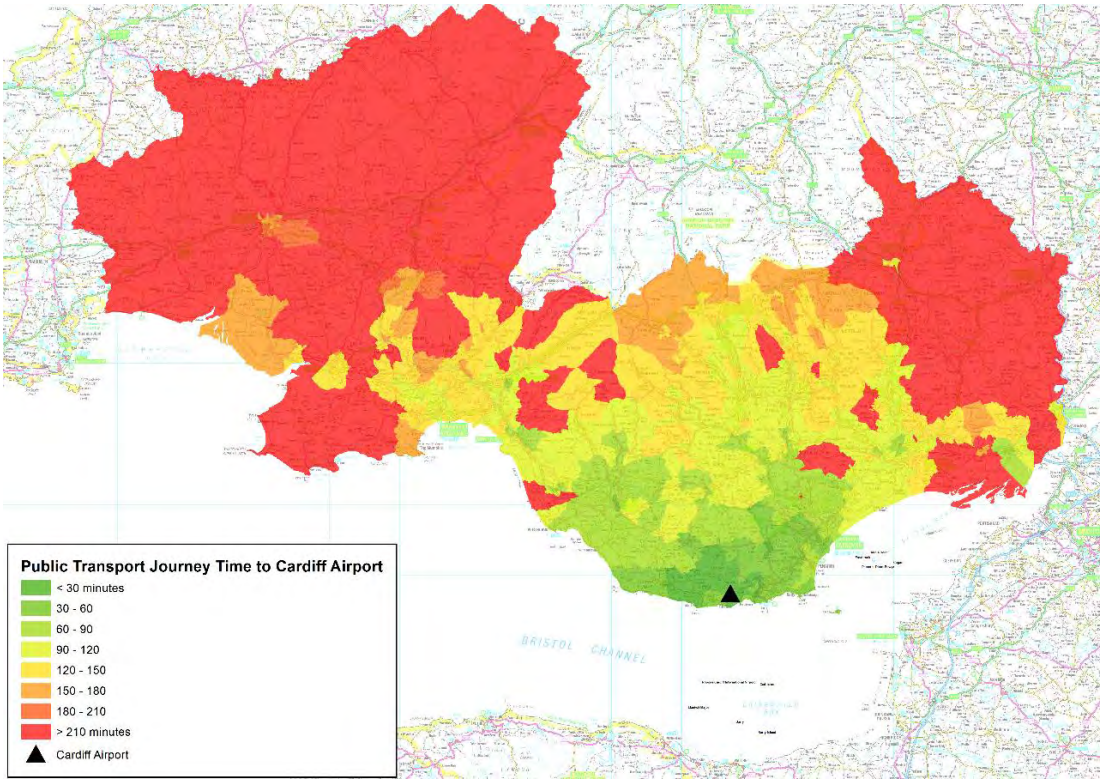


Figure 6.18: Public Transport Journey Time to Cardiff Airport

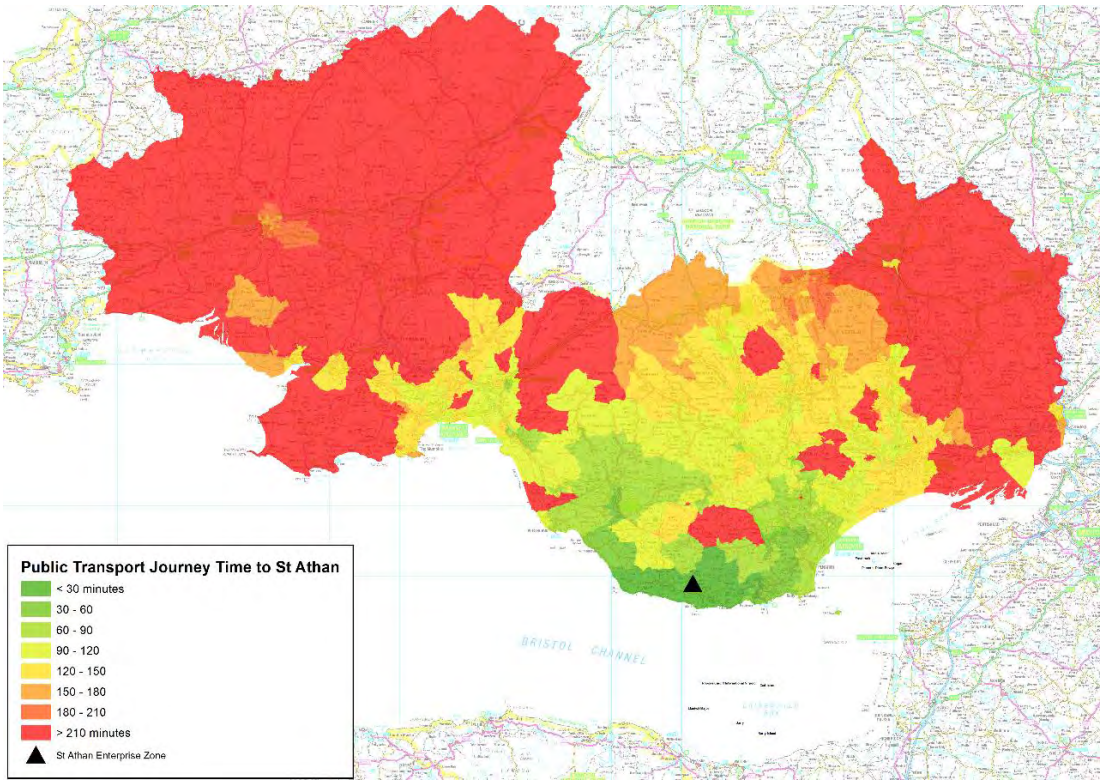


Figure 6.19: Public Transport Journey Time to St Athan

6.5.6 In order to put the above plots into context, the following table considers the working age population within various public transport time bands from each site – this is effectively a measure of **labour market accessibility** from the perspective of an employer.

Table 6.6: Working Age Population (16-74) in Ten Minute Public Transport Time Bands of Cardiff International Airport

Category	Working Age Population	Percentage
< 30 minutes	20,253	1.3%
30-60	129,897	8.6%
60-90	306,242	20.4%
90-120	453,465	30.2%
120-150	313,571	20.9%
150-180	89,216	5.9%
180-200	5,342	0.4%
>200 minutes	185,328	12.3%

Table 6.7: Working Age Population (16-74) in Ten Minute Public Transport Time Bands of St Athan Enterprise Zone

Category	Working Age Population	Percentage
< 30 minutes	26,914	1.8%
30-60	90,530	6.0%
60-90	277,844	18.5%
90-120	376,907	25.1%
120-150	377,030	25.1%
150-180	111,029	7.4%
180-200	16,707	1.1%
>200 minutes	191,809	14.6%

6.5.7 The key points from the above tables are as follows:

- **Cardiff International Airport:** Only 1.3% (20,235) of the study area population are within 30 minutes' public transport time of the airport, with 9.9% (150,150) being within one-hour public transport journey time.
- **St Athan EZ sites:** 1.8% (26,914) of the study area population are within 30 minutes' public transport journey time of the St Athan EZ sites, with 7.8% (117,444) being within one-hour drive time.

Key Point: The public transport journey time catchment of the Airport and St Athan EZ sites is extremely limited (9.9% and 7.8% respectively within one-hour public transport journey time) compared to the drive-based catchment.

6.6 Employment and Business-to-Business Accessibility

6.6.1 To provide an indication of access to employment across the study area more generally, a series of 'Hansen' Connectivity Indicators were developed. Hansen indicators provide a measure of the relative connectivity (based on travel times) of a set of 'origins' to all possible 'destinations' in a defined study area, weighted by a chosen destination 'criteria' (typically employment or population), with resulting high scores indicating good connectivity and low scores suggesting poorer connectivity. A decay-function is applied in the calculation such that opportunities at more distant locations (i.e. with a longer travel time) are valued' less than opportunities closer by, much in the fashion of a gravity model.

6.6.2 The weightings in this case were developed from analysis of National Travel Survey journey purpose by distance data. Each calculation produces a single value for each location reflecting its connectivity to all other locations (the so called 'Hansen' value). These values are unitless and are primarily intended to show the connectivity of locations relative to one another, rather than in any absolute sense.

6.6.3 Details of the journey time calculations undertaken in both Network Analyst (highway) and TRACC (public transport) to inform the development of the Hansen Indicators are provided in **Error! Reference source not found.** table below:

Table 6.8: Journey Time Calculations completed to Inform Hansen Indicators

Calculation	Origin	Destination	Start Time / Time Period
Network Analyst (Road)	MSOA[26]s in study area	MSOAs in study area	AM Period: 0630, 0700, 0730, 0800 Inter-peak Period: 1100, 1200, 1300, 1400
TRACC (Public Transport)	MSOAs in study area	MSOAs in study area	Am Period: 0500 - 0900 0600 - 1000 0700 – 1100 Inter-peak Period: 1000 - 1400 1100 - 1500 1200 - 1600

6.6.4 Using the results from the above journey time calculations, two connectivity indicators were then developed as follows:

[26] Medium Super Output Area (Census)

- **Access to Population within the study area** – the average AM journey times between each pair of origins & destinations was weighted by the number of people at the destination zones as the 'criteria'. The results for each origin-destination pair were then summed over all origin zones. This measure provides a representation of **business to people connectivity** in the study area i.e. the **potential labour market catchment** from each employment location.
- **Access to employment within the study area** - the average inter-peak journey times between each pair of origins & destinations was weighted by the number of jobs at the destination zones as the 'criteria'. The results for each origin-destination pair were then summed over all origin zones. This measure provides a representation **of business-to-business connectivity** in the study area.

6.6.5 Figures 6.20-6.23 show the Hansen indicators by highway and public transport modes respectively. All origins are split into 10 equal groups based on their Hansen score, representing best (dark green) to poorest (red) connectivity.

Labour Market Catchment

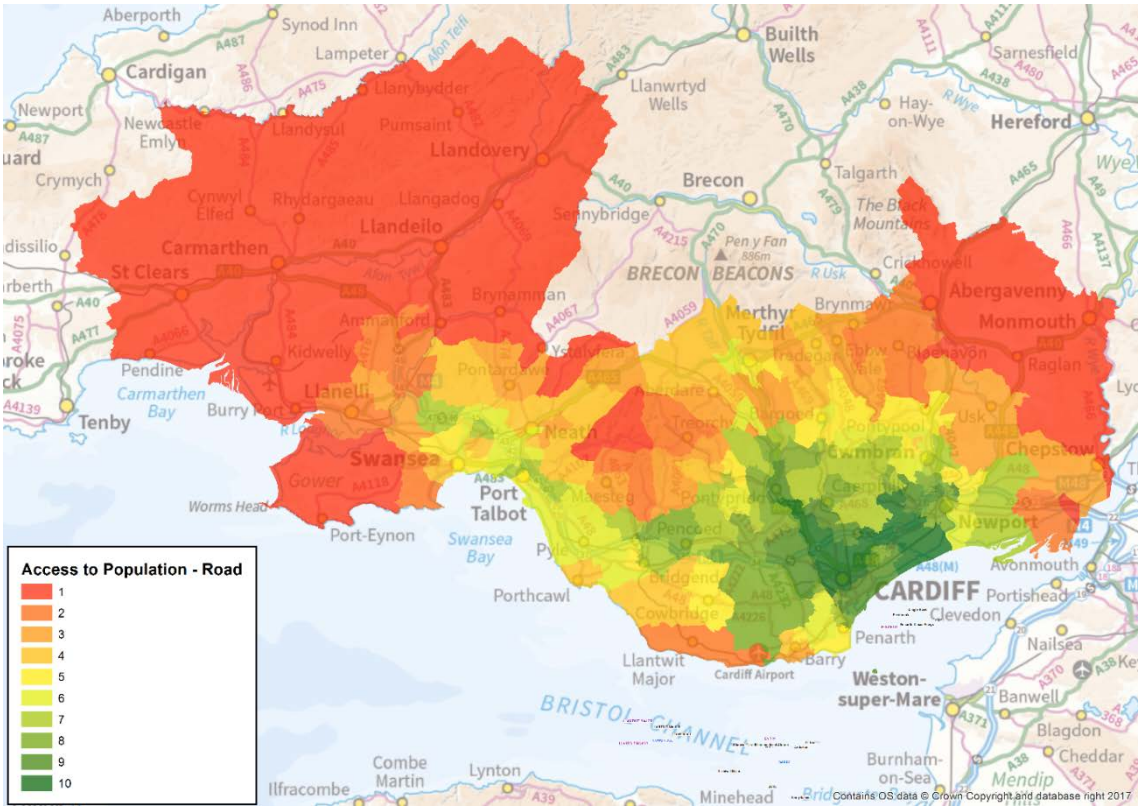


Figure 6.20: Access to Population / Labour within the Study Area (Highway)

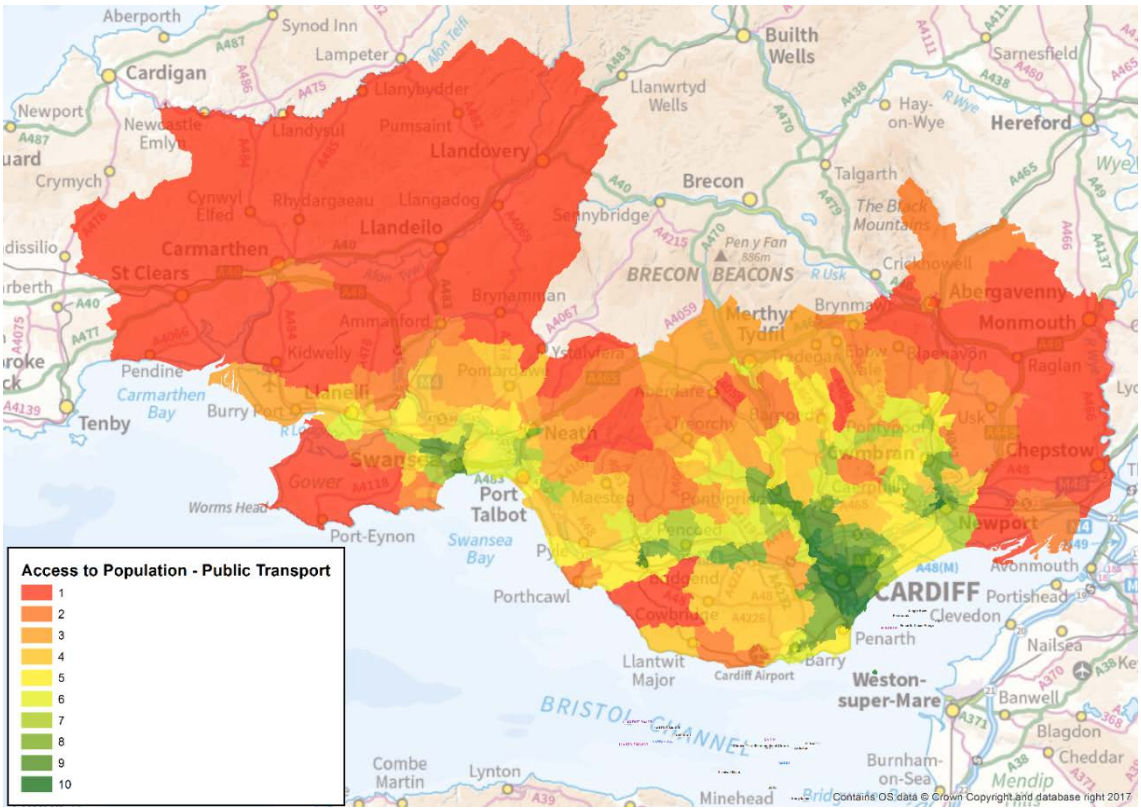


Figure 6.21: Access to Population / Labour within the Study Area (Public Transport)

6.6.6 The key point of note from the above maps is that, despite its geographic proximity to Cardiff City Centre, much of the VoG is mid-ranking in terms of its access to the wider labour market within the study area. In particular, the area around **the EZ is in the second lowest decile in terms of its labour market catchment by road and public transport**. This is a key finding - whilst the EZ offers a strategically important opportunity for South Wales as a whole, its labour market catchment is limited by its overall transport connectivity. This could present a challenge for businesses in the area recruiting and retaining staff and, perhaps more importantly, may negatively impact on the location decisions of prospective investors in the EZ.

6.6.7 The catchment analysis set out earlier in this chapter demonstrated that relatively modest journey time reductions (principally in terms of road travel) could significantly enhance the catchment of the EZ, and in itself makes a strong strategic case for investment.

Key Point: Whilst the EZ presents a regionally significant opportunity, the labour market catchment of the site is limited by the current transport infrastructure and services. If this issue is not resolved, it may have longer term implications for firms currently located in the VoG and in terms of the business location decisions of prospective investors.

Business-to-Business Accessibility

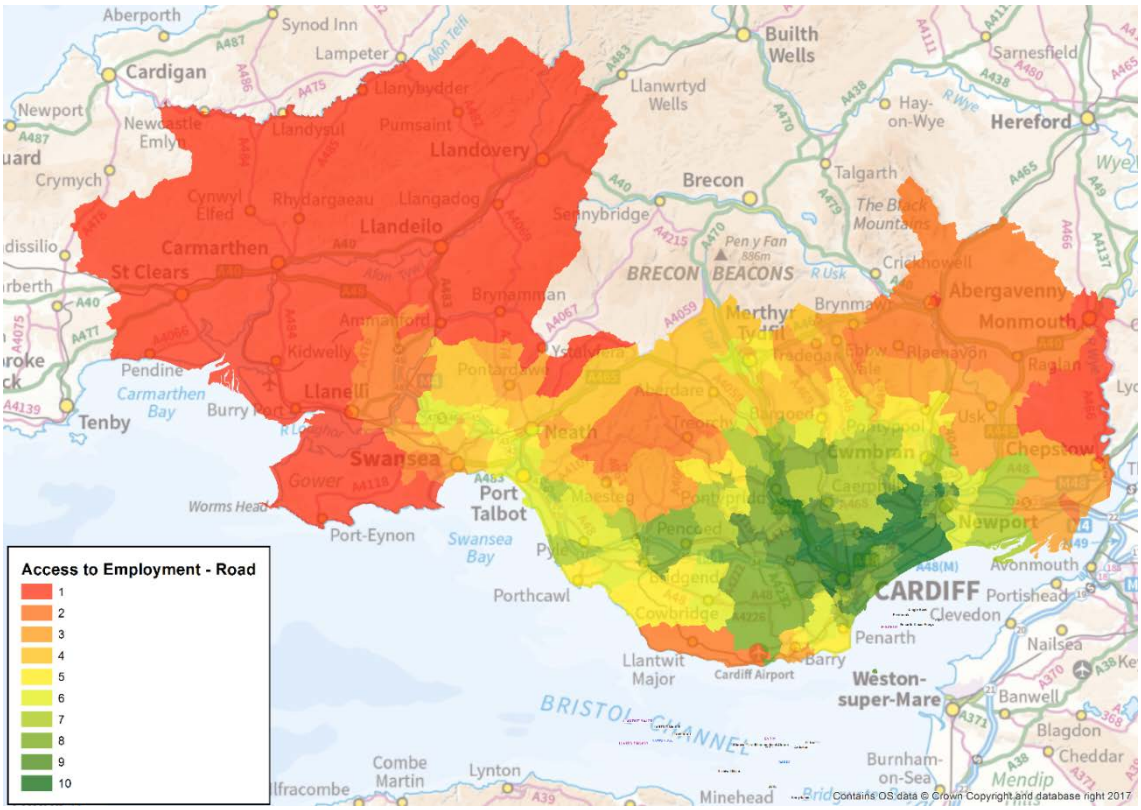


Figure 6.22: Access to Employment / Business in the Study Area (Highway)

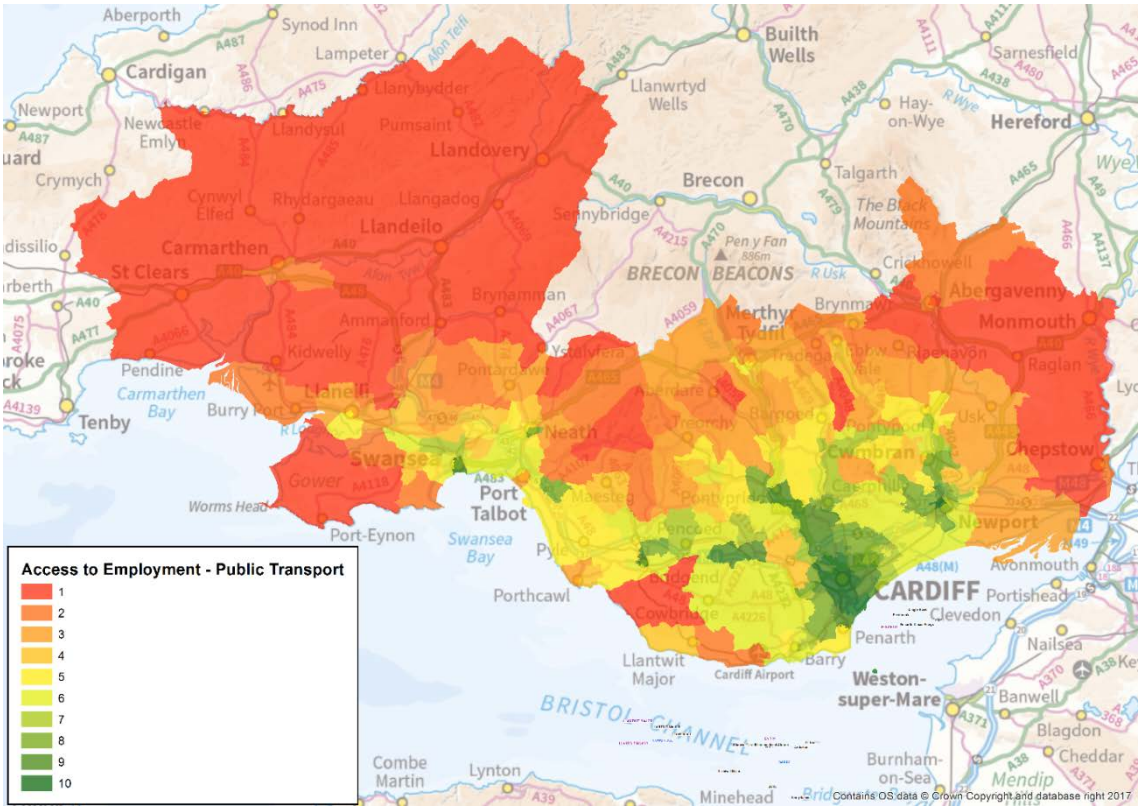


Figure 6.23: Access to Employment / Business in the Study Area (Public Transport)

6.6.8 The position of the VoG in relation to business-to-business accessibility is equally challenging. Whilst the eastern extent of the Vale is reasonably well-connected, the EZ is much less so.

Whilst business travel is generally less sensitive to journey times than commuter travel, it would nonetheless likely be an important consideration for any firm considering the VoG as an investment location.

6.6.9 The limited connectivity would also weaken the agglomeration benefits associated with the development of the aerospace cluster in the EZ by partially detaching it from the wider supply chain in South Wales.

Key Point: The limited labour market catchment of the EZ currently is compounded by comparatively poor business-to-business accessibility. This may have an impact on business decisions and would also weaken the agglomeration benefits associated with the development of an aerospace cluster in the Vale.

6.7 Freight Intensive Industries

6.7.1 The previous sections have focussed on personal and business-to-business accessibility. However, given the focus of the EZ on aerospace and manufacturing, it is also important to consider the movement of freight in the context of the transport network.

6.7.2 This section considers the distribution of freight intensive industries across the study area. Freight intensive industries includes agriculture, forestry and fishing; mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; water supply, sewerage waste management and remediation activities; construction; and transportation and storage as these sectors are most likely to be associated with the movement of goods.

6.7.3 The figure below shows the distribution of freight intensive industries in terms of the percentage of jobs in freight intensive industries at the MSOA level.

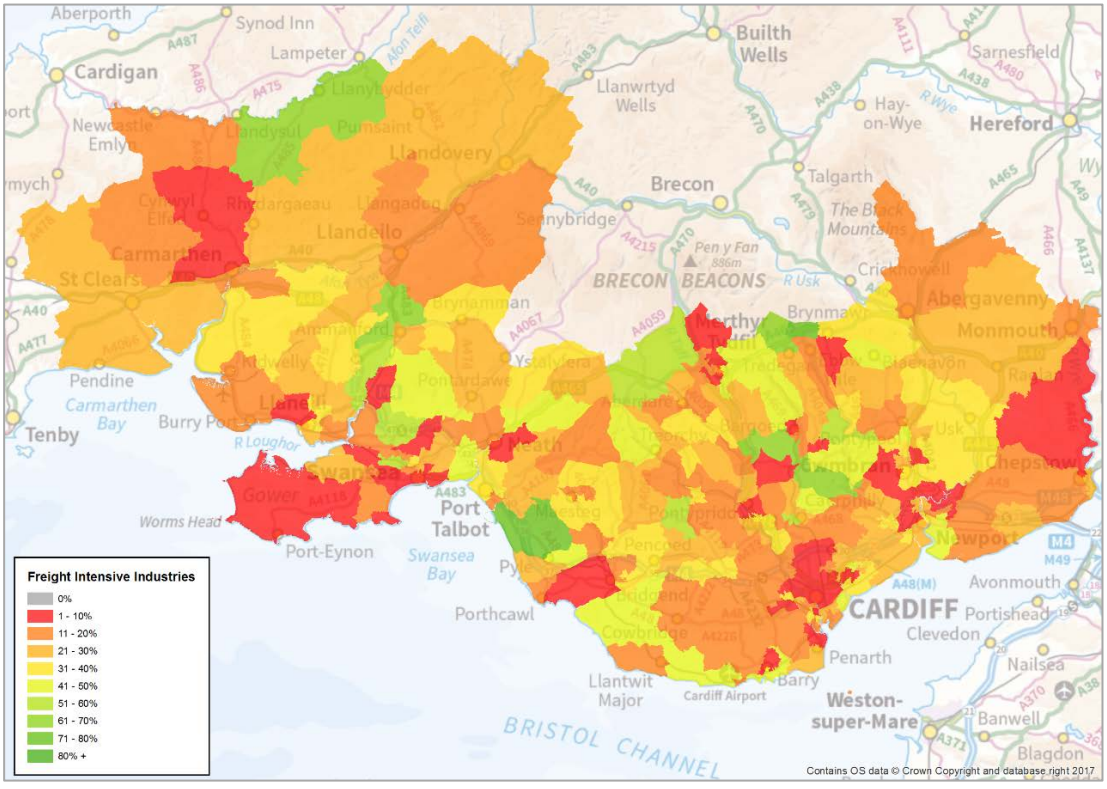


Figure 6.24: Percentage of Jobs in Freight intensive industries (MSOA level)

6.7.4 As would be expected, high concentrations of freight intensive industries are generally found outside urban areas in Blaenau Gwent, Neath Port Talbot, Caerphilly and Merthyr Tydfil. With freight intensive industries generally requiring greater areas of land, their location in the less built up areas is expected.

6.7.5 In terms of the Vale of Glamorgan, the area within which Cardiff Airport and St Athan Enterprise Zone are located has a relatively high proportion of jobs in freight intensive industries (42%). This includes transportation and storage, which makes up 15% of industry in the MSOA, and manufacturing and electricity, gas, steam and air conditioning supply which each account for 10% of industry in the MSOA. This level of freight intensity can be reasonably expected to grow as the EZ proposition is developed.

6.7.6 Despite the high freight intensity of the area, the existing transport network in the VoG is less than ideal for the movement of freight. Issues associated with journey time reliability, routing through broadly residential areas and a circuitous route to West Wales are negative from the perspective of the haulage and logistics industry, as well as the local population.

6.7.7 As part of this study, we consulted with a freight industry body to seek views on the connectivity of the VoG. The organisation noted that HGVs use the strategic routes into the VoG, departing the M4 at J33 and travelling via Culverhouse Cross and the A48. It was noted that this creates a challenging mix of strategic and local traffic, and it is argued that the congested road network serving the airport and wider EZ will act as a barrier to the growth of the site.

6.7.8 It was further noted that the routes within the are generally narrow and poorly aligned, particularly south of the A48. The ideal from the perspective of the consultee is accessing the EZ from J34, as it would allow freight to stay on the M4 longer, thus supporting improved strategic routing. However, current north-south connections do not support this.

Key Point: Freight access to and from the Vale of Glamorgan is sub-optimal, with issues associated with journey time reliability, routing through broadly residential areas and a circuitous route to West Wales. The area around Cardiff Airport has a high proportion of freight intensive industries, whilst the focus of the EZ on aerospace and manufacturing means that there is likely to be significant growth in freight movements from the VoG in the medium-term. The provision of appropriate freight routes to the M4 is a key consideration of any future improvements to VoG connectivity.

6.8 Wider Transport Developments in South Wales

6.8.1 Both WG and the South Wales City Regions recognise the importance of investment in transport infrastructure if wider economic aspirations are to be realised. Improvements in connectivity to / from the VoG would be realised within a wider context of almost unprecedented transport investment in the region. The key investments / schemes are set out below in order to provide a degree of context for the wider study.

South Wales Metro

6.8.2 The principal wider transport development in the study area is the South Wales Metro, an integral component of the Cardiff Capital Region City Deal, accounting for around three quarters of the total value of the deal. The Metro is a phased regional project intended to deliver higher public transport frequencies and enhanced inter-modal integration. It is envisaged that this will support economic development and regeneration within the Capital Region.[27]

6.8.3 Metro is anticipated to comprise some, or all, of these elements:

- an electrified rail system;
- integrated transport hubs;
- park-and-ride facilities;
- new (including some on-street) light rail and/or bus rapid transit routes;
- better integration of services across modes and operators; and

[27] http://gov.wales/docs/det/publications/160224-metro-information-brochure-en.pdf - p.8

- active travel interventions.

6.8.4 Enhanced services on the Valleys Lines are a core part of the project. This scope of Metro includes all of the lines in and north of Cardiff, the Vale of Glamorgan line, the Ebbw Valley and Maesteg branches, the Marches line to Abergavenny and the South Wales mainline. The Valley Lines Electrification (VLE) project has been integrated into the Metro programme as the Valley Lines Modernisation (VLM) scheme.[28]

6.8.5 Metro Phase 1 (£77million) has already made improvements, and significant progress has been made on the next phase of the project. Phase 2 is likely to be predominantly, although not exclusively, focussed on rail based measures.

6.8.6 The main point here is that Metro will enhance accessibility and reduce journey times across the Cardiff Capital Region, effectively bringing settlements in the region 'closer' together. Set against this backdrop, connectivity improvements to / from the VoG would complement the Metro initiatives, providing the widest possible labour market catchment for the EZ.

Key Point: Improving connectivity to and from the Vale of Glamorgan would be in keeping with the principles of the Metro proposals. When taken together, the Metro and VoG connectivity improvements would complement each other in supporting the regionally significant economic and employment opportunities offered by the EZ.

Other Transport Investment

6.8.7 Outwith the Metro proposals, there is an arguably once in a generation programme of transport investment ongoing in South Wales at present. This includes:

- Commitment to the construction of the £1 billion M4 Relief Road south of Newport, which will significantly reduce journey times and improve journey time reliability on the M4 Corridor.[29]
- Completion of the electrification of the South Wales Mainline between London Paddington and Cardiff Central (due to be completed by December 2018). The route will be served by new *Super Express* trains offering a 15% increase in capacity during the morning peak hours and a 15-minute end-to-end journey time reduction. The further electrification of the route to Swansea has been scrapped although the new rolling stock will be bi-mode, and thus can operate as diesel services between Cardiff and Swansea, offering a 19-minute end-to-end (i.e. Paddington to Swansea) journey time reduction.[30]
- The abolition of tolls on both Severn Crossings by the end of 2018 (following a small initial reduction in January 2018). It is estimated that this measure will save regular motorists around £1,400 per annum.[31]

6.8.8 The above listed programme of investment will improve connectivity across South Wales, but also with England (and in particular supporting the 'Great Western Cities', an initiative jointly launched in February 2015 by the cities of Cardiff, Newport and Bristol to improve cooperation across the area and to develop economic and environmental partnerships).

6.8.9 Improvements to inter-regional connectivity present an important opportunity for the Vale of Glamorgan and South Wales more generally, particularly in terms of attracting inward investment and skilled labour. However, transport is a **two-way street** – improving connectivity exposes an area to additional competition. The VoG, including the EZ and Cardiff Airport, will be more readily competing with a wider area (particularly South-West England) for investment, skilled labour and, in the context of the airport, routes and patronage. From this perspective, it is therefore essential that the local / regional connections to the VoG are of a high standard,

[28] http://gov.wales/docs/det/publications/160224-metro-information-brochure-en.pdf - p.10

[29] http://gov.wales/topics/transport/roads/schemes/m4/corridor-around-newport/?lang=en

[30] http://webarchive.nationalarchives.gov.uk/20100516005022/http://dft.gov.uk/pgr/rail/pi/rail-electrification.pdf

[31] http://www.bbc.co.uk/news/uk-wales-politics-41271239

making the EZ and the area more generally an attractive place to live, work and invest. There is otherwise a risk that the economic gravity of the area could shift to the east.

Key Point: There is a once in a generation programme of strategic transport investment taking place in South Wales at present. This presents a significant opportunity for the VoG, particularly the EZ, in terms of attracting investment and skilled labour. However, transport is a two-way street and the area will be competing for investment, skilled labour and, in the context of Cardiff Airport, routes & patronage, against a much wider geographic area. It is therefore essential that local / regional connections to and from the VoG are of a high standard if the economic potential of the EZ and wider area are to be realised.

7 The Future of Cardiff International Airport

7.1 Overview

7.1.1 The focus of this report has been on the case for improving connectivity to the VoG, with a view to supporting the strategic development and employment opportunities associated with the EZ. However, a by-product of any such measure would be improved surface access to Cardiff Airport, which could support route development, an increase in passenger numbers and the development of air freight. This chapter therefore considers the current market context in which the airport operates, the competitive positon of Cardiff International Airport and the emerging opportunities and threats.

7.2 Cardiff International Airport

7.2.1 Cardiff International Airport was nationalised by the Welsh Government in 2013, operating as an arms-length commercial business. The decision to nationalise the airport, taken against a backdrop of declining passenger numbers, reflected the strategic importance of the facility for Wales as a whole. As the owners of the airport, WG provides the policy and strategic framework under which it operates and develops. WG own the airport and plan to retain and grow it for the benefit of the people of Wales. There is seen to be an underlying need to safeguard and develop the airport for future generations.

7.3 Market Context

Air Traffic and Terminal Passenger Movements

7.3.1 In 2016, Cardiff Airport hosted 26,256 air traffic movements (ATMs) and circa 1.3 million terminal passengers, making it the 34th busiest airport in the UK by ATMs and the 20th busiest by terminal passengers[32]. This represents a circa 40% reduction in ATMs and 35% reduction in terminal passengers relative to volumes seen in the mid to late 2000s. However, this has not been a continuing decline as ATMs have been relatively consistent since 2012 and passenger volumes have seen 32% growth since 2014.

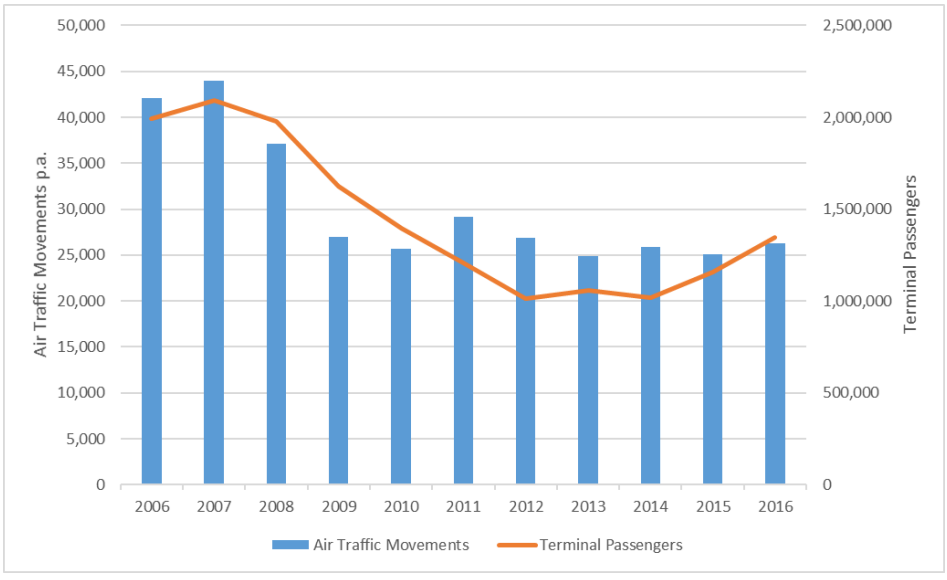


Figure 7.1: Annual Air Traffic Movements and Terminal Passengers at Cardiff Airport

7.3.2 Bristol Airport is located around 60 miles from Cardiff Airport, and so is also well used by Welsh residents and visitors to Wales. Bristol Airport similarly saw a substantial reduction in traffic

[32] This reflects the focus of Cardiff Airport on commercial flights in comparison to other some other UK airports (e.g. those accepting substantial volumes of military or flight school traffic).

volumes during the recession, but entered recovery earlier with passenger volumes increasing steadily since 2009.

Key Point: Whilst passenger numbers and air traffic movements at Cardiff have grown in recent years, the airport significantly lags equivalent UK regional airports on these metrics. The consultation strongly suggests that surface access to the airport is one of the principal causes of this.

Types of Air Traffic Movements

7.3.3 The figure below provides a full breakdown of ATMs by type at Cardiff Airport in 2016. Similar data is provided for Bristol Airport, the closest as the crow flies, for comparison.

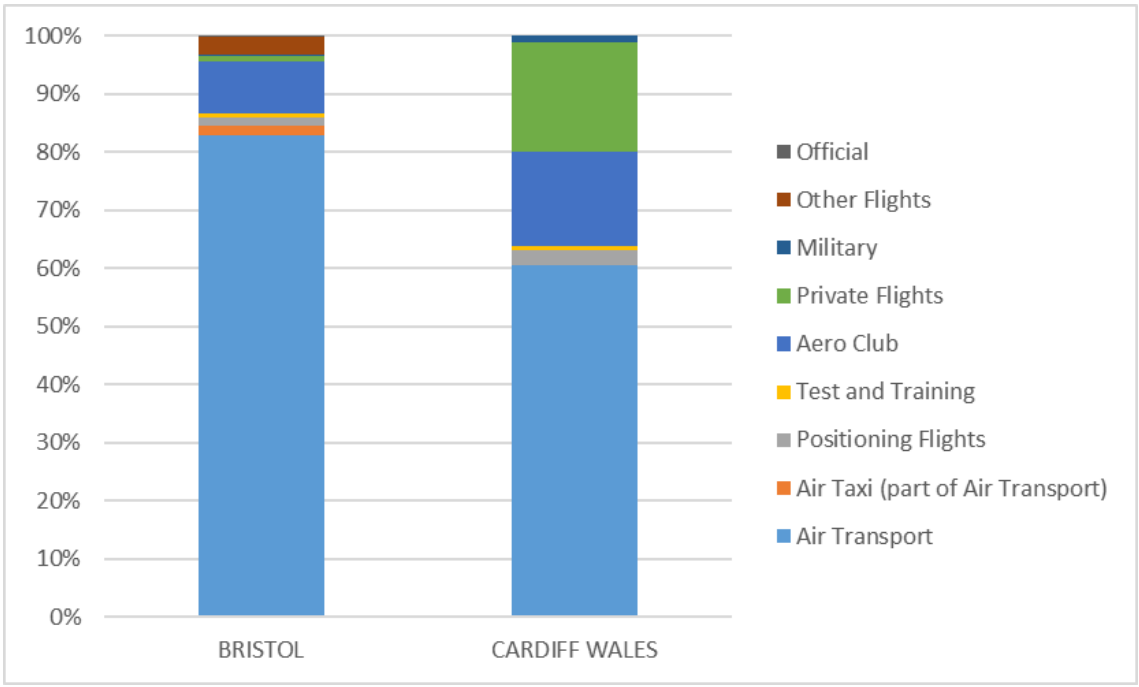


Figure 7.2: Breakdown of Air Traffic Movements

7.3.4 Some 61% of ATMs from Cardiff are classed as 'air transport' flights by the CAA. Air transport flights comprise all landings and take-offs of aircraft transporting passengers, mail and cargo on a commercial basis.

7.3.5 Cardiff Airport also supports high proportions of Private Flights and Aero-Club movements, and is home to two private aviation companies (Dragonfly and Signature Flight Support) and the Aeros Flying School. The Aeros Flying School has 45 planes and, also accommodates visiting aircraft.

7.3.6 There are no dedicated air freight flights from the airport at present.

7.3.7 In 2016, all air traffic movements from Cardiff Airport were undertaken by fixed wing aircraft.

Key Operational Facilities

7.3.8 Cardiff Airport has the following facilities:

- The runway length is 2,392 metres, which is capable of accommodating any aircraft currently in service. The runway is open 24 hours a day, seven days a week.
- The Instrument Landing System (ILS), a critical navigational aid for landing aircraft, is Category 3, which is slightly restricted during periods of poor visibility. However, the ILS is

due for an upgrade in 2019/20, and it is likely that this will be to the highest performance Category 1 system.

- There are no slot constraints at the airport currently. Our consultation with Cardiff Airport suggested that there may be a need for some remodelling if passenger numbers increase significantly.
- The terminal building is seen to be the only medium-term constraint in growth. Built in the 1960s, the capacity of the building would cap out at around 3 million passengers (roughly double what the airport currently handles), although some investment would be required at 2-2.5 million passenger mark.

Routes and Airlines

7.3.9 Eighteen commercial airlines presently operate out of Cardiff Airport, serving a variety of destinations in the UK and Europe, in addition to Florida in the USA.[33] FlyBe is the largest airline by air traffic movements. The table below indicates the number of airports served by flights from Cardiff Airport and the frequency of those flights during the summer months.

Table 7.1: Summary of Flight Destinations from Cardiff Airport[34]

Country	No. Destinations	No. Flights per Week (Summer)	
UK	9	62[35]	Year round
Spain	11	37	Summer only
		21	Year round
Netherlands	1	20	Year round
Ireland	2	16	Year round
Greece	6	9	Summer only
Italy	3	8	Year round
Portugal	1	7	Year round
		1	Summer only
France	1	7	Year round
Germany	3	7	Year round
Bulgaria	1	3	Summer only
Cyprus	2	3	Summer only
Turkey	1	3	Summer only
Switzerland	1	1	Year round
USA	1	1	Summer only
Total	**43**	**206**	**-**

7.3.10 Like many regional airports in the UK, Cardiff benefits from connections with European airport hubs such as Dublin, Paris and Amsterdam, facilitating long haul travel.

7.3.11 Bristol Airport is considerably larger and provides direct flights to 9 regional airports in the UK, 105 airports in Europe and 7 further airports across the rest of the world.

[33] https://www.cardiff-airport.com/uploads/Summer_2017%20Timetable%20for%20WEB.PDF

[34] https://www.cardiff-airport.com/uploads/Summer_2017%20Timetable%20for%20WEB.PDF

[35] Not all flights operate for full duration of summer period.

Prospective New Routes

7.3.12 In September, Qatar Airways announced that it would operate a direct daily service from Cardiff to Doha starting in May 2018. This new connection was described in the consultation as a 'game changer', as it will facilitate onward connections to South East Asia, Australia and New Zealand. In addition, the aircraft being used for the flight, a Boeing 787 Dreamliner, is capable of carrying around 20 tonnes of cargo and could therefore assist in creating a new freight industry at the airport, focussed on high value and time sensitive freight.

7.3.13 From a short-haul perspective, there are aspirations to enhance domestic connectivity, better connecting Cardiff with other key airport across the UK. In the context of long-haul, the immediate aspiration is to secure a connection to the east coast of the United States. Coupled with the connections to European hubs and Doha, this would ensure that Cardiff is connected to an extensive range of global destinations.

7.3.14 Flybe withdrew their Cardiff to London City service at the end of October 2017. In their statement, FlyBe noted that the service was not commercially viable under the current Air Passenger Duty regime, but would consider re-introducing flights to London City in the future if tax powers were devolved and rates adjusted.

7.4 Competition with Other Airports

7.4.1 A variety of airports are accessible from South Wales, with Cardiff, Bristol, Birmingham and the principal London terminals all located within around three hours' drive of Cardiff. Local residents therefore have a good selection of travel options, although Cardiff's proximity is likely to be a significant attractor.

7.4.2 The airport explained that, for short-haul, their catchment is the Cardiff, Swansea and part of the Newport postcode areas, whilst for long-haul this extends to Gloucestershire, Somerset, Devon and Cornwall. However, it was explained that, in the current short-haul market, there is significant leakage from these postcode areas. It was noted that there is a prevailing and hard to tackle perception that Cardiff Airport is 'awkward to get to' (irrespective of the reality). Addressing the surface connectivity issue is seen as essential in addressing this perception.

7.4.3 In order to evidence the travel choices of local residents, we have undertaken a review of the results from the CAA Passenger Survey 2015. As part of this research, travellers were surveyed at departure gates at each of the above airports, and asked questions about themselves, the journey they were making and their reasons for travel from that airport. All passengers are asked for a home postcode (although not all provided it), which allows us to 1) understand the catchment of Cardiff Airport and 2) analyse the extent of use of other airports by those living in the study area.

7.4.4 In the sections below, the findings of this analysis of outputs from the CAA Passenger Survey 2015 are discussed. In all cases, we have only considered passengers who are beginning their journey at the noted airport, omitting those who have arrived at the airport from another flight connection (although these are relatively few in number).

CAA Data Request

7.4.5 This section briefly establishes the parameters of the CAA data available to the study. We requested detailed survey responses to the CAA Passenger Survey 2015 for all passengers departing Cardiff and Bristol Airports, in addition to passengers departing from Birmingham and Gatwick airports who have a home in Blaenau Gwent, Bridgend, Caerphilly, Cardiff, Carmarthenshire, Merthyr Tydfil, Neath Port Talbot, Newport, RCT, Swansea, Torfaen or Vale of Glamorgan. In both cases, we stipulated that we were only interested in passengers beginning their air journey at the survey airport, i.e. they were not simply transferring between planes at the survey airport. This data request yielded records for circa 17,500 passenger records. We requested data on the passengers' home and surface origins, travel purpose,

travel destination, ticket type, group size, airport access mode and reasons for selecting airport used.

7.4.6 The CAA stratifies the survey design by carrier, route and quarter and seeks to survey as wide a range of flight numbers and routes as possible during each quarter. Nevertheless, it is not possible to survey every flight number and also it is unlikely that the proportion of survey responses gained for each flight number or route correspond with the true number of passengers carried on that same flight number or route over the quarter. As such, the CAA applies a weighting to each response, such that when the 'population' weighting values sum to the true number of passengers carried. This weighting is based on the carrier, flight number and sector for scheduled flights.

Users of Cardiff Airport

7.4.7 This section analyses the responses of all passengers who were surveyed at the departure gates at Cardiff and Bristol (as the main short haul competitor) airports, regardless of their surface origin.

7.4.8 The CAA calculates a weighting to be attributed to each passenger response, such that, when combined, the weighted responses total to the number of passengers which used a given route from the survey airport during that year. We have used the weighted passenger numbers in the following sections since we are considering all travel through Cardiff and Bristol Airports.

Travel Destinations

7.4.9 Although Cardiff Airport serves some long-haul destinations, many of these services have a limited frequency and operate only during peak season. CAA Data has been analysed to compare the destinations of those travelling from Cardiff (CWL) and Bristol (BRS) Airports. Destination countries were categorised as falling into one of the following five country types, as defined by the DfT's UK Aviation Forecasts 2017:

- Domestic;
- Western Europe;
- OECD (those OECD countries outside of Western Europe);
- Newly Industrialised Countries (NIC); and
- Less Developed Countries (LDC).

7.4.10 Trips to domestic destinations and those in Western Europe can largely be considered short-haul, and those to OECD, NIC and LDC country types are typically long haul.

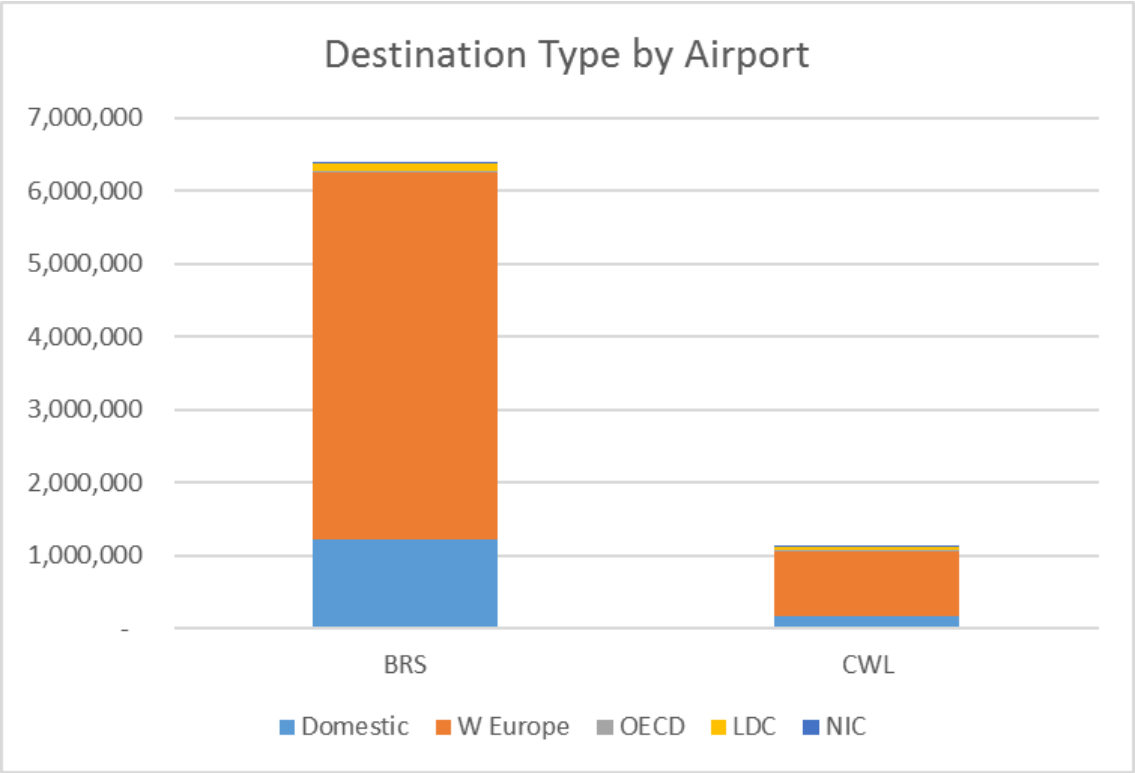


Figure 7.3: Trip Destination Breakdown by Airport

7.4.11 Although Cardiff carries a substantially smaller volume of traffic, it carries a slightly greater proportion of trips to OECD, NIC and LDC countries.

Key Point: Passenger movements through Cardiff Airport are dominated by short-haul trips to Western Europe, which is unsurprising given that FlyBe is the predominant scheduled airline operating from Cardiff, whilst there is also a well-established charter / package holiday flight market. It is however worth noting that Cardiff has a foothold in the long-haul market, with some 10% of trips to long-haul destinations (although a proportion of these are to North Africa, which may be considered short-haul and is also a market which has declined since the survey), whilst the equivalent figure at Bristol is less than 5%.

Travel Purpose

7.4.12 The data indicates that Cardiff and Bristol Airports carried similar proportions of business and leisure passengers in 2015.

Table 7.2: Journey Purpose Split by Airport

Airport	Business	Leisure
Cardiff	16%	84%
Bristol	13%	87%

Airport Catchment

7.4.13 Where postcode data was available, the surface origins of passengers using both Cardiff and Bristol Airports were mapped and this is shown in the figures below.

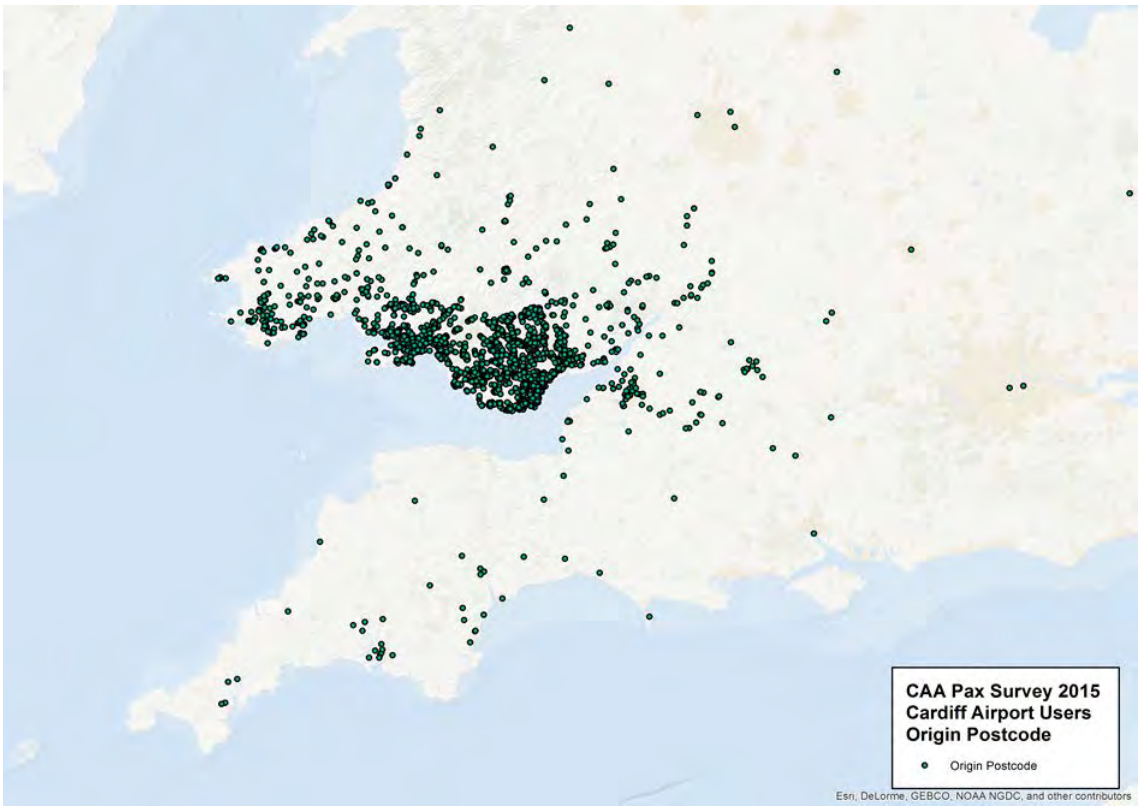


Figure 7.4: Passenger Surface Origins – Cardiff Airport

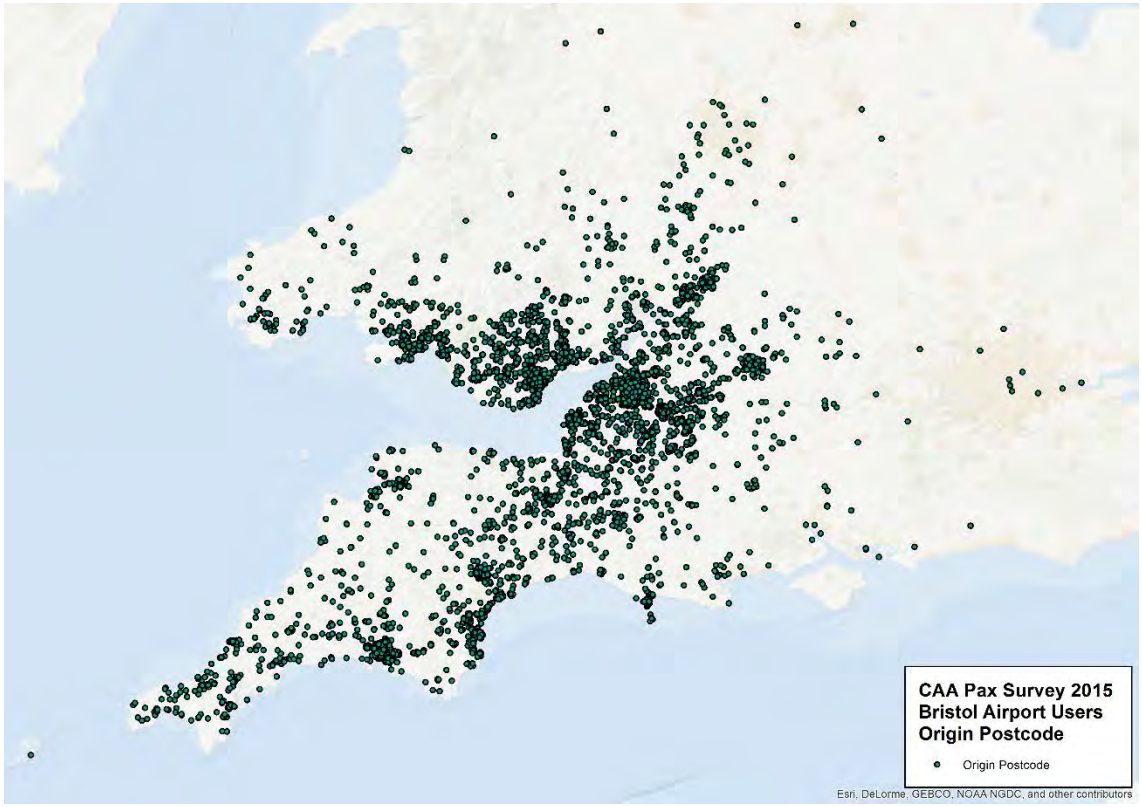


Figure 7.5: Passenger Surface Origins – Bristol Airport

7.4.14 It can be seen that Bristol Airport has a much wider passenger catchment area than Cardiff Airport, reaching further north towards Birmingham and south across Somerset, Devon and Cornwall. More notably, Bristol Airport draws a significant number of passengers from South Wales, particularly within the Cardiff Capital Region and Swansea Bay City Region. Indeed, it

is notable that a large number of users of Bristol Airport actually live much closer to Cardiff Airport, but use the former for reasons explained later in this chapter.

Short Haul Travel (Domestic and Western Europe)

7.4.15 The table below shows the surface origins or destinations of short haul travellers using Cardiff and Bristol airports. So for example the data suggests that there were 642,275 air journeys which began in the Cardiff Council area in 2015 via either Cardiff or Bristol airports – of these 49% used Cardiff Airport and 51% used Bristol Airport.

Table 7.3: Short Haul Passenger Surface Origins, 2015

Local Authority	Cardiff + Bristol Airport Terminal Passengers	% Cardiff	% Bristol
Wales			
Cardiff	642,275	49%	51%
Swansea	260,303	43%	57%
Newport	167,824	27%	73%
Rhondda Cynon Taff	153,010	58%	42%
Caerphilly	142,698	37%	63%
Vale of Glamorgan	132,035	78%	22%
Carmarthenshire	105,806	49%	51%
Neath Port Talbot	98,275	35%	65%
Pembrokeshire	82,704	31%	69%
Ceredigion	79,146	67%	33%
Monmouthshire	78,271	16%	84%
Bridgend	75,690	37%	63%
Blaenau Gwent	65,222	33%	67%
Torfaen	55,002	31%	69%
Powys	35,189	27%	73%
Merthyr Tydfil	31,561	68%	32%
England			
Bristol	1,538,198	1%	99%
Somerset	1,162,299	0%	100%
Devon	801,284	1%	99%
Gloucestershire	454,857	1%	99%
Wiltshire	388,435	2%	98%
Cornwall	286,692	1%	99%
Dorset	124,399	0%	100%
Worcestershire	56,964	1%	99%
Herefordshire	47,168	8%	92%
Oxfordshire	27,110	0%	100%
Berkshire	25,792	0%	100%
West Midlands	16,460	2%	98%
Hampshire County	14,493	5%	95%

Local Authority	Cardiff + Bristol Airport Terminal Passengers	% Cardiff	% Bristol
Greater London	13,199	10%	90%
West Sussex County	10,226	0%	100%
Other (LA's generating <10000 pax pa at Cardiff and Bristol)	64,809	8%	92%
Total	**7,237,395**	**14%**	**86%**

7.4.16 These figures clearly show that there is a large draw to Bristol Airport from Wales but very little movement in the other direction. For example, 51% of air travel from the Cardiff Council area (via Cardiff or Bristol Airports) goes via Bristol Airport, whilst only 1% of travel from Bristol goes via Cardiff Airport. In terms of the Welsh local authority areas, all except RCT, Vale of Glamorgan, Ceredigion and Merthyr see more air travel via Bristol than Cardiff. This suggests that there is a significant potential market for Cardiff Airport – if all of the above Wales based trips were to transfer to Cardiff Airport, this would represent an additional 1.2 million terminal passengers.

Catchment – Long Haul Travel (OECD, NIC & LDC)

7.4.17 The table below summarises the surface origins of travellers using both Cardiff and Bristol airports.

Table 7.4: Long Haul Passenger Surface Origins

Local Authority	Cardiff + Bristol Airport Terminal Passengers	Cardiff	Bristol
Wales			
Cardiff	40,319	82%	18%
The Vale of Glamorgan	12,657	93%	7%
Swansea	9,751	91%	9%
Rhondda, Cynon, Taff	7,462	81%	19%
Carmarthenshire	7,316	57%	43%
Caerphilly	4,927	67%	33%
Pembrokeshire	4,612	100%	0%
Newport	4,259	76%	24%
Ceredigion	3,177	100%	0%
Neath Port Talbot	2,612	82%	18%
Blaenau Gwent	2,260	100%	0%
Bridgend	2,187	20%	80%
Monmouthshire	697	65%	35%
Torfaen	497	100%	0%
Merthyr Tydfil	443	100%	0%
England	-	-	-
Bristol	43,480	1%	99%
Somerset	30,283	0%	100%
Devon	20,846	0%	100%
Gloucestershire	14,662	4%	96%

Local Authority	Cardiff + Bristol Airport Terminal Passengers	Cardiff	Bristol
Cornwall	6,492	2%	98%
Wiltshire	6,111	2%	98.0%
West Midlands	1,884	0%	100%
Greater Manchester	584	0%	100%
Oxfordshire	584	0%	100%
Worcestershire	584	0%	100%
Hampshire	463	100%	0%
Herefordshire	105	100%	0%
Berkshire	84	100%	0%
Essex	22	100%	0%
Staffordshire County	22	100%	0%
Other	0	-	-
Total	**229,386**	**62%**	**38%**

7.4.18 Although the sample numbers are much smaller, the evidence here suggests less leakage from Wales when long haul is considered. Whilst 55% of Wales based Cardiff/Bristol short haul air travel goes via Bristol, for long haul only 18% is 'leaked' in this way.

Airport Access

7.4.19 Consultation identified that there is a perception that Cardiff Airport is difficult to access. The figure below compares the last mode of transportation used to access Cardiff (CWL) and Bristol (BRS) Airports.

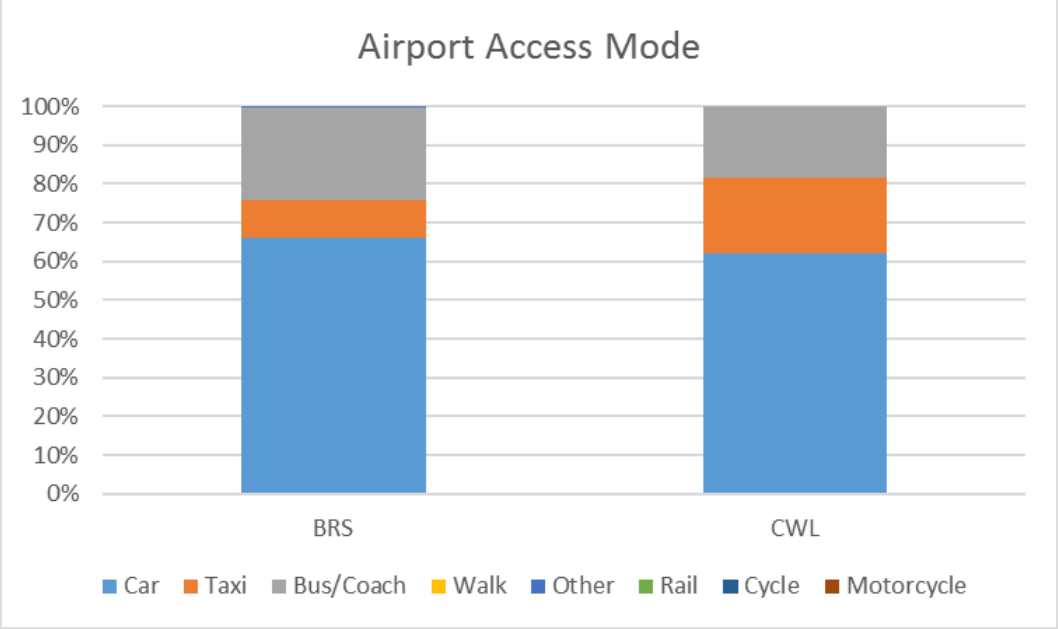


Figure 7.6: Last Mode of Travel Used to Access Airport

7.4.20 Similar proportions of passengers use the car, but a smaller proportion of passengers use the bus to access Cardiff Airport (which may include the rail-bus interchange at Rhoose). Correspondingly a greater proportion of Cardiff passengers travel by taxi.

Reasons for using Cardiff Airport

7.4.21 The survey also asks passengers the main reason why they chose to use their departure airport. The figure below contrasts the responses from travellers using Cardiff (CWL) and Bristol (BRS) Airports respectively.

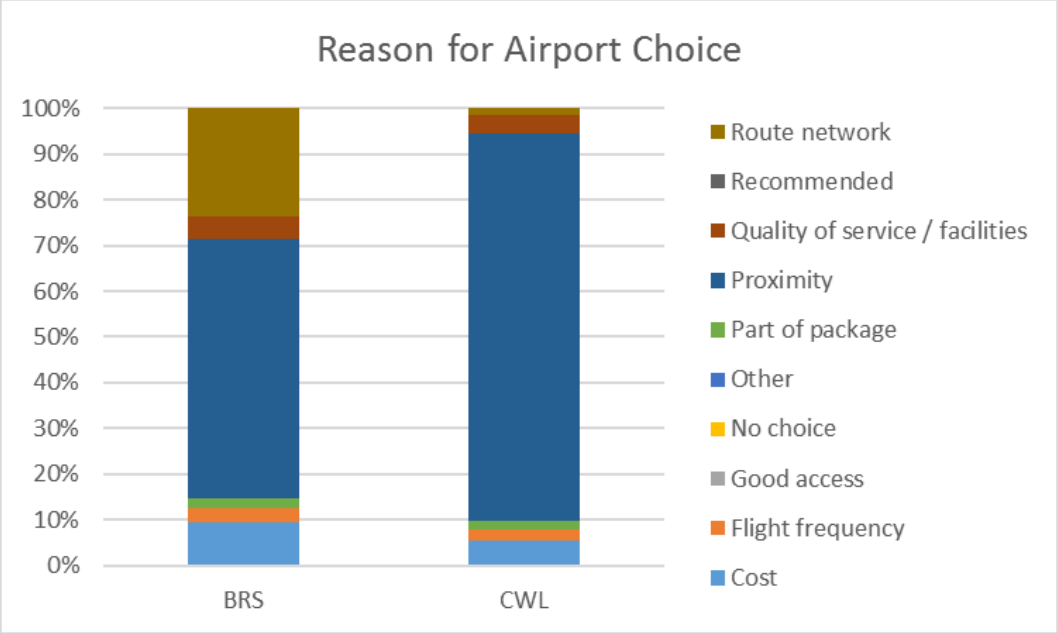


Figure 7.7 :Reasons for using Cardiff and Bristol Airports

7.4.22 85% of Cardiff Airport passengers indicated that they chose Cardiff Airport on account of its proximity to either their origin or destination (in probability the former). A far greater proportion (24% vs. 1%) chose Bristol Airport on account of its route network and flight connections, suggesting that an improved route network may increase the attractiveness of Cardiff Airport. The airports performed similarly in terms of the majority of other metrics, although Bristol appears to be chosen more frequently on the basis of cost.

Key Point: The data suggests that the overwhelming reason for passengers choosing Cardiff Airport is proximity. Only 1% of passengers choose to fly from Cardiff due to its route network. This suggests that Cardiff is currently seen as an airport of convenience rather than an airport of choice. There is however a degree of circularity here, with the limited route network influenced by a range of factors, one of which is understood to be surface connectivity.

Use of Other Airports by South Wales Residents

7.4.23 Many people resident in Wales elect to use English airports, which are generally located further from their homes than Cardiff Airport. This section analyses the responses of air passengers who are resident in one of the following 12 Welsh local authority areas, with a view to understanding why they have chosen to use another airport:

- Blaenau Gwent
- Bridgend
- Caerphilly
- Cardiff
- Carmarthenshire
- Merthyr Tydfil
- Neath Port Talbot

- Newport
- Rhondda Cynon Taf
- Swansea
- Torfaen
- Vale of Glamorgan

7.4.24 Welsh air passengers could have used any number of airports; however, this review focusses on Bristol, Birmingham and London Gatwick as these were considered to have a greater similarity in terms of service offering.

'Leakage' of Passengers

7.4.25 The figure below highlights airport use by South Wales residents from the CAA data:

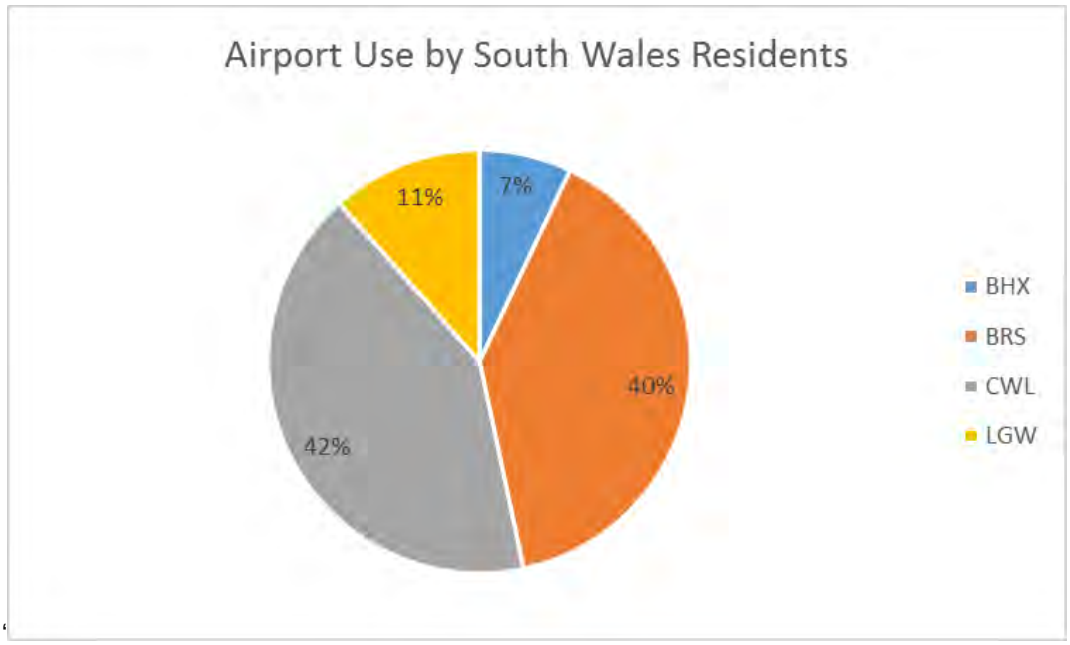


Figure 7.8: Leakage of Airport Passengers from South Wales

7.4.26 The figure shows that there is substantial leakage of passengers from South Wales to Birmingham, Bristol and Gatwick Airports, with only 42% of south Wales passengers surveyed using Cardiff Airport. This value is 44% for domestic trips. There will be additional leakage to London Heathrow; however, there is a lower level of direct competition between Cardiff and Heathrow airports on account of the destinations served.

7.4.27 Figure 7.9 below illustrates how this split varies by local authority area.

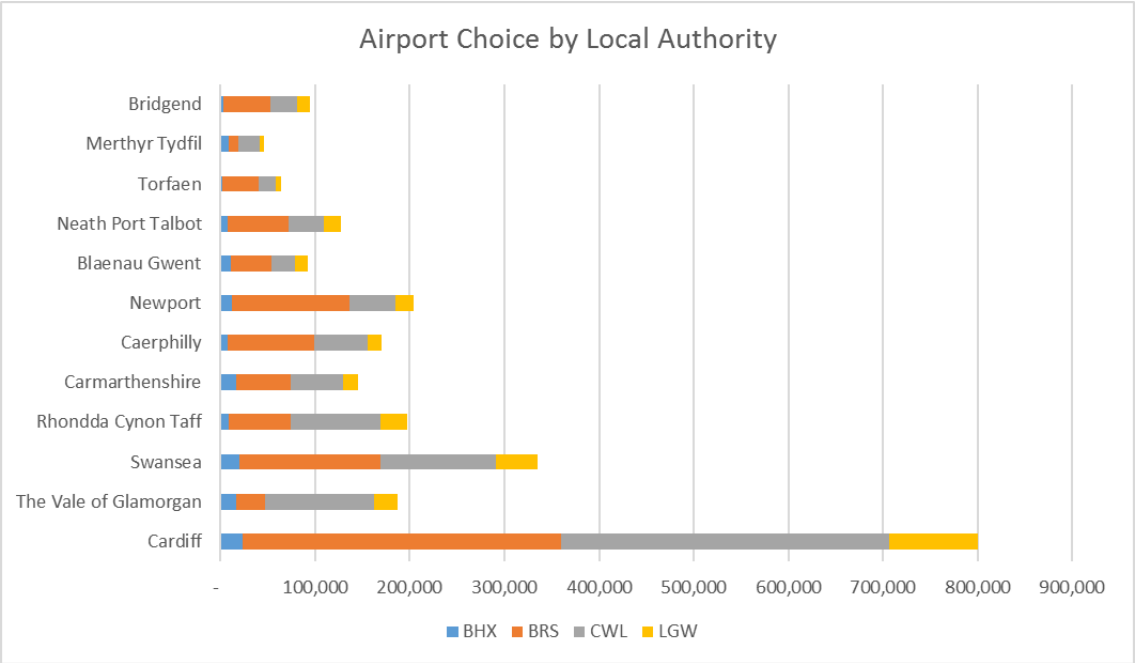


Figure 7.9: Airport Split by Local Authority (South Wales)

7.4.28 It is clear that the likelihood of travellers from South Wales using another airport is influenced by airport proximity but other factors also come into play, including cost, routes available and airport access. Reasons for airport choice are discussed later.

Long/short-haul destinations

7.4.29 Figure 7.10 indicates the destinations of South Wales residents air trips by airport used.

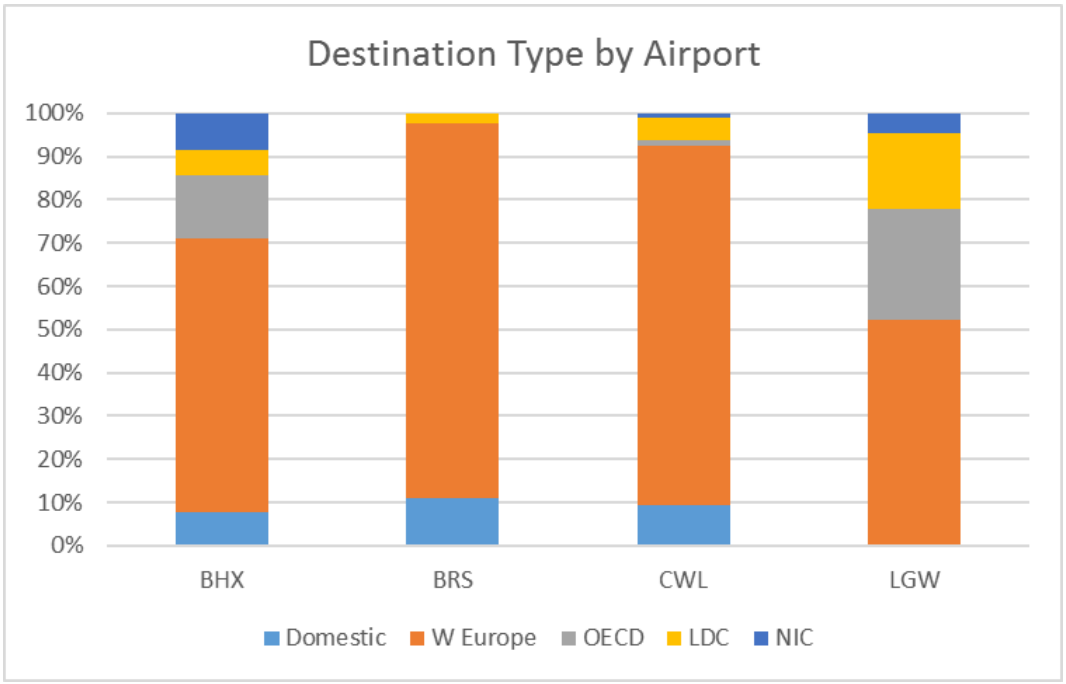


Figure 7.10: South Wales Passenger Destinations by Airport

7.4.30 As might be expected, passengers are much more likely to travel further afield to access long haul flights, which are unavailable locally. For example, circa 50% of South Wales passengers using Gatwick do so to access destinations in OECD, LDC and NIC countries. Given the focus of WG on growing the long-haul market through connections to key hubs, there is potential to

grow this market both locally within Wales and through attracting long-haul passengers from further afield.

Business/Leisure

7.4.31 The figure below shows travel from each airport split by type:

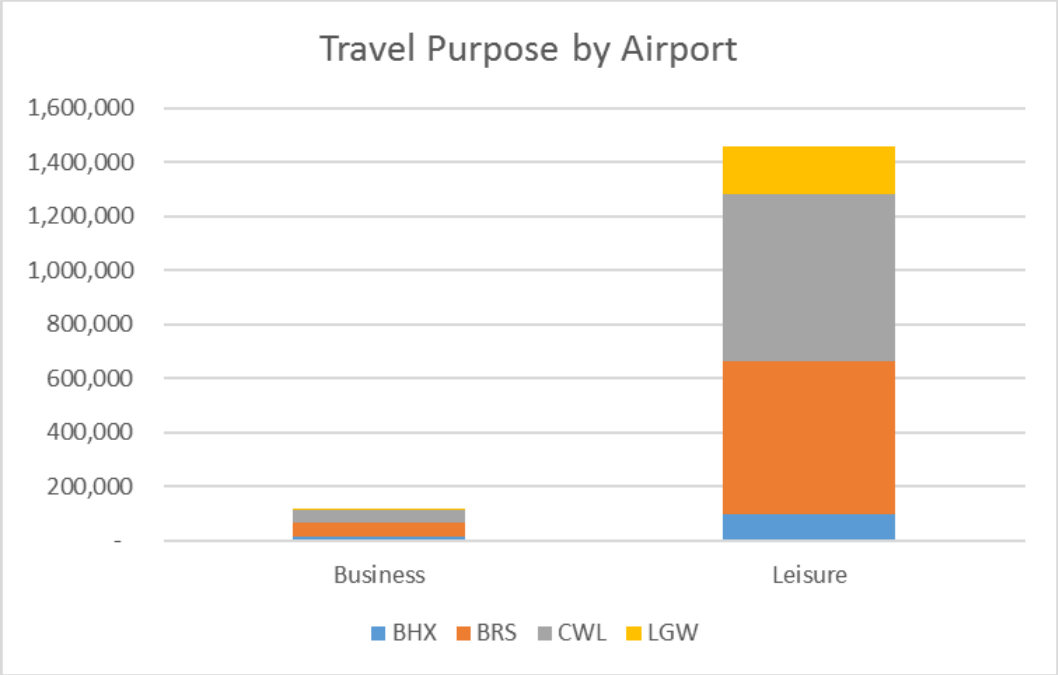


Figure 7.11: South Wales trips by Purpose and Airport

7.4.32 Approximately 7% of survey respondents living in South Wales indicated that they were travelling for business purposes. This value is lower than the average at each of the airports surveyed. 37% of business travellers used Cardiff, 49% used Bristol, 11% Birmingham and 3% Gatwick. Cardiff however was the most common choice for leisure travel, followed by Bristol, then Gatwick and then Birmingham.

Reasons for using another airport

7.4.33 The figure below sets out the reasons specified by South Wales residents for their choice of airport:

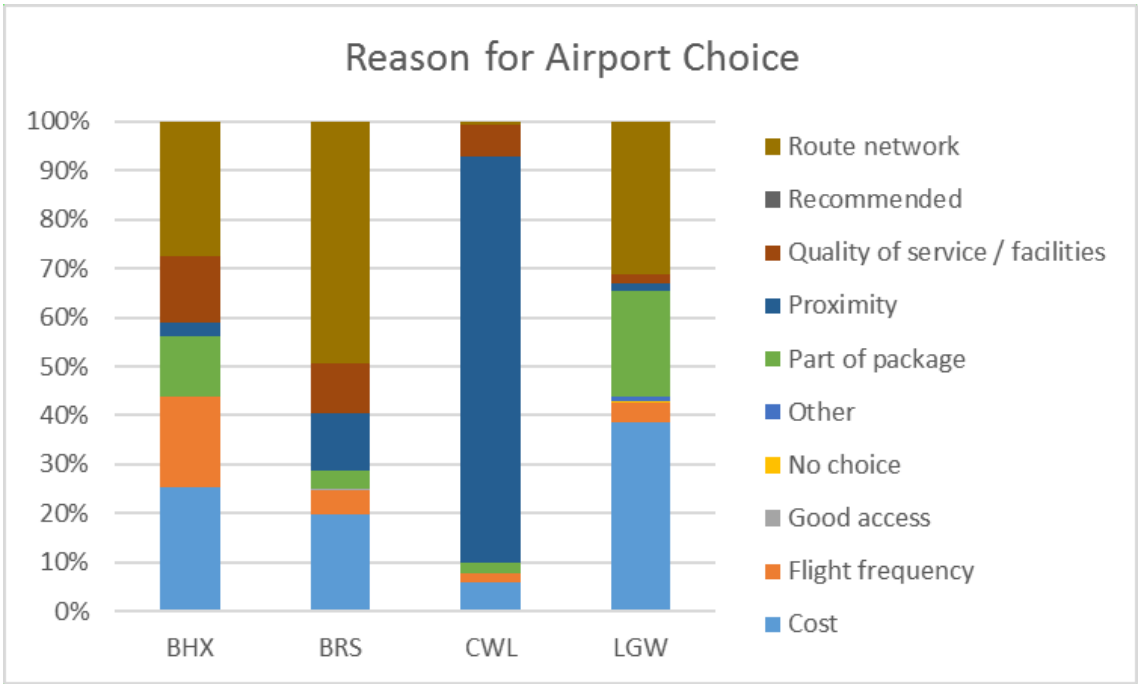


Figure 7.12: South Wales Passengers' Reasons for Airport Choice

7.4.34 The most notable point from the above figure is that the main reason for choosing Cardiff Airport is proximity, with only a fractionally small number of respondents citing the route network as a factor in their decision. This is contrast to neighbouring Bristol, where almost 50% of South Wales passengers cite the route network as the reason for their choice. This is a key finding as it implies that the proximity of Cardiff Airport is attractive to South Wales residents, but that the current route network limits the airport's use.

7.4.35 It also becomes clear that many of those travelling on package holidays, must travel through the larger airports of Birmingham and Gatwick as part of their package.

Key Point: The analysis of 'competing' airports clearly demonstrates that Cardiff is experiencing significant leakage of demand to Bristol, Gatwick and Birmingham airports amongst others.

7.5 Benchmarking

7.5.1 In developing the analysis, a degree of benchmarking was undertaken with 'secondary' comparator airports on the European periphery, with a view to identifying the level of Welsh connectivity compared to other 'peripheral' European airports. The results are shown in the table below:

Table 7.5: Benchmarking with EU Peripheral Secondary Airports (2015) [36]

City / Airport	Passengers (Million)	Long Haul Routes	Short Haul & Domestic Routes	National Population (Million)
Cardiff	1.35	1[37] & 1 Seasonal	43, numerous routes to southern Europe seasonal	3.1
Edinburgh & Glasgow (Combined)	19.8	6 & 10 Seasonal	113	5.3
Lisbon	20.1	25 & 5 Seasonal	137	10.5

[36] https://www.cardiff-airport.com/uploads/Summer_2017%20Timetable%20for%20WEB.PDF

[37] Cardiff – Doha, commences 1st May 2018

City / Airport	Passengers (Million)	Long Haul Routes	Short Haul & Domestic Routes	National Population (Million)
Copenhagen	26.6	36 & 7 Seasonal	139	5.6
Helsinki	16.4	20 & 8 Seasonal	96	5.4
Dublin	25.0	18 & 16 Seasonal	132	4.6
Keflavik	4.9	16 & more seasonal	48	0.3

7.5.2 It is important to note that Cardiff Airport does not represent an entirely 'like-for-like' comparison with the other cited airports for the following reasons:

- With the exception of the Scottish airports, the other benchmarked airports represent the primary airports in those countries. The long haul connectivity of Cardiff Airport is impacted heavily by the dominance of the London terminals.
- Wales does not have a national or 'flag' carrier, unlike the comparator countries (except Scotland).
- Lisbon and, to a lesser extent, Dublin serve large national diaspora further afield – e.g. Brazil and a number of Atlantic islands in the case of the former and the east coast of America in the case of the latter.
- There will be different taxation and charging regimes with respect to air travel and airports in these countries.

Key Point: Whilst not direct comparators, it can be seen from the above table that Cardiff significantly lags other European peripheral airports, including Edinburgh and Glasgow, in terms of overall connections, but particularly in terms of long haul. This in effect means that Wales is less well connected to key current and growing markets. Whilst surface access is only one of a large number of factors determining the scope and scale of the route network, it would nonetheless be one part of a package of measures which could assist in supporting route development.

7.6 Emerging Opportunities and Threats

7.6.1 This section considers emerging opportunities and threats relevant to the Welsh aviation sector.

Air Passenger Duty

7.6.2 The Welsh Government is currently lobbying UK Government for devolution of Air Passenger Duty (APD). If granted, WG would have the opportunity to vary the rates and bands of APD, potentially providing a basis for stimulating growth at Cardiff Airport.

7.6.3 The Silk Commission report on devolved powers to Wales recommended that APD be devolved to the Welsh Government. APD is a tax paid by passengers travelling on all flights departing Wales. The First Minister, Carwyn Jones AM, has pledged to scrap APD on long-haul flights if the powers are devolved.[38] The current APD rates for financial year 2017-18 are shown in the table below.

[38] http://www.bbc.co.uk/news/uk-wales-politics-41833833

Table 7.6: Current Air Passenger Duty Rates and Bands

Destination Bands and distance from London (miles)	Reduced rate: (for travel in the lowest class of travel available on the aircraft)	Standard rate: (for travel in any other class of travel)	Higher rate: (for travel in aircraft of 20 tonnes or more equipped to carry fewer than 19 passengers)
Band A (0 to 2,000 miles)	£13	£26	£78
Band B (over 2,000 miles)	£75	£150	£450

7.6.4 If there is only one class of travel available, the 'Reduced' rate applies (unless the seat pitch exceeds 40 inches). This means that for a typical UK internal return flight, the UK APD paid would be £26 per adult (2 * £13 in each direction) or a long-haul flight, it would be £75, as the tax only accrues to the UK Government on the outbound leg.

7.6.5 The potential scrapping of long-haul APD is a key opportunity for the Vale of Glamorgan and South Wales as a whole, with the potential to grow the long-haul aviation market through offering differential tax rates to the rest of the UK. Increased long-haul connections may also generate a derived demand for short-haul connecting flights.

Other Opportunities and Threats

7.6.6 There are a number of macroeconomic opportunities which could support the long-term growth of Cardiff Airport. These include:

- A number of airlines, including EasyJet and Ryanair, have substantial orders in place for new aircraft and thus there is a significant opportunity to realise new routes and enhanced frequencies on existing routes in the medium-term (although the former has no presence at Cardiff and the latter a relatively minimal presence compared to elsewhere). This could also feed into the longer-term aspiration to have more aircraft based in Wales.
- Improvements in aircraft technology is contributing to a climate for the emergence of low cost long haul. This could be a major 'market disruptor' and presents an important opportunity for Cardiff Airport. Norwegian has already commenced low cost long-haul flights from Edinburgh, Manchester and Gatwick amongst others to a wide range of destinations including a number of cities in the United States, initially on the East Coast. In addition, Level, an IAG subsidiary, has commenced flights from Barcelona to the United States, the Dominican Republic and Argentina. If this segment grows in a similar manner to how the short haul low cost sector did in the 1990s and early 2000s, it would represent a fundamental evolution in the aviation industry.
- Industry consultations on another study being carried out by PBA highlighted the significant risk posed by the United Kingdom's planned departure from the European Union. On both the demand and supply side, aviation is an industry which relies as far as possible on the free movement of people and assets. Our recent discussions with industry highlighted the significant risks to the aviation market posed by a so-called 'hard Brexit' and explained that, if these risks materialise, they would likely outweigh other positive developments in the UK aviation sector.

7.7 Summary

7.7.1 Whilst the aspiration to improve the connectivity of the Vale of Glamorgan is predominantly focussed on unlocking the land-use development and employment potential of the EZ, any such improvement would clearly be beneficial for Cardiff International Airport. Indeed, the desk-based analysis and consultation demonstrated that the current surface accessibility of the airport is acting as a key constraint on route development, frequency and ultimately passenger numbers.

7.7.2 Analysis of the CAA Passenger Survey data points to the issue of Cardiff Airport being uncompetitive within its target market. There is a significant proportion of leakage – the analysis shows that 58% of South Wales residents surveyed use Bristol, Birmingham and Gatwick when taking a flight, with the overall proportion of leakage likely to be higher if e.g. Heathrow, Manchester etc were included within the analysis.

7.7.3 Benchmarking has also demonstrated that Cardiff is also relatively poorly served in terms of both short and long-haul routes when compared with other EU peripheral secondary airports.

7.7.4 Despite the above points, there are several opportunities within the aviation sector (e.g. low cost long haul, reforms to Air Passenger Duty etc) which could be beneficial for Cardiff. In addition, the securing of the first scheduled long-haul route to Doha with Qatar Airways from May 2018 will significantly enhance the connectivity of Wales to Asia and Australasia. This connection may also provide a template for an expansion of the long-haul market and an air freight industry at Cardiff Airport. Any expansion of air services from Cardiff would generate significant benefits for Welsh residents currently travelling further afield to access flights. Realising these and other opportunities will however require resolution of the evidenced surface access to the airport, which are considered to be a major constraint.

8 Why invest in improved transport?

8.1 Overview

8.1.1 The previous chapters have set out the case for improving the transport connectivity of the VoG. To recap, the Cardiff Airport – St Athan EZ represents a strategically important development and employment opportunity for South Wales as a whole. However, the VoG and EZ site as a whole is characterised by relatively poor highway and public transport connections, which limits both the labour market catchment of the EZ and the agglomeration / productivity potential of the site. Improvements in transport connectivity to and from the VoG would assist in improving the accessibility of the EZ, and would better connect jobs to labour and businesses to other businesses, spreading the benefits across the study area.

8.1.2 This chapter encapsulates the above case within a 'logic map' - developing a logic map is an effective way of presenting the linkages between the infrastructure potentially being delivered and the potential outcomes and impacts that could be generated. It provides a visual representation of what might happen under certain scenarios.

8.1.3 The Logic Map tells the story along the lines of that set out diagrammatically in Figure 8.1 below. The Strategic Need sets out the rationale for the scheme with the evidence showing the current issues and problems. If there is investment of X (deliverables) this will then generate outputs which result in certain outcomes and then, ultimately, impacts. If the linkages are correct, these impacts should resolve the problems and issues identified under the Strategic Need / current situation.

8.1.4 The key stages of the Logic Map have been defined as follows:

- **Strategic Need:** The issues that the proposal will address and rationale for proceeding with the intervention.
- **Deliverable:** The proposal being taken forward, which in this case would need to be defined through a WelTAG appraisal and associated business case.
- **Outputs:** What the deliverable will directly achieve in the immediate future in terms of, for example, improving accessibility / connectivity and generating significant reductions in journey times etc.
- **Outcomes:** The outcomes are the short to medium term results of the project stemming from the outputs. In the context of this study, the outcomes will be:
  - Transport outcomes associated with improved connectivity; and
  - Wider socio-economic outcomes (which will feed into longer-term impacts). These could include for example: improved labour market performance and an improved trading and investment environment for businesses.
- **Impacts:** The long-term effects of the intervention. In this case: lower levels of unemployment and higher economic activity rates; higher levels of incomes and expenditure; increased development; improved business performance; and lower levels of social deprivation. If the linkages of the Logic Map are correct and can be evidenced, then the impacts will help address the issues set out in the Strategic Need and rationale for the investment in the first place.

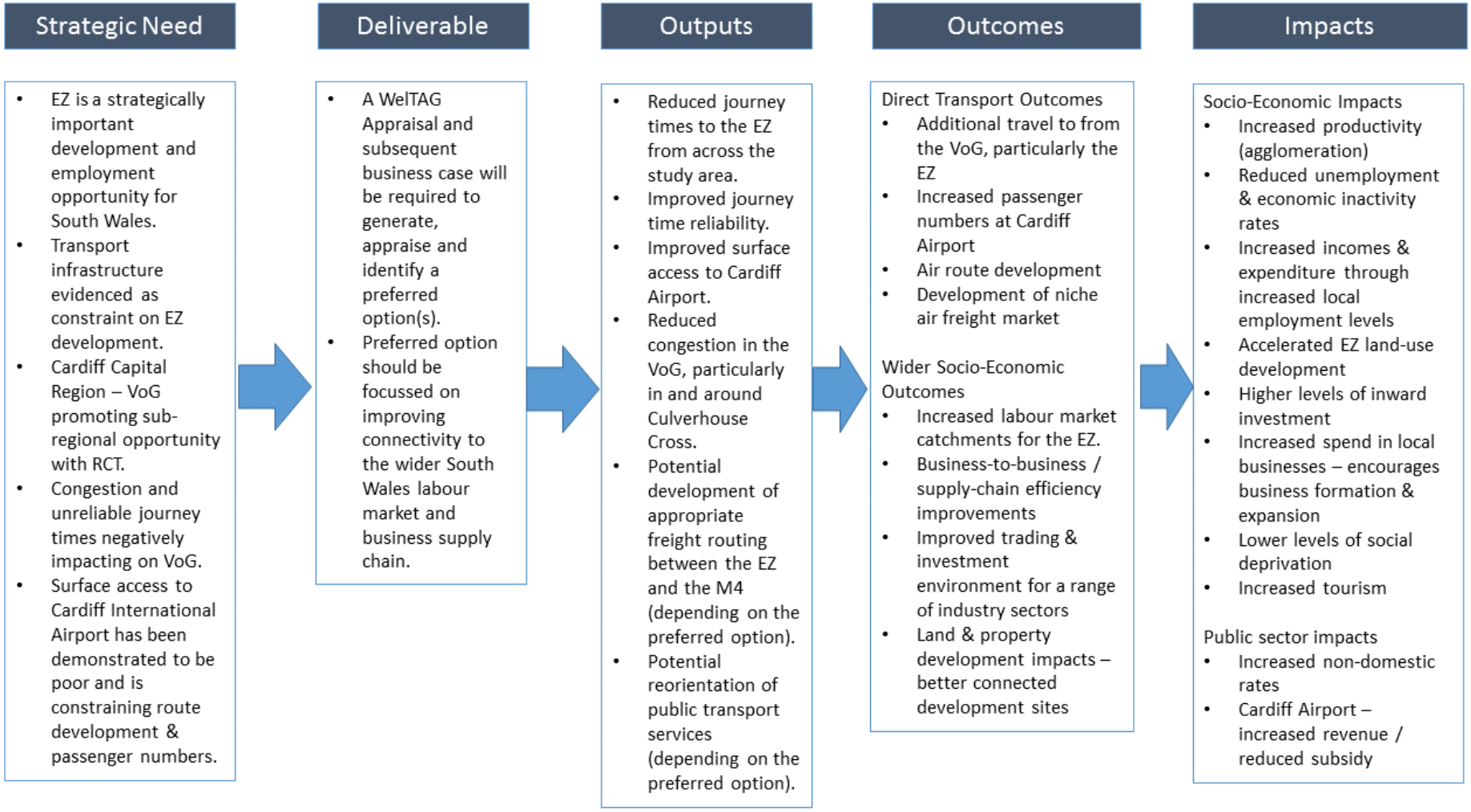


Figure 8.1: Logic Map

8.2 Logic Map Detail

8.2.1 The next stages of the case-making (e.g. the WelTAG and associated business case) will firm up the evidence on the existence and magnitude of the linkages between the different stages of the Logic Map and the potential impacts of the new crossing using secondary data and evidence from similar schemes elsewhere.

Strategic Need

8.2.2 The strategic need for improving connectivity to / from the VoG has been developed based on consideration of the baseline position in the study area with regards to development aspirations, socio-economic data and transport connectivity, as outlined in the previous chapters. The following factors have been identified as forming the strategic need:

- The EZ is a strategically important employment and development opportunity for South Wales as a whole. Its realisation, particularly when considered in the context of the wider sub-regional opportunity with RCT, provides a means by which the GVA of the Cardiff Capital Region and indeed South Wales as a whole can be increased, supporting positive socio-economic outcomes. However, transport connectivity to the sites (road and public transport) has been evidenced to be problematic, and will need to be addressed if the EZ is to achieve its full potential.
- Surface access to Cardiff International Airport, the gateway to Wales, has been demonstrated to be poor and is constraining route development and passenger numbers.
- At a more local level, congestion and unreliable journey times within the VoG are having a negative impact on both strategic traffic in the area and on VoG residents. In the longer-term, these transport problems may impact on development aspirations for the area and the attractiveness of the VoG as a place to work, live and do business.

Deliverable

8.2.3 The deliverable is the ultimate preferred option which will emerge from the appraisal and business case process. This report has established the 'case for change' but has not yet considered options for how this could be delivered (e.g. the 'why' rather than the 'what' has been identified). It would be inappropriate to comment on options in advance of a WelTAG appraisal. However, in terms of meeting the strategic need, any transport option which does emerge should be focussed on:

- effectively and efficiently connecting the emerging employment market in the VoG with the wider labour market in the Cardiff Capital Region and Swansea Bay City Region - it is essential that the benefits of the solution are regional rather than local in nature; and
- promoting / enhancing business-to-business interactions within the study area through improving overall connectivity, reducing journey times and improving journey time reliability.

Outputs

8.2.4 The outputs of the project relate to the opportunities that the deliverable provides. In this case, the anticipated outputs are:

- reduce journey times to and from the VoG and EZ from across the study area;
- improved journey time reliability;
- reduced congestion in the VoG, particularly in and around Culverhouse Cross;
- improved surface access to Cardiff International Airport;
- development of appropriate freight routing between the EZ and the M4, splitting out local and strategic traffic (depending on the preferred option); and

- potential reorientation of public transport services, providing better connectivity between the local authorities surrounding Cardiff (depending on the preferred option).

Outcomes

8.2.5 The outcomes of this investment are twofold – direct transport outcomes and wider socio-economic outcomes. Whilst this project is not being undertaken purely on the basis of transport considerations, there will be positive transport outcomes which in turn will form the basis of, and thus enable, the socio-economic outcomes.

Direct Transport Outcomes

8.2.6 By improving connectivity to and from the VoG, the following transport outcomes are likely to be delivered:

- additional trips to / from the VoG by car and / or public transport; and
- increased routes, flight frequency and passenger numbers at Cardiff International Airport.

Socio-economic Outcomes

8.2.7 The potential outcomes from a wider socio-economic perspective are extensive and varied:

- Labour market
  - Increased labour market catchments for the EZ due to better accessibility and journey reliability (i.e. better matching of labour supply and jobs market). Outcomes could include:
    - people entering the jobs market who are currently unemployed or economically inactive;
    - people moving to more productive jobs due to improved accessibility; and
    - people working longer hours due to reduced commute times / enhanced accessibility.
  - Enhanced skills development and training opportunities.
- Business-to-business / supply-chain efficiency improvements.
- Improved trading and investment environment for a range of industry sectors, particularly in the aerospace cluster and in terms of attracting inward investment.
- Land and property development outcomes (short-term)
  - The realisation of improved connectivity to the VoG may assist in promoting the earlier development of sites within the study area. It is also considered possible that the new connection will increase land values and overall marketability of sites.

Impacts

8.2.8 The final element of the Logic Map is the consideration of the impacts generated by the outputs and outcomes of the intervention as outlined above. The identified impacts can be split in terms of:

- wider socio-economic impacts; and
- public sector impacts.

Wider Socio-Economic Impacts

8.2.9 The potential wider socio-economic impacts of the intervention are set out below:

- increased productivity (i.e. agglomeration);

- reduced unemployment and economic inactivity rates;
- increased local incomes and expenditure through increasing employment levels and attracting people to live / work in the area;
- longer-term higher levels of inward investment and accelerated EZ investment;
- higher local incomes and expenditure levels encourage businesses to locate / expand in the area;
- lower levels of social deprivation as, for example, incomes and education levels rise; and
- increased tourism to South Wales as a whole, including the VoG heritage coast.

Public Sector Impacts

8.2.10 Public sector impacts include:

- increased revenue through more non-domestic rates; and
- increase in revenue / reduction in subsidy associated with Cardiff International Airport.

8.2.11 The Logic Map presented above sets out outcomes and impacts which could be realised by improving connectivity to the VoG. Subsequent stages of this study, including the WelTAG and any subsequent business case, would investigate the evidence in relation to whether the outcomes and impacts are likely to occur and, if so, the magnitude of those impacts.

8.3 Summary

8.3.1 This chapter has reaffirmed the strategic need for improving the connectivity of the VoG and identified through a logic map how addressing that need could deliver positive transport and socio-economic outcomes and impacts.

8.3.2 The extent to which each of the desirable outcomes and impacts, and their relative magnitude, will be realised through improving connectivity to the VoG will be dependent on the preferred option pursued. The subsequent WelTAG study and business case should therefore be framed within the above logic map (updating it as necessary), with the appraisal focussed on:

- defining a set of Transport Planning Objectives which reflect the strategic need;
- generation and appraisal of options which, through an iterative process, will define a preferred option(s) which best addresses the evidenced strategic need;
- application of available data and tools (e.g. the South-East Wales Transport Model (SEWTM), accessibility software, business surveys etc) to evidence the type and magnitude of outcomes and impacts which can be expected; and
- development of a robust monitoring and evaluation plan, which will create a framework for establishing the baseline position and tracking the emergence of outcomes and impacts over time (and in the long-term with relation to wider socio-economic impacts).

9 Conclusions & Next Steps

9.1 Conclusions

9.1.1 This report has explored the case for improving the transport connectivity of the Vale of Glamorgan. A 'case for change' has been made predominantly on the basis of realising the strategic development and employment opportunities associated with the Cardiff Airport – St Athan Enterprise Zone, which will offer economic development benefits for South Wales as a whole.

9.1.2 Taken together, consultation and desk-based analysis has demonstrated that the current transport connectivity of the VoG, in the context of the EZ and airport, is sub-optimal in terms of journey times, journey time reliability, public transport coverage and the routing of strategic traffic, including goods vehicles. If these issues are not addressed, there is a risk that the opportunities offered by the EZ may not be fully realised.

9.1.3 The socio-economic baselining of the study area has clearly highlighted the multitude of problems currently being experienced in the Cardiff Capital Region and Swansea Bay City Region. These include low levels of productivity and business competitiveness, limited inward investment, high rates of economic inactivity & unemployment and concentrated areas of multiple deprivation. The EZ is part of a package of measures across the respective City Regions which could begin to tackle these issues through creating (high value) direct, indirect and induced employment opportunities, as well as wider supply-chain opportunities for Welsh businesses across the region. However, its success is dependent on connecting the employment opportunities to the labour market and ensuring that business-to-business interactions are as seamless as possible.

9.1.4 Moreover, with a once in a generation programme of capital investment in transport infrastructure in the Capital Region and connecting Wales with England underway, there is an opportunity for the areas to the west of Cardiff to better access a wider range of employment and business opportunities. However, this improved connectivity also presents a risk, in that by failing to address the transport problems in the VoG, the economic gravity of the area could shift to the east, with potential for economic leakage to England.

9.1.5 There are also a number of opportunities for Cardiff International Airport to better position itself as the gateway to Wales, particularly in terms of the long-haul market. The presence of a well-connected international airport is generally seen to be positive in promoting economic development and high-value inward investment. However, the current surface access to the airport has been widely cited as a constraint which, if not addressed, could continue to limit the route development potential of the airport.

9.1.6 Finally, within the VoG itself, the current transport infrastructure is considered to be having a negative impact on the area, particularly in terms of congestion and journey time reliability. The transport issues are considered to be having a negative impact on business performance, the attractiveness of the VoG as a place to live, work and do business and, in the longer-term, land-use aspirations within the Vale.

9.1.7 In short, improving the transport connectivity of the VoG is considered necessary to support national, regional and local economic performance.

9.2 Next Steps

9.2.1 This study has developed the strategic case for improving the transport connectivity of the VoG. This report delivers the requirement of a WelTAG Stage 1 appraisal, whereby the strategic case should be 'almost fully developed'.

9.2.2 The next step in the process should therefore be the undertaking of a full WelTAG Stage 1 appraisal which:

- further develops evidence on the transport problems, opportunities, issues and constraints within the study area;
- identifies a set of Transport Planning Objectives which reflect the identified strategic need identified in this study;
- generates a long-list of options; and
- undertakes an initial appraisal of those options, identifying those which merit further consideration in a WelTAG Stage 2 appraisal.

9.2.3 At the early stages of the WelTAG Stage 2 Appraisal, this strategic case should be revisited and updated if necessary.

Appendix A List of Stakeholder Consultees

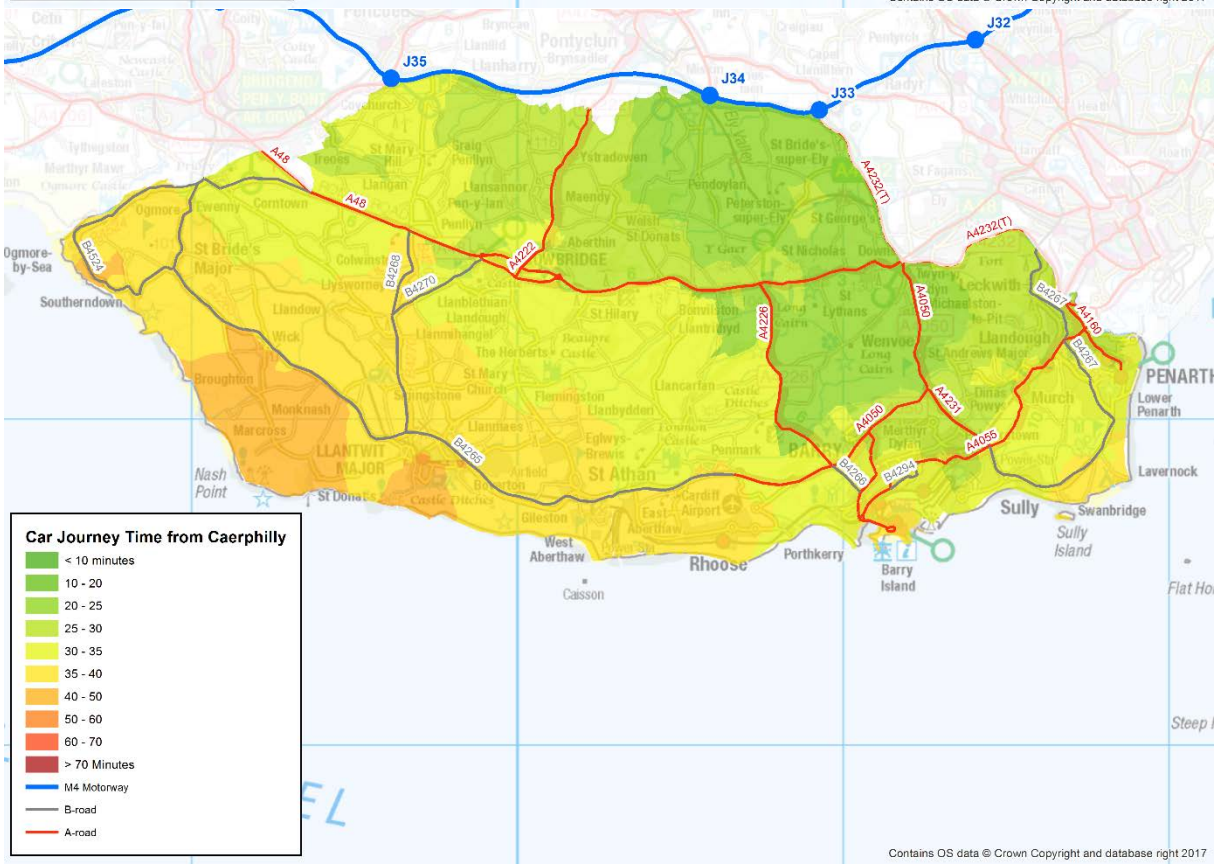
The following stakeholders responded to the consultation request:

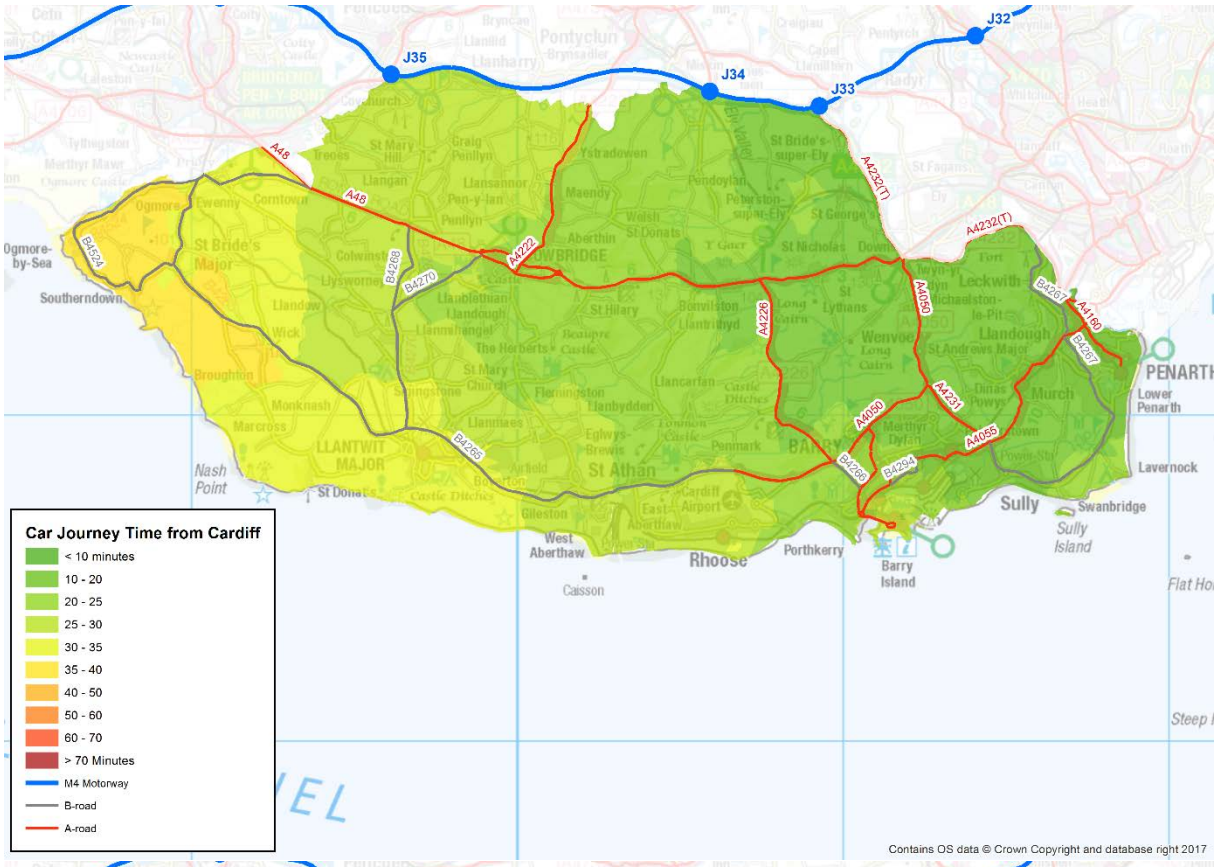
- Aston Martin
- Blaenau Gwent County Borough Council
- Bridgend County Borough Council
- Cardiff City Council
- Caerphilly County Borough Council
- Cardiff Airport and St Athan Enterprise Zone
- Cardiff International Airport
- Federation of Small Businesses
- Freight Transport Association
- Merthyr Tydfil County Borough Council
- Rhondda Cynon Taf County Borough Council
- Torfaen County Borough Council
- Transport for Wales
- Traws Cymru
- Vale of Glamorgan County Borough Council
- Welsh Government – Aviation

The following stakeholders were invited to participate in the consultation but either did not respond or declined to participate.

- BA Avionics Engineering
- Business Wales
- Carmarthenshire County Borough Council
- FlyBe
- Monmouthshire County Borough Council
- Neath Port Talbot County Borough Council
- Newport County Council
- Road Haulage Association
- Swansea City Council
- Visit Wales

Appendix B Network Analyst Accessibility Plots

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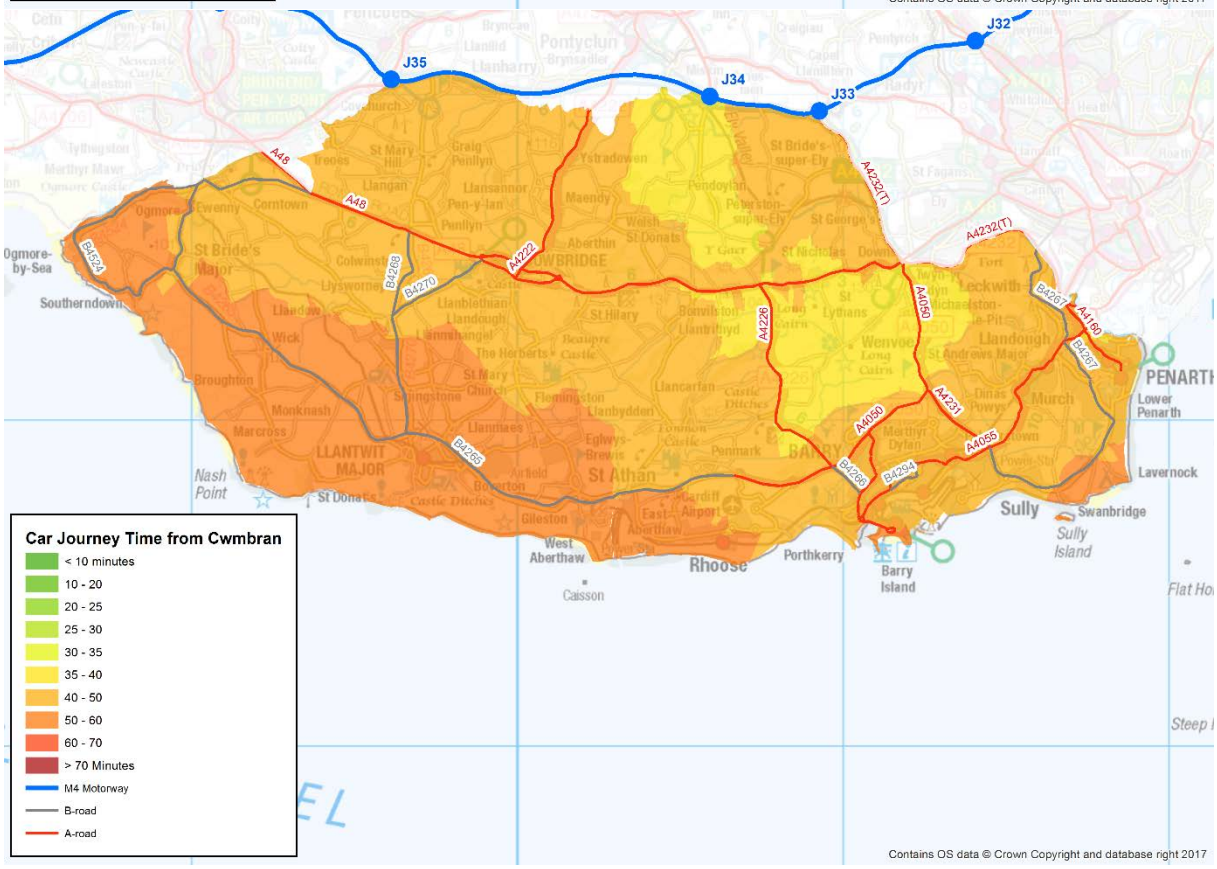
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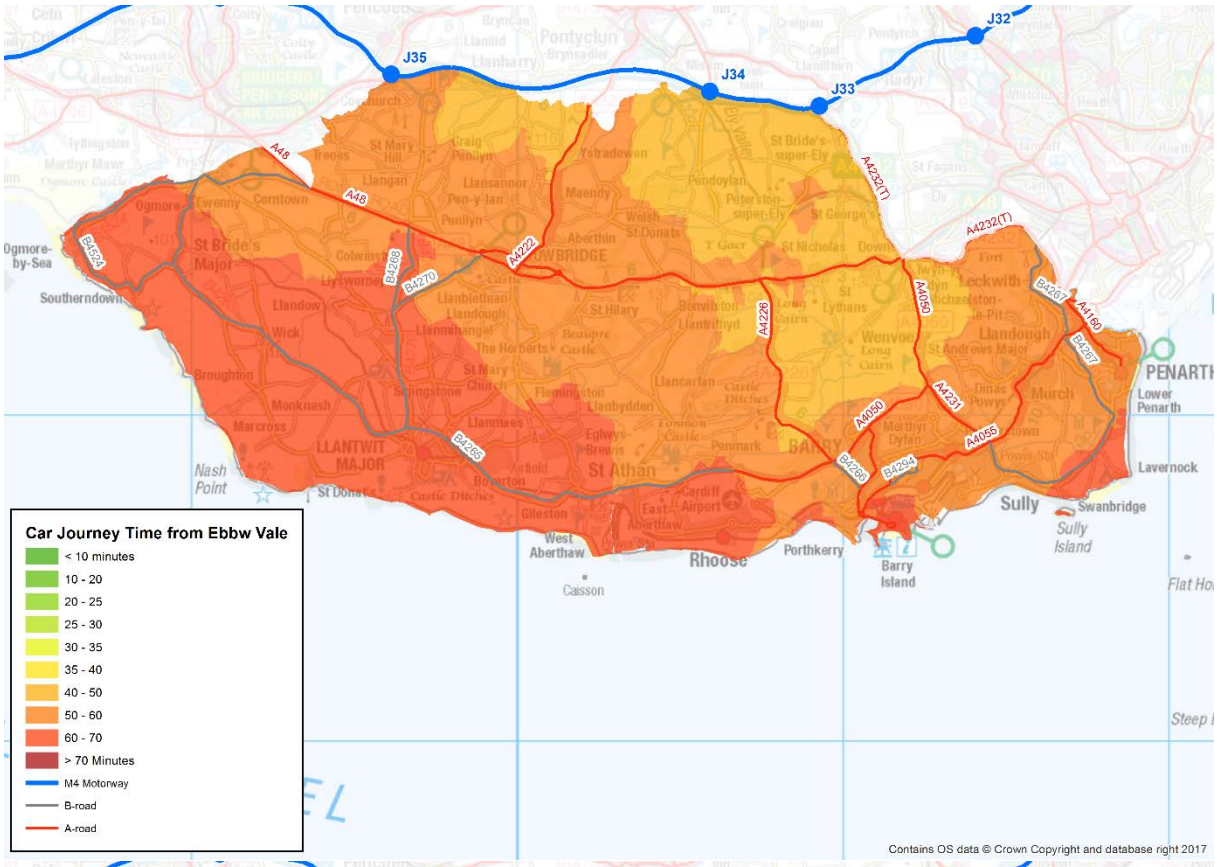
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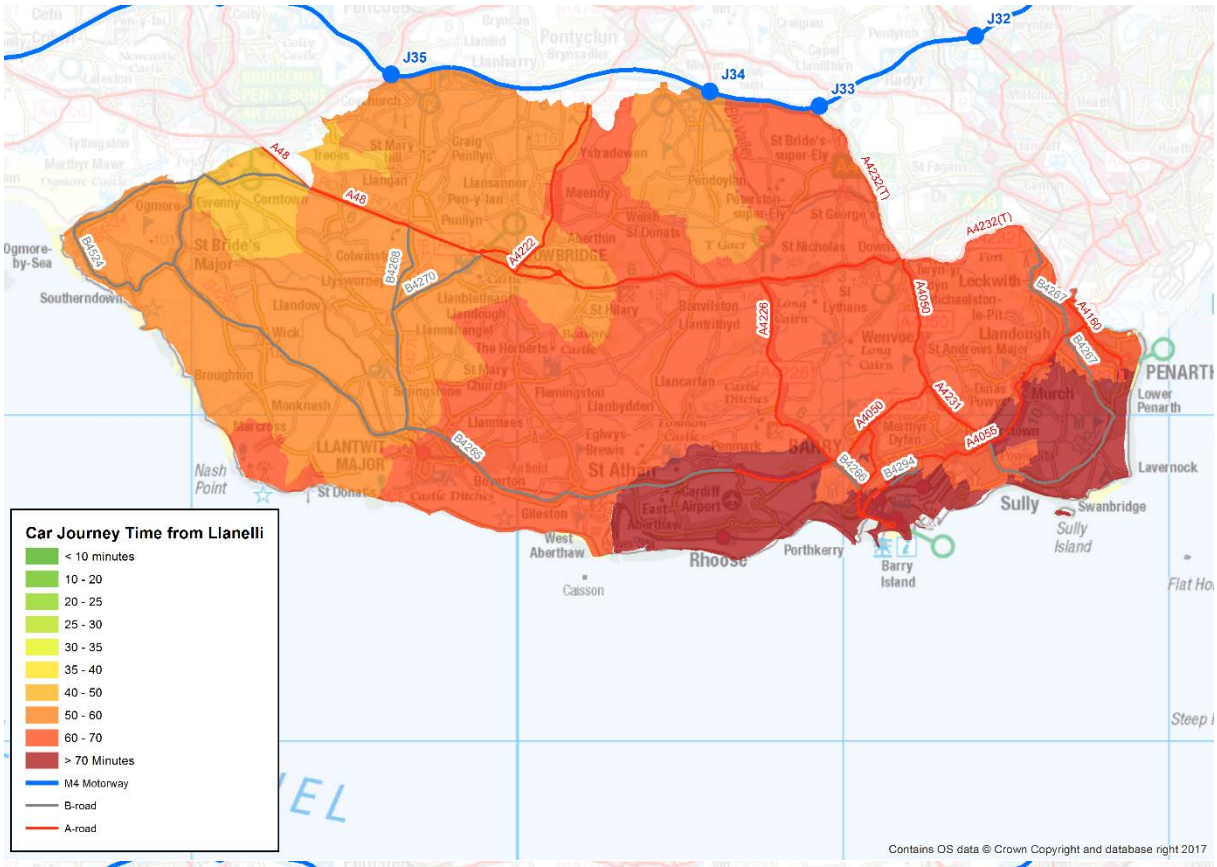
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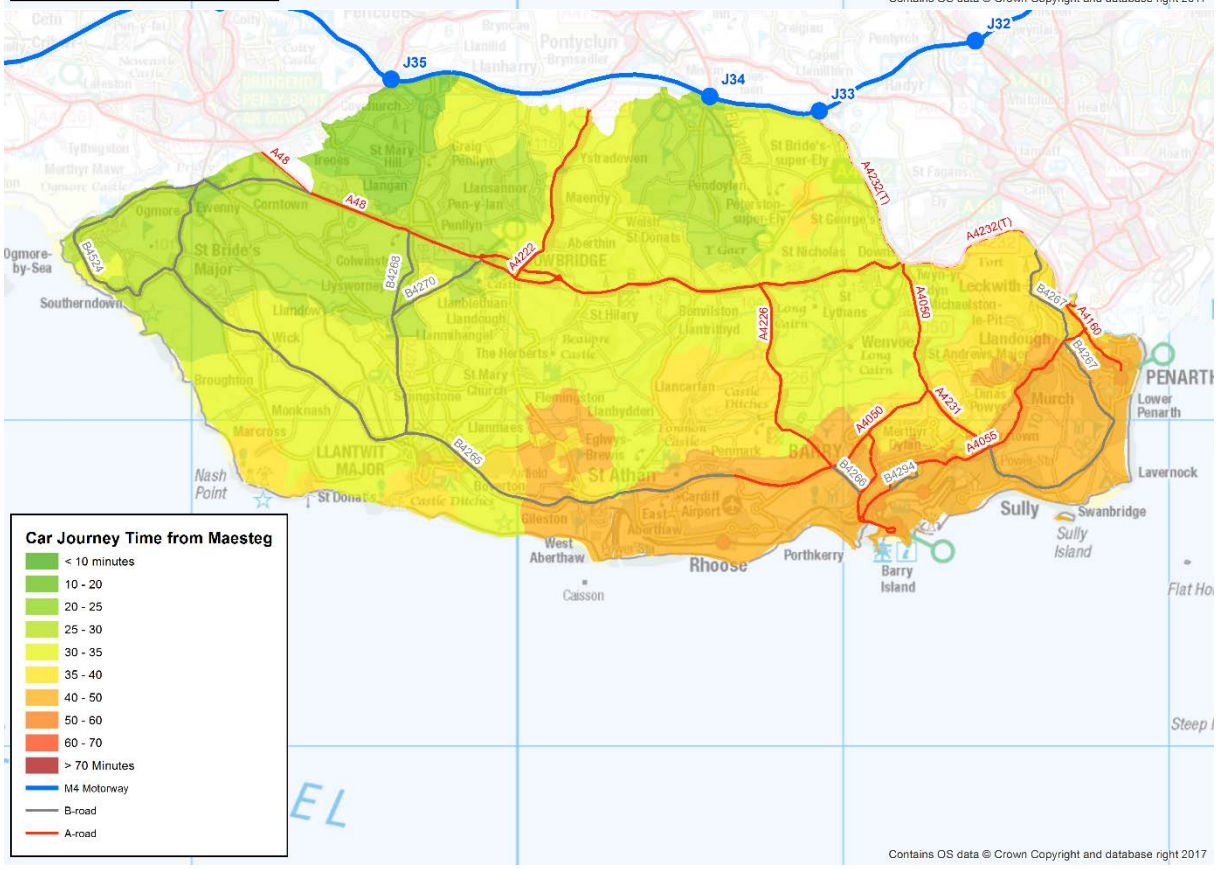
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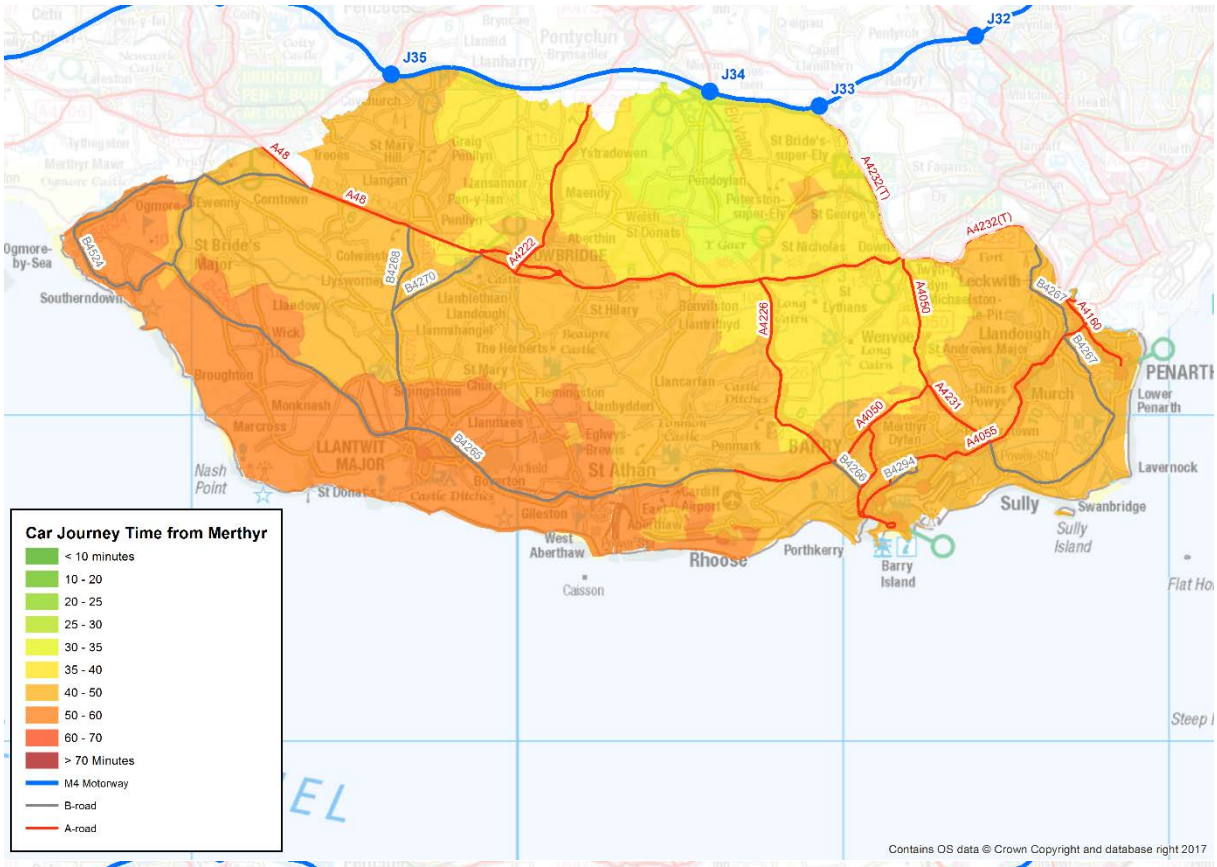
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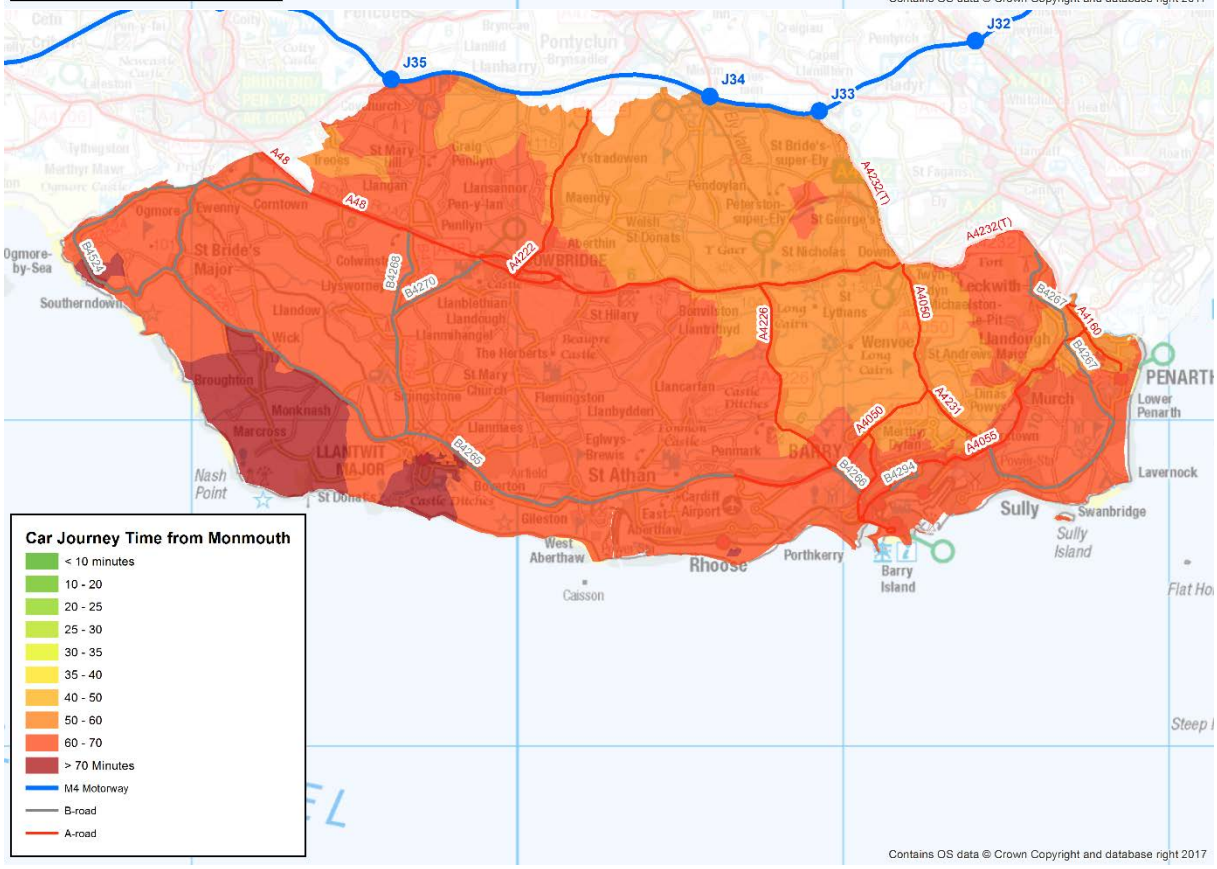
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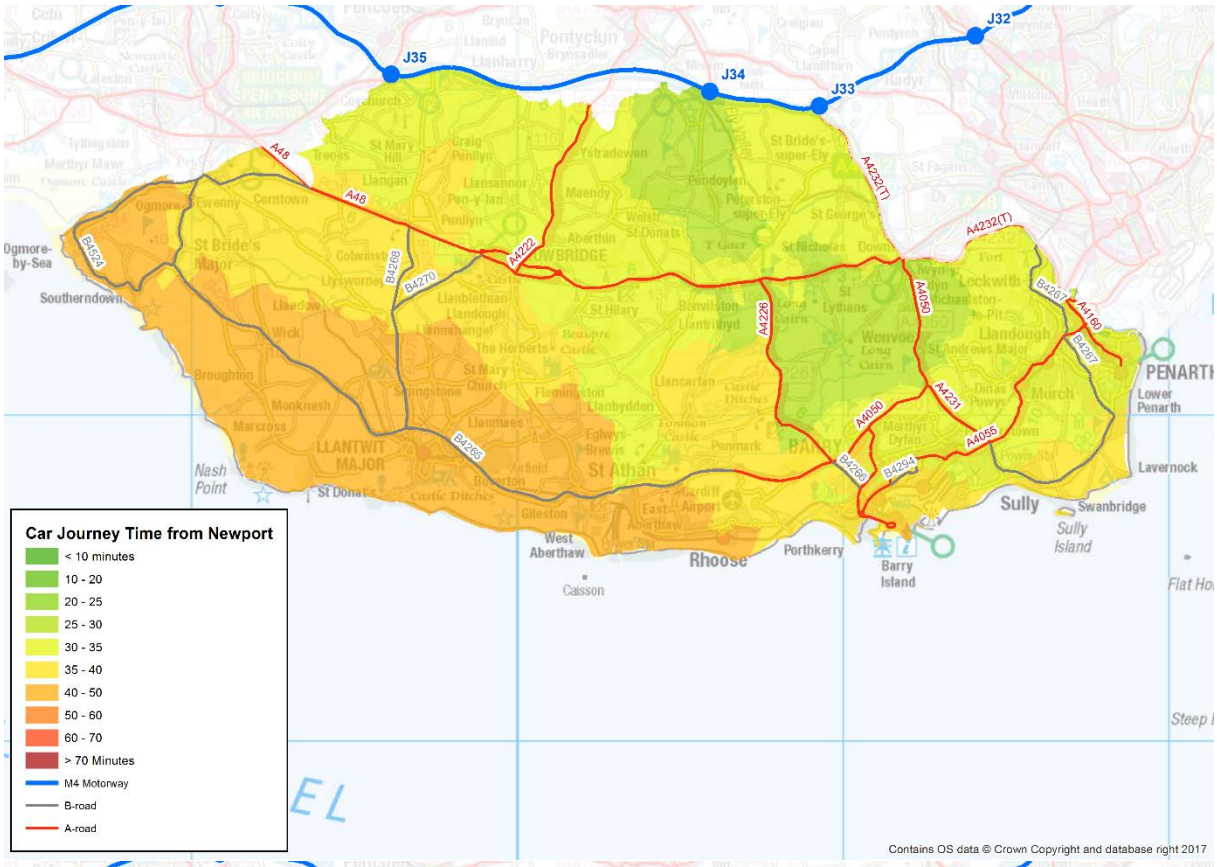
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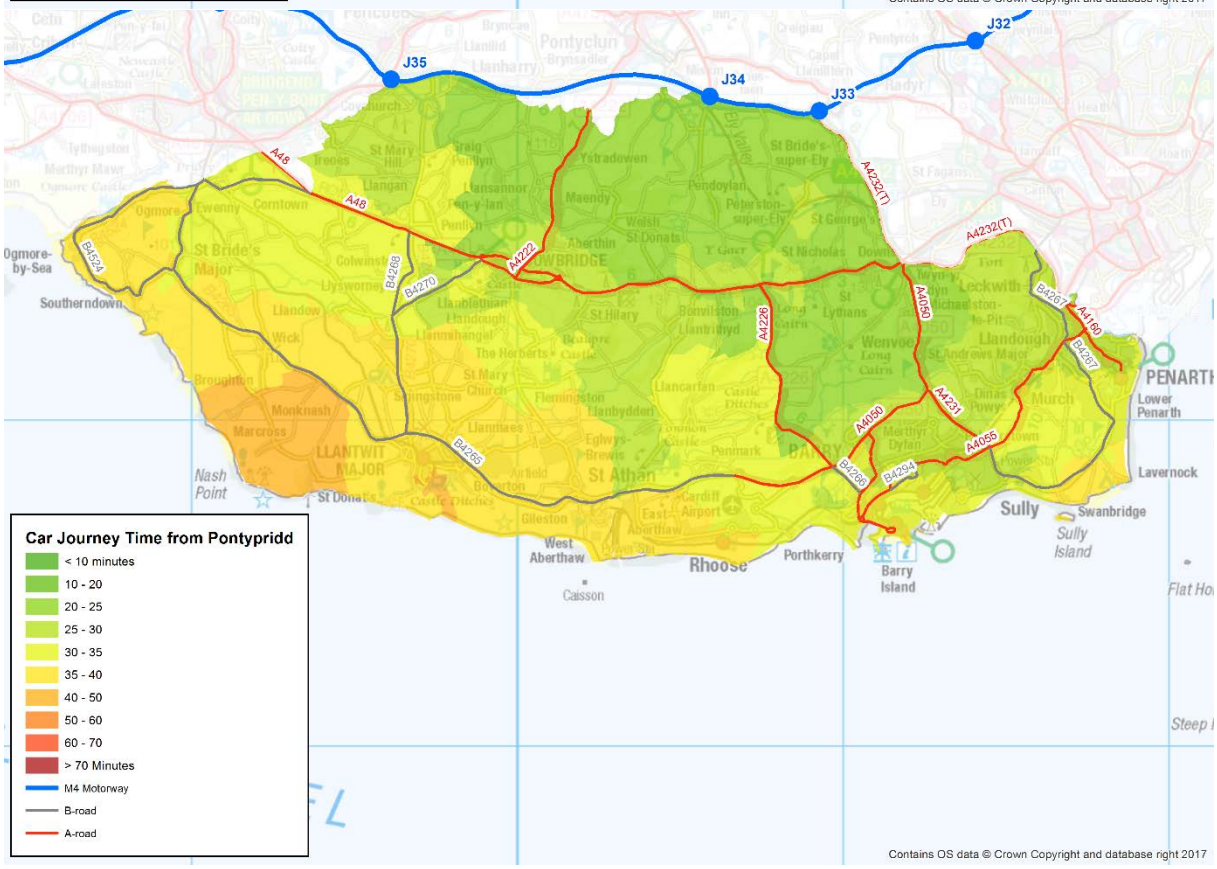
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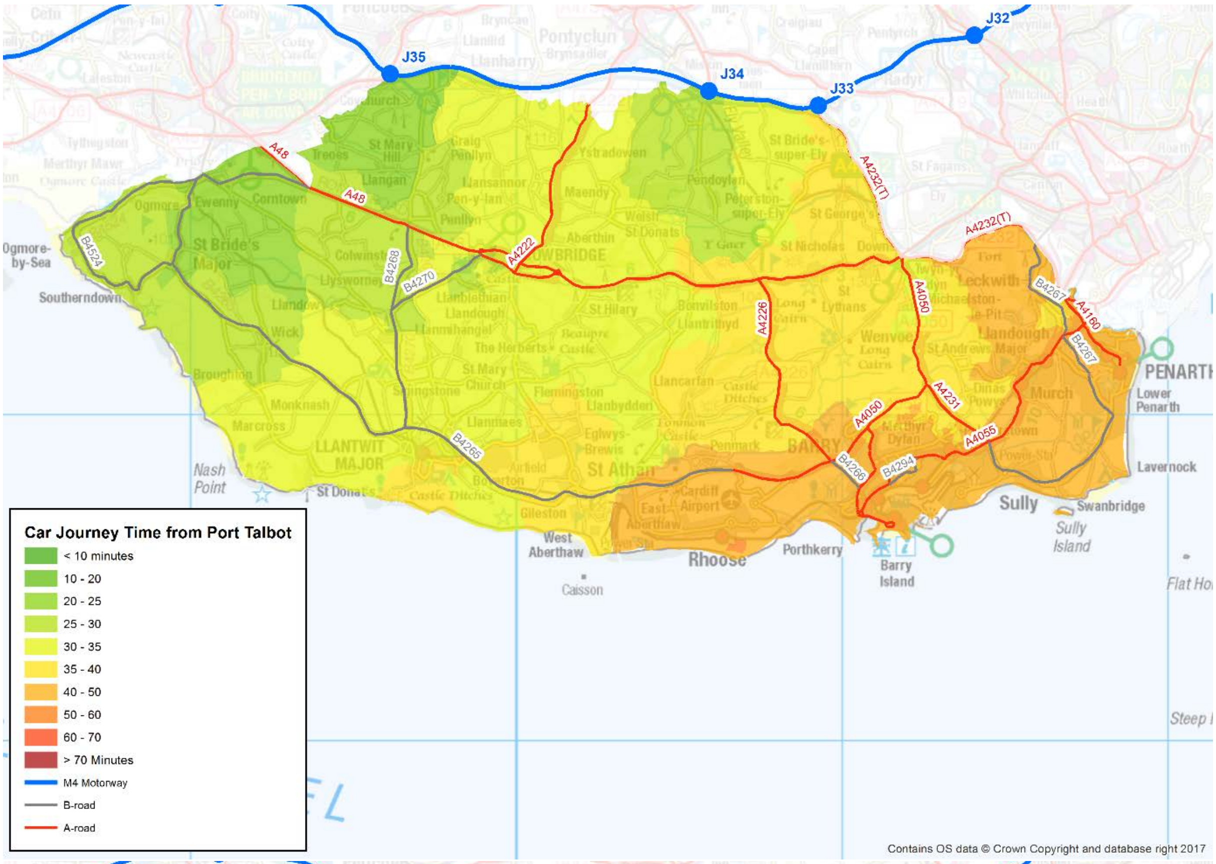
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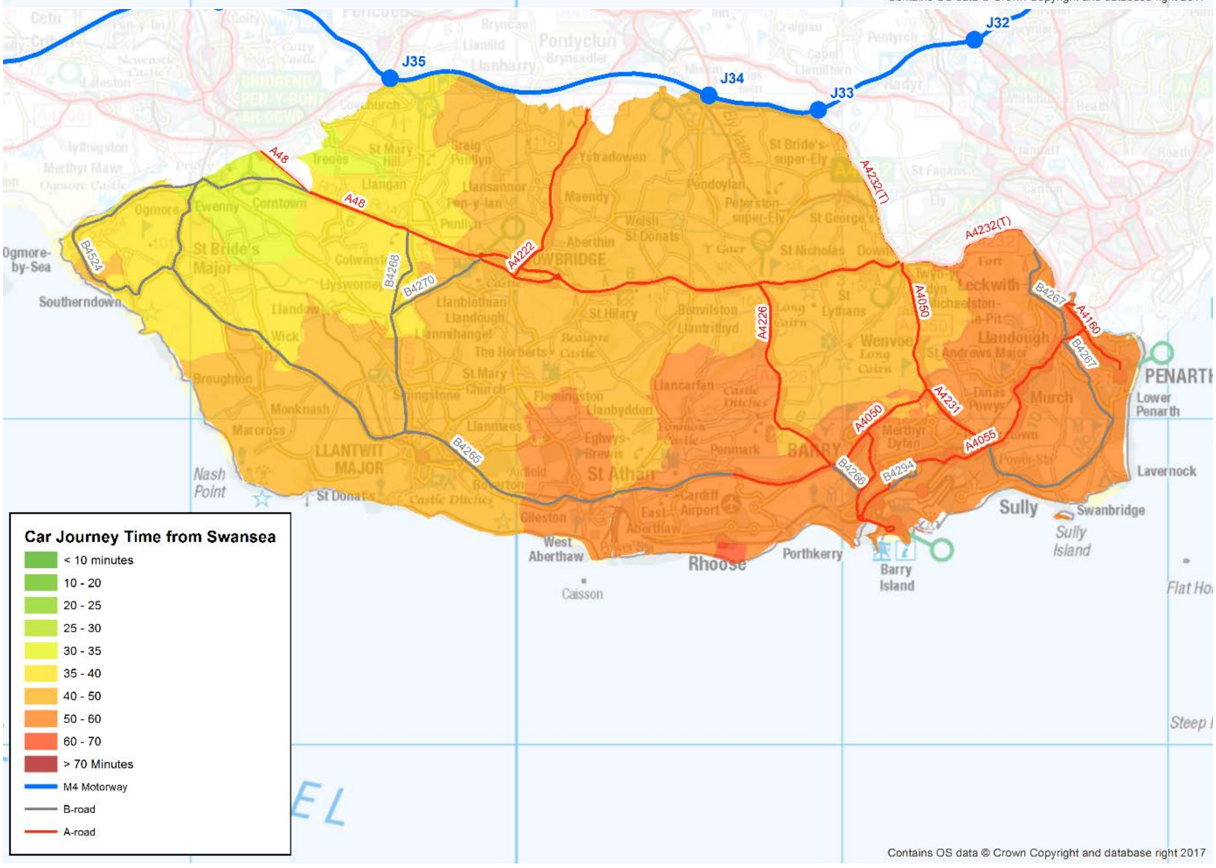
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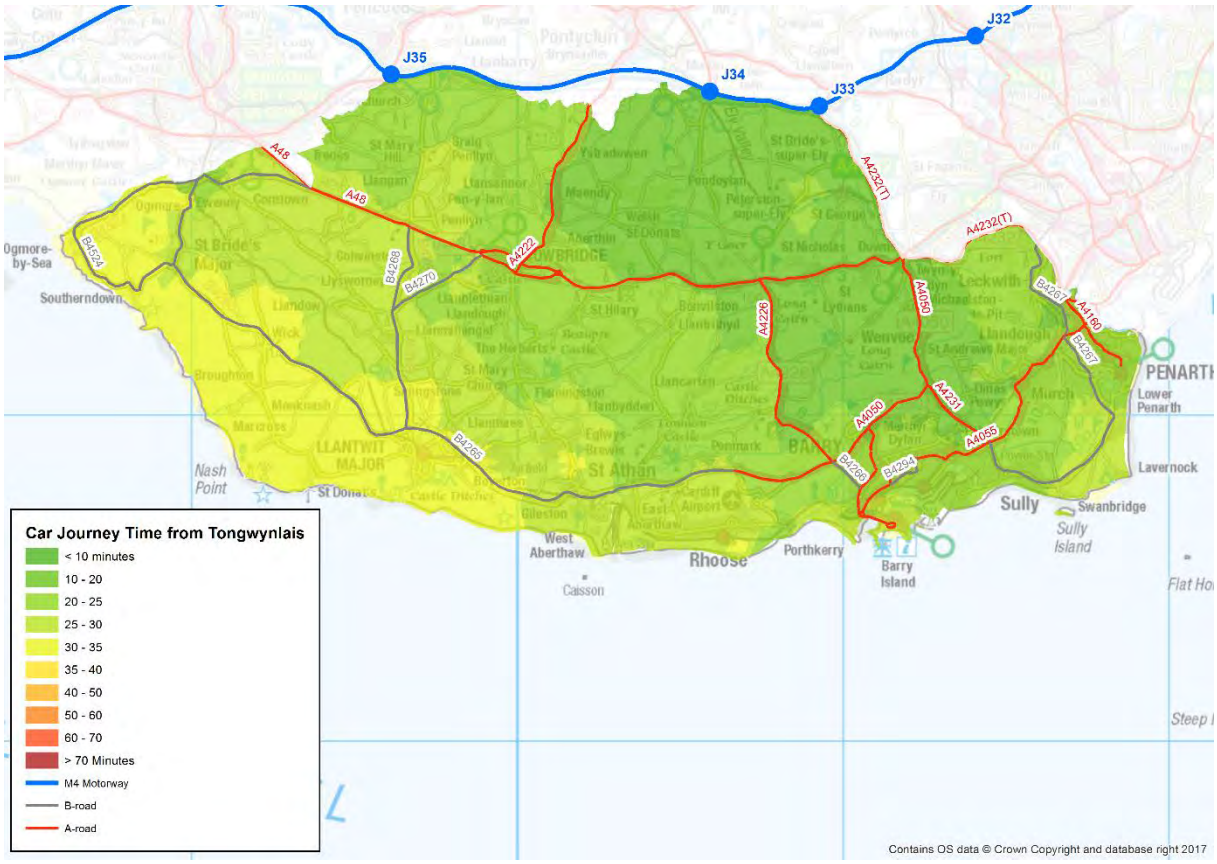
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B4267
B4294
B4286
Southerndown
Ogmore-by-Sea
St Bride's Major
LLANTWIT MAJOR
Nash Point
St Athan
West Aberthaw
Caisson
Rhoose
Porthkerry
Barry Island
Sully
Swanbridge
Sully Island
Lavernock
Lower Penarth
Car Journey Time from Tongwynlais
< 10 minutes
10 - 20
20 - 25
25 - 30
30 - 35
35 - 40
40 - 50
50 - 60
60 - 70
> 70 Minutes
M4 Motorway
B-road
A-road
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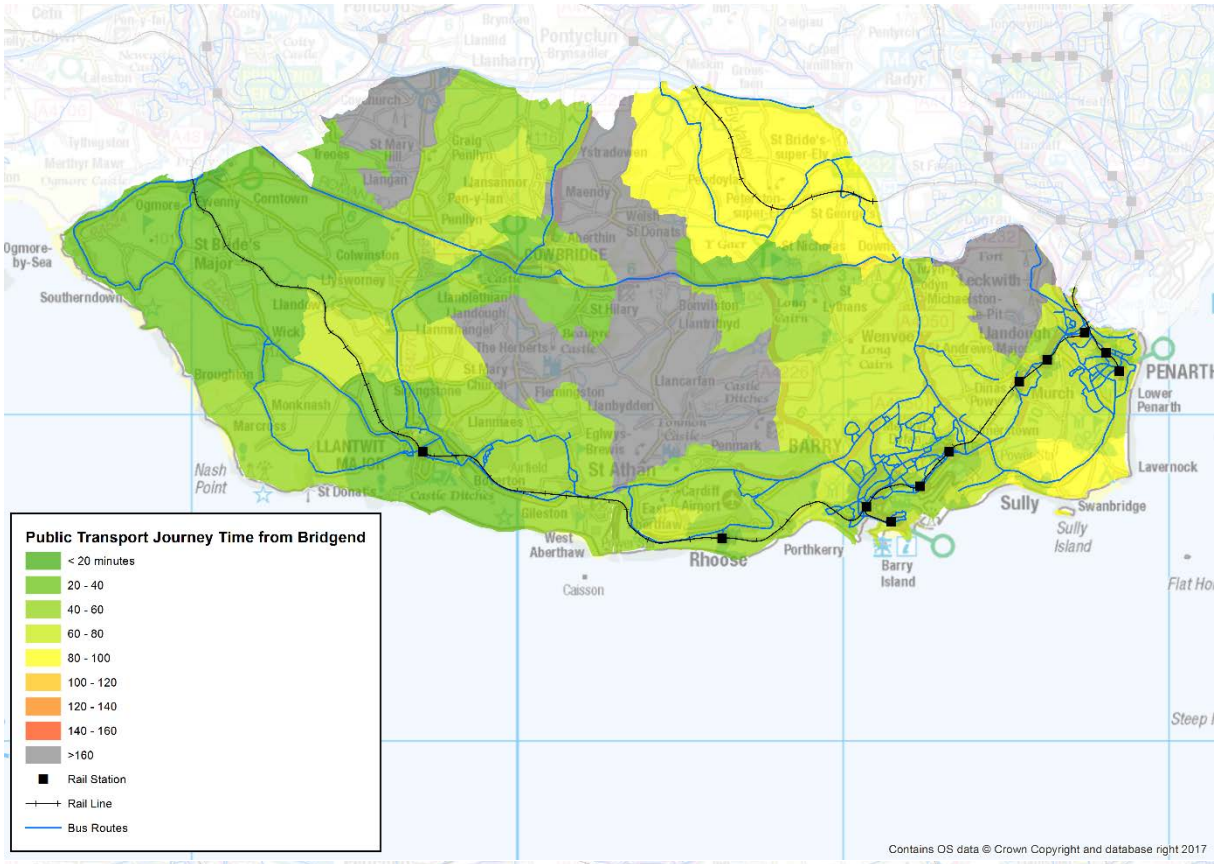
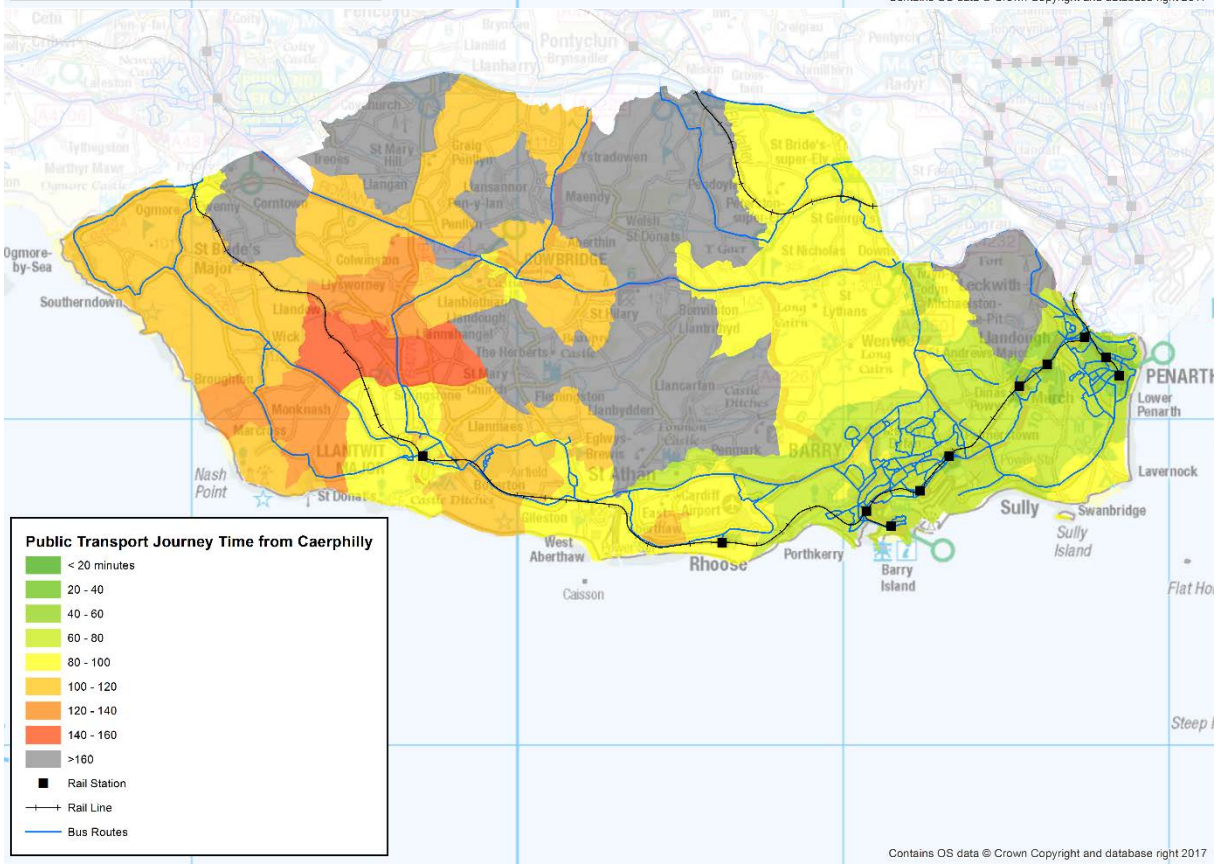
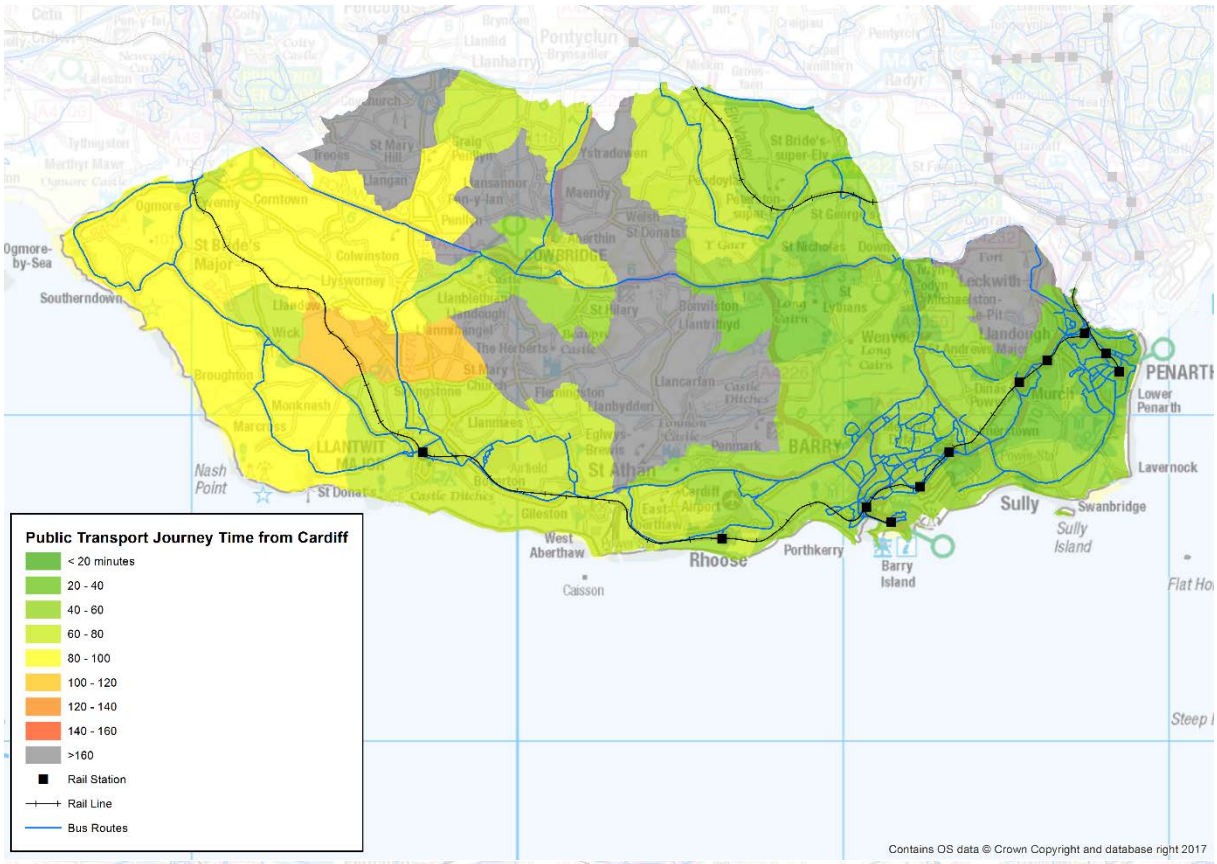
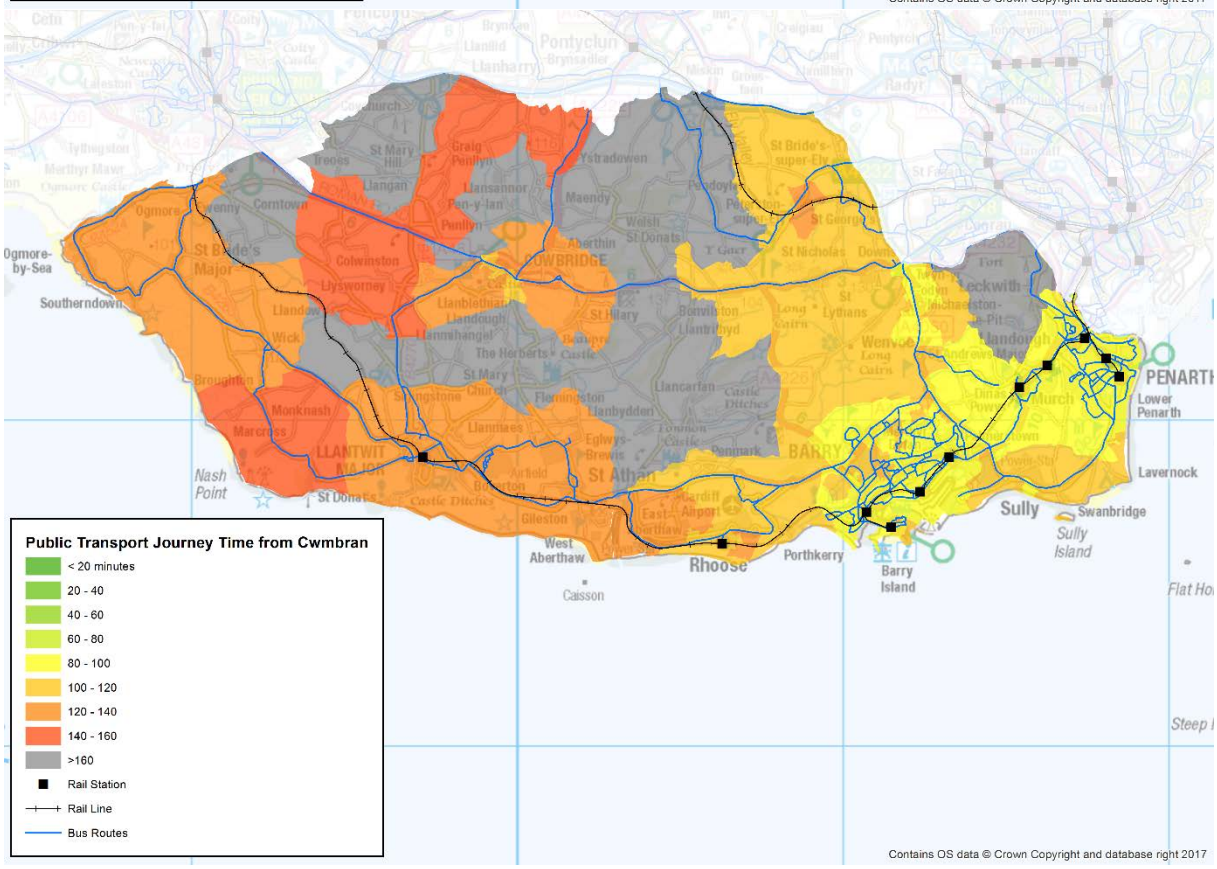
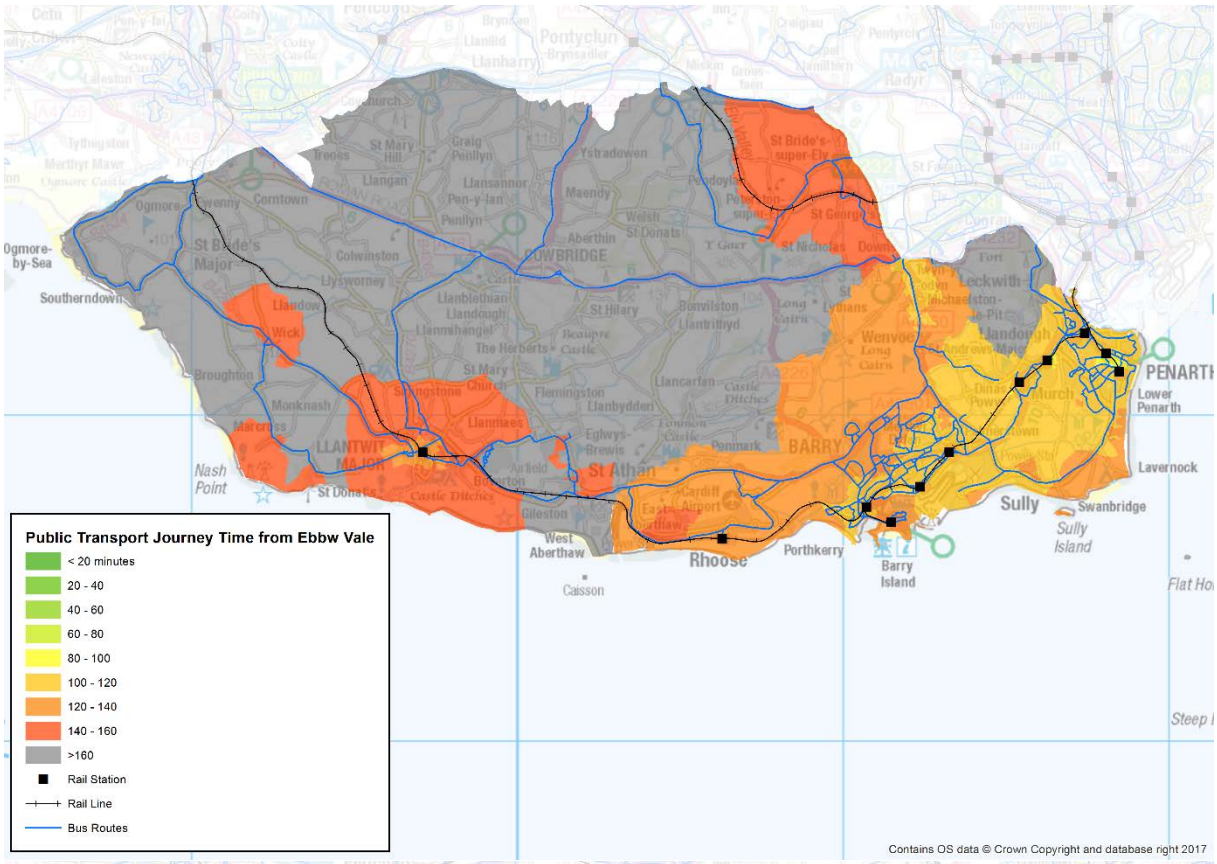
Appendix C TRACC Accessibility Plots

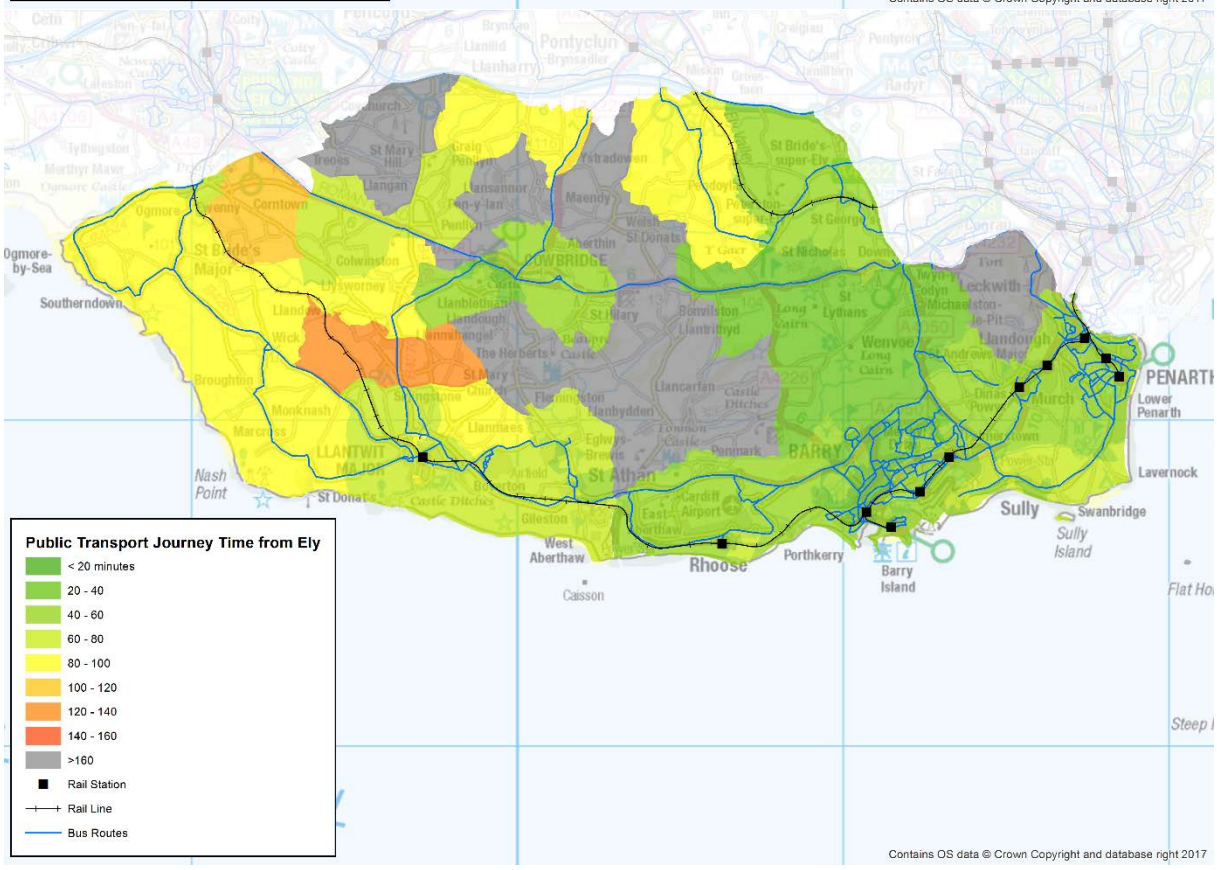


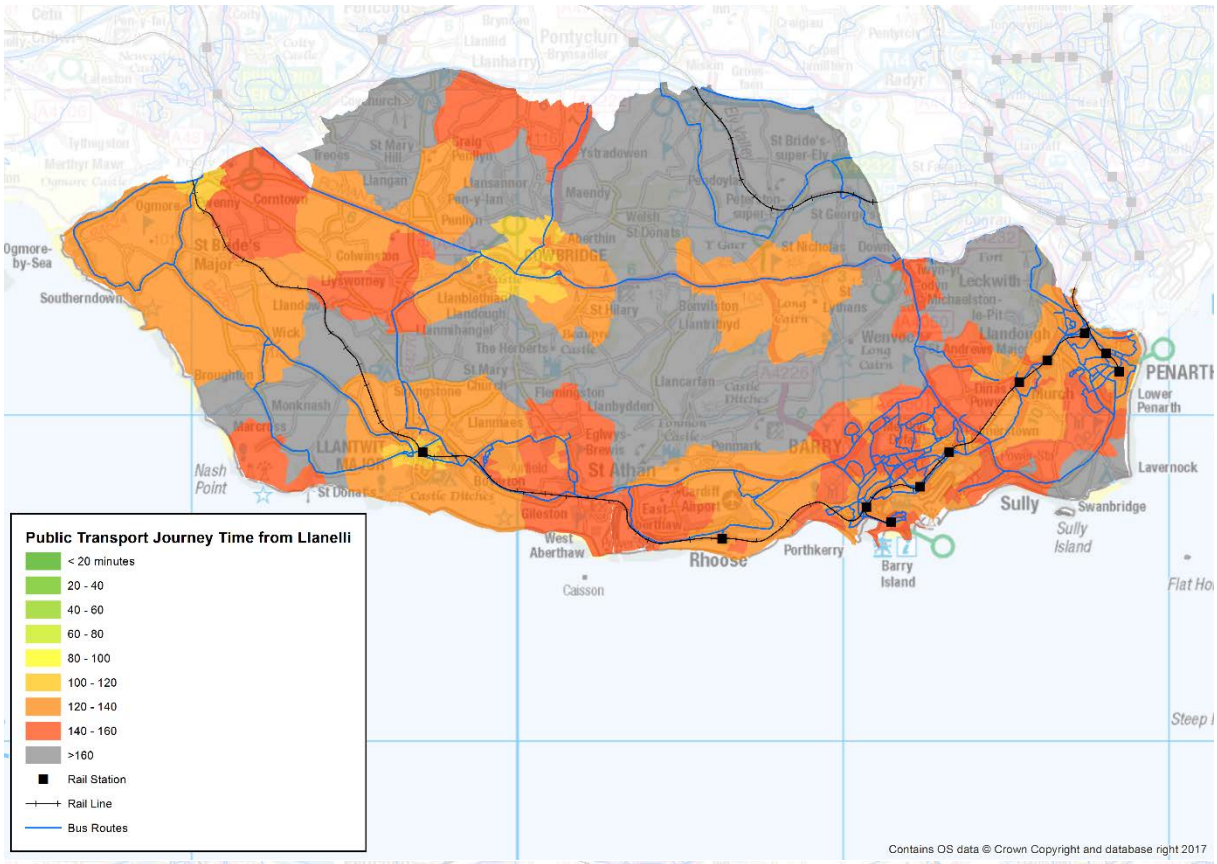


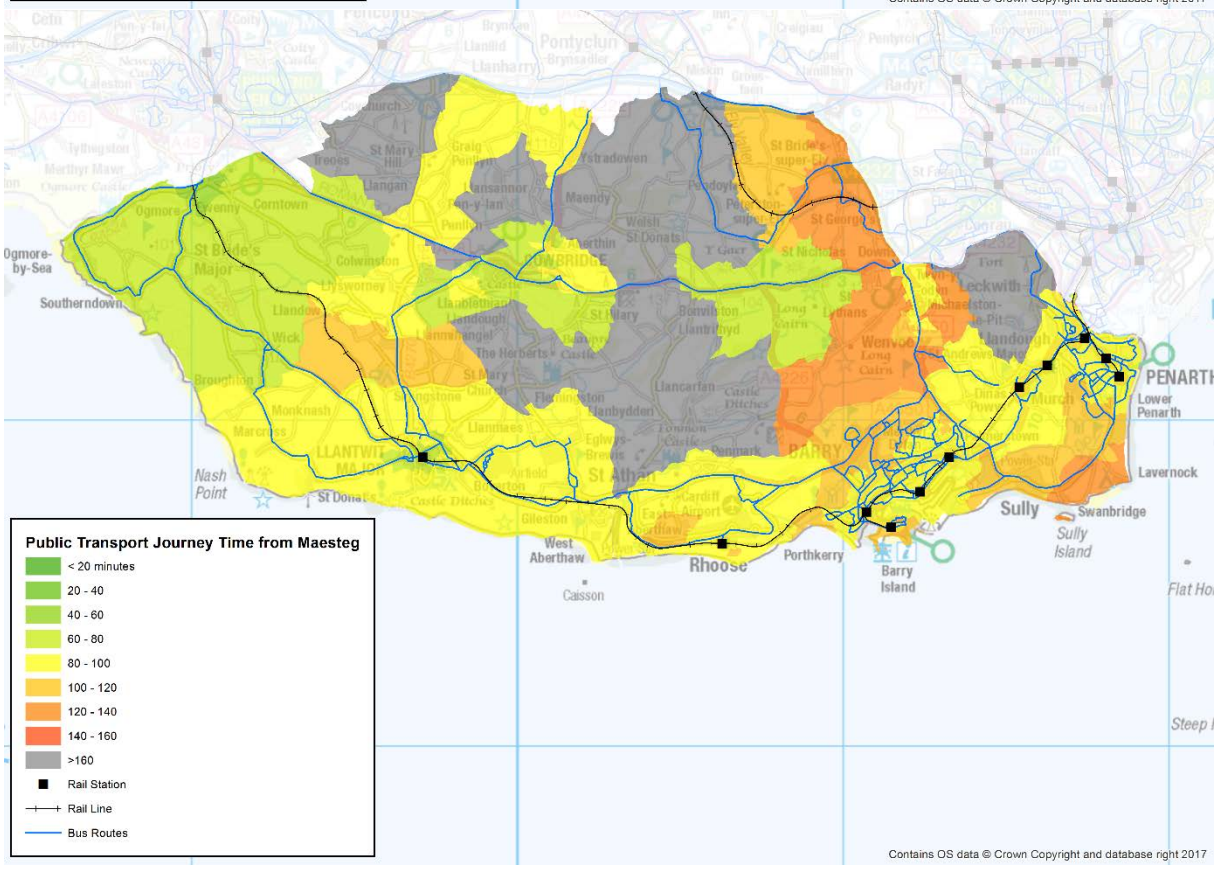

Public Transport Journey Time from Cardiff
< 20 minutes
20 - 40
40 - 60
60 - 80
80 - 100
100 - 120
120 - 140
140 - 160
>160
Rail Station
Rail Line
Bus Routes
Contains OS data © Crown Copyright and database right 2017

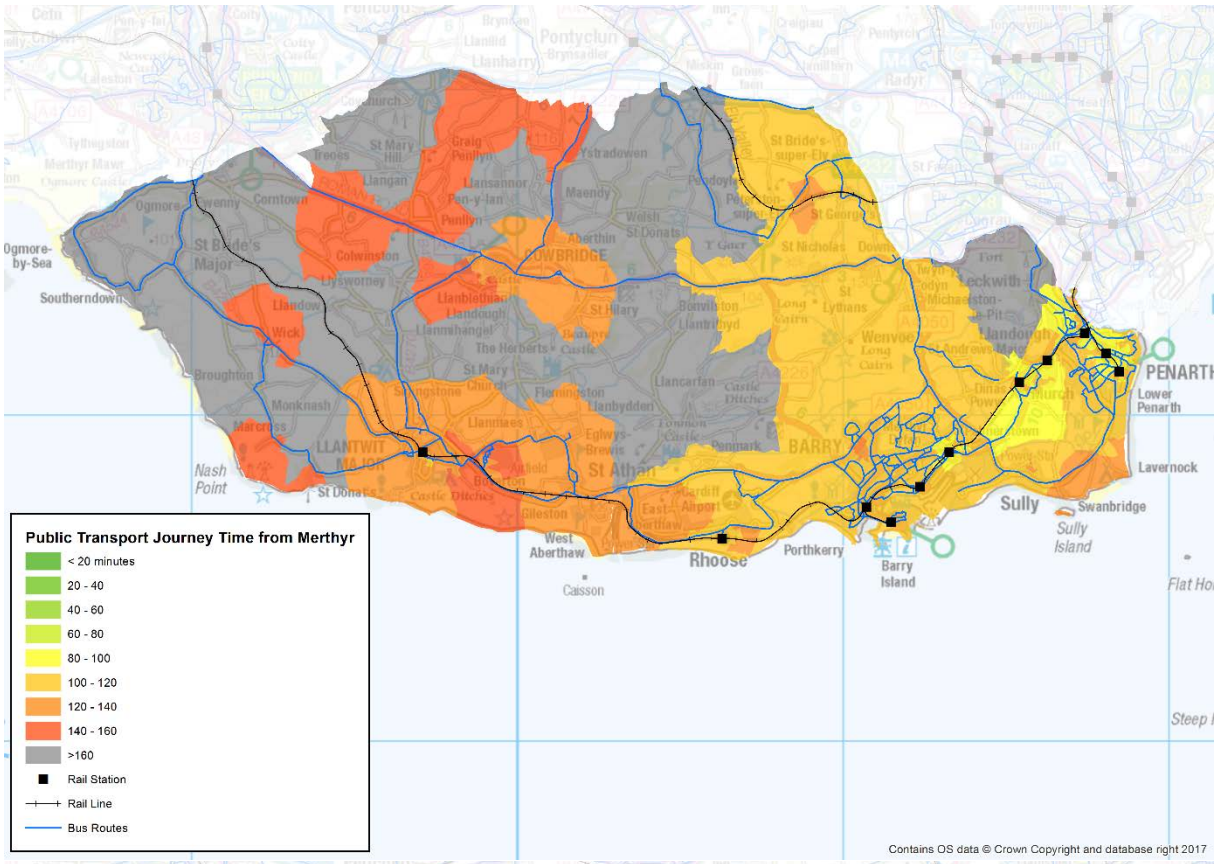

Public Transport Journey Time from Cwmbran
< 20 minutes
20 - 40
40 - 60
60 - 80
80 - 100
100 - 120
120 - 140
140 - 160
>160
Rail Station
Rail Line
Bus Routes
Contains OS data © Crown Copyright and database right 2017

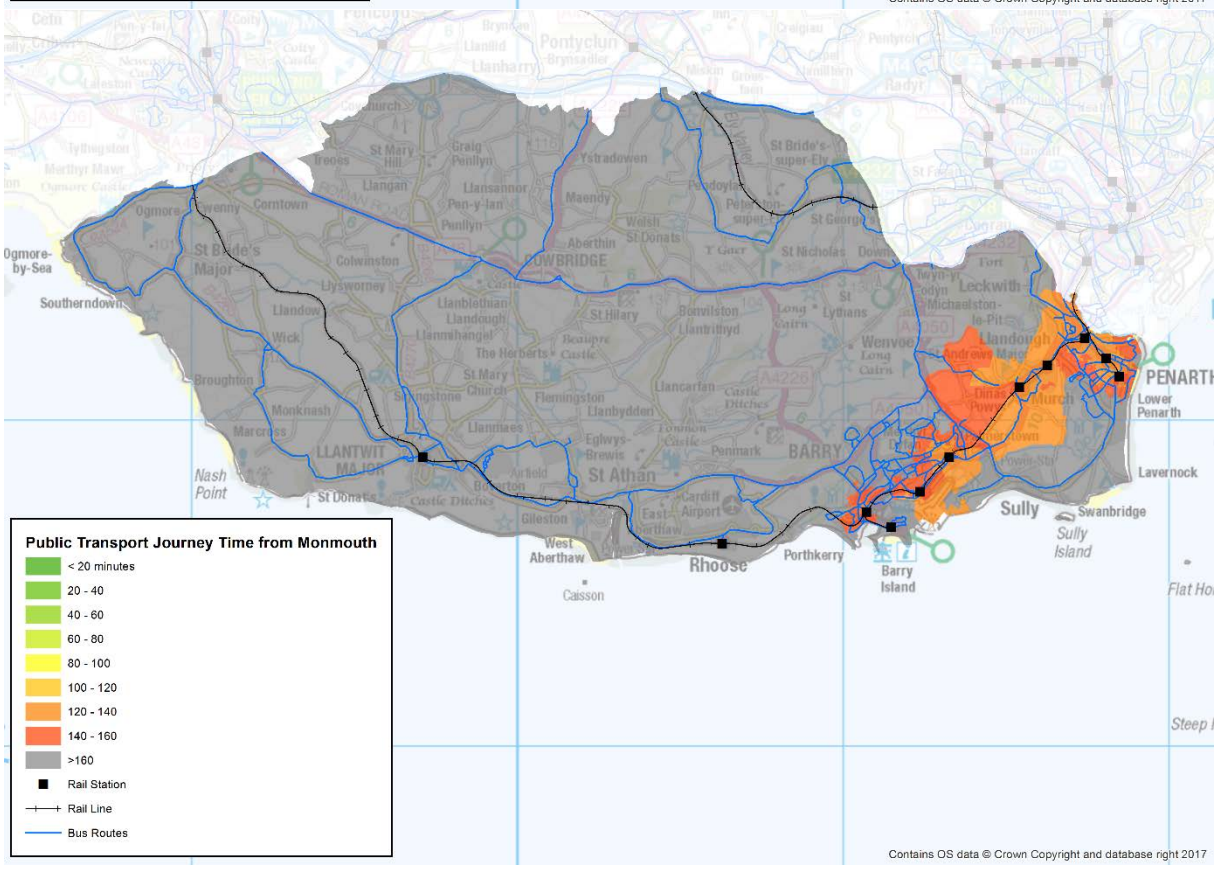

Public Transport Journey Time from Ebbw Vale
< 20 minutes
20 - 40
40 - 60
60 - 80
80 - 100
100 - 120
120 - 140
140 - 160
>160
Rail Station
Rail Line
Bus Routes
Contains OS data © Crown Copyright and database right 2017

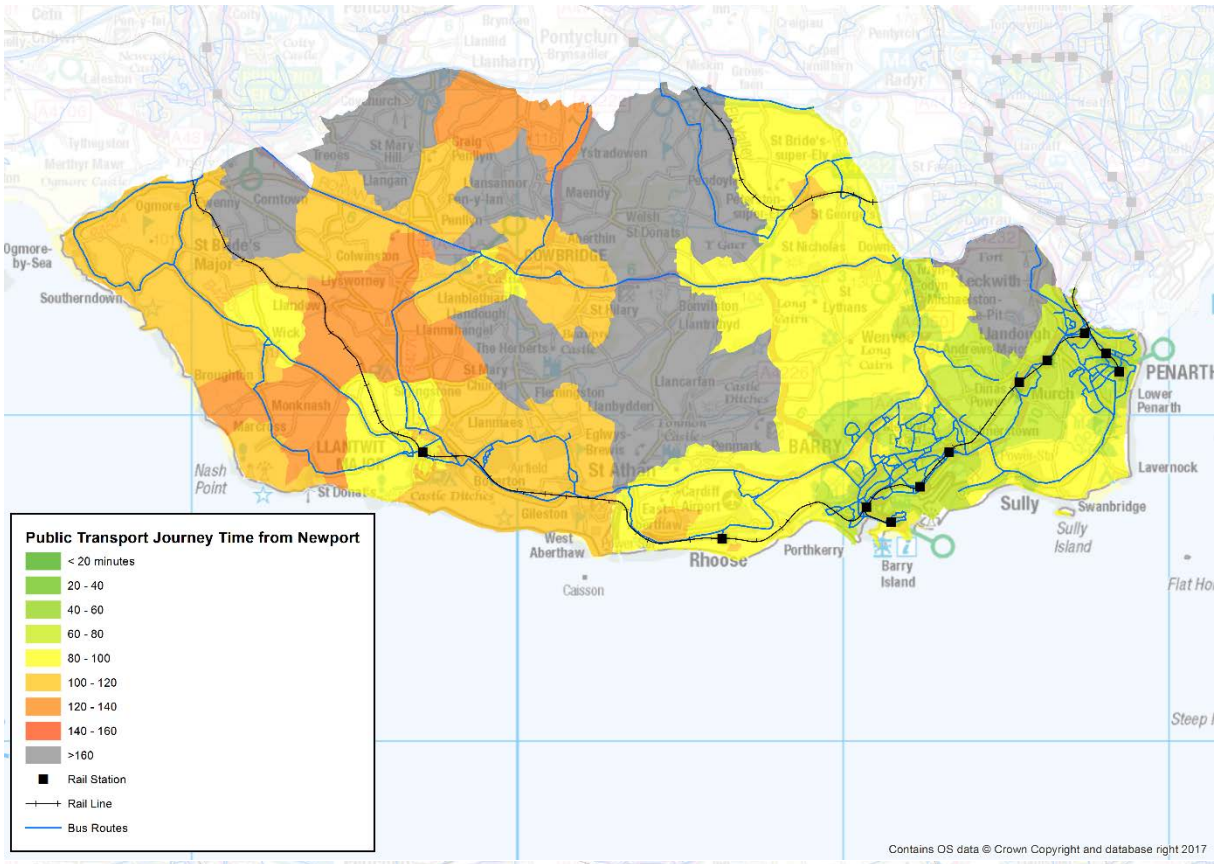

Public Transport Journey Time from Ely
< 20 minutes
20 - 40
40 - 60
60 - 80
80 - 100
100 - 120
120 - 140
140 - 160
>160
Rail Station
Rail Line
Bus Routes
Contains OS data © Crown Copyright and database right 2017

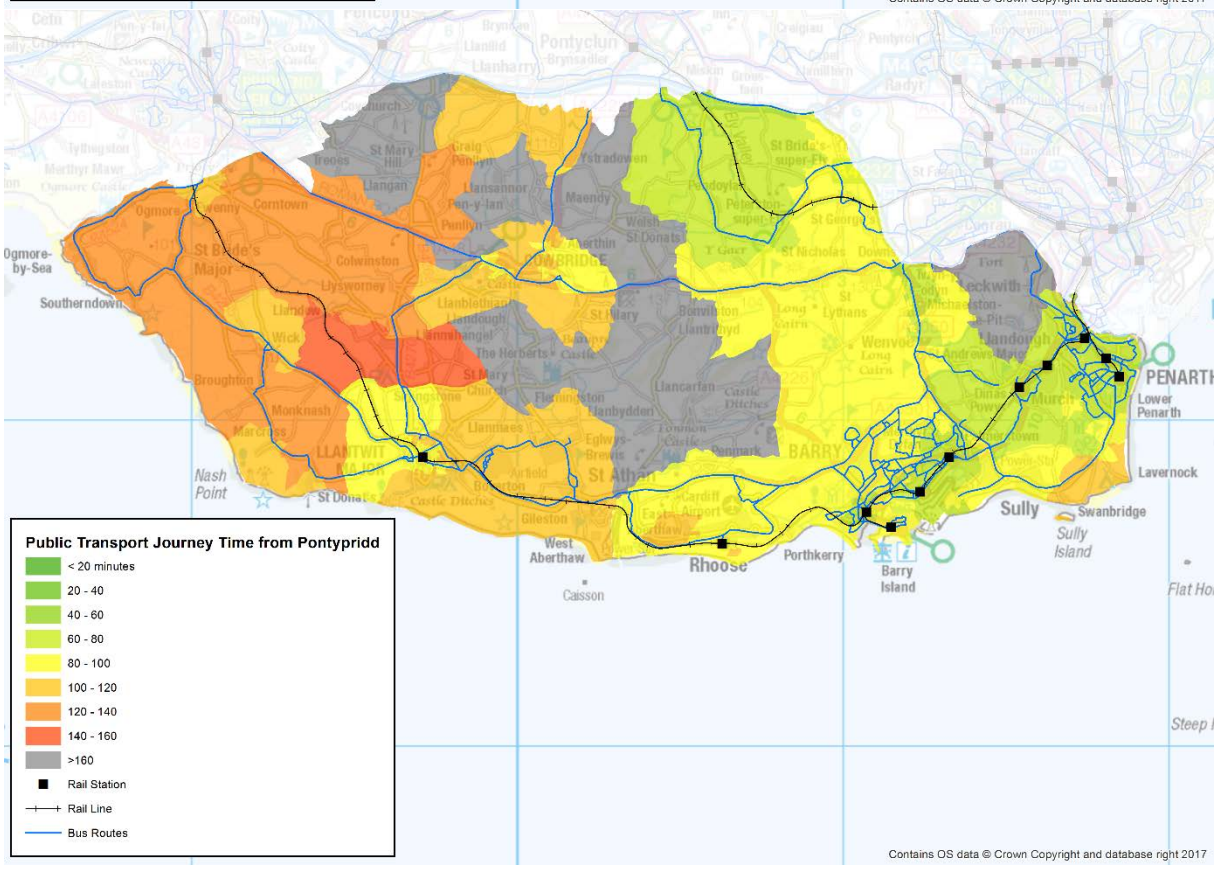

Public Transport Journey Time from Llanelli
< 20 minutes
20 - 40
40 - 60
60 - 80
80 - 100
100 - 120
120 - 140
140 - 160
>160
Rail Station
Rail Line
Bus Routes
Contains OS data © Crown Copyright and database right 2017

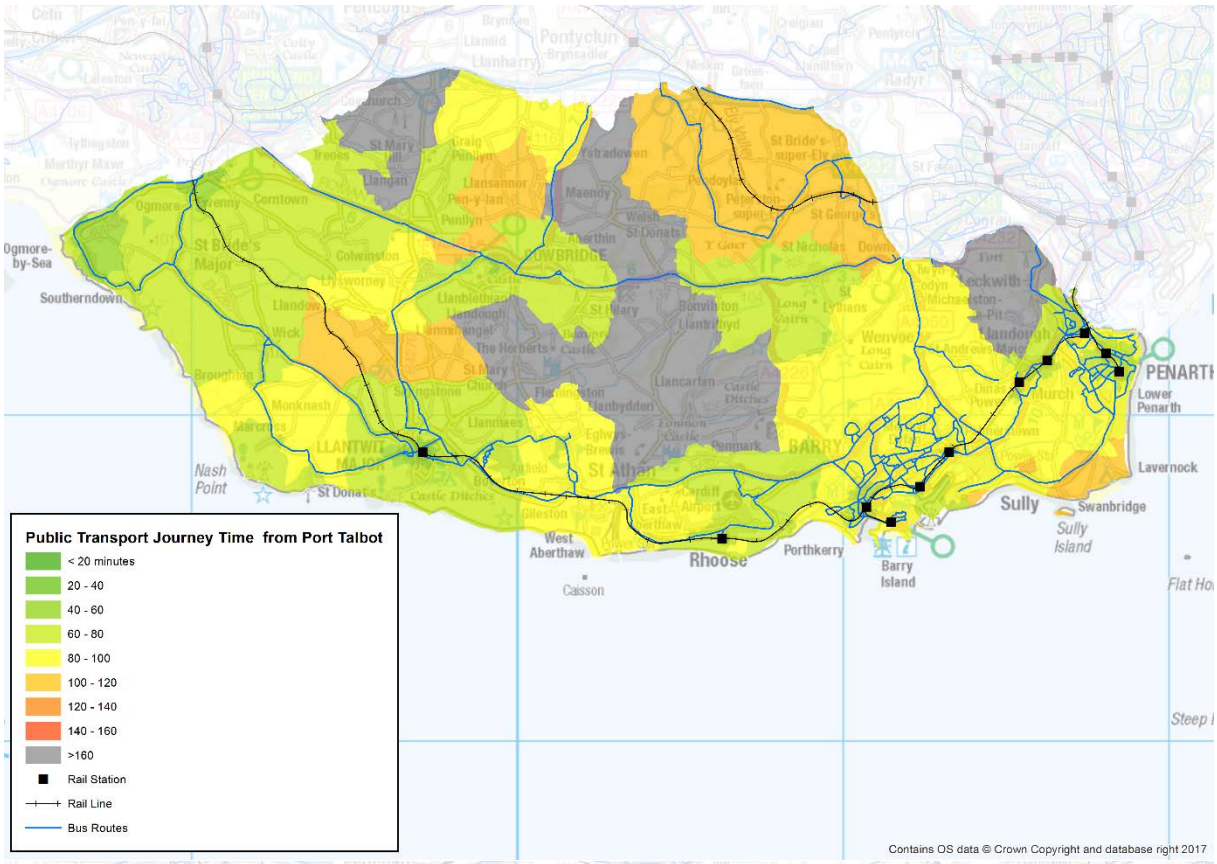

Public Transport Journey Time from Maesteg
< 20 minutes
20 - 40
40 - 60
60 - 80
80 - 100
100 - 120
120 - 140
140 - 160
>160
Rail Station
Rail Line
Bus Routes
Contains OS data © Crown Copyright and database right 2017

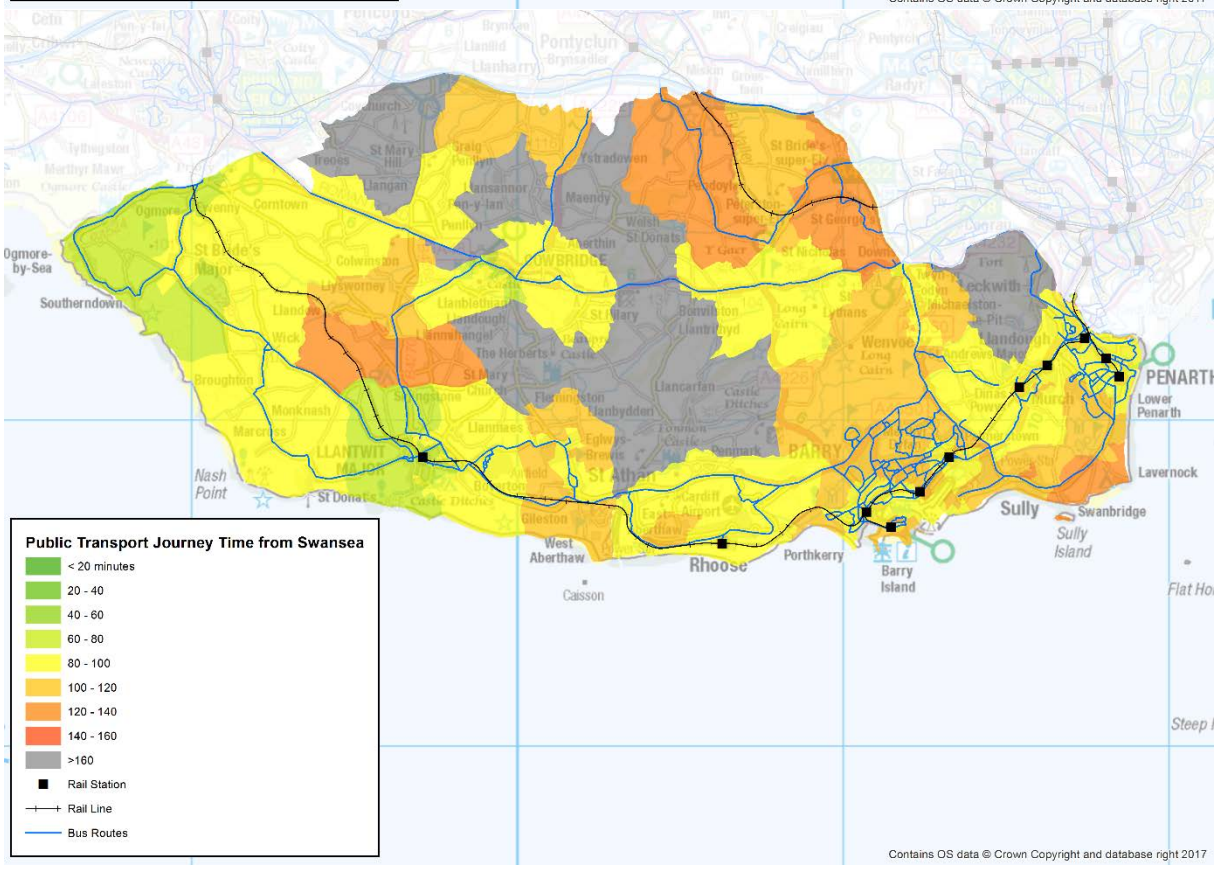

Public Transport Journey Time from Merthyr
< 20 minutes
20 - 40
40 - 60
60 - 80
80 - 100
100 - 120
120 - 140
140 - 160
>160
Rail Station
Rail Line
Bus Routes
Contains OS data © Crown Copyright and database right 2017

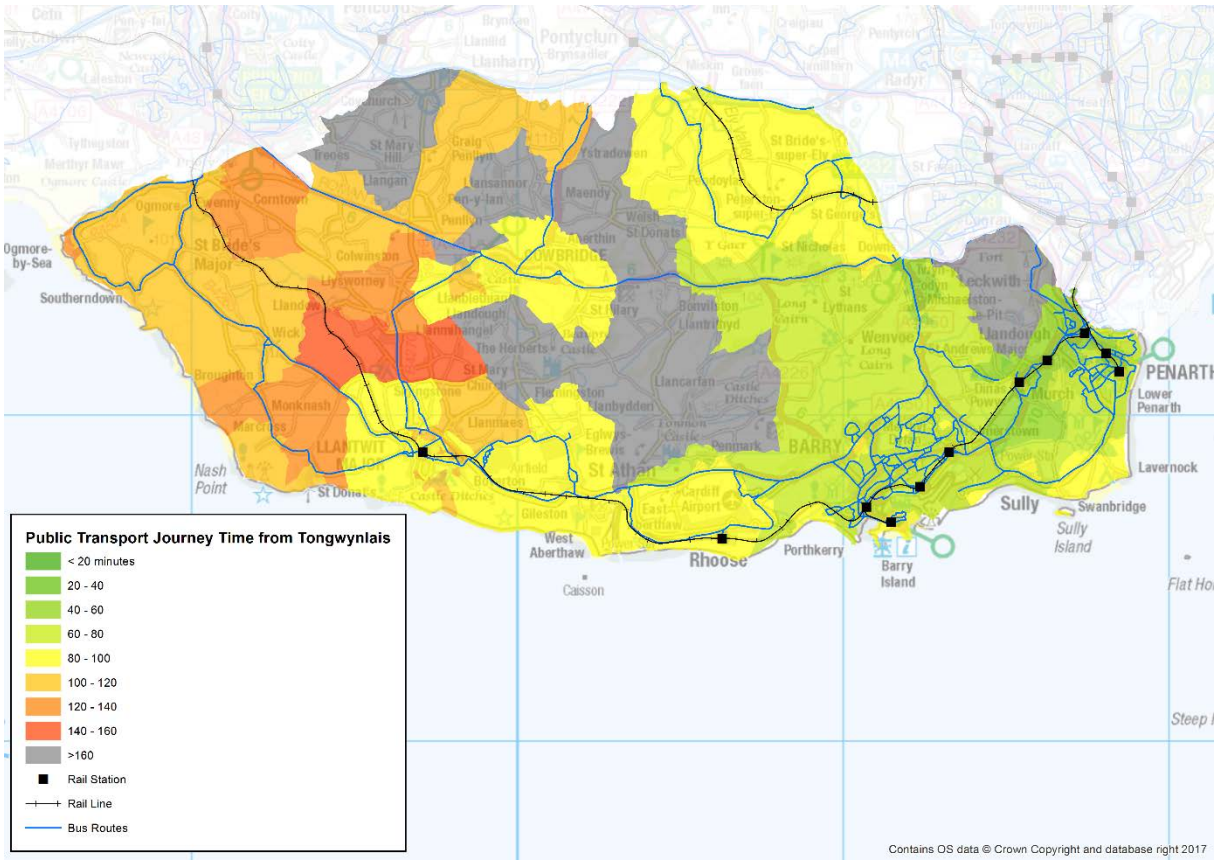

Public Transport Journey Time from Monmouth
< 20 minutes
20 - 40
40 - 60
60 - 80
80 - 100
100 - 120
120 - 140
140 - 160
>160
Rail Station
Rail Line
Bus Routes
Contains OS data © Crown Copyright and database right 2017


Public Transport Journey Time from Newport
< 20 minutes
20 - 40
40 - 60
60 - 80
80 - 100
100 - 120
120 - 140
140 - 160
>160
Rail Station
Rail Line
Bus Routes
Contains OS data © Crown Copyright and database right 2017


Public Transport Journey Time from Pontypridd
< 20 minutes
20 - 40
40 - 60
60 - 80
80 - 100
100 - 120
120 - 140
140 - 160
>160
Rail Station
Rail Line
Bus Routes
Contains OS data © Crown Copyright and database right 2017


Public Transport Journey Time from Port Talbot
< 20 minutes
20 - 40
40 - 60
60 - 80
80 - 100
100 - 120
120 - 140
140 - 160
>160
Rail Station
Rail Line
Bus Routes
Contains OS data © Crown Copyright and database right 2017


Public Transport Journey Time from Swansea
< 20 minutes
20 - 40
40 - 60
60 - 80
80 - 100
100 - 120
120 - 140
140 - 160
>160
Rail Station
Rail Line
Bus Routes
Contains OS data © Crown Copyright and database right 2017


Public Transport Journey Time from Tongwynlais
< 20 minutes
20 - 40
40 - 60
60 - 80
80 - 100
100 - 120
120 - 140
140 - 160
>160
Rail Station
Rail Line
Bus Routes
Contains OS data © Crown Copyright and database right 2017
Southerndown
Nash Point
LLANTWIT
BARRY
Rhoose
Porthkerry
Barry Island
Sully
Swanbridge
Sully Island
Lavernock
Lower Penarth
West Aberthaw
Caisson

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Peter Brett Associates

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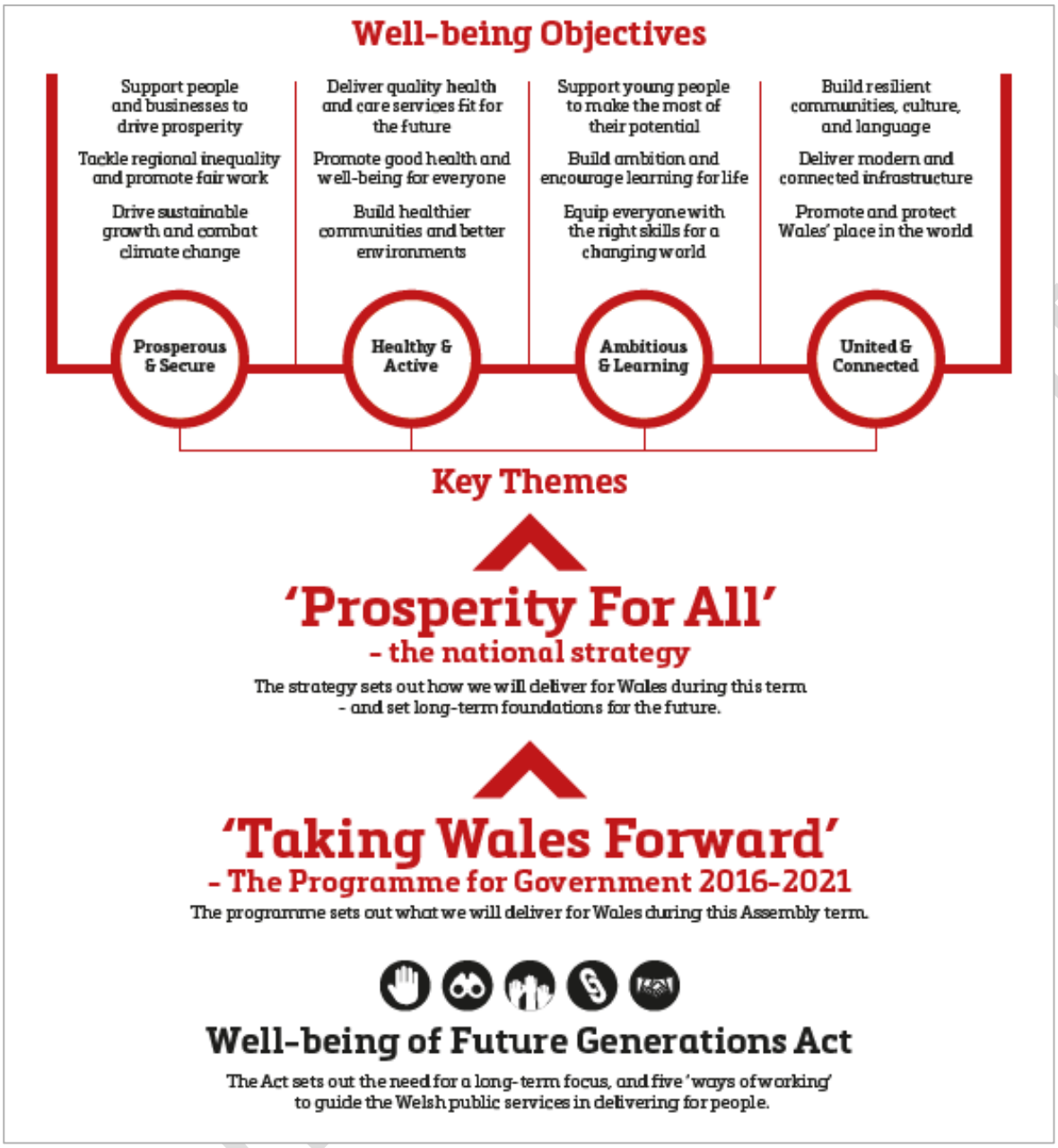
APPENDIX B

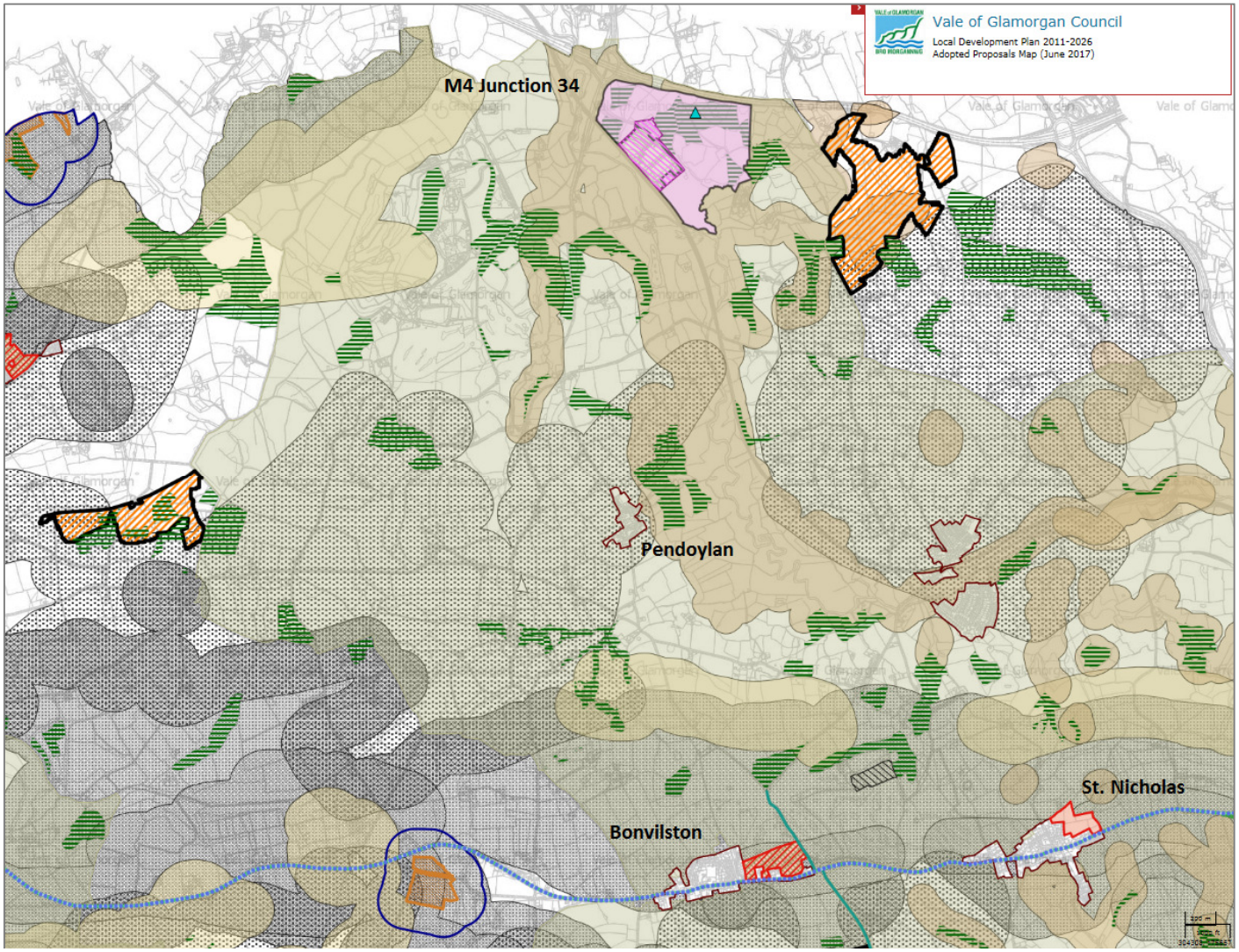
Taking Wales Forward Relationship with Prosperity for All



Taking Wales Forward Relationship with Prosperity for All

APPENDIX C

Vale of Glamorgan Local Development Plan Map



Key

Proposal	Policy / Site Reference
Living	
Housing Allocation	MG 2
Housing Allocation with Infrastructure Provision	MG 2
Strategic Site	MG 3 / MG 10
Residential Settlement Boundary	MD 5
Gypsy and Traveller Site	MG 5
Provision of Education Facilities	MG 6
Provision of Community Facilities	MG 7
Provision of Healthcare Facilities	MG 8
Working	
Employment Allocation	MG 9
Enterprise Zone	MG 10
Retail Hierarchy	MG 12
Managing	
Transport - Walking and Cycling	MG 16 (1 - 5) / SP 7
Transport - National Cycle Network Route 88	MG 16 (1) / SP 7
Transport - Rail	MG 16 (6) / SP 7
Transport - Bus	MG 16 (7 - 12, 20) / SP 7
Transport - Highways	MG 16 (13 - 19) / SP 7
Special Landscape Area	MG 17
Green Wedge	MG 18
Sites of Importance for Nature Conservation	MG 19
Minerals Safeguarding - Limestone Category 1	SP 9, MG 20
Minerals Safeguarding - Limestone Category 2	SP 9, MG 20
Minerals Safeguarding - Sandstone Category 2	SP 9, MG 20
Minerals Safeguarding - Sand & Gravel Category 1	SP 9, MG 20
Minerals Safeguarding - Sand & Gravel Category 2	SP 9, MG 20
Quarry Buffer Zone	SP 9, MG 21
Dormant Mineral Site	SP 9, MG 22
Sand and Gravel Wharf Safeguarding	SP 9 (4)
Sites with known flooding constraints / Flood Consequence Assessments	MD 8
Enjoying	
Glamorgan Heritage Coast	MG 24, SP 10 (4)
Public Open Space	MG 25
Tourism and Leisure Facilities	MG 26, SP 11

APPENDIX D

Photographs

Photograph 1 – Pendoylan Corridor, south direction through Clawdd-Côch

Photograph 2 – North Pendoylan footway provision, south direction

Photograph 3 – Pendoylan Corridor, bus stop and footways in Pendoylan

Photograph 4 – Pendoylan Corridor – narrow highway with passing bays

APPENDIX E

Baseline Traffic Flows

Intelligent Data Collection Limited
Vale of Glamorgan

Client:	Arcadis
Project Number:	ID05235
Site Number:	Site 1
Date of Survey:	25.02.2020
Site Name:	A4226
Survey Type:	Two-way Link Count

Quality Assurance and Issue Record

Quality Assurance

Revision	Rev A			
Date	03.03.2020			
Prepared by	Grant Daniel Breddy			
Signature				
Checked by	Luke Martin			
Signature				
Project Director	Paul O'Neill			
Signature				
Project number	ID05235			
File Ref	ID05235 Vale of Glamorgan - Link Count Site 1 (Arm C) - 25.02.2020			

Issue Sheet

	Date			
Issued to	03.03.2020			
Chad Collins	E-mail			

Contents Page

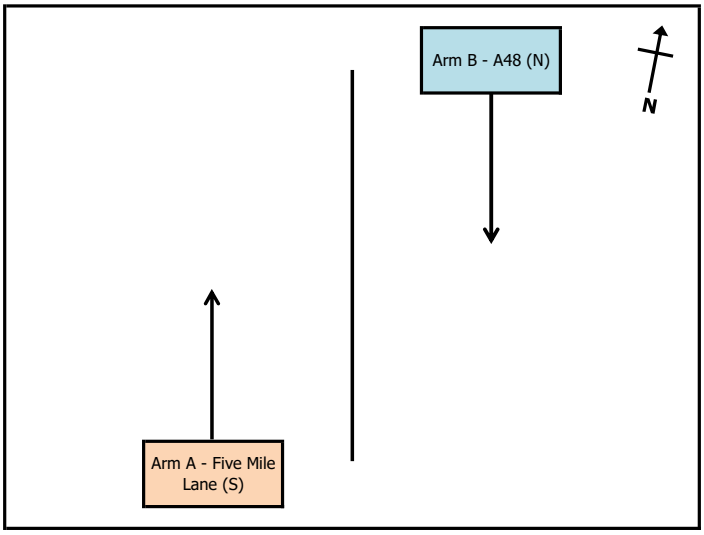
Location Plan & Summary
MCC Data
Movement Matrices

Intelligent Data Collection Limited

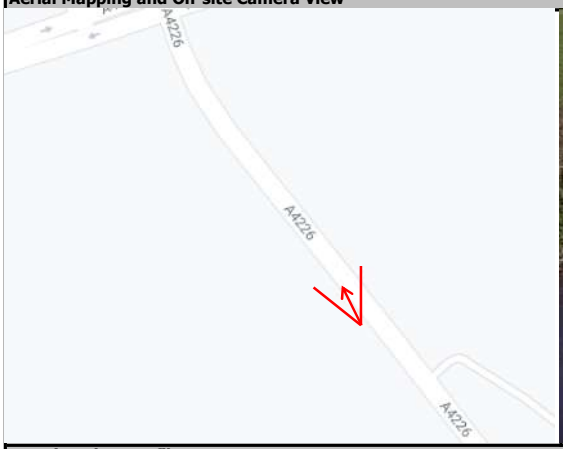
Client:	Arcadis	**Date of Survey:**	25.02.2020
Project Number:	ID05235	**Site Name:**	A4226
Site Number:	Site 1	**Survey Type:**	Two-way Link Count

X Coordinate	Y Coordinate	Google Maps Link	
51.458099	-3.333523	Click Here	
AM Peak Conditions	**Inter-Peak Conditions**	**PM Peak Conditions**	
Overcast	Overcast	Overcast	

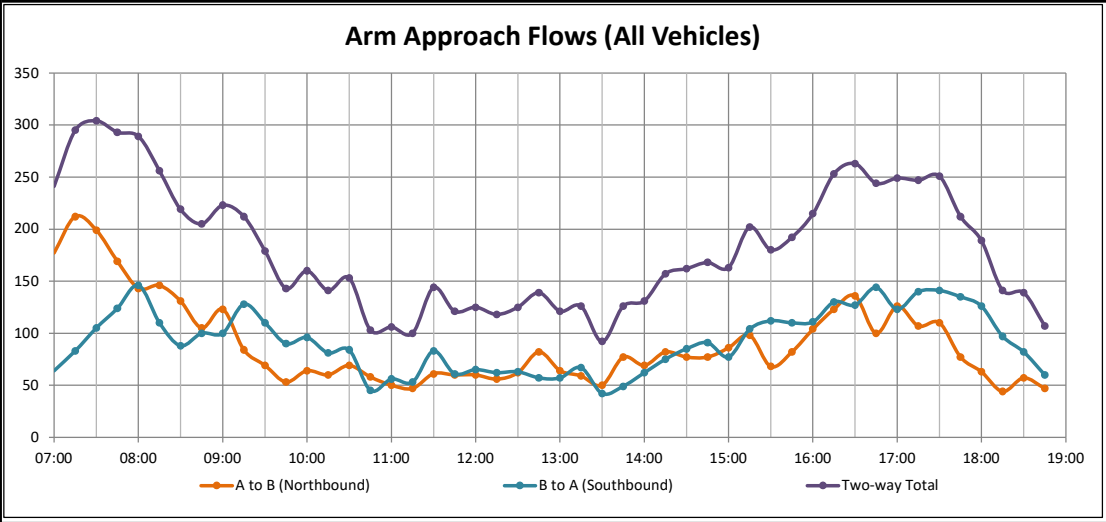
Junction Layout



Aerial Mapping and On-site Camera View



Junction Flow Profile



Additional Notes (Factors which may impact on survey results such as accidents, roadworks, special events):

The yellow line on the Camera View represents the count location.

As requested, these counts are unclassified so show Total Vehicle counts only. As a result, no PCU calculations are included.

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Site Number: Site 1

Date of Survey: 25.02.2020
Site Name: A4226
Survey Type: Two-way Link Count

Arm A: Five Mile Lane (S)
Arm B: A48 (N)

	A to B (Northbound)								B to A (Southbound)								Two-way Total							
Time	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**
07:00								177								64								241
07:15								212								83								295
07:30								199								105								304
07:45								169								124								293
08:00								143								146								289
08:15								146								110								256
08:30								131								88								219
08:45								105								100								205
09:00								123								100								223
09:15								84								128								212
09:30								69								110								179
09:45								53								90								143
10:00								64								96								160
10:15								60								81								141
10:30								69								84								153
10:45								58								45								103
11:00								50								56								106
11:15								47								53								100
11:30								61								83								144
11:45								60								61								121
12:00								60								65								125
12:15								56								62								118
12:30								62								63								125
12:45								82								57								139
13:00								64								57								121
13:15								59								67								126
13:30								50								42								92
13:45								77								49								126
14:00								69								62								131
14:15								82								75								157
14:30								77								85								162
14:45								77								91								168
15:00								86								77								163
15:15								98								104								202
15:30								68								112								180
15:45								82								110								192
16:00								104								111								215
16:15								123								130								253
16:30								136								127								263
16:45								100								144								244
17:00								126								123								249
17:15								107								140								247
17:30								110								141								251
17:45								77								135								212
18:00								63								126								189
18:15								44								97								141
18:30								57								82								139
18:45								47								60								107
Start Time	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**
07:00								757								376								1133
07:15								723								458								1181
07:30								657								485								1142
07:45								589								468								1057
08:00								525								444								969
08:15								505								398								903
08:30								443								416								859
08:45								381								438								819
09:00								329								428								757
09:15								270								424								694

09:30								246								377								623
09:45								246								351								597
10:00								251								306								557
10:15								237								266								503
10:30								224								238								462
10:45								216								237								453
11:00								218								253								471
11:15								228								262								490
11:30								237								271								508
11:45								238								251								489
12:00								260								247								507
12:15								264								239								503
12:30								267								244								511
12:45								255								223								478
13:00								250								215								465
13:15								255								220								475
13:30								278								228								506
13:45								305								271								576
14:00								305								313								618
14:15								322								328								650
14:30								338								357								695
14:45								329								384								713
15:00								334								403								737
15:15								352								437								789
15:30								377								463								840
15:45								445								478								923
16:00								463								512								975
16:15								485								524								1009
16:30								469								534								1003
16:45								443								548								991
17:00								420								539								959
17:15								357								542								899
17:30								294								499								793
17:45								241								440								681
18:00								211								365								576

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 1

Date of Survey: 25.02.2020
Junction Name: A4226
Junction Type: Two-way Link Count

Arm A: Five Mile Lane (S)
Arm B: A48 (N)

Count Method: Vehicles **Classes Included:** All Classes *Select the count method and desired user classes from the drop-downs in cells D8 and G8*

Maximum 15-minute Junction Flow:

AM Peak	**from:**	07:30	**until:**	07:45	**flow:**	304	*AM Peak covers 07:00 until 10:00*
Inter-Peak	**from:**	15:15	**until:**	15:30	**flow:**	202	*Inter-Peak covers 10:00 until 16:00*
PM Peak	**from:**	16:30	**until:**	16:45	**flow:**	263	*PM Peak covers 16:00 until 19:00*

Period Starting: 07:00 *Select the time from the drop-down in cell D16 to show the 15-minute data for that period*

Movement Counts

From \ *To*	**A**	**B**	**Total**
A	0	**177**	**177**
B	64	0	64
Total	64	**177**	241

HGV Proportions

From \ *To*	**A**	**B**	**Total**
A	**0.0%**	**0.0%**	**0.0%**
B	**0.0%**	**0.0%**	**0.0%**
Total	**0.0%**	**0.0%**	0.0%

Maximum Hourly Junction Flow:

AM Peak	**from:**	07:15	**until:**	08:15	**flow:**	1181
Inter-Peak	**from:**	15:45	**until:**	16:45	**flow:**	923
PM Peak	**from:**	16:15	**until:**	17:15	**flow:**	1009

Period Starting: 07:00 *Select the time from the drop-down in cell D31 to show the hourly data for that period*

Movement Counts

From \ *To*	**A**	**B**	**Total**
A	0	**757**	**757**
B	376	0	376
Total	376	**757**	1133

HGV Proportions

From \ *To*	**A**	**B**	**Total**
A	**0.0%**	**0.0%**	**0.0%**
B	**0.0%**	**0.0%**	**0.0%**
Total	**0.0%**	**0.0%**	0.0%

Bold entries in the above tables indicate the maximum movement, approach and exit flows for the selected time period, and similarly with the HGV proportions

Intelligent Data Collection Limited
Vale of Glamorgan

Client:	Arcadis
Project Number:	ID05235
Junction Number:	Site 1
Date of Survey:	11.02.2020
Junction Name:	A48 / A4226 / Unnamed Road
Junction Type:	Crossroads

Quality Assurance and Issue Record

Quality Assurance

Revision	Rev A			
Date	22.02.2020			
Prepared by	Grant Daniel Breddy			
Signature				
Checked by	David Brown			
Signature				
Project Director	Paul O'Neill			
Signature				
Project number	ID05235			
File Ref	ID05235 Vale of Glamorgan - MCC Site 1 - 11.02.2020			

Issue Sheet

Issued to	Date			
	24.02.2020			
Chad Collins	E-mail			

Contents Page

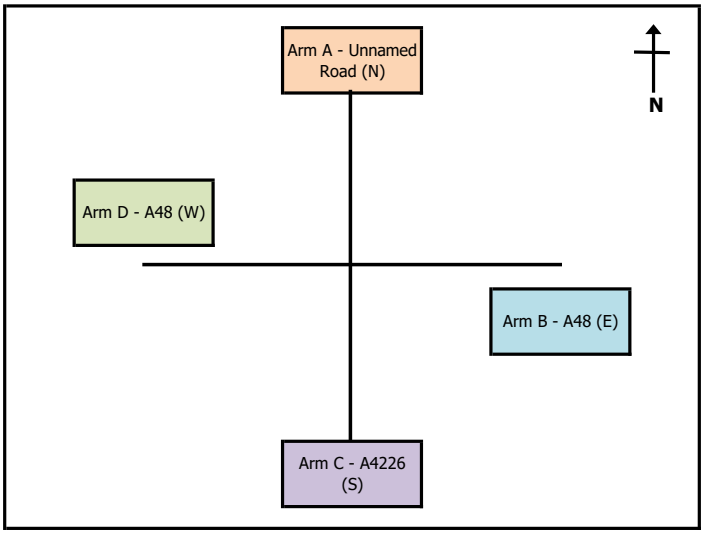
Location Plan & Summary
MCC Data
PCU Data
Movement Matrices

Intelligent Data Collection Limited

Client:	Arcadis	**Date of Survey:**	11.02.2020
Project Number:	ID05235	**Junction Name:**	A48 / A4226 / Unnamed Road
Junction Number:	Site 1	**Junction Type:**	Crossroads

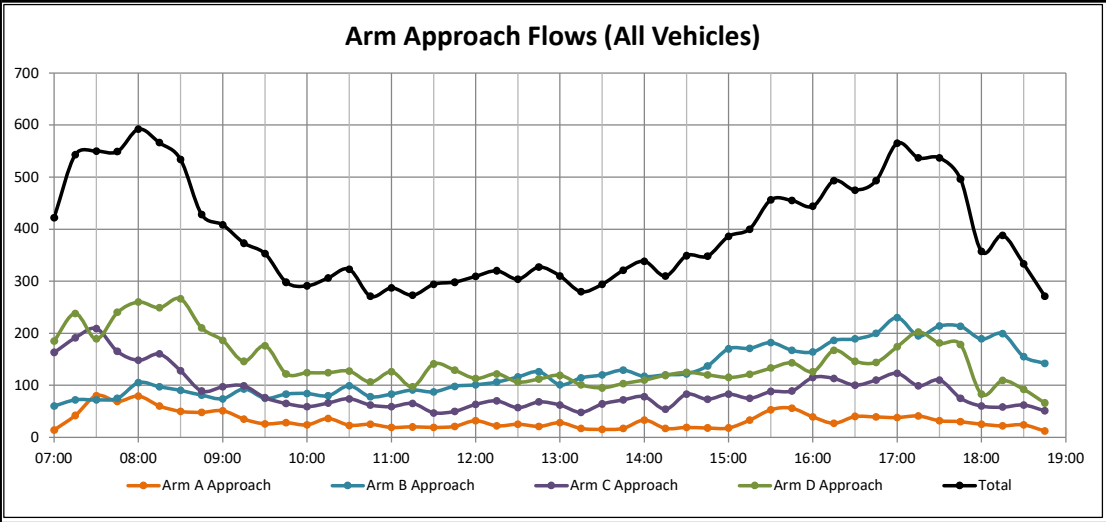
X Coordinate	Y Coordinate	Google Maps Link	
51.4588893004535	-3.334909207297889	Click Here	
AM Peak Conditions	**Inter-Peak Conditions**	**PM Peak Conditions**	
Sunny Intervals	Sunny Intervals	Overcast	

Junction Layout



Aerial Mapping and On-site Camera View

Junction Flow Profile



Additional Notes (Factors which may impact on survey results such as accidents, roadworks, special events):

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 1

Date of Survey: 11.02.2020
Junction Name: A48 / A4226 / Unnamed Road
Junction Type: Crossroads

Arm A: Unnamed Road (N)
Arm B: A48 (E)
Arm C: A4226 (S)
Arm D: A48 (W)

	A to A								A to D								A to C							
Time	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**
07:00								0	1	2	0	0	0	0	0	3	6	3	0	0	0	0	0	9
07:15								0	7	1	0	0	0	0	0	8	12	12	0	0	0	0	0	24
07:30								0	8	1	0	0	0	0	0	9	41	15	0	0	0	0	0	56
07:45								0	11	0	0	0	0	1	0	12	27	12	0	0	0	0	0	39
08:00								0	8	4	0	0	1	0	0	13	44	6	0	0	0	0	0	50
08:15								0	6	1	0	0	0	0	0	7	31	6	1	0	0	0	0	38
08:30								0	6	1	0	1	0	0	0	8	22	3	0	0	0	0	0	25
08:45								0	15	5	0	0	0	0	0	20	14	1	0	0	0	0	0	15
09:00								0	5	1	0	1	0	0	0	7	13	4	0	0	0	0	0	17
09:15								0	5	4	0	0	0	0	0	9	12	3	0	0	0	0	0	15
09:30								0	2	2	1	2	0	0	0	7	11	1	1	0	0	0	0	13
09:45								0	10	1	0	0	0	0	0	11	4	6	1	0	0	0	0	11
10:00								0	7	1	0	1	0	0	0	9	3	0	0	0	0	0	0	3
10:15								0	6	3	0	1	0	0	0	10	11	2	0	0	0	0	0	13
10:30								0	5	1	0	1	0	0	0	7	4	1	0	0	0	0	0	5
10:45								0	6	0	0	1	0	0	0	7	5	4	0	0	0	0	0	9
11:00								0	4	0	1	1	0	0	0	6	5	1	0	1	0	0	0	7
11:15								0	4	1	0	1	0	0	0	6	8	0	1	0	0	0	0	9
11:30								0	4	0	0	1	0	0	0	5	6	0	1	0	0	0	0	7
11:45								0	5	2	0	1	0	0	0	8	7	0	1	0	0	0	0	8
12:00								0	8	1	0	2	0	0	0	11	11	1	1	0	0	0	0	13
12:15								0	7	0	0	1	1	0	0	9	9	1	0	0	0	0	0	10
12:30								0	2	0	0	1	0	0	0	3	15	2	0	0	0	0	0	17
12:45								0	6	1	0	0	0	0	0	7	8	3	0	0	0	0	0	11
13:00								0	4	1	0	1	0	0	0	6	10	4	0	0	0	0	0	14
13:15								0	5	2	0	0	0	0	0	7	5	1	0	0	0	0	0	6
13:30								0	2	2	0	1	0	0	0	5	2	1	0	0	0	0	0	3
13:45								0	5	0	0	2	0	0	0	7	4	3	0	0	0	0	0	7
14:00								0	5	1	0	0	0	0	0	6	11	4	0	0	0	0	0	15
14:15								0	7	0	0	3	0	0	0	10	4	0	0	0	0	0	0	4
14:30								0	6	0	0	0	0	0	0	6	7	0	0	0	0	0	0	7
14:45								0	6	3	0	2	0	0	0	11	3	0	1	0	0	0	0	4
15:00								0	5	1	0	1	1	0	0	8	7	1	0	0	0	0	0	8
15:15								0	10	0	0	2	0	0	0	12	10	5	1	0	0	0	0	16
15:30								0	15	2	0	1	1	0	0	19	21	1	1	0	0	0	0	23
15:45								0	14	1	0	1	0	0	0	16	18	5	0	0	0	0	0	23
16:00								0	13	2	2	0	0	0	0	17	13	3	0	0	0	0	0	16
16:15								0	10	1	0	0	0	0	0	11	10	2	0	0	0	0	0	12
16:30								0	6	3	0	0	0	0	0	9	21	6	0	0	0	0	0	27
16:45								0	8	0	1	0	0	1	0	10	17	6	0	0	0	0	0	23
17:00								0	11	1	0	0	0	0	0	12	19	5	0	0	0	0	0	24
17:15								0	12	0	0	0	0	0	0	12	25	1	0	0	0	0	0	26
17:30								0	4	1	0	0	0	0	0	5	21	3	1	0	0	0	0	25
17:45								0	11	1	0	0	0	0	0	12	12	1	0	0	0	0	0	13
18:00								0	8	1	0	0	0	0	0	9	14	0	0	0	0	0	0	14
18:15								0	5	0	0	0	0	0	0	5	14	0	0	0	0	0	0	14
18:30								0	5	0	0	0	0	0	0	5	16	1	0	0	0	0	0	17
18:45								0	3	1	0	0	0	0	0	4	4	1	0	0	0	0	0	5
Start Time	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**
07:00	0	0	0	0	0	0	0	0	27	4	0	0	0	1	0	32	86	42	0	0	0	0	0	128
07:15	0	0	0	0	0	0	0	0	34	6	0	0	1	1	0	42	124	45	0	0	0	0	0	169
07:30	0	0	0	0	0	0	0	0	33	6	0	0	1	1	0	41	143	39	1	0	0	0	0	183
07:45	0	0	0	0	0	0	0	0	31	6	0	1	1	1	0	40	124	27	1	0	0	0	0	152
08:00	0	0	0	0	0	0	0	0	35	11	0	1	1	0	0	48	111	16	1	0	0	0	0	128
08:15	0	0	0	0	0	0	0	0	32	8	0	2	0	0	0	42	80	14	1	0	0	0	0	95

08:30	0	0	0	0	0	0	0	0	31	11	0	2	0	0	0	44	61	11	0	0	0	0	0	72
08:45	0	0	0	0	0	0	0	0	27	12	1	3	0	0	0	43	50	9	1	0	0	0	0	60
09:00	0	0	0	0	0	0	0	0	22	8	1	3	0	0	0	34	40	14	2	0	0	0	0	56
09:15	0	0	0	0	0	0	0	0	24	8	1	3	0	0	0	36	30	10	2	0	0	0	0	42
09:30	0	0	0	0	0	0	0	0	25	7	1	4	0	0	0	37	29	9	2	0	0	0	0	40
09:45	0	0	0	0	0	0	0	0	28	6	0	3	0	0	0	37	22	9	1	0	0	0	0	32
10:00	0	0	0	0	0	0	0	0	24	5	0	4	0	0	0	33	23	7	0	0	0	0	0	30
10:15	0	0	0	0	0	0	0	0	21	4	1	4	0	0	0	30	25	8	0	1	0	0	0	34
10:30	0	0	0	0	0	0	0	0	19	2	1	4	0	0	0	26	22	6	1	1	0	0	0	30
10:45	0	0	0	0	0	0	0	0	18	1	1	4	0	0	0	24	24	5	2	1	0	0	0	32
11:00	0	0	0	0	0	0	0	0	17	3	1	4	0	0	0	25	26	1	3	1	0	0	0	31
11:15	0	0	0	0	0	0	0	0	21	4	0	5	0	0	0	30	32	1	4	0	0	0	0	37
11:30	0	0	0	0	0	0	0	0	24	3	0	5	1	0	0	33	33	2	3	0	0	0	0	38
11:45	0	0	0	0	0	0	0	0	22	3	0	5	1	0	0	31	42	4	2	0	0	0	0	48
12:00	0	0	0	0	0	0	0	0	23	2	0	4	1	0	0	30	43	7	1	0	0	0	0	51
12:15	0	0	0	0	0	0	0	0	19	2	0	3	1	0	0	25	42	10	0	0	0	0	0	52
12:30	0	0	0	0	0	0	0	0	17	4	0	2	0	0	0	23	38	10	0	0	0	0	0	48
12:45	0	0	0	0	0	0	0	0	17	6	0	2	0	0	0	25	25	9	0	0	0	0	0	34
13:00	0	0	0	0	0	0	0	0	16	5	0	4	0	0	0	25	21	9	0	0	0	0	0	30
13:15	0	0	0	0	0	0	0	0	17	5	0	3	0	0	0	25	22	9	0	0	0	0	0	31
13:30	0	0	0	0	0	0	0	0	19	3	0	6	0	0	0	28	21	8	0	0	0	0	0	29
13:45	0	0	0	0	0	0	0	0	23	1	0	5	0	0	0	29	26	7	0	0	0	0	0	33
14:00	0	0	0	0	0	0	0	0	24	4	0	5	0	0	0	33	25	4	1	0	0	0	0	30
14:15	0	0	0	0	0	0	0	0	24	4	0	6	1	0	0	35	21	1	1	0	0	0	0	23
14:30	0	0	0	0	0	0	0	0	27	4	0	5	1	0	0	37	27	6	2	0	0	0	0	35
14:45	0	0	0	0	0	0	0	0	36	6	0	6	2	0	0	50	41	7	3	0	0	0	0	51
15:00	0	0	0	0	0	0	0	0	44	4	0	5	2	0	0	55	56	12	2	0	0	0	0	70
15:15	0	0	0	0	0	0	0	0	52	5	2	4	1	0	0	64	62	14	2	0	0	0	0	78
15:30	0	0	0	0	0	0	0	0	52	6	2	2	1	0	0	63	62	11	1	0	0	0	0	74
15:45	0	0	0	0	0	0	0	0	43	7	2	1	0	0	0	53	62	16	0	0	0	0	0	78
16:00	0	0	0	0	0	0	0	0	37	6	3	0	0	1	0	47	61	17	0	0	0	0	0	78
16:15	0	0	0	0	0	0	0	0	35	5	1	0	0	1	0	42	67	19	0	0	0	0	0	86
16:30	0	0	0	0	0	0	0	0	37	4	1	0	0	1	0	43	82	18	0	0	0	0	0	100
16:45	0	0	0	0	0	0	0	0	35	2	1	0	0	1	0	39	82	15	1	0	0	0	0	98
17:00	0	0	0	0	0	0	0	0	38	3	0	0	0	0	0	41	77	10	1	0	0	0	0	88
17:15	0	0	0	0	0	0	0	0	35	3	0	0	0	0	0	38	72	5	1	0	0	0	0	78
17:30	0	0	0	0	0	0	0	0	28	3	0	0	0	0	0	31	61	4	1	0	0	0	0	66
17:45	0	0	0	0	0	0	0	0	29	2	0	0	0	0	0	31	56	2	0	0	0	0	0	58
18:00	0	0	0	0	0	0	0	0	21	2	0	0	0	0	0	23	48	2	0	0	0	0	0	50

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 1

Date of Survey: 11.02.2020
Junction Name: A48 / A4226 / Unnamed Road
Junction Type: Crossroads

Arm A: Unnamed Road (N)
Arm B: A48 (E)
Arm C: A4226 (S)
Arm D: A48 (W)

	A to B								B to B								B to A							
Time	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**
07:00	2	0	0	0	0	0	0	2								0	1	0	0	0	0	0	0	1
07:15	8	2	0	0	0	0	0	10								0	3	2	1	0	0	0	0	6
07:30	12	3	0	0	0	0	0	15								0	3	0	0	0	0	0	0	3
07:45	16	1	1	0	0	0	0	18								0	1	3	0	0	0	0	0	4
08:00	15	1	0	0	0	0	0	16								0	5	0	0	0	0	0	0	5
08:15	14	0	0	0	0	1	0	15								0	3	2	0	0	0	0	0	5
08:30	15	2	0	0	0	0	0	17								0	10	0	0	0	0	0	0	10
08:45	13	0	0	0	0	0	0	13								0	3	3	1	0	0	0	0	7
09:00	25	2	0	0	0	0	0	27								0	4	3	0	0	0	0	0	7
09:15	11	0	0	0	0	0	0	11								0	1	0	0	0	0	0	0	1
09:30	5	1	0	0	0	0	0	6								0	3	3	0	0	0	0	0	6
09:45	6	0	0	0	0	0	0	6								0	3	0	2	0	0	0	0	5
10:00	10	1	0	1	0	0	0	12								0	6	0	1	0	0	0	0	7
10:15	10	0	3	0	0	0	0	13								0	5	1	0	0	0	0	0	6
10:30	8	3	0	0	0	0	0	11								0	8	1	0	0	0	0	0	9
10:45	8	1	0	0	0	0	0	9								0	7	1	0	0	0	0	0	8
11:00	4	2	0	0	0	0	0	6								0	3	2	0	0	0	0	1	6
11:15	5	0	0	0	0	0	0	5								0	4	2	0	0	0	0	0	6
11:30	7	0	0	0	0	0	0	7								0	8	0	0	1	0	0	0	9
11:45	3	1	0	1	0	0	0	5								0	3	2	0	0	0	0	0	5
12:00	7	1	0	0	0	0	0	8								0	7	0	0	0	0	0	0	7
12:15	3	0	0	0	0	0	0	3								0	4	0	0	0	0	0	0	4
12:30	4	1	0	0	0	0	0	5								0	3	0	1	0	0	0	0	4
12:45	2	0	1	0	0	0	0	3								0	4	0	0	0	0	0	0	4
13:00	7	0	1	0	0	0	0	8								0	1	0	0	1	0	0	0	2
13:15	4	0	0	0	0	0	0	4								0	6	0	0	0	0	0	0	6
13:30	6	0	1	0	0	0	0	7								0	7	1	0	0	0	0	0	8
13:45	3	0	0	0	0	0	0	3								0	13	1	0	0	0	0	0	14
14:00	10	2	0	0	0	0	0	12								0	3	2	0	0	0	0	0	5
14:15	3	0	0	0	0	0	0	3								0	3	0	1	0	0	0	0	4
14:30	4	2	0	0	0	0	0	6								0	5	0	1	0	0	0	0	6
14:45	2	1	0	0	0	0	0	3								0	6	0	0	0	0	0	0	6
15:00	1	1	0	0	0	0	0	2								0	12	1	0	0	0	0	0	13
15:15	5	0	0	0	0	0	0	5								0	8	0	0	0	0	0	0	8
15:30	10	1	0	0	0	0	0	11								0	7	1	0	0	0	0	0	8
15:45	16	1	0	0	0	0	0	17								0	8	0	0	0	0	0	0	8
16:00	5	1	0	0	0	0	0	6								0	6	0	0	0	0	0	0	6
16:15	3	1	0	0	0	0	0	4								0	8	2	0	0	0	0	0	10
16:30	3	1	0	0	0	0	0	4								0	4	2	0	0	0	0	0	6
16:45	6	0	0	0	0	0	0	6								0	7	1	0	0	0	0	0	8
17:00	2	0	0	0	0	0	0	2								0	2	0	0	0	0	0	0	2
17:15	3	0	0	0	0	0	0	3								0	7	1	0	0	0	0	0	8
17:30	2	0	0	0	0	0	0	2								0	7	0	0	0	0	0	0	7
17:45	4	1	0	0	0	0	0	5								0	6	0	0	0	0	0	0	6
18:00	2	0	0	0	0	0	0	2								0	5	0	0	0	0	0	0	5
18:15	2	1	0	0	0	0	0	3								0	9	0	0	0	0	0	0	9
18:30	1	1	0	0	0	0	0	2								0	6	0	0	0	0	0	0	6
18:45	3	0	0	0	0	0	0	3								0	5	0	0	0	0	0	0	5
Start Time	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**
07:00	38	6	1	0	0	0	0	45	0	0	0	0	0	0	0	0	8	5	1	0	0	0	0	14
07:15	51	7	1	0	0	0	0	59	0	0	0	0	0	0	0	0	12	5	1	0	0	0	0	18
07:30	57	5	1	0	0	1	0	64	0	0	0	0	0	0	0	0	12	5	0	0	0	0	0	17
07:45	60	4	1	0	0	1	0	66	0	0	0	0	0	0	0	0	19	5	0	0	0	0	0	24
08:00	57	3	0	0	0	1	0	61	0	0	0	0	0	0	0	0	21	5	1	0	0	0	0	27
08:15	67	4	0	0	0	1	0	72	0	0	0	0	0	0	0	0	20	8	1	0	0	0	0	29

08:30	64	4	0	0	0	0	0	68	0	0	0	0	0	0	0	0	18	6	1	0	0	0	0	25
08:45	54	3	0	0	0	0	0	57	0	0	0	0	0	0	0	0	11	9	1	0	0	0	0	21
09:00	47	3	0	0	0	0	0	50	0	0	0	0	0	0	0	0	11	6	2	0	0	0	0	19
09:15	32	2	0	1	0	0	0	35	0	0	0	0	0	0	0	0	13	3	3	0	0	0	0	19
09:30	31	2	3	1	0	0	0	37	0	0	0	0	0	0	0	0	17	4	3	0	0	0	0	24
09:45	34	4	3	1	0	0	0	42	0	0	0	0	0	0	0	0	22	2	3	0	0	0	0	27
10:00	36	5	3	1	0	0	0	45	0	0	0	0	0	0	0	0	26	3	1	0	0	0	0	30
10:15	30	6	3	0	0	0	0	39	0	0	0	0	0	0	0	0	23	5	0	0	0	0	1	29
10:30	25	6	0	0	0	0	0	31	0	0	0	0	0	0	0	0	22	6	0	0	0	0	1	29
10:45	24	3	0	0	0	0	0	27	0	0	0	0	0	0	0	0	22	5	0	1	0	0	1	29
11:00	19	3	0	1	0	0	0	23	0	0	0	0	0	0	0	0	18	6	0	1	0	0	1	26
11:15	22	2	0	1	0	0	0	25	0	0	0	0	0	0	0	0	22	4	0	1	0	0	0	27
11:30	20	2	0	1	0	0	0	23	0	0	0	0	0	0	0	0	22	2	0	1	0	0	0	25
11:45	17	3	0	1	0	0	0	21	0	0	0	0	0	0	0	0	17	2	1	0	0	0	0	20
12:00	16	2	1	0	0	0	0	19	0	0	0	0	0	0	0	0	18	0	1	0	0	0	0	19
12:15	16	1	2	0	0	0	0	19	0	0	0	0	0	0	0	0	12	0	1	1	0	0	0	14
12:30	17	1	2	0	0	0	0	20	0	0	0	0	0	0	0	0	14	0	1	1	0	0	0	16
12:45	19	0	3	0	0	0	0	22	0	0	0	0	0	0	0	0	18	1	0	1	0	0	0	20
13:00	20	0	2	0	0	0	0	22	0	0	0	0	0	0	0	0	27	2	0	1	0	0	0	30
13:15	23	2	1	0	0	0	0	26	0	0	0	0	0	0	0	0	29	4	0	0	0	0	0	33
13:30	22	2	1	0	0	0	0	25	0	0	0	0	0	0	0	0	26	4	1	0	0	0	0	31
13:45	20	4	0	0	0	0	0	24	0	0	0	0	0	0	0	0	24	3	2	0	0	0	0	29
14:00	19	5	0	0	0	0	0	24	0	0	0	0	0	0	0	0	17	2	2	0	0	0	0	21
14:15	10	4	0	0	0	0	0	14	0	0	0	0	0	0	0	0	26	1	2	0	0	0	0	29
14:30	12	4	0	0	0	0	0	16	0	0	0	0	0	0	0	0	31	1	1	0	0	0	0	33
14:45	18	3	0	0	0	0	0	21	0	0	0	0	0	0	0	0	33	2	0	0	0	0	0	35
15:00	32	3	0	0	0	0	0	35	0	0	0	0	0	0	0	0	35	2	0	0	0	0	0	37
15:15	36	3	0	0	0	0	0	39	0	0	0	0	0	0	0	0	29	1	0	0	0	0	0	30
15:30	34	4	0	0	0	0	0	38	0	0	0	0	0	0	0	0	29	3	0	0	0	0	0	32
15:45	27	4	0	0	0	0	0	31	0	0	0	0	0	0	0	0	26	4	0	0	0	0	0	30
16:00	17	3	0	0	0	0	0	20	0	0	0	0	0	0	0	0	25	5	0	0	0	0	0	30
16:15	14	2	0	0	0	0	0	16	0	0	0	0	0	0	0	0	21	5	0	0	0	0	0	26
16:30	14	1	0	0	0	0	0	15	0	0	0	0	0	0	0	0	20	4	0	0	0	0	0	24
16:45	13	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	23	2	0	0	0	0	0	25
17:00	11	1	0	0	0	0	0	12	0	0	0	0	0	0	0	0	22	1	0	0	0	0	0	23
17:15	11	1	0	0	0	0	0	12	0	0	0	0	0	0	0	0	25	1	0	0	0	0	0	26
17:30	10	2	0	0	0	0	0	12	0	0	0	0	0	0	0	0	27	0	0	0	0	0	0	27
17:45	9	3	0	0	0	0	0	12	0	0	0	0	0	0	0	0	26	0	0	0	0	0	0	26
18:00	8	2	0	0	0	0	0	10	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	25

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 1

Date of Survey: 11.02.2020
Junction Name: A48 / A4226 / Unnamed Road
Junction Type: Crossroads

Arm A: Unnamed Road (N)
Arm B: A48 (E)
Arm C: A4226 (S)
Arm D: A48 (W)

	B to D								B to C								C to C							
Time	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**
07:00	31	9	3	1	0	0	0	44	13	2	0	0	0	0	0	15								0
07:15	40	5	2	1	0	0	0	48	12	6	0	0	0	0	0	18								0
07:30	37	10	2	0	0	0	0	49	19	1	0	0	0	0	0	20								0
07:45	48	7	5	0	0	0	0	60	9	1	0	1	0	0	0	11								0
08:00	68	10	1	1	3	0	0	83	16	1	0	0	0	0	0	17								0
08:15	46	20	1	3	2	0	0	72	16	4	0	0	0	0	0	20								0
08:30	56	8	1	0	0	0	0	65	14	1	0	0	0	0	0	15								0
08:45	48	6	1	1	1	0	0	57	8	6	0	3	0	0	0	17								0
09:00	37	12	2	3	2	1	0	57	6	4	0	0	0	0	0	10								0
09:15	51	18	2	2	1	0	0	74	9	3	3	3	0	0	0	18								0
09:30	39	5	3	2	1	0	0	50	11	6	0	2	0	0	0	19								0
09:45	45	7	2	2	2	0	0	58	16	0	0	4	0	0	0	20								0
10:00	39	11	2	1	1	0	0	54	12	8	0	3	0	0	0	23								0
10:15	36	12	5	1	0	1	0	55	14	3	1	1	0	0	0	19								0
10:30	52	13	1	3	1	0	0	70	18	0	0	2	0	0	0	20								0
10:45	38	12	2	0	0	0	0	52	13	1	3	1	0	0	0	18								0
11:00	45	7	2	3	2	1	0	60	14	0	2	1	0	0	0	17								0
11:15	50	13	1	1	0	0	0	65	16	3	0	1	0	0	0	20								0
11:30	40	8	1	0	1	0	0	50	22	4	1	1	0	0	0	28								0
11:45	66	7	1	0	0	0	0	74	14	0	0	5	0	0	0	19								0
12:00	50	8	0	3	1	0	0	62	25	2	3	2	0	0	0	32								0
12:15	60	10	2	3	0	0	0	75	22	3	1	1	0	0	0	27								0
12:30	68	12	3	2	1	0	0	86	21	4	0	1	0	0	0	26								0
12:45	71	11	3	2	0	0	0	87	30	2	0	3	0	0	0	35								0
13:00	57	7	2	0	1	0	0	67	25	2	1	4	0	0	0	32								0
13:15	68	8	1	1	0	0	0	78	24	2	1	3	0	0	0	30								0
13:30	73	5	2	0	1	0	0	81	27	4	0	0	0	0	0	31								0
13:45	74	9	1	0	0	1	0	85	25	2	2	1	0	0	0	30								0
14:00	63	10	0	4	1	0	0	78	27	2	0	5	0	0	0	34								0
14:15	76	6	2	1	0	1	0	86	26	3	0	1	0	0	0	30								0
14:30	69	9	3	1	1	0	0	83	26	6	0	0	0	1	0	33								0
14:45	82	9	0	2	0	0	0	93	32	6	0	0	0	0	0	38								0
15:00	97	8	2	0	1	0	0	108	44	1	1	3	0	0	0	49								0
15:15	102	9	2	2	1	1	0	117	38	5	0	3	0	0	0	46								0
15:30	108	11	2	2	1	0	0	124	42	7	0	1	0	0	0	50								0
15:45	104	10	1	0	3	0	0	118	38	1	0	2	0	0	0	41								0
16:00	98	10	1	0	1	0	0	110	40	8	0	0	0	0	0	48								0
16:15	118	11	0	0	1	0	0	130	40	4	0	1	0	1	0	46								0
16:30	123	11	1	0	1	1	0	137	44	1	0	1	0	0	0	46								0
16:45	131	7	0	1	1	0	0	140	51	0	0	1	0	0	0	52								0
17:00	155	7	1	0	1	0	0	164	60	2	1	1	0	0	0	64								0
17:15	124	8	0	0	1	1	0	134	51	2	0	0	0	0	0	53								0
17:30	131	4	0	0	1	0	0	136	67	2	1	1	0	0	0	71								0
17:45	136	9	1	0	0	1	0	147	56	4	0	0	0	0	0	60								0
18:00	129	4	0	1	1	0	0	135	47	2	0	0	0	0	0	49								0
18:15	144	5	0	0	0	1	0	150	39	1	0	0	0	0	0	40								0
18:30	108	3	1	1	1	0	0	114	30	4	0	1	0	0	0	35								0
18:45	97	4	1	2	0	0	0	104	31	2	0	0	0	0	0	33								0
Start Time	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**
07:00	156	31	12	2	0	0	0	201	53	10	0	1	0	0	0	64	0	0	0	0	0	0	0	0
07:15	193	32	10	2	3	0	0	240	56	9	0	1	0	0	0	66	0	0	0	0	0	0	0	0
07:30	199	47	9	4	5	0	0	264	60	7	0	1	0	0	0	68	0	0	0	0	0	0	0	0
07:45	218	45	8	4	5	0	0	280	55	7	0	1	0	0	0	63	0	0	0	0	0	0	0	0
08:00	218	44	4	5	6	0	0	277	54	12	0	3	0	0	0	69	0	0	0	0	0	0	0	0
08:15	187	46	5	7	5	1	0	251	44	15	0	3	0	0	0	62	0	0	0	0	0	0	0	0

08:30	192	44	6	6	4	1	0	253	37	14	3	6	0	0	0	60	0	0	0	0	0	0	0	0
08:45	175	41	8	8	5	1	0	238	34	19	3	8	0	0	0	64	0	0	0	0	0	0	0	0
09:00	172	42	9	9	6	1	0	239	42	13	3	9	0	0	0	67	0	0	0	0	0	0	0	0
09:15	174	41	9	7	5	0	0	236	48	17	3	12	0	0	0	80	0	0	0	0	0	0	0	0
09:30	159	35	12	6	4	1	0	217	53	17	1	10	0	0	0	81	0	0	0	0	0	0	0	0
09:45	172	43	10	7	4	1	0	237	60	11	1	10	0	0	0	82	0	0	0	0	0	0	0	0
10:00	165	48	10	5	2	1	0	231	57	12	4	7	0	0	0	80	0	0	0	0	0	0	0	0
10:15	171	44	10	7	3	2	0	237	59	4	6	5	0	0	0	74	0	0	0	0	0	0	0	0
10:30	185	45	6	7	3	1	0	247	61	4	5	5	0	0	0	75	0	0	0	0	0	0	0	0
10:45	173	40	6	4	3	1	0	227	65	8	6	4	0	0	0	83	0	0	0	0	0	0	0	0
11:00	201	35	5	4	3	1	0	249	66	7	3	8	0	0	0	84	0	0	0	0	0	0	0	0
11:15	206	36	3	4	2	0	0	251	77	9	4	9	0	0	0	99	0	0	0	0	0	0	0	0
11:30	216	33	4	6	2	0	0	261	83	9	5	9	0	0	0	106	0	0	0	0	0	0	0	0
11:45	244	37	6	8	2	0	0	297	82	9	4	9	0	0	0	104	0	0	0	0	0	0	0	0
12:00	249	41	8	10	2	0	0	310	98	11	4	7	0	0	0	120	0	0	0	0	0	0	0	0
12:15	256	40	10	7	2	0	0	315	98	11	2	9	0	0	0	120	0	0	0	0	0	0	0	0
12:30	264	38	9	5	2	0	0	318	100	10	2	11	0	0	0	123	0	0	0	0	0	0	0	0
12:45	269	31	8	3	2	0	0	313	106	10	2	10	0	0	0	128	0	0	0	0	0	0	0	0
13:00	272	29	6	1	2	1	0	311	101	10	4	8	0	0	0	123	0	0	0	0	0	0	0	0
13:15	278	32	4	5	2	1	0	322	103	10	3	9	0	0	0	125	0	0	0	0	0	0	0	0
13:30	286	30	5	5	2	2	0	330	105	11	2	7	0	0	0	125	0	0	0	0	0	0	0	0
13:45	282	34	6	6	2	2	0	332	104	13	2	7	0	1	0	127	0	0	0	0	0	0	0	0
14:00	290	34	5	8	2	1	0	340	111	17	0	6	0	1	0	135	0	0	0	0	0	0	0	0
14:15	324	32	7	4	2	1	0	370	128	16	1	4	0	1	0	150	0	0	0	0	0	0	0	0
14:30	350	35	7	5	3	1	0	401	140	18	1	6	0	1	0	166	0	0	0	0	0	0	0	0
14:45	389	37	6	6	3	1	0	442	156	19	1	7	0	0	0	183	0	0	0	0	0	0	0	0
15:00	411	38	7	4	6	1	0	467	162	14	1	9	0	0	0	186	0	0	0	0	0	0	0	0
15:15	412	40	6	4	6	1	0	469	158	21	0	6	0	0	0	185	0	0	0	0	0	0	0	0
15:30	428	42	4	2	6	0	0	482	160	20	0	4	0	1	0	185	0	0	0	0	0	0	0	0
15:45	443	42	3	0	6	1	0	495	162	14	0	4	0	1	0	181	0	0	0	0	0	0	0	0
16:00	470	39	2	1	4	1	0	517	175	13	0	3	0	1	0	192	0	0	0	0	0	0	0	0
16:15	527	36	2	1	4	1	0	571	195	7	1	4	0	1	0	208	0	0	0	0	0	0	0	0
16:30	533	33	2	1	4	2	0	575	206	5	1	3	0	0	0	215	0	0	0	0	0	0	0	0
16:45	541	26	1	1	4	1	0	574	229	6	2	3	0	0	0	240	0	0	0	0	0	0	0	0
17:00	546	28	2	0	3	2	0	581	234	10	2	2	0	0	0	248	0	0	0	0	0	0	0	0
17:15	520	25	1	1	3	2	0	552	221	10	1	1	0	0	0	233	0	0	0	0	0	0	0	0
17:30	540	22	1	1	2	2	0	568	209	9	1	1	0	0	0	220	0	0	0	0	0	0	0	0
17:45	517	21	2	2	2	2	0	546	172	11	0	1	0	0	0	184	0	0	0	0	0	0	0	0
18:00	478	16	2	4	2	1	0	503	147	9	0	1	0	0	0	157	0	0	0	0	0	0	0	0

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 1

Date of Survey: 11.02.2020
Junction Name: A48 / A4226 / Unnamed Road
Junction Type: Crossroads

Arm A: Unnamed Road (N)
Arm B: A48 (E)
Arm C: A4226 (S)
Arm D: A48 (W)

	C to B								C to A								C to D							
Time	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**
07:00	107	4	0	3	0	0	0	114	12	1	0	0	0	0	0	13	27	8	1	0	0	0	0	36
07:15	122	10	1	1	0	0	0	134	11	1	0	0	0	0	0	12	38	5	2	0	0	0	0	45
07:30	103	6	0	2	0	0	0	111	17	6	0	0	0	0	0	23	57	14	2	1	0	1	0	75
07:45	73	6	0	4	0	0	0	83	25	2	0	0	0	0	0	27	46	9	0	0	0	0	0	55
08:00	61	7	0	6	0	0	0	74	16	2	0	0	0	0	0	18	51	4	1	0	0	0	0	56
08:15	64	11	0	3	0	0	0	78	14	3	0	0	0	0	0	17	59	6	0	0	0	0	0	65
08:30	45	4	0	1	0	0	0	50	19	2	0	0	0	0	0	21	46	8	1	1	1	0	0	57
08:45	43	3	0	1	0	0	0	47	10	1	0	0	0	0	0	11	25	3	1	1	1	0	0	31
09:00	45	5	2	3	0	0	0	55	11	0	0	0	0	0	0	11	20	5	1	3	1	1	0	31
09:15	53	0	0	2	0	0	0	55	10	1	0	0	0	0	0	11	20	10	0	1	2	0	0	33
09:30	26	3	0	1	0	0	0	30	8	1	0	1	0	0	0	10	27	8	0	0	0	0	1	36
09:45	23	4	0	2	0	0	0	29	6	0	1	0	0	0	0	7	23	2	1	3	0	0	0	29
10:00	25	1	1	1	0	0	0	28	4	1	0	0	0	0	0	5	18	5	1	2	0	0	0	26
10:15	20	3	2	4	0	0	0	29	14	3	0	0	0	0	0	17	16	3	0	1	0	0	0	20
10:30	30	1	1	3	0	0	0	35	9	2	0	0	0	0	0	11	21	4	2	1	0	0	0	28
10:45	18	1	0	4	0	0	0	23	7	2	0	0	0	0	0	9	17	8	1	3	0	1	0	30
11:00	27	2	0	3	0	0	0	32	3	1	1	0	0	0	0	5	12	6	1	3	0	0	0	22
11:15	22	4	1	1	0	0	0	28	4	5	0	0	0	0	0	9	18	5	4	1	0	0	0	28
11:30	17	1	1	0	0	0	0	19	11	0	1	0	0	0	0	12	14	1	1	0	0	0	0	16
11:45	23	1	0	0	0	0	0	24	2	0	1	0	0	0	0	3	16	3	1	3	0	0	0	23
12:00	14	5	1	0	0	0	0	20	5	2	1	0	0	0	0	8	30	1	2	1	1	0	0	35
12:15	29	3	0	0	0	0	0	32	5	3	0	0	0	0	0	8	22	7	0	1	0	0	0	30
12:30	23	1	1	1	0	0	0	26	5	0	0	0	0	0	0	5	20	2	3	1	0	0	0	26
12:45	21	4	1	5	0	0	0	31	6	0	0	0	0	0	0	6	26	5	0	0	0	0	0	31
13:00	16	3	0	1	1	0	0	21	7	2	0	0	0	0	0	9	26	3	3	0	0	0	0	32
13:15	17	4	0	3	0	0	0	24	4	2	2	0	0	0	0	8	11	4	0	1	0	0	0	16
13:30	25	4	0	3	0	0	0	32	8	5	0	0	0	0	0	13	16	1	0	2	0	0	0	19
13:45	21	2	1	5	0	0	0	29	8	1	0	0	0	0	0	9	29	2	0	2	1	0	0	34
14:00	22	4	1	1	1	0	0	29	6	2	1	0	0	0	0	9	31	8	1	0	0	0	0	40
14:15	18	2	0	4	0	0	0	24	4	3	0	0	0	0	0	7	15	5	0	2	1	0	0	23
14:30	16	2	1	5	0	0	0	24	15	0	0	0	0	0	0	15	30	9	2	2	1	0	0	44
14:45	18	1	2	2	0	0	0	23	12	5	1	0	0	0	0	18	27	2	1	2	0	0	0	32
15:00	19	4	1	3	0	1	0	28	10	7	0	0	0	1	0	18	25	10	0	2	0	0	0	37
15:15	25	2	2	1	0	0	0	30	11	3	0	0	0	0	0	14	19	9	2	1	0	0	0	31
15:30	25	3	0	3	0	0	0	31	10	4	0	0	0	0	0	14	33	9	0	1	0	0	0	43
15:45	16	3	0	0	0	0	0	19	14	3	0	0	0	0	0	17	39	9	1	2	2	0	0	53
16:00	20	3	0	2	0	0	0	25	22	11	0	0	0	0	0	33	44	9	1	2	1	0	0	57
16:15	27	8	0	2	1	0	0	38	17	4	0	0	0	0	0	21	42	7	1	1	3	0	0	54
16:30	25	2	0	1	0	0	0	28	17	3	0	0	0	0	0	20	38	9	1	3	1	0	0	52
16:45	25	2	1	0	0	0	0	28	25	8	0	0	0	0	0	33	38	10	0	0	1	0	0	49
17:00	37	4	0	2	0	0	0	43	22	9	0	0	0	0	0	31	36	10	3	0	0	0	0	49
17:15	19	1	0	0	0	0	0	20	20	4	0	0	0	0	0	24	50	4	0	0	1	0	0	55
17:30	30	0	1	0	0	0	0	31	20	3	0	0	0	0	0	23	50	6	0	0	0	0	0	56
17:45	18	0	0	2	0	0	0	20	14	0	0	0	0	0	0	14	39	1	1	0	0	0	0	41
18:00	17	1	0	0	0	0	0	18	13	1	0	0	0	0	0	14	23	5	0	0	0	0	0	28
18:15	18	0	0	0	0	0	0	18	9	0	0	0	0	0	0	9	28	2	0	0	1	0	0	31
18:30	31	0	0	0	0	0	0	31	9	1	0	0	0	0	0	10	18	3	0	0	0	0	0	21
18:45	18	0	0	1	0	0	0	19	6	1	0	0	0	0	0	7	22	2	1	0	0	0	0	25
Start Time	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**
07:00	405	26	1	10	0	0	0	442	65	10	0	0	0	0	0	75	168	36	5	1	0	1	0	211
07:15	359	29	1	13	0	0	0	402	69	11	0	0	0	0	0	80	192	32	5	1	0	1	0	231
07:30	301	30	0	15	0	0	0	346	72	13	0	0	0	0	0	85	213	33	3	1	0	1	0	251
07:45	243	28	0	14	0	0	0	285	74	9	0	0	0	0	0	83	202	27	2	1	1	0	0	233
08:00	213	25	0	11	0	0	0	249	59	8	0	0	0	0	0	67	181	21	3	2	2	0	0	209
08:15	197	23	2	8	0	0	0	230	54	6	0	0	0	0	0	60	150	22	3	5	3	1	0	184

08:30	186	12	2	7	0	0	0	207	50	4	0	0	0	0	0	54	111	26	3	6	5	1	0	152
08:45	167	11	2	7	0	0	0	187	39	3	0	1	0	0	0	43	92	26	2	5	4	1	1	131
09:00	147	12	2	8	0	0	0	169	35	2	1	1	0	0	0	39	90	25	2	7	3	1	1	129
09:15	127	8	1	6	0	0	0	142	28	3	1	1	0	0	0	33	88	25	2	6	2	0	1	124
09:30	94	11	3	8	0	0	0	116	32	5	1	1	0	0	0	39	84	18	2	6	0	0	1	111
09:45	98	9	4	10	0	0	0	121	33	6	1	0	0	0	0	40	78	14	4	7	0	0	0	103
10:00	93	6	4	12	0	0	0	115	34	8	0	0	0	0	0	42	72	20	4	7	0	1	0	104
10:15	95	7	3	14	0	0	0	119	33	8	1	0	0	0	0	42	66	21	4	8	0	1	0	100
10:30	97	8	2	11	0	0	0	118	23	10	1	0	0	0	0	34	68	23	8	8	0	1	0	108
10:45	84	8	2	8	0	0	0	102	25	8	2	0	0	0	0	35	61	20	7	7	0	1	0	96
11:00	89	8	2	4	0	0	0	103	20	6	3	0	0	0	0	29	60	15	7	7	0	0	0	89
11:15	76	11	3	1	0	0	0	91	22	7	3	0	0	0	0	32	78	10	8	5	1	0	0	102
11:30	83	10	2	0	0	0	0	95	23	5	3	0	0	0	0	31	82	12	4	5	1	0	0	104
11:45	89	10	2	1	0	0	0	102	17	5	2	0	0	0	0	24	88	13	6	6	1	0	0	114
12:00	87	13	3	6	0	0	0	109	21	5	1	0	0	0	0	27	98	15	5	3	1	0	0	122
12:15	89	11	2	7	1	0	0	110	23	5	0	0	0	0	0	28	94	17	6	2	0	0	0	119
12:30	77	12	2	10	1	0	0	102	22	4	2	0	0	0	0	28	83	14	6	2	0	0	0	105
12:45	79	15	1	12	1	0	0	108	25	9	2	0	0	0	0	36	79	13	3	3	0	0	0	98
13:00	79	13	1	12	1	0	0	106	27	10	2	0	0	0	0	39	82	10	3	5	1	0	0	101
13:15	85	14	2	12	1	0	0	114	26	10	3	0	0	0	0	39	87	15	1	5	1	0	0	109
13:30	86	12	2	13	1	0	0	114	26	11	1	0	0	0	0	38	91	16	1	6	2	0	0	116
13:45	77	10	3	15	1	0	0	106	33	6	1	0	0	0	0	40	105	24	3	6	3	0	0	141
14:00	74	9	4	12	1	0	0	100	37	10	2	0	0	0	0	49	103	24	4	6	2	0	0	139
14:15	71	9	4	14	0	1	0	99	41	15	1	0	0	1	0	58	97	26	3	8	2	0	0	136
14:30	78	9	6	11	0	1	0	105	48	15	1	0	0	1	0	65	101	30	5	7	1	0	0	144
14:45	87	10	5	9	0	1	0	112	43	19	1	0	0	1	0	64	104	30	3	6	0	0	0	143
15:00	85	12	3	7	0	1	0	108	45	17	0	0	0	1	0	63	116	37	3	6	2	0	0	164
15:15	86	11	2	6	0	0	0	105	57	21	0	0	0	0	0	78	135	36	4	6	3	0	0	184
15:30	88	17	0	7	1	0	0	113	63	22	0	0	0	0	0	85	158	34	3	6	6	0	0	207
15:45	88	16	0	5	1	0	0	110	70	21	0	0	0	0	0	91	163	34	4	8	7	0	0	216
16:00	97	15	1	5	1	0	0	119	81	26	0	0	0	0	0	107	162	35	3	6	6	0	0	212
16:15	114	16	1	5	1	0	0	137	81	24	0	0	0	0	0	105	154	36	5	4	5	0	0	204
16:30	106	9	1	3	0	0	0	119	84	24	0	0	0	0	0	108	162	33	4	3	3	0	0	205
16:45	111	7	2	2	0	0	0	122	87	24	0	0	0	0	0	111	174	30	3	0	2	0	0	209
17:00	104	5	1	4	0	0	0	114	76	16	0	0	0	0	0	92	175	21	4	0	1	0	0	201
17:15	84	2	1	2	0	0	0	89	67	8	0	0	0	0	0	75	162	16	1	0	1	0	0	180
17:30	83	1	1	2	0	0	0	87	56	4	0	0	0	0	0	60	140	14	1	0	1	0	0	156
17:45	84	1	0	2	0	0	0	87	45	2	0	0	0	0	0	47	108	11	1	0	1	0	0	121
18:00	84	1	0	1	0	0	0	86	37	3	0	0	0	0	0	40	91	12	1	0	1	0	0	105

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 1

Date of Survey: 11.02.2020
Junction Name: A48 / A4226 / Unnamed Road
Junction Type: Crossroads

Arm A: Unnamed Road (N)
Arm B: A48 (E)
Arm C: A4226 (S)
Arm D: A48 (W)

	D to D								D to C								D to B							
Time	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**
07:00								0	27	9	0	4	1	0	0	41	126	11	1	0	2	0	1	141
07:15								0	29	11	1	1	2	0	0	44	161	16	1	1	2	0	0	181
07:30								0	20	12	2	0	3	0	0	37	130	13	2	0	1	2	0	148
07:45								0	38	8	1	0	0	1	0	48	166	15	1	0	3	0	0	185
08:00								0	69	12	1	1	1	0	0	84	156	10	0	2	0	1	0	169
08:15								0	52	9	0	2	0	1	0	64	161	10	1	2	1	0	0	175
08:30								0	60	6	3	0	2	0	0	71	166	13	2	1	1	0	0	183
08:45								0	42	5	2	1	0	0	0	50	128	13	6	3	1	1	0	152
09:00								0	31	5	0	1	0	0	0	37	118	18	0	1	0	0	0	137
09:15								0	24	8	0	2	0	0	0	34	95	6	3	1	1	0	0	106
09:30								0	24	5	0	1	0	0	0	30	113	13	5	1	0	0	0	132
09:45								0	18	6	0	2	0	0	0	26	80	7	2	1	2	0	0	92
10:00								0	18	4	2	2	0	0	0	26	74	8	2	2	0	0	0	86
10:15								0	24	5	0	2	0	0	0	31	74	5	4	6	1	0	0	90
10:30								0	20	2	0	1	0	0	0	23	79	13	4	0	0	0	0	96
10:45								0	11	3	1	2	0	0	0	17	70	9	2	3	1	0	0	85
11:00								0	21	3	1	1	0	0	0	26	75	7	3	3	1	0	0	89
11:15								0	24	2	0	2	0	0	0	28	53	8	4	0	0	0	0	65
11:30								0	19	9	2	2	0	0	0	32	79	12	5	2	1	0	0	99
11:45								0	25	4	2	1	0	0	0	32	76	9	3	3	0	0	0	91
12:00								0	11	7	3	2	1	0	0	24	72	9	1	0	1	0	0	83
12:15								0	28	3	1	4	0	0	0	36	72	7	0	0	0	0	0	79
12:30								0	17	0	1	1	0	0	0	19	65	10	4	0	1	0	0	80
12:45								0	15	5	1	0	0	0	0	21	68	9	4	0	0	0	0	81
13:00								0	22	3	1	1	0	0	0	27	68	9	4	1	1	0	0	83
13:15								0	16	4	2	0	0	3	0	25	57	7	2	4	0	0	0	70
13:30								0	21	3	2	1	0	0	0	27	49	7	2	3	1	0	0	62
13:45								0	23	6	1	3	1	0	0	34	57	4	3	0	0	0	0	64
14:00								0	23	5	1	0	3	0	0	32	61	5	5	0	1	0	0	72
14:15								0	22	6	1	2	0	0	0	31	62	15	6	0	0	0	0	83
14:30								0	26	7	1	2	0	0	0	36	65	10	1	2	1	0	0	79
14:45								0	29	6	0	1	2	0	1	39	60	7	1	1	2	0	0	71
15:00								0	28	8	1	2	0	0	0	39	49	11	2	0	1	0	0	63
15:15								0	25	3	0	2	1	0	1	32	54	12	3	1	2	0	0	72
15:30								0	39	4	1	0	0	0	0	44	71	4	1	0	3	0	0	79
15:45								0	31	8	2	5	0	1	0	47	68	6	2	0	1	0	0	77
16:00								0	39	8	0	1	0	0	0	48	59	7	1	2	0	0	0	69
16:15								0	43	14	0	0	0	0	0	57	79	14	0	1	1	0	0	95
16:30								0	50	7	0	1	1	0	0	59	58	16	0	1	0	0	0	75
16:45								0	44	11	1	0	0	0	0	56	75	3	0	1	1	0	0	80
17:00								0	62	9	1	0	0	0	0	72	81	9	1	0	0	0	0	91
17:15								0	72	9	0	0	0	1	0	82	104	7	2	1	1	0	0	115
17:30								0	85	5	1	0	0	0	0	91	75	3	2	0	1	1	0	82
17:45								0	69	4	0	0	0	0	0	73	79	10	0	0	1	0	1	91
18:00								0	27	2	0	0	0	0	0	29	45	1	1	1	0	1	0	49
18:15								0	32	2	0	0	0	0	0	34	62	5	0	0	1	1	0	69
18:30								0	24	3	0	0	0	0	0	27	54	2	0	0	0	0	0	56
18:45								0	17	3	0	0	0	0	0	20	41	1	0	0	1	0	0	43
Start Time	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**
07:00	0	0	0	0	0	0	0	0	114	40	4	5	6	1	0	170	583	55	5	1	8	2	1	655
07:15	0	0	0	0	0	0	0	0	156	43	5	2	6	1	0	213	613	54	4	3	6	3	0	683
07:30	0	0	0	0	0	0	0	0	179	41	4	3	4	2	0	233	613	48	4	4	5	3	0	677
07:45	0	0	0	0	0	0	0	0	219	35	5	3	3	2	0	267	649	48	4	5	5	1	0	712
08:00	0	0	0	0	0	0	0	0	223	32	6	4	3	1	0	269	611	46	9	8	3	2	0	679
08:15	0	0	0	0	0	0	0	0	185	25	5	4	2	1	0	222	573	54	9	7	3	1	0	647

08:30	0	0	0	0	0	0	0	0	157	24	5	4	2	0	0	192	507	50	11	6	3	1	0	578
08:45	0	0	0	0	0	0	0	0	121	23	2	5	0	0	0	151	454	50	14	6	2	1	0	527
09:00	0	0	0	0	0	0	0	0	97	24	0	6	0	0	0	127	406	44	10	4	3	0	0	467
09:15	0	0	0	0	0	0	0	0	84	23	2	7	0	0	0	116	362	34	12	5	3	0	0	416
09:30	0	0	0	0	0	0	0	0	84	20	2	7	0	0	0	113	341	33	13	10	3	0	0	400
09:45	0	0	0	0	0	0	0	0	80	17	2	7	0	0	0	106	307	33	12	9	3	0	0	364
10:00	0	0	0	0	0	0	0	0	73	14	3	7	0	0	0	97	297	35	12	11	2	0	0	357
10:15	0	0	0	0	0	0	0	0	76	13	2	6	0	0	0	97	298	34	13	12	3	0	0	360
10:30	0	0	0	0	0	0	0	0	76	10	2	6	0	0	0	94	277	37	13	6	2	0	0	335
10:45	0	0	0	0	0	0	0	0	75	17	4	7	0	0	0	103	277	36	14	8	3	0	0	338
11:00	0	0	0	0	0	0	0	0	89	18	5	6	0	0	0	118	283	36	15	8	2	0	0	344
11:15	0	0	0	0	0	0	0	0	79	22	7	7	1	0	0	116	280	38	13	5	2	0	0	338
11:30	0	0	0	0	0	0	0	0	83	23	8	9	1	0	0	124	299	37	9	5	2	0	0	352
11:45	0	0	0	0	0	0	0	0	81	14	7	8	1	0	0	111	285	35	8	3	2	0	0	333
12:00	0	0	0	0	0	0	0	0	71	15	6	7	1	0	0	100	277	35	9	0	2	0	0	323
12:15	0	0	0	0	0	0	0	0	82	11	4	6	0	0	0	103	273	35	12	1	2	0	0	323
12:30	0	0	0	0	0	0	0	0	70	12	5	2	0	3	0	92	258	35	14	5	2	0	0	314
12:45	0	0	0	0	0	0	0	0	74	15	6	2	0	3	0	100	242	32	12	8	2	0	0	296
13:00	0	0	0	0	0	0	0	0	82	16	6	5	1	3	0	113	231	27	11	8	2	0	0	279
13:15	0	0	0	0	0	0	0	0	83	18	6	4	4	3	0	118	224	23	12	7	2	0	0	268
13:30	0	0	0	0	0	0	0	0	89	20	5	6	4	0	0	124	229	31	16	3	2	0	0	281
13:45	0	0	0	0	0	0	0	0	94	24	4	7	4	0	0	133	245	34	15	2	2	0	0	298
14:00	0	0	0	0	0	0	0	0	100	24	3	5	5	0	1	138	248	37	13	3	4	0	0	305
14:15	0	0	0	0	0	0	0	0	105	27	3	7	2	0	1	145	236	43	10	3	4	0	0	296
14:30	0	0	0	0	0	0	0	0	108	24	2	7	3	0	2	146	228	40	7	4	6	0	0	285
14:45	0	0	0	0	0	0	0	0	121	21	2	5	3	0	2	154	234	34	7	2	8	0	0	285
15:00	0	0	0	0	0	0	0	0	123	23	4	9	1	1	1	162	242	33	8	1	7	0	0	291
15:15	0	0	0	0	0	0	0	0	134	23	3	8	1	1	1	171	252	29	7	3	6	0	0	297
15:30	0	0	0	0	0	0	0	0	152	34	3	6	0	1	0	196	277	31	4	3	5	0	0	320
15:45	0	0	0	0	0	0	0	0	163	37	2	7	1	1	0	211	264	43	3	4	2	0	0	316
16:00	0	0	0	0	0	0	0	0	176	40	1	2	1	0	0	220	271	40	1	5	2	0	0	319
16:15	0	0	0	0	0	0	0	0	199	41	2	1	1	0	0	244	293	42	1	3	2	0	0	341
16:30	0	0	0	0	0	0	0	0	228	36	2	1	1	1	0	269	318	35	3	3	2	0	0	361
16:45	0	0	0	0	0	0	0	0	263	34	3	0	0	1	0	301	335	22	5	2	3	1	0	368
17:00	0	0	0	0	0	0	0	0	288	27	2	0	0	1	0	318	339	29	5	1	3	1	1	379
17:15	0	0	0	0	0	0	0	0	253	20	1	0	0	1	0	275	303	21	5	2	3	2	1	337
17:30	0	0	0	0	0	0	0	0	213	13	1	0	0	0	0	227	261	19	3	1	3	3	1	291
17:45	0	0	0	0	0	0	0	0	152	11	0	0	0	0	0	163	240	18	1	1	2	2	1	265
18:00	0	0	0	0	0	0	0	0	100	10	0	0	0	0	0	110	202	9	1	1	2	2	0	217

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 1

Date of Survey: 11.02.2020
Junction Name: A48 / A4226 / Unnamed Road
Junction Type: Crossroads

Arm A: Unnamed Road (N)
Arm B: A48 (E)
Arm C: A4226 (S)
Arm D: A48 (W)

	D to A							
Time	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**
07:00	2	1	0	0	0	0	0	3
07:15	10	2	0	0	0	1	0	13
07:30	4	0	0	0	0	0	0	4
07:45	6	0	0	0	1	0	0	7
08:00	6	1	0	0	0	0	0	7
08:15	8	1	0	1	0	0	0	10
08:30	12	0	0	0	0	0	0	12
08:45	8	0	0	0	0	0	0	8
09:00	8	3	0	1	0	0	0	12
09:15	6	0	0	0	0	0	0	6
09:30	10	3	0	1	0	0	0	14
09:45	3	1	0	0	0	0	0	4
10:00	9	0	1	2	0	0	0	12
10:15	3	0	0	0	0	0	0	3
10:30	4	0	1	3	0	0	0	8
10:45	4	0	0	0	0	0	0	4
11:00	7	2	0	2	0	0	0	11
11:15	2	0	0	1	1	0	0	4
11:30	6	2	0	2	0	0	0	10
11:45	3	2	0	1	0	0	0	6
12:00	5	0	0	1	0	0	0	6
12:15	5	1	0	1	0	0	0	7
12:30	5	1	0	1	0	0	0	7
12:45	8	1	0	1	0	0	0	10
13:00	7	1	0	1	0	0	0	9
13:15	3	1	0	2	0	0	0	6
13:30	3	3	0	0	0	0	0	6
13:45	2	1	2	0	0	0	0	5
14:00	2	2	0	2	0	0	0	6
14:15	3	1	0	1	0	0	0	5
14:30	6	1	1	1	1	0	0	10
14:45	6	2	0	2	0	0	0	10
15:00	12	0	0	1	0	0	0	13
15:15	9	5	0	2	1	0	0	17
15:30	7	2	0	1	0	0	0	10
15:45	13	5	0	1	0	0	0	19
16:00	4	4	1	0	0	0	0	9
16:15	15	0	0	0	0	0	0	15
16:30	11	1	0	0	0	0	0	12
16:45	8	0	0	0	0	0	0	8
17:00	10	1	0	0	0	0	0	11
17:15	5	0	0	0	0	0	0	5
17:30	8	0	0	0	0	0	0	8
17:45	14	0	0	0	0	0	0	14
18:00	5	0	0	0	0	0	0	5
18:15	5	1	0	0	0	0	0	6
18:30	7	2	0	0	0	0	0	9
18:45	3	0	0	0	0	0	0	3
Start Time	**Rolling Hour**							**Total**
07:00	22	3	0	0	1	1	0	27
07:15	26	3	0	0	1	1	0	31
07:30	24	2	0	1	1	0	0	28
07:45	32	2	0	1	1	0	0	36
08:00	34	2	0	1	0	0	0	37
08:15	36	4	0	2	0	0	0	42
08:30	34	3	0	1	0	0	0	38
08:45	32	6	0	2	0	0	0	40
09:00	27	7	0	2	0	0	0	36
09:15	28	4	1	3	0	0	0	36

09:30	25	4	1	3	0	0	0	33
09:45	19	1	2	5	0	0	0	27
10:00	20	0	2	5	0	0	0	27
10:15	18	2	1	5	0	0	0	26
10:30	17	2	1	6	1	0	0	27
10:45	19	4	0	5	1	0	0	29
11:00	18	6	0	6	1	0	0	31
11:15	16	4	0	5	1	0	0	26
11:30	19	5	0	5	0	0	0	29
11:45	18	4	0	4	0	0	0	26
12:00	23	3	0	4	0	0	0	30
12:15	25	4	0	4	0	0	0	33
12:30	23	4	0	5	0	0	0	32
12:45	21	6	0	4	0	0	0	31
13:00	15	6	2	3	0	0	0	26
13:15	10	7	2	4	0	0	0	23
13:30	10	7	2	3	0	0	0	22
13:45	13	5	3	4	1	0	0	26
14:00	17	6	1	6	1	0	0	31
14:15	27	4	1	5	1	0	0	38
14:30	33	8	1	6	2	0	0	50
14:45	34	9	0	6	1	0	0	50
15:00	41	12	0	5	1	0	0	59
15:15	33	16	1	4	1	0	0	55
15:30	39	11	1	2	0	0	0	53
15:45	43	10	1	1	0	0	0	55
16:00	38	5	1	0	0	0	0	44
16:15	44	2	0	0	0	0	0	46
16:30	34	2	0	0	0	0	0	36
16:45	31	1	0	0	0	0	0	32
17:00	37	1	0	0	0	0	0	38
17:15	32	0	0	0	0	0	0	32
17:30	32	1	0	0	0	0	0	33
17:45	31	3	0	0	0	0	0	34
18:00	20	3	0	0	0	0	0	23

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 1

Date of Survey: 11.02.2020
Junction Name: A48 / A4226 / Unnamed Road
Junction Type: Crossroads

	Arm A Approach								Arm A Exit							
Time	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**
07:00	9	5	0	0	0	0	0	14	15	2	0	0	0	0	0	17
07:15	27	15	0	0	0	0	0	42	24	5	1	0	0	1	0	31
07:30	61	19	0	0	0	0	0	80	24	6	0	0	0	0	0	30
07:45	54	13	1	0	0	1	0	69	32	5	0	0	1	0	0	38
08:00	67	11	0	0	1	0	0	79	27	3	0	0	0	0	0	30
08:15	51	7	1	0	0	1	0	60	25	6	0	1	0	0	0	32
08:30	43	6	0	1	0	0	0	50	41	2	0	0	0	0	0	43
08:45	42	6	0	0	0	0	0	48	21	4	1	0	0	0	0	26
09:00	43	7	0	1	0	0	0	51	23	6	0	1	0	0	0	30
09:15	28	7	0	0	0	0	0	35	17	1	0	0	0	0	0	18
09:30	18	4	2	2	0	0	0	26	21	7	0	2	0	0	0	30
09:45	20	7	1	0	0	0	0	28	12	1	3	0	0	0	0	16
10:00	20	2	0	2	0	0	0	24	19	1	2	2	0	0	0	24
10:15	27	5	3	1	0	0	0	36	22	4	0	0	0	0	0	26
10:30	17	5	0	1	0	0	0	23	21	3	1	3	0	0	0	28
10:45	19	5	0	1	0	0	0	25	18	3	0	0	0	0	0	21
11:00	13	3	1	2	0	0	0	19	13	5	1	2	0	0	1	22
11:15	17	1	1	1	0	0	0	20	10	7	0	1	1	0	0	19
11:30	17	0	1	1	0	0	0	19	25	2	1	3	0	0	0	31
11:45	15	3	1	2	0	0	0	21	8	4	1	1	0	0	0	14
12:00	26	3	1	2	0	0	0	32	17	2	1	1	0	0	0	21
12:15	19	1	0	1	1	0	0	22	14	4	0	1	0	0	0	19
12:30	21	3	0	1	0	0	0	25	13	1	1	1	0	0	0	16
12:45	16	4	1	0	0	0	0	21	18	1	0	1	0	0	0	20
13:00	21	5	1	1	0	0	0	28	15	3	0	2	0	0	0	20
13:15	14	3	0	0	0	0	0	17	13	3	2	2	0	0	0	20
13:30	10	3	1	1	0	0	0	15	18	9	0	0	0	0	0	27
13:45	12	3	0	2	0	0	0	17	23	3	2	0	0	0	0	28
14:00	26	7	0	0	0	0	0	33	11	6	1	2	0	0	0	20
14:15	14	0	0	3	0	0	0	17	10	4	1	1	0	0	0	16
14:30	17	2	0	0	0	0	0	19	26	1	2	1	1	0	0	31
14:45	11	4	1	2	0	0	0	18	24	7	1	2	0	0	0	34
15:00	13	3	0	1	1	0	0	18	34	8	0	1	0	1	0	44
15:15	25	5	1	2	0	0	0	33	28	8	0	2	1	0	0	39
15:30	46	4	1	1	1	0	0	53	24	7	0	1	0	0	0	32
15:45	48	7	0	1	0	0	0	56	35	8	0	1	0	0	0	44
16:00	31	6	2	0	0	0	0	39	32	15	1	0	0	0	0	48
16:15	23	4	0	0	0	0	0	27	40	6	0	0	0	0	0	46
16:30	30	10	0	0	0	0	0	40	32	6	0	0	0	0	0	38
16:45	31	6	1	0	0	1	0	39	40	9	0	0	0	0	0	49
17:00	32	6	0	0	0	0	0	38	34	10	0	0	0	0	0	44
17:15	40	1	0	0	0	0	0	41	32	5	0	0	0	0	0	37
17:30	27	4	1	0	0	0	0	32	35	3	0	0	0	0	0	38
17:45	27	3	0	0	0	0	0	30	34	0	0	0	0	0	0	34
18:00	24	1	0	0	0	0	0	25	23	1	0	0	0	0	0	24
18:15	21	1	0	0	0	0	0	22	23	1	0	0	0	0	0	24
18:30	22	2	0	0	0	0	0	24	22	3	0	0	0	0	0	25
18:45	10	2	0	0	0	0	0	12	14	1	0	0	0	0	0	15
Start Time	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**
07:00	151	52	1	0	0	1	0	205	95	18	1	0	1	1	0	116
07:15	209	58	1	0	1	1	0	270	107	19	1	0	1	1	0	129
07:30	233	50	2	0	1	2	0	288	108	20	0	1	1	0	0	130
07:45	215	37	2	1	1	2	0	258	125	16	0	1	1	0	0	143
08:00	203	30	1	1	1	1	0	237	114	15	1	1	0	0	0	131
08:15	179	26	1	2	0	1	0	209	110	18	1	2	0	0	0	131

08:30	156	26	0	2	0	0	0	184	102	13	1	1	0	0	0	117
08:45	131	24	2	3	0	0	0	160	82	18	1	3	0	0	0	104
09:00	109	25	3	3	0	0	0	140	73	15	3	3	0	0	0	94
09:15	86	20	3	4	0	0	0	113	69	10	5	4	0	0	0	88
09:30	85	18	6	5	0	0	0	114	74	13	5	4	0	0	0	96
09:45	84	19	4	4	0	0	0	111	74	9	6	5	0	0	0	94
10:00	83	17	3	5	0	0	0	108	80	11	3	5	0	0	0	99
10:15	76	18	4	5	0	0	0	103	74	15	2	5	0	0	1	97
10:30	66	14	2	5	0	0	0	87	62	18	2	6	1	0	1	90
10:45	66	9	3	5	0	0	0	83	66	17	2	6	1	0	1	93
11:00	62	7	4	6	0	0	0	79	56	18	3	7	1	0	1	86
11:15	75	7	4	6	0	0	0	92	60	15	3	6	1	0	0	85
11:30	77	7	3	6	1	0	0	94	64	12	3	6	0	0	0	85
11:45	81	10	2	6	1	0	0	100	52	11	3	4	0	0	0	70
12:00	82	11	2	4	1	0	0	100	62	8	2	4	0	0	0	76
12:15	77	13	2	3	1	0	0	96	60	9	1	5	0	0	0	75
12:30	72	15	2	2	0	0	0	91	59	8	3	6	0	0	0	76
12:45	61	15	3	2	0	0	0	81	64	16	2	5	0	0	0	87
13:00	57	14	2	4	0	0	0	77	69	18	4	4	0	0	0	95
13:15	62	16	1	3	0	0	0	82	65	21	5	4	0	0	0	95
13:30	62	13	1	6	0	0	0	82	62	22	4	3	0	0	0	91
13:45	69	12	0	5	0	0	0	86	70	14	6	4	1	0	0	95
14:00	68	13	1	5	0	0	0	87	71	18	5	6	1	0	0	101
14:15	55	9	1	6	1	0	0	72	94	20	4	5	1	1	0	125
14:30	66	14	2	5	1	0	0	88	112	24	3	6	2	1	0	148
14:45	95	16	3	6	2	0	0	122	110	30	1	6	1	1	0	149
15:00	132	19	2	5	2	0	0	160	121	31	0	5	1	1	0	159
15:15	150	22	4	4	1	0	0	181	119	38	1	4	1	0	0	163
15:30	148	21	3	2	1	0	0	175	131	36	1	2	0	0	0	170
15:45	132	27	2	1	0	0	0	162	139	35	1	1	0	0	0	176
16:00	115	26	3	0	0	1	0	145	144	36	1	0	0	0	0	181
16:15	116	26	1	0	0	1	0	144	146	31	0	0	0	0	0	177
16:30	133	23	1	0	0	1	0	158	138	30	0	0	0	0	0	168
16:45	130	17	2	0	0	1	0	150	141	27	0	0	0	0	0	168
17:00	126	14	1	0	0	0	0	141	135	18	0	0	0	0	0	153
17:15	118	9	1	0	0	0	0	128	124	9	0	0	0	0	0	133
17:30	99	9	1	0	0	0	0	109	115	5	0	0	0	0	0	120
17:45	94	7	0	0	0	0	0	101	102	5	0	0	0	0	0	107
18:00	77	6	0	0	0	0	0	83	82	6	0	0	0	0	0	88

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 1

Date of Survey: 11.02.2020
Junction Name: A48 / A4226 / Unnamed Road
Junction Type: Crossroads

	Arm B Approach								Arm B Exit							
Time	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**
07:00	45	11	3	1	0	0	0	60	235	15	1	3	2	0	1	257
07:15	55	13	3	1	0	0	0	72	291	28	2	2	2	0	0	325
07:30	59	11	2	0	0	0	0	72	245	22	2	2	1	2	0	274
07:45	58	11	5	1	0	0	0	75	255	22	2	4	3	0	0	286
08:00	89	11	1	1	3	0	0	105	232	18	0	8	0	1	0	259
08:15	65	26	1	3	2	0	0	97	239	21	1	5	1	1	0	268
08:30	80	9	1	0	0	0	0	90	226	19	2	2	1	0	0	250
08:45	59	15	2	4	1	0	0	81	184	16	6	4	1	1	0	212
09:00	47	19	2	3	2	1	0	74	188	25	2	4	0	0	0	219
09:15	61	21	5	5	1	0	0	93	159	6	3	3	1	0	0	172
09:30	53	14	3	4	1	0	0	75	144	17	5	2	0	0	0	168
09:45	64	7	4	6	2	0	0	83	109	11	2	3	2	0	0	127
10:00	57	19	3	4	1	0	0	84	109	10	3	4	0	0	0	126
10:15	55	16	6	2	0	1	0	80	104	8	9	10	1	0	0	132
10:30	78	14	1	5	1	0	0	99	117	17	5	3	0	0	0	142
10:45	58	14	5	1	0	0	0	78	96	11	2	7	1	0	0	117
11:00	62	9	4	4	2	1	1	83	106	11	3	6	1	0	0	127
11:15	70	18	1	2	0	0	0	91	80	12	5	1	0	0	0	98
11:30	70	12	2	2	1	0	0	87	103	13	6	2	1	0	0	125
11:45	83	9	1	5	0	0	0	98	102	11	3	4	0	0	0	120
12:00	82	10	3	5	1	0	0	101	93	15	2	0	1	0	0	111
12:15	86	13	3	4	0	0	0	106	104	10	0	0	0	0	0	114
12:30	92	16	4	3	1	0	0	116	92	12	5	1	1	0	0	111
12:45	105	13	3	5	0	0	0	126	91	13	6	5	0	0	0	115
13:00	83	9	3	5	1	0	0	101	91	12	5	2	2	0	0	112
13:15	98	10	2	4	0	0	0	114	78	11	2	7	0	0	0	98
13:30	107	10	2	0	1	0	0	120	80	11	3	6	1	0	0	101
13:45	112	12	3	1	0	1	0	129	81	6	4	5	0	0	0	96
14:00	93	14	0	9	1	0	0	117	93	11	6	1	2	0	0	113
14:15	105	9	3	2	0	1	0	120	83	17	6	4	0	0	0	110
14:30	100	15	4	1	1	1	0	122	85	14	2	7	1	0	0	109
14:45	120	15	0	2	0	0	0	137	80	9	3	3	2	0	0	97
15:00	153	10	3	3	1	0	0	170	69	16	3	3	1	1	0	93
15:15	148	14	2	5	1	1	0	171	84	14	5	2	2	0	0	107
15:30	157	19	2	3	1	0	0	182	106	8	1	3	3	0	0	121
15:45	150	11	1	2	3	0	0	167	100	10	2	0	1	0	0	113
16:00	144	18	1	0	1	0	0	164	84	11	1	4	0	0	0	100
16:15	166	17	0	1	1	1	0	186	109	23	0	3	2	0	0	137
16:30	171	14	1	1	1	1	0	189	86	19	0	2	0	0	0	107
16:45	189	8	0	2	1	0	0	200	106	5	1	1	1	0	0	114
17:00	217	9	2	1	1	0	0	230	120	13	1	2	0	0	0	136
17:15	182	11	0	0	1	1	0	195	126	8	2	1	1	0	0	138
17:30	205	6	1	1	1	0	0	214	107	3	3	0	1	1	0	115
17:45	198	13	1	0	0	1	0	213	101	11	0	2	1	0	1	116
18:00	181	6	0	1	1	0	0	189	64	2	1	1	0	1	0	69
18:15	192	6	0	0	0	1	0	199	82	6	0	0	1	1	0	90
18:30	144	7	1	2	1	0	0	155	86	3	0	0	0	0	0	89
18:45	133	6	1	2	0	0	0	142	62	1	0	1	1	0	0	65
Start Time	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**
07:00	217	46	13	3	0	0	0	279	1026	87	7	11	8	2	1	1142
07:15	261	46	11	3	3	0	0	324	1023	90	6	16	6	3	0	1144
07:30	271	59	9	5	5	0	0	349	971	83	5	19	5	4	0	1087
07:45	292	57	8	5	5	0	0	367	952	80	5	19	5	2	0	1063
08:00	293	61	5	8	6	0	0	373	881	74	9	19	3	3	0	989
08:15	251	69	6	10	5	1	0	342	837	81	11	15	3	2	0	949

08:30	247	64	10	12	4	1	0	338	757	66	13	13	3	1	0	853
08:45	220	69	12	16	5	1	0	323	675	64	16	13	2	1	0	771
09:00	225	61	14	18	6	1	0	325	600	59	12	12	3	0	0	686
09:15	235	61	15	19	5	0	0	335	521	44	13	12	3	0	0	593
09:30	229	56	16	16	4	1	0	322	466	46	19	19	3	0	0	553
09:45	254	56	14	17	4	1	0	346	439	46	19	20	3	0	0	527
10:00	248	63	15	12	2	1	0	341	426	46	19	24	2	0	0	517
10:15	253	53	16	12	3	2	1	340	423	47	19	26	3	0	0	518
10:30	268	55	11	12	3	1	1	351	399	51	15	17	2	0	0	484
10:45	260	53	12	9	3	1	1	339	385	47	16	16	3	0	0	467
11:00	285	48	8	13	3	1	1	359	391	47	17	13	2	0	0	470
11:15	305	49	7	14	2	0	0	377	378	51	16	7	2	0	0	454
11:30	321	44	9	16	2	0	0	392	402	49	11	6	2	0	0	470
11:45	343	48	11	17	2	0	0	421	391	48	10	5	2	0	0	456
12:00	365	52	13	17	2	0	0	449	380	50	13	6	2	0	0	451
12:15	366	51	13	17	2	0	0	449	378	47	16	8	3	0	0	452
12:30	378	48	12	17	2	0	0	457	352	48	18	15	3	0	0	436
12:45	393	42	10	14	2	0	0	461	340	47	16	20	3	0	0	426
13:00	400	41	10	10	2	1	0	464	330	40	14	20	3	0	0	407
13:15	410	46	7	14	2	1	0	480	332	39	15	19	3	0	0	408
13:30	417	45	8	12	2	2	0	486	337	45	19	16	3	0	0	420
13:45	410	50	10	13	2	3	0	488	342	48	18	17	3	0	0	428
14:00	418	53	7	14	2	2	0	496	341	51	17	15	5	0	0	429
14:15	478	49	10	8	2	2	0	549	317	56	14	17	4	1	0	409
14:30	521	54	9	11	3	2	0	600	318	53	13	15	6	1	0	406
14:45	578	58	7	13	3	1	0	660	339	47	12	11	8	1	0	418
15:00	608	54	8	13	6	1	0	690	359	48	11	8	7	1	0	434
15:15	599	62	6	10	6	1	0	684	374	43	9	9	6	0	0	441
15:30	617	65	4	6	6	1	0	699	399	52	4	10	6	0	0	471
15:45	631	60	3	4	6	2	0	706	379	63	3	9	3	0	0	457
16:00	670	57	2	4	4	2	0	739	385	58	2	10	3	0	0	458
16:15	743	48	3	5	4	2	0	805	421	60	2	8	3	0	0	494
16:30	759	42	3	4	4	2	0	814	438	45	4	6	2	0	0	495
16:45	793	34	3	4	4	1	0	839	459	29	7	4	3	1	0	503
17:00	802	39	4	2	3	2	0	852	454	35	6	5	3	1	1	505
17:15	766	36	2	2	3	2	0	811	398	24	6	4	3	2	1	438
17:30	776	31	2	2	2	2	0	815	354	22	4	3	3	3	1	390
17:45	715	32	2	3	2	2	0	756	333	22	1	3	2	2	1	364
18:00	650	25	2	5	2	1	0	685	294	12	1	2	2	2	0	313

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 1

Date of Survey: 11.02.2020
Junction Name: A48 / A4226 / Unnamed Road
Junction Type: Crossroads

	Arm C Approach								Arm C Exit							
Time	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**
07:00	146	13	1	3	0	0	0	163	46	14	0	4	1	0	0	65
07:15	171	16	3	1	0	0	0	191	53	29	1	1	2	0	0	86
07:30	177	26	2	3	0	1	0	209	80	28	2	0	3	0	0	113
07:45	144	17	0	4	0	0	0	165	74	21	1	1	0	1	0	98
08:00	128	13	1	6	0	0	0	148	129	19	1	1	1	0	0	151
08:15	137	20	0	3	0	0	0	160	99	19	1	2	0	1	0	122
08:30	110	14	1	2	1	0	0	128	96	10	3	0	2	0	0	111
08:45	78	7	1	2	1	0	0	89	64	12	2	4	0	0	0	82
09:00	76	10	3	6	1	1	0	97	50	13	0	1	0	0	0	64
09:15	83	11	0	3	2	0	0	99	45	14	3	5	0	0	0	67
09:30	61	12	0	2	0	0	1	76	46	12	1	3	0	0	0	62
09:45	52	6	2	5	0	0	0	65	38	12	1	6	0	0	0	57
10:00	47	7	2	3	0	0	0	59	33	12	2	5	0	0	0	52
10:15	50	9	2	5	0	0	0	66	49	10	1	3	0	0	0	63
10:30	60	7	3	4	0	0	0	74	42	3	0	3	0	0	0	48
10:45	42	11	1	7	0	1	0	62	29	8	4	3	0	0	0	44
11:00	42	9	2	6	0	0	0	59	40	4	3	3	0	0	0	50
11:15	44	14	5	2	0	0	0	65	48	5	1	3	0	0	0	57
11:30	42	2	3	0	0	0	0	47	47	13	4	3	0	0	0	67
11:45	41	4	2	3	0	0	0	50	46	4	3	6	0	0	0	59
12:00	49	8	4	1	1	0	0	63	47	10	7	4	1	0	0	69
12:15	56	13	0	1	0	0	0	70	59	7	2	5	0	0	0	73
12:30	48	3	4	2	0	0	0	57	53	6	1	2	0	0	0	62
12:45	53	9	1	5	0	0	0	68	53	10	1	3	0	0	0	67
13:00	49	8	3	1	1	0	0	62	57	9	2	5	0	0	0	73
13:15	32	10	2	4	0	0	0	48	45	7	3	3	0	3	0	61
13:30	49	10	0	5	0	0	0	64	50	8	2	1	0	0	0	61
13:45	58	5	1	7	1	0	0	72	52	11	3	4	1	0	0	71
14:00	59	14	3	1	1	0	0	78	61	11	1	5	3	0	0	81
14:15	37	10	0	6	1	0	0	54	52	9	1	3	0	0	0	65
14:30	61	11	3	7	1	0	0	83	59	13	1	2	0	1	0	76
14:45	57	8	4	4	0	0	0	73	64	12	1	1	2	0	1	81
15:00	54	21	1	5	0	2	0	83	79	10	2	5	0	0	0	96
15:15	55	14	4	2	0	0	0	75	73	13	1	5	1	0	1	94
15:30	68	16	0	4	0	0	0	88	102	12	2	1	0	0	0	117
15:45	69	15	1	2	2	0	0	89	87	14	2	7	0	1	0	111
16:00	86	23	1	4	1	0	0	115	92	19	0	1	0	0	0	112
16:15	86	19	1	3	4	0	0	113	93	20	0	1	0	1	0	115
16:30	80	14	1	4	1	0	0	100	115	14	0	2	1	0	0	132
16:45	88	20	1	0	1	0	0	110	112	17	1	1	0	0	0	131
17:00	95	23	3	2	0	0	0	123	141	16	2	1	0	0	0	160
17:15	89	9	0	0	1	0	0	99	148	12	0	0	0	1	0	161
17:30	100	9	1	0	0	0	0	110	173	10	3	1	0	0	0	187
17:45	71	1	1	2	0	0	0	75	137	9	0	0	0	0	0	146
18:00	53	7	0	0	0	0	0	60	88	4	0	0	0	0	0	92
18:15	55	2	0	0	1	0	0	58	85	3	0	0	0	0	0	88
18:30	58	4	0	0	0	0	0	62	70	8	0	1	0	0	0	79
18:45	46	3	1	1	0	0	0	51	52	6	0	0	0	0	0	58
Start Time	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**
07:00	638	72	6	11	0	1	0	728	253	92	4	6	6	1	0	362
07:15	620	72	6	14	0	1	0	713	336	97	5	3	6	1	0	448
07:30	586	76	3	16	0	1	0	682	382	87	5	4	4	2	0	484
07:45	519	64	2	15	1	0	0	601	398	69	6	4	3	2	0	482
08:00	453	54	3	13	2	0	0	525	388	60	7	7	3	1	0	466
08:15	401	51	5	13	3	1	0	474	309	54	6	7	2	1	0	379

08:30	347	42	5	13	5	1	0	413	255	49	8	10	2	0	0	324
08:45	298	40	4	13	4	1	1	361	205	51	6	13	0	0	0	275
09:00	272	39	5	16	3	1	1	337	179	51	5	15	0	0	0	250
09:15	243	36	4	13	2	0	1	299	162	50	7	19	0	0	0	238
09:30	210	34	6	15	0	0	1	266	166	46	5	17	0	0	0	234
09:45	209	29	9	17	0	0	0	264	162	37	4	17	0	0	0	220
10:00	199	34	8	19	0	1	0	261	153	33	7	14	0	0	0	207
10:15	194	36	8	22	0	1	0	261	160	25	8	12	0	0	0	205
10:30	188	41	11	19	0	1	0	260	159	20	8	12	0	0	0	199
10:45	170	36	11	15	0	1	0	233	164	30	12	12	0	0	0	218
11:00	169	29	12	11	0	0	0	221	181	26	11	15	0	0	0	233
11:15	176	28	14	6	1	0	0	225	188	32	15	16	1	0	0	252
11:30	188	27	9	5	1	0	0	230	199	34	16	18	1	0	0	268
11:45	194	28	10	7	1	0	0	240	205	27	13	17	1	0	0	263
12:00	206	33	9	9	1	0	0	258	212	33	11	14	1	0	0	271
12:15	206	33	8	9	1	0	0	257	222	32	6	15	0	0	0	275
12:30	182	30	10	12	1	0	0	235	208	32	7	13	0	3	0	263
12:45	183	37	6	15	1	0	0	242	205	34	8	12	0	3	0	262
13:00	188	33	6	17	2	0	0	246	204	35	10	13	1	3	0	266
13:15	198	39	6	17	2	0	0	262	208	37	9	13	4	3	0	274
13:30	203	39	4	19	3	0	0	268	215	39	7	13	4	0	0	278
13:45	215	40	7	21	4	0	0	287	224	44	6	14	4	1	0	293
14:00	214	43	10	18	3	0	0	288	236	45	4	11	5	1	1	303
14:15	209	50	8	22	2	2	0	293	254	44	5	11	2	1	1	318
14:30	227	54	12	18	1	2	0	314	275	48	5	13	3	1	2	347
14:45	234	59	9	15	0	2	0	319	318	47	6	12	3	0	2	388
15:00	246	66	6	13	2	2	0	335	341	49	7	18	1	1	1	418
15:15	278	68	6	12	3	0	0	367	354	58	5	14	1	1	1	434
15:30	309	73	3	13	7	0	0	405	374	65	4	10	0	2	0	455
15:45	321	71	4	13	8	0	0	417	387	67	2	11	1	2	0	470
16:00	340	76	4	11	7	0	0	438	412	70	1	5	1	1	0	490
16:15	349	76	6	9	6	0	0	446	461	67	3	5	1	1	0	538
16:30	352	66	5	6	3	0	0	432	516	59	3	4	1	1	0	584
16:45	372	61	5	2	2	0	0	442	574	55	6	3	0	1	0	639
17:00	355	42	5	4	1	0	0	407	599	47	5	2	0	1	0	654
17:15	313	26	2	2	1	0	0	344	546	35	3	1	0	1	0	586
17:30	279	19	2	2	1	0	0	303	483	26	3	1	0	0	0	513
17:45	237	14	1	2	1	0	0	255	380	24	0	1	0	0	0	405
18:00	212	16	1	1	1	0	0	231	295	21	0	1	0	0	0	317

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 1

Date of Survey: 11.02.2020
Junction Name: A48 / A4226 / Unnamed Road
Junction Type: Crossroads

	Arm D Approach								Arm D Exit							
Time	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**
07:00	155	21	1	4	3	0	1	185	59	19	4	1	0	0	0	83
07:15	200	29	2	2	4	1	0	238	85	11	4	1	0	0	0	101
07:30	154	25	4	0	4	2	0	189	102	25	4	1	0	1	0	133
07:45	210	23	2	0	4	1	0	240	105	16	5	0	0	1	0	127
08:00	231	23	1	3	1	1	0	260	127	18	2	1	4	0	0	152
08:15	221	20	1	5	1	1	0	249	111	27	1	3	2	0	0	144
08:30	238	19	5	1	3	0	0	266	108	17	2	2	1	0	0	130
08:45	178	18	8	4	1	1	0	210	88	14	2	2	2	0	0	108
09:00	157	26	0	3	0	0	0	186	62	18	3	7	3	2	0	95
09:15	125	14	3	3	1	0	0	146	76	32	2	3	3	0	0	116
09:30	147	21	5	3	0	0	0	176	68	15	4	4	1	0	1	93
09:45	101	14	2	3	2	0	0	122	78	10	3	5	2	0	0	98
10:00	101	12	5	6	0	0	0	124	64	17	3	4	1	0	0	89
10:15	101	10	4	8	1	0	0	124	58	18	5	3	0	1	0	85
10:30	103	15	5	4	0	0	0	127	78	18	3	5	1	0	0	105
10:45	85	12	3	5	1	0	0	106	61	20	3	4	0	1	0	89
11:00	103	12	4	6	1	0	0	126	61	13	4	7	2	1	0	88
11:15	79	10	4	3	1	0	0	97	72	19	5	3	0	0	0	99
11:30	104	23	7	6	1	0	0	141	58	9	2	1	1	0	0	71
11:45	104	15	5	5	0	0	0	129	87	12	2	4	0	0	0	105
12:00	88	16	4	3	2	0	0	113	88	10	2	6	2	0	0	108
12:15	105	11	1	5	0	0	0	122	89	17	2	5	1	0	0	114
12:30	87	11	5	2	1	0	0	106	90	14	6	4	1	0	0	115
12:45	91	15	5	1	0	0	0	112	103	17	3	2	0	0	0	125
13:00	97	13	5	3	1	0	0	119	87	11	5	1	1	0	0	105
13:15	76	12	4	6	0	3	0	101	84	14	1	2	0	0	0	101
13:30	73	13	4	4	1	0	0	95	91	8	2	3	1	0	0	105
13:45	82	11	6	3	1	0	0	103	108	11	1	4	1	1	0	126
14:00	86	12	6	2	4	0	0	110	99	19	1	4	1	0	0	124
14:15	87	22	7	3	0	0	0	119	98	11	2	6	1	1	0	119
14:30	97	18	3	5	2	0	0	125	105	18	5	3	2	0	0	133
14:45	95	15	1	4	4	0	1	120	115	14	1	6	0	0	0	136
15:00	89	19	3	3	1	0	0	115	127	19	2	3	2	0	0	153
15:15	88	20	3	5	4	0	1	121	131	18	4	5	1	1	0	160
15:30	117	10	2	1	3	0	0	133	156	22	2	4	2	0	0	186
15:45	112	19	4	6	1	1	0	143	157	20	2	3	5	0	0	187
16:00	102	19	2	3	0	0	0	126	155	21	4	2	2	0	0	184
16:15	137	28	0	1	1	0	0	167	170	19	1	1	4	0	0	195
16:30	119	24	0	2	1	0	0	146	167	23	2	3	2	1	0	198
16:45	127	14	1	1	1	0	0	144	177	17	1	1	2	1	0	199
17:00	153	19	2	0	0	0	0	174	202	18	4	0	1	0	0	225
17:15	181	16	2	1	1	1	0	202	186	12	0	0	2	1	0	201
17:30	168	8	3	0	1	1	0	181	185	11	0	0	1	0	0	197
17:45	162	14	0	0	1	0	1	178	186	11	2	0	0	1	0	200
18:00	77	3	1	1	0	1	0	83	160	10	0	1	1	0	0	172
18:15	99	8	0	0	1	1	0	109	177	7	0	0	1	1	0	186
18:30	85	7	0	0	0	0	0	92	131	6	1	1	1	0	0	140
18:45	61	4	0	0	1	0	0	66	122	7	2	2	0	0	0	133
Start Time	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**
07:00	719	98	9	6	15	4	1	852	351	71	17	3	0	2	0	444
07:15	795	100	9	5	13	5	0	927	419	70	15	3	4	2	0	513
07:30	816	91	8	8	10	5	0	938	445	86	12	5	6	2	0	556
07:45	900	85	9	9	9	3	0	1015	451	78	10	6	7	1	0	553
08:00	868	80	15	13	6	3	0	985	434	76	7	8	9	0	0	534
08:15	794	83	14	13	5	2	0	911	369	76	8	14	8	2	0	477

08:30	698	77	16	11	5	1	0	808	334	81	9	14	9	2	0	449
08:45	607	79	16	13	2	1	0	718	294	79	11	16	9	2	1	412
09:00	530	75	10	12	3	0	0	630	284	75	12	19	9	2	1	402
09:15	474	61	15	15	3	0	0	568	286	74	12	16	7	0	1	396
09:30	450	57	16	20	3	0	0	546	268	60	15	16	4	1	1	365
09:45	406	51	16	21	3	0	0	497	278	63	14	17	4	1	0	377
10:00	390	49	17	23	2	0	0	481	261	73	14	16	2	2	0	368
10:15	392	49	16	23	3	0	0	483	258	69	15	19	3	3	0	367
10:30	370	49	16	18	3	0	0	456	272	70	15	19	3	2	0	381
10:45	371	57	18	20	4	0	0	470	252	61	14	15	3	2	0	347
11:00	390	60	20	20	3	0	0	493	278	53	13	15	3	1	0	363
11:15	375	64	20	17	4	0	0	480	305	50	11	14	3	0	0	383
11:30	401	65	17	19	3	0	0	505	322	48	8	16	4	0	0	398
11:45	384	53	15	15	3	0	0	470	354	53	12	19	4	0	0	442
12:00	371	53	15	11	3	0	0	453	370	58	13	17	4	0	0	462
12:15	380	50	16	11	2	0	0	459	369	59	16	12	3	0	0	459
12:30	351	51	19	12	2	3	0	438	364	56	15	9	2	0	0	446
12:45	337	53	18	14	2	3	0	427	365	50	11	8	2	0	0	436
13:00	328	49	19	16	3	3	0	418	370	44	9	10	3	1	0	437
13:15	317	48	20	15	6	3	0	409	382	52	5	13	3	1	0	456
13:30	328	58	23	12	6	0	0	427	396	49	6	17	4	2	0	474
13:45	352	63	22	13	7	0	0	457	410	59	9	17	5	2	0	502
14:00	365	67	17	14	10	0	1	474	417	62	9	19	4	1	0	512
14:15	368	74	14	15	7	0	1	479	445	62	10	18	5	1	0	541
14:30	369	72	10	17	11	0	2	481	478	69	12	17	5	1	0	582
14:45	389	64	9	13	12	0	2	489	529	73	9	18	5	1	0	635
15:00	406	68	12	15	9	1	1	512	571	79	10	15	10	1	0	686
15:15	419	68	11	15	8	1	1	523	599	81	12	14	10	1	0	717
15:30	468	76	8	11	5	1	0	569	638	82	9	10	13	0	0	752
15:45	470	90	6	12	3	1	0	582	649	83	9	9	13	1	0	764
16:00	485	85	3	7	3	0	0	583	669	80	8	7	10	2	0	776
16:15	536	85	3	4	3	0	0	631	716	77	8	5	9	2	0	817
16:30	580	73	5	4	3	1	0	666	732	70	7	4	7	3	0	823
16:45	629	57	8	2	3	2	0	701	750	58	5	1	6	2	0	822
17:00	664	57	7	1	3	2	1	735	759	52	6	0	4	2	0	823
17:15	588	41	6	2	3	3	1	644	717	44	2	1	4	2	0	770
17:30	506	33	4	1	3	3	1	551	708	39	2	1	3	2	0	755
17:45	423	32	1	1	2	2	1	462	654	34	3	2	3	2	0	698
18:00	322	22	1	1	2	2	0	350	590	30	3	4	3	1	0	631

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 1

Date of Survey: 11.02.2020
Junction Name: A48 / A4226 / Unnamed Road
Junction Type: Crossroads

	Total Junction Flow							
Time	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**
07:00	355	50	5	8	3	0	1	422
07:15	453	73	8	4	4	1	0	543
07:30	451	81	8	3	4	3	0	550
07:45	466	64	8	5	4	2	0	549
08:00	515	58	3	10	5	1	0	592
08:15	474	73	3	11	3	2	0	566
08:30	471	48	7	4	4	0	0	534
08:45	357	46	11	10	3	1	0	428
09:00	323	62	5	13	3	2	0	408
09:15	297	53	8	11	4	0	0	373
09:30	279	51	10	11	1	0	1	353
09:45	237	34	9	14	4	0	0	298
10:00	225	40	10	15	1	0	0	291
10:15	233	40	15	16	1	1	0	306
10:30	258	41	9	14	1	0	0	323
10:45	204	42	9	14	1	1	0	271
11:00	220	33	11	18	3	1	1	287
11:15	210	43	11	8	1	0	0	273
11:30	233	37	13	9	2	0	0	294
11:45	243	31	9	15	0	0	0	298
12:00	245	37	12	11	4	0	0	309
12:15	266	38	4	11	1	0	0	320
12:30	248	33	13	8	2	0	0	304
12:45	265	41	10	11	0	0	0	327
13:00	250	35	12	10	3	0	0	310
13:15	220	35	8	14	0	3	0	280
13:30	239	36	7	10	2	0	0	294
13:45	264	31	10	13	2	1	0	321
14:00	264	47	9	12	6	0	0	338
14:15	243	41	10	14	1	1	0	310
14:30	275	46	10	13	4	1	0	349
14:45	283	42	6	12	4	0	1	348
15:00	309	53	7	12	3	2	0	386
15:15	316	53	10	14	5	1	1	400
15:30	388	49	5	9	5	0	0	456
15:45	379	52	6	11	6	1	0	455
16:00	363	66	6	7	2	0	0	444
16:15	412	68	1	5	6	1	0	493
16:30	400	62	2	7	3	1	0	475
16:45	435	48	3	3	3	1	0	493
17:00	497	57	7	3	1	0	0	565
17:15	492	37	2	1	3	2	0	537
17:30	500	27	6	1	2	1	0	537
17:45	458	31	2	2	1	1	1	496
18:00	335	17	1	2	1	1	0	357
18:15	367	17	0	0	2	2	0	388
18:30	309	20	1	2	1	0	0	333
18:45	250	15	2	3	1	0	0	271
Start Time	**Rolling Hour**							**Total**
07:00	1725	268	29	20	15	6	1	2064
07:15	1885	276	27	22	17	7	0	2234
07:30	1906	276	22	29	16	8	0	2257
07:45	1926	243	21	30	16	5	0	2241
08:00	1817	225	24	35	15	4	0	2120
08:15	1625	229	26	38	13	5	0	1936

08:30	1448	209	31	38	14	3	0	1743
08:45	1256	212	34	45	11	3	1	1562
09:00	1136	200	32	49	12	2	1	1432
09:15	1038	178	37	51	10	0	1	1315
09:30	974	165	44	56	7	1	1	1248
09:45	953	155	43	59	7	1	0	1218
10:00	920	163	43	59	4	2	0	1191
10:15	915	156	44	62	6	3	1	1187
10:30	892	159	40	54	6	2	1	1154
10:45	867	155	44	49	7	2	1	1125
11:00	906	144	44	50	6	1	1	1152
11:15	931	148	45	43	7	0	0	1174
11:30	987	143	38	46	7	0	0	1221
11:45	1002	139	38	45	7	0	0	1231
12:00	1024	149	39	41	7	0	0	1260
12:15	1029	147	39	40	6	0	0	1261
12:30	983	144	43	43	5	3	0	1221
12:45	974	147	37	45	5	3	0	1211
13:00	973	137	37	47	7	4	0	1205
13:15	987	149	34	49	10	4	0	1233
13:30	1010	155	36	49	11	2	0	1263
13:45	1046	165	39	52	13	3	0	1318
14:00	1065	176	35	51	15	2	1	1345
14:15	1110	182	33	51	12	4	1	1393
14:30	1183	194	33	51	16	4	2	1483
14:45	1296	197	28	47	17	3	2	1590
15:00	1392	207	28	46	19	4	1	1697
15:15	1446	220	27	41	18	2	1	1755
15:30	1542	235	18	32	19	2	0	1848
15:45	1554	248	15	30	17	3	0	1867
16:00	1610	244	12	22	14	3	0	1905
16:15	1744	235	13	18	13	3	0	2026
16:30	1824	204	14	14	10	4	0	2070
16:45	1924	169	18	8	9	4	0	2132
17:00	1947	152	17	7	7	4	1	2135
17:15	1785	112	11	6	7	5	1	1927
17:30	1660	92	9	5	6	5	1	1778
17:45	1469	85	4	6	5	4	1	1574
18:00	1261	69	4	7	5	3	0	1349

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 1

Date of Survey: 11.02.2020
Junction Name: A48 / A4226 / Unnamed Road
Junction Type: Crossroads

Arm A: Unnamed Road (N) **Arm B:** A48 (E) **Arm C:** A4226 (S) **Arm D:** A48 (W)

	PCU Summary															
Time	A to A	A to D	A to C	A to B	B to B	B to A	B to D	B to C	C to C	C to B	C to A	C to D	D to D	D to C	D to B	D to A
07:00	0	3	9	2	0	1	49	15	0	120	13	37	0	50	144	3
07:15	0	8	24	10	0	7	52	18	0	137	12	47	0	50	187	12
07:30	0	9	56	15	0	3	51	20	0	115	23	78	0	43	150	4
07:45	0	11	39	19	0	4	65	13	0	91	27	55	0	48	190	9
08:00	0	15	50	16	0	5	90	17	0	85	18	57	0	88	172	7
08:15	0	7	39	14	0	5	82	20	0	84	17	65	0	67	181	12
08:30	0	10	25	17	0	10	66	15	0	52	21	61	0	77	188	12
08:45	0	20	15	13	0	8	61	23	0	49	11	35	0	54	164	8
09:00	0	9	17	27	0	7	67	10	0	63	11	39	0	39	139	14
09:15	0	9	15	11	0	1	81	26	0	59	11	38	0	38	112	6
09:30	0	12	14	6	0	6	58	23	0	32	12	35	0	32	138	16
09:45	0	11	12	6	0	7	67	28	0	33	8	36	0	30	99	4
10:00	0	11	3	14	0	8	59	29	0	31	5	31	0	32	92	17
10:15	0	12	13	16	0	6	61	22	0	38	17	22	0	35	107	3
10:30	0	9	5	11	0	9	78	24	0	42	11	32	0	25	100	15
10:45	0	9	9	9	0	8	54	23	0	31	9	36	0	22	94	4
11:00	0	9	9	6	0	5	70	21	0	38	6	29	0	29	99	15
11:15	0	8	10	5	0	6	68	22	0	31	9	34	0	32	69	7
11:30	0	7	8	7	0	11	52	31	0	20	13	17	0	38	109	14
11:45	0	10	9	7	0	5	75	29	0	24	4	30	0	36	99	8
12:00	0	15	14	8	0	7	69	39	0	21	9	40	0	32	85	8
12:15	0	12	10	3	0	4	83	30	0	32	8	32	0	45	79	9
12:30	0	5	17	5	0	5	94	28	0	29	5	31	0	22	85	9
12:45	0	7	11	4	0	4	94	41	0	41	6	31	0	22	85	12
13:00	0	8	14	9	0	4	70	41	0	24	9	35	0	30	90	11
13:15	0	7	6	4	0	6	81	37	0	30	10	18	0	25	79	10
13:30	0	7	3	8	0	8	84	31	0	38	13	23	0	31	71	6
13:45	0	11	7	3	0	14	85	34	0	39	9	39	0	42	67	7
14:00	0	6	15	12	0	5	87	44	0	33	10	41	0	37	78	10
14:15	0	16	4	3	0	5	89	32	0	32	7	28	0	36	88	7
14:30	0	6	7	6	0	7	89	32	0	34	15	51	0	41	85	14
14:45	0	15	5	3	0	6	97	38	0	29	19	37	0	43	77	14
15:00	0	11	8	2	0	13	111	56	0	34	17	41	0	44	66	15
15:15	0	16	17	5	0	8	124	52	0	34	14	35	0	37	80	22
15:30	0	22	24	11	0	8	131	52	0	37	14	45	0	45	84	12
15:45	0	18	23	17	0	8	123	45	0	19	17	61	0	58	80	21
16:00	0	19	16	6	0	6	112	48	0	29	33	63	0	50	74	10
16:15	0	11	12	4	0	10	132	47	0	43	21	61	0	57	98	15
16:30	0	9	27	4	0	6	139	48	0	30	20	60	0	62	77	12
16:45	0	10	23	6	0	8	143	54	0	29	33	51	0	57	83	8
17:00	0	12	24	2	0	2	166	67	0	47	31	52	0	73	92	11
17:15	0	12	26	3	0	8	135	53	0	20	24	57	0	81	120	5
17:30	0	5	26	2	0	7	138	74	0	32	23	56	0	92	85	8
17:45	0	12	13	5	0	6	147	60	0	24	14	42	0	73	92	14
18:00	0	9	14	2	0	5	138	49	0	18	14	28	0	29	51	5
18:15	0	5	14	3	0	9	149	40	0	18	9	33	0	34	70	6
18:30	0	5	17	2	0	6	118	37	0	31	10	21	0	27	56	9

18:45	0	4	5	3	0	5	109	33	0	21	7	26	0	20	45	3
Start Time	**Rolling Hour**															
07:00	0	31	128	46	0	15	216	66	0	462	75	217	0	192	671	28
07:15	0	43	169	60	0	19	257	68	0	428	80	237	0	230	700	32
07:30	0	42	184	64	0	17	287	70	0	375	85	255	0	247	694	31
07:45	0	43	153	66	0	24	302	65	0	312	83	238	0	281	732	39
08:00	0	51	129	60	0	28	299	75	0	270	67	219	0	286	706	39
08:15	0	46	96	71	0	30	276	68	0	247	60	200	0	237	672	46
08:30	0	48	72	68	0	26	275	74	0	222	54	173	0	207	603	40
08:45	0	50	61	57	0	22	267	82	0	202	45	147	0	162	553	44
09:00	0	41	58	50	0	21	273	87	0	186	42	147	0	138	488	40
09:15	0	43	44	37	0	22	265	106	0	154	36	139	0	131	441	43
09:30	0	46	42	42	0	27	245	101	0	134	42	123	0	128	435	40
09:45	0	43	33	47	0	30	265	102	0	144	41	120	0	121	396	38
10:00	0	41	30	50	0	31	252	97	0	141	42	120	0	113	392	38
10:15	0	39	36	42	0	28	263	89	0	148	43	118	0	110	399	36
10:30	0	35	33	31	0	28	270	89	0	141	35	130	0	107	361	41
10:45	0	33	36	27	0	30	244	96	0	119	37	115	0	120	370	40
11:00	0	34	36	25	0	27	265	102	0	112	32	109	0	134	376	44
11:15	0	40	41	27	0	29	264	120	0	96	35	120	0	137	362	37
11:30	0	44	41	25	0	27	279	128	0	97	34	119	0	150	373	39
11:45	0	42	50	23	0	21	321	125	0	106	26	132	0	134	349	34
12:00	0	39	52	20	0	20	339	137	0	123	28	134	0	120	334	38
12:15	0	32	52	21	0	17	340	139	0	127	28	128	0	118	339	41
12:30	0	27	48	22	0	19	339	146	0	124	30	114	0	99	339	42
12:45	0	29	34	25	0	22	329	149	0	133	38	106	0	107	325	39
13:00	0	33	30	24	0	32	321	142	0	131	41	115	0	128	307	34
13:15	0	31	31	27	0	33	338	145	0	140	42	121	0	135	295	32
13:30	0	39	29	26	0	32	346	140	0	142	39	131	0	146	304	30
13:45	0	39	33	24	0	31	351	142	0	139	41	160	0	156	318	38
14:00	0	43	31	24	0	23	362	146	0	128	51	157	0	157	328	45
14:15	0	48	24	14	0	31	386	158	0	129	58	157	0	163	317	50
14:30	0	48	37	16	0	34	421	178	0	131	65	163	0	164	308	65
14:45	0	64	54	21	0	35	463	197	0	133	64	157	0	168	307	63
15:00	0	68	72	35	0	37	489	204	0	123	62	181	0	183	311	70
15:15	0	75	80	39	0	30	490	196	0	118	78	204	0	189	318	65
15:30	0	70	75	38	0	32	498	192	0	128	85	230	0	210	337	58
15:45	0	57	78	31	0	30	506	188	0	121	91	245	0	227	329	58
16:00	0	49	78	20	0	30	526	197	0	131	107	235	0	226	332	45
16:15	0	42	86	16	0	26	580	216	0	149	105	224	0	249	351	46
16:30	0	43	100	15	0	24	584	222	0	126	108	219	0	274	372	36
16:45	0	39	99	13	0	25	582	248	0	128	111	215	0	303	380	32
17:00	0	41	89	12	0	23	586	254	0	123	92	206	0	319	389	38
17:15	0	38	79	12	0	26	558	236	0	94	75	182	0	275	348	32
17:30	0	31	67	12	0	27	573	223	0	92	60	158	0	228	298	33
17:45	0	31	58	12	0	26	553	186	0	91	47	123	0	163	269	34
18:00	0	23	50	10	0	25	515	159	0	88	40	107	0	110	222	23

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 1

Date of Survey: 11.02.2020
Junction Name: A48 / A4226 / Unnamed Road
Junction Type: Crossroads

Arm A: Unnamed Road (N)
Arm B: A48 (E)
Arm C: A4226 (S)
Arm D: A48 (W)

Count Method: PCUs **Classes Included:** Excluding M/Cs and P/Cs *Select the count method and desired user classes from the drop-downs in cells D10 and G10*

Maximum 15-minute Junction Flow:

AM Peak	**from:**	08:00	**until:**	08:15	**flow:**	620
Inter-Peak	**from:**	15:45	**until:**	16:00	**flow:**	489
PM Peak	**from:**	17:00	**until:**	17:15	**flow:**	579

AM Peak covers 07:00 until 10:00
Inter-Peak covers 10:00 until 16:00
PM Peak covers 16:00 until 19:00

Period Starting: 08:00 *Select the time from the drop-down in cell D18 to show the 15-minute data for that period*

Movement Counts

From \ To	A	B	C	D	Total
A	0	16	50	15	81
B	5	0	17	90	112
C	18	85	0	57	160
D	7	**172**	88	0	**267**
Total	30	**273**	155	162	620

HGV Proportions

From \ To	A	B	C	D	Total
A	0.0%	0.0%	0.0%	17.2%	3.1%
B	0.0%	0.0%	0.0%	13.6%	11.0%
C	0.0%	**20.4%**	0.0%	3.3%	**12.0%**
D	0.0%	3.4%	8.3%	0.0%	4.9%
Total	0.0%	8.5%	4.7%	**10.3%**	7.6%

Maximum Hourly Junction Flow:

AM Peak	**from:**	07:30	**until:**	08:30	**flow:**	2348
Inter-Peak	**from:**	15:45	**until:**	16:45	**flow:**	1960
PM Peak	**from:**	16:45	**until:**	17:45	**flow:**	2173

Period Starting: 16:45 *Select the time from the drop-down in cell D35 to show the hourly data for that period*

Movement Counts

From \ To	A	B	C	D	Total
A	0	13	99	39	151
B	25	0	248	**582**	**854**
C	111	128	0	215	453
D	32	380	303	0	715
Total	168	520	649	**835**	2173

HGV Proportions

From \ To	A	B	C	D	Total
A	0.0%	0.0%	1.9%	4.9%	2.5%
B	0.0%	0.0%	5.1%	2.5%	3.2%
C	0.0%	**7.5%**	0.0%	5.0%	**4.5%**
D	0.0%	4.8%	1.9%	0.0%	3.4%
Total	0.0%	**5.4%**	3.1%	3.3%	3.5%

Bold entries in the above tables indicate the maximum movement, approach and exit flows for the selected time period, and similarly with the HGV proportions

Intelligent Data Collection Limited

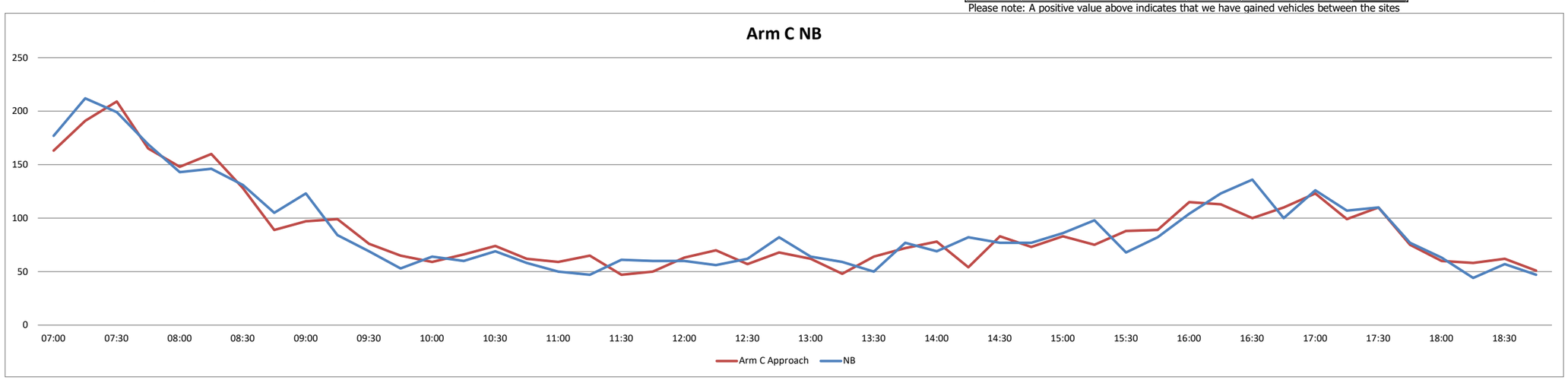
Survey Date 25.02.2020
Project Number ID05235
Project Name Vale of Glamorgan

PM Comments
Resurvey counts are unclassified.

	Site 1								Site 1 Resurvey								Difference (Entry minus Exit)								Graph Data		
	Arm C Approach								NB																		
Time	Cars	LGV	OGV1	OGV2	Buses	M/C	Cycle	Total	Cars	LGV	OGV1	OGV2	Buses	M/C	Cycle	Total	Cars	LGV	OGV1	OGV2	Buses	M/C	Cycle	Total	Time	Exit	Entry
07:00	146	13	1	3	0	0	0	163								177								0	07:00	163	177
07:15	171	16	3	1	0	0	0	191								212								0	07:15	191	212
07:30	177	26	2	3	0	1	0	209								199								0	07:30	209	199
07:45	144	17	0	4	0	0	0	165								169								0	07:45	165	169
08:00	128	13	1	6	0	0	0	148								143								0	08:00	148	143
08:15	137	20	0	3	0	0	0	160								146								0	08:15	160	146
08:30	110	14	1	2	1	0	0	128								131								0	08:30	128	131
08:45	78	7	1	2	1	0	0	89								105								0	08:45	89	105
09:00	76	10	3	6	1	1	0	97								123								0	09:00	97	123
09:15	83	11	0	3	2	0	0	99								84								0	09:15	99	84
09:30	61	12	0	2	0	0	1	76								69								0	09:30	76	69
09:45	52	6	2	5	0	0	0	65								53								0	09:45	65	53
10:00	47	7	2	3	0	0	0	59								64								0	10:00	59	64
10:15	50	9	2	5	0	0	0	66								60								0	10:15	66	60
10:30	60	7	3	4	0	0	0	74								69								0	10:30	74	69
10:45	42	11	1	7	0	1	0	62								58								0	10:45	62	58
11:00	42	9	2	6	0	0	0	59								50								0	11:00	59	50
11:15	44	14	5	2	0	0	0	65								47								0	11:15	65	47
11:30	42	2	3	0	0	0	0	47								61								0	11:30	47	61
11:45	41	4	2	3	0	0	0	50								60								0	11:45	50	60
12:00	49	8	4	1	1	0	0	63								60								0	12:00	63	60
12:15	56	13	0	1	0	0	0	70								56								0	12:15	70	56
12:30	48	3	4	2	0	0	0	57								62								0	12:30	57	62
12:45	53	9	1	5	0	0	0	68								82								0	12:45	68	82
13:00	49	8	3	1	1	0	0	62								64								0	13:00	62	64
13:15	32	10	2	4	0	0	0	48								59								0	13:15	48	59
13:30	49	10	0	5	0	0	0	64								50								0	13:30	64	50
13:45	58	5	1	7	1	0	0	72								77								0	13:45	72	77
14:00	59	14	3	1	1	0	0	78								69								0	14:00	78	69
14:15	37	10	0	6	1	0	0	54								82								0	14:15	54	82
14:30	61	11	3	7	1	0	0	83								77								0	14:30	83	77
14:45	57	8	4	4	0	0	0	73								77								0	14:45	73	77
15:00	54	21	1	5	0	2	0	83								86								0	15:00	83	86
15:15	55	14	4	2	0	0	0	75								98								0	15:15	75	98
15:30	68	16	0	4	0	0	0	88								68								0	15:30	88	68
15:45	69	15	1	2	2	0	0	89								82								0	15:45	89	82
16:00	86	23	1	4	1	0	0	115								104								0	16:00	115	104
16:15	86	19	1	3	4	0	0	113								123								0	16:15	113	123
16:30	80	14	1	4	1	0	0	100								136								0	16:30	100	136
16:45	88	20	1	0	1	0	0	110								100								0	16:45	110	100
17:00	95	23	3	2	0	0	0	123								126								0	17:00	123	126
17:15	89	9	0	0	1	0	0	99								107								0	17:15	99	107
17:30	100	9	1	0	0	0	0	110								110								0	17:30	110	110
17:45	71	1	1	2	0	0	0	75								77								0	17:45	75	77
18:00	53	7	0	0	0	0	0	60								63								0	18:00	60	63
18:15	55	2	0	0	1	0	0	58								44								0	18:15	58	44
18:30	58	4	0	0	0	0	0	62								57								0	18:30	62	57
18:45	46	3	1	1	0	0	0	51								47								0	18:45	51	47
Total	**3492**	**537**	**75**	**143**	**22**	**5**	**1**	**4275**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4323**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**			
																	0%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**			

Please link the above cells directly to the relevant arm totals from the count sheets

Please note: A positive value above indicates that we have gained vehicles between the sites



Intelligent Data Collection Limited

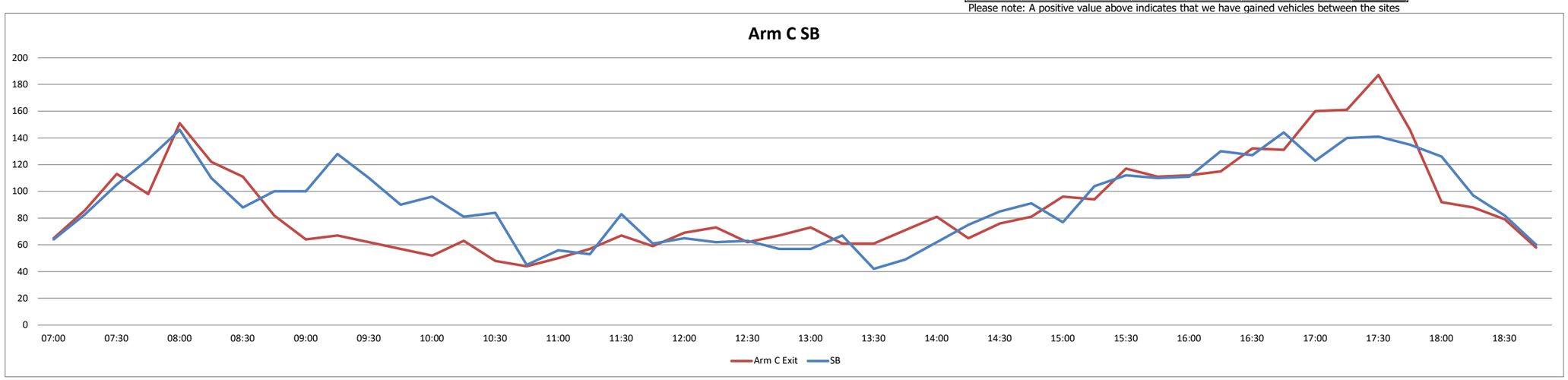
Survey Date 25.02.2020
Project Number ID05235
Project Name Vale of Glamorgan

PM Comments
Resurvey counts are unclassified.

	Site 1								Site 1 Resurvey								Difference (Entry minus Exit)								Graph Data		
	Arm C Exit								SB																		
Time	Cars	LGV	OGV1	OGV2	Buses	M/C	Cycle	Total	Cars	LGV	OGV1	OGV2	Buses	M/C	Cycle	Total	Cars	LGV	OGV1	OGV2	Buses	M/C	Cycle	Total	Time	Exit	Entry
07:00	46	14	0	4	1	0	0	65								64								0	07:00	65	64
07:15	53	29	1	1	2	0	0	86								83								0	07:15	86	83
07:30	80	28	2	0	3	0	0	113								105								0	07:30	113	105
07:45	74	21	1	1	0	1	0	98								124								0	07:45	98	124
08:00	129	19	1	1	1	0	0	151								146								0	08:00	151	146
08:15	99	19	1	2	0	1	0	122								110								0	08:15	122	110
08:30	96	10	3	0	2	0	0	111								88								0	08:30	111	88
08:45	64	12	2	4	0	0	0	82								100								0	08:45	82	100
09:00	50	13	0	1	0	0	0	64								100								0	09:00	64	100
09:15	45	14	3	5	0	0	0	67								128								0	09:15	67	128
09:30	46	12	1	3	0	0	0	62								110								0	09:30	62	110
09:45	38	12	1	6	0	0	0	57								90								0	09:45	57	90
10:00	33	12	2	5	0	0	0	52								96								0	10:00	52	96
10:15	49	10	1	3	0	0	0	63								81								0	10:15	63	81
10:30	42	3	0	3	0	0	0	48								84								0	10:30	48	84
10:45	29	8	4	3	0	0	0	44								45								0	10:45	44	45
11:00	40	4	3	3	0	0	0	50								56								0	11:00	50	56
11:15	48	5	1	3	0	0	0	57								53								0	11:15	57	53
11:30	47	13	4	3	0	0	0	67								83								0	11:30	67	83
11:45	46	4	3	6	0	0	0	59								61								0	11:45	59	61
12:00	47	10	7	4	1	0	0	69								65								0	12:00	69	65
12:15	59	7	2	5	0	0	0	73								62								0	12:15	73	62
12:30	53	6	1	2	0	0	0	62								63								0	12:30	62	63
12:45	53	10	1	3	0	0	0	67								57								0	12:45	67	57
13:00	57	9	2	5	0	0	0	73								57								0	13:00	73	57
13:15	45	7	3	3	0	3	0	61								67								0	13:15	61	67
13:30	50	8	2	1	0	0	0	61								42								0	13:30	61	42
13:45	52	11	3	4	1	0	0	71								49								0	13:45	71	49
14:00	61	11	1	5	3	0	0	81								62								0	14:00	81	62
14:15	52	9	1	3	0	0	0	65								75								0	14:15	65	75
14:30	59	13	1	2	0	1	0	76								85								0	14:30	76	85
14:45	64	12	1	1	2	0	1	81								91								0	14:45	81	91
15:00	79	10	2	5	0	0	0	96								77								0	15:00	96	77
15:15	73	13	1	5	1	0	1	94								104								0	15:15	94	104
15:30	102	12	2	1	0	0	0	117								112								0	15:30	117	112
15:45	87	14	2	7	0	1	0	111								110								0	15:45	111	110
16:00	92	19	0	1	0	0	0	112								111								0	16:00	112	111
16:15	93	20	0	1	0	1	0	115								130								0	16:15	115	130
16:30	115	14	0	2	1	0	0	132								127								0	16:30	132	127
16:45	112	17	1	1	0	0	0	131								144								0	16:45	131	144
17:00	141	16	2	1	0	0	0	160								123								0	17:00	160	123
17:15	148	12	0	0	0	1	0	161								140								0	17:15	161	140
17:30	173	10	3	1	0	0	0	187								141								0	17:30	187	141
17:45	137	9	0	0	0	0	0	146								135								0	17:45	146	135
18:00	88	4	0	0	0	0	0	92								126								0	18:00	92	126
18:15	85	3	0	0	0	0	0	88								97								0	18:15	88	97
18:30	70	8	0	1	0	0	0	79								82								0	18:30	79	82
18:45	52	6	0	0	0	0	0	58								60								0	18:45	58	60
Total	**3453**	**562**	**72**	**121**	**18**	**9**	**2**	**4237**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4401**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**			
																	0%	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**			

Please link the above cells directly to the relevant arm totals from the count sheets

Please note: A positive value above indicates that we have gained vehicles between the sites



Intelligent Data Collection Limited
Vale of Glamorgan

Client:	Arcadis
Project Number:	ID05235
Site Number:	Site 1
Date of Survey:	11.02.2020
Junction Name:	A48 / A4226 / Unnamed Road
Survey Type:	Queue Length Survey

Quality Assurance and Issue Record

Quality Assurance

Revision	Rev A			
Date	22.02.2020			
Prepared by	Grant Daniel Breddy			
Signature				
Checked by	David Brown			
Signature				
Project Director	Paul O'Neill			
Signature				
Project number	ID05235			
File Ref	ID05235 Vale of Glamorgan - Queue Report Site 1 - 11.02.2020			

Issue Sheet

Issued to	Date			
	24.02.2020			
Chad Collins	E-mail			

Contents Page

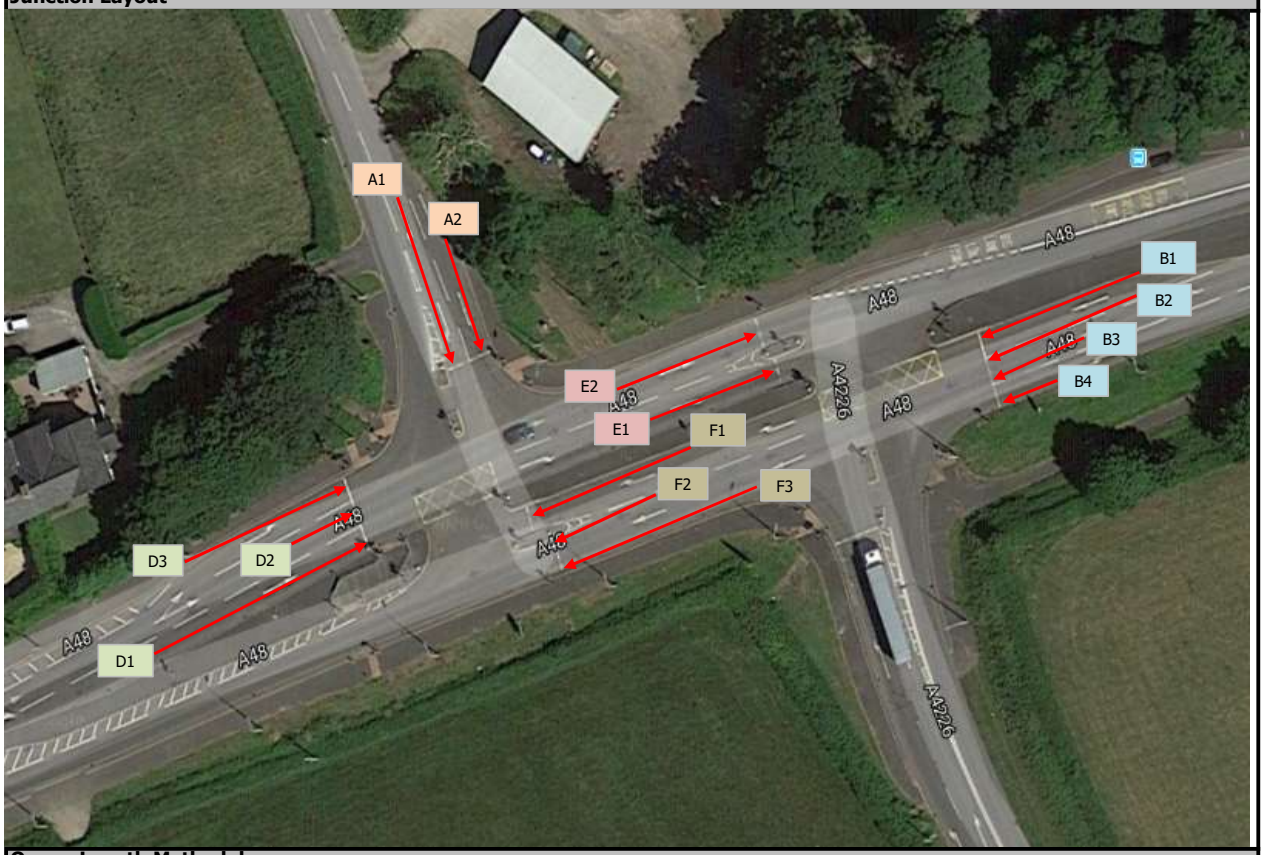
Location Plan
Queue Lengths

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Site Number: Site 1
Date of Survey: 11.02.2020
Junction Name: A48 / A4226 / Unnamed Road
Survey Type: Queue Length Survey

X Coordinate	Y Coordinate	Google Maps Link
51.45876782	-3.334839625	Click Here
Weather Conditions		
Sunny Intervals		

Junction Layout



Queue Length Methodology

The maximum queue length, in vehicles, is reported by lane for each five-minute period.

These are segregated into 'light' and 'heavy' vehicles, and are then presented as a maximum queue length using the assumption that a light vehicle contributes 6m to a queue and a heavy vehicle 15m. These values can be updated by the user.

Vehicle Length Assumptions (metres)

Lights	Heavies
6	15

Additional Notes (Factors which may impact on survey results such as accidents, roadworks, special events)

Any shaded entries indicate where queues reach the extent of the camera view.

Shaded entries for Lanes E1, E2, F1, F2 and F3 indicate where the queue reaches the upstream junction.

Intelligent Data Collection Limited

intelligentdata

Client: Arcadis
Project Number: ID05235
Site Number: Site 1
Date of Survey: 11.02.2020
Junction Name: A48 / A4226 / Unnamed Road
Survey Type: Queue Length Survey

	Lane A1				Lane A2				Lane B1				Lane B2			
Time	Lights	Heavies	Total	Length (m)	Lights	Heavies	Total	Length (m)	Lights	Heavies	Total	Length (m)	Lights	Heavies	Total	Length (m)
07:00	1	0	1	6	3	0	3	18	0	0	0	0	2	0	2	12
07:05	1	0	1	6	1	0	1	6	0	0	0	0	2	0	2	12
07:10	1	0	1	6	1	0	1	6	1	0	1	6	6	0	6	36
07:15	0	0	0	0	6	0	6	36	0	0	0	0	5	0	5	30
07:20	1	0	1	6	5	0	5	30	2	0	2	12	2	0	2	12
07:25	3	0	3	18	4	0	4	24	2	0	2	12	4	0	4	24
07:30	2	0	2	12	12	0	12	72	2	0	2	12	3	0	3	18
07:35	3	0	3	18	11	0	11	66	1	0	1	6	2	0	2	12
07:40	2	0	2	12	11	0	11	66	0	0	0	0	5	0	5	30
07:45	3	0	3	18	5	1	6	45	1	0	1	6	3	0	3	18
07:50	1	0	1	6	15	0	15	90	0	0	0	0	1	1	2	21
07:55	2	0	2	12	17	0	17	102	1	0	1	6	6	0	6	36
08:00	3	0	3	18	11	0	11	66	1	0	1	6	6	0	6	36
08:05	1	0	1	6	11	0	11	66	2	0	2	12	5	0	5	30
08:10	1	1	2	21	15	0	15	90	0	0	0	0	4	0	4	24
08:15	0	0	0	0	4	1	5	39	2	0	2	12	4	0	4	24
08:20	3	0	3	18	8	0	8	48	1	0	1	6	3	0	3	18
08:25	2	0	2	12	5	0	5	30	1	0	1	6	5	0	5	30
08:30	1	0	1	6	9	0	9	54	1	0	1	6	3	0	3	18
08:35	0	1	1	15	3	0	3	18	2	0	2	12	4	0	4	24
08:40	1	0	1	6	9	0	9	54	3	0	3	18	4	0	4	24
08:45	3	0	3	18	2	0	2	12	1	0	1	6	3	0	3	18
08:50	4	0	4	24	3	0	3	18	2	0	2	12	3	0	3	18
08:55	3	0	3	18	4	0	4	24	0	0	0	0	2	0	2	12
09:00	2	0	2	12	6	0	6	36	1	0	1	6	2	0	2	12
09:05	3	0	3	18	4	0	4	24	1	0	1	6	2	0	2	12
09:10	0	1	1	15	5	0	5	30	1	0	1	6	1	0	1	6
09:15	2	0	2	12	4	0	4	24	0	0	0	0	1	0	1	6
09:20	1	0	1	6	2	0	2	12	0	0	0	0	3	0	3	18
09:25	2	0	2	12	3	0	3	18	0	0	0	0	2	0	2	12
09:30	0	0	0	0	3	0	3	18	3	0	3	18	1	0	1	6
09:35	0	1	1	15	3	1	4	33	0	0	0	0	3	0	3	18
09:40	0	1	1	15	1	0	1	6	1	0	1	6	2	0	2	12
09:45	1	0	1	6	2	0	2	12	2	0	2	12	2	0	2	12
09:50	1	0	1	6	5	0	5	30	0	0	0	0	1	0	1	6
09:55	1	0	1	6	1	0	1	6	2	0	2	12	2	0	2	12
10:00	0	1	1	15	2	0	2	12	2	0	2	12	1	0	1	6
10:05	1	0	1	6	3	1	4	33	1	0	1	6	2	0	2	12
10:10	1	1	2	21	5	0	5	30	0	0	0	0	0	0	0	0
10:15	3	0	3	18	5	0	5	30	3	0	3	18	2	0	2	12
10:20	1	0	1	6	2	1	3	27	0	0	0	0	1	0	1	6
10:25	1	0	1	6	2	1	3	27	1	0	1	6	2	0	2	12
10:30	2	0	2	12	3	0	3	18	0	0	0	0	4	0	4	24
10:35	0	0	0	0	3	0	3	18	1	0	1	6	2	0	2	12
10:40	0	1	1	15	3	0	3	18	2	0	2	12	1	0	1	6
10:45	0	1	1	15	3	0	3	18	1	0	1	6	2	0	2	12
10:50	1	0	1	6	2	0	2	12	1	0	1	6	2	0	2	12
10:55	0	0	0	0	2	0	2	12	3	0	3	18	1	0	1	6
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11:35	1	0	1	6	1	0	1	6	1	0	1	6	3	0	3	18
11:40	1	0	1	6	0	1	1	15	1	0	1	6	2	0	2	12
11:45	1	0	1	6	1	0	1	6	1	0	1	6	3	0	3	18
11:50	1	0	1	6	2	0	2	12	0	0	0	0	1	0	1	6
11:55	1	0	1	6	5	1	6	45	0	0	0	0	3	0	3	18
12:00	1	1	2	21	1	1	2	21	3	0	3	18	2	0	2	12
12:05	0	1	1	15	3	0	3	18	0	0	0	0	2	0	2	12
12:10	3	0	3	18	3	0	3	18	1	0	1	6	1	0	1	6
12:15	0	1	1	15	1	0	1	6	0	0	0	0	2	0	2	12
12:20	2	0	2	12	5	0	5	30	2	0	2	12	2	0	2	12
12:25	1	0	1	6	2	0	2	12	1	0	1	6	2	0	2	12
12:30	1	0	1	6	2	0	2	12	1	0	1	6	2	0	2	12
12:35	0	0	0	0	2	0	2	12	1	0	1	6	1	0	1	6
12:40	0	1	1	15	4	0	4	24	1	0	1	6	2	0	2	12
12:45	2	0	2	12	1	0	1	6	1	0	1	6	0	1	1	15
12:50	1	0	1	6	3	0	3	18	0	0	0	0	4	0	4	24
12:55	1	0	1	6	4	0	4	24	1	0	1	6	3	0	3	18
13:00	1	0	1	6	4	0	4	24	0	0	0	0	1	0	1	6
13:05	0	1	1	15	2	0	2	12	0	0	0	0	3	0	3	18
13:10	3	0	3	18	4	0	4	24	0	0	0	0	1	0	1	6
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13:20	1	0	1	6	3	0	3	18	1	0	1	6	2	0	2	12
13:25	1	0	1	6	3	0	3	18	1	0	1	6	1	0	1	6
13:30	1	0	1	6	2	0	2	12	1	0	1	6	3	0	3	18
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13:40	0	1	1	15	2	0	2	12	0	0	0	0	2	0	2	12
13:45	0	1	1	15	2	0	2	12	2	0	2	12	2	0	2	12
13:50	1	1	2	21	2	0	2	12	1	0	1	6	3	0	3	18
13:55	1	0	1	6	2	0	2	12	2	0	2	12	2	0	2	12
14:00	1	0	1	6	3	0	3	18	1	0	1	6	1	0	1	6
14:05	2	0	2	12	4	0	4	24	1	0	1	6	3	0	3	18
14:10	1	0	1	6	4	0	4	24	0	0	0	0	2	0	2	12
14:15	0	1	1	15	1	0	1	6	1	0	1	6	1	0	1	6
14:20	1	0	1	6	2	0	2	12	0	0	0	0	3	0	3	18
14:25	2	1	3	27	2	0	2	12	0	1	1	15	1	0	1	6
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14:35	2	0	2	12	1	0	1	6	1	0	1	6	2	0	2	12
14:40	2	0	2	12	3	0	3	18	0	0	0	0	9	0	9	54
14:45	1	1	2	21	1	0	1	6	2	0	2	12	2	0	2	12
14:50	4	0	4	24	1	0	1	6	1	0	1	6	2	0	2	12
14:55	1	0	1	6	2	0	2	12	1	0	1	6	3	0	3	18
15:00	0	1	1	15	3	0	3	18	1	0	1	6	3	0	3	18
15:05	3	0	3	18	1	0	1	6	1	0	1	6	3	0	3	18
15:10	1	0	1	6	4	0	4	24	2	0	2	12	3	0	3	18
15:15	1	0	1	6	4	0	4	24	2	0	2	12	3	0	3	18
15:20	1	0	1	6	1	0	1	6	1	0	1	6	1	0	1	6
15:25	3	0	3	18	5	0	5	30	1	0	1	6	5	0	5	30
15:30	2	0	2	12	5	0	5	30	1	0	1	6	4	0	4	24
15:35	1	1	2	21	3	0	3	18	1	0	1	6	8	0	8	48
15:40	2	0	2	12	5	0	5	30	0	0	0	0	4	0	4	24
15:45	2	1	3	27	6	0	6	36	2	0	2	12	3	0	3	18
15:50	1	0	1	6	8	0	8	48	2	0	2	12	5	0	5	30
15:55	1	2	3	36	4	0	4	24	1	0	1	6	4	0	4	24
16:00	2	2	4	42	4	0	4	24	1	0	1	6	6	0	6	36
16:05	3	0	3	18	3	0	3	18	1	0	1	6	5	0	5	30
16:10	3	0	3	18	1	0	1	6	1	0	1	6	2	0	2	12
16:15	2	0	2	12	3	0	3	18	1	0	1	6	5	0	5	30
16:20	2	0	2	12	1	0	1	6	1	0	1	6	5	0	5	30
16:25	2	0	2	12	5	0	5	30	2	0	2	12	5	0	5	30
16:30	2	0	2	12	5	0	5	30	1	0	1	6	7	0	7	42
16:35	2	0	2	12	5	0	5	30	2	0	2	12	4	0	4	24
16:40	2	0	2	12	5	0	5	30	1	0	1	6	3	0	3	18
16:45	2	0	2	12	6	0	6	36	2	0	2	12	5	0	5	30
16:50	1	0	1	6	4	0	4	24	1	0	1	6	4	0	4	24
16:55	1	0	1	6	2	0	2	12	0	0	0	0	8	0	8	48
17:00	2	0	2	12	3	0	3	18	0	0	0	0	6	0	6	36
17:05	3	0	3	18	4	0	4	24	1	0	1	6	6	0	6	36
17:10	2	0	2	12	5	0	5	30	1	0	1	6	7	0	7	42
17:15	3	0	3	18	4	0	4	24	2	0	2	12	3	0	3	18
17:20	4	0	4	24	8	0	8	48	1	0	1	6	5	0	5	30
17:25	2	0	2	12	4	0	4	24	0	0	0	0	6	0	6	36
17:30	1	0	1	6	6	0	6	36	1	0	1	6	2	0	2	12
17:35	0	0	0	0	4	0	4	24	1	0	1	6	5	0	5	30
17:40	3	0	3	18	5	0	5	30	2	0	2	12	5	0	5	30
17:45	1	0	1	6	2	0	2	12	1	0	1	6	3	0	3	18
17:50	1	0	1	6	5	0	5	30	1	0	1	6	5	0	5	30
17:55	2	0	2	12	3	0	3	18	1	0	1	6	3	0	3	18
18:00	2	0	2	12	3	0	3	18	0	0	0	0	3	0	3	18
18:05	1	0	1	6	2	0	2	12	1	0	1	6	3	0	3	18

	Lane B3				Lane B4				Lane D1				Lane D2				Lane D3			
Time	Lights	Heavies	Total	Length (m)	Lights	Heavies	Total	Length (m)	Lights	Heavies	Total	Length (m)	Lights	Heavies	Total	Length (m)	Lights	Heavies	Total	Length (m)
07:00	3	0	3	18	3	0	3	18	0	1	1	15	14	0	14	84	0	0	0	0
07:05	2	0	2	12	3	0	3	18	0	2	2	30	11	1	12	81	0	0	0	0
07:10	3	1	4	33	1	0	1	6	2	0	2	12	11	0	11	66	1	0	1	6
07:15	3	0	3	18	1	0	1	6	2	0	2	12	18	1	19	123	0	0	0	0
07:20	5	0	5	30	1	0	1	6	3	1	4	33	13	3	16	123	1	0	1	6
07:25	5	0	5	30	0	0	0	0	2	0	2	12	18	1	19	123	0	0	0	0
07:30	4	0	4	24	1	0	1	6	2	1	3	27	18	1	19	123	2	0	2	12
07:35	5	0	5	30	1	0	1	6	5	0	5	30	20	0	20	120	0	0	0	0
07:40	2	1	3	27	1	0	1	6	1	2	3	36	20	0	20	120	0	0	0	0
07:45	2	3	5	57	0	1	1	15	6	0	6	36	18	1	19	123	1	0	1	6
07:50	6	0	6	36	1	0	1	6	6	0	6	36	18	1	19	123	0	0	0	0
07:55	5	1	6	45	1	0	1	6	7	0	7	42	20	0	20	120	1	0	1	6
08:00	8	0	8	48	2	0	2	12	8	1	9	63	20	0	20	120	1	0	1	6
08:05	6	1	7	51	1	0	1	6	8	0	8	48	20	0	20	120	0	0	0	0
08:10	6	0	6	36	1	0	1	6	7	0	7	42	20	0	20	120	0	0	0	0
08:15	5	0	5	30	1	0	1	6	4	0	4	24	18	1	19	123	1	0	1	6
08:20	5	3	8	75	1	0	1	6	10	0	10	60	20	0	20	120	0	0	0	0
08:25	7	0	7	42	3	0	3	18	5	0	5	30	20	0	20	120	0	1	1	15
08:30	7	0	7	42	1	0	1	6	5	1	6	45	20	0	20	120	0	0	0	0
08:35	4	0	4	24	2	0	2	12	10	1	11	75	15	2	17	120	1	0	1	6
08:40	4	0	4	24	3	0	3	18	4	1	5	39	20	0	20	120	1	0	1	6
08:45	4	0	4	24	0	0	0	0	4	1	5	39	20	0	20	120	1	0	1	6
08:50	2	1	3	27	1	0	1	6	2	0	2	12	8	1	9	63	0	0	0	0
08:55	5	1	6	45	1	0	1	6	3	0	3	18	8	0	8	48	0	0	0	0
09:00	5	3	8	75	1	0	1	6	3	0	3	18	14	1	15	99	0	1	1	15
09:05	3	1	4	33	0	0	0	0	2	0	2	12	11	1	12	81	0	0	0	0
09:10	4	0	4	24	0	0	0	0	2	0	2	12	11	0	11	66	1	0	1	6
09:15	2	1	3	27	1	0	1	6	4	0	4	24	8	0	8	48	1	0	1	6
09:20	5	0	5	30	0	0	0	0	5	0	5	30	9	0	9	54	0	0	0	0
09:25	4	1	5	39	1	0	1	6	0	1	1	15	3	1	4	33	0	0	0	0
09:30	3	1	4	33	0	0	0	0	3	0	3	18	14	1	15	99	1	0	1	6
09:35	6	1	7	51	1	0	1	6	0	0	0	0	4	0	4	24	1	0	1	6
09:40	6	0	6	36	0	0	0	0	0	0	0	0	9	1	10	69	0	0	0	0
09:45	2	1	3	27	1	0	1	6	3	1	4	33	7	0	7	42	1	0	1	6
09:50	0	1	1	15	0	0	0	0	3	0	3	18	5	0	5	30	0	0	0	0
09:55	2	0	2	12	1	0	1	6	3	0	3	18	10	0	10	60	0	0	0	0
10:00	3	0	3	18	2	0	2	12	1	0	1	6	5	0	5	30	1	1	2	21
10:05	4	0	4	24	0	0	0	0	2	0	2	12	7	0	7	42	0	1	1	15
10:10	2	0	2	12	1	0	1	6	0	1	1	15	3	1	4	33	0	0	0	0
10:15	3	0	3	18	0	0	0	0	2	0	2	12	4	1	5	39	0	0	0	0
10:20	7	0	7	42	1	0	1	6	1	0	1	6	0	1	1	15	0	0	0	0
10:25	7	1	8	57	2	0	2	12	1	1	2	21	5	3	8	75	0	0	0	0
10:30	6	0	6	36	1	0	1	6	0	0	0	0	5	0	5	30	0	0	0	0
10:35	3	1	4	33	1	0	1	6	1	1	2	21	10	0	10	60	0	1	1	15
10:40	3	0	3	18	0	1	1	15	3	0	3	18	5	1	6	45	0	1	1	15
10:45	4	0	4	24	0	1	1	15	2	1	3	27	11	0	11	66	0	0	0	0
10:50	2	0	2	12	2	0	2	12	1	1	2	21	5	0	5	30	0	0	0	0
10:55	2	1	3	27	1	0	1	6	1	1	2	21	4	1	5	39	0	0	0	0
11:00	2	1	3	27	0	1	1	15	1	0	1	6	6	1	7	51	1	0	1	6
11:05	2	0	2	12	1	0	1	6	1	0	1	6	2	1	3	27	2	0	2	12
11:10	5	1	6	45	1	0	1	6	2	0	2	12	4	2	6	54	0	0	0	0
11:15	7	0	7	42	0	0	0	0	1	0	1	6	4	0	4	24	1	0	1	6
11:20	2	1	3	27	2	0	2	12	1	0	1	6	4	0	4	24	0	0	0	0
11:25	5	0	5	30	3	0	3	18	0	0	0	0	4	0	4	24	0	0	0	0
11:30	4	0	4	24	3	0	3	18	0	1	1	15	5	2	7	60	1	0	1	6
11:35	2	1	3	27	0	1	1	15	3	1	4	33	8	1	9	63	0	0	0	0
11:40	3	0	3	18	1	0	1	6	0	0	0	0	10	0	10	60	0	1	1	15
11:45	8	0	8	48	0	0	0	0	2	0	2	12	15	2	17	120	0	0	0	0
11:50	4	0	4	24	1	1	2	21	2	0	2	12	4	1	5	39	0	0	0	0
11:55	11	0	11	66	2	0	2	12	0	0	0	0	3	1	4	33	0	0	0	0
12:00	1	1	2	21	2	0	2	12	2	0	2	12	4	0	4	24	0	0	0	0
12:05	5	0	5	30	2	0	2	12	0	0	0	0	15	0	15	90	0	1	1	15
12:10	4	1	5	39	1	1	2	21	0	1	1	15	7	0	7	42	0	0	0	0
12:15	1	1	2	21	1	0	1	6	3	1	4	33	13	0	13	78	0	0	0	0
12:20	7	1	8	57	2	1	3	27	2	0	2	12	4	0	4	24	1	0	1	6
12:25	5	1	6	45	2	0	2	12	3	0	3	18	9	0	9	54	1	0	1	6
12:30	6	0	6	36	1	0	1	6	1	0	1	6	9	0	9	54	1	0	1	6
12:35	6	0	6	36	2	0	2	12	3	1	4	33	5	0	5	30	0	0	0	0
12:40	2	2	4	42	3	0	3	18	1	0	1	6	4	0	4	24	1	0	1	6
12:45	5	2	7	60	1	2	3	36	0	1	1	15	1	1	2	21	0	0	0	0
12:50	5	0	5	30	3	0	3	18	3	0	3	18	10	0	10	60	1	0	1	6
12:55	6	2	8	66	1	0	1	6	2	0	2	12	4	0	4	24	0	1	1	15
13:00	4	0	4	24	1	0	1	6	1	0	1	6	13	0	13	78	0	0	0	0
13:05	4	0	4	24	0	1	1	15	1	0	1	6	3	0	3	18	0	0	0	0
13:10	7	0	7	42	1	1	2	21	4	0	4	24	6	1	7	51	0	0	0	0
13:15	4	0	4	24	2	0	2	12	2	0	2	12	2	2	4	42	0	1	1	15
13:20	3	2	5	48	0	0	0	0	1	0	1	6	4	0	4	24	0	0	0	0
13:25	6	0	6	36	2	0	2	12	1	0	1	6	2	1	3	27	0	1	1	15
13:30	1	1	2	21	2	0	2	12	2	0	2	12	6	0	6	36	0	0	0	0
13:35	9	0	9	54	0	0	0	0	1	0	1	6	4	1	5	39	1	0	1	6
13:40	3	0	3	18	2	0	2	12	2	0	2	12	2	1	3	27	2	0	2	12
13:45	6	0	6	36	0	1	1	15	3	0	3	18	4	0	4	24	0	0	0	0
13:50	5	0	5	30	2	0	2	12	1	0	1	6	5	0	5	30	0	0	0	0
13:55	6	1	7	51	1	1	2	21	0	0	0	0	5	0	5	30	0	0	0	0
14:00	9	0	9	54	1	0	1	6	4	0	4	24	4	0	4	24	0	0	0	0
14:05	5	0	5	30	2	0	2	12	1	0	1	6	7	0	7	42	1	0	1	6
14:10	4	0	4	24	1	0	1	6	2	0	2	12	10	0	10	60	0	0	0	0
14:15	6	0	6	36	0	0	0	0	2	0	2	12	8	1	9	63	0	0	0	0
14:20	9	0	9	54	2	0	2	12	4	0	4	24	5	1	6	45	0	0	0	0
14:25	5	0	5	30	1	0	1	6	1	1	2	21	3	0	3	18	0	0	0	0
14:30	9	1	10	69	2	0	2	12	1	0	1	6	2	0	2	12	3	0	3	18
14:35	3	1	4	33	1	0	1	6	2	0	2	12	4	0	4	24	1	0	1	6
14:40	10	1	11	75	3	0	3	18	4	0	4	24	3	0	3	18	1	0	1	6
14:45	4	0	4	24	2	0	2	12	3	0	3	18	7	0	7	42	0	0	0	0
14:50	8	0	8	48	1	0	1	6	4	0	4	24	4	0	4	24	1	0	1	6
14:55	8	0	8	48	1	0	1	6	0	1	1	15	4	1	5	39	2	0	2	12
15:00	14	2	16	114	3	1	4	33	3	0	3	18	4	0	4	24	0	0	0	0
15:05	7	0	7	42	1	1	2	21	3	1	4	33	5	0	5	30	3	0	3	18
15:10	7	0	7	42	2	0	2	12	1	0	1	6	3	0	3	18	0	0	0	0
15:15	5	0	5	30	4	0	4	24	3	0	3	18	3	0	3	18	1	0	1	6
15:20	5	0	5	30	1	0	1	6	3	0	3	18	4	0	4	24	0	0	0	0
15:25	16	0	16	96	1	1	2	21	0	1	1	15	6	0	6	36	0	1	1	15
15:30	9	0	9	54	1	0	1	6	0	0	0	0	3	0	3	18	0	0	0	0
15:35	10	0	10	60	2	0	2	12	4	0	4	24	7	0	7	42	0	0	0	0
15:40	6	1	7	51	3	0	3	18	1	0	1	6	6	0	6	36	0	1	1	15
15:45	8	0	8	48	3	0	3	18	2	0	2	12	5	1	6	45	1	0	1	6
15:50	11	1	12	81	1	0	1	6	2	1	3	27	5	0	5	30	0	1	1	15
15:55	11	0	11	66	3	0	3	18	4	0	4	24	4	0	4	24	0	0	0	0
16:00	11	1	12	81	3	0	3	18	1	0	1	6	4	0	4	24	0	0	0	0
16:05	8	0	8	48	3	0	3	18	3	0	3	18	6	0	6	36	1	0	1	6
16:10	3	0	3	18	5	0	5	30	4	0	4	24	5	1	6	45	0	0	0	0
16:15	12	0	12	72	3	0	3	18	5	0	5	30	4	0	4	24	0	0	0	0
16:20	8	0	8	48	2	0	2	12	3	0	3	18	20	0	20	120	1	0	1	6
16:25	11	0	11	66	3	0	3	18	9	0	9	54	20	0	20	120	2	0	2	12
16:30	10	0	10	60	4	1	5	39	6	0	6	36	7	0	7	42	1	0	1	6
16:35	13	0	13	78	4	0	4	24	4	1	5	39	5	0	5	30	1	0	1	6
16:40	9	0	9	54	2	0	2	12	3	0	3	18	4	0	4	24	4	0	4	24
16:45	12	0	12	72	11	0	11	66	7	0	7	42	5	0	5	30	0	0	0	0
16:50	17	0	17	102	5	0	5	30	6	0	6	36	8	0	8	48	2	0	2	12
16:55	14	0	14	84	2	0	2	12	1	0	1	6	4	0	4	24	0	0	0	0
17:00	11	0	11	66	3	0	3	18	5	0	5	30	4	0	4	24	2	0	2	12
17:05	10	1	11	75	2	0	2	12	6	0	6	36	3	0	3	18	1	0	1	6
17:10	12	0	12	72	3	1	4	33	7	0	7	42	7	1	8	57	2	0	2	12
17:15	7	0	7	42	3	0	3	18	5	0	5	30	4	0	4	24	1	0	1	6
17:20	11	0	11	66	5	0	5	30	4	0	4	24	10	1	11	75	1	0	1	6
17:25	14	0	14	84	2	0	2	12	8	0	8	48	8	0	8	48	1	0	1	6
17:30	10	0	10	60	3	0	3	18	5	0	5	30	3	2	5	48	1	0	1	6
17:35	10	0	10	60	5	0	5	30	8	0	8	48	8	2	10	78	1	0	1	6
17:40	11	0	11	66	3	1	4	33	10	0	10	60	4	0	4	24	1	0	1	6
17:45	11	0	11	66	3	0	3	18	3	0	3	18	8	0	8	48	1	0	1	6
17:50	9	0	9	54	2	0	2	12	7	0	7	42	9	0	9	54	2	0	2	12
17:55	8	0	8	48	3	0	3	18	6	0	6	36	9	0	9	54	1	0	1	6
18:00	6	1	7	51	2	0	2	12	5	0	5	30	6	0	6	36	0	0	0	0
18:05	5	0	5	30	2	0	2	12	1	0	1	6	1	0	1	6	0	0	0	0

	Lane E1				Lane E2				Lane F1				Lane F2				Lane F3			
Time	Lights	Heavies	Total	Length (m)	Lights	Heavies	Total	Length (m)	Lights	Heavies	Total	Length (m)	Lights	Heavies	Total	Length (m)	Lights	Heavies	Total	Length (m)
07:00	3	0	3	18	0	0	0	0	3	0	3	18	1	0	1	6	1	0	1	6
07:05	3	1	4	33	1	0	1	6	3	0	3	18	2	0	2	12	2	1	3	27
07:10	4	1	5	39	1	0	1	6	3	0	3	18	0	0	0	0	5	0	5	30
07:15	6	0	6	36	1	0	1	6	1	0	1	6	0	0	0	0	6	0	6	36
07:20	5	0	5	30	3	0	3	18	2	0	2	12	1	0	1	6	4	0	4	24
07:25	6	0	6	36	2	0	2	12	4	0	4	24	1	0	1	6	3	0	3	18
07:30	7	0	7	42	1	1	2	21	5	0	5	30	0	0	0	0	5	0	5	30
07:35	7	0	7	42	3	0	3	18	2	0	2	12	2	0	2	12	7	0	7	42
07:40	7	0	7	42	3	0	3	18	2	0	2	12	2	0	2	12	7	0	7	42
07:45	7	0	7	42	3	0	3	18	3	0	3	18	2	0	2	12	7	0	7	42
07:50	6	0	6	36	3	0	3	18	2	0	2	12	2	0	2	12	4	0	4	24
07:55	7	0	7	42	5	0	5	30	7	0	7	42	2	0	2	12	5	0	5	30
08:00	7	0	7	42	5	0	5	30	3	0	3	18	1	0	1	6	5	0	5	30
08:05	7	0	7	42	5	0	5	30	3	0	3	18	2	0	2	12	4	0	4	24
08:10	7	0	7	42	3	0	3	18	3	0	3	18	4	0	4	24	6	0	6	36
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09:55	4	0	4	24	1	0	1	6	0	1	1	15	0	0	0	0	0	1	1	15
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11:55	3	0	3	18	2	0	2	12	1	0	1	6	0	0	0	0	0	0	0	0
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12:05	3	1	4	33	3	0	3	18	0	1	1	15	1	0	1	6	3	1	4	33
12:10	2	0	2	12	1	0	1	6	2	0	2	12	0	0	0	0	1	0	1	6
12:15	4	1	5	39	0	0	0	0	0	0	0	0	2	0	2	12	4	0	4	24
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12:25	3	0	3	18	1	0	1	6	3	0	3	18	0	0	0	0	0	1	1	15
12:30	4	0	4	24	1	0	1	6	1	0	1	6	0	0	0	0	4	0	4	24
12:35	4	1	5	39	1	0	1	6	1	0	1	6	0	0	0	0	0	0	0	0
12:40	4	0	4	24	2	0	2	12	1	0	1	6	0	0	0	0	1	0	1	6
12:45	2	0	2	12	1	0	1	6	2	0	2	12	0	0	0	0	3	0	3	18
12:50	5	0	5	30	0	0	0	0	1	0	1	6	0	0	0	0	1	0	1	6
12:55	4	0	4	24	1	0	1	6	2	0	2	12	1	0	1	6	2	0	2	12
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13:10	5	0	5	30	3	0	3	18	1	0	1	6	1	1	2	21	3	0	3	18
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13:25	4	0	4	24	0	0	0	0	0	1	1	15	0	0	0	0	1	0	1	6
13:30	3	1	4	33	2	0	2	12	1	0	1	6	0	0	0	0	0	0	0	0
13:35	3	0	3	18	1	0	1	6	1	0	1	6	0	0	0	0	0	1	1	15
13:40	1	0	1	6	2	0	2	12	2	0	2	12	0	0	0	0	2	0	2	12
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14:20	2	0	2	12	1	0	1	6	0	0	0	0	0	0	0	0	1	0	1	6
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14:30	1	1	2	21	1	0	1	6	3	0	3	18	0	0	0	0	2	1	3	27
14:35	3	1	4	33	0	0	0	0	2	0	2	12	0	0	0	0	7	0	7	42
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16:10	7	0	7	42	1	0	1	6	4	0	4	24	1	0	1	6	4	0	4	24
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17:40	7	0	7	42	1	0	1	6	4	0	4	24	1	0	1	6	5	0	5	30
17:45	7	0	7	42	0	0	0	0	4	0	4	24	2	0	2	12	3	0	3	18
17:50	7	0	7	42	2	0	2	12	2	0	2	12	1	0	1	6	7	0	7	42
17:55	6	0	6	36	0	0	0	0	3	0	3	18	0	0	0	0	4	0	4	24
18:00	7	0	7	42	0	0	0	0	4	0	4	24	1	0	1	6	3	0	3	18
18:05	5	0	5	30	0	0	0	0	2	0	2	12	0	0	0	0	2	0	2	12

18:10	1	0	1	6	2	0	2	12	0	0	0	0	3	0	3	18	6	0	6	36	1	0	1	6	0	0	0	0	4	0	4	24	2	0	2	12	3	0	3	18	1	0	1	6	2	0	2	12	0	0	0	0	2	0	2	12
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Intelligent Data Collection Limited
Vale of Glamorgan

Client:	Arcadis
Project Number:	ID05235
Site Number:	Site 1
Date of Survey:	25.02.2020
Junction Name:	A4226 / A48
Survey Type:	Queue Length Survey

Quality Assurance and Issue Record

Quality Assurance

Revision	Rev A			
Date	03.03.2020			
Prepared by	Grant Daniel Breddy			
Signature				
Checked by	Luke Martin			
Signature				
Project Director	Paul O'Neill			
Signature				
Project number	ID05235			
File Ref	ID05235 Vale of Glamorgan - Queue Report Site 1 (Arm C) - 25.02.2020			

Issue Sheet

Issued to	Date			
	03.03.2020			
Chad Collins	E-mail			

Contents Page

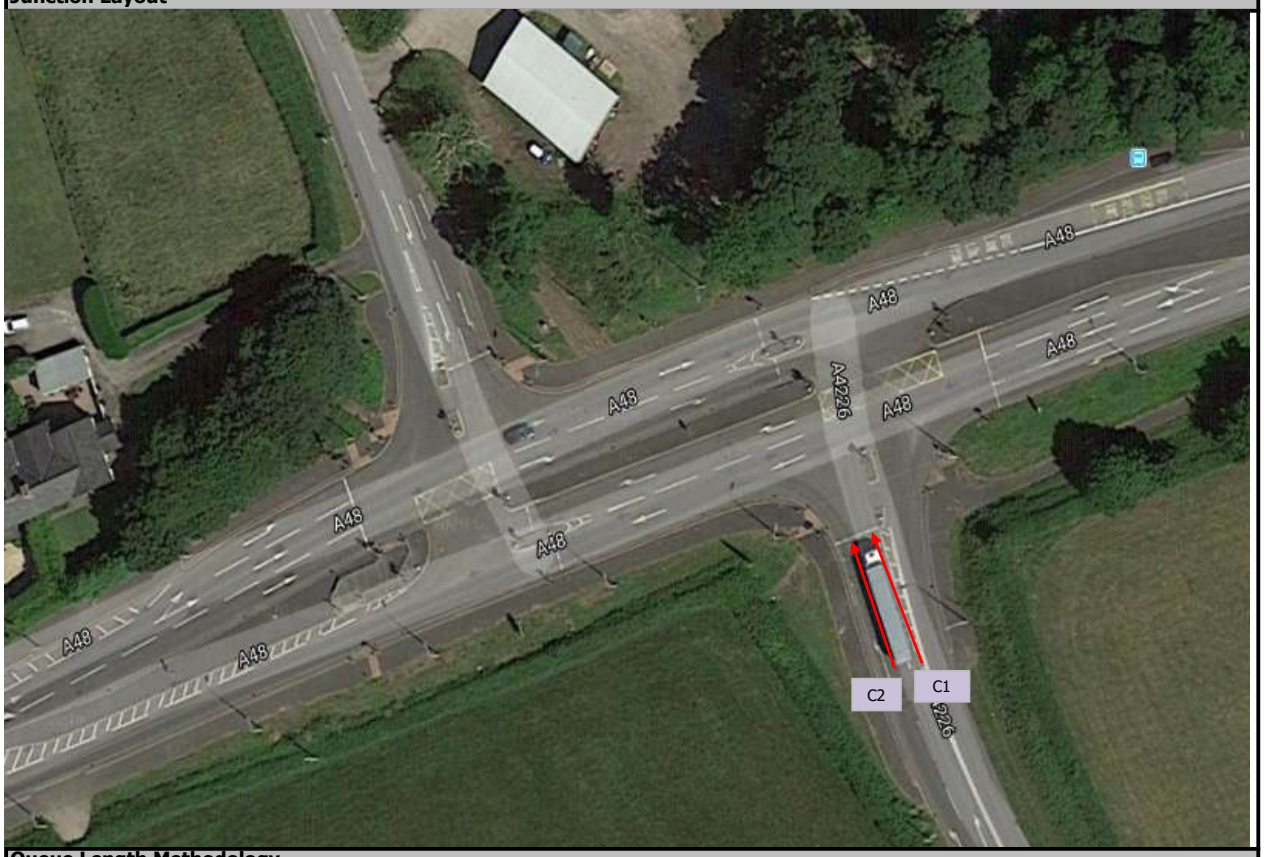
Location Plan
Queue Lengths

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Site Number: Site 1
Date of Survey: 25.02.2020
Junction Name: A4226 / A48
Survey Type: Queue Length Survey

X Coordinate	Y Coordinate	Google Maps Link
51.458611	-3.333957	Click Here
AM Peak Conditions	**Inter-Peak Conditions**	**PM Peak Conditions**
Overcast	Overcast	Overcast

Junction Layout



Queue Length Methodology

The maximum queue length, in vehicles, is reported by lane for each five-minute period.

These are segregated into 'light' and 'heavy' vehicles, and are then presented as a maximum queue length using the assumption that a light vehicle contributes 6m to a queue and a heavy vehicle 15m. These values can be updated by the user.

Vehicle Length Assumptions (metres)

Lights	Heavies
6	15

Additional Notes (Factors which may impact on survey results such as accidents, roadworks, special events)

Any shaded entries indicate where queues reach the extent of the camera view.

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Site Number: Site 1
Date of Survey: 25.02.2020
Junction Name: A4226 / A48
Survey Type: Queue Length Survey

	Lane C1				Lane C2			
Time	**Lights**	**Heavies**	**Total**	**Length (m)**	**Lights**	**Heavies**	**Total**	**Length (m)**
07:00	10	0	10	60	5	0	5	30
07:05	7	0	7	42	5	1	6	45
07:10	16	0	16	96	4	1	5	39
07:15	19	0	19	114	8	0	8	48
07:20	30	0	30	180	8	0	8	48
07:25	10	0	10	60	8	0	8	48
07:30	9	1	10	69	9	0	9	54
07:35	17	1	18	117	34	0	34	204
07:40	26	0	26	156	6	1	7	51
07:45	8	0	8	48	22	0	22	132
07:50	9	2	11	84	12	0	12	72
07:55	11	0	11	66	6	0	6	36
08:00	10	0	10	60	6	0	6	36
08:05	8	0	8	48	5	1	6	45
08:10	7	0	7	42	7	1	8	57
08:15	4	0	4	24	18	1	19	123
08:20	6	0	6	36	10	0	10	60
08:25	8	0	8	48	10	0	10	60
08:30	5	0	5	30	7	1	8	57
08:35	3	0	3	18	11	0	11	66
08:40	5	0	5	30	5	1	6	45
08:45	4	0	4	24	5	1	6	45
08:50	5	0	5	30	11	1	12	81
08:55	9	0	9	54	6	0	6	36
09:00	7	0	7	42	9	0	9	54
09:05	4	0	4	24	7	2	9	72
09:10	8	0	8	48	5	0	5	30
09:15	3	1	4	33	8	1	9	63
09:20	3	0	3	18	4	0	4	24
09:25	1	0	1	6	7	0	7	42
09:30	2	0	2	12	0	1	1	15
09:35	4	0	4	24	7	0	7	42
09:40	3	0	3	18	3	0	3	18
09:45	3	0	3	18	4	0	4	24
09:50	1	0	1	6	3	0	3	18
09:55	4	0	4	24	1	0	1	6
10:00	3	0	3	18	3	0	3	18
10:05	2	0	2	12	7	0	7	42
10:10	2	0	2	12	2	0	2	12
10:15	2	0	2	12	5	0	5	30
10:20	1	1	2	21	5	0	5	30
10:25	1	1	2	21	2	0	2	12
10:30	5	0	5	30	3	0	3	18
10:35	3	0	3	18	2	0	2	12
10:40	2	1	3	27	3	0	3	18
10:45	3	0	3	18	2	0	2	12
10:50	4	0	4	24	1	0	1	6
10:55	3	0	3	18	2	0	2	12
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11:05	2	0	2	12	3	0	3	18
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11:15	2	0	2	12	1	0	1	6
11:20	1	0	1	6	4	0	4	24
11:25	1	0	1	6	3	1	4	33
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11:35	2	0	2	12	7	0	7	42
11:40	5	0	5	30	3	1	4	33
11:45	4	0	4	24	3	0	3	18
11:50	1	1	2	21	5	0	5	30
11:55	3	0	3	18	3	0	3	18
12:00	2	0	2	12	2	0	2	12
12:05	2	0	2	12	4	0	4	24
12:10	3	0	3	18	3	0	3	18
12:15	2	1	3	27	2	0	2	12

12:20	2	1	3	27	4	0	4	24
12:25	2	0	2	12	1	1	2	21
12:30	4	0	4	24	2	1	3	27
12:35	2	1	3	27	5	0	5	30
12:40	2	0	2	12	4	0	4	24
12:45	4	0	4	24	5	0	5	30
12:50	2	1	3	27	5	0	5	30
12:55	3	0	3	18	6	0	6	36
13:00	2	0	2	12	3	0	3	18
13:05	3	0	3	18	3	0	3	18
13:10	0	1	1	15	6	0	6	36
13:15	0	0	0	0	3	0	3	18
13:20	3	0	3	18	3	0	3	18
13:25	2	0	2	12	2	0	2	12
13:30	1	0	1	6	2	0	2	12
13:35	3	0	3	18	4	0	4	24
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13:45	3	0	3	18	7	0	7	42
13:50	2	0	2	12	4	0	4	24
13:55	4	0	4	24	4	0	4	24
14:00	3	1	4	33	5	0	5	30
14:05	1	0	1	6	3	0	3	18
14:10	3	0	3	18	6	1	7	51
14:15	2	0	2	12	5	0	5	30
14:20	6	0	6	36	5	0	5	30
14:25	2	0	2	12	3	0	3	18
14:30	4	0	4	24	7	0	7	42
14:35	4	0	4	24	3	1	4	33
14:40	3	0	3	18	5	0	5	30
14:45	3	0	3	18	4	0	4	24
14:50	2	0	2	12	5	2	7	60
14:55	1	1	2	21	8	0	8	48
15:00	2	0	2	12	3	0	3	18
15:05	1	1	2	21	5	0	5	30
15:10	2	0	2	12	6	0	6	36
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15:40	0	0	0	0	4	1	5	39
15:45	3	0	3	18	6	0	6	36
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16:20	3	0	3	18	10	1	11	75
16:25	4	0	4	24	9	1	10	69
16:30	5	0	5	30	11	0	11	66
16:35	1	0	1	6	14	0	14	84
16:40	3	1	4	33	11	0	11	66
16:45	5	0	5	30	9	0	9	54
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17:35	4	0	4	24	8	0	8	48
17:40	5	0	5	30	7	0	7	42
17:45	1	0	1	6	4	0	4	24
17:50	1	0	1	6	5	0	5	30
17:55	3	0	3	18	8	0	8	48
18:00	1	0	1	6	3	0	3	18
18:05	3	0	3	18	8	0	8	48
18:10	3	0	3	18	9	0	9	54
18:15	2	0	2	12	2	0	2	12
18:20	3	0	3	18	2	0	2	12
18:25	4	0	4	24	4	0	4	24
18:30	2	0	2	12	3	0	3	18
18:35	2	0	2	12	4	0	4	24
18:40	1	0	1	6	5	0	5	30
18:45	1	0	1	6	3	0	3	18

18:50	2	0	2	12	4	0	4	24
18:55	0	0	0	0	2	0	2	12

Intelligent Data Collection Limited
Vale of Glamorgan

Client:	Arcadis
Project Number:	ID05235
Site Number:	Site 2
Date of Survey:	11.02.2020
Junction Name:	Unnamed Road / Renishaw Access
Survey Type:	Queue Length Survey

Quality Assurance and Issue Record

Quality Assurance

Revision	Rev A			
Date	22.02.2020			
Prepared by	Grant Daniel Breddy			
Signature				
Checked by	David Brown			
Signature				
Project Director	Paul O'Neill			
Signature				
Project number	ID05235			
File Ref	ID05235 Vale of Glamorgan - Queue Report Site 2 - 11.02.2020			

Issue Sheet

Issued to	Date			
	24.02.2020			
Chad Collins	E-mail			

Contents Page

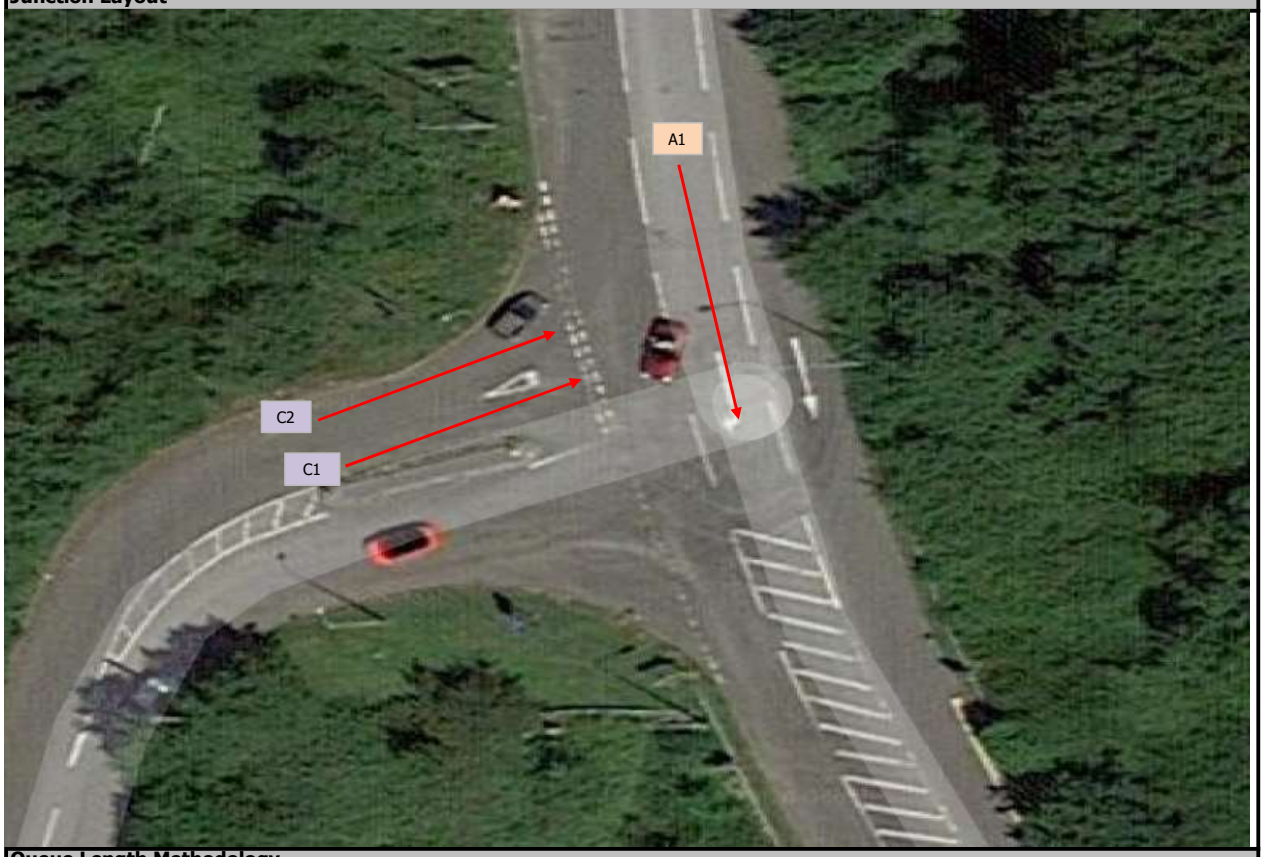
Location Plan
Queue Lengths

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Site Number: Site 2
Date of Survey: 11.02.2020
Junction Name: Unnamed Road / Renishaw Access
Survey Type: Queue Length Survey

X Coordinate	Y Coordinate	Google Maps Link
51.50814099	-3.35855845	Click Here
Weather Conditions		
Sunny Intervals		

Junction Layout



Queue Length Methodology

The maximum queue length, in vehicles, is reported by lane for each five-minute period.

These are segregated into 'light' and 'heavy' vehicles, and are then presented as a maximum queue length using the assumption that a light vehicle contributes 6m to a queue and a heavy vehicle 15m. These values can be updated by the user.

Vehicle Length Assumptions (metres)

Lights	Heavies
6	15

Additional Notes (Factors which may impact on survey results such as accidents, roadworks, special events)

Any shaded entries indicate where queues reach the extent of the camera view.

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Site Number: Site 2
Date of Survey: 11.02.2020
Junction Name: Unnamed Road / Renishaw Access
Survey Type: Queue Length Survey

	Lane A1				Lane C1				Lane C2			
Time	Lights	Heavies	Total	Length (m)	Lights	Heavies	Total	Length (m)	Lights	Heavies	Total	Length (m)
07:00	0	0	0	0	0	0	0	0	0	0	0	0
07:05	0	0	0	0	0	0	0	0	0	0	0	0
07:10	0	0	0	0	0	0	0	0	1	0	1	6
07:15	0	0	0	0	0	0	0	0	0	0	0	0
07:20	2	0	2	12	1	0	1	6	2	0	2	12
07:25	0	0	0	0	0	0	0	0	0	0	0	0
07:30	0	0	0	0	0	0	0	0	0	0	0	0
07:35	0	0	0	0	1	0	1	6	0	0	0	0
07:40	0	0	0	0	0	0	0	0	2	0	2	12
07:45	0	0	0	0	0	0	0	0	8	0	8	48
07:50	0	0	0	0	0	0	0	0	8	0	8	48
07:55	0	0	0	0	0	0	0	0	6	1	7	51
08:00	0	0	0	0	1	0	1	6	8	0	8	48
08:05	0	0	0	0	0	0	0	0	0	0	0	0
08:10	0	0	0	0	0	0	0	0	0	0	0	0
08:15	1	0	1	6	0	0	0	0	1	0	1	6
08:20	1	0	1	6	0	0	0	0	2	0	2	12
08:25	0	0	0	0	0	0	0	0	0	0	0	0
08:30	0	0	0	0	0	0	0	0	2	0	2	12
08:35	1	0	1	6	0	0	0	0	0	0	0	0
08:40	0	0	0	0	0	0	0	0	0	0	0	0
08:45	0	0	0	0	0	0	0	0	1	0	1	6
08:50	0	0	0	0	0	0	0	0	1	0	1	6
08:55	0	0	0	0	0	0	0	0	3	0	3	18
09:00	0	0	0	0	0	0	0	0	0	0	0	0
09:05	0	0	0	0	0	0	0	0	0	0	0	0
09:10	0	0	0	0	0	0	0	0	0	0	0	0
09:15	0	0	0	0	0	0	0	0	1	0	1	6
09:20	0	0	0	0	0	0	0	0	1	0	1	6
09:25	0	0	0	0	0	0	0	0	0	0	0	0
09:30	0	0	0	0	0	0	0	0	0	0	0	0
09:35	0	0	0	0	0	0	0	0	0	0	0	0
09:40	0	0	0	0	0	0	0	0	1	0	1	6
09:45	0	0	0	0	0	0	0	0	0	0	0	0
09:50	0	0	0	0	0	0	0	0	1	0	1	6
09:55	0	0	0	0	0	0	0	0	1	0	1	6
10:00	0	0	0	0	0	0	0	0	0	0	0	0
10:05	0	0	0	0	0	0	0	0	1	0	1	6

10:10	0	0	0	0	0	0	0	0	0	2	2	30
10:15	0	0	0	0	0	0	0	0	0	0	0	0
10:20	0	0	0	0	0	0	0	0	0	0	0	0
10:25	0	0	0	0	0	0	0	0	0	0	0	0
10:30	0	0	0	0	0	0	0	0	0	0	0	0
10:35	0	0	0	0	0	0	0	0	2	0	2	12
10:40	1	0	1	6	0	0	0	0	2	0	2	12
10:45	0	0	0	0	0	0	0	0	1	0	1	6
10:50	0	0	0	0	0	0	0	0	1	0	1	6
10:55	0	0	0	0	0	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0	0	0	0
11:05	0	0	0	0	0	0	0	0	1	0	1	6
11:10	0	0	0	0	0	0	0	0	3	1	4	33
11:15	0	0	0	0	0	0	0	0	1	0	1	6
11:20	0	0	0	0	0	0	0	0	0	0	0	0
11:25	0	0	0	0	0	0	0	0	1	0	1	6
11:30	0	0	0	0	0	0	0	0	0	0	0	0
11:35	0	0	0	0	0	0	0	0	0	0	0	0
11:40	0	0	0	0	0	0	0	0	0	0	0	0
11:45	0	0	0	0	0	0	0	0	0	0	0	0
11:50	0	0	0	0	0	0	0	0	0	0	0	0
11:55	0	0	0	0	0	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	0	0	0	0	0	0
12:05	0	0	0	0	0	0	0	0	1	0	1	6
12:10	0	0	0	0	0	0	0	0	2	0	2	12
12:15	0	0	0	0	0	0	0	0	1	0	1	6
12:20	0	0	0	0	0	0	0	0	1	0	1	6
12:25	0	0	0	0	0	0	0	0	1	0	1	6
12:30	0	0	0	0	0	0	0	0	1	0	1	6
12:35	0	0	0	0	0	0	0	0	0	0	0	0
12:40	0	0	0	0	0	0	0	0	0	0	0	0
12:45	3	0	3	18	0	0	0	0	0	0	0	0
12:50	0	0	0	0	0	0	0	0	1	0	1	6
12:55	0	1	1	15	0	0	0	0	3	0	3	18
13:00	0	0	0	0	0	0	0	0	1	0	1	6
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13:10	0	0	0	0	0	0	0	0	1	0	1	6
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13:25	0	0	0	0	0	0	0	0	1	0	1	6
13:30	0	0	0	0	0	0	0	0	0	0	0	0
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13:40	0	0	0	0	0	0	0	0	1	0	1	6
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13:50	0	0	0	0	0	0	0	0	0	0	0	0
13:55	0	0	0	0	0	0	0	0	0	0	0	0
14:00	0	0	0	0	0	0	0	0	0	0	0	0
14:05	1	0	1	6	0	0	0	0	2	0	2	12
14:10	2	0	2	12	0	0	0	0	2	0	2	12
14:15	0	0	0	0	0	0	0	0	0	0	0	0
14:20	0	0	0	0	0	0	0	0	0	0	0	0
14:25	1	0	1	6	0	0	0	0	0	0	0	0

14:30	0	0	0	0	0	0	0	0	1	0	1	6
14:35	0	0	0	0	0	0	0	0	1	0	1	6
14:40	2	0	2	12	0	0	0	0	0	0	0	0
14:45	0	0	0	0	0	0	0	0	1	0	1	6
14:50	3	0	3	18	0	0	0	0	0	0	0	0
14:55	3	0	3	18	0	0	0	0	1	0	1	6
15:00	0	0	0	0	0	0	0	0	1	0	1	6
15:05	0	0	0	0	0	0	0	0	0	0	0	0
15:10	0	0	0	0	0	0	0	0	2	0	2	12
15:15	0	0	0	0	0	0	0	0	0	0	0	0
15:20	1	0	1	6	0	0	0	0	1	0	1	6
15:25	0	0	0	0	0	0	0	0	1	0	1	6
15:30	2	0	2	12	0	0	0	0	4	0	4	24
15:35	2	0	2	12	0	0	0	0	5	0	5	30
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15:50	1	0	1	6	0	0	0	0	1	0	1	6
15:55	0	0	0	0	0	0	0	0	5	0	5	30
16:00	1	0	1	6	0	0	0	0	0	0	0	0
16:05	1	0	1	6	0	0	0	0	2	0	2	12
16:10	0	0	0	0	0	0	0	0	0	0	0	0
16:15	4	0	4	24	0	0	0	0	1	0	1	6
16:20	0	0	0	0	0	0	0	0	3	0	3	18
16:25	1	0	1	6	0	0	0	0	2	0	2	12
16:30	0	0	0	0	0	0	0	0	1	0	1	6
16:35	1	0	1	6	0	0	0	0	3	0	3	18
16:40	3	0	3	18	0	0	0	0	3	0	3	18
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16:50	0	0	0	0	0	0	0	0	1	0	1	6
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17:00	0	0	0	0	0	0	0	0	1	0	1	6
17:05	0	0	0	0	0	0	0	0	1	0	1	6
17:10	0	0	0	0	0	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0	0	0	0	0
17:20	0	0	0	0	0	0	0	0	0	0	0	0
17:25	1	0	1	6	0	0	0	0	1	0	1	6
17:30	2	0	2	12	0	0	0	0	1	0	1	6
17:35	0	0	0	0	0	0	0	0	0	0	0	0
17:40	0	0	0	0	0	0	0	0	1	0	1	6
17:45	0	0	0	0	0	0	0	0	0	0	0	0
17:50	0	0	0	0	0	0	0	0	1	0	1	6
17:55	0	0	0	0	0	0	0	0	0	0	0	0
18:00	2	0	2	12	0	0	0	0	1	0	1	6
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18:10	0	0	0	0	0	0	0	0	1	0	1	6
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18:20	0	0	0	0	0	0	0	0	0	0	0	0
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18:35	0	0	0	0	0	0	0	0	0	0	0	0
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18:50	0	0	0	0	0	0	0	0	0	0	0	0
18:55	0	0	0	0	0	0	0	0	1	0	1	6

Intelligent Data Collection Limited
Vale of Glamorgan

Client:	Arcadis
Project Number:	ID05235
Junction Number:	Site 2
Date of Survey:	11.02.2020
Junction Name:	Unnamed Road / Renishaw Access
Junction Type:	T-Junction

Quality Assurance and Issue Record

Quality Assurance

Revision	Rev A			
Date	22.02.2020			
Prepared by	Grant Daniel Breddy			
Signature				
Checked by	David Brown			
Signature				
Project Director	Paul O'Neill			
Signature				
Project number	ID05235			
File Ref	ID05235 Vale of Glamorgan - MCC Site 2 - 11.02.2020			

Issue Sheet

Issued to	Date			
	24.02.2020			
Chad Collins	E-mail			

Contents Page

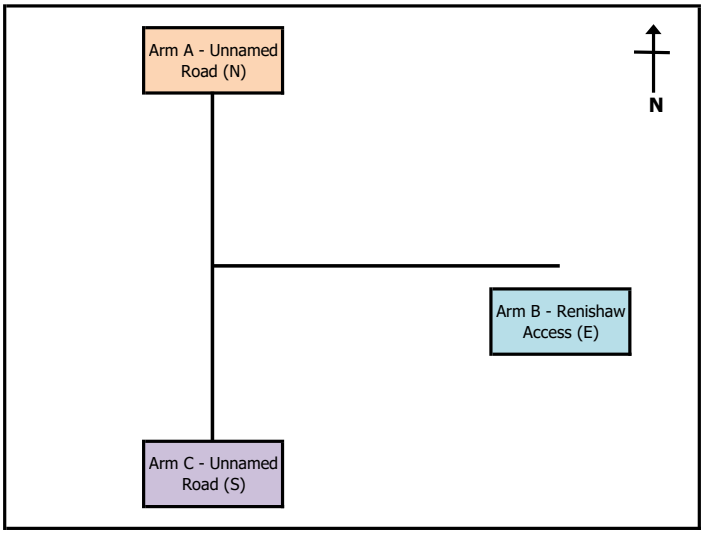
Location Plan & Summary
MCC Data
PCU Data
Movement Matrices

Intelligent Data Collection Limited

Client:	Arcadis	**Date of Survey:**	11.02.2020
Project Number:	ID05235	**Junction Name:**	Unnamed Road / Renishaw Access
Junction Number:	Site 2	**Junction Type:**	T-Junction

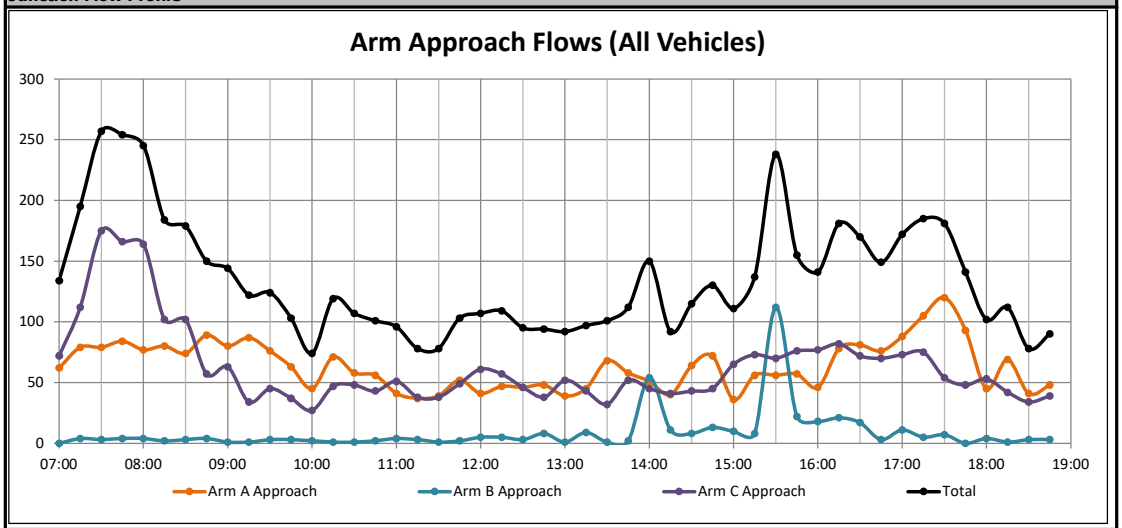
X Coordinate	Y Coordinate	Google Maps Link	
51.507996875632365	-3.3587255566839103	Click Here	
AM Peak Conditions	**Inter-Peak Conditions**	**PM Peak Conditions**	
Sunny Intervals	Sunny Intervals	Overcast	

Junction Layout



Aerial Mapping and On-site Camera View

Junction Flow Profile



Additional Notes (Factors which may impact on survey results such as accidents, roadworks, special events):

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 2

Date of Survey: 11.02.2020
Junction Name: Unnamed Road / Renishaw Access
Junction Type: T-Junction

Arm A: Unnamed Road (N)
Arm B: Renishaw Access (E)
Arm C: Unnamed Road (S)

	A to A								A to C								A to B							
Time	Cars	LGV	OGV1	OGV2	Buses	M/C	Cycle	Total	Cars	LGV	OGV1	OGV2	Buses	M/C	Cycle	Total	Cars	LGV	OGV1	OGV2	Buses	M/C	Cycle	Total
07:00								0	41	11	1	0	0	0	0	53	8	0	1	0	0	0	0	9
07:15								0	48	16	1	0	0	0	0	65	13	1	0	0	0	0	0	14
07:30								0	50	18	0	0	0	0	1	69	8	2	0	0	0	0	0	10
07:45								0	56	16	0	0	0	0	0	72	10	2	0	0	0	0	0	12
08:00								0	59	10	3	0	0	0	0	72	4	1	0	0	0	0	0	5
08:15								0	55	20	0	1	0	0	0	76	2	2	0	0	0	0	0	4
08:30								0	53	12	1	0	2	0	0	68	6	0	0	0	0	0	0	6
08:45								0	68	8	3	0	0	0	0	79	7	2	1	0	0	0	0	10
09:00								0	68	9	2	0	0	0	0	79	0	1	0	0	0	0	0	1
09:15								0	77	7	0	0	0	0	0	84	2	1	0	0	0	0	0	3
09:30								0	56	12	1	1	1	0	0	71	4	1	0	0	0	0	0	5
09:45								0	44	11	3	0	0	0	0	58	4	0	1	0	0	0	0	5
10:00								0	39	6	0	0	0	0	0	45	0	0	0	0	0	0	0	0
10:15								0	57	13	0	0	0	0	0	70	1	0	0	0	0	0	0	1
10:30								0	44	10	1	0	0	0	0	55	3	0	0	0	0	0	0	3
10:45								0	46	6	0	1	0	0	0	53	3	0	0	0	0	0	0	3
11:00								0	32	4	0	0	1	0	0	37	4	0	0	0	0	0	0	4
11:15								0	27	5	3	0	0	0	0	35	1	0	1	0	0	0	0	2
11:30								0	29	6	2	0	0	0	0	37	2	0	0	0	0	0	0	2
11:45								0	45	2	1	1	0	0	0	49	1	1	1	0	0	0	0	3
12:00								0	24	7	1	0	0	0	0	32	4	2	3	0	0	0	0	9
12:15								0	40	3	1	0	0	0	0	44	3	0	0	0	0	0	0	3
12:30								0	34	3	2	0	0	0	0	39	4	2	1	0	0	0	0	7
12:45								0	31	9	1	0	0	0	0	41	4	1	1	1	0	0	0	7
13:00								0	32	5	1	0	0	0	0	38	1	0	0	0	0	0	0	1
13:15								0	27	8	1	0	0	0	0	36	7	2	0	0	0	0	0	9
13:30								0	36	4	0	1	0	0	0	41	26	1	0	0	0	0	0	27
13:45								0	38	6	0	1	0	0	0	45	13	0	0	0	0	0	0	13
14:00								0	40	7	0	0	0	0	0	47	4	0	0	0	0	0	0	4
14:15								0	33	3	2	0	0	0	0	38	2	0	0	0	0	0	0	2
14:30								0	44	9	1	0	0	0	0	54	9	0	1	0	0	0	0	10
14:45								0	58	8	0	0	1	0	0	67	4	1	0	0	0	0	0	5
15:00								0	33	2	0	0	0	0	0	35	1	0	0	0	0	0	0	1
15:15								0	43	7	0	0	1	0	0	51	5	0	0	0	0	0	0	5
15:30								0	38	12	3	0	0	0	0	53	3	0	0	0	0	0	0	3
15:45								0	48	5	2	0	0	0	0	55	2	0	0	0	0	0	0	2
16:00								0	37	8	0	0	0	0	0	45	1	0	0	0	0	0	0	1
16:15								0	68	6	1	0	0	0	0	75	3	0	0	0	0	0	0	3
16:30								0	68	11	0	1	0	0	0	80	1	0	0	0	0	0	0	1
16:45								0	65	9	0	0	0	0	0	74	2	0	0	0	0	0	0	2
17:00								0	74	10	0	0	0	0	0	84	4	0	0	0	0	0	0	4
17:15								0	88	13	0	0	0	0	0	101	3	1	0	0	0	0	0	4
17:30								0	105	13	0	0	0	0	0	118	2	0	0	0	0	0	0	2
17:45								0	87	6	0	0	0	0	0	93	0	0	0	0	0	0	0	0
18:00								0	41	4	0	0	0	0	0	45	0	0	0	0	0	0	0	0
18:15								0	63	4	0	0	0	0	0	67	2	0	0	0	0	0	0	2
18:30								0	38	2	0	0	0	0	0	40	0	1	0	0	0	0	0	1
18:45								0	42	1	1	0	0	0	0	44	3	0	1	0	0	0	0	4
Start Time	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**
07:00	0	0	0	0	0	0	0	0	195	61	2	0	0	0	1	259	39	5	1	0	0	0	0	45
07:15	0	0	0	0	0	0	0	0	213	60	4	0	0	0	1	278	35	6	0	0	0	0	0	41
07:30	0	0	0	0	0	0	0	0	220	64	3	1	0	0	1	289	24	7	0	0	0	0	0	31
07:45	0	0	0	0	0	0	0	0	223	58	4	1	2	0	0	288	22	5	0	0	0	0	0	27
08:00	0	0	0	0	0	0	0	0	235	50	7	1	2	0	0	295	19	5	1	0	0	0	0	25
08:15	0	0	0	0	0	0	0	0	244	49	6	1	2	0	0	302	15	5	1	0	0	0	0	21
08:30	0	0	0	0	0	0	0	0	266	36	6	0	2	0	0	310	15	4	1	0	0	0	0	20
08:45	0	0	0	0	0	0	0	0	269	36	6	1	1	0	0	313	13	5	1	0	0	0	0	19
09:00	0	0	0	0	0	0	0	0	245	39	6	1	1	0	0	292	10	3	1	0	0	0	0	14
09:15	0	0	0	0	0	0	0	0	216	36	4	1	1	0	0	258	10	2	1	0	0	0	0	13

09:30	0	0	0	0	0	0	0	0	196	42	4	1	1	0	0	244	9	1	1	0	0	0	0	11
09:45	0	0	0	0	0	0	0	0	184	40	4	0	0	0	0	228	8	0	1	0	0	0	0	9
10:00	0	0	0	0	0	0	0	0	186	35	1	1	0	0	0	223	7	0	0	0	0	0	0	7
10:15	0	0	0	0	0	0	0	0	179	33	1	1	1	0	0	215	11	0	0	0	0	0	0	11
10:30	0	0	0	0	0	0	0	0	149	25	4	1	1	0	0	180	11	0	1	0	0	0	0	12
10:45	0	0	0	0	0	0	0	0	134	21	5	1	1	0	0	162	10	0	1	0	0	0	0	11
11:00	0	0	0	0	0	0	0	0	133	17	6	1	1	0	0	158	8	1	2	0	0	0	0	11
11:15	0	0	0	0	0	0	0	0	125	20	7	1	0	0	0	153	8	3	5	0	0	0	0	16
11:30	0	0	0	0	0	0	0	0	138	18	5	1	0	0	0	162	10	3	4	0	0	0	0	17
11:45	0	0	0	0	0	0	0	0	143	15	5	1	0	0	0	164	12	5	5	0	0	0	0	22
12:00	0	0	0	0	0	0	0	0	129	22	5	0	0	0	0	156	15	5	5	1	0	0	0	26
12:15	0	0	0	0	0	0	0	0	137	20	5	0	0	0	0	162	12	3	2	1	0	0	0	18
12:30	0	0	0	0	0	0	0	0	124	25	5	0	0	0	0	154	16	5	2	1	0	0	0	24
12:45	0	0	0	0	0	0	0	0	126	26	3	1	0	0	0	156	38	4	1	1	0	0	0	44
13:00	0	0	0	0	0	0	0	0	133	23	2	2	0	0	0	160	47	3	0	0	0	0	0	50
13:15	0	0	0	0	0	0	0	0	141	25	1	2	0	0	0	169	50	3	0	0	0	0	0	53
13:30	0	0	0	0	0	0	0	0	147	20	2	2	0	0	0	171	45	1	0	0	0	0	0	46
13:45	0	0	0	0	0	0	0	0	155	25	3	1	0	0	0	184	28	0	1	0	0	0	0	29
14:00	0	0	0	0	0	0	0	0	175	27	3	0	1	0	0	206	19	1	1	0	0	0	0	21
14:15	0	0	0	0	0	0	0	0	168	22	3	0	1	0	0	194	16	1	1	0	0	0	0	18
14:30	0	0	0	0	0	0	0	0	178	26	1	0	2	0	0	207	19	1	1	0	0	0	0	21
14:45	0	0	0	0	0	0	0	0	172	29	3	0	2	0	0	206	13	1	0	0	0	0	0	14
15:00	0	0	0	0	0	0	0	0	162	26	5	0	1	0	0	194	11	0	0	0	0	0	0	11
15:15	0	0	0	0	0	0	0	0	166	32	5	0	1	0	0	204	11	0	0	0	0	0	0	11
15:30	0	0	0	0	0	0	0	0	191	31	6	0	0	0	0	228	9	0	0	0	0	0	0	9
15:45	0	0	0	0	0	0	0	0	221	30	3	1	0	0	0	255	7	0	0	0	0	0	0	7
16:00	0	0	0	0	0	0	0	0	238	34	1	1	0	0	0	274	7	0	0	0	0	0	0	7
16:15	0	0	0	0	0	0	0	0	275	36	1	1	0	0	0	313	10	0	0	0	0	0	0	10
16:30	0	0	0	0	0	0	0	0	295	43	0	1	0	0	0	339	10	1	0	0	0	0	0	11
16:45	0	0	0	0	0	0	0	0	332	45	0	0	0	0	0	377	11	1	0	0	0	0	0	12
17:00	0	0	0	0	0	0	0	0	354	42	0	0	0	0	0	396	9	1	0	0	0	0	0	10
17:15	0	0	0	0	0	0	0	0	321	36	0	0	0	0	0	357	5	1	0	0	0	0	0	6
17:30	0	0	0	0	0	0	0	0	296	27	0	0	0	0	0	323	4	0	0	0	0	0	0	4
17:45	0	0	0	0	0	0	0	0	229	16	0	0	0	0	0	245	2	1	0	0	0	0	0	3
18:00	0	0	0	0	0	0	0	0	184	11	1	0	0	0	0	196	5	1	1	0	0	0	0	7

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 2

Date of Survey: 11.02.2020
Junction Name: Unnamed Road / Renishaw Access
Junction Type: T-Junction

Arm A: Unnamed Road (N)
Arm B: Renishaw Access (E)
Arm C: Unnamed Road (S)

	B to B								B to A								B to C							
Time	Cars	LGV	OGV1	OGV2	Buses	M/C	Cycle	Total	Cars	LGV	OGV1	OGV2	Buses	M/C	Cycle	Total	Cars	LGV	OGV1	OGV2	Buses	M/C	Cycle	Total
07:00								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15								0	3	0	0	0	0	0	0	3	0	0	1	0	0	0	0	1
07:30								0	2	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0
07:45								0	4	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
08:00								0	0	1	0	0	0	0	0	1	2	1	0	0	0	0	0	3
08:15								0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2
08:30								0	2	0	0	0	0	0	0	2	0	1	0	0	0	0	0	1
08:45								0	0	1	0	0	0	0	0	1	2	1	0	0	0	0	0	3
09:00								0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
09:15								0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
09:30								0	1	1	0	0	0	0	0	2	1	0	0	0	0	0	0	1
09:45								0	1	0	0	0	0	0	0	1	2	0	0	0	0	0	0	2
10:00								0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	1
10:15								0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
10:30								0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
10:45								0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
11:00								0	2	0	0	0	0	0	0	2	2	0	0	0	0	0	0	2
11:15								0	0	0	1	0	0	0	0	1	2	0	0	0	0	0	0	2
11:30								0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
11:45								0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2
12:00								0	2	1	0	0	0	0	0	3	1	1	0	0	0	0	0	2
12:15								0	1	0	2	0	0	0	0	3	2	0	0	0	0	0	0	2
12:30								0	1	0	1	0	0	0	0	2	1	0	0	0	0	0	0	1
12:45								0	2	2	3	0	0	0	0	7	0	1	0	0	0	0	0	1
13:00								0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
13:15								0	3	1	0	1	0	0	0	5	4	0	0	0	0	0	0	4
13:30								0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
13:45								0	1	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0
14:00								0	53	1	0	0	0	0	0	54	0	0	0	0	0	0	0	0
14:15								0	8	1	0	0	0	0	0	9	2	0	0	0	0	0	0	2
14:30								0	6	0	1	0	0	0	0	7	1	0	0	0	0	0	0	1
14:45								0	10	1	0	0	0	0	0	11	1	1	0	0	0	0	0	2
15:00								0	8	0	0	0	0	0	0	8	2	0	0	0	0	0	0	2
15:15								0	5	1	0	0	0	0	0	6	2	0	0	0	0	0	0	2
15:30								0	101	5	0	0	0	0	0	106	6	0	0	0	0	0	0	6
15:45								0	19	1	0	0	0	0	0	20	2	0	0	0	0	0	0	2
16:00								0	17	1	0	0	0	0	0	18	0	0	0	0	0	0	0	0
16:15								0	17	2	0	0	0	0	0	19	2	0	0	0	0	0	0	2
16:30								0	15	0	1	0	0	0	0	16	1	0	0	0	0	0	0	1
16:45								0	2	0	0	0	0	0	0	2	1	0	0	0	0	0	0	1
17:00								0	9	0	0	0	0	0	0	9	2	0	0	0	0	0	0	2
17:15								0	4	0	0	0	0	0	0	4	1	0	0	0	0	0	0	1
17:30								0	5	0	0	0	0	0	0	5	2	0	0	0	0	0	0	2
17:45								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00								0	3	0	0	0	0	0	0	3	1	0	0	0	0	0	0	1
18:15								0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
18:30								0	2	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0
18:45								0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	3
Start Time	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**
07:00	0	0	0	0	0	0	0	0	9	1	0	0	0	0	0	10	0	0	1	0	0	0	0	1
07:15	0	0	0	0	0	0	0	0	9	2	0	0	0	0	0	11	2	1	1	0	0	0	0	4
07:30	0	0	0	0	0	0	0	0	6	2	0	0	0	0	0	8	2	3	0	0	0	0	0	5
07:45	0	0	0	0	0	0	0	0	6	1	0	0	0	0	0	7	2	4	0	0	0	0	0	6
08:00	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	4	4	5	0	0	0	0	0	9
08:15	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	3	2	4	1	0	0	0	0	7
08:30	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	3	2	3	1	0	0	0	0	6
08:45	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	3	3	2	1	0	0	0	0	6
09:00	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	3	3	1	1	0	0	0	0	5
09:15	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	4	3	1	1	0	0	0	0	5

09:30	0	0	0	0	0	0	0	0	3	2	0	0	0	0	0	5	3	0	1	0	0	0	0	4
09:45	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	4	2	0	1	0	0	0	0	3
10:00	0	0	0	0	0	0	0	0	4	1	0	0	0	0	0	5	0	0	1	0	0	0	0	1
10:15	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	6	2	0	0	0	0	0	0	2
10:30	0	0	0	0	0	0	0	0	5	0	1	0	0	0	0	6	4	0	0	0	0	0	0	4
10:45	0	0	0	0	0	0	0	0	5	0	1	0	0	0	0	6	4	0	0	0	0	0	0	4
11:00	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	4	5	1	0	0	0	0	0	6
11:15	0	0	0	0	0	0	0	0	3	1	1	0	0	0	0	5	4	2	0	0	0	0	0	6
11:30	0	0	0	0	0	0	0	0	4	1	2	0	0	0	0	7	4	2	0	0	0	0	0	6
11:45	0	0	0	0	0	0	0	0	4	1	3	0	0	0	0	8	5	2	0	0	0	0	0	7
12:00	0	0	0	0	0	0	0	0	6	3	6	0	0	0	0	15	4	2	0	0	0	0	0	6
12:15	0	0	0	0	0	0	0	0	5	2	6	0	0	0	0	13	3	1	0	0	0	0	0	4
12:30	0	0	0	0	0	0	0	0	7	3	4	1	0	0	0	15	5	1	0	0	0	0	0	6
12:45	0	0	0	0	0	0	0	0	6	3	3	1	0	0	0	13	5	1	0	0	0	0	0	6
13:00	0	0	0	0	0	0	0	0	5	2	0	1	0	0	0	8	5	0	0	0	0	0	0	5
13:15	0	0	0	0	0	0	0	0	57	3	0	1	0	0	0	61	5	0	0	0	0	0	0	5
13:30	0	0	0	0	0	0	0	0	62	3	0	0	0	0	0	65	3	0	0	0	0	0	0	3
13:45	0	0	0	0	0	0	0	0	68	3	1	0	0	0	0	72	3	0	0	0	0	0	0	3
14:00	0	0	0	0	0	0	0	0	77	3	1	0	0	0	0	81	4	1	0	0	0	0	0	5
14:15	0	0	0	0	0	0	0	0	32	2	1	0	0	0	0	35	6	1	0	0	0	0	0	7
14:30	0	0	0	0	0	0	0	0	29	2	1	0	0	0	0	32	6	1	0	0	0	0	0	7
14:45	0	0	0	0	0	0	0	0	124	7	0	0	0	0	0	131	11	1	0	0	0	0	0	12
15:00	0	0	0	0	0	0	0	0	133	7	0	0	0	0	0	140	12	0	0	0	0	0	0	12
15:15	0	0	0	0	0	0	0	0	142	8	0	0	0	0	0	150	10	0	0	0	0	0	0	10
15:30	0	0	0	0	0	0	0	0	154	9	0	0	0	0	0	163	10	0	0	0	0	0	0	10
15:45	0	0	0	0	0	0	0	0	68	4	1	0	0	0	0	73	5	0	0	0	0	0	0	5
16:00	0	0	0	0	0	0	0	0	51	3	1	0	0	0	0	55	4	0	0	0	0	0	0	4
16:15	0	0	0	0	0	0	0	0	43	2	1	0	0	0	0	46	6	0	0	0	0	0	0	6
16:30	0	0	0	0	0	0	0	0	30	0	1	0	0	0	0	31	5	0	0	0	0	0	0	5
16:45	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	20	6	0	0	0	0	0	0	6
17:00	0	0	0	0	0	0	0	0	18	0	0	0	0	0	0	18	5	0	0	0	0	0	0	5
17:15	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	12	4	0	0	0	0	0	0	4
17:30	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	9	3	0	0	0	0	0	0	3
17:45	0	0	0	0	0	0	0	0	6	1	0	0	0	0	0	7	1	0	0	0	0	0	0	1
18:00	0	0	0	0	0	0	0	0	6	1	0	0	0	0	0	7	3	0	1	0	0	0	0	4

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 2

Date of Survey: 11.02.2020
Junction Name: Unnamed Road / Renishaw Access
Junction Type: T-Junction

Arm A: Unnamed Road (N)
Arm B: Renishaw Access (E)
Arm C: Unnamed Road (S)

	C to C								C to B								C to A							
Time	Cars	LGV	OGV1	OGV2	Buses	M/C	Cycle	Total	Cars	LGV	OGV1	OGV2	Buses	M/C	Cycle	Total	Cars	LGV	OGV1	OGV2	Buses	M/C	Cycle	Total
07:00								0	1	0	0	0	0	0	0	1	56	15	0	0	0	0	0	71
07:15								0	2	0	0	0	0	0	0	2	106	4	0	0	0	0	0	110
07:30								0	2	1	0	0	0	0	0	3	150	17	5	0	0	0	0	172
07:45								0	0	0	0	0	0	0	0	0	147	10	8	1	0	0	0	166
08:00								0	1	0	0	0	0	0	0	1	148	14	1	0	0	0	0	163
08:15								0	0	0	0	0	0	0	0	0	95	7	0	0	0	0	0	102
08:30								0	0	0	0	0	0	0	0	0	91	9	2	0	0	0	0	102
08:45								0	0	0	0	0	0	0	0	0	50	6	0	1	0	0	0	57
09:00								0	0	0	0	0	0	0	0	0	56	6	1	0	0	0	0	63
09:15								0	0	0	0	0	0	0	0	0	30	3	1	0	0	0	0	34
09:30								0	0	0	0	0	0	0	0	0	37	7	1	0	0	0	0	45
09:45								0	0	0	0	0	0	0	0	0	27	5	5	0	0	0	0	37
10:00								0	0	0	0	0	0	0	0	0	21	4	2	0	0	0	0	27
10:15								0	0	0	0	0	0	0	0	0	39	6	1	0	1	0	0	47
10:30								0	0	0	0	0	0	0	0	0	43	4	1	0	0	0	0	48
10:45								0	0	0	0	0	0	0	0	0	37	5	1	0	0	0	0	43
11:00								0	0	0	0	0	0	0	0	0	41	8	2	0	0	0	0	51
11:15								0	2	0	0	0	0	0	0	2	29	7	0	0	0	0	0	36
11:30								0	0	0	0	0	0	0	0	0	31	7	0	0	0	0	0	38
11:45								0	0	0	0	0	0	0	0	0	45	2	2	0	0	0	0	49
12:00								0	0	0	0	0	0	0	0	0	51	8	1	1	0	0	0	61
12:15								0	0	0	0	0	0	0	0	0	51	5	1	0	0	0	0	57
12:30								0	0	0	0	0	0	0	0	0	40	5	0	0	1	0	0	46
12:45								0	0	0	0	0	0	0	0	0	35	2	1	0	0	0	0	38
13:00								0	0	0	0	0	0	0	0	0	47	3	2	0	0	0	0	52
13:15								0	0	0	0	0	0	0	0	0	31	9	3	0	0	0	0	43
13:30								0	0	0	0	0	0	0	0	0	30	2	0	0	0	0	0	32
13:45								0	0	0	0	0	0	0	0	0	43	7	1	1	0	0	0	52
14:00								0	0	0	0	0	0	0	0	0	37	7	0	1	0	0	0	45
14:15								0	0	0	0	0	0	0	0	0	32	7	1	1	0	0	0	41
14:30								0	0	0	0	0	0	0	0	0	30	12	1	0	0	0	0	43
14:45								0	0	0	0	0	0	0	0	0	36	7	1	1	0	0	0	45
15:00								0	0	0	0	0	0	0	0	0	52	13	0	0	0	0	0	65
15:15								0	0	0	0	0	0	0	0	0	62	11	0	0	0	0	0	73
15:30								0	1	0	0	0	0	0	0	1	54	13	0	0	2	0	0	69
15:45								0	0	0	0	0	0	0	0	0	59	16	1	0	0	0	0	76
16:00								0	0	0	1	0	0	0	0	1	62	13	1	0	0	0	0	76
16:15								0	0	0	0	0	0	0	0	0	69	12	1	0	0	0	0	82
16:30								0	0	0	0	0	0	0	0	0	55	16	1	0	0	0	0	72
16:45								0	0	0	0	0	0	0	0	0	55	15	0	0	0	0	0	70
17:00								0	0	0	0	0	0	0	0	0	61	11	1	0	0	0	0	73
17:15								0	0	0	0	0	0	0	0	0	65	8	1	1	0	0	0	75
17:30								0	0	0	0	0	0	0	0	0	46	8	0	0	0	0	0	54
17:45								0	0	0	0	0	0	0	0	0	43	5	0	0	0	0	0	48
18:00								0	0	0	0	0	0	0	0	0	49	4	0	0	0	0	0	53
18:15								0	0	0	0	0	0	0	0	0	39	3	0	0	0	0	0	42
18:30								0	0	0	0	0	0	0	0	0	33	1	0	0	0	0	0	34
18:45								0	0	0	0	0	0	0	0	0	36	2	1	0	0	0	0	39
Start Time	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**
07:00	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	6	459	46	13	1	0	0	0	519
07:15	0	0	0	0	0	0	0	0	5	1	0	0	0	0	0	6	551	45	14	1	0	0	0	611
07:30	0	0	0	0	0	0	0	0	3	1	0	0	0	0	0	4	540	48	14	1	0	0	0	603
07:45	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	481	40	11	1	0	0	0	533
08:00	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	384	36	3	1	0	0	0	424
08:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	292	28	3	1	0	0	0	324
08:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	227	24	4	1	0	0	0	256
08:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	173	22	3	1	0	0	0	199
09:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	150	21	8	0	0	0	0	179
09:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	115	19	9	0	0	0	0	143

09:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	124	22	9	0	1	0	0	156
09:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	130	19	9	0	1	0	0	159
10:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	140	19	5	0	1	0	0	165
10:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	160	23	5	0	1	0	0	189
10:30	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	150	24	4	0	0	0	0	178
10:45	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	138	27	3	0	0	0	0	168
11:00	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	146	24	4	0	0	0	0	174
11:15	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	156	24	3	1	0	0	0	184
11:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	178	22	4	1	0	0	0	205
11:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	187	20	4	1	1	0	0	213
12:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	177	20	3	1	1	0	0	202
12:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	173	15	4	0	1	0	0	193
12:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	153	19	6	0	1	0	0	179
12:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	143	16	6	0	0	0	0	165
13:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	151	21	6	1	0	0	0	179
13:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	141	25	4	2	0	0	0	172
13:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	142	23	2	3	0	0	0	170
13:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	142	33	3	3	0	0	0	181
14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	135	33	3	3	0	0	0	174
14:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	150	39	3	2	0	0	0	194
14:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	180	43	2	1	0	0	0	226
14:45	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	204	44	1	1	2	0	0	252
15:00	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	227	53	1	0	2	0	0	283
15:15	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	2	237	53	2	0	2	0	0	294
15:30	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	2	244	54	3	0	2	0	0	303
15:45	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	245	57	4	0	0	0	0	306
16:00	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	241	56	3	0	0	0	0	300
16:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	240	54	3	0	0	0	0	297
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	236	50	3	1	0	0	0	290
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	227	42	2	1	0	0	0	272
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	215	32	2	1	0	0	0	250
17:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	203	25	1	1	0	0	0	230
17:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	177	20	0	0	0	0	0	197
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	164	13	0	0	0	0	0	177
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	157	10	1	0	0	0	0	168

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 2

Date of Survey: 11.02.2020
Junction Name: Unnamed Road / Renishaw Access
Junction Type: T-Junction

	Arm A Approach								Arm A Exit							
Time	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**
07:00	49	11	2	0	0	0	0	62	56	15	0	0	0	0	0	71
07:15	61	17	1	0	0	0	0	79	109	4	0	0	0	0	0	113
07:30	58	20	0	0	0	0	1	79	152	18	5	0	0	0	0	175
07:45	66	18	0	0	0	0	0	84	151	10	8	1	0	0	0	170
08:00	63	11	3	0	0	0	0	77	148	15	1	0	0	0	0	164
08:15	57	22	0	1	0	0	0	80	95	7	0	0	0	0	0	102
08:30	59	12	1	0	2	0	0	74	93	9	2	0	0	0	0	104
08:45	75	10	4	0	0	0	0	89	50	7	0	1	0	0	0	58
09:00	68	10	2	0	0	0	0	80	56	6	1	0	0	0	0	63
09:15	79	8	0	0	0	0	0	87	30	3	1	0	0	0	0	34
09:30	60	13	1	1	1	0	0	76	38	8	1	0	0	0	0	47
09:45	48	11	4	0	0	0	0	63	28	5	5	0	0	0	0	38
10:00	39	6	0	0	0	0	0	45	21	5	2	0	0	0	0	28
10:15	58	13	0	0	0	0	0	71	40	6	1	0	1	0	0	48
10:30	47	10	1	0	0	0	0	58	44	4	1	0	0	0	0	49
10:45	49	6	0	1	0	0	0	56	39	5	1	0	0	0	0	45
11:00	36	4	0	0	1	0	0	41	43	8	2	0	0	0	0	53
11:15	28	5	4	0	0	0	0	37	29	7	1	0	0	0	0	37
11:30	31	6	2	0	0	0	0	39	32	7	0	0	0	0	0	39
11:45	46	3	2	1	0	0	0	52	45	2	2	0	0	0	0	49
12:00	28	9	4	0	0	0	0	41	53	9	1	1	0	0	0	64
12:15	43	3	1	0	0	0	0	47	52	5	3	0	0	0	0	60
12:30	38	5	3	0	0	0	0	46	41	5	1	0	1	0	0	48
12:45	35	10	2	1	0	0	0	48	37	4	4	0	0	0	0	45
13:00	33	5	1	0	0	0	0	39	48	3	2	0	0	0	0	53
13:15	34	10	1	0	0	0	0	45	34	10	3	1	0	0	0	48
13:30	62	5	0	1	0	0	0	68	30	2	0	0	0	0	0	32
13:45	51	6	0	1	0	0	0	58	44	8	1	1	0	0	0	54
14:00	44	7	0	0	0	0	0	51	90	8	0	1	0	0	0	99
14:15	35	3	2	0	0	0	0	40	40	8	1	1	0	0	0	50
14:30	53	9	2	0	0	0	0	64	36	12	2	0	0	0	0	50
14:45	62	9	0	0	1	0	0	72	46	8	1	1	0	0	0	56
15:00	34	2	0	0	0	0	0	36	60	13	0	0	0	0	0	73
15:15	48	7	0	0	1	0	0	56	67	12	0	0	0	0	0	79
15:30	41	12	3	0	0	0	0	56	155	18	0	0	2	0	0	175
15:45	50	5	2	0	0	0	0	57	78	17	1	0	0	0	0	96
16:00	38	8	0	0	0	0	0	46	79	14	1	0	0	0	0	94
16:15	71	6	1	0	0	0	0	78	86	14	1	0	0	0	0	101
16:30	69	11	0	1	0	0	0	81	70	16	2	0	0	0	0	88
16:45	67	9	0	0	0	0	0	76	57	15	0	0	0	0	0	72
17:00	78	10	0	0	0	0	0	88	70	11	1	0	0	0	0	82
17:15	91	14	0	0	0	0	0	105	69	8	1	1	0	0	0	79
17:30	107	13	0	0	0	0	0	120	51	8	0	0	0	0	0	59
17:45	87	6	0	0	0	0	0	93	43	5	0	0	0	0	0	48
18:00	41	4	0	0	0	0	0	45	52	4	0	0	0	0	0	56
18:15	65	4	0	0	0	0	0	69	40	3	0	0	0	0	0	43
18:30	38	3	0	0	0	0	0	41	35	2	0	0	0	0	0	37
18:45	45	1	2	0	0	0	0	48	36	2	1	0	0	0	0	39
Start Time	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**
07:00	234	66	3	0	0	0	1	304	468	47	13	1	0	0	0	529
07:15	248	66	4	0	0	0	1	319	560	47	14	1	0	0	0	622
07:30	244	71	3	1	0	0	1	320	546	50	14	1	0	0	0	611
07:45	245	63	4	1	2	0	0	315	487	41	11	1	0	0	0	540
08:00	254	55	8	1	2	0	0	320	386	38	3	1	0	0	0	428
08:15	259	54	7	1	2	0	0	323	294	29	3	1	0	0	0	327
08:30	281	40	7	0	2	0	0	330	229	25	4	1	0	0	0	259
08:45	282	41	7	1	1	0	0	332	174	24	3	1	0	0	0	202
09:00	255	42	7	1	1	0	0	306	152	22	8	0	0	0	0	182
09:15	226	38	5	1	1	0	0	271	117	21	9	0	0	0	0	147

09:30	205	43	5	1	1	0	0	255	127	24	9	0	1	0	0	161
09:45	192	40	5	0	0	0	0	237	133	20	9	0	1	0	0	163
10:00	193	35	1	1	0	0	0	230	144	20	5	0	1	0	0	170
10:15	190	33	1	1	1	0	0	226	166	23	5	0	1	0	0	195
10:30	160	25	5	1	1	0	0	192	155	24	5	0	0	0	0	184
10:45	144	21	6	1	1	0	0	173	143	27	4	0	0	0	0	174
11:00	141	18	8	1	1	0	0	169	149	24	5	0	0	0	0	178
11:15	133	23	12	1	0	0	0	169	159	25	4	1	0	0	0	189
11:30	148	21	9	1	0	0	0	179	182	23	6	1	0	0	0	212
11:45	155	20	10	1	0	0	0	186	191	21	7	1	1	0	0	221
12:00	144	27	10	1	0	0	0	182	183	23	9	1	1	0	0	217
12:15	149	23	7	1	0	0	0	180	178	17	10	0	1	0	0	206
12:30	140	30	7	1	0	0	0	178	160	22	10	1	1	0	0	194
12:45	164	30	4	2	0	0	0	200	149	19	9	1	0	0	0	178
13:00	180	26	2	2	0	0	0	210	156	23	6	2	0	0	0	187
13:15	191	28	1	2	0	0	0	222	198	28	4	3	0	0	0	233
13:30	192	21	2	2	0	0	0	217	204	26	2	3	0	0	0	235
13:45	183	25	4	1	0	0	0	213	210	36	4	3	0	0	0	253
14:00	194	28	4	0	1	0	0	227	212	36	4	3	0	0	0	255
14:15	184	23	4	0	1	0	0	212	182	41	4	2	0	0	0	229
14:30	197	27	2	0	2	0	0	228	209	45	3	1	0	0	0	258
14:45	185	30	3	0	2	0	0	220	328	51	1	1	2	0	0	383
15:00	173	26	5	0	1	0	0	205	360	60	1	0	2	0	0	423
15:15	177	32	5	0	1	0	0	215	379	61	2	0	2	0	0	444
15:30	200	31	6	0	0	0	0	237	398	63	3	0	2	0	0	466
15:45	228	30	3	1	0	0	0	262	313	61	5	0	0	0	0	379
16:00	245	34	1	1	0	0	0	281	292	59	4	0	0	0	0	355
16:15	285	36	1	1	0	0	0	323	283	56	4	0	0	0	0	343
16:30	305	44	0	1	0	0	0	350	266	50	4	1	0	0	0	321
16:45	343	46	0	0	0	0	0	389	247	42	2	1	0	0	0	292
17:00	363	43	0	0	0	0	0	406	233	32	2	1	0	0	0	268
17:15	326	37	0	0	0	0	0	363	215	25	1	1	0	0	0	242
17:30	300	27	0	0	0	0	0	327	186	20	0	0	0	0	0	206
17:45	231	17	0	0	0	0	0	248	170	14	0	0	0	0	0	184
18:00	189	12	2	0	0	0	0	203	163	11	1	0	0	0	0	175

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 2

Date of Survey: 11.02.2020
Junction Name: Unnamed Road / Renishaw Access
Junction Type: T-Junction

	Arm B Approach								Arm B Exit							
Time	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**
07:00	0	0	0	0	0	0	0	0	9	0	1	0	0	0	0	10
07:15	3	0	1	0	0	0	0	4	15	1	0	0	0	0	0	16
07:30	2	1	0	0	0	0	0	3	10	3	0	0	0	0	0	13
07:45	4	0	0	0	0	0	0	4	10	2	0	0	0	0	0	12
08:00	2	2	0	0	0	0	0	4	5	1	0	0	0	0	0	6
08:15	0	2	0	0	0	0	0	2	2	2	0	0	0	0	0	4
08:30	2	1	0	0	0	0	0	3	6	0	0	0	0	0	0	6
08:45	2	2	0	0	0	0	0	4	7	2	1	0	0	0	0	10
09:00	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	1
09:15	0	1	0	0	0	0	0	1	2	1	0	0	0	0	0	3
09:30	2	1	0	0	0	0	0	3	4	1	0	0	0	0	0	5
09:45	3	0	0	0	0	0	0	3	4	0	1	0	0	0	0	5
10:00	0	1	1	0	0	0	0	2	0	0	0	0	0	0	0	0
10:15	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1
10:30	1	0	0	0	0	0	0	1	3	0	0	0	0	0	0	3
10:45	2	0	0	0	0	0	0	2	3	0	0	0	0	0	0	3
11:00	4	0	0	0	0	0	0	4	4	0	0	0	0	0	0	4
11:15	2	0	1	0	0	0	0	3	3	0	1	0	0	0	0	4
11:30	1	0	0	0	0	0	0	1	2	0	0	0	0	0	0	2
11:45	1	1	0	0	0	0	0	2	1	1	1	0	0	0	0	3
12:00	3	2	0	0	0	0	0	5	4	2	3	0	0	0	0	9
12:15	3	0	2	0	0	0	0	5	3	0	0	0	0	0	0	3
12:30	2	0	1	0	0	0	0	3	4	2	1	0	0	0	0	7
12:45	2	3	3	0	0	0	0	8	4	1	1	1	0	0	0	7
13:00	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1
13:15	7	1	0	1	0	0	0	9	7	2	0	0	0	0	0	9
13:30	1	0	0	0	0	0	0	1	26	1	0	0	0	0	0	27
13:45	1	1	0	0	0	0	0	2	13	0	0	0	0	0	0	13
14:00	53	1	0	0	0	0	0	54	4	0	0	0	0	0	0	4
14:15	10	1	0	0	0	0	0	11	2	0	0	0	0	0	0	2
14:30	7	0	1	0	0	0	0	8	9	0	1	0	0	0	0	10
14:45	11	2	0	0	0	0	0	13	4	1	0	0	0	0	0	5
15:00	10	0	0	0	0	0	0	10	1	0	0	0	0	0	0	1
15:15	7	1	0	0	0	0	0	8	5	0	0	0	0	0	0	5
15:30	107	5	0	0	0	0	0	112	4	0	0	0	0	0	0	4
15:45	21	1	0	0	0	0	0	22	2	0	0	0	0	0	0	2
16:00	17	1	0	0	0	0	0	18	1	0	1	0	0	0	0	2
16:15	19	2	0	0	0	0	0	21	3	0	0	0	0	0	0	3
16:30	16	0	1	0	0	0	0	17	1	0	0	0	0	0	0	1
16:45	3	0	0	0	0	0	0	3	2	0	0	0	0	0	0	2
17:00	11	0	0	0	0	0	0	11	4	0	0	0	0	0	0	4
17:15	5	0	0	0	0	0	0	5	3	1	0	0	0	0	0	4
17:30	7	0	0	0	0	0	0	7	2	0	0	0	0	0	0	2
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00	4	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
18:15	1	0	0	0	0	0	0	1	2	0	0	0	0	0	0	2
18:30	2	1	0	0	0	0	0	3	0	1	0	0	0	0	0	1
18:45	2	0	1	0	0	0	0	3	3	0	1	0	0	0	0	4
Start Time	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**
07:00	9	1	1	0	0	0	0	11	44	6	1	0	0	0	0	51
07:15	11	3	1	0	0	0	0	15	40	7	0	0	0	0	0	47
07:30	8	5	0	0	0	0	0	13	27	8	0	0	0	0	0	35
07:45	8	5	0	0	0	0	0	13	23	5	0	0	0	0	0	28
08:00	6	7	0	0	0	0	0	13	20	5	1	0	0	0	0	26
08:15	4	5	1	0	0	0	0	10	15	5	1	0	0	0	0	21
08:30	4	4	1	0	0	0	0	9	15	4	1	0	0	0	0	20
08:45	4	4	1	0	0	0	0	9	13	5	1	0	0	0	0	19
09:00	5	2	1	0	0	0	0	8	10	3	1	0	0	0	0	14
09:15	5	3	1	0	0	0	0	9	10	2	1	0	0	0	0	13

09:30	6	2	1	0	0	0	0	9	9	1	1	0	0	0	0	11
09:45	5	1	1	0	0	0	0	7	8	0	1	0	0	0	0	9
10:00	4	1	1	0	0	0	0	6	7	0	0	0	0	0	0	7
10:15	8	0	0	0	0	0	0	8	11	0	0	0	0	0	0	11
10:30	9	0	1	0	0	0	0	10	13	0	1	0	0	0	0	14
10:45	9	0	1	0	0	0	0	10	12	0	1	0	0	0	0	13
11:00	8	1	1	0	0	0	0	10	10	1	2	0	0	0	0	13
11:15	7	3	1	0	0	0	0	11	10	3	5	0	0	0	0	18
11:30	8	3	2	0	0	0	0	13	10	3	4	0	0	0	0	17
11:45	9	3	3	0	0	0	0	15	12	5	5	0	0	0	0	22
12:00	10	5	6	0	0	0	0	21	15	5	5	1	0	0	0	26
12:15	8	3	6	0	0	0	0	17	12	3	2	1	0	0	0	18
12:30	12	4	4	1	0	0	0	21	16	5	2	1	0	0	0	24
12:45	11	4	3	1	0	0	0	19	38	4	1	1	0	0	0	44
13:00	10	2	0	1	0	0	0	13	47	3	0	0	0	0	0	50
13:15	62	3	0	1	0	0	0	66	50	3	0	0	0	0	0	53
13:30	65	3	0	0	0	0	0	68	45	1	0	0	0	0	0	46
13:45	71	3	1	0	0	0	0	75	28	0	1	0	0	0	0	29
14:00	81	4	1	0	0	0	0	86	19	1	1	0	0	0	0	21
14:15	38	3	1	0	0	0	0	42	16	1	1	0	0	0	0	18
14:30	35	3	1	0	0	0	0	39	19	1	1	0	0	0	0	21
14:45	135	8	0	0	0	0	0	143	14	1	0	0	0	0	0	15
15:00	145	7	0	0	0	0	0	152	12	0	0	0	0	0	0	12
15:15	152	8	0	0	0	0	0	160	12	0	1	0	0	0	0	13
15:30	164	9	0	0	0	0	0	173	10	0	1	0	0	0	0	11
15:45	73	4	1	0	0	0	0	78	7	0	1	0	0	0	0	8
16:00	55	3	1	0	0	0	0	59	7	0	1	0	0	0	0	8
16:15	49	2	1	0	0	0	0	52	10	0	0	0	0	0	0	10
16:30	35	0	1	0	0	0	0	36	10	1	0	0	0	0	0	11
16:45	26	0	0	0	0	0	0	26	11	1	0	0	0	0	0	12
17:00	23	0	0	0	0	0	0	23	9	1	0	0	0	0	0	10
17:15	16	0	0	0	0	0	0	16	5	1	0	0	0	0	0	6
17:30	12	0	0	0	0	0	0	12	4	0	0	0	0	0	0	4
17:45	7	1	0	0	0	0	0	8	2	1	0	0	0	0	0	3
18:00	9	1	1	0	0	0	0	11	5	1	1	0	0	0	0	7

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 2

Date of Survey: 11.02.2020
Junction Name: Unnamed Road / Renishaw Access
Junction Type: T-Junction

	Arm C Approach								Arm C Exit							
Time	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**
07:00	57	15	0	0	0	0	0	72	41	11	1	0	0	0	0	53
07:15	108	4	0	0	0	0	0	112	48	16	2	0	0	0	0	66
07:30	152	18	5	0	0	0	0	175	50	18	0	0	0	0	1	69
07:45	147	10	8	1	0	0	0	166	56	16	0	0	0	0	0	72
08:00	149	14	1	0	0	0	0	164	61	11	3	0	0	0	0	75
08:15	95	7	0	0	0	0	0	102	55	22	0	1	0	0	0	78
08:30	91	9	2	0	0	0	0	102	53	13	1	0	2	0	0	69
08:45	50	6	0	1	0	0	0	57	70	9	3	0	0	0	0	82
09:00	56	6	1	0	0	0	0	63	68	9	3	0	0	0	0	80
09:15	30	3	1	0	0	0	0	34	77	8	0	0	0	0	0	85
09:30	37	7	1	0	0	0	0	45	57	12	1	1	1	0	0	72
09:45	27	5	5	0	0	0	0	37	46	11	3	0	0	0	0	60
10:00	21	4	2	0	0	0	0	27	39	6	1	0	0	0	0	46
10:15	39	6	1	0	1	0	0	47	57	13	0	0	0	0	0	70
10:30	43	4	1	0	0	0	0	48	44	10	1	0	0	0	0	55
10:45	37	5	1	0	0	0	0	43	46	6	0	1	0	0	0	53
11:00	41	8	2	0	0	0	0	51	34	4	0	0	1	0	0	39
11:15	31	7	0	0	0	0	0	38	29	5	3	0	0	0	0	37
11:30	31	7	0	0	0	0	0	38	29	6	2	0	0	0	0	37
11:45	45	2	2	0	0	0	0	49	46	3	1	1	0	0	0	51
12:00	51	8	1	1	0	0	0	61	25	8	1	0	0	0	0	34
12:15	51	5	1	0	0	0	0	57	42	3	1	0	0	0	0	46
12:30	40	5	0	0	1	0	0	46	35	3	2	0	0	0	0	40
12:45	35	2	1	0	0	0	0	38	31	10	1	0	0	0	0	42
13:00	47	3	2	0	0	0	0	52	32	5	1	0	0	0	0	38
13:15	31	9	3	0	0	0	0	43	31	8	1	0	0	0	0	40
13:30	30	2	0	0	0	0	0	32	37	4	0	1	0	0	0	42
13:45	43	7	1	1	0	0	0	52	38	6	0	1	0	0	0	45
14:00	37	7	0	1	0	0	0	45	40	7	0	0	0	0	0	47
14:15	32	7	1	1	0	0	0	41	35	3	2	0	0	0	0	40
14:30	30	12	1	0	0	0	0	43	45	9	1	0	0	0	0	55
14:45	36	7	1	1	0	0	0	45	59	9	0	0	1	0	0	69
15:00	52	13	0	0	0	0	0	65	35	2	0	0	0	0	0	37
15:15	62	11	0	0	0	0	0	73	45	7	0	0	1	0	0	53
15:30	55	13	0	0	2	0	0	70	44	12	3	0	0	0	0	59
15:45	59	16	1	0	0	0	0	76	50	5	2	0	0	0	0	57
16:00	62	13	2	0	0	0	0	77	37	8	0	0	0	0	0	45
16:15	69	12	1	0	0	0	0	82	70	6	1	0	0	0	0	77
16:30	55	16	1	0	0	0	0	72	69	11	0	1	0	0	0	81
16:45	55	15	0	0	0	0	0	70	66	9	0	0	0	0	0	75
17:00	61	11	1	0	0	0	0	73	76	10	0	0	0	0	0	86
17:15	65	8	1	1	0	0	0	75	89	13	0	0	0	0	0	102
17:30	46	8	0	0	0	0	0	54	107	13	0	0	0	0	0	120
17:45	43	5	0	0	0	0	0	48	87	6	0	0	0	0	0	93
18:00	49	4	0	0	0	0	0	53	42	4	0	0	0	0	0	46
18:15	39	3	0	0	0	0	0	42	63	4	0	0	0	0	0	67
18:30	33	1	0	0	0	0	0	34	38	2	0	0	0	0	0	40
18:45	36	2	1	0	0	0	0	39	44	1	2	0	0	0	0	47
Start Time	**Rolling Hour**							**Total**	**Rolling Hour**							**Total**
07:00	464	47	13	1	0	0	0	525	195	61	3	0	0	0	1	260
07:15	556	46	14	1	0	0	0	617	215	61	5	0	0	0	1	282
07:30	543	49	14	1	0	0	0	607	222	67	3	1	0	0	1	294
07:45	482	40	11	1	0	0	0	534	225	62	4	1	2	0	0	294
08:00	385	36	3	1	0	0	0	425	239	55	7	1	2	0	0	304
08:15	292	28	3	1	0	0	0	324	246	53	7	1	2	0	0	309
08:30	227	24	4	1	0	0	0	256	268	39	7	0	2	0	0	316
08:45	173	22	3	1	0	0	0	199	272	38	7	1	1	0	0	319
09:00	150	21	8	0	0	0	0	179	248	40	7	1	1	0	0	297
09:15	115	19	9	0	0	0	0	143	219	37	5	1	1	0	0	263

09:30	124	22	9	0	1	0	0	156	199	42	5	1	1	0	0	248
09:45	130	19	9	0	1	0	0	159	186	40	5	0	0	0	0	231
10:00	140	19	5	0	1	0	0	165	186	35	2	1	0	0	0	224
10:15	160	23	5	0	1	0	0	189	181	33	1	1	1	0	0	217
10:30	152	24	4	0	0	0	0	180	153	25	4	1	1	0	0	184
10:45	140	27	3	0	0	0	0	170	138	21	5	1	1	0	0	166
11:00	148	24	4	0	0	0	0	176	138	18	6	1	1	0	0	164
11:15	158	24	3	1	0	0	0	186	129	22	7	1	0	0	0	159
11:30	178	22	4	1	0	0	0	205	142	20	5	1	0	0	0	168
11:45	187	20	4	1	1	0	0	213	148	17	5	1	0	0	0	171
12:00	177	20	3	1	1	0	0	202	133	24	5	0	0	0	0	162
12:15	173	15	4	0	1	0	0	193	140	21	5	0	0	0	0	166
12:30	153	19	6	0	1	0	0	179	129	26	5	0	0	0	0	160
12:45	143	16	6	0	0	0	0	165	131	27	3	1	0	0	0	162
13:00	151	21	6	1	0	0	0	179	138	23	2	2	0	0	0	165
13:15	141	25	4	2	0	0	0	172	146	25	1	2	0	0	0	174
13:30	142	23	2	3	0	0	0	170	150	20	2	2	0	0	0	174
13:45	142	33	3	3	0	0	0	181	158	25	3	1	0	0	0	187
14:00	135	33	3	3	0	0	0	174	179	28	3	0	1	0	0	211
14:15	150	39	3	2	0	0	0	194	174	23	3	0	1	0	0	201
14:30	180	43	2	1	0	0	0	226	184	27	1	0	2	0	0	214
14:45	205	44	1	1	2	0	0	253	183	30	3	0	2	0	0	218
15:00	228	53	1	0	2	0	0	284	174	26	5	0	1	0	0	206
15:15	238	53	3	0	2	0	0	296	176	32	5	0	1	0	0	214
15:30	245	54	4	0	2	0	0	305	201	31	6	0	0	0	0	238
15:45	245	57	5	0	0	0	0	307	226	30	3	1	0	0	0	260
16:00	241	56	4	0	0	0	0	301	242	34	1	1	0	0	0	278
16:15	240	54	3	0	0	0	0	297	281	36	1	1	0	0	0	319
16:30	236	50	3	1	0	0	0	290	300	43	0	1	0	0	0	344
16:45	227	42	2	1	0	0	0	272	338	45	0	0	0	0	0	383
17:00	215	32	2	1	0	0	0	250	359	42	0	0	0	0	0	401
17:15	203	25	1	1	0	0	0	230	325	36	0	0	0	0	0	361
17:30	177	20	0	0	0	0	0	197	299	27	0	0	0	0	0	326
17:45	164	13	0	0	0	0	0	177	230	16	0	0	0	0	0	246
18:00	157	10	1	0	0	0	0	168	187	11	2	0	0	0	0	200

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 2

Date of Survey: 11.02.2020
Junction Name: Unnamed Road / Renishaw Access
Junction Type: T-Junction

	Total Junction Flow							
Time	**Cars**	**LGV**	**OGV1**	**OGV2**	**Buses**	**M/C**	**Cycle**	**Total**
07:00	106	26	2	0	0	0	0	134
07:15	172	21	2	0	0	0	0	195
07:30	212	39	5	0	0	0	1	257
07:45	217	28	8	1	0	0	0	254
08:00	214	27	4	0	0	0	0	245
08:15	152	31	0	1	0	0	0	184
08:30	152	22	3	0	2	0	0	179
08:45	127	18	4	1	0	0	0	150
09:00	124	16	4	0	0	0	0	144
09:15	109	12	1	0	0	0	0	122
09:30	99	21	2	1	1	0	0	124
09:45	78	16	9	0	0	0	0	103
10:00	60	11	3	0	0	0	0	74
10:15	98	19	1	0	1	0	0	119
10:30	91	14	2	0	0	0	0	107
10:45	88	11	1	1	0	0	0	101
11:00	81	12	2	0	1	0	0	96
11:15	61	12	5	0	0	0	0	78
11:30	63	13	2	0	0	0	0	78
11:45	92	6	4	1	0	0	0	103
12:00	82	19	5	1	0	0	0	107
12:15	97	8	4	0	0	0	0	109
12:30	80	10	4	0	1	0	0	95
12:45	72	15	6	1	0	0	0	94
13:00	81	8	3	0	0	0	0	92
13:15	72	20	4	1	0	0	0	97
13:30	93	7	0	1	0	0	0	101
13:45	95	14	1	2	0	0	0	112
14:00	134	15	0	1	0	0	0	150
14:15	77	11	3	1	0	0	0	92
14:30	90	21	4	0	0	0	0	115
14:45	109	18	1	1	1	0	0	130
15:00	96	15	0	0	0	0	0	111
15:15	117	19	0	0	1	0	0	137
15:30	203	30	3	0	2	0	0	238
15:45	130	22	3	0	0	0	0	155
16:00	117	22	2	0	0	0	0	141
16:15	159	20	2	0	0	0	0	181
16:30	140	27	2	1	0	0	0	170
16:45	125	24	0	0	0	0	0	149
17:00	150	21	1	0	0	0	0	172
17:15	161	22	1	1	0	0	0	185
17:30	160	21	0	0	0	0	0	181
17:45	130	11	0	0	0	0	0	141
18:00	94	8	0	0	0	0	0	102
18:15	105	7	0	0	0	0	0	112
18:30	73	5	0	0	0	0	0	78
18:45	83	3	4	0	0	0	0	90
Start Time	**Rolling Hour**							**Total**
07:00	707	114	17	1	0	0	1	840
07:15	815	115	19	1	0	0	1	951
07:30	795	125	17	2	0	0	1	940
07:45	735	108	15	2	2	0	0	862
08:00	645	98	11	2	2	0	0	758
08:15	555	87	11	2	2	0	0	657
08:30	512	68	12	1	2	0	0	595
08:45	459	67	11	2	1	0	0	540
09:00	410	65	16	1	1	0	0	493
09:15	346	60	15	1	1	0	0	423

09:30	335	67	15	1	2	0	0	420
09:45	327	60	15	0	1	0	0	403
10:00	337	55	7	1	1	0	0	401
10:15	358	56	6	1	2	0	0	423
10:30	321	49	10	1	1	0	0	382
10:45	293	48	10	1	1	0	0	353
11:00	297	43	13	1	1	0	0	355
11:15	298	50	16	2	0	0	0	366
11:30	334	46	15	2	0	0	0	397
11:45	351	43	17	2	1	0	0	414
12:00	331	52	19	2	1	0	0	405
12:15	330	41	17	1	1	0	0	390
12:30	305	53	17	2	1	0	0	378
12:45	318	50	13	3	0	0	0	384
13:00	341	49	8	4	0	0	0	402
13:15	394	56	5	5	0	0	0	460
13:30	399	47	4	5	0	0	0	455
13:45	396	61	8	4	0	0	0	469
14:00	410	65	8	3	1	0	0	487
14:15	372	65	8	2	1	0	0	448
14:30	412	73	5	1	2	0	0	493
14:45	525	82	4	1	4	0	0	616
15:00	546	86	6	0	3	0	0	641
15:15	567	93	8	0	3	0	0	671
15:30	609	94	10	0	2	0	0	715
15:45	546	91	9	1	0	0	0	647
16:00	541	93	6	1	0	0	0	641
16:15	574	92	5	1	0	0	0	672
16:30	576	94	4	2	0	0	0	676
16:45	596	88	2	1	0	0	0	687
17:00	601	75	2	1	0	0	0	679
17:15	545	62	1	1	0	0	0	609
17:30	489	47	0	0	0	0	0	536
17:45	402	31	0	0	0	0	0	433
18:00	355	23	4	0	0	0	0	382

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 2

Date of Survey: 11.02.2020
Junction Name: Unnamed Road / Renishaw Access
Junction Type: T-Junction

Arm A: Unnamed Road (N) **Arm B:** Renishaw Access (E) **Arm C:** Unnamed Road (S)

	PCU Summary								
Time	**A to A**	**A to C**	**A to B**	**B to B**	**B to A**	**B to C**	**C to C**	**C to B**	**C to A**
07:00	0	54	10	0	0	0	0	1	71
07:15	0	66	14	0	3	2	0	2	110
07:30	0	68	10	0	3	0	0	3	177
07:45	0	72	12	0	4	0	0	0	175
08:00	0	75	5	0	1	3	0	1	164
08:15	0	78	4	0	0	2	0	0	102
08:30	0	72	6	0	2	1	0	0	104
08:45	0	82	11	0	1	3	0	0	59
09:00	0	81	1	0	0	2	0	0	64
09:15	0	84	3	0	0	1	0	0	35
09:30	0	75	5	0	2	1	0	0	46
09:45	0	61	6	0	1	2	0	0	42
10:00	0	45	0	0	1	2	0	0	29
10:15	0	70	1	0	1	0	0	0	49
10:30	0	56	3	0	1	0	0	0	49
10:45	0	55	3	0	2	0	0	0	44
11:00	0	39	4	0	2	2	0	0	53
11:15	0	38	3	0	2	2	0	2	36
11:30	0	39	2	0	1	0	0	0	38
11:45	0	52	4	0	0	2	0	0	51
12:00	0	33	12	0	3	2	0	0	64
12:15	0	45	3	0	5	2	0	0	58
12:30	0	41	8	0	3	1	0	0	48
12:45	0	42	10	0	10	1	0	0	39
13:00	0	39	1	0	1	0	0	0	54
13:15	0	37	9	0	7	4	0	0	46
13:30	0	43	27	0	0	1	0	0	32
13:45	0	47	13	0	2	0	0	0	55
14:00	0	47	4	0	54	0	0	0	47
14:15	0	40	2	0	9	2	0	0	44
14:30	0	55	11	0	8	1	0	0	44
14:45	0	69	5	0	11	2	0	0	48
15:00	0	35	1	0	8	2	0	0	65
15:15	0	53	5	0	6	2	0	0	73
15:30	0	56	3	0	106	6	0	1	72
15:45	0	57	2	0	20	2	0	0	77
16:00	0	45	1	0	18	0	0	2	77
16:15	0	76	3	0	19	2	0	0	83
16:30	0	82	1	0	17	1	0	0	73
16:45	0	74	2	0	2	1	0	0	70
17:00	0	84	4	0	9	2	0	0	74
17:15	0	101	4	0	4	1	0	0	78
17:30	0	118	2	0	5	2	0	0	54
17:45	0	93	0	0	0	0	0	0	48
18:00	0	45	0	0	3	1	0	0	53
18:15	0	67	2	0	1	0	0	0	42
18:30	0	40	1	0	3	0	0	0	34
18:45	0	45	5	0	0	4	0	0	40
Start Time	**Rolling Hour**								
07:00	0	260	46	0	10	2	0	6	533
07:15	0	281	41	0	11	5	0	6	626
07:30	0	293	31	0	8	5	0	4	618
07:45	0	297	27	0	7	6	0	1	545
08:00	0	306	26	0	4	9	0	1	429
08:15	0	312	22	0	3	8	0	0	329
08:30	0	318	21	0	3	7	0	0	262
08:45	0	322	20	0	3	7	0	0	204
09:00	0	301	15	0	3	6	0	0	186
09:15	0	265	14	0	4	6	0	0	151
09:30	0	251	12	0	5	5	0	0	166
09:45	0	232	10	0	4	4	0	0	169
10:00	0	226	7	0	5	2	0	0	171
10:15	0	219	11	0	6	2	0	0	195
10:30	0	187	13	0	7	4	0	2	182
10:45	0	170	12	0	7	4	0	2	171
11:00	0	167	13	0	5	6	0	2	178
11:15	0	161	21	0	6	6	0	2	189
11:30	0	168	21	0	9	6	0	0	211
11:45	0	170	27	0	11	7	0	0	220
12:00	0	161	32	0	20	6	0	0	208
12:15	0	167	22	0	18	4	0	0	198
12:30	0	159	28	0	21	6	0	0	186
12:45	0	161	47	0	18	6	0	0	170
13:00	0	166	50	0	10	5	0	0	186
13:15	0	174	53	0	63	5	0	0	179
13:30	0	177	46	0	65	3	0	0	178
13:45	0	189	30	0	73	3	0	0	189
14:00	0	210	22	0	82	5	0	0	182
14:15	0	198	19	0	36	7	0	0	201
14:30	0	211	22	0	33	7	0	0	230
14:45	0	212	14	0	131	12	0	1	258
15:00	0	200	11	0	140	12	0	1	287
15:15	0	210	11	0	150	10	0	3	299
15:30	0	233	9	0	163	10	0	3	309
15:45	0	260	7	0	74	5	0	2	310
16:00	0	277	7	0	56	4	0	2	303

16:15	0	316	10	0	47	6	0	0	300
16:30	0	341	11	0	32	5	0	0	295
16:45	0	377	12	0	20	6	0	0	276
17:00	0	396	10	0	18	5	0	0	254
17:15	0	357	6	0	12	4	0	0	233
17:30	0	323	4	0	9	3	0	0	197
17:45	0	245	3	0	7	1	0	0	177
18:00	0	197	8	0	7	5	0	0	169

Intelligent Data Collection Limited

Client: Arcadis
Project Number: ID05235
Junction Number: Site 2

Date of Survey: 11.02.2020
Junction Name: Unnamed Road / Renishaw Access
Junction Type: T-Junction

Arm A: Unnamed Road (N)
Arm B: Renishaw Access (E)
Arm C: Unnamed Road (S)

Count Method: Vehicles **Classes Included:** All Classes *Select the count method and desired user classes from the drop-downs in cells D10 and G10*

Maximum 15-minute Junction Flow:

AM Peak	**from:**	07:30	**until:**	07:45	**flow:**	257	*AM Peak covers 07:00 until 10:00*
Inter-Peak	**from:**	15:30	**until:**	15:45	**flow:**	238	*Inter-Peak covers 10:00 until 16:00*
PM Peak	**from:**	17:15	**until:**	17:30	**flow:**	185	*PM Peak covers 16:00 until 19:00*

Period Starting: 07:00 *Select the time from the drop-down in cell D18 to show the 15-minute data for that period*

Movement Counts

From \ To	A	B	C	Total
A	0	9	53	62
B	0	0	0	0
C	**71**	1	0	**72**
Total	**71**	10	53	134

HGV Proportions

From \ To	A	B	C	Total
A	0.0%	**11.1%**	1.9%	**3.2%**
B	0.0%	0.0%	0.0%	0.0%
C	0.0%	0.0%	0.0%	0.0%
Total	0.0%	**10.0%**	1.9%	1.5%

Maximum Hourly Junction Flow:

AM Peak	**from:**	07:15	**until:**	08:15	**flow:**	951
Inter-Peak	**from:**	15:30	**until:**	16:30	**flow:**	715
PM Peak	**from:**	16:45	**until:**	17:45	**flow:**	687

Period Starting: 16:45 *Select the time from the drop-down in cell D34 to show the hourly data for that period*

Movement Counts

From \ To	A	B	C	Total
A	0	12	**377**	**389**
B	20	0	6	26
C	272	0	0	272
Total	292	12	**383**	687

HGV Proportions

From \ To	A	B	C	Total
A	0.0%	0.0%	0.0%	0.0%
B	0.0%	0.0%	0.0%	0.0%
C	**1.1%**	0.0%	0.0%	**1.1%**
Total	**1.0%**	0.0%	0.0%	0.4%

Bold entries in the above tables indicate the maximum movement, approach and exit flows for the selected time period, and similarly with the HGV proportions

APPENDIX F

SEWTM Technical Note

MOTT MACDONALD

Technical Note

Project:	SEWTM – M4 J34 to A48 Link WelTAG Stage 2		
Prepared by:	S Bukowski (Arup) / G Bate	**Date:**	23 March 2018
Approved by:	P Chase	**To:**	Arcadis
Subject:	SEWTM Modelling Approach		

1 Introduction

1.1 Purpose

Mott MacDonald (working with Arup) has been commissioned by Transport for Wales to undertake strategic transport modelling for the M4 J34 to A48 Link using the South East Wales Transport Model (SEWTM), following a request from Arcadis working on behalf of Vale of Glamorgan Council. Strategic modelling is required to support a WelTAG Stage 2 study for the scheme.

This Technical Note has been prepared to summarise the modelling approach adopted for the study, including validation checks, network coding assumptions, and outputs delivered. It is expected that this Note will be included as an appendix to the WelTAG stage report.

1.2 South East Wales Transport Model (SEWTM)

SEWTM is a multi-modal disaggregate demand model focused on South East Wales, covering the eleven unitary authority areas of Blaenau Gwent, Bridgend, Caerphilly, Cardiff, Merthyr Tydfil, Monmouthshire, Neath Port Talbot, Newport, Rhondda Cynon Taf, Torfaen, and Vale of Glamorgan. The model comprises separate highway and public transport assignment models linked together with a demand model. The model was commissioned by Welsh Government in 2015 and has been developed by a team led by Mott MacDonald, and including Arup, RAND Europe, and David Simmonds Consultancy.

The SEWTM has been designed to:

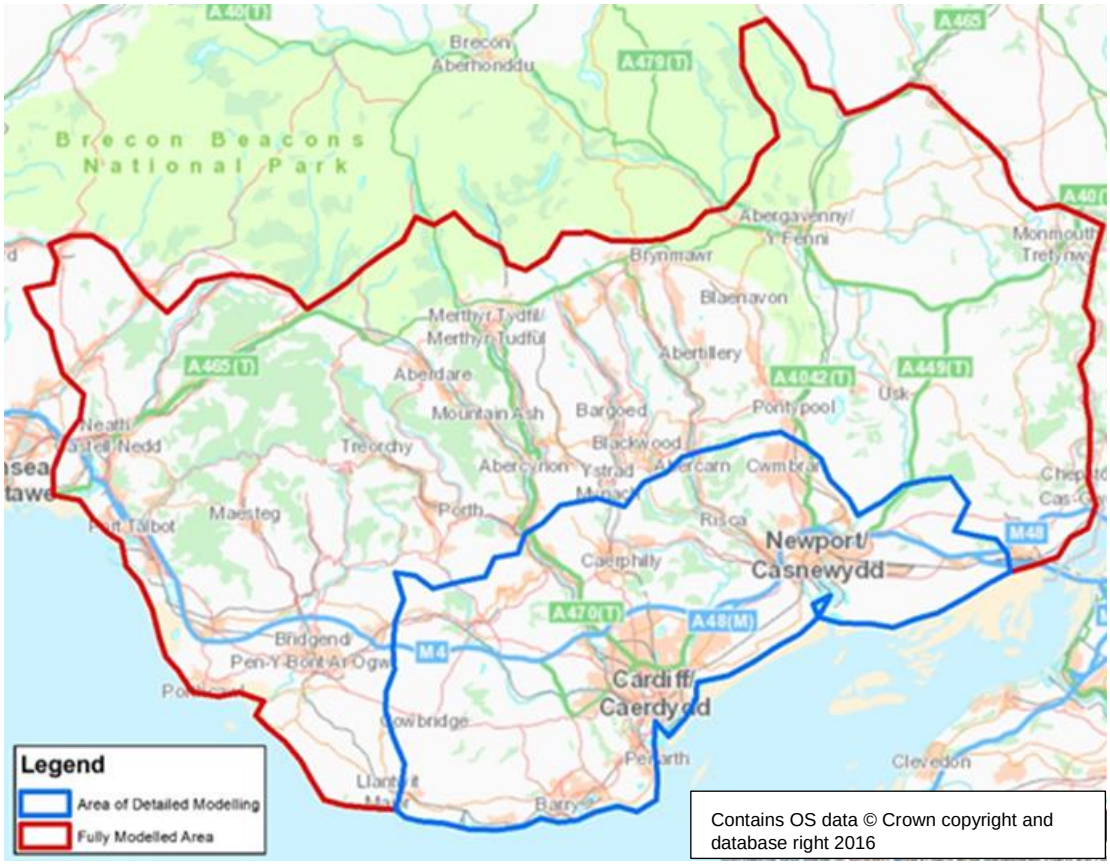
- Understand the current travel patterns in South East Wales and the performance of the transport system;
- Monitor changes in travel patterns over time;
- Predict future travel patterns and conditions on the transport network;
- Assess the impacts of possible interventions in the transport system in a consistent manner;
- Assess the impacts of land use changes such as new housing developments and employment locations in a consistent manner; and
- Provide inputs required for transport appraisals and business cases.

The model represents an average weekday for four time periods: an AM average hour between 0700 and 0930, an inter-peak (IP) average hour between 0930 and 1530, an average PM hour between 1530 and 1800 and an off-peak (OP) average hour between 1800 and 0700. The assignment models can also represent peak hours within the AM and PM peak periods. Peak hours are the single hours during which the

highest volume of trips are undertaken; between 0745 and 0845, and between 1630 and 1730. The SEWTM base year is 2015, with forecast years of 2026 and 2036 currently available.

SEWTM geographical coverage is shown in Figure 1. The M4 J34 to A48 Link, as well as the wider area in which the greatest transport impacts are likely to be felt, is within the Area of Detailed Modelling. This is the area of the transport model within which significant impacts of interventions are more certain. Within this area the model represents all trips (demand), model zones are small and highly disaggregated, the transport network is detailed, and junction modelling is included.

Figure 1: SEWTM modelled area



Source: Mott MacDonald

1.3 Approach Overview

An overall approach to the strategic modelling, which is proportionate to the scale of the scheme and current development stage, was agreed with Arcadis in advance:

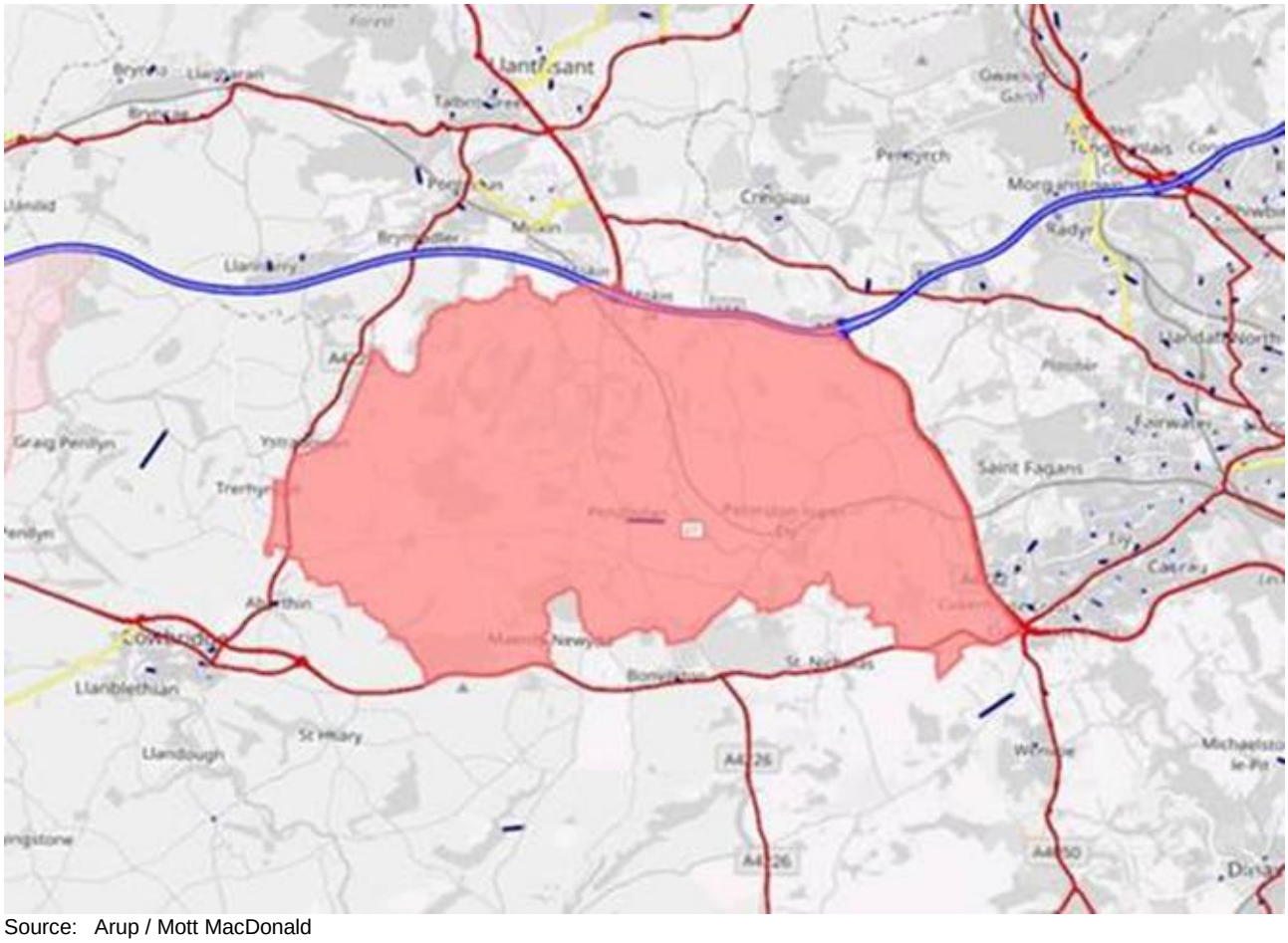
- Running the highway component of SEWTM only; and
- 2036 forecast year only, with model outputs used to complete a single year TUBA assessment.

2 Zoning and Network Structure

The zoning structure within the scheme area has been reviewed. Model zone 27 (highlighted in Figure 2) is the main zone in the study area. All villages local to the scheme and the Renishaw factory are included within this zone.

The zone boundaries are based on the LSOA (Lower Layer Super Output Area) in this area and the zone is connected to the highway network near to Pendoylan village. Having such a large zone could have an impact on the local assignment of trips within this area of the model. However, given the rural nature of the zone, the level of trip generation is relatively low (compared to the rest of the model area) and therefore the zone size is unlikely to have a significant impact on the results of this high-level analysis of the proposed scheme. However, this is an area that could be developed further in any future modelling work for the scheme.

Figure 2: Extent of Model Zone 27



Source: Arup / Mott MacDonald

Within SEWTM, all lower rank, non-strategic routes are modelled as fixed low speed links. In this case the existing road between M4 J34 and A48 was modelled as such in the Base and Do-Minimum scenarios. Considering the existing characteristics of this road and sections with a single track/passing places specifically, this approach was deemed as appropriate in the development phase of the model.

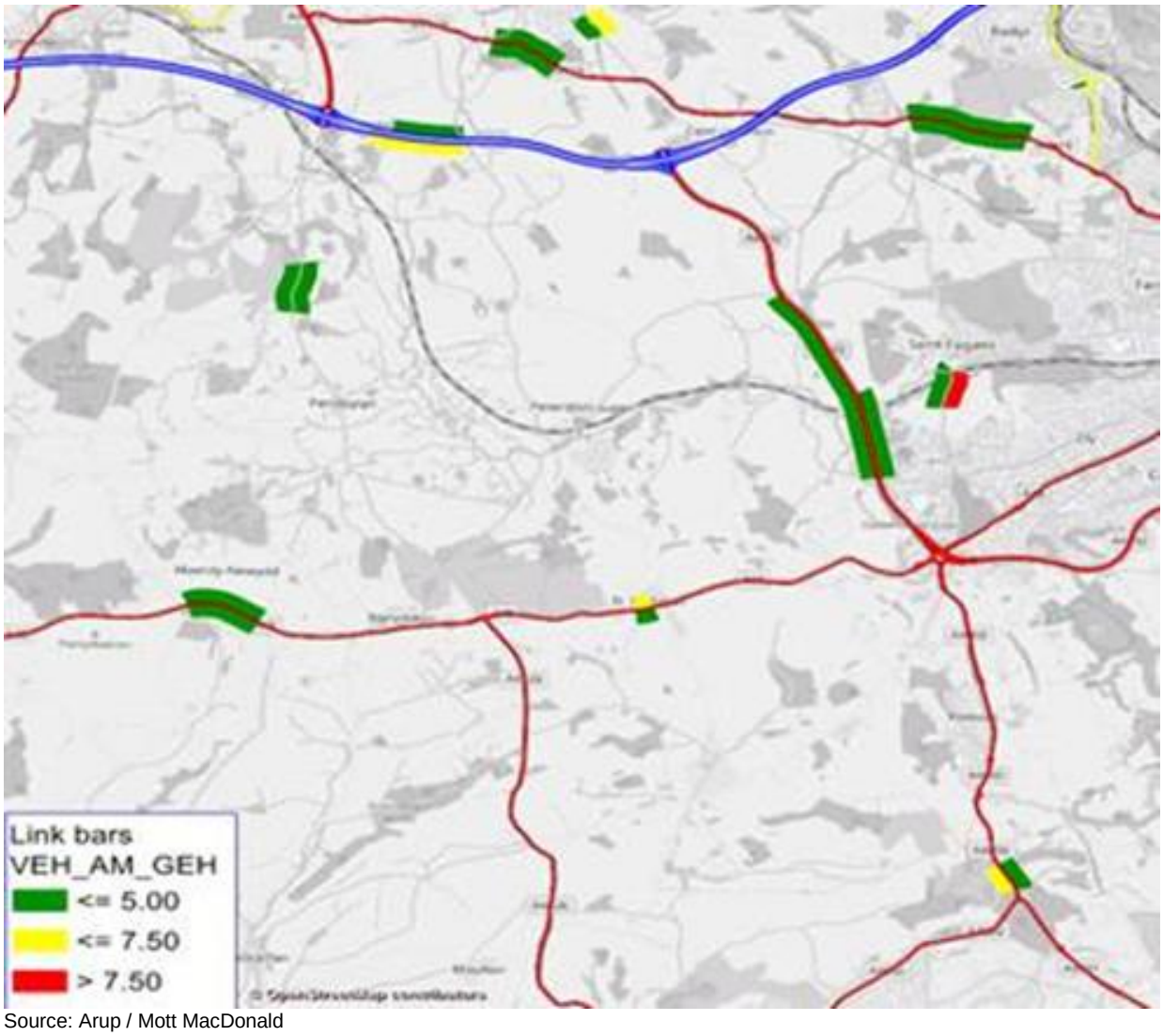
3 Highway Validation

A review of 2015 base year highway model performance in the study area has been undertaken. The review indicated that the model presented a good level of validation in terms of screenlines and link flow volumes on most validation points in the area around the scheme. This includes the existing road section adjacent to the scheme and the A48 west of the scheme. Link validation results for all time periods, based on the standard GEH statistic, are shown in Figure 3, Figure 4 and Figure 5.

The link flow volumes on the A48 to the east of the scheme did not validate quiet as well and are slightly underestimated in the base year.

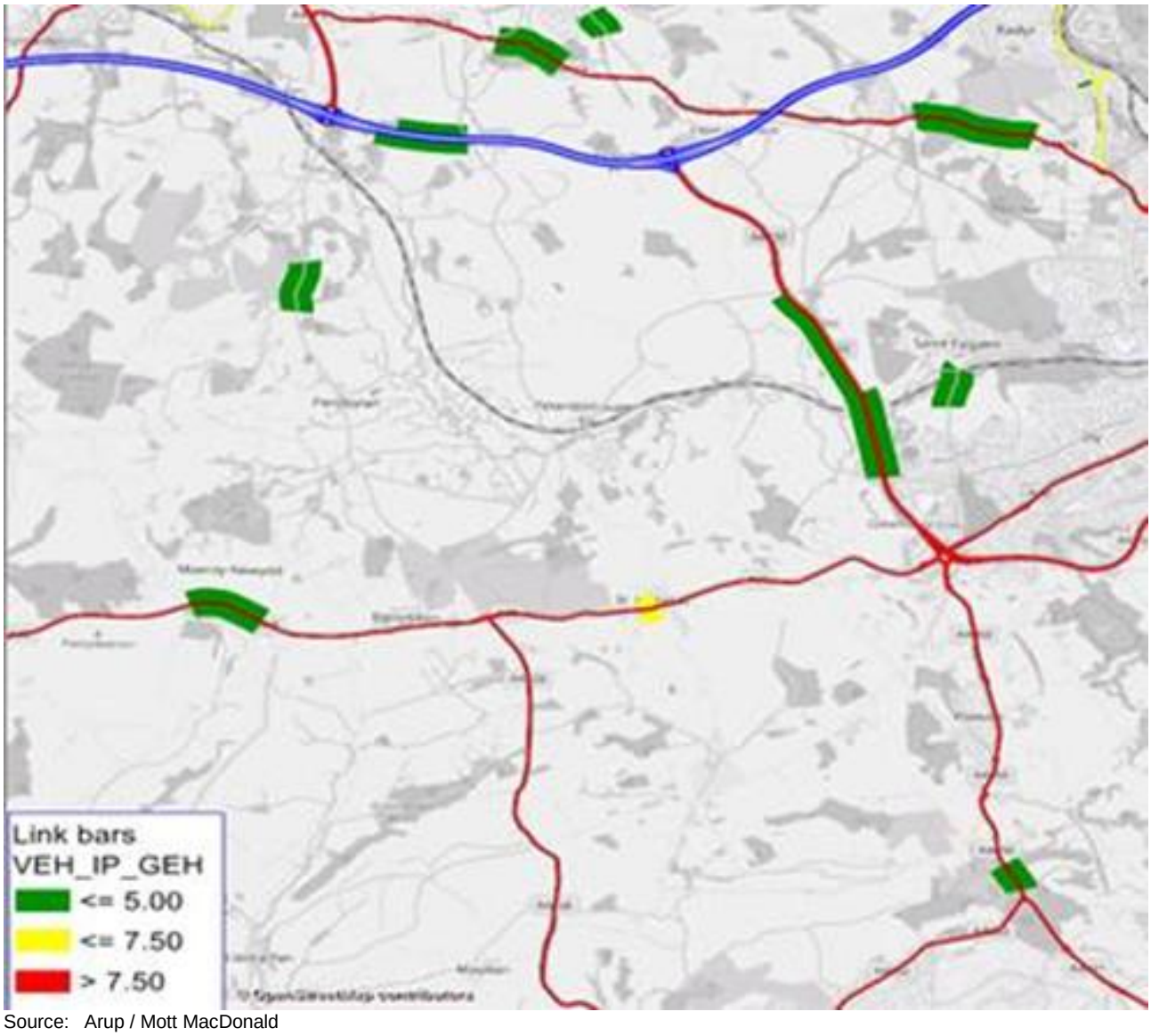
The model journey times were analysed along strategic routes. Routes in proximity of the proposed scheme (A48, A4232 and M4) display a good level of validation across all time periods.

Figure 3: Base Year Model Link Validation – All Vehicles, AM 2015



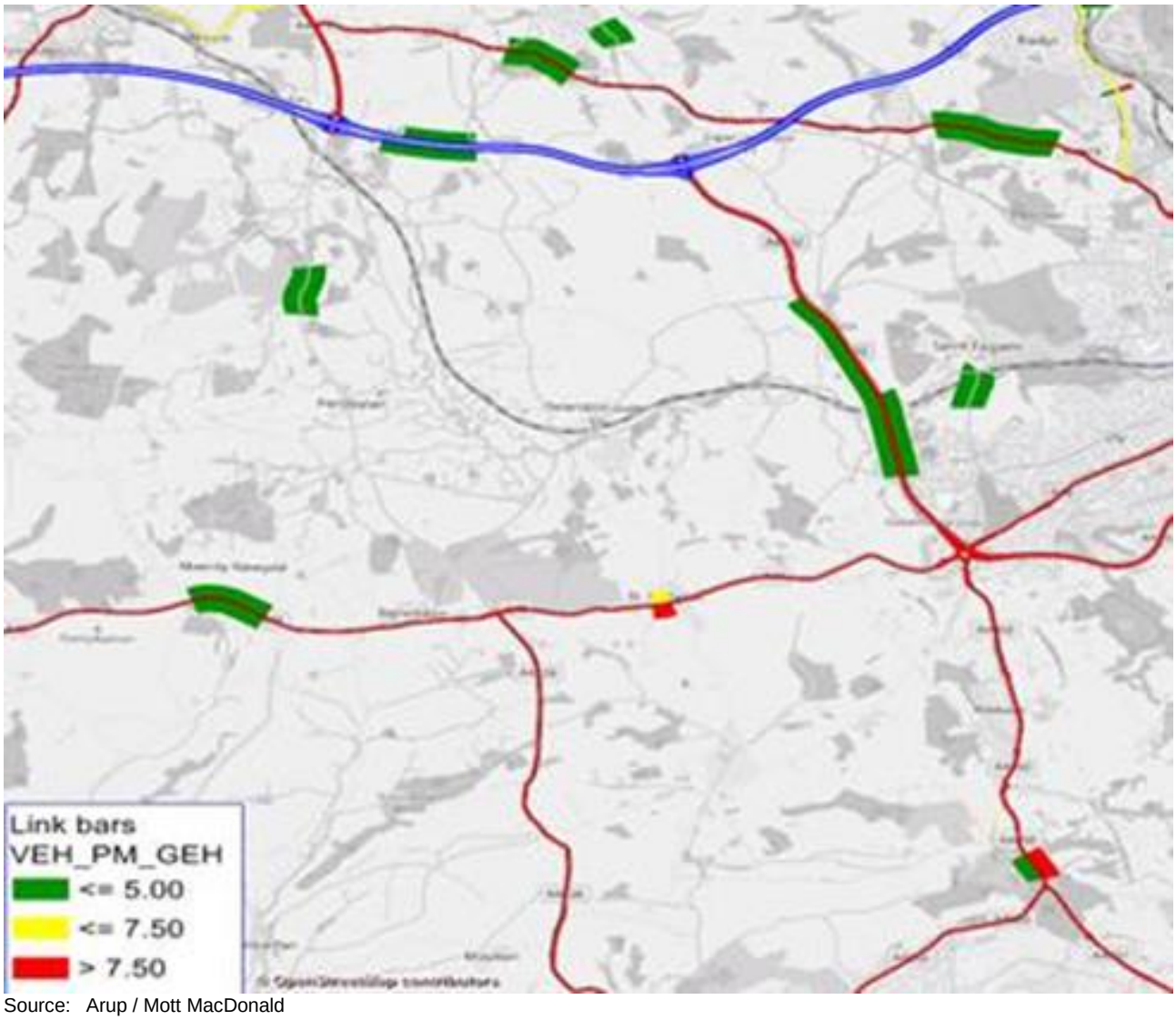
Source: Arup / Mott MacDonald

Figure 4: Base Year Model Link Validation – All Vehicles, Inter-Peak 2015



Source: Arup / Mott MacDonald

Figure 5: Base Year Model Link Validation – All Vehicles, PM 2015



Source: Arup / Mott MacDonald

4 Do-Minimum Networks

The 2036 Do-Minimum highway networks in SEWTM already include the following schemes:

- Five Mile Lane Scheme, involving a range of improvements to the A4226 between Sycamore Cross and Weycock Cross;
- A465 Dualling between Gilwern and Dowlais Top; and
- M4 Junction 32 improvements, including a new dedicated left turn lane from the M4 westbound.

Additionally, the following schemes and amendments have now been included as part of Do-Minimum network updates:

- Eastern Bay Link Stage 1 between the Butetown Tunnel and Ocean Way; and
- Revised A4226 Five Mile Lane coding, to incorporate the latest information outlined in the Five Mile Lane Transport Assessment, provided by Arcadis. Changes were made to the road characteristics and junction control settings including new signal phasing and timings.

5 Do-Something Networks

The 2036 Do-Something networks consist of the revised Do-Minimum network with the additional coding of the M4 J34 to A48 link road. The following assumptions are made in terms of modelling the proposed scheme:

- Single carriageway link classification and speed-flow curve (60mph/100km design speed);
- The section of the scheme road 450 metres north of the A48 Sycamore Cross junction is coded as suburban single carriageway link classification and speed-flow curve (40mph/64km design speed);
- No adjustments were made to the coding of Sycamore Cross junction signals to account for the new scheme road section; and
- Due to the size of zones (and zone loading points) in the proximity of the scheme road, no intermediate junctions were coded along the scheme link.

6 Outputs

Mott MacDonald / Arup has issued the following information and model run outputs:

- GIS shapefiles containing modelled link vehicle flows (actual and demand for AM / Inter-Peak / PM) for:
  - 2015 Base
  - 2036 Do-Minimum
  - 2036 Do-Something
- Flow difference plots for AM, Inter-Peak, and PM time periods, comparing the 2036 Do-Minimum and 2036 Do-Something scenarios;
- Spreadsheet containing additional attributes describing model links characteristics;
- Full set of TUBA 1.9.9 input and output files for a single year (2036); and
- Highway hour to period factors to assist in forecasting Annual Average Daily Traffic (AADT) flows – AM (2.1977), Inter-Peak (6), PM (2.3768), and Off-Peak (13).

7 Considerations for WelTAG Stage 3

Future development work on the M4 J34 to A48 Link scheme, potentially as part of a WelTAG Stage 3 assessment, should consider the following options to refine the modelling:

- Additional journey time data could be collected and used for validation along the existing road between M4 J34 and the A48;
- Disaggregation of model zones local to the scheme road section, with the aim of helping to improve model validation on the A48 to the east of the scheme;
- Refining coding of the existing road in the Do-Minimum, considering the link speed and replicating the performance of the road, which on some sections is single track with passing places;
- Junction / signal optimisation at Sycamore Cross (A48) and M4 J34;
- Use of a cordoned version of SEWTM to remove the impacts of any model noise in the economic appraisal.

APPENDIX G

SEWTM | Output Traffic Flows

Link ID	Reference	Direction of Flow	2015 Base			2036 Do-Minimum (DM)			2036 Do-Something (DS)			2015 Base to 2036 DM (% Change)			2036 DM to DS (% Change)		
			AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM
1	Pendoylan	Southbound	295	209	283	353	281	342	792	573	772	20%	34%	21%	124%	104%	126%
		Northbound	409	203	303	476	268	389	1234	832	1200	16%	32%	28%	159%	210%	208%
		Two-way	**704**	**412**	**586**	**829**	**549**	**731**	**2026**	**1405**	**1972**	**18%**	**33%**	**25%**	**144%**	**156%**	**170%**
2	M4 west of Junction 34	Eastbound	4045	2196	3184	5215	3099	4433	5037	3049	4360	29%	41%	39%	-3%	-2%	-2%
		Westbound	3268	2309	4131	4507	3306	5255	4522	3349	5270	38%	43%	27%	0%	1%	0%
		Two-way	**7313**	**4505**	**7315**	**9722**	**6405**	**9688**	**9559**	**6398**	**9630**	**33%**	**42%**	**32%**	**-2%**	**0%**	**-1%**
3	M4 east of Junction 34	Eastbound	4777	2771	3774	5813	3818	4989	5940	4000	5145	22%	38%	32%	2%	5%	3%
		Westbound	3686	2676	5105	5020	3783	6169	5292	3867	6295	36%	41%	21%	5%	2%	2%
		Two-way	**8463**	**5447**	**8879**	**10833**	**7601**	**11158**	**11232**	**7867**	**11440**	**28%**	**40%**	**26%**	**4%**	**3%**	**3%**
4	A4119	Southbound	2076	1277	1854	2219	1810	2083	2021	1768	1894	7%	42%	12%	-9%	-2%	-9%
		Northbound	1814	1064	2252	2256	1557	2488	2330	1593	2562	24%	46%	10%	3%	2%	3%
		Two-way	**3890**	**2341**	**4106**	**4475**	**3367**	**4571**	**4351**	**3361**	**4456**	**15%**	**44%**	**11%**	**-3%**	**0%**	**-3%**
5	M4 east of Junction 33	Eastbound	4419	2808	3801	5506	3794	5166	5544	3854	5155	25%	35%	36%	1%	2%	0%
		Westbound	4025	2707	4751	5350	3848	6156	5419	3856	6132	33%	42%	30%	1%	0%	0%
		Two-way	**8444**	**5515**	**8552**	**10856**	**7642**	**11322**	**10963**	**7710**	**11287**	**29%**	**39%**	**32%**	**1%**	**1%**	**0%**
6	A4232 Link Road	Southbound	2972	1813	2541	3729	2614	3468	3651	2513	3472	25%	44%	36%	-2%	-4%	0%
		Northbound	2384	1818	3163	3092	2527	3659	3127	2377	3645	30%	39%	16%	1%	-6%	0%
		Two-way	**5356**	**3631**	**5704**	**6821**	**5141**	**7127**	**6778**	**4890**	**7117**	**27%**	**42%**	**25%**	**-1%**	**-5%**	**0%**
7	A48 east of Sycamore Cross	Eastbound	999	325	623	715	584	1282	701	205	239	-28%	80%	106%	-2%	-65%	-81%
		Westbound	384	310	505	1137	615	840	389	407	992	196%	98%	66%	-66%	-34%	18%
		Two-way	**1383**	**635**	**1128**	**1852**	**1199**	**2122**	**1090**	**612**	**1231**	**34%**	**89%**	**88%**	**-41%**	**-49%**	**-42%**
8	A48 west of Sycamore Cross	Eastbound	872	458	601	1047	564	673	1362	679	787	20%	23%	12%	30%	20%	17%
		Westbound	553	459	816	737	639	998	552	588	732	33%	39%	22%	-25%	-8%	-27%
		Two-way	**1425**	**917**	**1417**	**1784**	**1203**	**1671**	**1914**	**1267**	**1519**	**25%**	**31%**	**18%**	**7%**	**5%**	**-9%**
9	Five-mile Lane	Eastbound	397	215	398	797	521	1008	823	516	952	101%	142%	153%	3%	-1%	-6%
		Westbound	804	252	666	954	652	911	713	520	544	19%	159%	37%	-25%	-20%	-40%
		Two-way	**1201**	**467**	**1064**	**1751**	**1173**	**1919**	**1536**	**1036**	**1496**	**46%**	**151%**	**80%**	**-12%**	**-12%**	**-22%**

APPENDIX H

Local Authority Population Projections for South East Wales (2018 to 2043)

Local Authority Population Projections for South East Wales (2018 to 2043)

All People

Age (All ages) | Gender (Persons) | Variant (Principal projection) | Age | Gender | Area Code | Variant | Year

Area			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Wales			3,138,631	3,145,030	3,150,764	3,154,906	3,157,707	3,159,741	3,160,080	3,159,700	3,159,070	3,158,151	3,156,911	3,155,347	3,153,444	3,151,232	3,148,713	3,145,903	3,142,829	3,139,518	3,136,034	3,132,436	3,128,772	3,125,064	3,121,318	3,117,538	3,113,704	3,109,838
Wales	North Wales		698,369	698,614	698,755	698,645	698,287	697,721	696,756	695,580	694,336	693,004	691,628	690,200	688,724	687,228	685,739	684,277	682,850	681,382	679,935	678,506	677,128	675,763	674,369	672,999	671,627	670,284
Wales	Mid and South West Wales		907,434	908,224	908,922	909,212	909,155	908,950	908,394	907,750	907,077	906,368	905,599	904,765	903,824	902,787	901,650	900,409	899,075	897,647	896,158	894,659	893,140	891,641	890,139	888,675	887,250	885,865
Wales	South East Wales		1,532,828	1,538,192	1,543,087	1,547,049	1,550,265	1,553,070	1,554,929	1,556,370	1,557,657	1,558,779	1,559,684	1,560,382	1,560,896	1,561,217	1,561,324	1,561,217	1,560,905	1,560,489	1,559,942	1,559,271	1,558,504	1,557,660	1,556,810	1,555,864	1,554,827	1,553,689
Wales	South East Wales	Bridgend	144,876	145,549	146,169	146,740	147,257	147,712	148,073	148,362	148,625	148,862	149,084	149,261	149,375	149,467	149,566	149,653	149,749	149,807	149,874	149,934	149,997	150,043	150,077	150,099	150,105	150,099
Wales	South East Wales	Vale of Glamorgan	132,165	132,836	133,541	134,202	134,804	135,351	135,772	136,135	136,448	136,721	136,986	137,215	137,417	137,578	137,744	137,893	137,995	138,081	138,147	138,211	138,281	138,336	138,381	138,414	138,430	138,432
Wales	South East Wales	Cardiff	364,248	365,972	367,327	368,171	368,761	369,321	369,719	370,177	370,680	371,215	371,670	372,085	372,521	372,873	373,036	372,994	372,841	372,693	372,405	371,997	371,445	370,899	370,420	369,917	369,439	368,938
Wales	South East Wales	Rhondda Cynon Taf	240,131	240,787	241,398	241,903	242,300	242,651	242,858	242,994	243,116	243,203	243,256	243,287	243,289	243,271	243,246	243,213	243,174	243,129	243,085	243,035	242,983	242,916	242,852	242,774	242,680	242,570
Wales	South East Wales	Merthyr Tydfil	60,183	60,335	60,481	60,605	60,700	60,779	60,825	60,844	60,849	60,841	60,831	60,818	60,799	60,773	60,746	60,721	60,690	60,657	60,622	60,586	60,555	60,523	60,485	60,442	60,394	60,341
Wales	South East Wales	Caerphilly	181,019	181,186	181,334	181,416	181,421	181,367	181,224	181,011	180,775	180,510	180,226	179,922	179,612	179,307	179,004	178,709	178,415	178,110	177,822	177,536	177,258	176,976	176,688	176,392	176,086	175,775
Wales	South East Wales	Blaenau Gwent	69,713	69,623	69,535	69,441	69,327	69,197	69,029	68,832	68,639	68,446	68,252	68,056	67,863	67,677	67,491	67,312	67,139	66,968	66,805	66,641	66,484	66,328	66,170	66,013	65,852	65,687
Wales	South East Wales	Torfaen	93,049	93,257	93,464	93,638	93,782	93,900	93,943	93,950	93,954	93,949	93,933	93,907	93,869	93,830	93,786	93,747	93,707	93,659	93,607	93,555	93,509	93,457	93,393	93,322	93,243	93,160
Wales	South East Wales	Monmouthshire	94,142	94,259	94,386	94,506	94,579	94,615	94,598	94,539	94,447	94,366	94,273	94,185	94,080	93,975	93,866	93,777	93,675	93,558	93,444	93,344	93,254	93,158	93,048	92,937	92,816	92,697
Wales	South East Wales	Newport	153,302	154,387	155,451	156,427	157,334	158,177	158,888	159,525	160,125	160,664	161,172	161,646	162,072	162,466	162,839	163,200	163,520	163,827	164,130	164,433	164,737	165,023	165,296	165,554	165,782	165,990

Local Authority Population Projections for South East Wales (2018 to 2043)

Aged 15 and Under

Age (Aged 15 and under) | Gender (Persons) | Variant (Principal projection) | Age | Gender | Area Code | Variant | Year

Area			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Wales			562,709	562,255	561,808	559,991	556,583	552,515	546,950	541,831	536,184	530,045	524,378	519,892	516,043	512,564	509,345	507,316	506,374	506,775	506,672	506,778	507,102	507,578	507,976	508,366	508,700	508,958
Wales	North Wales		124,182	124,033	123,778	123,109	122,022	120,763	119,241	117,810	116,185	114,630	113,247	112,071	111,116	110,390	109,704	109,196	108,927	108,958	108,884	108,860	108,885	108,945	108,993	109,041	109,078	109,100
Wales	Mid and South West Wales		153,744	153,464	153,106	152,464	151,548	150,464	148,889	147,651	146,188	144,478	142,849	141,663	140,689	139,736	138,893	138,364	138,053	138,128	138,067	138,063	138,124	138,230	138,314	138,397	138,464	138,512
Wales	South East Wales		284,783	284,758	284,924	284,417	283,013	281,289	278,820	276,370	273,812	270,938	268,282	266,158	264,239	262,438	260,748	259,756	259,394	259,688	259,721	259,855	260,093	260,402	260,669	260,928	261,158	261,346
Wales	South East Wales	Bridgend	26,109	26,226	26,296	26,323	26,260	26,195	26,086	26,008	25,872	25,570	25,298	25,109	24,869	24,747	24,570	24,459	24,385	24,367	24,326	24,300	24,289	24,289	24,292	24,299	24,308	24,319
Wales	South East Wales	Vale of Glamorgan	24,451	24,580	24,708	24,722	24,750	24,662	24,492	24,376	24,213	24,096	23,917	23,843	23,757	23,627	23,552	23,450	23,425	23,458	23,465	23,476	23,495	23,518	23,538	23,560	23,583	23,606
Wales	South East Wales	Cardiff	67,425	67,310	67,277	67,150	66,647	66,038	65,373	64,732	64,105	63,316	62,584	62,081	61,632	61,252	60,886	60,784	60,854	61,069	61,221	61,383	61,552	61,720	61,860	61,982	62,083	62,159
Wales	South East Wales	Rhondda Cynon Taf	44,855	44,716	44,690	44,464	44,120	43,844	43,430	42,923	42,483	41,979	41,522	41,174	40,874	40,629	40,375	40,271	40,240	40,318	40,353	40,400	40,464	40,536	40,601	40,661	40,711	40,750
Wales	South East Wales	Merthyr Tydfil	11,553	11,574	11,647	11,683	11,665	11,602	11,475	11,376	11,298	11,183	11,052	10,940	10,862	10,721	10,622	10,549	10,500	10,490	10,475	10,471	10,476	10,488	10,501	10,515	10,529	10,543
Wales	South East Wales	Caerphilly	34,079	33,816	33,551	33,362	33,053	32,723	32,249	31,828	31,318	30,936	30,608	30,321	30,039	29,769	29,520	29,370	29,269	29,252	29,208	29,178	29,165	29,163	29,159	29,156	29,149	29,138
Wales	South East Wales	Blaenau Gwent	12,189	12,180	12,164	12,100	11,943	11,846	11,704	11,548	11,359	11,196	11,088	10,937	10,801	10,687	10,593	10,544	10,474	10,440	10,397	10,362	10,334	10,311	10,290	10,271	10,253	10,234
Wales	South East Wales	Torfaen	17,250	17,293	17,359	17,262	17,135	17,039	16,915	16,763	16,576	16,392	16,236	16,079	15,942	15,854	15,740	15,644	15,604	15,603	15,586	15,576	15,574	15,579	15,583	15,586	15,589	15,590
Wales	South East Wales	Monmouthshire	15,462	15,359	15,246	15,153	15,064	14,854	14,708	14,515	14,370	14,195	14,060	13,912	13,827	13,722	13,631	13,543	13,533	13,542	13,536	13,534	13,536	13,542	13,544	13,549	13,555	13,560
Wales	South East Wales	Newport	31,410	31,706	31,986	32,199	32,375	32,487	32,387	32,302	32,219	32,076	31,917	31,762	31,635	31,431	31,260	31,142	31,112	31,148	31,155	31,176	31,211	31,256	31,301	31,349	31,398	31,448

Local Authority Population Projections for South East Wales (2020 to 2043)

Aged 16 to 64

Age (Aged 16 to 64) | Gender (Persons) | Variant (Principal projection)

Area			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Wales			1,923,929	1,921,393	1,920,412	1,918,805	1,916,448	1,913,511	1,910,365	1,906,169	1,901,389	1,896,052	1,890,308	1,882,394	1,874,057	1,866,793	1,859,406	1,852,001	1,843,278	1,835,119	1,826,436	1,819,738	1,815,390	1,813,152	1,812,169	1,812,363	1,812,899	1,813,529
	North Wales		413,300	411,464	410,375	409,193	408,106	406,914	405,465	403,705	401,911	399,900	397,609	394,848	391,977	389,302	386,764	384,444	381,807	379,296	376,668	374,572	373,160	372,395	371,943	371,797	371,817	371,870
	Mid and South West Wales		546,000	544,126	542,716	541,187	539,407	537,439	535,762	533,751	531,722	529,571	527,277	524,425	521,316	518,770	516,259	513,743	510,951	508,426	505,672	503,523	502,052	501,258	500,753	500,711	500,867	501,022
	South East Wales		964,629	965,803	967,320	968,425	968,935	969,157	969,138	968,713	967,755	966,581	965,422	963,121	960,764	958,721	956,383	953,814	950,520	947,397	944,096	941,643	940,178	939,500	939,472	939,854	940,215	940,638
		Bridgend	89,388	89,483	89,652	89,785	89,939	89,971	89,935	89,772	89,581	89,520	89,449	89,229	89,008	88,713	88,492	88,227	88,009	87,734	87,438	87,206	87,121	87,111	87,156	87,258	87,395	87,528
		Vale of Glamorgan	80,023	79,998	80,040	80,169	80,220	80,345	80,400	80,300	80,227	80,030	79,958	79,731	79,518	79,470	79,288	79,161	79,004	78,819	78,573	78,400	78,355	78,390	78,453	78,539	78,652	78,748
		Cardiff	245,484	246,578	247,350	247,736	248,003	248,407	248,607	248,954	249,173	249,581	249,935	249,961	250,049	250,112	249,964	249,569	248,846	248,086	247,307	246,553	245,797	245,097	244,585	244,196	243,817	243,529
		Rhondda Cynon Taf	149,282	149,593	149,812	150,150	150,372	150,330	150,435	150,574	150,504	150,360	150,296	149,903	149,526	149,174	148,794	148,388	147,891	147,409	146,850	146,467	146,289	146,297	146,428	146,636	146,815	147,024
		Merthyr Tydfil	37,406	37,375	37,344	37,317	37,309	37,221	37,223	37,116	37,001	36,865	36,814	36,691	36,606	36,534	36,448	36,351	36,244	36,162	36,052	35,964	35,955	35,977	35,995	36,040	36,067	36,088
		Caerphilly	111,948	111,785	111,832	111,606	111,365	111,168	111,025	110,772	110,485	110,080	109,612	108,975	108,378	107,879	107,369	106,792	106,124	105,584	105,069	104,623	104,294	104,148	104,093	104,063	104,016	103,929
		Blaenau Gwent	43,592	43,377	43,278	43,159	43,054	42,916	42,707	42,502	42,349	42,086	41,767	41,522	41,281	40,986	40,666	40,357	40,049	39,765	39,526	39,341	39,232	39,132	39,099	39,068	39,061	39,044
		Torfaen	56,826	56,665	56,610	56,655	56,693	56,584	56,446	56,347	56,189	56,013	55,815	55,654	55,388	55,159	54,984	54,836	54,565	54,373	54,178	54,091	54,037	54,039	54,087	54,169	54,203	54,276
		Monmouthshire	55,256	54,993	54,808	54,676	54,399	54,261	54,049	53,793	53,435	53,017	52,591	52,157	51,656	51,230	50,866	50,556	50,249	49,944	49,636	49,444	49,342	49,337	49,332	49,394	49,458	49,537
		Newport	95,424	95,957	96,594	97,174	97,581	97,952	98,312	98,583	98,811	99,028	99,184	99,297	99,353	99,463	99,512	99,578	99,539	99,521	99,466	99,554	99,756	99,972	100,245	100,490	100,731	100,936

Local Authority Population Projections for South East Wales (2020 to 2043)

Aged 65 and over

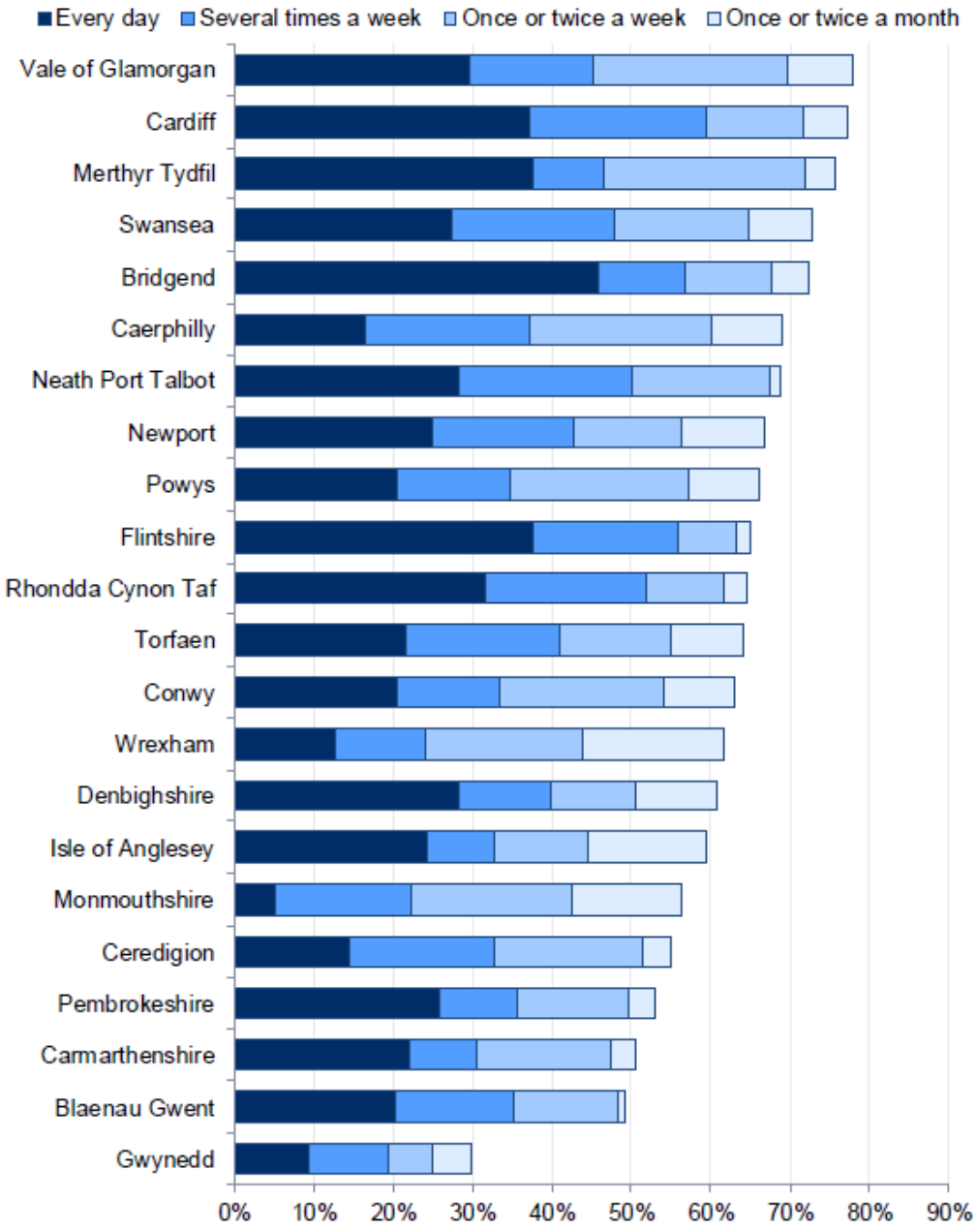
Age (Aged 65 and over) | Gender (Persons) | Variant (Principal projection)

Area			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Wales			651,993	661,382	668,544	676,110	684,676	693,715	702,765	711,700	721,497	732,054	742,225	753,061	763,344	771,875	779,962	786,586	793,177	797,624	802,926	805,920	806,280	804,334	801,173	796,809	792,105	787,351
	North Wales		160,887	163,117	164,602	166,343	168,159	170,043	172,051	174,065	176,240	178,475	180,773	183,281	185,631	187,536	189,271	190,638	192,116	193,127	194,382	195,074	195,083	194,423	193,433	192,161	190,732	189,315
	Mid and South West Wales		207,690	210,635	213,099	215,560	218,200	221,047	223,743	226,349	229,167	232,319	235,473	238,677	241,819	244,281	246,498	248,301	250,070	251,093	252,419	253,073	252,965	252,153	251,072	249,567	247,919	246,332
	South East Wales		283,416	287,630	290,843	294,207	298,317	302,625	306,971	311,287	316,090	321,261	325,979	331,103	335,894	340,058	344,192	347,647	350,991	353,404	356,125	357,772	358,233	357,758	356,669	355,081	353,453	351,705
		Bridgend	29,379	29,841	30,220	30,633	31,058	31,545	32,052	32,583	33,172	33,772	34,338	34,923	35,497	36,007	36,504	36,968	37,356	37,706	38,109	38,428	38,587	38,643	38,629	38,542	38,402	38,252
		Vale of Glamorgan	27,691	28,258	28,793	29,311	29,835	30,345	30,881	31,459	32,008	32,595	33,111	33,641	34,143	34,481	34,904	35,282	35,566	35,803	36,110	36,334	36,431	36,428	36,390	36,315	36,195	36,078
		Cardiff	51,339	52,084	52,701	53,285	54,111	54,877	55,739	56,491	57,402	58,318	59,150	60,043	60,840	61,509	62,186	62,641	63,142	63,538	63,877	64,062	64,097	64,083	63,976	63,739	63,539	63,250
		Rhondda Cynon Taf	45,994	46,478	46,896	47,289	47,809	48,477	48,993	49,497	50,129	50,864	51,437	52,210	52,889	53,468	54,077	54,555	55,043	55,402	55,883	56,167	56,230	56,084	55,823	55,477	55,154	54,796
		Merthyr Tydfil	11,224	11,387	11,490	11,606	11,726	11,957	12,127	12,352	12,551	12,794	12,965	13,186	13,331	13,518	13,676	13,820	13,946	14,005	14,095	14,151	14,125	14,058	13,989	13,887	13,798	13,710
		Caerphilly	34,992	35,585	35,952	36,449	37,003	37,476	37,950	38,411	38,972	39,494	40,007	40,625	41,194	41,659	42,115	42,546	43,022	43,274	43,545	43,734	43,800	43,665	43,436	43,174	42,922	42,709
		Blaenau Gwent	13,932	14,067	14,093	14,181	14,330	14,435	14,617	14,782	14,930	15,165	15,398	15,597	15,781	16,003	16,233	16,411	16,617	16,763	16,881	16,938	16,918	16,885	16,780	16,674	16,538	16,409
		Torfaen	18,973	19,299	19,495	19,722	19,953	20,276	20,582	20,840	21,190	21,545	21,881	22,175	22,539	22,818	23,062	23,266	23,539	23,683	23,843	23,889	23,898	23,839	23,723	23,567	23,451	23,294
		Monmouthshire	23,424	23,907	24,332	24,677	25,116	25,500	25,841	26,231	26,642	27,154	27,622	28,116	28,597	29,023	29,369	29,678	29,893	30,072	30,272	30,366	30,377	30,280	30,172	29,994	29,804	29,600
		Newport	26,468	26,725	26,871	27,054	27,377	27,738	28,190	28,640	29,095	29,560	30,071	30,587	31,083	31,572	32,067	32,480	32,868	33,157	33,509	33,703	33,770	33,795	33,751	33,715	33,652	33,606

APPENDIX I

Vale of Glamorgan Active Travel by Walking by Local Authority

Chart 10: Active travel by walking, by local authority (r[2])

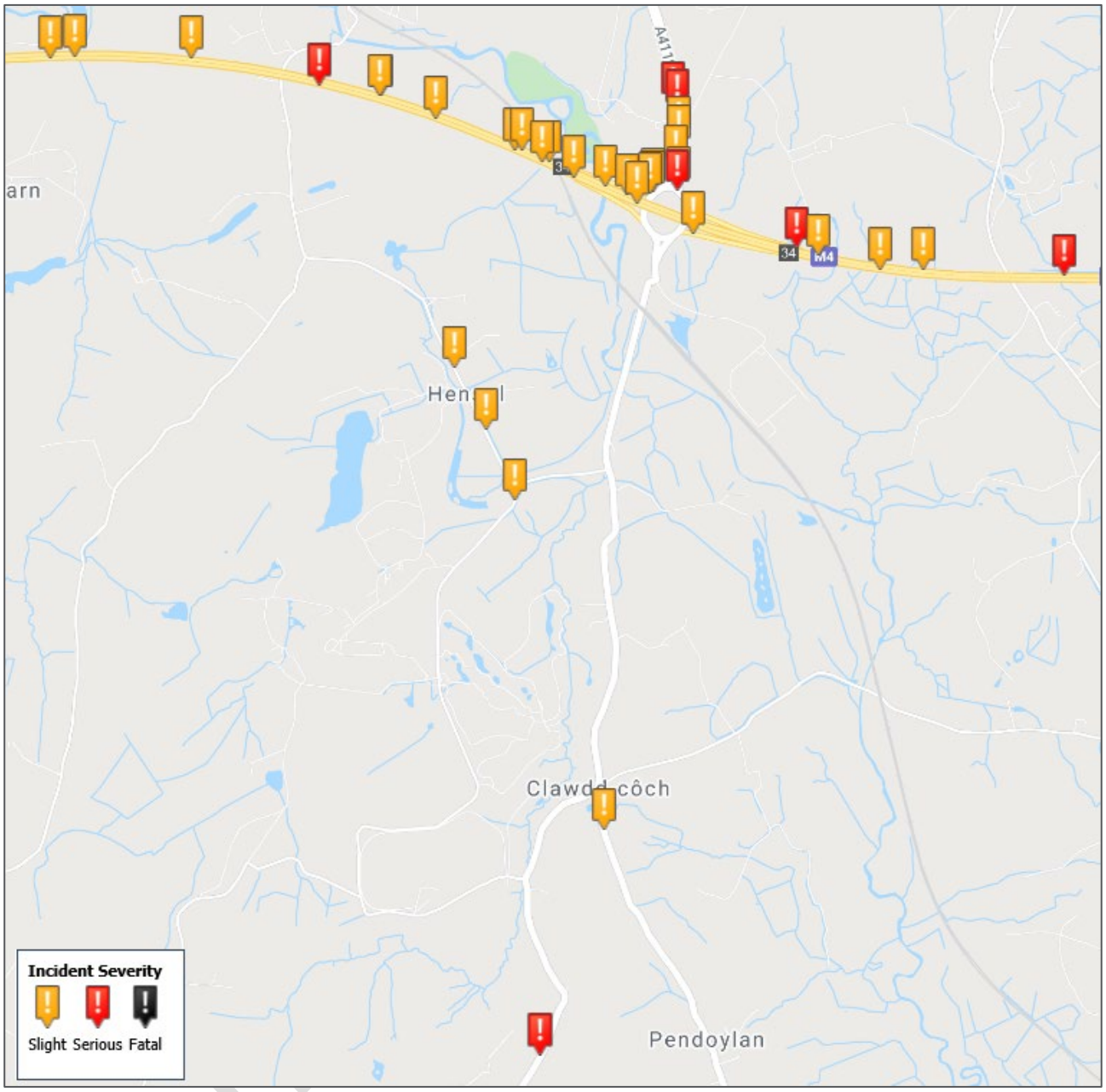


[2] (r) – This bulletin was originally published on 11/12/18. Data presented in Chart 10 were found to be incorrect due to a processing error and the bulletin was re-published with corrected data on 13/12/18.

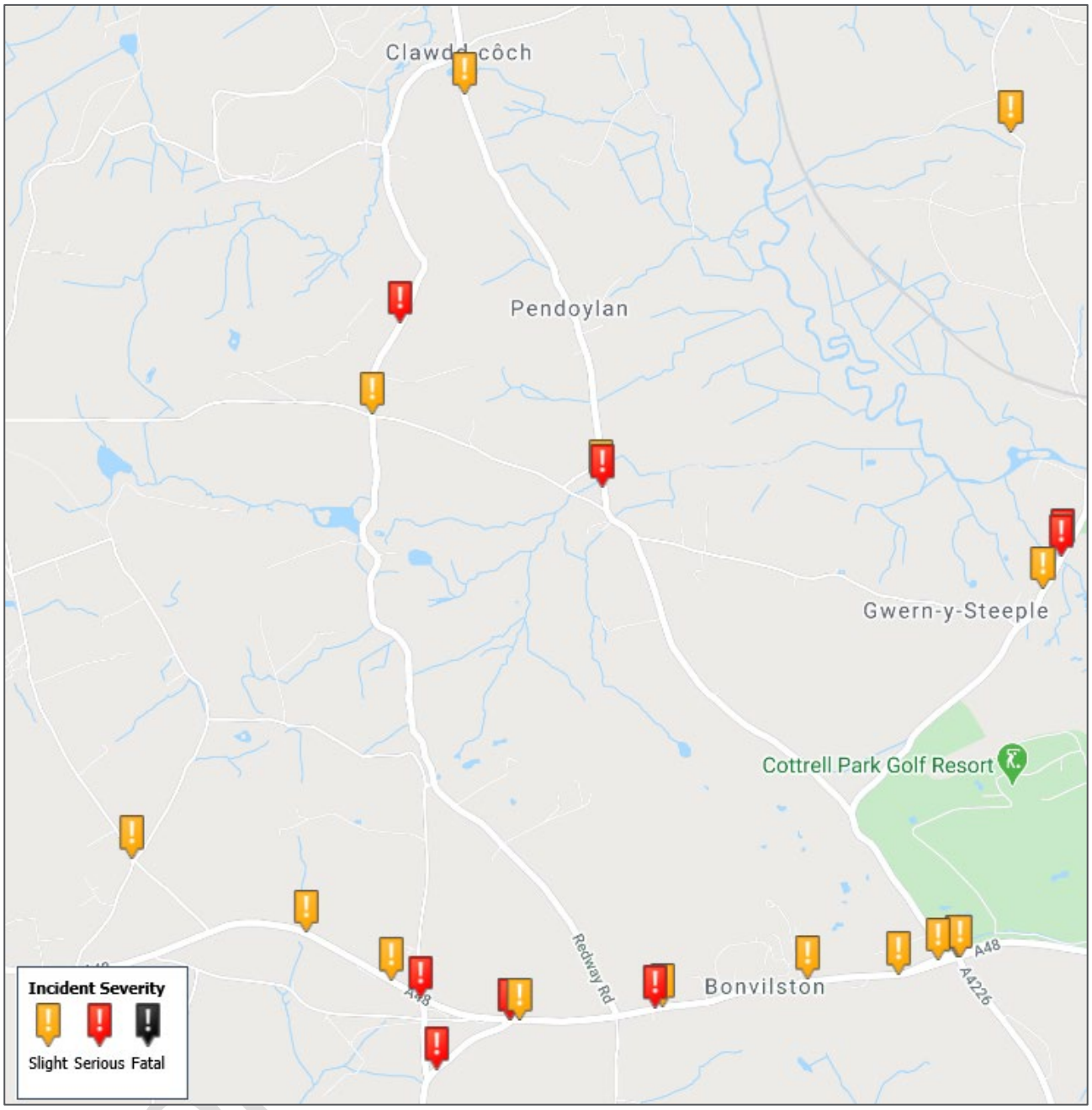
*https://gov.wales/sites/default/files/statistics-and-research/2018-12/active-travel-financial-year-2017-to-2018_*

APPENDIX J

Accidents by Severity within the Appraisal Area (2014-18)



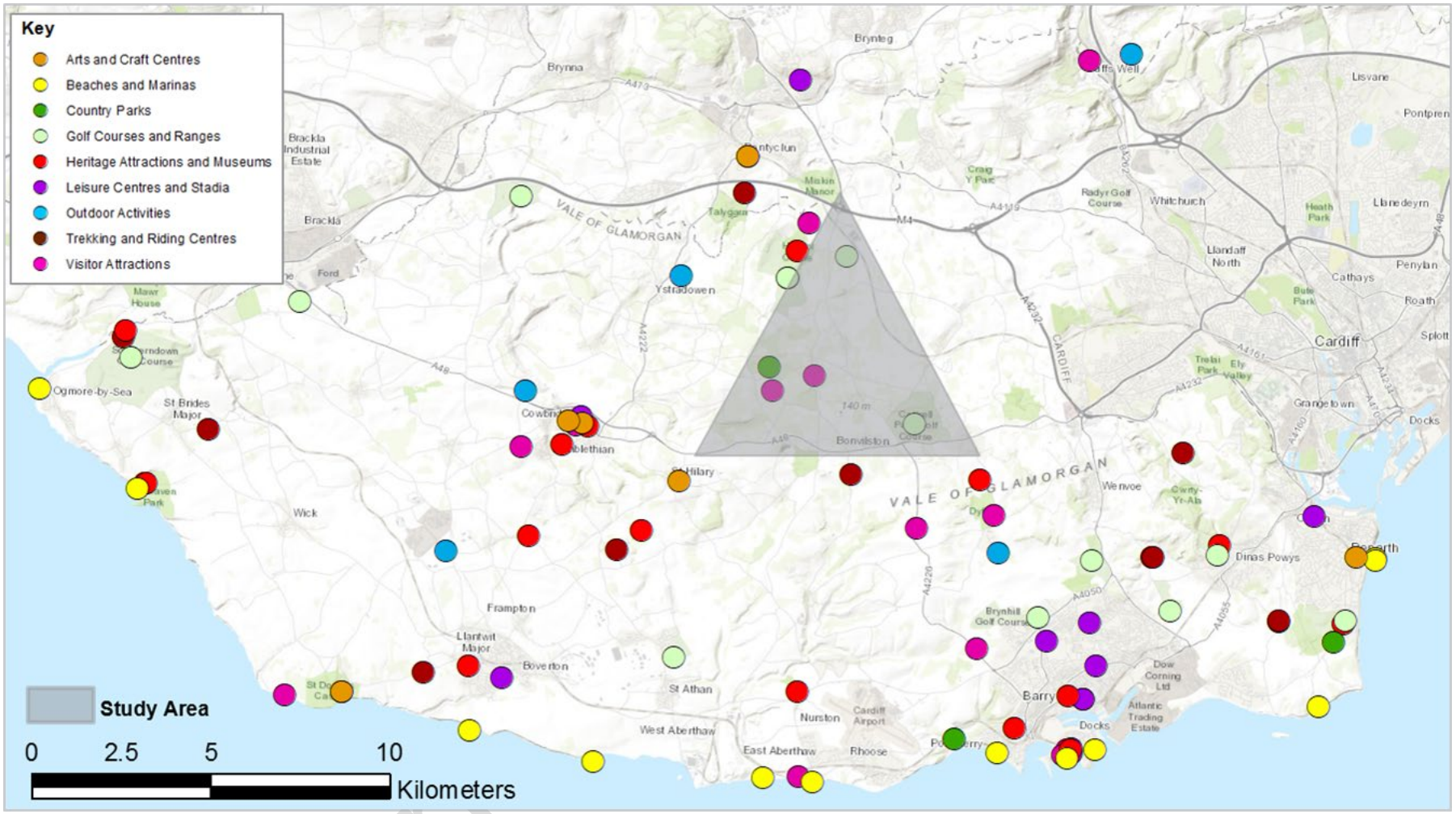
https://www.crashmap.co.uk



https://www.crashmap.co.uk

APPENDIX K

Vale of Glamorgan Cultural Facilities


Key
Arts and Craft Centres
Beaches and Marinas
Country Parks
Golf Courses and Ranges
Heritage Attractions and Museums
Leisure Centres and Stadia
Outdoor Activities
Trekking and Riding Centres
Visitor Attractions
Study Area
0
2.5
5
10
Kilometers
VALE OF GLAMORGAN
Brynna
Brynteg
Brackla Industrial Estate
Brackla
Ystradowen
Talygarn
Miskin Manor
Craig Y Parc
Radyr Golf Course
Whitchurch
Llisvane
Pontprennau
Llanedeyrn
Heath Park
Llandaff North
Cathays
Penylan
Roath
Splott
Cardiff
Bute Park
Trelai Park
Ely Valley
Grangetown
Docks
Ogmore-by-Sea
St Brides Major
Wick
Cowbridge
Bonvilston
St Hilary
Wenvoe
Cwrt-Yr-Ala
Dinas Powys
Penarth
Frampton
Llantwit Major
Boverton
St Athan
West Aberthaw
East Aberthaw
Rhoose
Nurston
Cardiff Airport
Barry
Dow Corning Ltd
Atlantic Trading Estate
Brynhill Golf Course
A48
A4222
A4232
A4119
A4050
A4055
A4226
M4
CARDIFF

APPENDIX L

WelTAG Stage Two | Preliminary Ecological Appraisal Report

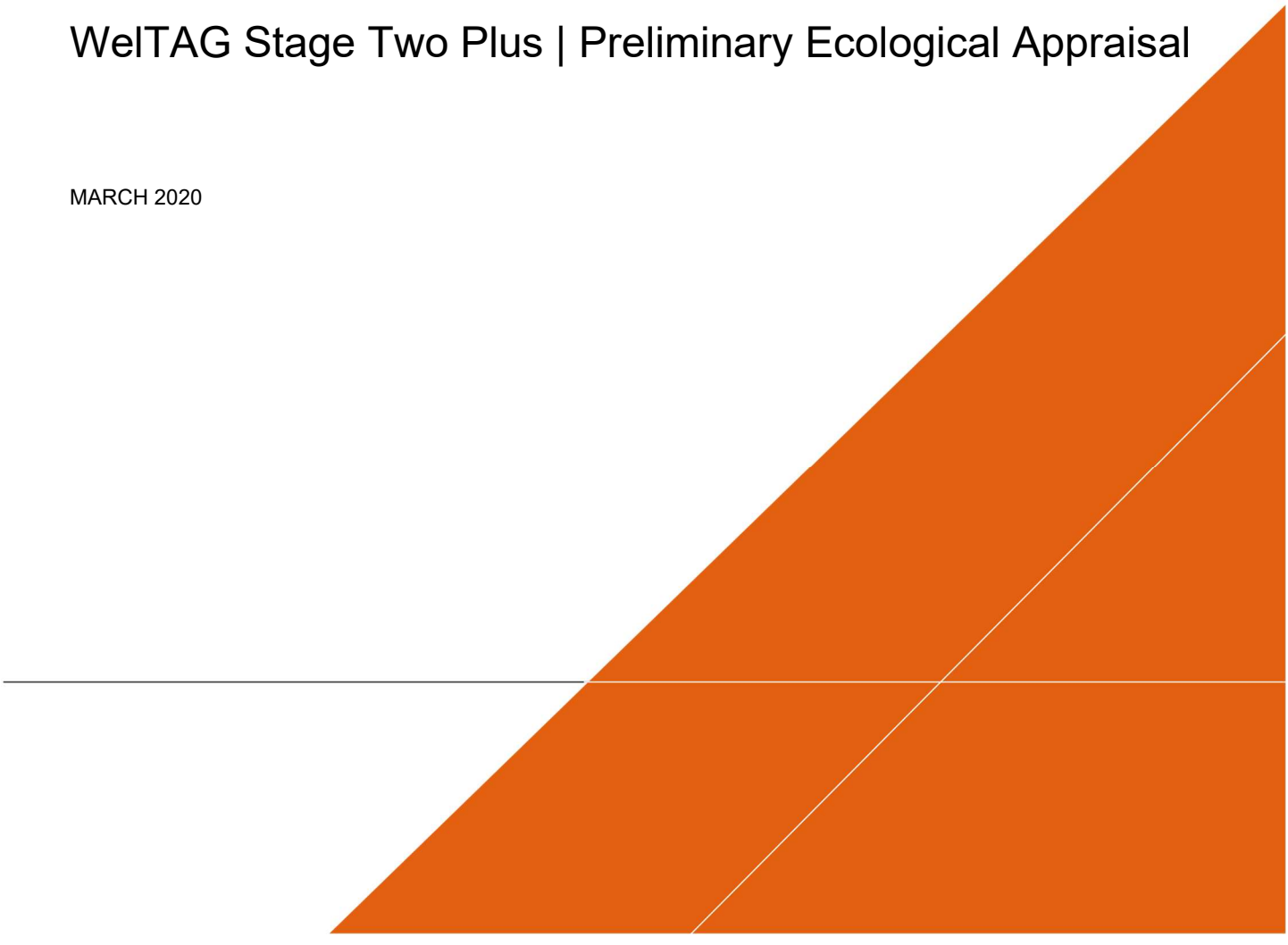
ARCADIS Design & Consultancy for natural and built assets

IMPROVING STRATEGIC TRANSPORT ENCOMPASSING CORRIDORS FROM M4 JUNCTION 34 TO THE A48 | HIGHWAY LINK STUDY

VALE OF GLAMORGAN GATEWAY STATION

WelTAG Stage Two Plus | Preliminary Ecological Appraisal

MARCH 2020



Improving Strategic Transport Encompassing Corridors from M4 Junction 34 to the A48 | Highway Link Study

Vale of Glamorgan Gateway Station

WelTAG Stage Two Plus | Preliminary Ecological Appraisal

Author	MJ
Checker	SH
Approver	SS
Report No	10028657-ARC-XX-XX-RP-EA-0001
Date	MARCH 2020

VERSION CONTROL

Version	Date	Author	Changes
P01	08/11/2019	MJ	First draft
P02	16/03/2020	MJ	Updated following project review

This report dated 16 March 2020 has been prepared for Vale of Glamorgan Council (the 'Client') in accordance with the terms and conditions of appointment dated 19 December 2018 (the 'Appointment') between the Client and Arcadis Consulting (UK) Limited ('Arcadis') for the purposes specified in the Appointment. For avoidance of doubt, no other person(s) may use or rely upon this report or its contents, and Arcadis accepts no responsibility for any such use or reliance thereon by any other third party.

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Executive Summary

Arcadis Consulting (UK) ('Arcadis') Limited has been commissioned by the Vale of Glamorgan Council to develop and appraise potential options for improving the strategic transport network encompassing corridors from M4 Junction 34 to the A48 (Five Mile Lane), including the Pendoylan Corridor (or alternative). The appraisal of options has been undertaken in accordance with the Welsh Government's latest version of WelTAG (December 2017) including advice on the appraisal in relation to the Future Generations of Wales (2015) Act Well-being Goals.

The WelTAG Stage Two Plus options subject to appraisal are as follows:

- M4 Junction 34 to A48 Highway Route East of Pendoylan
- M4 Junction 34 to A48 Highway Route West of Pendoylan
- Vale of Glamorgan Gateway Station (formerly Parkway Station) with Park and Ride facility and bus integration near to the M4 Junction 34

Arcadis has subsequently been instructed to undertake an ecological assessment of the proposed WelTAG Stage Two Plus options. This report presents the findings of the Preliminary Ecological Appraisal (PEA) and has been prepared to identify ecological constraints and opportunities in order to inform the option appraisal process.

Following further recommendations made by the Vale of Glamorgan Council Environment and Regeneration Committee and Cabinet, the WelTAG Stage Two Plus study is now considering the following four highway options, in comparison to the Do Minimum without a highway link improvement:

- **M4 Junction 34 to A48 | Option A – Highway Route East of Pendoylan**
- **M4 Junction 34 to A48 | Option B – Highway Route West of Pendoylan**
- **M4 Junction 34 to A48 | Option C1 – Existing Infrastructure (Online) Enhancement**
- **M4 Junction 34 to A48 | Option C2 – Existing Infrastructure (Online) Enhancement**

This report has focussed on the two online options in line with the original commission. However, as the online route is fully encompassed within the study area, this report has been used to complete the WelTAG Stage Two Plus assessment and supporting WebTAG appraisals for biodiversity which can be referenced separately.

To facilitate completion of the ecological assessment, the two highway alignment options have been separated into four sub-sections (Sub-Sections 1 – 4). Sub-Sections 1 and 4 are those located on the northern and southern extents of the scheme, respectively and are common to both of the highway alignment options. Sub-Section 2 is the highway alignment option routed east of Pendoylan and Sub-Section 3 is the option routed west of Pendoylan. The proposed Vale of Glamorgan Gateway Station is referred to as Sub-Section 5.

It should be noted that in agreement with Welsh Government, a decision has been made by the Vale of Glamorgan Council to separate the WelTAG assessment of the Vale of Glamorgan Gateway Station option from the M4 Junction 34 to A48 highway link options, although for the purposes of this WelTAG Stage Two Plus PEA, all ecological information has been retained within the same report.

As part of the PEA, a desk study and an extended Phase 1 habitat survey were undertaken to identify existing ecological information and to map the habitats present within proximity of the proposed highway alignment options and new railway station.

The desk study and extended Phase 1 habitat survey confirmed the presence, within the study area, of sites designated for nature conservation value and Priority Habitats as listed within Section 7 of the Environment Act (Wales) 2016. The designated sites and Priority Habitats identified within the study area include:

- Ely Valley SSSI
- Coed Ffos-Ceibr SINC
- Land West of Hensol Mill SINC
- Coed Waunn-Lloff SINC

- Land West of Llanfarach Farm SINC
- South West of Castell Bach SINC
- Land South West of Llanfarach Farm SINC
- Coed Cadw SINC
- Land at Pendoylan Moors SINC
- Coed Ffos-Ceibr SINC
- North of Pendoylan Moors SINC
- Log Wood SINC
- Coed Counsellor SINC
- Ancient Woodland (ASNW/RAWS/PAW)
- TPOs
- Wet Woodland
- River Ely
- Ponds
- Native Species-rich Hedges

The extended Phase 1 habitat survey confirmed the presence of the following Priority Species:

- Violet Oil Beetle (*Meloe violaceus*)
- Cinnabar Moth (*Tyria jacobaeae*)
- Brown Hare (*Lepus europaeus*)
- Hedgehog (*Erinaceus europaeus*)

The two offline highway alignment options feature many of the same important ecological features and, from what can be determined from the currently available data, are similar in ecological value. However, the proposed eastern highway alignment appears to have the greater ecological impact due to the slightly higher number of SINCs, larger area of species-rich Marshy grassland (likely to be classed as a Priority Habitat) and greater number of hedgerows that would be impacted in comparison to the western highway alignment.

Due to the presence of suitable habitat, there is the potential that other Protected and Priority Species may also be present within the study area. Further ecological surveys are required at the next stage to fully establish baseline conditions within the study area, allowing for the accurate assessment of impacts and the design of an appropriate mitigation strategy for the scheme.

1 Introduction and Aims

1.1 Background

1.1.1 Arcadis has been commissioned by the Vale of Glamorgan Council to develop and appraise potential options for improving the strategic transport network encompassing corridors from M4 Junction 34 to the A48 (Five Mile Lane), including the Pendoylan Corridor (or alternative). The appraisal of options has been undertaken in accordance with the Welsh Government's latest version of WelTAG (December 2017) including advice on the appraisal in relation to the Future Generations of Wales (2015) Act Well-being Goals.

1.1.2 This report presents the findings of the Preliminary Ecological Appraisal (PEA) to support the WelTAG Stage Two Plus appraisal and has been prepared to identify ecological constraints and opportunities in order to inform the option appraisal process.

1.2 Context | WelTAG Stage Two Report (October 2018)

1.2.1 A draft WelTAG Stage Two report was prepared by Arcadis and presented to the project Review Group on 2nd October 2018 (10013270-ARC-XX-XX-RP-TP-0001-D03). The report appraised the following three options:

- M4 Junction 34 to A48 Highway Route East of Pendoylan
- M4 Junction 34 to A48 Highway Route West of Pendoylan
- Vale of Glamorgan Gateway Station (formerly Parkway Station) with Park and Ride facility and bus integration near to the M4 Junction 34

1.2.2 In relation to ecology, the desk study and ground truthing exercise from public rights of way showed that:

- Route options cross the Ely Valley Site of Special Scientific Interest (SSSI).
- Route options cross Sites of Importance for Nature Conservation (SINCs) (three on the west alignment and four on the east alignment).
- Route options crossed agricultural land, mainly grazed pasture but some fields were identified that supported rush (*Juncus* sp.) species; some potential for the priority habitat marshy grassland/ rhos pasture to be present.
- Route options crossed hedgerow boundaries, some of which were species-rich and may be considered 'important' under the Hedgerow Regulations.
- Route options crossed small drainage ditches, often associated with hedgerows, and small watercourses as well as the River Ely.
- Route options pass through areas of woodland, four of which are designated as ancient woodland.

1.2.3 The desk-based report supported development of two highway route options either side of Pendoylan village and identified that priority habitats are present along the route options and that there is potential for a variety of protected and priority species to be present, which could be affected by the route proposals. It was anticipated that the majority of impacts could be mitigated through standard techniques in accordance with the relevant best practice guidelines. However, both of the routes were considered to have at least a moderate adverse impact on biodiversity due to the loss and damage of ancient woodland.

1.2.4 Following consideration of the initial WelTAG Stage Two report, several recommendations were agreed by the Review Group for completion at Stage Two including a programme of early stage environmental surveys and investigations (to include completion of a PEA), more detailed development of the highway link concept designs and completion of Vale of Glamorgan Gateway Station GRIP Stage 1 and GRIP Stage 2 studies. The proposals for additional Stage Two assessment (referred to as Stage Two Plus) were considered and agreed by the Vale of Glamorgan

Council Environment and Regeneration Scrutiny Committee and Vale of Glamorgan Council Cabinet over several meetings.

1.2.5 **Following further recommendations made by the Vale of Glamorgan Council Environment and Regeneration Committee and Cabinet, the WelTAG Stage Two Plus study is now considering the following four highway options, in comparison to the Do Minimum without a highway link improvement:**

- **M4 Junction 34 to A48 | Option A – Highway Route East of Pendoylan**
- **M4 Junction 34 to A48 | Option B – Highway Route West of Pendoylan**
- **M4 Junction 34 to A48 | Option C1 – Existing Infrastructure (Online) Enhancement**
- **M4 Junction 34 to A48 | Option C2 – Existing Infrastructure (Online) Enhancement**

1.2.6 **This report has focussed on the two online options in line with the original commission. However, as the online route is fully encompassed within the study area, this report has been used to complete the WelTAG Stage Two Plus assessment and supporting WebTAG appraisals for biodiversity which can be referenced separately.**

1.3 Scheme Location

1.3.1 The proposed scheme originates in the north at M4 Junction 34 and heads south to the A48 Junction (Sycamore Cross). The two highway alignment options share a common alignment at the northern and southern extents of the scheme but deviate to the east and west around the village of Pendoylan.

1.3.2 For the purposes of this appraisal, the two highway alignment options have been separated into four sub-sections (**Sub-Sections 1 – 4**). Sub-Sections 1 and 4 are those located on the northern and southern extents of the scheme, respectively and are common to both highway alignment options. Sub-Section 2 encompasses the highway alignment option routed east of Pendoylan and Sub-Section 3 encompasses the option routed west of Pendoylan. The proposed Vale of Glamorgan Gateway Station, located south-east of M4 Junction 34, is referred to as **Sub-Section 5**.

1.3.3 The ecological features of importance to the proposed scheme will be discussed per individual sub-section. Each sub-section comprises the following.

- The **study area**, which refers to the proposed highway alignment options and railway station, plus a buffer around the alignment options (250m radius for the highway alignment options in Sub-Sections 1-4, and 500m radius around the railway station in Sub-Section 5).
- The **2km search area**, which refers to the proposed highway alignment options and railway station, plus a 2km buffer around the alignment options, within which relevant ecological data was collated and reviewed.

1.3.4 Drawing 10028657-ARC-XX-XX-DR-EA-0039-P1 shows the location of the proposed scheme (including both highway alignment options and the new railway station), the extent of each of the five Sub-Sections and the 250m or 500m radius study areas.

1.3.5 Drawing 10028657-ARC-XX-XX-DR-EC-0057-P1 shows the 2km search area around the proposed highway alignment options and new railway station, including the location of records for protected and notable flora and fauna.

1.4 Planning Policy and Legislation

1.4.1 Appendix A includes relevant ecological planning and legislation for the study areas.

2 Methodology

2.1 Desk Study

2.1.1 A desk study was undertaken in order to identify any existing ecological information relating to the study area (as defined in Section 1.3 of this report) and its surroundings. The Multi-Agency Geographic Information for the Countryside (MAGIC) website (Ref 3) was used to search for statutory designated nature conservation sites within the 2km search area (as defined in Section 1.3 of this report); the search area was extended to 10km for Special Areas of Conservation (SAC) designated for bats.

2.1.2 The South-East Wales Biodiversity Records Centre (SEWBReC) was consulted in February 2019 to request records of local nature conservation sites and of protected/ notable habitats and species within the 2km search area. This included a request for records of Priority Habitats and Priority Species, as listed within Section 7 of the Environment (Wales) Act 2016 (Ref 4).

2.1.3 The Natural Resources Wales (NRW) Ancient Woodland Inventory Map (Ref 5) was reviewed in February 2019 in order to identify areas of ancient woodland, including Ancient Semi-Natural Woodland (ASNW), Restored Ancient Woodland Sites (RAWS) and Plantation on Ancient Woodland Sites (PAWS), within the 2km search area.

2.1.4 The Vale of Glamorgan GIS data set was searched for Tree Preservation Orders (TPOs) within the 2km search area.

2.1.5 A review of the following documents was undertaken:

- Cardiff International Airport and Culverhouse Cross Access Improvements WelTAG Appraisal Report Stage 1 (Ref 1).
- Corridors from M4 Junction 34 to the A48: WelTAG Stage Two Outline Business Case (Ref 2).
- Enid Evans and Family Planning Application (2018/00155/FUL) with particular reference to the Preliminary Ecological Appraisal (Ref 6).
- Land at Sycamore Cross Planning Application (2015/00960/FUL) with particular reference to the Environment Statement and Addendum (Ref 7).

2.2 Field Survey

2.2.1 The field survey was undertaken by Arcadis Senior Ecologist Marielle James with support from Arcadis Graduate Ecologists Maico Weites, Kailey O'Brien and Joe D'Souza.

2.2.2 Marielle James is a full member of the Chartered Institute of Water and Environmental Management and holds Natural England personal survey licences for bats, dormouse and great crested newts. Marielle has six years professional experience within the environmental sector, during which she has developed excellent botanical and protected species survey skills. Marielle has worked on a wide range of large infrastructure projects and been the lead surveyor for numerous extended Phase 1 habitat surveys.

2.2.3 The field survey comprised an extended Phase 1 habitat survey of the study area and was undertaken between 15th and 26th July 2019. Throughout the duration of the survey, the weather conditions were generally warm, calm, sunny and dry.

2.2.4 The survey comprised a walkover survey to map habitats present within the proposed development site following the methodology detailed within the Handbook for Phase 1 Habitat Survey: A Technique for Environmental Audit (Ref 8). Dominant plant species were noted, as were any uncommon species or species indicative of particular habitat types, but there was no attempt to compile exhaustive species lists. Botanical names for higher plants are written in accordance with the New Flora of the British Isles (4th Ed) by Stace (Ref 9). Professional judgement was used to categorise the relative abundance of species or difference habitat types present in accordance with the DAFOR scale, as follows:

- **D**ominant: species/ habitat is present in three quarters of the habitat/ survey area.
- **A**bundant: very commonly represented.
- **F**requent: found in several places.
- **O**ccasional: found in several places; but on a smaller scale.
- **R**are: a small number of a given species/ habitats occurs within the study area.

2.2.5 Habitats were assessed for their potential to support protected/ notable species of fauna and observation was made of any incidental signs of protected/ notable species. Habitats were assessed with cognisance of the results of the desk study environmental records search, the ecology of fauna with potential to be present within the study area, and of industry standard species/ species group survey methodologies.

2.2.6 In addition to detailed descriptions of the habitats, flora and fauna identified within the study area, the outputs of the survey include photographs of important ecological features (Appendix D), a Phase 1 habitat plan (Drawing 10028657-ARC-00-XX-DR-EC-0056-P1) and a corresponding list of Target Notes (TNs) (Appendix C). Important ecological features are ecological features that require specific attention within an Ecological Assessment. They can be important for a variety of reasons, including habitat/species rarity, quality and extent of designated sites or habitats (Ref 10).

2.3 Limitations

2.3.1 The survey was undertaken in July when early flowering floral species may not be in flower and, as such, may be more difficult to identify. However, it is acknowledged that the purpose of the survey was not to provide an exhaustive species list. It is considered that the habitats present within the study area were appropriately identified.

2.3.2 Where access was restricted or refused by landowners, habitats were assessed using a combination of viewing from public footpaths or public roads and supported by aerial imagery. It must be noted that certain features may not have been visible (e.g. ponds in the corners of fields overtopped by trees) and areas which could not be surveyed have been identified on Drawing 10028657-ARC-00-XX-DR-EC-0056-P1.

3 Results Overview

3.1.1 The results of the desk study and field survey are described, with sites or features of nature conservation interest detailed as appropriate. Appendix B details a summary of the protected and priority species results of the local record centre data search, along with relevant legislation. The Phase 1 habitat survey plan is presented on Drawing 10028657-ARC-00-XX-DR-EC-0056-P1, with the associated Target Notes (TN 1 – TN137) and Photographic Record included in Appendix C and Appendix D, respectively.

3.1.2 The dominant land use across the survey area is farmed land, used to grow hay for silage and/ or pasture for livestock. Field boundaries were typically defined by either tall, dense hedgerows, with or without trees, or a dry ditch (at time of the survey) and narrow grassland strips. Areas of woodland are located across the survey area. Typically, these areas were small woodland blocks; however, larger areas of woodland are present in the north, between the M4 Junction 34 and Clawdd-coch. Other frequently occurring habitats include fields of semi-improved grassland, marshy grassland, tall ruderals and scattered trees.

3.1.3 The River Ely is located towards the north of the study area, where it flows from the north to south east, and passes under the M4, west of Junction 34 and the railway. The river continues east where it flows under the existing road, south of Pont-tal-y-bont and then passes under the railway south of the Renishaw plant. Smaller watercourses, which are tributaries of the River Ely, are also present within the study area for both the east (Sub-Section 2) and west (Sub-Section 3) highway alignment options.

3.1.4 The study area encompasses several small settlements as well as the large Renishaw plant in the north east and the golf course in the south. Areas of amenity grassland, scattered trees and buildings are present within these settlements.

4 Results | Sub-Section 1

4.1 Desk Study

Designated Sites

Statutory Designated Sites

4.1.1 There is one statutory designated site within the study area, and one further site within the 2km search area, as summarised in Table 1 below. The locations of the statutory designated sites are shown on Drawing 10028657-ARC-XX-XX-DR-EC-0057-P1 Sheet Number 1.

Table 1 Statutory Designated Sites | Sub-Section 1

Site Name	Reasons for Designation	Location in relation to the proposed development
Ely Valley SSSI	9.5 km section of the River Ely which runs through the north-eastern part of the Vale near Cardiff. The Ely Valley supports the largest known population of the nationally scarce plant Monk's-hood (Aconitum napellus).	Crosses the proposed highway alignment.
Brofiscin Quarry, Groes Faen SSSI	Exposed early Carboniferous geological formations.	1.6 km north

Non-Statutory Designated Sites

4.1.2 There are six non-statutory designated sites within the study area and 39 non-statutory designated sites within the 2km search area, as summarised in Table 2 below. The locations of the non-statutory designated sites are shown on Drawing 10028657-ARC-XX-XX-DR-EC-0057-P1 Sheet Number 1.

Table 2 Non-Statutory Designated Sites | Sub-Section 1

Site Name	Reasons for Designation	Distance from the proposed development
Coed Ffos-Ceibr SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1m
Land West of Hensol Mill SINC	A series of wet meadows supporting Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	5m
Coed Waunn-Lloff SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	5m
Land West of Llanfarach Farm SINC	Semi-natural broadleaved wet woodland and native woodland. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	50m

Site Name	Reasons for Designation	Distance from the proposed development
South West of Castell Bach SINC	Ancient semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	60m
Land South West of Llanfarach Farm SINC	Semi-natural broadleaved wet woodland with associated pond. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland, Ponds.	80m
Land near Hensol Mill SINC	Semi-natural broadleaved wet woodland, part on an ancient woodland site and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	290m
South West of Dyffryn Bach SINC	Ancient semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	300m
Mill Ponds SINC	A linear former mill pond with dense stands of reedbed. It consists of UK BAP Priority Habitat – Ponds, Reedbeds.	350m
Hafod Y Wennol SINC	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	360m
Land between M4 and Industrial Estate SINC	Semi-natural broadleaved wet woodland and native woodland. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	400m
North West of Duffryn Mawr Farm SINC	Species-rich rush pasture with pond. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	480m
Land South of Llanfarach Farm SINC	Series of small wet meadows supporting species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture.	500m
Land South of Hadod Y Wennol SINC	Species-rich Purple Moor-grass and rush pasture with semi-improved neutral grassland margins. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	550m
Land near Coed Pen-Brych SINC	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	600m
West of Clawdd-Coch Farm SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	600m

Site Name	Reasons for Designation	Distance from the proposed development
Coed Cadw SINC	A predominantly ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	700m
Hensol Lake SINC	A large body of open water with reedbed and wet woodland fringe. It consists of UK BAP Priority Habitat – Ponds, Reedbeds, Wet woodland.	900m
Land West of Ty Newydd Farm SINC	Two wet meadows supporting species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture.	1km
Land North of Brooklands Farm SINC	Semi-natural broadleaved woodland of which half is ancient woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.1km
North of Gwern-y-Gedrynch SINC	Semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	1.1km
Land at Pendoylan Moors SINC	A complex of many small enclosed meadows supporting species-rich Purple Moor-grass and rush pasture with associated ditches, hedgerows and areas of tall-herb fen. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture, Reedbeds.	1.2km
North of Pendoylan Moors SINC	Semi-natural broadleaved wet woodland that is contiguous with an extensive area of rush pasture. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	1.2km
Nant Coslech SINC	Unimproved tributary with diverse riparian habitat including a number of quality in-line and off-line ponds.	1.2km
Groes Faen Fen Meadow SINC	Species-rich fen-meadow, associated with the adjacent Nant Coslech.	1.2km
Land near Gwern y Gae Isaf SINC	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.4km
West of Markswood SINC	Two semi-natural broadleaved wet woodlands and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	1.4km
West of Newydd Stables SINC	Species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	1.4km

Site Name	Reasons for Designation	Distance from the proposed development
Coed Llwyn-Rhyddid SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.4km
North of Coed Leision SINC	A series of species-rich neutral grasslands with areas of transitional rush pasture. It consists of UK BAP Priority Habitat – Lowland meadows.	1.5km
Groes Faen Wood SINC	Woodland including some areas of wet woodland associated with the Nant Coslech.	1.5km
South East of Llwyn-Rhyddid Cottages SINC	Ancient semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	1.6km
Land South of Oakfield SINC	A series of wet Purple Moor-grass and rush pastures. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	1.6km
Llwyn-yoy Pond SINC	Pond supporting diverse marginal vegetation and developing wet woodland. It consists of UK BAP Priority Habitat – Ponds, Wet woodland.	1.6km
Land South of Glenholme SINC	Semi-natural broadleaved woodland of which the majority is ancient woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.7km
Maes Mawr Wood SINC	Woodland of possibly ancient origin, lying in a complex of springs that feed the Nant Coslech. The proposed development supports a range of ancient semi-natural woodland species.	1.8km
Nant Henstaff SINC	An unimproved tributary with diverse riparian habitat including a quality in-line pond and adjacent wet woodland and mires with a large population of Monk's-hood.	1.9km
Fforest Fach Farm SINC	Two meadows supporting a mosaic of lowland fen, sedge swamp and rush pasture habitats. It consists of UK BAP Priority Habitat – Lowland fens, Purple Moor-grass and rush pastures, Reedbeds.	1.9km

4.1.3 Five areas of Ancient Semi-Natural Woodland (ASNW) and 2 Restored Ancient Woodland Sites (RAWS) are present within the study area, including 3 ASNWs within 50m of the proposed development. A total of 84 ancient woodland sites, including ASNWs, RAWS and Plantation on Ancient Woodland Sites (PAWS), are present within 2km of the proposed development.

4.1.4 Five Tree Preservation Orders (TPOs) are present within the study area, with one within 50m of the proposed development. A total of 128 TPOs are present within 2km of the proposed development.

4.1.5 The location of the ancient woodland and TPOs are shown in Drawing 10028657-ARC-XX-XX-DR-EC-0057-P1 Sheet Number 1.

Habitats and Flora

Protected and Priority Plant Species

4.1.6 The desk study returned no records of protected or priority floral species within the study area. Records of Bluebell (*Hyacinthoides non-scripta*) and *Parmotrema perlatum* (a lichen), Fen Bedstraw (*Galium uliginosum*) and Monk's-hood (*Aconitum napellus*) were returned within the 2km search area.

4.1.7 Bluebell is protected under Schedule 8 of the Wildlife and Countryside Act (WCA) 1981 (as amended) (Ref 11). The closest record is 760m west of the proposed development.

4.1.8 *Parmotrema perlatum* is listed on Section 7 of the Environment Act (Wales) 2016 (Ref 4). The closest record is 1.8 km south of the proposed development.

4.1.9 Fen Bedstraw and Monk's-hood are listed under the Local Biodiversity Action Plan for the Vale of Glamorgan (LBAP VOG) (Ref 12). The closest record is of Monk's-hood 490m north-east of the proposed development and is a known feature of the River Ely SSSI which crosses the study area.

Invasive Plant Species

4.1.10 The desk study returned records of Japanese Knotweed (*Fallopia japonica*) and Indian Balsam (*Impatiens glandulifera*) within the study area. Both species are listed under Schedule 9 of the WCA 1981 (as amended) (Ref 11). The desk study also returned records of 10 invasive plant species within the 2km search area, summarised in Table 3 below. The closest record is of Japanese Knotweed and Indian Balsam 40m west of the proposed development.

Table 3 Invasive Plant Species Desk Study Records | Sub-Section 1

Common Name	Latin Name	Designation
Hybrid Bluebell	Hyacinthoides non-scripta x hispanica = H. x massartiana	INNS
Japanese Knotweed	Fallopia japonica	WCA9, INNS
Indian Balsam	Impatiens glandulifera	WCA9, INNS
Giant Butterbur	Petasites japonicus	INNS
Garden Yellow Archangel	Lamium galeobdolon subsp. argentatum	WCA9, INNS
Montbretia	Crocosmia pottsii x aurea = C. x crocosmiiflora	WCA9, INNS
Cherry Laurel	Prunus laurocerasus	INNS
Rhododendron ponticum	Rhododendron ponticum	WCA9, INNS
Spanish Bluebell	Hyacinthoides hispanica	INNS
White Stonecrop	Sedum album	INNS

Protected and Notable Fauna

Terrestrial and Aquatic Invertebrates

4.1.11 The desk study returned records of beautiful demoiselle (*Calopteryx virgo*) within the study area. The closest record is 225m west of the proposed development. The desk study also returned records of 14 terrestrial and aquatic invertebrates within the 2km search area including white-letter hairstreak (*Satyrium w-album*), black-tailed skimmer (*Orthetrum cancellatum*) and speckled bush-cricket (*Leptophyes punctatissima*).

Fish

4.1.12 The desk study returned no records of fish within the study area or 2km search area.

Amphibians

4.1.13 The desk study returned records of common frog (*Rana temporaria*) within the study area. The closest record is 250m north of the proposed development. The desk study also returned records of common frog and common toad (*Bufo bufo*) within the 2km search area.

Reptiles

4.1.14 The desk study returned no records of reptiles within the study area. However, there are records of common lizard (*Zootoca vivipara*) within the 2km search area. The closest record is 1.7 km west of the proposed development.

Birds

4.1.15 The desk study returned records of Hobby (*Falco subbuteo*), a species afforded full protection under Schedule 1 of the WCA 1981 (as amended) (Ref 11), within the study area. The closest record is 225m west of the proposed development. The desk study also returned records of 10 species afforded full protection under Schedule 1 of the WCA 1981 (as amended) (Ref 11) within the 2km search area. These include fieldfare (*Turdus pilaris*), red kite (*Milvus milvus*) and barn owl (*Tyto alba*).

4.1.16 Four species listed on the Red List of the Birds of Conservation Concern (BoCC) (Ref 13) have been recorded within the study area including skylark (*Alauda arvensis*), song thrush (*Turdus philomelos*) and bullfinch (*Pyrrhula pyrrhula*). The closest record is of bullfinch 45m west of the proposed development. Fourteen species listed on the Red List of the BoCC (Ref 13) have also been recorded within the 2km search area including house sparrow (*Passer domesticus*), redwing (*Turdus iliacus*) and tree pipit (*Anthus trivialis*).

4.1.17 Kestrel (*Falco tinnunculus*) and dunnock (*Prunella modularis*), species listed on the Amber List of the BoCC (Ref 13), have been recorded within the study area. The closest record is of kestrel 130m south west of the proposed development. Eight species listed on the Amber List of the BoCC (Ref 13) have been recorded within the 2km search area including red kite, tree pipit and green sandpiper (*Tringa ochropus*).

Bats

4.1.18 The desk study returned no records of bat species within the study area. However, there are records of seven bat species and two bat roosts within the 2km search area. These included noctule bat (*Nyctalus noctula*), brown long-eared bat (*Plecotus auritus*) and pipistrelle bat species (*Pipistrellus spp.*). The closest record is of an unidentified bat species roost 640m west of the proposed development.

Otter

4.1.19 The desk study returned no records of European otter (*Lutra lutra*) within the study area or within the 2km search area.

Water Vole

4.1.20 The desk study returned no records of European water vole (*Arvicola amphibius*) within the study area or within the 2km search area.

Hazel Dormouse

4.1.21 The desk study returned no records of hazel dormouse (*Muscardinus avellanarius*) within the study area. However, there are records within the 2km search area. The closest record is 500m north of the proposed development.

Badger

4.1.22 The desk study returned no records of Eurasian badger (*Meles meles*) within the study area or within the 2km search area.

Other Mammals

4.1.23 The desk study returned records of European hedgehog (*Erinaceus europaeus*) and polecat (*Mustela putorius*) within the study area. The closest record is of a European hedgehog 30m north of the proposed development. The desk study also returned records of European hedgehog, American Mink (*Neovison vison*), brown hare (*Lepus europaeus*) and weasel (*Mustela nivalis*) within the 2km search area. American Mink is listed as an Invasive Non-Native Species (INNS).

4.2 Field Study

4.2.1 The following description of the findings of the field study should be read in conjunction with the Phase 1 habitat plan (Drawing 10028657-ARC-XX-XX-DR-EC-0056, Sheet Number 1).

Habitats and Flora

Woodland

- Broadleaved Semi-Natural Woodland
  - Areas of broadleaved woodland were recorded throughout the survey area as large and small stands and as small strips between field boundaries. In some areas, such as in the north eastern section of the survey area (adjacent to the Renishaw site), ground conditions were damp, and the woodland areas included wetland tolerant trees such as Willow species (*Salix sp.*) and Alder (*Alnus glutinosa*), which were sufficient in area and species composition to qualify as wet woodland.
  - In the majority of areas, a diverse range of canopy species were frequently recorded including Pedunculate Oak (*Quercus robur),* Ash (*Fraxinus excelsior),* Alder, Willow species and Sycamore (*Acer pseudoplatanus*). Less frequently recorded canopy species included Field Maple (*Acer campestre),* Yew (*Taxus baccata*), Lime species (*Tilia sp.),* and Birch species (*Betula sp.).* Understorey species typically present included Hazel (*Corylus avellana*), Holly (*Ilex aquifolium)*, Honeysuckle (*Lonicera periclymenum*), Hawthorn (*Crataegus monogyna),* Blackthorn (*Prunus spinosa),* Rose species (*Rosa sp.)* and Bramble (*Rubus fruticosus* agg*).*
  - Ground flora species typically present included Cow Parsley (*Anthriscus sylvestris),* Hogweed (*Heracleum sphondylium*), Hemlock Water-dropwort (*Oenanthe crocata*), Lords-and-Ladies (*Arum maculatum*), Ivy (*Hedera helix*), Hart's-tongue Fern (*Asplenium scolopendrium*), Marsh Thistle (*Cirsium palustre*), Nipplewort *(Lapsana communis*), Garlic Mustard (*Alliaria petiolata*), Red Campion (*Silene dioica*), Scaly Male-fern (*Dryopteris affinis agg.*), Male-fern (*Dryopteris filix-mas*), Dog's Mercury (*Mercurialis perennis*), Herb-Robert (*Geranium robertianum*), Soft-rush (*Juncus effusus*), Ground Ivy (*Glechoma hederacea*), Selfheal (*Prunella vulgaris*), Hedge Woundwort (*Stachys sylvatica*), Rosebay Willowherb (*Chamaenerion angustifolium*), Enchanter's-nightshade (*Circaea lutetiana*), Germander Speedwell (*Veronica chamaedrys*), False Oat-grass (*Arrhenatherum elatius*), False-brome (*Brachypodium sylvaticum*), Hairy-brome (*Bromopsis ramosa*), Giant Fescue (*Festuca gigantea*), Water Pepper (*Persicaria*

hydropiper), Broad-leaved Dock (*Rumex obtusifolius*), Wood Avens (*Geum urbanum*), Common Nettle (*Urtica dioica)* and Cleavers (*Galium aparine*).

- Some of the woodland areas had abundant leaf litter and bare earth present as part of the ground layer, and in places Bramble and Common Nettle were often abundant.

- Mixed Semi-Natural Woodland
  - One large area of mixed semi-natural woodland was present within the survey area. Species recorded within the canopy layer included Pedunculate Oak, Ash, Beech (*Fagus sylvatica)*, Willow, Field Maple, Birch species, Sycamore and Fir species (*Abies sp.)*. Species recorded within the understorey included Elder (*Sambucus nigra*), Hazel, Dogwood (*Cornus sanguinea),* Hawthorn, Holly, Rose species, Bramble, Honeysuckle, Ivy and Rowan (*Sorbus aucuparia).* Species recorded within the ground layer included Wild Angelica (*Angelica sylvestris*), Hogweed, Hemlock Water-dropwort, Lords-and-Ladies, Hart's-tongue Fern, Nipplewort, Dandelion (*Taraxacum officinale agg.*), Wavy Bitter-cress (*Cardamine flexuosa*), Red Campion, Remote Sedge (*Carex remota*), Wood Sedge (*Carex sylvatica*), Scaly Male-fern, Narrow Buckler-fern (*Dryopteris dilatata*), Broad Buckler-fern, Dog's Mercury, Herb-Robert, Ground Ivy, Garden Yellow Archangel (*Lamiastrum galeobdolon*), Selfheal, Enchanter's-nightshade, Foxglove, Wood Speedwell (*Veronica montana*), False-brome, Hairy-brome, Giant Fescue, Polypody Fern species (*Polypodium sp.*), Yellow Pimpernel, Wood Anemone (*Anemone nemorosa*), Creeping Buttercup, Meadowsweet, Wood Avens, Cleavers and Marsh Bedstraw.
- Broadleaved Plantation Woodland
  - A small area of broadleaved plantation woodland was present at the northern section of the survey area, adjacent to the highway. The woodland comprised mostly even-aged young trees and semi-mature trees and scattered shrubs. Species recorded included Oak, Lime, Sweet Chestnut (*Castanea sativa*), Sycamore, Cherry species, Rowan, Hazel, Blackthorn, Hawthorn, Holly, Bramble, Ivy, Black Bryony (*Tamus communis),* Dog's Mercury, Hart's-tongue Fern, Enchanter's-nightshade, Wood Avens, False Oat-grass, Giant Fescue, Common Nettle, Bracken and Hogweed.
- Mixed Plantation Woodland
  - Three areas of mixed plantation woodland were recorded at the northern and south western sections of the survey area. Species recorded included conifer species, Ash, Oak, Beech, Birch species, Scot's Pine (*Pinus sylvestris)*, Willow species, Lime species, Sweet Chestnut, Hawthorn, Dogwood, Bramble, Enchanter's-nightshade, Bittersweet, Dog's Mercury, Clustered Dock (*Rumex conglomeratus*), Male Fern, Ivy, Hart's-tongue Fern, Wood Avens, Herb-Robert, Selfheal, Spear Thistle (*Cirsium vulgare*), Meadowsweet, Hedge Woundwort, Scaly Male-fern, Angelica (*Angelica sylvestris),* Wood Melick (*Melica uniflora),* Hemlock Water-dropwort, Marsh Bedstraw, Red Campion, Soft-rush, Willowherb species (*Epilobium sp.),* Yellow Pimpernel, Lords-and-Ladies, Remote Sedge, Common Nettle and Greater Plantain (*Plantago major*).

Dense and Scattered Scrub

4.2.2 Dense and scattered scrub occurred frequently throughout the survey area at locations which were relatively unmanaged, typically between grassland margins, along field boundaries e.g. adjacent to hedgerows and woodland edges. The stands typically comprised Bramble, however, in places, stands of young Willow were recorded. Where this occurred, willow was the dominant species present. The structure was dense, with little understorey or ground flora.

4.2.3 Along field margins, dense and scattered scrub frequently formed a mosaic with tall ruderal vegetation. The Phase 1 habitat maps only show where dense scrub occurred in larger areas.

4.2.4 Species present included young Willow saplings, Alder saplings, Bramble, Elder and Hazel.

Scattered Trees and Treelines

4.2.5 Scattered trees of varying ages were recorded across the study area within grassland fields and hedgerows. Mature and semi-mature Pedunculate Oak and Ash were the most prominent scattered trees along hedgerows and/ or located within grassland fields, many of which were considered to have bat potential. Species recorded included Hazel, Sycamore (*Acer pseudoplatanus*), Pine (*Pinus sp.)*, Birch (*Betula sp.)*, Turkey oak (*Q. cerris*), Sweet Chestnut, Horse Chestnut (*Aesculus hippocastanum)*, Poplar (*Populus sp.)*, Willow, Cherry (*Prunus sp.),* Alder*,* Hornbeam (*Carpinus betulus)* and Beech*.*

4.2.6 Treelines of mature and semi-mature trees were recorded across the survey area. The majority of these treelines were located along field boundaries, and often connected areas of woodland throughout the survey area. Species recorded included Oak, Ash, Alder, Lime species, Beech, Hazel and Sycamore.

4.2.7 Detailed surveys of the trees present within these features were not undertaken during the Phase 1 Habitat walkover, however, a large number of these were noted with bat roosting potential.

Neutral Semi-Improved Grassland

4.2.8 Areas of neutral semi-improved grassland were identified to the north west of the M4 and to the south west of the railway. The sward height was predominantly high, however, in the area north west of the M4 the grass had been recently cut. Dominant and abundant plant species recorded included False Oat-grass, Crested Dog's-tail (*Cynosurus cristatus*), Cock's-foot, Common Couch (*Elytrigia repens*), Yorkshire Fog (*Holcus lanatus*), Perennial Rye-grass (*Lolium perenne*), Timothy (*Phleum pratense*), Rough Meadow-grass (*Poa trivialis*), Hogweed, Yarrow, Knapweed (*Centaurea nigra*), Creeping Thistle (*Cirsium arvense*), Dandelion, , White Clover (*T. repens*), Ribwort Plantain (*Plantago lanceolata*), Meadow Buttercup (*Ranunculus acris*) and Creeping Buttercup (*R. repens*). These plant species were typically recorded across the survey area.

4.2.9 The following plant species were recorded less frequently or only occasionally throughout the survey area. Common Bent (Agrostis capillaris), Sweet Vernal-grass (Anthoxanthum odoratum), Spear Thistle (C. vulgare), Teasel (Dipsacus fullonum), Cat's-ear (Hypochaeris radicata), Oxeye Daisy (Leucanthemum vulgare), Ragwort (Senecio jacobaea), Lesser Stitchwort (Stellaria graminea), Meadow Vetchling (Lathyrus pratensis), Red Clover (Trifolium pratense), Tufted Vetch (Vicia cracca), Common Vetch (V. sativa), Bush Vetch (V. sepium), Selfheal, Yellow Rattle (Rhinanthus minor), Foxglove (Digitalis purpurea), Common Sorrel (Rumex acetosa), Creeping Cinquefoil (Potentilla reptans), Silverweed (P. anserina), Dock (Rumex sp.) and Cleavers.

4.2.10 Common Fleabane (Pulicaria dysenterica) and Common Spotted-orchid (Dactylorhiza fuchsii) were only recorded in the fields located to the south west of the railway.

4.2.11 In some fields located south west of the railway, small watercourses with a low flow and/ or dry drainage ditches were present along field margins. Adjacent to these features, the ground conditions were damper, and several species preferring damp conditions were recorded. These include Marsh Thistle, Marsh Bird's-foot Trefoil (Lotus pedunculatus), Meadowsweet (Filipendula ulmaria), Horsetail (Equisetum sp.), Water Mint (Mentha aquatica) and Hemlock Water-dropwort (Oenanthe crocata).

Improved Grassland

4.2.12 A number of fields throughout the survey area supported improved grassland fields. At the time of survey some of the fields had been recently cut and some were subject to cattle grazing. Along the field margins, a higher diversity of plant species was recorded and small areas of tall ruderals and/ or scrub habitat were also noted. The grass species composition was generally consistent throughout the study area with similar grass species frequently recorded throughout the different fields. Dominant grass species recorded across the survey area included False Oat-grass, Crested Dog's-tail, Cock's-foot, Yorkshire Fog, Italian Rye-grass (*Lolium multiflorum*), Perennial Rye-grass (*L. perenne*).

4.2.13 The following plant species were typically identified along the margins of the improved grassland fields; however, some species were also present within the grassland field. The following species

were considered abundant across the survey area; Hogweed, Daisy (*Bellis perennis*), Creeping Thistle, Spear Thistle, Dandelion, White Clover, Soft Brome (*Bromus hordeaceus*), Meadow Buttercup, Creeping Buttercup, Silverweed and Common Nettle.

4.2.14 The following plant species were recorded less frequently or only occasionally throughout the survey area. The majority of these species occurred within the field margins or were occasionally present among the Common Bent, Creeping Bent (*Agrostis stolonifera*), Sweet Vernal Grass, Timothy, Annual Meadow-grass (*Poa annua*), Smooth Meadow-grass (*P. pratensis*), Rough Meadow-grass (*P. trivialis*), Yarrow, Pineapple Weed (*Matricaria discoidea*), Prickly Sow-thistle (*Sonchus asper*), Scentless Mayweed (*Tripleurospermum maritimum*), Shepherd's Purse (*Capsella bursa-pastoris*), Lesser Swine-cress (*Coronopus didymus*), Common Mouse-ear (*Cerastium fontanum*), Lesser Stitchwort (*Stellaria graminea*), Red Clover, Cut-leaved Crane's-bill (*Geranium dissectum*), Selfheal, Ribwort Plantain, Greater Plantain, Pale Smartweed (*Persicaria lapathifolia*), Redshank (*P. maculosa*), Knotgrass (*Polygonum aviculare*), Broad-leaved Dock and Creeping Cinquefoil.

4.2.15 Several fields across the survey area had field margins and/ or corners which had wetter ground conditions, likely due to the local topography. In these areas, the following plant species were recorded; Marsh Foxtail (*Alopecurus geniculatus*), Jointed Rush (Juncus articulates), Toad Rush (*J. bufonius*), Soft-rush (*J. effusus*), Hard Rush (*J. inflexus*), Floating Sweet-grass (*Glyceria fluitans*), Marsh Cudweed (*Gnaphalium uliginosum*), Marsh Thistle and Water Forget-me-not (*Myosotis scorpioides*).

Marshy Grassland

4.2.16 Several fields, predominately to the south west, contained areas of marshy grassland. Soft-rush, Marsh Ragwort and Meadowsweet were common and widespread in these areas.

4.2.17 Species recorded included Fool's Water-cress (*Apium nodiflorum*), Hemlock Water-dropwort, Knapweed, Creeping Thistle, Marsh Thistle, Spear Thistle, Dandelion, Indian Balsam (*Impatiens glandulifera*), Water Forget-me-not, Valerian (*Valeriana officinalis*), Common Mouse-ear, Ragged Robin (*Silene flos-cuculi*), Marsh Horsetail (*Equisetum palustre*), Great Horsetail (*E. telmateia*), Meadow Vetchling, Marsh Bird's-foot Trefoil (*Lotus pedunculatus*), Lesser Trefoil (*Trifolium dubium*), Red Clover, White Clover, Tufted Vetch, Square-stalked St. John's-wort (*Hypericum tetrapterum*), Yellow Iris (*Iris pseudacorus*), Jointed Rush, Toad Rush, Soft-rush, Hard Rush, Water Mint, Selfheal, Purple Loosestrife (*Lythrum salicaria*), Foxglove, Ribwort Plantain, Greater Plantain, Brookline (*Veronica becca-bunga*), Marsh Foxtail (*Alopecurus geniculatus*), Crested Dog's Tail, Tufted hair-grass (*Deschampsia cespitosa*), Yorkshire Fog, Perenial Rye-grass, Reed Canary Grass (*Phalaris arundinacea*), Common Reed (*Phragmites australis*), Water Pepper, Clustered Dock, Creeping Jenny (*Lysimachia nummularia*), Marsh Marigold (*Caltha palustris*), Lesser Spearwort (*Ranunculus flammula*), Creeping Buttercup, Silverweed, Cleavers, Marsh Bedstraw (*Galium palustre*), Bittersweet (*Solanum dulcamara*) and Branched Bur-Reed (*Sparganium erectum*).

Tall Ruderals

4.2.18 Tall ruderal vegetation was common and widespread across the survey area and typically occurred between grassland margins, woodland/ scrub edges and along field boundaries.

4.2.19 The Phase 1 habitat maps only show where tall ruderal vegetation occurred in larger areas.

4.2.20 Species recorded included Nettle (*Urtica dioica*), Bracken (*Pteridium aquilinum)*, Rosebay Willowherb (*Chamerion angustifolium),* Greater Willowherb (*Epilobium hirsutum*)*,* Pendulous Sedge (*Carex pendula*), Hogweed, Vervain (*Verbena sp.*), Ragwort (*Senecio jacobaea),* Yarrow (*Achillea millefolium*), Ribwort Plantain*,* Knapweed, Raspberry (*Rubus sp.)*, Hedge Woundwort*,* Hedge Bindweed (*Calystegia sepium*), Giant Bindweed (*Calystegia sylvatica),* Hedge Parsley (*Torilis japonica),* Nipplewort (*Lapsana communis*), Red Campion*,* Herb-Robert (*Geranium robertianum),* Broad-leaved Dock, Spear Thistle, Creeping Thistle, Marsh Thistle, Cleavers, Prickly Sow-thistle, Common Sow-thistle (*S. oleraceus*), Fleabane, Cock's-foot, Yorkshire Fog, Timothy, Hemlock Water-dropwort, Creeping Buttercup, White Clover.

Running Water

- Rivers
  - The River Ely was recorded at the north of the survey area, where it flows from the north west to the south east through areas of broadleaved woodland and grassland. Surveyors were able to access the River at the north west of the survey area, south of the railway. The river had a moderate flow and the water was turbid. The channel was approximately 10m wide, and had steep earth and sand banks, with little emergent wetland vegetation.
  - Access was limited along the River Ely, due to landowner permissions, dense vegetation and/ or health & safety considerations (steep, unsafe banks). Surveyors were only able to view the river from a few viewpoints within the survey area, located south of the railway line and west of the existing road. Monk's hood was not observed at these locations at the time of the survey,
- Streams
  - The watercourse Nant Tredodridge was recorded on the western side of the survey area and flows from the south west to the north east where it joins with the River Ely (outside of the study area). The water level was particularly low and in places only held small pools of water or had a sluggish flow. In locations, cattle had poached the stream banks. The channel was approximately 2m wide. The watercourse flows through areas of woodland and there was little riparian or emergent vegetation.
- Ditches
  - Numerous ditches and drains were recorded across the survey area and were associated with field boundaries, however, at the time of survey, the majority were dry or held very little water.

Arable

4.2.21 One arable field was recorded within the eastern section of the survey area. At the time of the survey, this field supported Barley (*Hordeum vulgare*) crops.

Amenity Grassland

4.2.22 Some areas of amenity grassland were recorded on the eastern and northern section of the survey area. The largest area was recorded at the Hensol Golf Academy to the east. The grass was regularly cut and maintained with a very short sward therefore abundances of species could not be estimated accurately. Species recorded included Meadow-grass (*Poa sp.)*, White Clover, Creeping Buttercup and Broadleaved Plantain (*Plantago major)*.

4.2.23 Smaller areas of amenity grassland were recorded towards the north of the survey area on the Miskin Manor estate.

Hedges Intact – Native Species-Rich, including with and without trees

4.2.24 A large number of hedgerows were recorded throughout the survey area. These hedgerows were identified as species-rich as they supported five or more native woody species and a good hedgerow ground flora. The majority of these hedgerows were located along field boundaries, and often connected areas of woodland throughout the survey area. The hedgerows were typically dense in structure and were of varied width (approximately 2m to 3m) and height (approximately 2m to 4m). Many hedgerows were present along drainage ditches, although the vast majority of these ditches were dry. The most common woody species recorded within the hedgerows were Hazel, Ash, Pedunculate Oak, Hawthorn, Blackthorn, Elder, Holly, Honeysuckle (*Lonicera periclymenum)* and Willow (*Salix sp.)*. Other woody species recorded less frequently included Alder, Beech, Birch, Cherry, Crab Apple (*Malus sylvestris)*, Dogwood, Field Maple (*Acer campestre)*, Rowan, Sycamore and Wych Elm (*Ulmus glabra)*.

4.2.25 The hedgerows supported a diversity of flora species. The most dominant species was Bramble, which was present in every hedgerow. Frequently recorded species included Black Bryony, Bracken,

Cleavers, Common Vetch, Bush Vetch, Creeping Buttercup, Creeping Thistle, Dandelion, False-brome, False Oat-grass, Foxglove, Hedge Bindweed, Greater Willowherb, Hart's-tongue Fern, Hogweed, Ivy (*Hedera helix),* Lesser Stitchwort, Lords-and-Ladies (*Arum maculatum)*, Meadowsweet, Common Nettle, Nipplewort, Red Campion, Dog Rose (*Rosa canina),* Selfheal, Wood Avens and Yorkshire Fog.

4.2.26 Other flora species less frequently recorded included Bittersweet, Couch, Dog's Mercury (*Mercurialis perennis)*, Garlic Mustard (*Alliaria petiolata),* Giant Fescue, Greater Celandine (*Chelidonium majus)*, Hops (*Humulus lupulus),* Marsh Bedstraw, Clustered Dock, Sterile Brome (*Bromus sterilis),* Wild Strawberry (*Fragaria vesca)* and Violet (*Viola sp.).*

4.2.27 Mature or semi-mature trees, often including Pedunculate Oak, Ash, Willow, Beech, Alder, Field Maple, Sycamore and Hazel were also a regular feature present along the hedgerows.

Hedges Intact and Defunct – Species Poor, including with and without trees

4.2.28 A number of hedges were identified as species poor as they supported fewer than five woody species along the length of the hedgerow. These hedgerows, similar to the species-rich hedgerows, were located along field boundaries and connected areas of woodland and occasionally were present along a dry drainage ditch. A small number of hedgerows were identified as 'defunct' as the hedge had gaps along the length of them, rendering them no longer stock-proof. Some of these hedgerows contained semi-mature, young and mature trees.

Species frequently recorded in the hedgerows included Hazel, Hawthorn, Ash, Sycamore, Oak, Beech, Dogwood, Field Maple, Wych Elm, Cherry, Holly, Bracken, Bramble and Dog Rose.

Buildings

4.2.29 Within the northern section of the survey area, Miskin Manor and associated buildings, and within the eastern section of the survey area, Hensol Golf Academy, were a number of buildings. Detailed surveys of these buildings were not undertaken during the Phase 1 habitat survey.

Non-Native Invasive Plant Species

4.2.30 Indian Balsam was recorded throughout the survey area and was typically encountered along hedgerows, ditches, within woodland and within grassland fields. Surveyors recorded all observations of the plant on site (TN2, TN10, TN42, TN43, TN96, TN99, TN100, TN103, TN104 and TN125); however, a detailed search for this species was not undertaken and some areas may have been missed.

4.2.31 Japanese Knotweed (*Fallopia japonica*) (TN41) and Butterfly-bush (*Buddleja sp.*) (TN7, TN90, THN91, TN92, TN93, TN954) were also recorded in the survey area.

Protected Plant Species

4.2.32 Bluebell (*Hyacinthoides non-scripta*) was recorded in the area of mixed semi-natural woodland located to the south east of the survey area.

Protected and Notable Fauna

Terrestrial Invertebrates

4.2.33 Multiple species of beetles, butterflies, dragonflies and crickets were recorded during the survey. Species of beetles recorded during the survey included common red soldier beetle (*Rhagonycha fulva*) and green dock beetle (*Gastrophysa viridula*).

4.2.34 The following species of butterflies were recorded during the survey; small copper (*Lycaena phlaeas*), peacock (*Aglais io*), small tortoiseshell (*Aglais urticae*), meadow brown (*Maniola jurtina*) speckled wood (*Pararge aegeria*), gatekeeper (*Pyronia Tithonus*), comma butterfly (*Polygonia c-album*), and small white (*Pieris rapae*). Meadow brown was the most commonly recorded species.

4.2.35 Black-tailed skimmer dragonfly (*Orthetrum cancellatum*) was recorded during the survey area.

4.2.36 The following species of cricket were recorded during the survey; meadow grasshopper (*Pseudochorthippus parallelus*), speckled bush-cricket (*Leptophyes punctatissima*) and dark bush-cricket (*Pholidoptera griseoaptera*).

4.2.37 The grassland, scrub, tall ruderal and woodland margins were considered suitable to support a diverse range of invertebrate species. Deadwood was common within woodland, hedgerows and treeline habitats which could provide habitat for a number of common terrestrial invertebrate species.

Aquatic Invertebrates

4.2.38 A number of ditches, watercourses and ponds were recorded across the survey area and are considered likely to be of value to a diverse range of invertebrate species.

Fish

4.2.39 The River Ely and Nant Tredodridge within the survey area are considered suitable to support fish species.

Amphibians

4.2.40 The grassland, hedgerow, scrub, tall ruderal and woodland habitats within the study area provide suitable foraging, commuting and hibernating opportunities for great crested newts and other species of amphibians.

Reptiles

4.2.41 A number of habitats throughout the study area are considered suitable to support foraging and hibernating reptiles in particular the areas of broadleaved woodland, scrub, grassland and tall ruderal vegetation, in particular field margins. A rubble and log pile (TN89) was identified as a potential hibernacula.

Birds

4.2.42 A number of incidental bird sightings were recorded during the Phase 1 habitat survey including blackbird (*Turdus merula*), siskin (*Spinus spinus*), long-tailed tit (*Aegithalos caudatus*), nuthatch (*Sitta europaea*), buzzard (*Buteo buteo*), great spotted woodpecker (*Dendrocopos major*), wren (*Troglodytes troglodytes*), barn swallow (*Hirundo rustica*), goldfinch (*Carduelis carduelis*), coal tit (*Periparus ater*), stock dove (*Columba oenas*), wood pigeon (*Columba palumbus*), blue tit (*Cyanistes caeruleus*), yellowhammer (*Emberiza citronella*), reed bunting (*Emberiza schoeniclus*), coot (*Fulica atra*), lesser black-backed gull (*Larus fuscus*), linnet (Linaria cannabina), pied wagtail (*Motacilla alba yarrellii*), house sparrow (*Passer domesticus*), coal tit (*Periparus ater*), chiffchaff (*Phylloscopus collybita*), green woodpecker (*Picus viridis*), bullfinch (*Pyrrhula pyrrhula*), blackcap (*Sylvia atricapilla*) and starling (*Sturnus vulgaris*).

4.2.43 The woodland, scattered trees, scrub and hedgerow habitats present throughout the survey area are likely to support breeding birds typical of these habitats and provide good foraging habitat, whilst the areas of less disturbed grassland were considered to be suitable for ground nesting birds It is possible that barn owl could use mature trees with suitable cavities for nesting and grassland and arable field margins for foraging, although no evidence was recorded during the Phase 1 habitat survey.

Bats

4.2.44 The woodland areas and scattered trees, some associated with hedgerows, throughout the study area have potential to support roosting bats (TN9, TN44, TN48, TN97, TN100, TN101, TN125). Several buildings were scattered across the survey area which may also have potential to support roosting bats. No buildings within the survey area were subject to detailed (interior or exterior) building inspections.

4.2.45 Areas of potential foraging and commuting habitat for bats were found throughout the survey area. High value habitats included the woodland areas, hedgerows and treelines, watercourses, permanent waterbodies and grassland field margins with scrub and tall ruderal vegetation.

Hazel Dormouse

4.2.46 An analysis of aerial photography indicates that there is good connectivity and continuity of woodland and scrub habitat within the wider landscape to support dormice (*Muscardinus avellanarius*) within the survey area.

4.2.47 The areas of woodland and connecting hedgerow habitat within the survey area were considered suitable to support hazel dormouse (TN48). The majority of woodlands had a diverse range of tree and shrub species, which are a valuable food source throughout the year for dormice. These species included abundant fruiting Hazel stools, Oak, Bramble, Sycamore, Ash, Honeysuckle and Hawthorn. These woodland areas also had a good physical structure, with the majority having a dense or well-structured understorey which provides suitable dormouse habitat.

Water Vole

4.2.48 A large number of ditches were recorded within the survey area, however, the majority of these were either dry at the time of survey and not considered suitable to support water vole (*Arvicola amphibius)*.

4.2.49 The River Ely and parts of the Nant Tredodridge which were less shaded by the woodland were considered to be suitable to support water vole.

Otter

4.2.50 The River Ely and Nant Tredodridge were assessed as suitable to support otters (*Lutra lutra*). Suitable habitat was present along the River Ely which would provide opportunities for resting otters. Both watercourses were considered suitable to support foraging and/ commuting otters.

Badger

4.2.51 The areas of woodland, scrub and hedgerows within the survey area were assessed as suitable to support badgers (*Meles meles).*

Other Mammals

4.2.52 Incidental sightings of brown hare (*Lepus europaeus*) and Hedgehog (*Erinaceus europaeus*) were recorded during the Phase 1 habitat survey.

4.2.53 A number of habitats present within the survey area were assessed as suitable to support the following species; polecat (*Mustela putorius),* weasel (*Mustela nivalis), stoat (Mustela erminea)* and harvest mouse (*Micromys minutus).*

5 Results | Sub-Section 2

5.1 Desk Study

Designated Sites

Statutory Designated Sites

5.1.1 There are no statutory designated sites within the study area, however one is present within the 2km search area, as listed in Table 4 below. The location of the statutory designated site is shown on Drawing 10028657-ARC-XX-XX-DR-EC-0057-P1 Sheet Number 2.

Table 4 Statutory Designated Sites | Sub-Section 2

Site Name	Reasons for Designation	Location in relation to the proposed development
Ely Valley SSSI	9.5 km section of the River Ely which runs through the north-eastern part of the Vale near Cardiff. The Ely Valley supports the largest known population of the nationally scarce plant Monk's-hood.	500m east

Non-Statutory Designated Sites

5.1.2 There are eight non-statutory designated sites within the study area and 49 non-statutory designated sites within the 2km search area, as summarised in Table 5 below. The locations of the non-statutory designated sites are shown on Drawing 10028657-ARC-XX-XX-DR-EC-0057-P1 Sheet Number 2.

Table 5 Non-statutory Designated Sites | Sub-Section 2

Site Name	Reasons for Designation	Distance from the proposed development
Coed Cadw SINC	A predominantly ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	0m
Land at Pendoylan Moors SINC	A complex of many small enclosed meadows supporting species-rich Purple Moor-grass and rush pasture with associated ditches, hedgerows and areas of tall-herb fen. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture, Reedbeds.	0m
Coed Ffos-Ceibr SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1m
Coed Waunn-Lloff SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	3m
Land West of Hensol Mill SINC	A series of wet meadows supporting Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	101m

Site Name	Reasons for Designation	Distance from the proposed development
South West of Castell Bach SINC	Ancient semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	130m
North of Pendoylan Moors SINC	Semi-natural broadleaved wet woodland that is contiguous with an extensive area of rush pasture. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	130m
Log Wood SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	180m
West of Clawdd-Coch Farm SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	290m
South West of Dyffryn Bach SINC	Ancient semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	380m
Gaer Wood SINC	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	380m
North West of Duffryn Mawr Farm SINC	Species-rich rush pasture with pond. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	410m
Land near Hensol Mill SINC	Semi-natural broadleaved wet woodland, part on an ancient woodland site and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	440m
Land near Coed Pen-Brych SINC	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	510m
Coed Counsellor SINC	Extensive area of part-ancient semi-natural broadleaved woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	530m
East of Ty'n-y-Pwll SINC	Two distinct groups of meadows supporting species-rich mosaic of Purple Moor-grass and rush pasture and mire. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture.	550m

Site Name	Reasons for Designation	Distance from the proposed development
Cottrell Wood SINC	Semi-natural broadleaved woodland on an ancient woodland site and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	560m
Land South of Hadod Y Wennol SINC	Species-rich Purple Moor-grass and rush pasture with semi-improved neutral grassland margins. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	620m
Hafod Y Wennol SINC	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	630m
Mill Ponds SINC	A linear former mill pond with dense stands of reedbed. It consists of UK BAP Priority Habitat – Ponds, Reedbeds.	640m
Land near Gwern y Gae Isaf SINC	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	740m
Gwern-y-Steeple SINC	Semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	950m
Ravenswood SINC	Series of ponds supporting tall herbs and swamp. It consists of UK BAP Priority Habitat – Ponds, Reedbeds.	1km
North West of Croes-y-Parc Baptist Chapel SINC	Species-rich neutral meadows. It consists of UK BAP Priority Habitat – Lowland meadows.	1km
Warren Mill Farm Park SINC	Species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	1.1km
West of Warren Mill Farm Park SINC	Species-rich neutral grassland. It consists of UK BAP Priority Habitat – Lowland meadows.	1.1km
Land North of Brooklands Farm SINC	Semi-natural broadleaved woodland of which half is ancient woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.1km
Hensol Lake SINC	A large body of open water with reedbed and wet woodland fringe. It consists of UK BAP Priority Habitat – Ponds, Reedbeds, Wet woodland.	1.1km

Site Name	Reasons for Designation	Distance from the proposed development
Land South West of Llanfarach Farm SINC	Semi-natural broadleaved wet woodland with associated pond. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland, Ponds.	1.1km
Land between M4 and Industrial Estate SINC	Semi-natural broadleaved wet woodland and native woodland. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	1.2km
Kingsland SINC	Ancient semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	1.2km
West of Newydd Stables SINC	Species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	1.3km
North of Coed Leision SINC	A series of species-rich neutral grasslands with areas of transitional rush pasture. It consists of UK BAP Priority Habitat – Lowland meadows.	1.3km
Land South of Llanfarach Farm SINC	Series of small wet meadows supporting species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture.	1.3km
Land West of Llanfarach Farm SINC	Semi-natural broadleaved wet woodland and native woodland. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	1.4km
Land West of Ty Newydd Farm SINC	Two wet meadows supporting species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture.	1.4km
Mill Pond SINC	Old mill pond supporting diverse vegetation and associated marshy grassland. Mosaic habitats present. It consists of UK BAP Priority Habitat – Ponds.	1.4km
West of Markswood SINC	Two semi-natural broadleaved wet woodlands and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	1.4km
Land South of Glenholme SINC	Semi-natural broadleaved woodland of which the majority is ancient woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.4km
South East of Llwyn-Rhyddid Cottages SINC	Ancient semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority	1.4km

Site Name	Reasons for Designation	Distance from the proposed development
	Habitat – Lowland mixed deciduous woodland, Wet woodland.	
Coed Llwyn-Rhyddid SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.5km
Coed Llwyn Rhyddid Wildlife Trust Reserve	A mixed secondary woodland supporting a large heronry.	1.5km
North of Gwern-y-Gedrynch SINC	Semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	1.5km
Land South of Oakfield SINC	A series of wet Purple Moor-grass and rush pastures. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	1.6km
Coed y Lan SINC	Semi-natural broadleaved woodland on an ancient woodland site and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.7km
Llwyn-yoy Pond SINC	Pond supporting diverse marginal vegetation and developing wet woodland. It consists of UK BAP Priority Habitat – Ponds, Wet woodland.	1.7km
East of Kingsland SINC	Part ancient semi-natural broadleaved woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.8km
Coed y Cwm SINC	Semi-natural broadleaved woodland, part on an ancient woodland site. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	2 km

5.1.3 Eleven areas of Ancient Semi-Natural Woodland (ASNW) and 2 Restored Ancient Woodland Sites (RAWS) are present within the study area, including 6 ASNWs within 50m of the proposed development. A total of 91 ancient woodland sites, including ASNWs, RAWS and Plantation on Ancient Woodland Site (PAWS), are present within 2km of the proposed development. Five Tree Preservation Orders (TPOs) are present within the study area, with the nearest 185m from the proposed development. A total of 260 TPOs are present within 2km of the proposed development. The location of the ancient woodland and TPOs are shown in Drawing 10028657-ARC-XX-XX-DR-EC-0057-P1 Sheet Number 2.

Habitats and Flora

Protected and Priority Plant Species

5.1.4 The desk study returned records of Bluebell within the study area and within the 2km search area. The closest record is 80m west of the proposed development. Bluebell is protected under Schedule 8 of the Wildlife and Countryside Act (WCA) 1981 (as amended) (Ref 11).

5.1.5 The desk study also returned records of Cornflower (*Centaurea cyanus*) and *Parmotrema perlatum* within the 2km search area. Both species are listed under Section 7 of the Environment Act (Wales) 2016 (Ref 4). The closest record is 800m west of the proposed development.

5.1.6 The desk study also returned records of Corn Chamomile (*Anthemis arvensis*), Corn Spurrey (*Spergula arvensis*), Cornflower, Monk's-hood and Corn Marigold (*Glebionis segetum*) within the 2km search area. These species are listed under the Local Biodiversity Action Plan for the Vale of Glamorgan (LBAP VOG) (Ref 12). The closest record is of Corn Chamomile 620m south of the proposed development.

Invasive Plant Species

5.1.7 The desk study returned records of Spanish Bluebell (*Hyacinthoides hispanica*), Indian Balsam and Japanese Knotweed within the study area. Indian Balsam and Japanese Knotweed are listed under Schedule 9 of the WCA 1981 (as amended) (Ref 11), whilst Spanish Bluebell is listed as an INNS. The closest record is of all three said species 80m south of the proposed development. The desk study also returned records of 12 invasive plant species within the 2km search area, summarised in Table 6 below.

Table 6 Invasive Plant Species Desk Study Records | Sub-Section 2

Common Name	Latin Name	Designation
Indian Balsam	*Impatiens glandulifera*	WCA9, INNS
Japanese Knotweed	*Fallopia japonica*	WCA9, INNS
Montbretia	*Crocosmia pottsii x aurea = C. x crocosmiiflora*	WCA9, INNS
Rhododendron ponticum	*Rhododendron ponticum*	WCA9, INNS
Three-cornered Garlic	*Allium triquetrum*	WCA9, INNS
Wall Cotoneaster	*Cotoneaster horizontalis*	WCA9, INNS
Garden Yellow Archangel	*Lamium galeobdolon subsp. argentatum*	WCA9, INNS
Bluebell	*Hyacinthoides non-scripta x hispanica = H. x massartiana*	INNS
Cherry Laurel	*Prunus laurocerasus*	INNS
Giant Butterbur	*Petasites japonicus*	INNS
Orange Balsam	*Impatiens capensis*	INNS
Spanish Bluebell	*Hyacinthoides hispanica*	INNS

Protected and Notable Fauna

Terrestrial and Aquatic Invertebrates

5.1.8 The desk study returned records of golden-ringed dragonfly (*Cordulegaster boltonii*) and short-winged cone-head (*Conocephalus dorsalis*) within the study area. The closest record is of a golden-ringed dragonfly 80m west of the proposed development. The desk study also returned records of 18

terrestrial and aquatic invertebrate species within the 2km search area including black oil-beetle (*Meloe proscarabaeus*), beautiful demoiselle and grass rivulet (*Perizoma albulata*).

Fish

5.1.9 The desk study returned no records of fish within the study area or 2km search area.

Amphibians

5.1.10 The desk study returned no records of amphibians within the study area. However, there are records of five species of amphibians within the 2km search area. These include common frog, common toad and great crested newt (*Triturus cristatus*). The closest record is of common frog and common toad 420m west of the proposed development.

Reptiles

5.1.11 The desk study returned no records of reptiles within the study area. However, there are records of common lizard and grass snake (*Natrix helvetica*) within the 2km search area. The closest record is of grass snake 420m west of the proposed development.

Birds

5.1.12 Eight species afforded full protection under Schedule 1 of the WCA 1981 (as amended) (Ref 11) have been recorded within the study area. These include merlin (*Falco columbarius*), red kite and fieldfare. The closest record is of a merlin 80m west of the proposed development. The desk study also returned records of 14 species afforded full protection under Schedule 1 of the WCA 1981 (as amended) (Ref 11) within the 2km search area. These include kingfisher (*Alcedo atthis*), bittern (*Botaurus stellaris*) and brambling (*Fringilla montifringilla*).

5.1.13 Eight species listed on the Red List of the BoCC (Ref 13) have been recorded within the study area including reed bunting (*Emberiza schoeniclus*), skylark (*Alauda arvensis*) and spotted flycatcher (*Muscicapa striata*). The closest record is of house sparrow, skylark, song thrush, spotted flycatcher and starling (*Sturnus vulgaris*) 80m west of the proposed development. Nineteen species listed on the Red List of the BoCC (Ref 13) have also been recorded within the 2km search area including wood warbler (*Phylloscopus sibilatrix*) redwing and tree pipit.

5.1.14 Seventeen species listed on the Amber List of the BoCC (Ref 13), have been recorded within the study area including dipper (*Cinclus cinclus*), house martin (*Delichon urbicum*) and swallow (*Gallinago gallinago*). The closest record is of dunnock, house martin, mallard (*Anas platyrhynchos*), meadow pipit (*Anthus pratensis*), merlin (*Falco columbarius*), swallow and willow warbler (*Phylloscopus trochilus*) 80m west of the proposed development. Thirty-six species listed on the Amber List of the BoCC (Ref 13) have been recorded within the 2km search area including barn owl, goldcrest (*Regulus regulus*) and swift (*Apus apus*).

Bats

5.1.15 The desk study returned no records of bats within the study area. However, there are records of seven bat species (including within the 2km search area). These include noctule bat (*Nyctalus noctula*), brown long-eared bat (*Plecotus auritus*) and serotine bat (*Eptesicus serotinus*). The records also include at least one roost for each of the seven bat species. The closest record is of an unidentified bat species roost 540m west of the proposed development.

Otter

5.1.16 The desk study returned no records of European otter (*Lutra lutra*) within the study area. However, there are records within the 2km search area. The closest record is of an otter spraint 670m east of the proposed development.

Water Vole

5.1.17 The desk study returned no records of European water vole (*Arvicola amphibius*) within the study area or within the 2km search area.

Hazel Dormouse

5.1.18 The desk study returned no records of hazel dormouse (*Muscardinus avellanarius*) within the study area or within the 2km search area.

Badger

5.1.19 The desk study returned no records of Eurasian badger (*Meles meles*) within the study area however did return records within the 2km search area. The closest record is of a dead individual 1.4 km east of the proposed development.

Other Mammals

5.1.20 The desk study returned records of European hedgehog within the study area. The closest record is 240m east of the proposed development. The desk study also returned records of American mink, European hedgehog, brown hare, harvest mouse (*Micromys minutus*), polecat and weasel within the 2km search area.

5.2 Field Study

5.2.1 The following description of the findings of the field study should be read in conjunction with the Phase 1 habitat plan (Drawing 10028657-ARC-XX-XX-DR-EC-0056, Sheet Number 2).

Habitats and Flora

Woodland

- Broadleaved Semi-Natural Woodland
  - Areas of broadleaved woodland were recorded throughout the survey area as large and small stands and as small strips between field boundaries. In some areas, such as in the central section of the survey area, ground conditions were damp, and the woodland areas included wetland tolerant trees such as Willow species (*Salix sp*.) and Alder (*Alnus glutinosa*), which were sufficient in area and species composition to qualify as wet woodland.
  - In the majority of areas, a diverse range of canopy species were frequently recorded including Pedunculate Oak (*Quercus robur),* Ash (*Fraxinus excelsior),* Alder, Willow species and Sycamore (*Acer pseudoplatanus*). Less frequently recorded canopy species included Field Maple (*Acer campestre),* Yew (*Taxus baccata*), Lime species (*Tilia sp.),* and Birch species (*Betula sp.).* Understorey species typically present included Hazel (*Corylus avellana*), Holly (*Ilex aquifolium)*, Honeysuckle (*Lonicera periclymenum*), Hawthorn (*Crataegus monogyna),* Blackthorn (*Prunus spinosa),* Rose species (*Rosa sp.)* and Bramble.
  - Ground flora species typically present included Cow Parsley (*Anthriscus sylvestris),* Hogweed (Heracleum sphondylium), Hemlock Water-dropwort (*Oenanthe crocata*), Lords-and-Ladies (*Arum maculatum*), Ivy (*Hedera helix*), Hart's-tongue Fern (*Asplenium scolopendrium*), Marsh Thistle (*Cirsium palustre*), Nipplewort (*Lapsana communis*), Garlic Mustard (*Alliaria petiolata*), Red Campion (*Silene dioica*), Scaly Male-fern (*Dryopteris affinis agg*.), Male-fern (*Dryopteris filix-mas*), Dog's Mercury (*Mercurialis perennis*), Herb-Robert (*Geranium robertianum*), Soft-rush (*Juncus effusus*), Ground-ivy (*Glechoma hederacea*), Selfheal (*Prunella vulgaris*), Hedge Woundwort (*Stachys sylvatica*), Rosebay Willowherb (*Chamaenerion angustifolium*), Enchanter's-nightshade (*Circaea lutetiana*), Germander Speedwell (*Veronica chamaedrys*), False Oat-grass (*Arrhenatherum elatius*), False-brome (*Brachypodium sylvaticum*), Hairy-brome (*Bromopsis ramosa*), Giant Fescue (*Festuca gigantea*), Water Pepper (*Persicaria hydropiper*), Broad-leaved Dock (*Rumex obtusifolius*), Wood Avens (*Geum urbanum*), Common Nettle (*Urtica dioica)* and Cleavers (*Galium aparine*).
  - Some of the woodland areas had abundant leaf litter and bare earth present as part of the ground layer, and in places Bramble and common nettles were often abundant.

- Mixed Semi-Natural Woodland
  - One large area of mixed semi-natural woodland was present within the survey area towards the north. Species recorded within the canopy layer included Pedunculate Oak, Ash, Beech, Willow, Field Maple, Birch species, Sycamore and Fir species (*Abies sp.)*. Species recorded within the understorey included Elder, Hazel, Dogwood (*Cornus sanguinea),* Hawthorn, Holly, Rose species, Bramble, Honeysuckle, Ivy and Rowan (*Sorbus aucuparia).* Species recorded within the ground layer included Wild Angelica (*Angelica sylvestris*), Hogweed, Hemlock Water-dropwort, Lords-and-Ladies, Hart's-tongue Fern, Nipplewort, Dandelion, Wavy Bitter-cress (*Cardamine flexuosa*), Red Campion, Remote Sedge (*Carex remota*), Wood Sedge (*Carex sylvatica*), Scaly Male-fern, Narrow Buckler-fern (*Dryopteris dilatata*), Broad Buckler-fern, Dog's Mercury, Herb-Robert, Ground-ivy, Garden Yellow Archangel (*Lamiastrum galeobdolon*), Selfheal, Enchanter's-nightshade, Foxglove, Wood Speedwell (*Veronica montana*), False-brome, Hairy-Brome, Giant Fescue, Polypody Fern species (*Polypodium* sp.), Yellow Pimpernel, Wood Anemone (*Anemone nemorosa*), Creeping Buttercup, Meadowsweet, Wood Avens, Cleavers and Marsh Bedstraw.
- Mixed Plantation Woodland
  - An area of mixed plantation woodland was recorded at the northern section of the survey area. Species recorded included conifer species, Ash, Oak, Beech, Birch species, Scot's Pine (*Pinus Sylvestris)*, Willow species, Lime species, Sweet Chestnut, Hawthorn, Dogwood, Bramble, Enchanter's-nightshade, Bittersweet, Dog's Mercury, Clustered Dock, Male Fern, Ivy, Hart's-tongue Fern, Wood Avens, Herb-Robert, Selfheal, Spear Thistle (*Cirsium vulgare*), Meadowsweet, Hedge Woundwort, Scaly Male-fern, Angelica (*Angelica sylvestris),* Wood Melick (*Melica uniflora),* Hemlock Water-dropwort, Marsh Bedstraw, Red Campion, Soft-rush, Willowherb species (*Epilobium sp.),* Yellow Pimpernel, Lords-and-Ladies, Remote Sedge, Common Nettle and Greater Plantain (*Plantago major*).

Dense and Scattered Scrub

5.2.2 Dense and scattered scrub occurred frequently throughout the survey area at locations which were relatively unmanaged, typically between grassland margins, along field boundaries e.g. adjacent to hedgerows and woodland edges. The stands typically comprised Bramble, however, in places, stands of young Willow were recorded. Where this occurred, willow was the dominant species present. The structure was dense, with little understorey or ground flora.

5.2.3 Along field margins, dense and scattered scrub frequently formed a mosaic with tall ruderal vegetation. The Phase 1 habitat maps only show where dense scrub occurred in larger areas.

5.2.4 Species present included young Willow saplings*,* Alder saplings*,* Bramble, Elder (*Sambucus nigra*) and Hazel.

Scattered Trees and Treelines

5.2.5 Scattered trees of varying ages were recorded across the study area within grassland fields and hedgerows. Mature and semi-mature Pedunculate Oak and Ash were the most prominent scattered trees along hedgerows and/ or located within grassland fields, many of which were considered to have bat potential. Species recorded included Hazel, Sycamore (*Acer pseudoplatanus*), Pine (*Pinus sp.)*, Birch (*Betula sp.)*, Turkey oak (*Q. cerris*), Sweet Chestnut, Horse Chestnut (*Aesculus hippocastanum)*, Poplar (*Populus sp.)*, Willow, Cherry (*Prunus sp.),* Alder*,* Hornbeam (*Carpinus betulus)* and Beech (*Fagus sylvatica).*

5.2.6 Treelines of mature and semi-mature trees were recorded across the survey area. The majority of these treelines were located along field boundaries, and often connected areas of woodland throughout the survey area. Species recorded included Oak, Ash, Alder, Lime species, Beech, Hazel and Sycamore.

5.2.7 Detailed surveys of the trees present within these features were not undertaken during the Phase 1 Habitat walkover, however, a large number of these were noted with bat roosting potential.

Neutral Semi-Improved Grassland

5.2.8 Two fields of neutral semi-improved grassland were identified in the survey area. The sward height was predominantly high; however, a pathway had been cut along the northern field boundary allowing access. The grassland comprised abundant

5.2.9 Dominant and abundant species recorded included False Oat-grass, Crested Dog's-tail (*Cynosurus cristatus*), Cock's-foot, Common Couch (*Elytrigia repens*), Yorkshire Fog (*Holcus lanatus*), Perennial Rye-grass (*Lolium perenne*), Timothy (*Phleum pratense*), Rough Meadow-grass (*Poa trivialis*), Hogweed, Yarrow, Knapweed (*Centaurea nigra*), Creeping Thistle (*Cirsium arvense*), Dandelion, White Clover (*T. repens*), Ribwort Plantain (*Plantago lanceolata*), Meadow Buttercup (*Ranunculus acris*) and Creeping Buttercup (*R. repens*).

5.2.10 The following plant species were recorded less frequently or only occasionally throughout the survey area. Common Bent (*Agrostis capillaris*), Sweet Vernal-grass (*Anthoxanthum odoratum*), Spear Thistle (*C. vulgare*), Cat's-ear (*Hypochaeris radicata*), Oxeye Daisy (*Leucanthemum vulgare*), Ragwort (*Senecio jacobaea*), Teasel (*Dipsacus fullonum*), Lesser Stitchwort (*Stellaria gramine*a), Meadow Vetchling (*Lathyrus pratensis*), Red Clover (*Trifolium pratense*), Tufted Vetch (*Vicia cracca*), Common Vetch (*V. sativa*), Bush Vetch (*V. sepium*), Selfheal, Yellow Rattle (*Rhinanthus minor*), Foxglove (*Digitalis purpurea*), Common Sorrel (*Rumex acetosa*), Creeping Cinquefoil (*Potentilla reptans*), Silverweed (*P. anserina*), Dock (*Rumex sp*.) and Cleavers.

Improved Grassland

5.2.11 A number of fields throughout the survey area supported improved grassland fields. At the time of survey some of the fields had been recently cut and some were subject to cattle grazing. Along the field margins, a higher diversity of plant species were recorded and small areas of tall ruderals and/ or scrub habitat were also noted. The grass species composition was generally consistent throughout the study area with grass species frequently recorded throughout the different fields.

5.2.12 Dominant grass species recorded across the survey area included False Oat-grass, Crested Dog's-tail, Cock's-foot, Yorkshire Fog, Italian Rye-grass (*Lolium multiflorum*), Perennial Rye-grass (*L. perenne*).

5.2.13 The following plant species were typically identified along the margins of the improved grassland fields; however, some species were also present within the grassland field. The following species were considered abundant across the survey area; Hogweed, Daisy (*Bellis perennis*), Creeping Thistle, Spear Thistle, Dandelion, White Clover, Soft Brome (*Bromus hordeaceus*), Meadow Buttercup, Creeping Buttercup, Silverweed and Common Nettle.

5.2.14 The following plant species were recorded less frequently or only occasionally throughout the survey area. The majority of these species occurred within the field margins or were occasionally present among the Common Bent, Creeping Bent (*Agrostis stolonifera*), Sweet Vernal Grass, Timothy, Annual Meadow-grass (*Poa annua*), Smooth Meadow-grass (*P. pratensis*), Rough Meadow-grass (*P. trivialis*), Yarrow, Pineapple Weed (*Matricaria discoidea*), Prickly Sow-thistle (*Sonchus asper*), Scentless Mayweed (*Tripleurospermum maritimum*), Shepherd's Purse (*Capsella bursa-pastoris*), Lesser Swine-cress (*Coronopus didymus*), Common Mouse-ear (*Cerastium fontanum*), Lesser Stitchwort (*Stellaria graminea*), Red Clover, Cut-leaved Crane's-bill (*Geranium dissectum*), Selfheal, Ribwort Plantain, Greater Plantain, Pale Smartweed (*Persicaria lapathifolia*), Redshank (*P. maculosa*), Knotgrass (*Polygonum aviculare*), Broad-leaved Dock and Creeping Cinquefoil.

5.2.15 Several fields across the survey area had field margins and/ or corners which had wetter ground conditions, likely due to the local topography. In these areas, the following plant species were recorded; Marsh Foxtail (*Alopecurus geniculatus*), Jointed Rush (Juncus articulates), Toad Rush (*J. bufonius*), Soft-rush (*J. effusus*), Hard Rush (*J. inflexus*), Floating Sweet-grass (*Glyceria fluitans*), Marsh Cudweed (*Gnaphalium uliginosum*), Marsh Thistle and Water Forget-me-not (*Myosotis scorpioides*).

Marshy Grassland

5.2.16 Several smaller fields, predominately to the north east of the survey area, contained areas of marshy grassland. Soft-rush, Marsh Ragwort and Meadowsweet were common and widespread in these areas. Species recorded included Fool's Water-cress (*Apium nodiflorum*), Hemlock Water-dropwort, Knapweed, Creeping Thistle, Marsh Thistle, Spear Thistle, Dandelion, Indian Balsam (*Impatiens glandulifera*), Water Forget-me-not, Valerian (*Valeriana officinalis*), Common Mouse-ear, Ragged Robin (*Silene flos-cuculi*), Marsh Horsetail (*Equisetum palustre*), Great Horsetail (*E. telmateia*), Meadow Vetchling, Marsh Bird's-foot Trefoil (*Lotus pedunculatus*), Lesser Trefoil (*Trifolium dubium*), Red Clover, White Clover, Tufted Vetch, Square-stalked St. John's-wort (*Hypericum tetrapterum*), Yellow Iris (*Iris pseudacorus*), Jointed Rush, Toad Rush, Soft-rush, Hard Rush, Water Mint, Selfheal, Purple Loosestrife (*Lythrum salicaria*), Foxglove, Ribwort Plantain, Greater Plantain, Brooklime (*Veronica becca-bunga*), Marsh Foxtail (*Alopecurus geniculatus*), Crested Dog's Tail, Tufted hair-grass (*Deschampsia cespitosa*), Yorkshire Fog, Perennial Rye-grass, Reed Canary Grass (*Phalaris arundinacea*), Common Reed (*Phragmitis australis*), Water Pepper, Clustered Dock (*Rumex conglomeratus*), Creeping Jenny (*Lysimachia nummularia*), Marsh Marigold (*Caltha palustris*), Lesser Spearwort (*Ranunculus flammula*), Creeping Buttercup, Silverweed, Cleavers, Marsh Bedstraw (*Galium palustre*), Bittersweet (*Solanum dulcamara*) and Branched Bur-Reed (*Sparganium erectum*).

Tall Ruderals

5.2.17 Tall ruderal vegetation was common and widespread across the survey area and typically occurred between grassland margins, woodland/ scrub edges and along field boundaries. The Phase 1 habitat maps only show where tall ruderal vegetation occurred in larger areas. Species recorded included Common Nettle (*Urtica dioica*), Bracken (*Pteridium aquilinum)*, Rosebay Willowherb (*Chamerion angustifolium),* Greater Willowherb (*Epilobium hirsutum*)*,* Pendulous Sedge (*Carex pendula*), Hogweed, Vervain (*Verbena sp.*), Ragwort (*Senecio jacobaea),* Yarrow (*Achillea millefolium*), Ribwort Plantain*,* Knapweed, Raspberry (*Rubus sp.)*, Hedge Woundwort*,* Hedge Bindweed (*Calystegia sepium*), Giant Bindweed (*Calystegia sylvatica),* Hedge Parsley (*Torilis japonica),* Nipplewort (*Lapsana communis*), Red Campion*,* Herb Robert (*Geranium robertianum),* Broad-leaved Dock, Knapweed, Spear Thistle, Creeping Thistle, Marsh Thistle, Cleavers, Prickly Sow-thistle, Common Sow-thistle (*S. oleraceus*), Fleabane, Cock's-foot, Yorkshire Fog, Timothy, Hemlock Water-dropwort, Creeping Buttercup, White Clover,

Standing Water

- Ponds
  - Three ponds were recorded on the north western (TN80; TN104) and southern (TN22) section of the survey area. One pond (TN104) was located on the edge of a farmyard and was bordered by semi-mature and mature trees. At the time of the survey, the pond held water. The second pond (TN80) was located on the edge of a small block of woodland and was dry at the time of the survey. The third pond (TN22) was located within the corner of two improved fields and was surrounded by mature and semi-mature trees. At the time of the survey the pond held water.

Running Water

- Streams
  - The watercourse Nant Tredodridge was recorded on the north western section of the survey area and flows from the south west to the north east where it joins with the River Ely (outside of the scheme boundary). The water level was particularly low and in places only held small pools of water or had a sluggish flow. In locations, cattle had poached the stream banks. The channel was approximately 2m wide. The watercourse flows through areas of woodland and there was little riparian or emergent vegetation.
  - The watercourse Nant-y-Felin was recorded towards the southern section of the survey area and flows from the south west to the north east where it joins with the River Ely (outside of

the scheme boundary). The watercourse banks were densely vegetated with tall ruderal and scrub vegetation making it difficult to view the water level and flow, however, the watercourse did convey water. The channel was approximately 2-3m in wide and the banks were relatively steep. The watercourse flowed through improved grassland fields.

- Two further watercourses were identified towards the north east of the survey area. These were relatively small streams with slow flowing, very low water levels. The northern watercourse flowed through an area of broadleaved semi-natural woodland, and was approximately 1-2m in width, with an earth bed. The watercourse banks had been poached by cattle and had no riparian or emergent vegetation. The eastern watercourse (east of Pendoylan) flowed through woodland and grassland fields and was approximately 2m in width. It had a gravel and silt bed and was heavily shaded by the surrounding woodland, where it had little riparian or emergent vegetation.

- Ditches
  - Numerous ditches and drains were recorded across the survey area and were associated with field boundaries, however, at the time of survey, the majority were dry or held very little water.

Arable

5.2.18 A few arable fields were recorded within the north western section of the survey area. At the time of the survey, these fields supported Barley and Wheat (*Triticum aestivum*) crops.

Amenity Grassland

5.2.19 Some small areas of amenity grassland were recorded on the north western and western section of the survey area. These areas were typically associated with residential housing and local amenity areas within the village of Pendoylan. The grass was regularly cut and maintained with a very short sward therefore abundances of species could not be estimated accurately. Species recorded included meadow grass (*Poa sp.)*, White Clover, Creeping Buttercup and Broadleaved Plantain (*Plantago major)*.

Hedges Intact – Native Species-rich, including with and without trees

5.2.20 A large number of hedgerows were recorded throughout the survey area. These hedgerows were identified as species-rich as they supported five or more native woody species and a good hedgerow bottom flora. The majority of these hedgerows were located along field boundaries, and often connected areas of woodland throughout the survey area. The hedgerows were typically dense in structure and were of varied width (approximately 2m to 3m) and height (approximately 2m to 4m). Many hedgerows were present along drainage ditches, although the vast majority of these ditches were dry. The most common woody species recorded within the hedgerows were Hazel, Ash, Pedunculate Oak, Hawthorn, Blackthorn, Elder, Holly, Honeysuckle (Lonicera periclymenum) and Willow (Salix sp.). Other woody species recorded less frequently included Alder, Beech, Birch, Cherry, Crab Apple (Malus Sylvestris), Dogwood, Field Maple (Acer campestre), Rowan, Sycamore and Wych Elm (Ulmus glabra).

5.2.21 The hedgerows supported a diversity of flora species. The most dominant species was Bramble, which was present in every hedgerow. Frequently recorded species included Black Bryony, Bracken, Cleavers, Common Vetch, Bush Vetch, Creeping Buttercup, Creeping Thistle, Dandelion, False-brome, False Oat-grass, Foxglove, Hedge Bindweed, Greater Willowherb, Hart's-tongue Fern, Hogweed, Ivy (Hedera helix), Lesser Stitchwort, Lords-and-Ladies (Arum maculatum), Meadowsweet, Common Nettle, Nipplewort, Red Campion, Dog Rose (Rosa canina), Selfheal, Wood Avens and Yorkshire Fog.

5.2.22 Other flora species less frequently recorded included Bittersweet, Couch, Dog's Mercury (Mercurialis perennis), Garlic Mustard (Alliaria petiolata), Giant Fescue, Greater Celandine (Chelidonium majus), Hops (Humulus lupulus), Marsh Bedstraw, Clustered Dock, Sterile Brome (Bromus sterilis), Wild Strawberry (Fragaria vesca) and Violet (Viola sp.).

5.2.23 Mature or semi-mature trees, often including Pedunculate Oak, Ash, Willow, Beech, Alder, Field Maple, Sycamore and Hazel were also a regular feature present along the hedgerows.

Hedges Intact and Defunct – Species Poor, including with and without trees

5.2.24 A number of hedges were identified as species poor as they supported fewer than five woody species along the length of the hedgerow. These hedgerows, similar to the species-rich hedgerows, were located along field boundaries and connected areas of woodland and occasionally were present along a dry drainage ditch. A small number of hedgerows were identified as 'defunct' as the hedge had gaps along the length of them, rendering them no longer stock-proof. Some of these hedgerows contained semi-mature, young and mature trees.

5.2.25 Species frequently recorded in the hedgerows included Hazel, Hawthorn, Ash, Sycamore, Oak, Beech, Dogwood, Field Maple, Wych Elm, Cherry, Holly, Bracken, Bramble and Dog Rose.

Buildings

5.2.26 A number of buildings are located within the Village of Pendoylan and Clawdd-Coch. Several farm buildings were also scattered throughout the survey area. Detailed surveys of these buildings were not undertaken during the Phase 1 Habitat walkover.

Non-Native Invasive Plant Species

5.2.27 Indian Balsam was recorded throughout the survey area and was typically encountered along hedgerows, ditches, within woodland and within grassland fields. Surveyors recorded all observations of the plant on site TN20, TN21, TN60, TN67, TN105, TN106, TN107, TN122, TN123); however, it is more than likely that surveyors may have missed areas additional occurrences of this plant.

Protected Plant Species

5.2.28 Bluebell (*Hyacinthoides non-scripta*) was recorded in the broadleaved semi-natural woodland areas located at the north and centre of the survey area.

Protected and Notable Fauna

Terrestrial Invertebrates

5.2.29 Multiple species of beetles, butterflies, bees, moths and crickets were recorded during the survey. Violet oil beetle (*Meloe violaceus*) was recorded within the survey area.

5.2.30 The following species of butterflies were recorded during the survey; small copper (*Lycaena phlaeas*), Peacock (*Aglais io*), small tortoiseshell (*Aglais urticae*), meadow brown (*Maniola jurtina*) speckled wood (*Pararge aegeria*), comma butterfly (*Polygonia c-album*), Meadow brown was the most commonly recorded species.

5.2.31 One tree bumblebee (*Bombus hypnorum*) was recorded in a marshy grassland field east of Pendolyan.

5.2.32 Cinnabar moth (*Tyria jacobaeae*) and six-spot burnet (*Zygaena filipendulae*) were also recorded during the survey.

5.2.33 The following species of cricket were recorded during the survey; field grasshopper (*Chorthippus brunneus*), common green grasshopper (*Omocestus viridulus*), meadow grasshopper (*Pseudochorthippus parallelus*), short-winged cone-head (*Conocephalus dorsalis*) and speckled bush-cricket (*Leptophyes punctatissima*).

5.2.34 Of these species the cinnabar moth and violet oil beetle are both Priority Species, which are listed within Section 7 of the Environment (Wales) Act 2016.

5.2.35 The grassland, scrub, tall ruderal and woodland margins were considered suitable to support a diverse range of invertebrate species. Deadwood was common within woodland, hedgerows and treeline habitats which could provide habitat for a number of common terrestrial invertebrate species.

Aquatic Invertebrates

5.2.36 A number of ponds, ditches and watercourses were recorded across the survey area and are considered likely to be of value to a diverse range of invertebrate species.

Fish

5.2.37 The River Ely, Nant Tredodridge and Nant-y-Felin streams within the survey area are considered suitable to support fish species.

Amphibians

5.2.38 Three ponds (TN22, TN80, TN104) were identified within the survey area. One pond (TN80), located on the edge of a woodland, was dry at the time of the survey, however, it was considered that this pond could hold water at times in the year. The remaining two ponds held water at the time of the survey. The grassland, hedgerow, scrub, tall ruderal and woodland habitats in the vicinity of these ponds provide suitable foraging, commuting and hibernating opportunities for great crested newts and other species of amphibians.

Reptiles

5.2.39 A number of habitats throughout the study area are considered suitable to support foraging and hibernating reptiles in particular the areas of broadleaved woodland, scrub, grassland and tall ruderal vegetation, in particular field margins. A number of rubble piles and log piles were identified as potential hibernacula (TN83, TN88, TN119 and TN133).

Birds

5.2.40 A number of incidental bird sighting were recorded during the Phase 1 habitat survey including blackbird (*Turdus merula*) siskin (*Spinus spinus*), long-tailed tit (*Aegithalos caudatus*), nuthatch (*Sitta europaea*), buzzard (*Buteo buteo*), great spotted woodpecker (*Dendrocopos major*), wren (*Troglodytes troglodytes*), barn swallow (*Hirundo rustica*), goldfinch (*Carduelis carduelis*), coal tit (*Periparus ater*), stock dove (*Columba oenas*), wood pigeon (*Columba palumbus*), blue tit (*Cyanistes caeruleus*), yellowhammer (*Emberiza citronella*), reed bunting (*Emberiza schoeniclus*), coot (*Fulica atra*), lesser black-backed gull (*Larus fuscus*), linnet (*Linaria cannabina*), pied wagtail (*Motacilla alba yarrellii*), house sparrow (*Passer domesticus*chiffchaff (*Phylloscopus collybita*), green woodpecker (*Picus viridis*), bullfinch (*Pyrrhula pyrrhula*), blackcap (*Sylvia atricapilla*) and starling (*Sturnus vulgaris*).

5.2.41 The woodland, scattered trees, scrub and hedgerow habitats present throughout the survey area are likely to support breeding birds typical of these habitats and provide good foraging habitat, whilst the areas of less disturbed grassland were considered to be suitable for ground nesting birds It is possible that barn owl could use mature trees with suitable cavities for nesting and grassland and arable field margins for foraging, although no evidence was recorded during the Phase 1 habitat survey.

Bats

5.2.42 The woodland areas and scattered trees, some associated with hedgerows, throughout the study area have potential to support roosting bats (TN3, TN11, TN12, TN17, TN19, TN23, TN49, TN51, TN53, TN56, TN57 – TN69, TN 72, TN74, TN75, TN79, TN81, TN82, TN84, TN85. TN108, TN110, TN118 and TN134). Several farm buildings were identified with features suitable to support roosting bats e.g. cracks in brickwork, lose roof tiles (TN14, TN68, TN111 and TN135). Further buildings are scattered across the survey area which may also have potential to support roosting bats. No buildings within the survey area were subject to detailed (interior or exterior) building inspections.

5.2.43 Areas of potential foraging and commuting habitat for bats were found throughout the survey area. High value habitats included the woodland areas, hedgerows and treelines, watercourses, permanent waterbodies and grassland field margins with scrub and tall ruderal vegetation.

Hazel Dormouse

5.2.44 An analysis of aerial photography indicates that there is good connectivity and continuity of woodland and scrub habitat within the wider landscape to support dormice (*Muscardinus avellanarius*) within the survey area (TN4, TN18, TN55, TN57, TN69, TN71, TN73, TN74, TN75).

5.2.45 The areas of woodland and connecting hedgerow habitat within the survey area were considered suitable to support hazel dormice. The majority of woodlands had a diverse range of tree and shrub species, which are a valuable food source throughout the year for dormice. These species included abundant fruiting Hazel stools, Oak, Bramble, Sycamore, Ash, Honeysuckle and Hawthorn. These woodland areas also had a good physical structure, with the majority having a dense or well-structured understorey which provides suitable dormouse habitat.

Water Vole

5.2.46 A large number of ditches were recorded within the survey area, however, the majority of these were either dry at the time of survey and not considered suitable to support water vole (*Arvicola amphibius)*.

5.2.47 The River Ely, Nant Tredodridge and Nant-y-Felin which were less shaded by the woodland were considered to be suitable to support water vole.

Otter

5.2.48 The River Ely, Nant Tredodridge and Nant-y-Felin were assessed as suitable to support otters (*Lutra lutra*). Suitable habitat was present along the River Ely which would provide opportunities for resting otters. All of the watercourses were considered suitable to support foraging and/ commuting otters.

Badger

5.2.49 The areas of woodland, scrub and hedgerows within the survey area were assessed as suitable to support badgers (*Meles meles).*

Other Mammals

5.2.50 A number of habitats present within the survey area were assessed as suitable to support the following species; brown hare (*Lepus europaeus*), hedgehog (*Erinaceus europaeus*), polecat (*Mustela putorius), w*easel (*Mustela nivalis), stoat Mustela erminea* and harvest mouse (*Micromys minutus).*

6 Results | Sub-Section 3

6.1 Desk Study

Designated Sites

Statutory Designated Sites

6.1.1 There are no statutory designated sites within the study area, however two are present within the 2km search area, as summarised in Table 7 below. The locations of the statutory designated sites are shown on Drawing 10028657-ARC-XX-XX-DR-EC-0057-P1 Sheet Number 3.

Table 7 Statutory Designated Sites | Sub-Section 3

Site Name	Reasons for Designation	Location in relation to the proposed development
Ely Valley SSSI	9.5 km section of the River Ely which runs through the north-eastern part of the Vale near Cardiff. The Ely Valley supports the largest known population of the nationally scarce plant Monk's-hood.	900m east
Pysgodlyn Mawr SSSI	Small area of wetland which supports a wide range of habitats ranging from open water, through reed swamp, to heath and bog, which are very unusual in the lowland Vale area. There is an excellent dragonfly fauna which includes the nationally scarce downy emerald dragonfly (Cordulia aenea).	1.5km west

Non-Statutory Designated Sites

6.1.2 There are seven non-statutory designated sites within the study area and 50 non-statutory designated sites within the 2km search area, as summarised in Table 8 below. The locations of the non-statutory designated sites are shown on Drawing 10028657-ARC-XX-XX-DR-EC-0057-P1 Sheet Number 3.

Table 8 Non-Statutory Designated Sites | Sub-Section 3

Site Name	Reasons for designation	Location in relation to the proposed development
Coed Cadw SINC	A predominantly ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	0m
Coed Ffos-Ceibr SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1m
Coed Waunn-Lloff SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	3m

Site Name	Reasons for designation	Location in relation to the proposed development
Land West of Hensol Mill SINC	A series of wet meadows supporting Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	90m
South West of Castell Bach SINC	Ancient semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	120m
Coed Counsellor SINC	Extensive area of part-ancient semi-natural broadleaved woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	180m
Log Wood SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	180m
West of Clawdd-Coch Farm SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	260m
Land at Pendoylan Moors SINC	A complex of many small enclosed meadows supporting species-rich Purple Moor-grass and rush pasture with associated ditches, hedgerows and areas of tall-herb fen. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture, Reedbeds.	370m
South West of Dyffryn Bach SINC	Ancient semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	370m
Gaer Wood SINC	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	380m
North West of Duffryn Mawr Farm SINC	Species-rich rush pasture with pond. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	410m
Land near Hensol Mill SINC	Semi-natural broadleaved wet woodland, part on an ancient woodland site and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	430m
North of Pendoylan Moors SINC	Semi-natural broadleaved wet woodland that is contiguous with an extensive area of rush pasture. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	480m

Site Name	Reasons for designation	Location in relation to the proposed development
Land near Coed Pen-Brych SINC	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	510m
Cottrell Wood SINC	Semi-natural broadleaved woodland on an ancient woodland site and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	570m
East of Ty'n-y-Pwll SINC	Two distinct groups of meadows supporting species-rich mosaic of Purple Moor-grass and rush pasture and mire. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture.	570m
West of Warren Mill Farm Park SINC	Species-rich neutral grassland. It consists of UK BAP Priority Habitat – Lowland meadows.	600m
Land South of Hadod Y Wennol SINC	Species-rich Purple Moor-grass and rush pasture with semi-improved neutral grassland margins. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	620m
Hafod Y Wennol SINC	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	620m
Mill Ponds SINC	A linear former mill pond with dense stands of reedbed. It consists of UK BAP Priority Habitat – Ponds, Reedbeds.	620m
Warren Mill Farm Park SINC	Species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	640m
Mill Pond SINC	Old mill pond supporting diverse vegetation and associated marshy grassland. Mosaic habitats present. It consists of UK BAP Priority Habitat – Ponds.	820m
Ravenswood SINC	Series of ponds supporting tall herbs and swamp. It consists of UK BAP Priority Habitat – Ponds, Reedbeds.	930m
Gwern-y-Steeple SINC	Semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	960m
North of Coed Leision SINC	A series of species-rich neutral grasslands with areas of transitional rush pasture. It consists of UK BAP Priority Habitat – Lowland meadows.	1km

Site Name	Reasons for designation	Location in relation to the proposed development
West of Newydd Stables SINC	Species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	1km
Land near Gwern y Gae Isaf SINC	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1km
Land North of Brooklands Farm SINC	Semi-natural broadleaved woodland of which half is ancient woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.1km
Hensol Lake SINC	A large body of open water with reedbed and wet woodland fringe. It consists of UK BAP Priority Habitat – Ponds, Reedbeds, Wet woodland.	1.1km
North West of Croes-y-Parc Baptist Chapel SINC	Species-rich neutral meadows. It consists of UK BAP Priority Habitat – Lowland meadows.	1.1km
Land South West of Llanfarach Farm SINC	Semi-natural broadleaved wet woodland with associated pond. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland, Ponds.	1.1km
Land between M4 and Industrial Estate SINC	Semi-natural broadleaved wet woodland and native woodland. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	1.2km
Kingsland SINC	Ancient semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	1.3km
Land South of Llanfarach Farm SINC	Series of small wet meadows supporting species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture.	1.3km
Land West of Llanfarach Farm SINC	Semi-natural broadleaved wet woodland and native woodland. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	1.3km
Land West of Ty Newydd Farm SINC	Two wet meadows supporting species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture.	1.4km
South East of Llwyn-Rhyddid Cottages SINC	Ancient semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	1.4km

Site Name	Reasons for designation	Location in relation to the proposed development
West of Markswood SINC	Two semi-natural broadleaved wet woodlands and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	1.4km
Coed Llwyn-Rhyddid SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.5km
Coed Llwyn Rhyddid Wildlife Trust Reserve	A mixed secondary woodland supporting a large heronry.	1.5km
North of Gwern-y-Gedrynch SINC	Semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	1.5km
Redland Wood SINC	Predominantly ancient semi-natural broadleaved woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.5km
Land South of Glenholme SINC	Semi-natural broadleaved woodland of which the majority is ancient woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.6km
Land South of Oakfield SINC	A series of wet Purple Moor-grass and rush pastures. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	1.6km
Llwyn-yoy Pond SINC	Pond supporting diverse marginal vegetation and developing wet woodland. It consists of UK BAP Priority Habitat – Ponds, Wet woodland.	1.7km
Coed y Lan SINC	Semi-natural broadleaved woodland on an ancient woodland site and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.7km
Land adjacent to Forrester's House SINC	Semi-natural broadleaved woodland with fields signs of use by Common dormouse. Native woodlands and mammals present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.7km
East of Kingsland SINC	Part ancient semi-natural broadleaved woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.8km
Coed y Cwm SINC	Semi-natural broadleaved woodland, part on an ancient woodland site. Native woodlands present. It consists of	2km

Site Name	Reasons for designation	Location in relation to the proposed development
	UK BAP Priority Habitat – Lowland mixed deciduous woodland.	

6.1.3 Eleven areas of Ancient Semi-Natural Woodland (ASNW) and 1 Restored Ancient Woodland Site (RAWS) are present within the study area, including 6 ASNWs within 50m of the proposed development. A total of 93 ancient woodland sites, including ASNWs, RAWS and Plantation on Ancient Woodland Site (PAWS), are present within 2km of the proposed development.

6.1.4 Twenty-three Tree Preservation Orders (TPOs) are present within the study area, with 3 within 50m of the proposed development. A total of 255 TPOs are present within 2km of the proposed development.

6.1.5 The location of the ancient woodland and TPOs are shown in Drawing 10028657-ARC-XX-XX-DR-EC-0057-P1 Sheet Number 3.

Habitats and Flora

Protected and Priority Plant Species

6.1.6 The desk study returned records of bluebell within the study area and within the 2km search area. The closest record is 20m west of the proposed development. Bluebell is protected under Schedule 8 of the Wildlife and Countryside Act (WCA) 1981 (as amended) (Ref 11).

6.1.7 The desk study also returned records of Cornflower and *Parmotrema perlatum* (a lichen) within the 2km search area. The closest record is 225m west of the proposed development. Both species are listed under Section 7 of the Environment Act (Wales) 2016 (Ref 4).

6.1.8 The desk study also returned records of Broad-leaved Cottongrass (*Eriophorum latifolium*), Corn Chamomile, Corn Spurrey, Cornflower, Monk's-hood and Corn Marigold within the 2km search area. These species are listed under the Local Biodiversity Action Plan for the Vale of Glamorgan (LBAP (VOG)). The closest record is of Corn Chamomile 620m south of the proposed development.

Invasive Plant Species

6.1.9 The desk study returned records of Spanish Bluebell (*Hyacinthoides hispanica*), Indian Balsam and Japanese Knotweed within the study area. Indian Balsam and Japanese Knotweed are listed under Schedule 9 of the WCA 1981 (as amended) (Ref 11), whilst Spanish Bluebell is listed as an Invasive Non-Native Species (INNS). The closest record is of all three said species 20m south of the proposed development. The desk study also returned records of 12 invasive plant species within the 2km search area, summarised in Table 9 below.

Table 9 Invasive Plant Species Desk Study Records | Sub-Section 3

Common Name	Latin Name	Designation
Indian Balsam	Impatiens glandulifera	WCA9, INNS
Japanese Knotweed	Fallopia japonica	WCA9, INNS
Montbretia	Crocosmia pottsii x aurea = C. x crocosmiiflora	WCA9, INNS
Rhododendron ponticum	Rhododendron ponticum	WCA9, INNS

Common Name	Latin Name	Designation
Three-cornered Garlic	Allium triquetrum	WCA9, INNS
Wall Cotoneaster	Cotoneaster horizontalis	WCA9, INNS
Garden Yellow Archangel	Lamium galeobdolon subsp. argentatum	WCA9, INNS
Bluebell	Hyacinthoides non-scripta x hispanica = H. x massartiana	INNS
Cherry Laurel	Prunus laurocerasus	INNS
Giant Butterbur	Petasites japonicus	INNS
Orange Balsam	Impatiens capensis	INNS
Spanish Bluebell	Hyacinthoides hispanica	INNS

Protected and Notable Fauna

Terrestrial and Aquatic Invertebrates

6.1.10 The desk study returned records of golden-ringed dragonfly within the study area. The closest record is of a golden-ringed dragonfly 20m south of the proposed development. The desk study also returned records of 20 terrestrial and aquatic invertebrate species within the 2km search area including black-tailed skimmer (*Orthetrum cancellatum*), banded demoiselle (*Calopteryx splendens*) and silver-washed fritillary (*Argynnis paphia*).

Fish

6.1.11 The desk study returned no records of fish within the study area. However, there are records of European eel (*Anguilla anguilla*) within the 2km search area. European eel is listed under Section 7 of the Environment Act (Wales) 2016 (Ref 4). The closest record is of European eel 1.5 km west of the proposed development.

Amphibians

6.1.12 The desk study returned no records of amphibians within the study area, however returned records of five species of amphibians within the 2km search area. These include common frog, common toad and great crested newt. The closest record is of common frog and common toad 420m west of the proposed development.

Reptiles

6.1.13 The desk study returned no records of reptiles within the study area. However, there are records of common lizard and grass snake within the 2km search area. The closest record is of grass snake 420m west of the proposed development.

Birds

6.1.14 Four species afforded full protection under Schedule 1 of the WCA 1981 (as amended) have been recorded within the study area. These include merlin, red kite and fieldfare. The closest record is of a merlin 20m west of the proposed development. The desk study also returned records of 15 species afforded full protection under Schedule 1 of the WCA 1981 (as amended) (Ref 11) within the 2km search area. These include bittern, common crossbill (*Loxia curvirostra*) and brambling.

6.1.15 Nine species listed on the Red List of the BoCC (Ref 13) have been recorded within the study area including song thrush *(Turdus philomelos),* house sparrow, and linnet (*Linaria cannabina*). The

closest record is of house sparrow, skylark, song thrush, spotted flycatcher and starling 20m west of the proposed development. Nineteen species listed on the Red List of the BoCC (Ref 13) have also been recorded within the 2km search area including wood warbler, redwing and tree pipit.

6.1.16 Eleven species listed on the Amber List of the BoCC (Ref 13), have been recorded within the study area including mallard, dunnock and house martin. The closest record is of dunnock, house martin, mallard, meadow pipit, merlin, swallow and willow warbler 20m west of the proposed development. Thirty-six species listed on the Amber List of the BoCC (Ref 13) have been recorded within the 2km search area including barn owl, goldcrest and swift.

Bats

6.1.17 The desk study returned records of unidentified bat species within the study area. The closest record is of an unidentified bat species roost 230m south-west of the proposed development. The desk study also returned records of eight bat species within the 2km search area. These include lesser horseshoe bat (*Rhinolophus hipposideros),* noctule bat and brown long-eared bat. The records also include at least one roost for six of the eight bat species recorded.

Otter

6.1.18 The desk study returned no records of European otter (*Lutra lutra*) within the study area. However, there are records within the 2km search area. The closest record is of an otter spraint 1.4km east of the proposed development.

Water Vole

6.1.19 The desk study returned no records of European water vole (*Arvicola amphibius*) within the study area or within the 2km search area.

Hazel Dormouse

6.1.20 The desk study returned no records of hazel dormouse (*Muscardinus avellanarius*) within the study area. However, there are records within the 2km search area. The closest record is 1.4km west of the proposed development.

Badger

6.1.21 The desk study returned no records of Eurasian badger (*Meles meles*) within the study area however did return records within the 2km search area. The closest record is of a dead individual 1.4km west of the proposed development.

Other Mammals

6.1.22 The desk study returned records of European hedgehog within the study area. The closest record is 220m east of the proposed development. The desk study also returned records of European hedgehog, brown hare, harvest mouse (*Micromys minutus*), polecat and weasel within the 2km search area.

6.2 Field Study

6.2.1 The following description of the findings of the field study should be read in conjunction with the Phase 1 habitat plan (Drawing 10028657-ARC-XX-XX-DR-EC-0056, Sheet Number 3).

Habitats and Flora

Woodland

- Broadleaved Semi-Natural Woodland
  - Areas of broadleaved woodland were recorded to the north of the survey area as large and small stands and as small strips between field boundaries.
  - In the majority of areas, a diverse range of canopy species were frequently recorded including Pedunculate Oak (*Quercus robur),* Ash (*Fraxinus excelsior),* Alder, Willow species and Sycamore (*Acer pseudoplatanus*). Less frequently recorded canopy species included

Field Maple (*Acer campestre),* Yew (*Taxus baccata*), Lime species (*Tilia sp.),* and Birch species (*Betula sp.).* Understorey species typically present included Hazel (*Corylus avellana*), Holly (*Ilex aquifolium)*, Honeysuckle (*Lonicera periclymenum*), Hawthorn (*Crataegus monogyna),* Blackthorn (*Prunus spinosa),* Rose species (*Rosa sp.)* and Bramble.

- Ground flora species typically present included Cow Parsley (*Anthriscus sylvestris),* Hogweed (Heracleum sphondylium), Hemlock Water-dropwort (*Oenanthe crocata*), Lords-and-Ladies (*Arum maculatum*), Ivy (*Hedera helix*), Hart's-tongue Fern (*Asplenium scolopendrium*), Marsh Thistle (*Cirsium palustre*), Nipplewort (*Lapsana communis*), Garlic Mustard (*Alliaria petiolata*), Red Campion (*Silene dioica*), Scaly Male-fern (*Dryopteris affinis agg*.), Male-fern (*Dryopteris filix-mas*), Dog's Mercury (*Mercurialis perennis*), Herb-Robert (*Geranium robertianum*), Soft-rush (*Juncus effusus*), Ground-ivy (*Glechoma hederacea*), Selfheal (*Prunella vulgaris*), Hedge Woundwort (*Stachys sylvatica*), Rosebay Willowherb (*Chamaenerion angustifolium*), Enchanter's-nightshade (*Circaea lutetiana*), Germander Speedwell (*Veronica chamaedrys*), False Oat-grass (*Arrhenatherum elatius*), False-brome (*Brachypodium sylvaticum*), Hairy-brome (*Bromopsis ramosa*), Giant Fescue (*Festuca gigantea*), Water Pepper (*Persicaria hydropiper*), Broad-leaved Dock (*Rumex obtusifolius*), Wood Avens (*Geum urbanum*), Common Nettle (*Urtica dioica)* and Cleavers (*Galium aparine*).
- Some of the woodland areas had abundant leaf litter and bare earth present as part of the ground layer, but in places Bramble and common nettles were often abundant.

- Mixed Semi-Natural Woodland
  - One large area of mixed semi-natural woodland was present within the survey area towards the north east of the survey area. Species recorded within the canopy layer included Pedunculate Oak, Ash, Beech, Willow, Field Maple, Birch species, Sycamore and Fir species (*Abies sp.)*. Species recorded within the understorey included Elder, Hazel, Dogwood (*Cornus sanguinea),* Hawthorn, Holly, Rose species, Bramble, Honeysuckle, Ivy and Rowan (*Sorbus aucuparia).* Species recorded within the ground layer included Wild Angelica (*Angelica sylvestris*), Hogweed, Hemlock Water-dropwort, Lords-and-Ladies, Hart's-tongue Fern, Nipplewort, Dandelion, Wavy Bitter-cress (*Cardamine flexuosa*), Red Campion, Remote Sedge (*Carex remota*), Wood Sedge (*Carex sylvatica*), Scaly Male-fern, Narrow Buckler-fern (*Dryopteris dilatata*), Broad Buckler-fern, Dog's Mercury, Herb-Robert, Ground-ivy, Garden Yellow Archangel (*Lamiastrum galeobdolon*), Selfheal, Enchanter's-nightshade, Foxglove, Wood Speedwell (*Veronica montana*), False-brome, Hairy-Brome, Giant Fescue, Polypody Fern species (*Polypodium* sp.), Yellow Pimpernel, Wood Anemone (*Anemone nemorosa*), Creeping Buttercup, Meadowsweet, Wood Avens, Cleavers and Marsh Bedstraw.
- Mixed Plantation Woodland
  - Two areas of mixed plantation woodland were recorded at the northern and south western sections of the survey area. Species recorded included Conifer species, Ash, Oak, Beech, Birch species, Scot's Pine (*Pinus Sylvestris)*, Willow species, Lime species, Sweet Chestnut Hawthorn, Dogwood, Bramble, Enchanter's-nighshade, Bittersweet, Dog's Mercury, Clustered Dock, Male Fern, Ivy, Hart's-tongue Fern, Wood Avens, Herb-Robert, Selfheal, Spear Thistle (*Cirsium vulgare*), Meadowsweet, Hedge Woundwort, Scaly Male-fern, Angelica (*Angelica sylvestris),* Wood Melick (*Melica uniflora),* Hemlock Water-dropwort , Marsh Bedstraw, Red Campion, Soft-rush, Willowherb species (*Epilobium sp.),* Yellow Pimpernel, Lords-and-Ladies, Remote Sedge, Common Nettle and Greater Plantain (*Plantago major*).

Dense and Scattered Scrub

6.2.2 Dense and scattered scrub occurred frequently throughout the survey area at locations which were relatively unmanaged, typically between grassland margins, along field boundaries e.g. adjacent to hedgerows and woodland edges. The stands typically comprised Bramble, however, in places, stands of young Willow were recorded. Where this occurred, willow was the dominant species present. The structure was dense, with little understorey or ground flora.

6.2.3 Along field margins, dense and scattered scrub frequently formed a mosaic with tall ruderal vegetation. The Phase 1 habitat maps only show where dense scrub occurred in larger areas.

6.2.4 Species present included young Willow saplings, Alder saplings, Bramble, Elder (*Sambucus nigra*) and Hazel.

Scattered Trees and Treelines

6.2.5 Scattered trees of varying ages were recorded across the study area within grassland fields and hedgerows. Mature and semi-mature Pedunculate Oak and Ash were the most prominent scattered trees along hedgerows and/ or located within grassland fields, many of which were considered to have bat potential. Species recorded included Hazel, Sycamore (Acer pseudoplatanus), Pine (Pinus sp.), Birch (Betula sp.), Turkey oak (Q. Cerris), Sweet Chestnut, Horse Chestnut (Aesculus hippocastanum), Poplar (Populus sp.), Willow, Cherry (Prunus sp.), Alder, Hornbeam (Carpinus betulus) and Beech (Fagus sylvatica).

6.2.6 Treelines of mature and semi-mature trees were recorded across the survey area. The majority of these treelines were located along field boundaries, and often connected areas of woodland throughout the survey area. Species recorded included Oak, Ash, Alder, Lime species, Beech, Hazel and Sycamore.

6.2.7 Detailed surveys of the trees present within these features were not undertaken during the Phase 1 Habitat walkover, however, a large number of these were noted with bat roosting potential.

Neutral Semi-Improved Grassland

6.2.8 One field of neutral semi-improved grassland was identified in the south of the survey area. T

6.2.9 Dominant and abundant species recorded included False Oat-grass, Crested Dog's-tail (*Cynosurus cristatus*), Cock's-foot, Common Couch (*Elytrigia repens*), Yorkshire Fog (*Holcus lanatus*), Perennial Rye-grass (*Lolium perenne*), Timothy (*Phleum pratense*), Rough Meadow-grass (*Poa trivialis*), Hogweed, Yarrow, Knapweed (*Centaurea nigra*), Creeping Thistle (*Cirsium arvense*), Dandelion, White Clover (*T. repens*), Ribwort Plantain (*Plantago lanceolata*), Meadow Buttercup (*Ranunculus acris*) and Creeping Buttercup (*R. repens*).

6.2.10 The following plant species were recorded less frequently or only occasionally throughout the survey area. Common Bent (*Agrostis capillaris*), Sweet Vernal-grass (*Anthoxanthum odoratum*), Spear Thistle (*C. vulgare*), Cat's-ear (*Hypochaeris radicata*), Oxeye Daisy (*Leucanthemum vulgare*), Ragwort (*Senecio jacobaea*), Teasel (*Dipsacus fullonum*), Lesser Stitchwort (*Stellaria gramine*a), Meadow Vetchling (*Lathyrus pratensis*), Red Clover (*Trifolium pratense*), Tufted Vetch (*Vicia cracca*), Common Vetch (*V. sativa*), Bush Vetch (*V. sepium*), Selfheal, Yellow Rattle (*Rhinanthus minor*), Foxglove (*Digitalis purpurea*), Common Sorrel (*Rumex acetosa*), Creeping Cinquefoil (*Potentilla reptans*), Silverweed (*P. anserina*), Dock (*Rumex sp.*) and Cleavers.

Improved Grassland

6.2.11 A number of fields throughout the survey area supported improved grassland fields. At the time of survey some of the fields had been recently cut and some were subject to cattle grazing. Along the field margins, a higher diversity of plant species were recorded and small areas of tall ruderals and/ or scrub habitat were also noted. The grass species composition was generally consistent throughout the study area with grass species frequently recorded throughout the different fields.

6.2.12 Dominant grass species recorded across the survey area included False Oat-grass, Crested Dog's-tail, Cock's-foot, Yorkshire Fog, Italian Rye-grass (*Lolium multiflorum*), Perennial Rye-grass (*L. perenne*).

6.2.13 The following plant species were typically identified along the margins of the improved grassland fields; however, some species were also present within the grassland field. The following species were considered abundant across the survey area; Hogweed, Daisy (*Bellis perennis*), Creeping Thistle, Spear Thistle, Dandelion, White Clover, Soft Brome (*Bromus hordeaceus*), Meadow Buttercup, Creeping Buttercup, Silverweed and Common Nettle.

6.2.14 The following plant species were recorded less frequently or only occasionally throughout the survey area. The majority of these species occurred within the field margins or were occasionally present among the Common Bent, Creeping Bent (*Agrostis stolonifera*), Sweet Vernal Grass, Timothy, Annual Meadow-grass (*Poa annua*), Smooth Meadow-grass (*P. pratensis*), Rough Meadow-grass (*P. trivialis*), Yarrow, Pineapple Weed (*Matricaria discoidea*), Prickly Sow-thistle (*Sonchus asper*), Scentless Mayweed (*Tripleurospermum maritimum*), Shepherd's Purse (*Capsella bursa-pastoris*), Lesser Swine-cress (*Coronopus didymus*), Common Mouse-ear (*Cerastium fontanum*), Lesser Stitchwort (*Stellaria graminea*), Red Clover, Cut-leaved Crane's-bill (*Geranium dissectum*), Selfheal, Ribwort Plantain, Greater Plantain, Pale Smartweed (*Persicaria lapathifolia*), Redshank (*P. maculosa*), Knotgrass (*Polygonum aviculare*), Broad-leaved Dock and Creeping Cinquefoil.

6.2.15 Several fields across the survey area had field margins and/ or corners which had wetter ground conditions, likely due to the local topography. In these areas, the following plant species were recorded; Marsh Foxtail (*Alopecurus geniculatus*), Jointed Rush (Juncus articulates), Toad Rush (*J. bufonius*), Soft-rush (*J. effusus*), Hard Rush (*J. inflexus*), Floating Sweet-grass (*Glyceria fluitans*), Marsh Cudweed (*Gnaphalium uliginosum*), Marsh Thistle and Water Forget-me-not (*Myosotis scorpioides*).

Marshy Grassland

6.2.16 Several smaller fields, predominately to the north and north east of the survey area, contained areas of marshy grassland. Soft-rush, Marsh Ragwort and Meadowsweet were common and widespread in these areas. Species recorded included Fool's Water-cress (*Apium nodiflorum*), Hemlock Water-dropwort , Kanpweed, Creeping Thistle, Marsh Thistle, Spear Thistle, Dandelion, Indian Balsam (*Impatiens glandulifera*), Water Forget-me-not, Valerian (*Valeriana officinalis*), Common Mouse-ear, Ragged Robin (*Silene flos-cuculi*), Marsh Horsetail (*Equisetum palustre*), Great Horsetail (*E. telmateia*), Meadow Vetchling, Marsh Bird's-foot Trefoil (*Lotus pedunculatus*), Lesser Trefoil (*Trifolium dubium*), Red Clover, White Clover, Tufted Vetch, Square-stalked St. John's-wort (*Hypericum tetrapterum*), Yellow Iris (*Iris pseudacorus*), Jointed Rush, Toad Rush, Soft-rush, Hard Rush, Water Mint, Selfheal, Purple Loosestrife (*Lythrum salicaria*), Foxglove, Ribwort Plantain, Greater Plantain, Brookline (*Veronica becca-bunga*), Marsh Foxtail (*Alopecurus geniculatus*), Crested Dog's Tail, Tufted hair-grass (*Deschampsia cespitosa*), Yorkshire Fog, Perenial Rye-grass, Reed Canary Grass (*Phalaris arundinacea*), Common Reed (*Phragmitis australis*), Water Pepper, Clustered Dock (*Rumex conglomeratus*), Creeping Jenny (*Lysimachia nummularia*), Marsh Marigold (*Caltha palustris*), Lesser Spearwort (*Ranunculus flammula*), Creeping Buttercup, Silverweed, Cleavers, Marsh Bedstraw (*Galium palustre*), Bittersweet (*Solanum dulcamara*) and Branched Bur-Reed (*Sparganium erectum*).

Tall Ruderals

6.2.17 Tall ruderal vegetation was common and widespread across the survey area and typically occurred between grassland margins, woodland/ scrub edges and along field boundaries. The Phase 1 habitat maps only show where tall ruderal vegetation occurred in larger areas. Species recorded included Common Nettle (*Urtica dioica*), Bracken (*Pteridium aquilinum)*, Rosebay Willowherb (*Chamerion angustifolium),* Greater Willowherb (*Epilobium hirsutum*), Pendulous Sedge (*Carex pendula*), Hogweed, Vervain (*Verbena sp.*), Ragwort (*Senecio jacobaea),* Yarrow (*Achillea millefolium*), Ribwort Plantain, Knapweed, Raspberry (*Rubus sp.)*, Hedge Woundwort, Hedge Bindweed (*Calystegia sepium*), Giant Bindweed (*Calystegia sylvatica),* Hedge Parsley (*Torilis japonica),* Nipplewort (*Lapsana communis*), Red Campion, Herb Robert (*Geranium robertianum),* Broad-leaved Dock, Knapweed, Spear Thistle, Creeping Thistle, Marsh Thistle, Cleavers, Prickly Sow-thistle, Common Sow-thistle (*S. oleraceus*), Fleabane, Cock's-foot, Yorkshire Fog, Timothy, Hemlock Water-dropwort , Creeping Buttercup, White Clover,

Standing Water

- Ponds
  - Four ponds were recorded on the north western (TN76, TN80, TN104) and southern (TN22) section of the survey area. The first pond (TN76) was surrounded by dense scrub and young

trees and was located within the corner of an improved grassland field. Due to the dense vegetation it was not possible to see if the pond held water. The second pond (TN80) was located on the edge of a small block of woodland and was dry at the time of the survey. The third pond (TN104) was located on the edge of a farmyard and was boarded by semi-mature and mature trees. At the time of the survey the pond held water. The fourth pond (TN22) was located within the corner of two improved fields and was surrounded by mature and semi-mature trees. At the time of the survey the pond held water.

Running Water

- Streams
  - The watercourse Nant Tredodridge was recorded on the north western section of the survey area and flows from the south west to the north east where it joins with the River Ely (outside of the scheme boundary). The water level was particularly low and in places only held small pools of water or had a sluggish flow. In locations, cattle had poached the stream banks. The channel was approximately 2m wide. The watercourse flows through areas of woodland and there was little riparian or emergent vegetation.
  - The watercourse Nant-y-Felin was recorded towards the southern section of the survey area and flows from the south west to the north east where it joins with the River Ely (outside of the scheme boundary). The watercourse banks were densely vegetated with tall ruderal and scrub vegetation making it difficult to view the water level and flow, however, the watercourse did convey water. The channel was approximately 2-3m in wide and the banks were relatively steep. The watercourse flowed through improved grassland fields.
  - One further watercourse was identified towards the south west of the survey area and flows from the west to the east through woodland and along the boundary of a residential property. The stream joins with Nant-y-Felin further downstream. The channel was approximately 1-2m wide and the water was clear and unpolluted. Abundant Hemlock Water-dropwort was present along the length of the watercourse.
- Ditches
  - Numerous ditches and drains were recorded across the survey area and were associated with field boundaries, however, at the time of survey, the majority were dry or held very little water.

Arable

6.2.18 A few arable fields were recorded within the northern section of the survey area. At the time of the survey, these fields supported Barley and Wheat crops.

Amenity Grassland

6.2.19 Some small areas of amenity grassland were recorded on the north western and western section of the survey area. These areas were typically associated with residential housing and local amenity areas within the village of Pendoylan. The grass was regularly cut and maintained with a very short sward therefore abundances of species could not be estimated accurately. Species recorded included meadow grass (*Poa sp.)*, White Clover, Creeping Buttercup and Broadleaved Plantain (*Plantago major)*.

Hedges Intact – Native Species-rich, including with and without trees

6.2.20 A large number of hedgerows were recorded throughout the survey area. These hedgerows were identified as species-rich as they supported five or more native woody species and a good hedgerow bottom flora. The majority of these hedgerows were located along field boundaries, and often connected areas of woodland throughout the survey area. The hedgerows were typically dense in structure and were of varied width (approximately 2m to 3m) and height (approximately 2m to 4m). Many hedgerows were present along drainage ditches, although the vast majority of these ditches were dry. The most common woody species recorded within the hedgerows were Hazel, Ash, Pedunculate Oak, Hawthorn, Blackthorn, Elder, Holly, Honeysuckle (Lonicera periclymenum) and

Willow (Salix sp.). Other woody species recorded less frequently included Alder, Beech, Birch, Cherry, Crab Apple (Malus Sylvestris), Dogwood, Field Maple (Acer campestre), Rowan, Sycamore and Wych Elm (Ulmus glabra).

6.2.21 The hedgerows supported a diversity of flora species. The most dominant species was Bramble, which was present in every hedgerow. Frequently recorded species included Black Bryony, Bracken, Cleavers, Common Vetch, Bush Vetch, Creeping Buttercup, Creeping Thistle, Dandelion, False-brome, False Oat-grass, Foxglove, Hedge Bindweed, Greater Willowherb, Hart's-tongue Fern, Hogweed, Ivy (Hedera helix), Lesser Stitchwort, Lords-and-Ladies (Arum maculatum), Meadowsweet, Common Nettle, Nipplewort, Red Campion, Dog Rose (Rosa canina), Selfheal, Wood Avens and Yorkshire Fog.

6.2.22 Other flora species less frequently recorded included Bittersweet, Couch, Dog's Mercury (Mercurialis perennis), Garlic Mustard (Alliaria petiolata), Giant Fescue, Greater Celandine (Chelidonium majus), Hops (Humulus lupulus), Marsh Bedstraw, Clustered Dock, Sterile Brome (Bromus sterilis), Wild Strawberry (Fragaria vesca) and Violet (Viola sp.).

6.2.23 Mature or semi-mature trees, often including Pedunculate Oak, Ash, Willow, Beech, Alder, Field Maple, Sycamore and Hazel were also a regular feature present along the hedgerows.

Hedges Intact and Defunct – Species Poor, including with and without trees

6.2.24 A number of hedges were identified as species poor as they supported fewer than five woody species along the length of the hedgerow. These hedgerows, similar to the species-rich hedgerows, were located along field boundaries and connected areas of woodland and occasionally were present along a dry drainage ditch. A small number of hedgerows were identified as 'defunct' as the hedge had gaps along the length of them, rendering them no longer stock-proof. Some of these hedgerows contained semi-mature, young and mature trees.

6.2.25 Species frequently recorded in the hedgerows included Hazel, Hawthorn, Ash, Sycamore, Oak, Beech, Dogwood, Field Maple, Wych Elm, Cherry, Holly, Bracken, Bramble and Dog Rose.

Buildings

6.2.26 A number of buildings are located within the Village of Pendoylan and Clawdd-Coch. Several farm buildings were also scattered throughout the survey area. Detailed surveys of these buildings were not undertaken during the Phase 1 Habitat walkover.

Non-Native Invasive Plant Species

6.2.27 Indian Balsam was recorded throughout the survey area and was typically encountered along hedgerows, ditches, within woodland and within grassland fields. Surveyors recorded all observations of the plant on site (TN20, TN21, TN50, TN87, TN105, TN106, TN107, TN121 and TN123); however, it is more than likely that surveyors may have missed areas additional occurrences of this plant.

6.2.28 Japanese Knotweed (TN70) and Indian Balsam (*Impatiens glandulifera*) (TN78) were also recorded within the survey area.

Protected Plant Species

6.2.29 Bluebell (*Hyacinthoides non-scripta*) was recorded in the broadleaved semi-natural woodland areas located at the north east of the survey area.

Protected and Notable Fauna

Terrestrial Invertebrates

6.2.30 Multiple species of beetle, butterflies, moth and crickets were recorded during the survey. Green dock beetle (*Gastrophysa viridula*) was recorded within the survey area.

6.2.31 The following species of butterflies were recorded during the survey; Peacock (*Aglais io*), small tortoiseshell (*Aglais urticae*), meadow brown (*Maniola jurtina*) and comma butterfly (*Polygonia c-album*). Meadow brown was the most commonly recorded species.

6.2.32 Cinnabar moth (*Tyria jacobaeae*) was also recorded during the survey.

6.2.33 The following species of cricket were recorded during the survey; common green grasshopper (Omocestus viridulus), meadow grasshopper (Pseudochorthippus parallelus), speckled bush-cricket (Leptophyes punctatissima).

6.2.34 Of these species the cinnabar moth is a Priority Species, which is listed within Section 7 of the Environment (Wales) Act 2016.

6.2.35 The grassland, scrub, tall ruderal and woodland margins were considered suitable to support a diverse range of invertebrate species. Deadwood was common within woodland, hedgerows and treeline habitats which could provide habitat for a number of common terrestrial invertebrate species.

Aquatic Invertebrates

6.2.36 A number of ponds, ditches and watercourses were recorded across the survey area and are considered likely to be of value to a diverse range of invertebrate species.

Fish

6.2.37 The River Ely and Nant Tredodridge stream within the survey area are considered suitable to support fish species.

Amphibians

6.2.38 Four ponds were identified within the survey area. Due to dense vegetation it was not possible to see if pond (TN76) held water. One pond (TN80), located on the edge of a woodland, was dry at the time of the survey, however, it was considered that this pond could hold water at times in the year. The remaining two ponds (TN22, TN104) both held water at the time of the survey. The grassland, hedgerow, scrub, tall ruderal and woodland habitats in the vicinity of these ponds provide suitable foraging, commuting and hibernating opportunities to great crested newts and other species of amphibians.

Reptiles

6.2.39 A number of habitats throughout the study area are considered suitable to support foraging and hibernating reptiles in particular the areas of broadleaved woodland, scrub, grassland and tall ruderal vegetation, in particular field margins. A number of rubble piles and log piles were identified as potential hibernacula (TN86, TN88 and TN119).

Birds

6.2.40 A number of incidental bird sighting were recorded during the Phase 1 habitat survey including blackbird (*Turdus merula*) siskin (*Spinus spinus*), long-tailed tit (*Aegithalos caudatus*), nuthatch (*Sitta europaea*), buzzard (*Buteo buteo*), great spotted woodpecker (*Dendrocopos major*), wren (*Troglodytes troglodytes*), barn swallow (*Hirundo rustica*), goldfinch (*Carduelis carduelis*), coal tit (*Periparus ater*), stock dove (*Columba oenas*), wood pigeon (*Columba palumbus*), blue tit (*Cyanistes caeruleus*), yellowhammer (*Emberiza citronella*), reed bunting (*Emberiza schoeniclus*), coot (*Fulica atra*), lesser black-backed gull (*Larus fuscus*), linnet (*Linaria cannabina*), pied wagtail (*Motacilla alba yarrellii*), house sparrow (*Passer domesticus*chiffchaff (*Phylloscopus collybita*), green woodpecker (*Picus viridis*), bullfinch (*Pyrrhula pyrrhula*), blackcap (*Sylvia atricapilla*) and starling (*Sturnus vulgaris*).

6.2.41 The woodland, scattered trees, scrub and hedgerow habitats present throughout the survey area are likely to support breeding birds typical of these habitats and provide good foraging habitat, whilst the areas of less disturbed grassland were considered to be suitable for ground nesting birds It is possible that barn owl could use mature trees with suitable cavities for nesting and grassland and arable field margins for foraging, although no evidence was recorded during the Phase 1 habitat survey.

Bats

6.2.42 The woodland areas and scattered trees, some associated with hedgerows, throughout the study area have potential to support roosting bats (TN 11, TN17, TN19, TN23, TN79, TN81, TN108, TN110 and TN118). Several farm buildings were identified with features suitable to support roosting bats e.g. cracks in brickwork, lose roof tiles (TN111). Further buildings are scattered across the survey area which may also have potential to support roosting. No buildings within the survey area were subject to detailed (interior or exterior) building inspections.

6.2.43 Areas of potential foraging and commuting habitat for bats were found throughout the survey area. High value habitats included the woodland areas, hedgerows and treelines, watercourses, permanent waterbodies and grassland field margins with scrub and tall ruderal vegetation.

Hazel Dormouse

6.2.44 An analysis of aerial photography indicates that there is good connectivity and continuity of woodland and scrub habitat within the wider landscape to support dormice (*Muscardinus avellanarius*) within the survey area (TN6 and TN18).

6.2.45 The areas of woodland and connecting hedgerow habitat within the survey area were considered suitable to support hazel dormice. The majority of woodlands had a diverse range of tree and shrub species, which are a valuable food source throughout the year for dormice. These species included abundant fruiting Hazel stools, Oak, Bramble, Sycamore, Ash, Honeysuckle and Hawthorn. These woodland areas also had a good physical structure, with the majority having a dense or well-structured understorey which provides suitable dormouse habitat.

Water Vole

6.2.46 A large number of ditches were recorded within the survey area, however, the majority of these were either dry at the time of survey and not considered suitable to support water vole (*Arvicola amphibius)*.

6.2.47 The River Ely, Nant Tredodridge and Nant-y-Felin which were less shaded by the woodland were considered to be suitable to support water vole.

Otter

6.2.48 The River Ely, Nant Tredodridge and Nant-y-Felin were assessed as suitable to support otters (*Lutra lutra*). Suitable habitat was present along the River Ely which would provide opportunities for resting otters. All of the watercourses were considered suitable to support foraging and/ commuting otters.

Badger

6.2.49 The areas of woodland, scrub and hedgerows within the survey area were assessed as suitable to support badgers (*Meles meles).*

Other Mammals

6.2.50 A number of habitats present within the survey area were assessed as suitable to support the following species brown hare (*Lepus europaeus*), hedgehog (*Erinaceus europaeus*), polecat (*Mustela putorius), w*easel (*Mustela nivalis),* stoat *(Mustela erminea)* and harvest mouse (*Micromys minutus).*

7 Results | Sub-Section 4

7.1 Desk Study

Designated Sites

Statutory Designated Sites

7.1.1 There are no statutory designated sites within the study area, however one within the 2km search area, as listed in Table 10 below. The locations of the statutory designated sites are shown on Drawing 10028657-ARC-XX-XX-DR-EC-0057-P1 Sheet Number 4.

Table 10 Statutory Designated Sites | Sub-Section 4

Site Name	Reasons for designation	Location in relation to the proposed development
Ely Valley SSSI	9.5 km section of the River Ely which runs through the north-eastern part of the Vale near Cardiff. The Ely Valley supports the largest known population of the nationally scarce plant Monk's-hood.	1.1km north-east

Non-Statutory Designated Sites

7.1.2 There is one non-statutory designated site within the study area and 31 non-statutory designated sites within the 2km search area, as summarised in Table 11 below. The locations of the non-statutory designated sites are shown on Drawing 10028657-ARC-XX-XX-DR-EC-0057-P1 Sheet Number 4.

Table 11 Non-Statutory Designated Sites | Sub-Section 4

Site Name	Reasons for designation	Distance from the proposed development
Log Wood SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	0m
Cottrell Wood SINC	Semi-natural broadleaved woodland on an ancient woodland site and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	340m
Gaer Wood SINC	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	380m
Redland Wood SINC	Predominantly ancient semi-natural broadleaved woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	500m
East of Ty'n-y-Pwll SINC	Two distinct groups of meadows supporting species-rich mosaic of Purple Moor-grass and rush pasture and mire.	620m

Site Name	Reasons for designation	Distance from the proposed development
	It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture.	
Coed Counsellor SINC	Extensive area of part-ancient semi-natural broadleaved woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	810m
Gwern-y-Steeple SINC	Semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	930m
Coed y Cwm SINC	Semi-natural broadleaved woodland, part on an ancient woodland site. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	980m
Ravenswood SINC	Series of ponds supporting tall herbs and swamp. It consists of UK BAP Priority Habitat – Ponds, Reedbeds.	1.1km
North West of Croes-y-Parc Baptist Chapel SINC	Species-rich neutral meadows. It consists of UK BAP Priority Habitat – Lowland meadows.	1.1km
Kingsland SINC	Ancient semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	1.1km
Betty Lucas Wood SINC	Predominantly ancient semi-natural broadleaved woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.1km
Coed y Lan SINC	Semi-natural broadleaved woodland on an ancient woodland site and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.4km
Brook Wood SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.5km
Warren Mill Farm Park SINC	Species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	1.5km
West of Warren Mill Farm Park SINC	Species-rich neutral grassland. It consists of UK BAP Priority Habitat – Lowland meadows.	1.5km
Land South of Blackland Farm SINC	Species-rich Purple Moor-grass fen meadow. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	1.6km

Site Name	Reasons for designation	Distance from the proposed development
Land at Pendoylan Moors SINC	A complex of many small enclosed meadows supporting species-rich Purple Moor-grass and rush pasture with associated ditches, hedgerows and areas of tall-herb fen. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture, Reedbeds.	1.6km
Land North of Whitton Rosser Farm SINC	Two blocks of predominantly ancient seminatural broadleaved woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.6km
North of Coed Quinnet SINC	No data.	1.6km
Coed Quinnet SINC	Two large fields supporting a mosaic of semi-improved neutral grassland and scrub woodland on a predominantly ancient woodland site. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.6km
Land South of Ty'n-y-Coed SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.7km
Amelia Trust Woodland Pond SINC	Pond supporting diverse marginal vegetation and amphibian assemblage. It consists of UK BAP Priority Habitat – Ponds.	1.7km
East of Kingsland SINC	Part ancient semi-natural broadleaved woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.7km
Land along River Waycock SINC	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.8km
Coed Sion Hywel SINC	Predominantly ancient semi-natural broadleaved woodland with areas of mixed plantation on an ancient woodland site. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.8km
Land North West of Whitton Rosser Farm SINC	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.8km
Mill Pond SINC	Old mill pond supporting diverse vegetation and associated marshy grassland. Mosaic habitats present. It consists of UK BAP Priority Habitat – Ponds.	1.8km

Site Name	Reasons for designation	Distance from the proposed development
East of Homri Farm SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.9km
Land along Nant Llancarfan SINC	Three fields supporting a species-rich complex of fen and mire communities and associated springs. It consists of UK BAP Priority Habitat – Lowland fens, Purple Moor-grass and rush pastures.	1.9km
West of Coed Quinnet SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.9km

7.1.3 One area of Ancient Semi-Natural Woodland (ASNW) and 1 Restored Ancient Woodland Site (RAWS) are present within the study area and within 50m of the proposed development. A total of 39 ancient woodland sites, including ASNWs, RAWS and Plantation on Ancient Woodland Site (PAWS), are present within 2km of the proposed development.

7.1.4 One Tree Preservation Order (TPOs) is present within the study area, located 238m from the proposed development. A total of 278 TPOs are present within 2km of the proposed development.

7.1.5 The location of the ancient woodland and TPOs are shown in Drawing 10028657-ARC-XX-XX-DR-EC-0057-P1 Sheet Number 4.

Habitats and Flora

Protected and Priority Plant Species

7.1.6 The desk study returned records of bluebell within the study area and within the 2km search area. The closest record is 300m west of the proposed development. Bluebell is protected under Schedule 8 of the Wildlife and Countryside Act (WCA) 1981 (as amended) (Ref 11).

7.1.7 The desk study returned records of Cornflower and *Parmotrema perlatum* (a lichen) within the 2km search area. The closest record is of Cornflower 540m west of the proposed development. Both species are listed under Section 7 of the Environment Act (Wales) 2016 (Ref 4).

7.1.8 The desk study also returned records of Corn Chamomile, Corn Spurrey, Cornflower, Monk's-hood and Corn Marigold within the 2km search area. These species are listed under the Local Biodiversity Action Plan for the Vale of Glamorgan (LBAP (VOG)) (Ref 12). The closest record is of Corn Chamomile 540m west of the proposed development.

Invasive Plant Species

7.1.9 The desk study returned no records of within the study area. However, there are records of nine invasive plant species within the 2km search area, summarised in Table 12 below. The closest record is of Japanese Knotweed 300m west of the proposed development.

Table 12 Invasive Plant Species Desk Study Records | Sub-Section 4

Common Name	Latin Name	Designation
Indian Balsam	*Impatiens glandulifera*	WCA9, INNS
Japanese Knotweed	*Fallopia japonica*	WCA9, INNS

Common Name	Latin Name	Designation
Montbretia	*Crocosmia pottsii x aurea = C. x crocosmiiflora*	WCA9, INNS
Three-cornered Garlic	*Allium triquetrum*	WCA9, INNS
Wall Cotoneaster	*Cotoneaster horizontalis*	WCA9, INNS
Garden Yellow Archangel	*Lamium galeobdolon subsp. argentatum*	WCA9, INNS
Bluebell	*Hyacinthoides non-scripta x hispanica = H. x massartiana*	INNS
Orange Balsam	*Impatiens capensis*	INNS
Spanish Bluebell	*Hyacinthoides hispanica*	INNS

Protected and Notable Fauna

Terrestrial and Aquatic Invertebrates

7.1.10 The desk study returned no records of notable terrestrial or aquatic invertebrates within the study area. However, there are records of 18 notable species within the 2km search area. These include downy emerald (*Cordulia annua*), bright neb (*Argolamprotes micella*) and slender grass-hopper (*Tetrix subulate*). The closest record is of black oil beetle, violet oil beetle (*Meloe violaceus*) and harlequin ladybird (*Harmonia axyridis*) (an INNS) 540m west of the proposed development.

Fish

7.1.11 The desk study returned no records of fish within the study area or within the 2km search area.

Amphibians

7.1.12 The desk study returned no records of amphibians within the study area, however returned records of five species of amphibians within the 2km search area. These include common frog, common toad and great crested newt. The closest record is of common frog and common toad 450m west of the proposed development.

Reptiles

7.1.13 The desk study returned no records of reptiles within the study area. However, there are records of common lizard and grass snake (*Natrix helvetica*) within the 2km search area. The closest record is of grass snake 450m west of the proposed development.

Birds

7.1.14 No species afforded full protection under Schedule 1 of the WCA 1981 (as amended) have been recorded within the study area. However, 11 species afforded full protection under Schedule 1 of the WCA 1981 (as amended) have been recorded within the 2km search area. These include fieldfare, goshawk and redwing. The closest record is of merlin 540m west of the proposed development.

7.1.15 No species listed on the Red List of the BoCC (Ref 13) have been recorded within the study area. However, 16 species listed on the Red List of the BoCC (Ref 13) have also been recorded within the 2km search area including cuckoo (*Cuculus canorus*), quail (*Coturnix coturnix*) and reed bunting. The closest record is of house sparrow, skylark, song thrush, spotted flycatcher and starling (*Sturnus vulgaris*) 300m west of the proposed development.

7.1.16 Kestrel, a species listed on the Amber List of the BoCC (Ref 13), have been recorded within the study area. The closest record is 20m west of the proposed development. Thirty-three species listed on the Amber List of the BoCC (Ref 13) have been recorded within the 2km search area including goldcrest, lesser black-backed gull (*Larus fuscus*) and mute swan (*Cygnus olor*).

Bats

7.1.17 The desk study returned no records of bat species within the study area. However, there are records of seven bat species within the 2km search area. These include lesser horseshoe bat, noctule bat and brown long-eared bat. The closest record is of a Pipistrelle bat species (*Pipistrellus sp.*) day roost 700m west of the proposed development. The records also include at least one roost for six of the seven bat species recorded.

Otter

7.1.18 The desk study returned no records of European otter (*Lutra lutra*) within the study area. However, there are records within the 2km search area. The closest record is of an otter sighting 1.2km north-east of the proposed development.

Water Vole

7.1.19 The desk study returned no records of European water vole (*Arvicola amphibius*) within the study area or within the 2km search area.

Hazel Dormouse

7.1.20 The desk study returned no records of hazel dormouse (*Muscardinus avellanarius*) within the study area or within the 2km search area.

Badger

7.1.21 The desk study returned no records of Eurasian badger (*Meles meles*) within the study area however did return records within the 2km search area. The closest record is of a dead individual 540m east of the proposed development.

Other Mammals

7.1.22 The desk study returned records of European hedgehog within the study area. The closest record is 240metrewest of the proposed development. The desk study also returned records of American Mink (an INNS), European hedgehog, brown hare, harvest mouse (*Micromys minutus*), polecat, stoat (Mustela erminea*)* and weasel within the 2km search area.

7.2 Field Study

7.2.1 The following description of the findings of the field study should be read in conjunction with the Phase 1 habitat plan (Drawing 10028657-ARC-XX-XX-DR-EC-0056, Sheet Number 4).

Habitats and Flora

Woodland

- Broadleaved Semi-Natural Woodland
  - A large area of woodland is present to the north of the golf course, which was not surveyed due to access permission not being granted. A small area of broadleaved woodland was recorded to the north of the survey area adjacent to the previously mentioned woodland.
  - A diverse range of canopy species were frequently recorded including Pedunculate Oak (*Quercus robur),* Ash (*Fraxinus excelsior),* Alder, Willow species and Sycamore (*Acer pseudoplatanus*). Less frequently recorded canopy species included Field Maple (*Acer campestre),* Yew (*Taxus baccata*), Lime species (*Tilia sp.),* and Birch species (*Betula sp.).* Understorey species typically present included Hazel (*Corylus avellana*), Holly (*Ilex aquifolium)*, Honeysuckle (*Lonicera periclymenum*), Hawthorn (*Crataegus monogyna),* Blackthorn (*Prunus spinosa),* Rose species (*Rosa sp.)* and Bramble.

- Ground flora species typically present included Cow Parsley (*Anthriscus sylvestris),* Hogweed (Heracleum sphondylium), Hemlock Water-dropwort (*Oenanthe crocata*), Lords-and-Ladies (*Arum maculatum*), Ivy (*Hedera helix*), Hart's-tongue Fern (*Asplenium scolopendrium*), Marsh Thistle (*Cirsium palustre*), Nipplewort (*Lapsana communis*), Garlic Mustard (*Alliaria petiolata*), Red Campion (*Silene dioica*), Scaly Male-fern (*Dryopteris affinis agg*.), Male-fern (*Dryopteris filix-mas*), Dog's Mercury (*Mercurialis perennis*), Herb-Robert (*Geranium robertianum*), Soft-rush (*Juncus effusus*), Ground-ivy (*Glechoma hederacea*), Selfheal (*Prunella vulgaris*), Hedge Woundwort (*Stachys sylvatica*), Rosebay Willowherb (*Chamaenerion angustifolium*), Enchanter's-nightshade (*Circaea lutetiana*), Germander Speedwell (*Veronica chamaedrys*), False Oat-grass (*Arrhenatherum elatius*), False-brome (*Brachypodium sylvaticum*), Hairy-brome (*Bromopsis ramosa*), Giant Fescue (*Festuca gigantea*), Water Pepper (*Persicaria hydropiper*), Broad-leaved Dock (*Rumex obtusifolius*), Wood Avens (*Geum urbanum*), Common Nettle (*Urtica dioica)* and Cleavers (*Galium aparine*).

- Mixed Plantation Woodland
  - Areas of mixed semi-natural woodland was present within the centre of the survey area. These woodland blocks were located on the Cottrell Park Golf Resort. Species recorded within the canopy layer included Pedunculate Oak, Ash, Beech, Willow, Field Maple, Birch species, Sycamore and Fir species (*Abies sp.)*. Species recorded within the understorey included Elder, Hazel, Dogwood (*Cornus sanguinea),* Hawthorn, Holly, Rose species, Bramble, Honeysuckle, Ivy and Rowan (*Sorbus aucuparia).* Species recorded within the ground layer included Wild Angelica (*Angelica sylvestris*), Hogweed, Hemlock Water-dropwort, Lords-and-Ladies, Hart's-tongue Fern, Nipplewort, Dandelion, Wavy Bitter-cress (*Cardamine flexuosa*), Red Campion, Remote Sedge (*Carex remota*), Wood Sedge (Carex sylvatica), Scaly Male-fern, Narrow Buckler-fern (*Dryopteris dilatata*), Broad Buckler-fern, Dog's Mercury, Herb-Robert, Ground-ivy, Garden Yellow Archangel (Lamiastrum galeobdolon), Selfheal, Enchanter's-nightshade, Foxglove, Wood Speedwell (*Veronica montana*), False-brome, Hairy-Brome, Giant Fescue, Polypody Fern species (*Polypodium* sp.), Yellow Pimpernel, Wood Anemone (*Anemone nemorosa*), Creeping Buttercup, Meadowsweet, Wood Avens, Cleavers and Marsh Bedstraw.

Dense and Scattered Scrub

7.2.2 Dense and scattered scrub occurred frequently throughout the survey area at locations which were relatively unmanaged, typically between grassland margins, along field boundaries e.g. adjacent to hedgerows and woodland edges. The stands typically comprised Bramble. Other species recorded included young Willow saplings*,* Alder saplings*,* Bramble, Elder (*Sambucus nigra*) and Hazel.

7.2.3 Along field margins, dense and scattered scrub frequently formed a mosaic with tall ruderal vegetation. The Phase 1 habitat maps only show where dense scrub occurred in larger areas.

Scattered Trees and Treelines

7.2.4 Mixed scattered trees of varying ages were recorded across the study area within grassland fields, hedgerows and on the Cottrell Park Golf Resort. Mature and semi-mature Pedunculate Oak and Ash were the most prominent scattered trees along hedgerows and/ or located within grassland fields, many of which were considered to have bat potential. Species recorded included Hazel, Sycamore (*Acer pseudoplatanus*), Pine (*Pinus sp.)*, Birch (*Betula sp.)*, Turkey oak (*Q. Cerris*), Sweet Chestnut, Horse Chestnut (*Aesculus hippocastanum)*, Poplar (*Populus sp.)*, Willow, Cherry (*Prunus sp.),* Alder*,* Hornbeam (*Carpinus betulus)* and Beech (*Fagus sylvatica).*

7.2.5 Treelines of mature and semi-mature trees were recorded across the survey area. The majority of these treelines were located along field boundaries, and often connected areas of woodland throughout the survey area. Species recorded included Oak, Ash, Alder, Lime species, Beech, Hazel and Sycamore.

7.2.6 Detailed surveys of the trees present within these features were not undertaken during the Phase 1 Habitat walkover, however, a large number of these were noted with bat roosting potential.

Improved Grassland

7.2.7 A number of fields to the north and south of the survey area supported improved grassland fields. At the time of survey some of the fields had been recently cut. Along the field margins, a higher diversity of plant species was recorded and small areas of tall ruderals and/ or scrub habitat were also noted. The grass species composition was generally consistent throughout the study area with grass species frequently recorded throughout the different fields.

7.2.8 Dominant grass species recorded across the survey area included False Oat-grass, Crested Dog's-tail, Cock's-foot, Yorkshire Fog, Italian Rye-grass (*Lolium multiflorum*), Perennial Rye-grass (*L. perenne*).

7.2.9 The following plant species were typically identified along the margins of the improved grassland fields; however, some species were also present within the grassland field. The following species were considered abundant across the survey area; Hogweed, Daisy (*Bellis perennis*), Creeping Thistle, Spear Thistle, Dandelion, White Clover, Soft Brome (*Bromus hordeaceus*), Meadow Buttercup, Creeping Buttercup, Silverweed and Common Nettle.

7.2.10 The following plant species were recorded less frequently or only occasionally throughout the survey area. The majority of these species occurred within the field margins or were occasionally present among the Common Bent, Creeping Bent (*Agrostis stolonifera*), Sweet Vernal Grass, Timothy, Annual Meadow-grass (*Poa annua*), Smooth Meadow-grass (*P. pratensis*), Rough Meadow-grass (*P. trivialis*), Yarrow, Pineapple Weed (*Matricaria discoidea*), Prickly Sow-thistle (*Sonchus asper*), Scentless Mayweed (*Tripleurospermum maritimum*), Shepherd's Purse (*Capsella bursa-pastoris*), Lesser Swine-cress (*Coronopus didymus*), Common Mouse-ear (*Cerastium fontanum*), Lesser Stitchwort (*Stellaria graminea*), Red Clover, Cut-leaved Crane's-bill (*Geranium dissectum*), Selfheal, Ribwort Plantain, Greater Plantain, Pale Smartweed (*Persicaria lapathifolia*), Redshank (*P. maculosa*), Knotgrass (*Polygonum aviculare*), Broad-leaved Dock and Creeping Cinquefoil.

7.2.11 Several fields across the survey area had field margins and/ or corners which had wetter ground conditions, likely due to the local topography. In these areas, the following plant species were recorded; Marsh Foxtail (*Alopecurus geniculatus*), Jointed Rush (Juncus articulates), Toad Rush (*J. bufonius*), Soft-rush (*J. effusus*), Hard Rush (*J. inflexus*), Floating Sweet-grass (*Glyceria fluitans*), Marsh Cudweed (*Gnaphalium uliginosum*), Marsh Thistle and Water Forget-me-not (*Myosotis scorpioides*).

Tall Ruderals

7.2.12 Tall ruderal vegetation was common and widespread across the survey area and typically occurred between grassland margins, woodland/ scrub edges and along field boundaries. The Phase 1 habitat maps only show where tall ruderal vegetation occurred in larger areas. Species recorded included Common Nettle (*Urtica dioica*), Bracken (*Pteridium aquilinum)*, Rosebay Willowherb (*Chamerion angustifolium),* Greater Willowherb (*Epilobium hirsutum*), Pendulous Sedge (*Carex pendula*), Hogweed, Vervain (*Verbena sp.*), Ragwort (*Senecio jacobaea),* Yarrow (*Achillea millefolium*), Ribwort Plantain, Knapweed, Raspberry (*Rubus sp.)*, Hedge Woundwort, Hedge Bindweed (*Calystegia sepium*), Giant Bindweed (*Calystegia sylvatica),* Hedge Parsley (*Torilis japonica),* Nipplewort (*Lapsana communis*), Red Campion, Herb Robert (*Geranium robertianum),* Broad-leaved Dock, Knapweed, Spear Thistle, Creeping Thistle, Marsh Thistle, Cleavers, Prickly Sow-thistle, Common Sow-thistle (*S. oleraceus*), Fleabane, Cock's-foot, Yorkshire Fog, Timothy, Hemlock Water-dropwort, Creeping Buttercup, White Clover,

Standing Water

- Ponds
  - 14 ponds were recorded within the Cottrell Golf Park Resort towards the south of the survey area (TN24, TN29, TN30, TN31, TN32, TN33, TN34, TN35, TN36, TN37, TN39, TN40 and TN137). These ponds ranged in size and three of these ponds were dry at the time of the survey.

Running Water

- Ditches
  - Numerous ditches and drains were recorded across the survey area and were associated with field boundaries, however, at the time of survey, the majority were dry or held very little water.

Amenity Grassland

7.2.13 Within Cottrell Golf Park Resort were large expanses of amenity grassland. The grassland was regularly cut and maintained with a very short sward therefore abundances of species could not be estimated accurately. Species recorded included meadow grass (*Poa sp.)*, Yorkshire Fog, Cock's Foot, Perennial Rye-grass, White Clover, Creeping Buttercup and Broadleaved Plantain (*Plantago major)*.

Hedges Intact – Native Species-rich, including with and without trees

7.2.14 A large number of hedgerows were recorded throughout the survey area. These hedgerows were identified as species-rich as they supported five or more native woody species and a good hedgerow bottom flora. The majority of these hedgerows were located along field boundaries, and often connected areas of woodland throughout the survey area. The hedgerows were typically dense in structure and were of varied width (approximately 2m to 3m) and height (approximately 2m to 4m). Many hedgerows were present along drainage ditches, although the vast majority of these ditches were dry. The most common woody species recorded within the hedgerows were Hazel, Ash, Pedunculate Oak, Hawthorn, Blackthorn, Elder, Holly, Honeysuckle (*Lonicera periclymenum)* and Willow (*Salix sp.)*. Other woody species recorded less frequently included Alder, Beech, Birch, Cherry, Crab Apple (*Malus Sylvestris)*, Dogwood, Field Maple (*Acer campestre)*, Rowan, Sycamore and Wych Elm (*Ulmus glabra)*.

7.2.15 The hedgerows supported a diversity of flora species. The most dominant species was Bramble, which was present in every hedgerow. Frequently recorded species included Black Bryony, Bracken, Cleavers, Common Vetch, Bush Vetch, Creeping Buttercup, Creeping Thistle, Dandelion, False-brome, False Oat-grass, Foxglove, Hedge Bindweed, Greater Willowherb, Hart's-tongue Fern, Hogweed, Ivy (*Hedera helix),* Lesser Stitchwort, Lords-and-Ladies (*Arum maculatum)*, Meadowsweet, Common Nettle, Nipplewort, Red Campion, Dog Rose (*Rosa canina),* Selfheal, Wood Avens and Yorkshire Fog.

7.2.16 Other flora species less frequently recorded included Bittersweet, Couch, Dog's Mercury (*Mercurialis perennis)*, Garlic Mustard (*Alliaria petiolata),* Giant Fescue, Greater Celandine (*Chelidonium majus)*, Hops (*Humulus lupulus),* Marsh Bedstraw, Clustered Dock, Sterile Brome (*Bromus sterilis),* Wild Strawberry (*Fragaria vesca)* and Violet (*Viola sp.).*

7.2.17 Mature or semi-mature trees, often including Pedunculate Oak, Ash, Willow, Beech, Alder, Field Maple, Sycamore and Hazel were also a regular feature present along the hedgerows.

Hedges Intact and Defunct – Species Poor, including with and without trees

7.2.18 A number of hedges were identified as species poor as they supported fewer than five woody species along the length of the hedgerow. These hedgerows, similar to the species-rich hedgerows, were located along field boundaries and connected areas of woodland and occasionally were present along a dry drainage ditch. A small number of hedgerows were identified as 'defunct' as the hedge had gaps along the length of them, rendering them no longer stock-proof. Some of these hedgerows contained semi-mature, young and mature trees.

7.2.19 Species frequently recorded in the hedgerows included Hazel, Hawthorn, Ash, Sycamore, Oak, Beech, Dogwood, Field Maple, Wych Elm, Cherry, Holly, Bracken, Bramble and Dog Rose.

Buildings

7.2.20 Several farm and residential buildings were scattered throughout the survey area. A construction site for a residential housing development was located within the centre of the survey area. Old, derelict

buildings were present within the construction site (TN76). Detailed surveys of these buildings were not undertaken during the Phase 1 Habitat walkover.

Non-Native Invasive Plant Species

7.2.21 Indian Balsam was recorded in survey area and was typically encountered within woodland. Surveyors recorded all observations of the plant on site (TN25 and TN28); however, it is more than likely that surveyors may have missed areas additional occurrences of this plant. Nuttall's Waterweed (*Elodea nuttallii*) (TN26) was also recorded within a pond on the Cottrell's Golf Park Resort.

Protected and Notable Fauna

Terrestrial Invertebrates

7.2.22 Multiple species of beetles, butterflies, dragonflies, damselflies, moths and crickets were recorded during the survey. Green dock beetle (*Gastrophysa viridula*) was recorded within the survey area.

7.2.23 Meadow brown (*Maniola jurtina*) and red admiral (*Vanessa Atalanta*), species of butterfly, were recorded during the survey.

7.2.24 Species of dragonflies and damselfies recorded during the survey included blue emperor (*Anax imperator*), small red-eye damselfly (*Erythromma viridulum)* andcommon bluetail (*Ischnura elegans*).

7.2.25 Cinnabar moth (*Tyria jacobaeae*) was also recorded during the survey.

7.2.26 The following species of cricket were recorded during the survey; common green grasshopper (*Omocestus viridulus*), meadow grasshopper (*Pseudochorthippus parallelus*), and speckled bush-cricket (*Leptophyes punctatissima*).

7.2.27 Of these species the cinnabar moth is a Priority Species, which is listed within Section 7 of the Environment (Wales) Act 2016. The grassland, scrub, tall ruderal and woodland margins were considered suitable to support a diverse range of invertebrate species. Deadwood was common within woodland, hedgerows and treeline habitats which could provide habitat for a number of common terrestrial invertebrate species.

Aquatic Invertebrates

7.2.28 A number of ponds and ditches were recorded across the survey area and are considered likely to be of value to a diverse range of invertebrate species.

Fish

7.2.29 A number of ditches were recorded across the survey area, however, the majority of these were dry at the time of the survey. It is considered unlikely that these ditches are suitable to support fish species.

Amphibians

7.2.30 14 ponds (TN24, TN29, TN30, TN31, TN32, TN33, TN34, TN35, TN36, TN37, TN39, TN40 and TN137) were identified within the survey area, located on Cottrell Golf Park Resort. Three of these ponds was dry at the time of survey (TN31, TN35 and TN36), however, it was considered likely that they could hold water at points during the year. The grassland, hedgerow, scrub, tall ruderal and woodland habitats in the vicinity of these ponds provide suitable foraging, commuting and hibernating opportunities to great crested newts and other species of amphibians.

Reptiles

7.2.31 A number of habitats throughout the study area are considered suitable to support foraging and hibernating reptiles in particular the areas of broadleaved woodland, scrub, grassland and tall ruderal vegetation, in particular field margins.

Birds

7.2.32 A number of incidental bird sighting were recorded during the Phase 1 habitat survey including blackbird (*Turdus merula*) siskin (*Spinus spinus*), long-tailed tit (*Aegithalos caudatus*), nuthatch (*Sitta europaea*), buzzard (*Buteo buteo*), great spotted woodpecker (*Dendrocopos major*), wren (*Troglodytes troglodytes*), barn swallow (*Hirundo rustica*), goldfinch (*Carduelis carduelis*), coal tit (*Periparus ater*), stock dove (*Columba oenas*), wood pigeon (*Columba palumbus*), blue tit (*Cyanistes caeruleus*), yellowhammer (*Emberiza citronella*), reed bunting (*Emberiza schoeniclus*), coot (*Fulica atra*), lesser black-backed gull (*Larus fuscus*), linnet (*Linaria cannabina*), pied wagtail (*Motacilla alba yarrellii*), house sparrow (*Passer domesticus*chiffchaff (*Phylloscopus collybita*), green woodpecker (*Picus viridis*), bullfinch (*Pyrrhula pyrrhula*), blackcap (*Sylvia atricapilla*) and starling (*Sturnus vulgaris*).

7.2.33 The woodland, scattered trees, scrub and hedgerow habitats present throughout the survey area are likely to support breeding birds typical of these habitats and provide good foraging habitat. It is possible that barn owl could use mature trees with suitable cavities for nesting and grassland field margins for foraging, although no evidence was recorded during the Phase 1 habitat survey.

Bats

7.2.34 The woodland areas and scattered trees, some associated with hedgerows, throughout the study area have potential to support roosting bats (TN27). Buildings located within the construction site to the southern section of the survey area have potential to support roosting bats (TN77). Further buildings were also scattered across the survey area which may also have potential to support roosting bats. No buildings within the survey area were subject to detailed (interior or exterior) building inspections. Areas of potential foraging and commuting habitat for bats were found throughout the survey area. High value habitats included the woodland areas, hedgerows and treelines, watercourses, permanent waterbodies and grassland field margins with scrub and tall ruderal vegetation.

Hazel Dormouse

7.2.35 An analysis of aerial photography indicates that there is good connectivity and continuity of woodland and scrub habitat within the wider landscape to support dormice (*Muscardinus avellanarius*) within the survey area. The areas of woodland and connecting hedgerow habitat within the survey area were considered suitable to support hazel dormice. The majority of woodlands had a diverse range of tree and shrub species, which are a valuable food source throughout the year for dormice. These species included abundant fruiting Hazel stools, Oak, Bramble, Sycamore, Ash, Honeysuckle and Hawthorn. These woodland areas also had a good physical structure, with the majority having a dense or well-structured understorey which provides suitable dormouse habitat.

Water Vole

7.2.36 A number of ditches were recorded within the survey area, however, the majority of these were dry at the time of survey and not considered suitable to support water vole (*Arvicola amphibius)*.

Otter

7.2.37 A number of dry ditches were recorded within the survey area and these were not considered suitable to support otter.

Badger

7.2.38 The areas of woodland, scrub and hedgerows within the survey area were assessed as suitable to support badgers (*Meles meles).*

Other Mammals

7.2.39 A number of habitats present within the survey area were assessed as suitable to support the following species; brown hare (*Lepus europaeus*), hedgehog (*Erinaceus europaeus*), polecat (*Mustela putorius), w*easel (*Mustela nivalis), stoat Mustela erminea* and harvest mouse (*Micromys minutus).*

8 Results | Sub-Section 5

8.1 Desk Study

Designated Sites

Statutory Designated Sites

8.1.1 There is one statutory designated site within the study area, and one further site within the 2km search area, as listed in Table 13 below. The locations of the statutory designated sites are shown on Drawing 10028657-ARC-XX-XX-DR-EC-0057-P1 Sheet Number 5.

Table 13 Statutory Designated Sites | Sub-Section 5

Site Name	Reasons for Designation	Location in relation to the proposed development
Ely Valley SSSI	9.5 km section of the River Ely which runs through the north-eastern part of the Vale near Cardiff. The Ely Valley supports the largest known population of the nationally scarce plant Monk's-hood.	Crosses the proposed railway station railway track.
Brofiscin Quarry, Groes Faen SSSI	Exposed early Carboniferous geological formations.	1.6km north of the proposed railway station.

Non-Statutory Designated Sites

8.1.2 There are two non-statutory designated sites within the study area and 35 non-statutory designated sites within the 2km search area, as summarised in Table 14 below. The locations of the non-statutory designated sites are shown on Drawing 10028657-ARC-XX-XX-DR-EC-0057-P1 Sheet Number 5.

Table 14 Non-Statutory Designated Sites | Sub-Section 5

Site Name	Reasons for Designation	Distance from the proposed development
Land South West of Llanfarach Farm SINC	Semi-natural broadleaved wet woodland with associated pond. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland, Ponds.	4m
Land West of Llanfarach Farm SINC	Semi-natural broadleaved wet woodland and native woodland. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	150m
Land between M4 and Industrial Estate SINC	Semi-natural broadleaved wet woodland and native woodland. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	260m
Land South of Llanfarach Farm SINC	Series of small wet meadows supporting species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture.	370m

Site Name	Reasons for Designation	Distance from the proposed development
South West of Dyffryn Bach SINC	Ancient semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	390m
Land West of Ty Newydd Farm SINC	Two wet meadows supporting species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture.	430m
Coed Ffos-Ceibr SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	450m
Land North of Brooklands Farm SINC	Semi-natural broadleaved woodland of which half is ancient woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	490m
North of Gwern-y-Gedrynch SINC	Semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	580m
Land West of Hensol Mill SINC	A series of wet meadows supporting Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	630m
North West of Duffryn Mawr Farm SINC	Species-rich rush pasture with pond. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	710m
Mill Ponds SINC	A linear former mill pond with dense stands of reedbed. It consists of UK BAP Priority Habitat – Ponds, Reedbeds.	800m
Land South of Oakfield SINC	A series of wet Purple Moor-grass and rush pastures. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	810m
Land near Hensol Mill SINC	Semi-natural broadleaved wet woodland, part on an ancient woodland site and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	810m
South West of Castell Bach SINC	Ancient semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	840m
West of Markswood SINC	Two semi-natural broadleaved wet woodlands and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	850m

Site Name	Reasons for Designation	Distance from the proposed development
Coed Waunn-Lloff SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	890m
Hafod Y Wennol SINC	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	930m
Hensol Lake SINC	A large body of open water with reedbed and wet woodland fringe. It consists of UK BAP Priority Habitat – Ponds, Reedbeds, Wet woodland.	1.2km
Land South of Hadod Y Wennol SINC	Species-rich Purple Moor-grass and rush pasture with semi-improved neutral grassland margins. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.	1.2km
Land South of Glenholme SINC	Semi-natural broadleaved woodland of which the majority is ancient woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.3km
Nant Coslech SINC	Unimproved tributary with diverse riparian habitat including a number of quality in-line and off-line ponds.	1.3km
Land near Gwern y Gae Isaf SINC	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.3km
Coed Cadw SINC	A predominantly ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.4km
Maendy Farm SINC	Semi-natural broadleaved woodland of which the majority is ancient woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.4km
Groes Faen Fen Meadow SINC	Species-rich fen-meadow, associated with the adjacent Nant Coslech.	1.4km
West of Clawdd-Coch Farm SINC	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.4km
Land at Pendoylan Moors SINC	A complex of many small enclosed meadows supporting species-rich Purple Moor-grass and rush pasture with associated ditches, hedgerows and areas of tall-herb fen. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture, Reedbeds.	1.4km

Site Name	Reasons for Designation	Distance from the proposed development
North of Pendoylan Moors SINC	Semi-natural broadleaved wet woodland that is contiguous with an extensive area of rush pasture. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.	1.5km
Land near Coed Pen-Brych SINC	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.	1.5km
Nant Henstaff SINC	An unimproved tributary with diverse riparian habitat including a quality in-line pond and adjacent wet woodland and mires with a large population of Monk's-hood.	1.6km
North West of Hillfields Farm SINC	A series of species-rich neutral grasslands. It consists of UK BAP Priority Habitat – Lowland meadows.	1.8km
Groes Faen Wood SINC	Woodland including some areas of wet woodland associated with the Nant Coslech.	1.9km
South West of Parc Coed Machen SINC	A large area of lowland neutral grassland. It consists of UK BAP Priority Habitat – Lowland meadow.	1.9km
Fforest Fach Farm SINC	Two meadows supporting a mosaic of lowland fen, sedge swamp and rush pasture habitats. It consists of UK BAP Priority Habitat – Lowland fens, Purple Moor-grass and rush pastures, Reedbeds.	1.9km

8.1.3 One area of Ancient Semi-Natural Woodland (ASNW) and 1 Restored Ancient Woodland Site (RAWS) are present within the study area, with the nearest site 106m from the proposed development. A total of 73 ancient woodland sites, including ASNWs, RAWS and Plantation on Ancient Woodland Site (PAWS), are present within 2km of the proposed development.

8.1.4 Three Tree Preservation Orders (TPOs) are present within the study area, with one TPO within 50m of the proposed development. A total of 96 TPOs are present within 2km of the proposed development.

8.1.5 The location of the ancient woodland and TPOs are shown in Drawing 10028657-ARC-XX-XX-DR-EC-0057-P1 Sheet Number 5.

Habitats and Flora

Protected and Priority Plant Species

8.1.6 The desk study returned records Bluebell within the 2km search area. The closest record is 920m west of the proposed development. Bluebell is protected under Schedule 8 of the Wildlife and Countryside Act (WCA) 1981 (as amended) (Ref 11).

8.1.7 The desk study returned records of Cornflower and *Parmotrema perlatum* (a lichen) within the 2km search area. The closest record is of *Parmotrema perlatum* 1.7 km south of the proposed development. Both species are listed under Section 7 of the Environment Act (Wales) 2016 (Ref 4).

8.1.8 The desk study also returned records of Fen Bedstraw and Monk's-hood within the 2km search area. These species are listed under the Local Biodiversity Action Plan for the Vale of Glamorgan (LBAP (VOG)). The closest record is of Fen Bedstraw 1.1km north of the proposed development.

Invasive Plant Species

8.1.9 The desk study returned no records of within the study area. However, there are records of seven invasive plant species within the 2km search area, summarised in Table 15 below. The closest record is of Cherry Laurel Knotweed 1km west of the proposed development.

Table 15 Invasive Plant Species Desk Study Records | Sub-Section 5

Common Name	Latin Name	Designation
Indian Balsam	*Impatiens glandulifera*	WCA9, INNS
Japanese Knotweed	*Fallopia japonica*	WCA9, INNS
Montbretia	*Crocosmia pottsii x aurea = C. x crocosmiiflora*	WCA9, INNS
Garden Garden Yellow Archangel	*Lamium galeobdolon subsp. argentatum*	WCA9, INNS
Cherry Laurel	*Prunus laurocerasus*	INNS
Giant Butterbur	*Petasites japonicus*	INNS
Spanish Bluebell	*Hyacinthoides hispanica*	INNS

Protected and Notable Fauna

Terrestrial and Aquatic Invertebrates

8.1.10 The desk study returned records of beautiful demoiselle within the study area. The closest record is 250m east of the proposed development. The desk study also returned records of 17 notable species within the 2km search area. These include long-horned bee (*Eucera longicornis*), short-winged cone-head (*Conocephalus dorsalis*) and red-eyed damselfly (*Erythromma najas*).

Fish

8.1.11 The desk study returned no records of fish within the study area or within the 2km search area.

Amphibians

8.1.12 The desk study returned no records of amphibians within the study area or within the 2km search area.

Reptiles

8.1.13 The desk study returned no records of reptiles within the study area or within the 2km search area.

Birds

8.1.14 No species afforded full protection under Schedule 1 of the WCA 1981 (as amended) have been recorded within the study area. However, nine species afforded full protection under Schedule 1 of the WCA 1981 (as amended) have been recorded within the 2km search area. These include bittern, brambling and green sandpiper. The closest record is of redwing 1.2km north of the proposed development.

8.1.15 No species listed on the Red List of the BoCC (Ref 13) have been recorded within the study area. However, 11 species listed on the Red List of the BoCC (Ref 13) have also been recorded within the 2km search area including skylark, reed bunting and starling. The closest record is of bullfinch and song thrush 1 km east of the proposed development.

8.1.16 Sixteen species listed on the Amber List of the BoCC (Ref 13), have been recorded within the study area including teal (*Anas crecca*), willow warbler and green woodpecker (*Picus viridis*). The closest record is of barn owl 45m west of the proposed development. Twenty-six species listed on the Amber List of the BoCC (Ref 13) have also been recorded within the 2km search area including cormorant (*Phalacrocorax carbo*), dipper and goldcrest.

Bats

8.1.17 The desk study returned no records of bat species within the study area. However, there are records of five bat species within the 2km search area. These include Daubenton's bat (*Myotis daubentonii*), common pipistrelle bat *and* brown long-eared bat. The closest record is a field sighting of a Daubenton's bat 680m east of the proposed development. The records also include at least one roost for three of the five bat species recorded.

Otter

8.1.18 The desk study returned no records of European otter (*Lutra lutra*) within the study area or within the 2km search area.

Water Vole

8.1.19 The desk study returned no records of European water vole (*Arvicola amphibius*) within the study area or within the 2km search area.

Hazel Dormouse

8.1.20 The desk study returned no records of hazel dormouse (*Muscardinus avellanarius*) within the study area. However, there are records within the 2km search area. The closest record is 900m north of the proposed development.

Badger

8.1.21 The desk study returned no records of Eurasian badger (*Meles meles*) within the study area or within the 2km search area.

Other Mammals

8.1.22 The desk study returned records of European hedgehog and brown hare within the study area. The closest record is of brown hare 290m south of the proposed development. The desk study also returned records of American Mink (an INNS), European hedgehog, brown hare and polecat within the 2km search area.

8.2 Field Study

8.2.1 The following description of the findings of the field study should be read in conjunction with the Phase 1 habitat plan (Drawing 10028657-ARC-XX-XX-DR-EC-0056, Sheet Number 5).

Habitats and Flora

Woodland

- Broadleaved Semi-Natural Woodland
  - Areas of broadleaved woodland were recorded throughout the survey area as large and small stands and as small strips between field boundaries. In some areas, such as in the eastern section of the survey area, ground conditions were damp, and the woodland areas included wetland tolerant trees such as Willow species (*Salix sp.*) and Alder (*Alnus glutinosa*), which were sufficient in area and species composition to qualify as wet woodland.

- In the majority of areas, a diverse range of canopy species were frequently recorded including Pedunculate Oak (*Quercus robur),* Ash (*Fraxinus excelsior),* Alder, Willow species and Sycamore (*Acer pseudoplatanus*). Less frequently recorded canopy species included Field Maple (*Acer campestre),* Yew (*Taxus baccata*), Lime species (*Tilia sp.),* and Birch species (*Betula sp.).* Understorey species typically present included Hazel (*Corylus avellana*), Holly (*Ilex aquifolium)*, Honeysuckle (*Lonicera periclymenum*), Hawthorn (*Crataegus monogyna),* Blackthorn (*Prunus spinosa),* Rose species (*Rosa sp.)* and Bramble.
- Ground flora species typically present included Cow Parsley (*Anthriscus sylvestris),* Hogweed (Heracleum sphondylium), Hemlock Water-dropwort (*Oenanthe crocata*), Lords-and-Ladies (*Arum maculatum*), Ivy (*Hedera helix*), Hart's-tongue Fern (*Asplenium scolopendrium*), Marsh Thistle (*Cirsium palustre*), Nipplewort (*Lapsana communis*), Garlic Mustard (*Alliaria petiolata*), Red Campion (*Silene dioica*), Scaly Male-fern (*Dryopteris affinis agg*.), Male-fern (*Dryopteris filix-mas*), Dog's Mercury (*Mercurialis perennis*), Herb-Robert (*Geranium robertianum*), Soft-rush (*Juncus effusus*), Ground-ivy (*Glechoma hederacea*), Selfheal (*Prunella vulgaris*), Hedge Woundwort (*Stachys sylvatica*), Rosebay Willowherb (*Chamaenerion angustifolium*), Enchanter's-nightshade (*Circaea lutetiana*), Germander Speedwell (*Veronica chamaedrys*), False Oat-grass (*Arrhenatherum elatius*), False-brome (*Brachypodium sylvaticum*), Hairy-brome (*Bromopsis ramosa*), Giant Fescue (*Festuca gigantea*), Water Pepper (*Persicaria hydropiper*), Broad-leaved Dock (*Rumex obtusifolius*), Wood Avens (*Geum urbanum*), Common Nettle (*Urtica dioica)* and Cleavers (*Galium aparine*).
- Some of the woodland areas had abundant leaf litter and bare earth present as part of the ground layer, but in places Bramble and common nettles were often abundant.

- Mixed Semi-Natural Woodland
  - One area of mixed semi-natural woodland was present to the south west of the survey area. Species recorded within the canopy layer included Pedunculate Oak, Ash, Beech (*Fagus sylvatica)*, Willow, Field Maple, Birch species, Sycamore and Fir species (*Abies sp.)*. Species recorded within the understorey included Elder (*Sambucus nigra*), Hazel, Dogwood (*Cornus sanguinea),* Hawthorn, Holly, Rose species, Bramble, Honeysuckle, Ivy and Rowan (*Sorbus aucuparia).* Species recorded within the ground layer included Wild Angelica (*Angelica sylvestris*), Hogweed, Hemlock Water-dropwort , Lords-and-Ladies, Hart's-tongue Fern, Nipplewort, Dandelion (*Taraxacum officinale agg*.), Wavy Bitter-cress (*Cardamine flexuosa*), Red Campion, Remote Sedge (*Carex remota*), Wood Sedge (*Carex sylvatica*), Scaly Male-fern, Narrow Buckler-fern (*Dryopteris dilatata*), Broad Buckler-fern, Dog's Mercury, Herb-Robert, Ground-ivy, Garden Yellow Archangel (*Lamiastrum galeobdolon*), Selfheal, Enchanter's-nightshade, Foxglove, Wood Speedwell (*Veronica montana*), False-brome, Hairy-brome, Giant Fescue, Polypody Fern species (*Polypodium sp.*), Yellow Pimpernel, Wood Anemone (*Anemone nemorosa*), Creeping Buttercup, Meadowsweet, Wood Avens, Cleavers and Marsh Bedstraw.

Dense and Scattered Scrub

8.2.2 Dense and scattered scrub occurred frequently throughout the survey area at locations which were relatively unmanaged, typically between grassland margins, along field boundaries e.g. adjacent to hedgerows and woodland edges. The stands typically comprised Bramble, however, in places, stands of young Willow were recorded. Where this occurred, willow was the dominant species present. The structure was dense, with little understorey or ground flora.

8.2.3 Along field margins, dense and scattered scrub frequently formed a mosaic with tall ruderal vegetation. The Phase 1 habitat maps only show where dense scrub occurred in larger areas.

8.2.4 Species present included young Willow saplings*,* Alder saplings*,* Bramble, Elder and Hazel.

Scattered Trees and Treelines

8.2.5 Scattered trees of varying ages were recorded across the study area within grassland fields, hedgerows and within the Renishaw site. Mature and semi-mature Pedunculate Oak and Ash were

the most prominent scattered trees along hedgerows and/ or located within grassland fields, many of which were considered to have bat potential. Species recorded included Hazel, Sycamore (*Acer pseudoplatanus*), Pine (*Pinus sp.)*, Birch (*Betula sp.)*, Turkey oak (*Q. Cerris*), Sweet Chestnut, Horse Chestnut (*Aesculus hippocastanum)*, Poplar (*Populus sp.)*, Willow, Cherry (*Prunus sp.),* Alder*,* Hornbeam (*Carpinus betulus)* and Beech*.*

8.2.6 Treelines of mature and semi-mature trees were recorded across the survey area. The majority of these treelines were located along field boundaries, and often connected areas of woodland throughout the survey area. Species recorded included Oak, Ash, Alder, Lime species, Beech, Hazel and Sycamore.

8.2.7 Detailed surveys of the trees present within these features were not undertaken during the Phase 1 Habitat walkover, however, a large number of these were noted with bat roosting potential.

Neutral Semi-Improved Grassland

8.2.8 Areas of neutral semi-improved grassland were identified to the north west of the M4 and to the south west of the railway. The sward height was predominantly high, however, in the area north west of the M4 the grass had been recently cut.

8.2.9 Dominant and abundant plant species recorded included False Oat-grass, Crested Dog's-tail (*Cynosurus cristatus*), Cock's-foot, Common Couch (*Elytrigia repens*), Yorkshire Fog (*Holcus lanatus*), Perennial Rye-grass (*Lolium perenne*), Timothy (*Phleum pratense*), Rough Meadow-grass (*Poa trivialis*), Hogweed, Yarrow, Knapweed (*Centaurea nigra*), Creeping Thistle (*Cirsium arvense*), Dandelion, , White Clover (*T. repens*), Ribwort Plantain (*Plantago lanceolata*), Meadow Buttercup (*Ranunculus acris*) and Creeping Buttercup (*R. repens*). These plant species were typically recorded across the survey area.

8.2.10 The following plant species were recorded less frequently or only occasionally throughout the survey area. Common Bent (*Agrostis capillaris*), Sweet Vernal-grass (*Anthoxanthum odoratum*), Spear Thistle (*C. vulgare*), Teasel (*Dipsacus fullonum*), Cat's-ear (*Hypochaeris radicata*), Oxeye Daisy (*Leucanthemum vulgare*), Ragwort (*Senecio jacobaea*), Lesser Stitchwort (*Stellaria gramine*a), Meadow Vetchling (*Lathyrus pratensis*), Red Clover (*Trifolium pratense*), Tufted Vetch (*Vicia cracca*), Common Vetch (*V. sativa*), Bush Vetch (*V. sepium*), Selfheal, Yellow Rattle (*Rhinanthus minor*), Foxglove (*Digitalis purpurea*), Common Sorrel (*Rumex acetosa*), Creeping Cinquefoil (*Potentilla reptans*), Silverweed (*P. anserina*), Dock (*Rumex sp*.) and Cleavers.

8.2.11 Common Fleabane (*Pulicaria dysenterica*) and Common Spotted-orchid (*Dactylorhiza fuchsii*) were only recorded in the fields located to the south west of the railway.

8.2.12 In some fields located south west of the railway, small watercourses with a low flow and/ or dry drainage ditches were present along field margins. Adjacent to these features, the ground conditions were damper, and several species preferring damp conditions were recorded., these include Marsh Thistle, Marsh Bird's-foot Trefoil (*Lotus pedunculatus*), Meadowsweet (*Filipendula ulmaria*), Horsetail (*Equisetum sp.*), Water Mint (*Mentha aquatica*) and Hemlock Water-dropwort (*Oenanthe crocata*).

Improved Grassland

8.2.13 A number of fields throughout the survey area supported improved grassland fields. At the time of survey some of the fields had been recently cut and some were subject to cattle grazing. Along the field margins, a higher diversity of plant species were recorded and small areas of tall ruderals and/ or scrub habitat were also noted. The grass species composition was generally consistent throughout the study area with grass species frequently recorded throughout the different fields.

8.2.14 Dominant grass species recorded across the survey area included False Oat-grass, Crested Dog's-tail, Cock's-foot, Yorkshire Fog, Italian Rye-grass (*Lolium multiflorum*), Perennial Rye-grass (*L. perenne*).

8.2.15 The following plant species were typically identified along the margins of the improved grassland fields; however, some species were also present within the grassland field. The following species were considered abundant across the survey area; Hogweed, Daisy (*Bellis perennis*), Creeping

Thistle, Spear Thistle, Dandelion, White Clover, Soft Brome (*Bromus hordeaceus*), Meadow Buttercup, Creeping Buttercup, Silverweed and Common Nettle.

8.2.16 The following plant species were recorded less frequently or only occasionally throughout the survey area. The majority of these species occurred within the field margins or were occasionally present among the Common Bent, Creeping Bent (*Agrostis stolonifera*), Sweet Vernal Grass, Timothy, Annual Meadow-grass (*Poa annua*), Smooth Meadow-grass (*P. pratensis*), Rough Meadow-grass (*P. trivialis*), Yarrow, Pineapple Weed (*Matricaria discoidea*), Prickly Sow-thistle (*Sonchus asper*), Scentless Mayweed (*Tripleurospermum maritimum*), Shepherd's Purse (*Capsella bursa-pastoris*), Lesser Swine-cress (*Coronopus didymus*), Common Mouse-ear (*Cerastium fontanum*), Lesser Stitchwort (*Stellaria graminea*), Red Clover, Cut-leaved Crane's-bill (*Geranium dissectum*), Selfheal, Ribwort Plantain, Greater Plantain, Pale Smartweed (*Persicaria lapathifolia*), Redshank (*P. maculosa*), Knotgrass (*Polygonum aviculare*), Broad-leaved Dock and Creeping Cinquefoil.

8.2.17 Several fields across the survey area had field margins and/ or corners which had wetter ground conditions, likely due to the local topography. In these areas, the following plant species were recorded; Marsh Foxtail (*Alopecurus geniculatus*), Jointed Rush (Juncus articulates), Toad Rush (*J. bufonius*), Soft-rush (*J. effusus*), Hard Rush (*J. inflexus*), Floating Sweet-grass (*Glyceria fluitans*), Marsh Cudweed (*Gnaphalium uliginosum*), Marsh Thistle and Water Forget-me-not (*Myosotis scorpioides*).

Marshy Grassland

8.2.18 Several fields across the survey area contained areas of marshy grassland. Soft-rush, Marsh Ragwort and Meadowsweet were common and widespread in these areas. Species recorded included Fool's Water-cress (*Apium nodiflorum*), Hemlock Water-dropwort, Kanpweed, Creeping Thistle, Marsh Thistle, Spear Thistle, Dandelion, Indian Balsam (*Impatiens glandulifera*), Water Forget-me-not, Valerian (*Valeriana officinalis*), Common Mouse-ear, Ragged Robin (*Silene flos-cuculi*), Marsh Horsetail (*Equisetum palustre*), Great Horsetail (*E. telmateia*), Meadow Vetchling, Marsh Bird's-foot Trefoil (*Lotus pedunculatus*), Lesser Trefoil (*Trifolium dubium*), Red Clover, White Clover, Tufted Vetch, Square-stalked St. John's-wort (*Hypericum tetrapterum*), Yellow Iris (*Iris pseudacorus*), Jointed Rush, Toad Rush, Soft-rush, Hard Rush, Water Mint, Selfheal, Purple Loosestrife (*Lythrum salicaria*), Foxglove, Ribwort Plantain, Greater Plantain, Brookline (*Veronica becca-bunga*), Marsh Foxtail (*Alopecurus geniculatus*), Crested Dog's Tail, Tufted hair-grass (*Deschampsia cespitosa*), Yorkshire Fog, Perenial Rye-grass, Reed Canary Grass (*Phalaris arundinacea*), Common Reed (*Phragmitis australis*), Water Pepper, Clustered Dock (*Rumex conglomeratus*), Creeping Jenny (*Lysimachia nummularia*), Marsh Marigold (*Caltha palustris*), Lesser Spearwort (*Ranunculus flammula*), Creeping Buttercup, Silverweed, Cleavers, Marsh Bedstraw (*Galium palustre*), Bittersweet (*Solanum dulcamara*) and Branched Bur-Reed (*Sparganium erectum*).

Tall Ruderals

8.2.19 Tall ruderal vegetation was common and widespread across the survey area and typically occurred between grassland margins, woodland/ scrub edges and along field boundaries. The Phase 1 habitat maps only show where tall ruderal vegetation occurred in larger areas. Species recorded included Nettle (*Urtica dioica*), Bracken (*Pteridium aquilinum)*, Rosebay Willowherb (*Chamerion angustifolium),* Greater Willowherb (*Epilobium hirsutum*)*,* Pendulous Sedge (*Carex pendula*), Hogweed, Vervain (*Verbena sp.*), Ragwort (*Senecio jacobaea),* Yarrow (*Achillea millefolium*), Ribwort Plantain*,* Knapweed, Raspberry (*Rubus sp.)*, Hedge Woundwort*,* Hedge Bindweed (*Calystegia sepium*), Giant Bindweed (*Calystegia sylvatica),* Hedge Parsley (*Torilis japonica),* Nipplewort (*Lapsana communis*), Red Campion*,* Herb Robert (*Geranium robertianum),* Broad-leaved Dock, Knapweed, Spear Thistle, Creeping Thistle, Marsh Thistle, Cleavers, Prickly Sow-thistle, Common Sow-thistle (*S. oleraceus*), Fleabane, Cock's-foot, Yorkshire Fog, Timothy, Hemlock Water-dropwort, Creeping Buttercup, White Clover.

Standing Water

- Ponds
  - One pond was recorded on the south western (TN136) section of the survey area. The pond was a large farm pond, which had three small, scrub covered, islands located in the centre. At the time of the survey, the water levels in the pond had reduced significantly and only the southern end of the waterbody held water. The pond was surrounded by improved grassland which was used for sheep grazing.

Running Water

- Rivers
  - The River Ely was recorded at the north of the survey area, where it flows from the north west to the south east through areas of broadleaved woodland and grassland. Surveyors were able to access the River at the north west of the survey area, south of the railway. The river had a moderate flow and the water was turbid. The channel was approximately 10m wide, and had steep earth and sand banks, with little emergent wetland vegetation.
  - Access was limited along the River Ely, due to landowner permissions, dense vegetation and/ or health & safety considerations (steep, unsafe banks). Surveyors were only able to view the river from a few viewpoints within the survey area, located south of the railway line and west of the existing road. Monk's hood was not observed at these locations at the time of the survey, The Ely Valley supports the largest known population of the nationally scarce plant Monk's-hood.
- Streams
  - The watercourse Nant Tredodridge was recorded on the western side of the survey area and flows from the south west to the north east where it joins with the River Ely (outside of the scheme boundary). The water level was particularly low and in places only held small pools of water or had a sluggish flow. In locations, cattle had poached the stream banks. The channel was approximately 2m wide. The watercourse flows through areas of woodland and there was little riparian or emergent vegetation.
  - The watercourse Nant Coslech was recorded on the south eastern section of the survey area and flows from the north east to the south where it joins with the River Ely. The stream flows through areas of woodland and grassland. Where surveyors accessed the watercourse, it was heavily shaded by woodland. The channel was approximately 2-3m wide and the water level and flow were low and relatively slow.
- Ditches
  - Numerous ditches and drains were recorded across the survey area and were associated with field boundaries, however, at the time of survey, the majority were dry or held very little water.
  - One drainage ditch located at the north east of the survey area. This watercourse flows from the north to the south east, where it joins with the Nant Coslech. The drainage flows through areas of woodland and marshy grassland, where cattle have access, and the water was turbid with the banks degraded from poaching. The channel varied in width from 1-3m and the water level was low, in some places, it held small pool of water.

Amenity Grassland

8.2.20 Some areas of amenity grassland were recorded within the central section of the survey area, north and south of the railway. The largest areas were recorded at the Hensol Golf Academy and the Renishaw site. The grass was regularly cut and maintained with a very short sward therefore abundances of species could not be estimated accurately. Species recorded included meadow grass (*Poa sp.)*, White Clover, Creeping Buttercup and Broadleaved Plantain (*Plantago major)*.

Hedges Intact – Native Species-rich, including with and without trees

8.2.21 A large number of hedgerows were recorded throughout the survey area. These hedgerows were identified as species rich as they supported five or more native woody species and a good hedgerow bottom flora. The majority of these hedgerows were located along field boundaries, and often connected areas of woodland throughout the survey area. The hedgerows were typically dense in structure and were of varied width (approximately 2m to 3m) and height (approximately 2m to 4m). Many hedgerows were present along drainage ditches, although the vast majority of these ditches were dry. The most common woody species recorded within the hedgerows were Hazel, Ash, Pedunculate Oak, Hawthorn, Blackthorn, Elder, Holly, Honeysuckle (*Lonicera periclymenum)* and Willow (*Salix sp.)*. Other woody species recorded less frequently included Alder, Beech, Birch, Cherry, Crab Apple (*Malus Sylvestris)*, Dogwood, Field Maple (*Acer campestre)*, Rowan, Sycamore and Wych Elm (*Ulmus glabra)*.

8.2.22 The hedgerows supported a diversity of flora species. The most dominant species was Bramble, which was present in every hedgerow. Frequently recorded species included Black Bryony, Bracken, Cleavers, Common Vetch, Bush Vetch, Creeping Buttercup, Creeping Thistle, Dandelion, False-brome, False Oat-grass, Foxglove, Hedge Bindweed, Greater Willowherb, Hart's-tongue Fern, Hogweed, Ivy (*Hedera helix),* Lesser Stitchwort, Lords-and-Ladies (*Arum maculatum)*, Meadowsweet, Common Nettle, Nipplewort, Red Campion, Dog Rose (*Rosa canina),* Selfheal, Wood Avens and Yorkshire Fog.

8.2.23 Other flora species less frequently recorded included Bittersweet, Couch, Dog's Mercury (*Mercurialis perennis)*, Garlic Mustard (*Alliaria petiolata),* Giant Fescue, Greater Celandine (*Chelidonium majus)*, Hops (*Humulus lupulus),* Marsh Bedstraw, Clustered Dock, Sterile Brome (*Bromus sterilis),* Wild Strawberry (*Fragaria vesca)* and Violet (*Viola sp.).*

8.2.24 Mature or semi-mature trees, often including Pedunculate Oak, Ash, Willow, Beech, Alder, Field Maple, Sycamore and Hazel were also a regular feature present along the hedgerows.

Hedges Intact and Defunct – Species Poor, including with and without trees

8.2.25 A number of hedges were identified as species poor as they supported fewer than five woody species along the length of the hedgerow. These hedgerows, similar to the species-rich hedgerows, were located along field boundaries and connected areas of woodland and occasionally were present along a dry drainage ditch. A small number of hedgerows were identified as 'defunct' as the hedge had gaps along the length of them, rendering them no longer stock-proof. Some of these hedgerows contained semi-mature, young and mature trees.

8.2.26 Species frequently recorded in the hedgerows included Hazel, Hawthorn, Ash, Sycamore, Oak, Beech, Dogwood, Field Maple, Wych Elm, Cherry, Holly, Bracken, Bramble and Dog Rose.

Buildings

8.2.27 Commercial buildings were located on the Hensol Golf Academy and Renishaw site. Several farm and residential buildings were also scattered throughout the survey area. Detailed surveys of these buildings were not undertaken during the Phase 1 Habitat walkover.

Non-Native Invasive Plant Species

8.2.28 Indian Balsam was recorded throughout the survey area and was typically encountered along hedgerows, ditches, within woodland and within grassland fields. Surveyors recorded all observations of the plant on site (TN1, TN42, TN43, TN45, TN114, TN115, TN116, TN124 and TN131); however, it is more than likely that surveyors may have missed areas additional occurrences of this plant.

8.2.29 Japanese Knotweed (*Fallopia japonica*) (TN41) was also recorded in the survey area.

Protected and Notable Fauna

Terrestrial Invertebrates

8.2.30 Multiple species of beetles, butterflies, dragonflies and crickets were recorded during the survey. Species of beetles recorded during the survey included common red soldier beetle (*Rhagonycha fulva*) andgreen dock beetle (*Gastrophysa viridula*).

8.2.31 The following species of butterflies were recorded during the survey; Peacock (*Aglais io*), small tortoiseshell (*Aglais urticae*), meadow brown (*Maniola jurtina*) speckled wood (*Pararge aegeria*), and small white (*Pieris rapae*). Meadow brown was the most commonly recorded species.

8.2.32 Black-tailed skimmer (*Orthetrum cancellatum*), species of dragonflywas recorded during the survey.

8.2.33 The following species of cricket were recorded during the survey; field grasshopper (*Chorthippus brunneus*), common green grasshopper (*Omocestus viridulus*), meadow grasshopper (*Pseudochorthippus parallelus*),, speckled bush-cricket (*Leptophyes punctatissima*) and dark bush-cricket (*Pholidoptera griseoaptera*).

8.2.34 The grassland, scrub, tall ruderal and woodland margins were considered suitable to support a diverse range of invertebrate species. Deadwood was common within woodland, hedgerows and treeline habitats which could provide habitat for a number of common terrestrial invertebrate species

Aquatic Invertebrates

8.2.35 A number of ditches and watercourses were recorded across the survey area and are considered likely to be of value to a diverse range of invertebrate species.

Fish

8.2.36 The River Ely, Nant Tredodridge and Nant Coslech within the survey area are considered suitable to support fish species.

Amphibians

8.2.37 One pond was identified within the survey area during the survey (TN136). At the time of the survey, the pond held water.

8.2.38 The grassland, hedgerow, scrub, tall ruderal and woodland habitats in the vicinity of these ponds provide suitable foraging, commuting and hibernating opportunities to great crested newts and other species of amphibians.

Reptiles

8.2.39 A number of habitats throughout the study area are considered suitable to support foraging and hibernating reptiles in particular the areas of broadleaved woodland, scrub, grassland and tall ruderal vegetation, in particular field margins.

Birds

8.2.40 A number of incidental bird sighting were recorded during the Phase 1 habitat survey including blackbird (*Turdus merula*) siskin (*Spinus spinus*), long-tailed tit (*Aegithalos caudatus*), nuthatch (*Sitta europaea*), buzzard (*Buteo buteo*), great spotted woodpecker (*Dendrocopos major*), wren (*Troglodytes troglodytes*), barn swallow (*Hirundo rustica*), goldfinch (*Carduelis carduelis*), coal tit (*Periparus ater*), stock dove (*Columba oenas*), wood pigeon (*Columba palumbus*), blue tit (*Cyanistes caeruleus*), yellowhammer (*Emberiza citronella*), reed bunting (*Emberiza schoeniclus*), coot (*Fulica atra*), lesser black-backed gull (*Larus fuscus*), linnet (*Linaria cannabina*), pied wagtail (*Motacilla alba yarrellii*), house sparrow (*Passer domesticus*chiffchaff (*Phylloscopus collybita*), green woodpecker (*Picus viridis*), bullfinch (*Pyrrhula pyrrhula*), blackcap (*Sylvia atricapilla*) and starling (*Sturnus vulgaris*).

8.2.41 The woodland, scattered trees, scrub and hedgerow habitats present throughout the survey area are likely to support breeding birds typical of these habitats and provide good foraging habitat, whilst the areas of less disturbed grassland were considered to be suitable for ground nesting birds It is

possible that barn owl could use mature trees with suitable cavities for nesting and grassland and arable field margins for foraging, although no evidence was recorded during the Phase 1 habitat survey.

Bats

8.2.42 The woodland areas and scattered trees, some associated with hedgerows, throughout the study area have potential to support roosting bats (TN117, TN128, TN129 and TN132). Several buildings were scattered across the survey area which may also have potential to support roosting bats. No buildings within the survey area were subject to detailed (interior or exterior) building inspections.

8.2.43 Areas of potential foraging and commuting habitat for bats were found throughout the survey area. High value habitats included the woodland areas, hedgerows and treelines, watercourses, permanent waterbodies and grassland field margins with scrub and tall ruderal vegetation.

Hazel Dormouse

8.2.44 An analysis of aerial photography indicates that there is good connectivity and continuity of woodland and scrub habitat within the wider landscape to support dormice (*Muscardinus avellanarius*) within the survey area.

8.2.45 The areas of woodland and connecting hedgerow habitat within the survey area were considered suitable to support hazel dormice. The majority of woodlands had a diverse range of tree and shrub species, which are a valuable food source throughout the year for dormice. These species included abundant fruiting Hazel stools, Oak, Bramble, Sycamore, Ash, Honeysuckle and Hawthorn. These woodland areas also had a good physical structure, with the majority having a dense or well-structured understorey which provides suitable dormouse habitat.

Water Vole

8.2.46 A large number of ditches were recorded within the survey area, however, the majority of these were either dry at the time of survey and not considered suitable to support water vole (*Arvicola amphibius)*.

8.2.47 The River Ely, Nant Coslech and parts of the Nant Tredodridge which were less shaded by the woodland were considered to be suitable to support water vole.

Otter

8.2.48 The River Ely, Nant Coslech and Nant Tredodridge were assessed as suitable to support otters (*Lutra lutra*). Suitable habitat was present along the River Ely which would provide opportunities for resting otters. All three water were considered suitable to support foraging and/ commuting otters.

Badger

8.2.49 The areas of woodland, scrub and hedgerows within the survey area were assessed as suitable to support badgers (*Meles meles).*

Other Mammals

8.2.50 A number of habitats present within the survey area were assessed as suitable to support the following species; brown hare (*Lepus europaeus*), hedgehog (*Erinaceus europaeus*), polecat (*Mustela putorius), w*easel (*Mustela nivalis), stoat Mustela erminea* and harvest mouse (*Micromys minutus).*

9 Evaluation of Ecological Features and Potential Impacts

9.1 Background

9.1.1 Section 3 of this report presented the results of the desk study and field survey, identifying a variety of ecological features of value to nature conservation that were found to be present, or that may potentially be present, within the study area.

9.1.2 Within Section 4, those ecological features that may potentially be impacted by the proposed development have been evaluated in terms of their importance within a defined geographical context (international, national, regional, county, local) and potential impacts to them have been identified, in accordance with CIEEM guidance (Ref 10). Table 16 to Table 20 detail the results of the evaluation and the identified potential impacts for each of the 5 sub-sections of the proposed development.

9.1.3 The habitats in the table below have been compared against SINC designation criteria where possible to help inform this initial evaluation (Ref 14).

9.2 Sub-Section 1

Table 16 Sub-Section 1 | Ecological Feature Evaluation and Potential Impacts

Sub-Section 1 Ecological Feature	Evaluation and Justification	Potential Impact
Ely Valley SSSI Site supports important population of nationally scarce Monk's-hood (*Aconitum napellus*) located within the study area.	National; SSSI designation	0m from the proposed development Works on or near to the riverbank may lead to loss of Monk's-hood individual specimens if present at this location. Works on or near to the riverbank may cause pollution of watercourse.
SINCS Coed Ffos-Ceibr SINC Land West of Hensol Mill SINC Coed Waunn-Lloff SINC Land West of Llanfarach Farm SINC South West of Castell Bach SINC Land South West of Llanfarach Farm SINC	County up to Regional; SINC designation	SINCS located less than 50m from the proposed development Habitat loss/ degradation/ fragmentation; air quality impacts through operational traffic and dust deposition during construction; loss of viability of site and designation as a SINC.
Ancient Woodland ASNW/RAWS/PAWS	County up to Regional; Irreplaceable habitat, but not SSSI/SAC quality.	3 ASNWs within 50m of the proposed development Habitat loss/ degradation/ fragmentation; air quality impacts through operational traffic and dust deposition during construction.
TPOs	Local to County;	1 TPO within 50m of proposed development Loss of important trees and/ or reduction in ecological function due to pruning works; loss of connecting and/ or steppingstone habitat.
Broadleaved Semi-Natural Woodland (including Wet Woodland) Mixed Semi-Natural Woodland Broadleaved Plantation Woodland	Local up to County; Important habitats including Priority Habitat (Wet Woodland), with some of the sites potentially being of SINC quality and others of local importance only	Habitat loss/ degradation/ fragmentation; air quality impacts through operational traffic and dust deposition during construction; hydrological change to wet woodland through drainage change in operational phase.

Sub-Section 1 Ecological Feature	Evaluation and Justification	Potential Impact
Mixed Plantation Woodland	-further survey required for more accurate evaluation	
Scattered Trees & Treelines	Local; No veteran trees were identified	Habitat loss/ degradation/ fragmentation; loss of wildlife corridors/ steppingstone habitat.
Neutral Semi-Improved Grassland	Local up to County; Important habitat type potentially of SINC quality -further survey required for more accurate evaluation	Habitat loss/ degradation/ fragmentation;
Marshy Grassland	Local up to County; Important habitat type potentially of SINC quality as species-rich with 19 indicator species across all fields -further survey required for more accurate evaluation	Habitat loss/ degradation/ fragmentation; hydrological change through drainage change in operational phase.
Running Water – Rivers River Ely	National Priority Habitats within SSSI designation	Habitat loss/ degradation through pollution in construction and operational phases.
Running Water – Streams Nant Tredodridge	Local up to County; Important habitat potentially of SINC quality	Habitat loss/ degradation through pollution in construction and operational phases.
Hedges Intact – Native Species-rich (with and without trees)	Local up to County; Priority Habitat and potentially SINC quality -further survey required for more accurate evaluation	Habitat loss/ degradation/ fragmentation; loss of wildlife corridors/ steppingstone habitat.
Buildings	TBC; Further survey required to determine potential to support protected species	Habitat loss/ degradation
Other habitats (including Scrub, Improved Grassland, Tall Ruderals, Hedges Intact & Defunct – Species Poor, Arable, Amenity Grassland	Local; Common and widespread habitats	Habitat loss/ degradation, loss of wildlife corridors/ steppingstone habitat.

Sub-Section 1 Ecological Feature	Evaluation and Justification	Potential Impact
Protected & Priority Plant Species Bluebell	Local; Significant populations are generally found within sites that are designated for their dominant woodland habitats, thus individuals of the species are of lesser value	Loss of individuals
Terrestrial Invertebrates	Local up to County; Numerous invertebrate species and wide range of habitats observed during survey -further survey required for more accurate evaluation	Loss of habitat suitable to support priority species, reduction and/ or loss of individuals and populations; pollution effects and road mortality in operational phase.
Aquatic Invertebrates	Local up to County; Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of habitat potentially suitable to support priority species, habitat degradation due to pollution and/ or drainage changes in construction and operational phase, reduction and/ or loss of individuals, populations and/ or communities;
Fish	Local up to County; Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of habitat potentially suitable to support priority species, habitat degradation due to pollution and/ or drainage changes in construction and operational phase, reduction and/ or loss of individuals, populations and/ or communities;
Amphibians & Reptiles	Local; No ponds within the survey area and low numbers of desk study records for common frog, common toad and common lizard suggest an absence of populations of significant importance	Loss of terrestrial habitat, reduction and/ or loss of individuals and populations.
Birds	Local up to County; Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of suitable habitat for nesting and foraging, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and through road mortality in operational phase, increased disturbance (including to

Sub-Section 1 Ecological Feature	Evaluation and Justification	Potential Impact
		Schedule 1 species) from construction and operational noise and visual disturbance which may cause displacement.
Bats	Local up to County; Records of 7 species of bat within 2km Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of suitable habitat for roosting and foraging, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and through road mortality in operational phase, increased disturbance from construction and operational noise and lighting disturbance which may cause displacement.
Hazel Dormouse	Local up to County; Suitable habitat is present within study area and nearest desk study record located 500m from proposed development. -further survey required for more accurate evaluation	Loss of suitable habitat for nesting, foraging and hibernation, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance, increased disturbance from construction and operational noise and lighting disturbance which may cause displacement.
Water Vole & Otter	Local up to County; Suitable habitat is present within study area along River Ely and Nant Tredodridge -further survey required for more accurate evaluation	Loss of suitable habitat for breeding and foraging, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and increased chance of road mortality in operational phase (otters), increased disturbance from construction and operational noise and lighting disturbance which may cause displacement, Pollution degradation impacts to foraging resource (i.e. fish stocks for otters).
Badger	Local; Relatively common and widespread species	Loss of suitable habitat for breeding, foraging and overwintering, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and increased chance of road mortality in operational phase, increased disturbance from

Sub-Section 1 Ecological Feature	Evaluation and Justification	Potential Impact
		construction and operational noise and lighting disturbance which may cause displacement.
Other Mammals Brown Hare, Hedgehog, Polecat	Local up to County Priority Species: Brown Hare and Hedgehog recorded during survey Desk study record for Priority Species: Brown Hare, Hedgehog and Polecat within 2km Suitable habitat present within study area -further survey required for more accurate evaluation	Loss of suitable habitat for breeding, foraging and overwintering/ hibernation, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and increased chance of road mortality in operational phase, increased disturbance from construction and operational noise and lighting disturbance which may cause displacement.

9.3 Sub-Section 2

Table 17 Sub-Section 2 | Ecological Feature Evaluation and Potential Impacts

Sub-Section 2 Ecological Feature	Evaluation and Justification	Potential Impact
SINCS Coed Cadw SINC Land at Pendoylan Moors SINC Coed Ffos-Ceibr SINC Coed Waunn-Lloff SINC Land West of Hensol Mill SINC South West of Castell Bach SINC North of Pendoylan Moors SINC Log Wood SINC	County up to Regional; SINC designation	4 SINCS within 50m of proposed development Habitat loss/ degradation/ fragmentation; air quality impacts through operational traffic and dust deposition during construction; loss of viability of site and designation as a SINC.
Ancient Woodland ASNW/RAWS/PAWS	County up to Regional; Irreplaceable habitat, but not but not SSSI/SAC quality	6 ANSWs within 50m of the proposed development Habitat loss/ degradation/ fragmentation; air quality impacts through operational traffic and dust deposition during construction.
TPOs	Local to County; Important woodland/ trees but not considered finest examples	0 TPOs within 50m of proposed development Limited potential for loss of important trees and/ or reduction in ecological function due to pruning works; loss of connecting and/ or steppingstone habitat.
Broadleaved Semi-Natural Woodland (including Wet Woodland) Mixed Semi-Natural Woodland Mixed Plantation Woodland	Local up to County; Important habitats including Priority Habitat (Wet Woodland), with some of the sites potentially being of SINC quality and others of local importance only -further survey required for more accurate evaluation	Habitat loss/ degradation/ fragmentation; air quality impacts through operational traffic and dust deposition during construction; hydrological change to wet woodland through drainage change in operational phase.
Scattered Trees & Treelines	Local; No veteran trees were identified	Habitat loss/ degradation/ fragmentation; loss of wildlife corridors/ steppingstone habitat.
Neutral Semi-Improved Grassland	Local up to County; Important habitat type potentially of SINC quality	Habitat loss/degradation/ fragmentation;

Sub-Section 2 Ecological Feature	Evaluation and Justification	Potential Impact
	-further survey required for more accurate evaluation	
Marshy Grassland	Local up to County; Important habitat type potentially of SINC quality as species-rich with 19 indicator species across all fields -further survey required for more accurate evaluation	Habitat loss/ degradation/ fragmentation; hydrological change through drainage change in operational phase.
Standing Water – Ponds and Ditches	Local Priority Habitat but not of SINC quality	Habitat loss/ degradation through pollution in construction and operational phase, loss of steppingstone habitat.
Running Water – Streams Nant Tredodridge, Nant-y-Felin and ditches	Local up to County Important habitat potentially of SINC quality -further survey required for more accurate evaluation	Habitat loss/ degradation through pollution in construction and operational phases.
Hedges Intact – Native Species-rich (with and without trees)	Local up to County; Priority Habitat and potentially SINC quality -further survey required for more accurate evaluation	Habitat loss/degradation/ fragmentation; loss of wildlife corridors/ steppingstone habitat.
Buildings	TBC; Further survey required to determine potential to support protected species	Habitat loss/ degradation
Other habitats (including Scrub, Improved Grassland, Tall Ruderals, Hedges Intact & Defunct – Species Poor, Arable, Amenity Grassland	Local; Common and widespread habitats	Habitat loss/ degradation, loss of wildlife corridors/ steppingstone habitat.
Protected & Priority Plant Species Bluebell	Local; Significant populations are generally found within sites that are designated for their dominant woodland habitats, thus individuals of the species are of lesser value	Loss of individuals

Sub-Section 2 Ecological Feature	Evaluation and Justification	Potential Impact
Terrestrial Invertebrates	Local up to County; Priority Species: Violet oil beetle and Cinnabar moth recorded during survey Numerous species and range of suitable habitats observed during survey -further survey required for me accurate evaluation	Loss of habitat suitable to support priority species, reduction and/ or loss of individuals and populations; pollution effects and road mortality in operational phase.
Aquatic Invertebrates	Local up to County; Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of habitat potentially suitable to support priority species, habitat degradation due to pollution and/ or drainage changes in construction and operational phase, reduction and/ or loss of individuals, populations and/ or communities;
Fish	Local up to County; Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of habitat potentially suitable to support priority species, habitat degradation due to pollution and/ or drainage changes in construction and operational phase, reduction and/ or loss of individuals, populations and/ or communities;
Amphibians	Local up to County; Records of 5 species of amphibian within 2km, including great crested newt. Suitable habitat present within study area -further survey required for more accurate evaluation	Loss of terrestrial habitat, reduction and/ or loss of individuals and populations.
Reptiles	Local up to County; Records of common lizard and grass snake within 2km Suitable habitat present within study area -further survey required for more accurate evaluation	Loss of terrestrial habitat, reduction and/ or loss of individuals and populations.
Birds	Local up to County; Suitable habitat is present within study area.	Loss of suitable habitat for nesting and foraging, fragmentation and loss of connectivity, reduction and/ or

Sub-Section 2 Ecological Feature	Evaluation and Justification	Potential Impact
	-further survey required for more accurate evaluation	loss of individuals and populations during site clearance and through road mortality in operational phase, increased disturbance (including to Schedule 1 species) from construction and operational noise and visual disturbance which may cause displacement.
Bats	Local up to County; Records of 7 species of bat within 2km Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of suitable habitat for roosting and foraging, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and through road mortality in operational phase, increased disturbance from construction and operational noise and lighting disturbance which may cause displacement.
Hazel Dormouse	Local up to County; Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of suitable habitat for nesting, foraging and hibernation, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance, increased disturbance from construction and operational noise and lighting disturbance which may cause displacement.
Water Vole & Otter	Local up to County; Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of suitable habitat for breeding and foraging, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and increased chance of road mortality in operational phase (otters), increased disturbance from construction and operational noise and lighting disturbance which may cause displacement, Pollution degradation impacts to foraging resource (i.e. fish stocks for otters).
Badger	Local; Relatively common and widespread species	Loss of suitable habitat for breeding, foraging and overwintering, fragmentation and loss of connectivity, reduction

Sub-Section 2 Ecological Feature	Evaluation and Justification	Potential Impact
		and/ or loss of individuals and populations during site clearance and increased chance of road mortality in operational phase, increased disturbance from construction and operational noise and lighting disturbance which may cause displacement.
Other Mammals Brown Hare, Hedgehog, Polecat, Harvest Mouse	Local up to County Desk study record for Priority Species: Brown Hare, Hedgehog, Polecat and Harvest Mouse within 2km Suitable habitat present within study area -further survey required for more accurate evaluation	Loss of suitable habitat for breeding, foraging and overwintering/ hibernation, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and increased chance of road mortality in operational phase, increased disturbance from construction and operational noise and lighting disturbance which may cause displacement.

9.4 Sub-Section 3

Table 18 Sub-Section 3 | Ecological Feature Evaluation and Potential Impacts

Sub-Section 3 Ecological Feature	Evaluation and Justification	Potential Impact
SINCS Coed Cadw SINC Coed Ffos-Ceibr SINC Coed Waunn-Lloff SINC Land West of Hensol Mill SINC South West of Castell Bach SINC Coed Counsellor SINC Log Wood SINC	County up to Regional; SINC designation	3 SINCS within 50m of proposed development Habitat loss/ degradation/ fragmentation; air quality impacts through operational traffic and dust deposition during construction; loss of viability of site and designation as a SINC.
Ancient Woodland ASNW/RAWS/PAWS	County up to Regional; Irreplaceable habitat, but not SSSI/SAC quality.	6 ASNWs within 50m of the proposed development Habitat loss/ degradation/ fragmentation; air quality impacts through operational traffic and dust deposition during construction.
TPOs	Local to County; Important woodland/trees but not considered finest examples	3 TPO within 50m of proposed development Loss of important trees and/ or reduction in ecological function due to pruning works; loss of connecting and/ or steppingstone habitat.
Broadleaved Semi-Natural Woodland (including Wet Woodland) Mixed Semi-Natural Woodland Mixed Plantation Woodland	Local up to County; Important habitats with some of the sites potentially being of SINC quality and others of local importance only -further survey required for more accurate evaluation	Habitat loss/degradation/ fragmentation; air quality impacts through operational traffic and dust deposition during construction; hydrological change to wet woodland through drainage change in operational phase.
Scattered Trees & Treelines	Local; No veteran trees were identified	Habitat loss/ degradation /fragmentation; loss of wildlife corridors/ steppingstone habitat.
Neutral Semi-Improved Grassland	Local up to County; Important habitat type potentially of SINC quality -further survey required for more accurate evaluation	Habitat loss/ degradation/ fragmentation;

Sub-Section 3 Ecological Feature	Evaluation and Justification	Potential Impact
Marshy Grassland	Local up to County; Important habitat type potentially of SINC quality as species-rich with 19 indicator species across all fields -further survey required for more accurate evaluation	Habitat loss/ degradation/ fragmentation; hydrological change through drainage change in operational phase.
Standing Water - Ponds and Ditches	Local Priority Habitat but not of SINC quality	Habitat loss/ degradation through pollution in construction and operational phases.
Running Water – Streams Nant Tredodridge and Nant-y-Felin	Local up to County Important habitat potentially of SINC quality -further survey required for more accurate evaluation	Habitat loss/ degradation through pollution in construction and operational phases.
Hedges Intact – Native Species-rich (with and without trees)	Local up to County; Priority Habitat and potentially SINC quality -further survey required for more accurate evaluation	Habitat loss/ degradation/ fragmentation; loss of wildlife corridors/ steppingstone habitat.
Buildings	TBC; Further survey required to determine potential to support protected species	Habitat loss/ degradation
Other habitats (including Scrub, Improved Grassland, Tall Ruderals, Hedges Intact & Defunct – Species Poor, Arable, Amenity Grassland	Local; Common and widespread habitats	Habitat loss/ degradation, loss of wildlife corridors/ steppingstone habitat.
Protected & Priority Plant Species Cornflower, *Parmotrema perlatum* (a lichen)	Local; Desk study records of Priority Species	Loss of individuals, indirect loss through air quality impacts (lichen).
Terrestrial Invertebrates	Local up to County; Priority Species: Cinnabar moth recorded during survey	Loss of habitat suitable to support priority species, reduction and/ or loss of individuals and populations; pollution effects and road mortality in operational phase.

Sub-Section 3 Ecological Feature	Evaluation and Justification	Potential Impact
	Numerous species and range of suitable habitats observed during survey -further survey required for me accurate evaluation	
Aquatic Invertebrates	Local up to County; Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of habitat potentially suitable to support priority species, habitat degradation due to pollution and/ or drainage changes in construction and operational phase, reduction and/ or loss of individuals, populations and/or communities;
Fish	Local up to County; Desk study record for Priority Species: European Eel within 2km Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of habitat potentially suitable to support priority species, habitat degradation due to pollution and/ or drainage changes in construction and operational phase, reduction and/or loss of individuals, populations and/ or communities;
Amphibians	Local up to County; Records of 5 species of amphibian within 2km, including great crested newt. Suitable habitat present within study area -further survey required for more accurate evaluation	Loss of terrestrial habitat, reduction and/ or loss of individuals and populations.
Reptiles	Local up to County; Records of common lizard and grass snake within 2km Suitable habitat present within study area -further survey required for more accurate evaluation	Reduction and/ or loss of individuals, populations and/ or communities
Birds	Local up to County; Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of suitable habitat for nesting and foraging, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and through road mortality in operational phase, increased

Sub-Section 3 Ecological Feature	Evaluation and Justification	Potential Impact
		disturbance (including to Schedule 1 species) from construction and operational noise and visual disturbance which may cause displacement.
Bats	Local up to County; Records of 7 species of bat within 2km Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of suitable habitat for roosting and foraging, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and through road mortality in operational phase, increased disturbance from construction and operational noise and lighting disturbance which may cause displacement.
Hazel Dormouse	Local up to County; Records of Priority Species within 2km Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of suitable habitat for nesting, foraging and hibernation, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance, increased disturbance from construction and operational noise and lighting disturbance which may cause displacement.
Water Vole & Otter	Local up to County; Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of suitable habitat for breeding and foraging, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and increased chance of road mortality in operational phase (otters), increased disturbance from construction and operational noise and lighting disturbance which may cause displacement, Pollution degradation impacts to foraging resource (i.e. fish stocks for otters).
Badger	Local; Relatively common and widespread species	Loss of suitable habitat for breeding, foraging and overwintering, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and increased chance of road mortality in operational phase,

Sub-Section 3 Ecological Feature	Evaluation and Justification	Potential Impact
		increased disturbance from construction and operational noise and lighting disturbance which may cause displacement.
Other Mammals Brown Hare, Hedgehog, Polecat, Harvest Mouse	Local up to County Desk study record for Priority Species: Brown Hare, Hedgehog, Polecat and Harvest Mouse within 2km Suitable habitat present within study area -further survey required for more accurate evaluation	Loss of suitable habitat for breeding, foraging and overwintering/ hibernation, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and increased chance of road mortality in operational phase, increased disturbance from construction and operational noise and lighting disturbance which may cause displacement.

9.5 Sub-Section 4

Table 19 Sub-Section 4 | Ecological Feature Evaluation and Potential Impacts

Sub-Section 4 Ecological Feature	Evaluation and Justification	Potential Impact
SINCS Log Wood SINC	County up to Regional; SINC designation	1 SINC within 50m of proposed development Habitat loss/ degradation/ fragmentation; air quality impacts through operational traffic and dust deposition during construction; loss of viability of site and designation as a SINC.
Ancient Woodland ASNW/RAWS/PAWS	County up to Regional; Irreplaceable habitat, but not but not SSSI/SAC quality	1 ASNWs and 1 RAWS within 50m of the proposed development Habitat loss/degradation/ fragmentation; air quality impacts through operational traffic and dust deposition during construction.
TPOs	Local to County; Important woodland/ trees but not considered finest examples	0 TPO within 50m of proposed development Loss of important trees and/ or reduction in ecological function due to pruning works; loss of connecting and/ or steppingstone habitat.
Broadleaved Semi-Natural Woodland (including Wet Woodland) Mixed Plantation Woodland	Local up to County; Important habitats with some of the sites potentially being of SINC quality and others of local importance only -further survey required for more accurate evaluation	Habitat loss, habitat fragmentation, habitat degradation
Scattered Trees & Treelines	Local; No veteran trees were identified	Habitat loss/ degradation/ fragmentation; loss of wildlife corridors/ steppingstone habitat.
Standing Water – Ponds and Ditches	Local; Priority Habitat and potentially some of SINC quality -further survey required for more accurate evaluation	Habitat loss/ degradation through pollution in construction and operational phase, loss of steppingstone habitat.

Sub-Section 4 Ecological Feature	Evaluation and Justification	Potential Impact
Hedges Intact – Native Species-rich (with and without trees)	Local up to County; Priority Habitat and potentially SINC quality -further survey required for more accurate evaluation	Habitat loss/ degradation/ fragmentation; loss of wildlife corridors/ steppingstone habitat.
Buildings	TBC; Further survey required to determine potential to support protected species	Habitat loss/ degradation
Other habitats (including Scrub, Improved Grassland, Tall Ruderals, Hedges Intact & Defunct – Species Poor, Arable, Amenity Grassland	Local; Common and widespread habitats	Habitat loss/ degradation, loss of wildlife corridors/ steppingstone habitat.
Protected & Priority Plant Species Cornflower, *Parmotrema perlatum* (a lichen)	Local; Desk study records of Priority Species	Loss of individuals, indirect loss through air quality impacts (lichen).
Terrestrial Invertebrates	Local up to County; Priority Species: Cinnabar moth recorded during survey Numerous species and range of suitable habitats observed during survey -further survey required for me accurate evaluation	Loss of habitat suitable to support priority species, reduction and/ or loss of individuals and populations; pollution effects and road mortality in operational phase.
Aquatic Invertebrates	Local up to County; Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of habitat potentially suitable to support priority species, habitat degradation due to pollution and/ or drainage changes in construction and operational phase, reduction and/ or loss of individuals, populations and/or communities;
Fish	Local up to County; Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of habitat potentially suitable to support priority species, habitat degradation due to pollution and/ or drainage changes in construction and operational phase, reduction and/ or loss of individuals, populations and/ or communities;

Sub-Section 4 Ecological Feature	Evaluation and Justification	Potential Impact
Amphibians	Local up to County; Records of 5 species of amphibian within 2km, including great crested newt. Suitable habitat present within study area -further survey required for more accurate evaluation	Loss of terrestrial habitat, reduction and/ or loss of individuals and populations.
Reptiles	Local up to County; Records of common lizard and grass snake within 2km Suitable habitat present within study area -further survey required for more accurate evaluation	Loss of terrestrial habitat, reduction and/ or loss of individuals and populations.
Birds	Local up to County; Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of suitable habitat for nesting and foraging, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and through road mortality in operational phase, increased disturbance (including to Schedule 1 species) from construction and operational noise and visual disturbance which may cause displacement.
Bats	Local up to County; Records of 7 species of bat within 2km Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of suitable habitat for roosting and foraging, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and through road mortality in operational phase, increased disturbance from construction and operational noise and lighting disturbance which may cause displacement.
Hazel Dormouse	Local up to County; Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of suitable habitat for nesting, foraging and hibernation, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance,

Sub-Section 4 Ecological Feature	Evaluation and Justification	Potential Impact
		increased disturbance from construction and operational noise and lighting disturbance which may cause displacement.
Water Vole & Otter	Local; No suitable habitat is present within study area as many of the ditches were dry and lacked riparian vegetation	Loss of suitable habitat for breeding and foraging, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and increased chance of road mortality in operational phase (otters), increased disturbance from construction and operational noise and lighting disturbance which may cause displacement, Pollution degradation impacts to foraging resource (i.e. fish stocks for otters).
Badger	Local; Relatively common and widespread species	Loss of suitable habitat for breeding, foraging and overwintering, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and increased chance of road mortality in operational phase, increased disturbance from construction and operational noise and lighting disturbance which may cause displacement.
Other Mammals Brown Hare, Hedgehog, Polecat, Harvest Mouse	Local up to County Desk study record for Priority Species: Brown Hare, Hedgehog, Polecat and Harvest Mouse within 2km Suitable habitat present within study area -further survey required for more accurate evaluation	Loss of suitable habitat for breeding, foraging and overwintering/ hibernation, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and increased chance of road mortality in operational phase, increased disturbance from construction and operational noise and lighting disturbance which may cause displacement.

9.6 Sub-Section 5

Table 20 Sub-Section 5 | Ecological Feature Evaluation and Potential Impacts

Sub-Section 5 Ecological Feature	Evaluation and Justification	Potential Impact
Ely Valley SSSI Site supports important population of nationally scarce Monk's-hood (*Aconitum napellus*) located within the study area.	National; SSSI designation	0m from the proposed development Works on or near to the riverbank may lead to loss of Monk's-hood individual specimens if present at this location. Works on or near to the riverbank may cause pollution of watercourse.
SINCS Land South West of Llanfarach Farm SINC Land West of Llanfarach Farm SINC	County up to Regional; SINC designation	2 SINCS located less than 50m from the proposed development Habitat loss/ degradation/ fragmentation; air quality impacts through operational traffic and dust deposition during construction; loss of viability of site and designation as a SINC.
Ancient Woodland ASNW/RAWS/PAWS	County up to Regional; Irreplaceable habitat, but not SSSI/SAC quality	0 sites located within 50m from the proposed development Habitat loss/ degradation/ fragmentation; air quality impacts through operational traffic and dust deposition during construction.
TPOs	Local to County; Important woodland/ trees but not considered finest examples	1 TPO within 50m of proposed development Loss of important trees and/ or reduction in ecological function due to pruning works; loss of connecting and/ or steppingstone habitat.
Broadleaved Semi-Natural Woodland (including Wet Woodland) Mixed Semi-Natural Woodland	Local up to County; Important habitats including Priority Habitat (Wet Woodland), with some of the sites potentially being of SINC quality and others of local importance only -further survey required for more accurate evaluation	Habitat loss/ degradation/ fragmentation; air quality impacts through operational traffic and dust deposition during construction; hydrological change to wet woodland through drainage change in operational phase.

Sub-Section 5 Ecological Feature	Evaluation and Justification	Potential Impact
Scattered Trees & Treelines	Local; No veteran trees were identified	Habitat loss/ degradation/ fragmentation; loss of wildlife corridors/ steppingstone habitat.
Neutral Semi-Improved Grassland	Local up to County; Important habitat type potentially of SINC quality -further survey required for more accurate evaluation	Habitat loss/ degradation/ fragmentation;
Marshy Grassland	Local up to County; Important habitat type potentially of SINC quality -further survey required for more accurate evaluation	Habitat loss/ degradation/ fragmentation; hydrological change through drainage change in operational phase.
Standing Water - Ponds	Local; Priority Habitat but not of SINC quality	Habitat loss/ degradation through pollution in construction and operational phases.
Running Water – Rivers River Ely	County up to National Priority Habitats and meets SINC criteria	Habitat loss/ degradation through pollution in construction and operational phases.
Running Water – Streams Nant Tredodridge, Nant Coslech	Local up to County; Important habitat potentially of SINC quality	Habitat loss/ degradation through pollution in construction and operational phases.
Running Water – Ditches	Local; Common and widespread habitat type	Habitat loss/ degradation through pollution in construction and operational phases.
Hedges Intact – Native Species-rich (with and without trees)	Local up to County; Priority Habitat and potentially SINC quality -further survey required for more accurate evaluation	Habitat loss/ degradation/ fragmentation; loss of wildlife corridors/ steppingstone habitat.
Buildings	TBC; Further survey required to determine potential to support protected species	Habitat loss/ degradation
Other habitats (including Scrub, Improved Grassland, Tall Ruderals, Hedges Intact & Defunct –	Local; Common and widespread habitats	Habitat loss/ degradation, loss of wildlife corridors/ steppingstone habitat.

Sub-Section 5 Ecological Feature	Evaluation and Justification	Potential Impact
Species Poor, Arable, Amenity Grassland		
Protected & Priority Plant Species Cornflower, *Parmotrema perlatum* (a lichen)	Local; Desk study records of Priority Species within 2km	Loss of individuals, indirect loss through air quality impacts (lichen).
Terrestrial Invertebrates	Local up to County; Numerous invertebrate species and wide range of habitats observed during survey -further survey required for more accurate evaluation	Loss of habitat suitable to support priority species, reduction and/ or loss of individuals and populations; pollution effects and road mortality in operational phase.
Aquatic Invertebrates	Local up to County; Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of habitat potentially suitable to support priority species, habitat degradation due to pollution and/ or drainage changes in construction and operational phase, reduction and/ or loss of individuals, populations and/ or communities;
Fish	Local up to County; Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of habitat potentially suitable to support priority species, habitat degradation due to pollution and/ or drainage changes in construction and operational phase, reduction and/ or loss of individuals, populations and/ or communities;
Amphibians & Reptiles	Local; No desk study records for common amphibian or reptiles within 2km suggests absence of significant populations	Loss of terrestrial habitat, loss of individuals and/ or small populations.
Birds	Local up to County; Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of suitable habitat for nesting and foraging, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and through road mortality in operational phase, increased disturbance (including to Schedule 1 species) from construction and operational

Sub-Section 5 Ecological Feature	Evaluation and Justification	Potential Impact
		noise and visual disturbance which may cause displacement.
Bats	Local up to County; Records of 5 species of bat within 2km Suitable habitat is present within study area. -further survey required for more accurate evaluation	Loss of suitable habitat for roosting and foraging, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and through road mortality in operational phase, increased disturbance from construction and operational noise and lighting disturbance which may cause displacement.
Hazel Dormouse	Local up to County; Desk study record for Priority Species within 2km Suitable habitat is present within study area -further survey required for more accurate evaluation	Loss of suitable habitat for nesting, foraging and hibernation, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance, increased disturbance from construction and operational noise and lighting disturbance which may cause displacement.
Water Vole & Otter	Local up to County; Suitable habitat is present within study area along River Ely and Nant Tredodridge -further survey required for more accurate evaluation	Loss of suitable habitat for breeding and foraging, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and increased chance of road mortality in operational phase (otters), increased disturbance from construction and operational noise and lighting disturbance which may cause displacement, Pollution degradation impacts to foraging resource (i.e. fish stocks for otters).
Badger	Local; Relatively common and widespread species	Loss of suitable habitat for breeding, foraging and overwintering, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and increased chance of road mortality in operational phase, increased disturbance from construction and operational

Sub-Section 5 Ecological Feature	Evaluation and Justification	Potential Impact
		noise and lighting disturbance which may cause displacement.
Other Mammals Brown Hare, Hedgehog, Polecat	Local up to County Desk study record for Priority Species: Brown Hare, Hedgehog and Polecat within 2km Suitable habitat present within study area -further survey required for more accurate evaluation	Loss of suitable habitat for breeding, foraging and overwintering/ hibernation, fragmentation and loss of connectivity, reduction and/ or loss of individuals and populations during site clearance and increased chance of road mortality in operational phase, increased disturbance from construction and operational noise and lighting disturbance which may cause displacement.

10 Conclusions and Recommendations

10.1 Designated Sites & Priority Habitats and Species within the Study Area

10.1.1 The desk study and extended Phase 1 habitat survey has confirmed the presence within the study area of sites designated for nature conservation value and Priority Habitats as listed within Section 7 of the Environment Act (Wales) 2016. The designated sites and Priority Habitats identified within the study area include:

- Ely Valley SSSI
- Coed Ffos-Ceibr SINC
- Land West of Hensol Mill SINC
- Coed Waunn-Lloff SINC
- Land West of Llanfarach Farm SINC
- South West of Castell Bach SINC
- Land South West of Llanfarach Farm SINC
- Coed Cadw SINC
- Land at Pendoylan Moors SINC
- Coed Ffos-Ceibr SINC
- North of Pendoylan Moors SINC
- Log Wood SINC
- Coed Counsellor SINC
- Ancient Woodland (ASNW/RAWS/PAW)
- TPOs
- Wet Woodland
- River Ely
- Ponds
- Native Species-rich Hedges

10.1.2 The extended Phase 1 habitat survey confirmed the presence of the following Priority Species:

- Violet Oil Beetle
- Cinnabar Moth
- Brown Hare
- Hedgehog

10.1.3 Due to the presence of suitable habitat, there is the potential that other Protected and Priority Species may also be present within the study area. However, further botanical and fauna species/ species group specific surveys are required to accurately determine whether the study area supports these species. Section 5.3 provides a list of these species and recommendations for further surveys.

10.2 Comparison of Results for East and West Highway Alignment Options

10.2.1 As the 2 highway alignment options share common northern (Sub-Section 1) and southern (Sub-Section 4) extents, the results of the ecological assessment are only different between Sub-Section

2 (east alignment) and Sub-Section 3 (west alignment). A comparison of the results for Sub-Sections 2 and 3 has been undertaken through the review of text within Sections 3.3 and 3.4 of this report and by studying the Phase 1 habitat survey plan (Drawing 10028657-ARC-00-XX-DR-EC-0056-P1). Table 21 provides a summary of the key findings for Sub-Section 2 and 3.

Table 21 Comparison of Ecological Assessment Results for Sub-Sections 2 and 3

<table>
<tr><th colspan="2">Sub-Section 2 (East Highways Alignment Option) Ecological Assessment Results Summary</th><th colspan="2">Sub-Section 3 (West Highways Alignment Option) Ecological Assessment Results Summary</th></tr>
<tr><td colspan="2">4 SINCS crossed by proposed route</td><td colspan="2">3 SINCS crossed by proposed route</td></tr>
<tr><td colspan="2">6 ASNWs within 50m of proposed route</td><td colspan="2">6 ASNWs within 50m of proposed route</td></tr>
<tr><td colspan="2">0 TPOs within 50m of proposed route</td><td colspan="2">3 TPOs within 50m of proposed route</td></tr>
<tr><td colspan="2">Priority Habitats within study area:</td><td colspan="2">Priority Habitats within study area:</td></tr>
<tr><td>Priority Habitats</td><td>Area (Hectares)</td><td>Priority Habitats</td><td>Area (Hectares)</td></tr>
<tr><td>Broadleaved Semi-Natural Woodland (including Wet Woodland)</td><td>6.54</td><td>Broadleaved Semi-Natural Woodland (including Wet Woodland)</td><td>6.32</td></tr>
<tr><td>Ponds</td><td>None</td><td>Ponds</td><td>None</td></tr>
<tr><td>Hedges Intact – Native Species-rich (with and without trees)</td><td>18.1 km (length)</td><td>Hedges Intact – Native Species-rich (with and without trees)</td><td>19.5 km (length)</td></tr>
<tr><td>Species rich Marshy grassland</td><td>45.4</td><td>Species rich Marshy grassland</td><td>11.5</td></tr>
<tr><td colspan="2">Priority Species identified within study area:
Violet oil beetle
Cinnabar moth</td><td colspan="2">Priority Species identified within study area:
Cinnabar moth</td></tr>
<tr><td colspan="2">Protected Species records within 2km search area:
Great crested newt
Common lizard
Grass snake
Bats (7 species)
Brown hare
Hedgehog
Polecat
Harvest mouse
NB Suitable dormouse habitat occurs on both alignments</td><td colspan="2">Protected Species records within 2km search area:
Great crested newt
Common lizard
Grass snake
Bats (7 species)
Dormouse
Brown hare
Hedgehog
Polecat
Harvest mouse</td></tr>
</table>

Sub-Section 2 (East Highways Alignment Option) Ecological Assessment Results Summary	Sub-Section 3 (West Highways Alignment Option) Ecological Assessment Results Summary
Phase 1 habitat survey plan results: • Large proportion of the study area comprised of Marshy grassland habitat, in addition to Improved grassland and Arable. • Study area features large number of smaller sized fields, resulting in greater number of hedgerows.	Phase 1 habitat survey plan results: • Large proportion of the study area comprised of Improved grassland and Arable. • Study area features proportion of larger fields resulting in reduced number of hedgerows.

10.2.2 The two offline highway alignment options feature many of the same important ecological features and, from what can be determined from the currently available data, are similar in ecological value. However, Sub-Section 2 (the east highway alignment option) does have the greater ecological impact due to the slightly higher number of SINCs, larger area of species-rich Marshy grassland (likely to be classed as a Priority Habitat) and greater number of hedgerows to be impacted.

10.3 Recommendations

10.3.1 Further ecological surveys are required at the next stage of assessment to fully establish baseline conditions within the study area, allowing for the accurate assessment of impacts and the design of an appropriate mitigation strategy for the scheme.

10.3.2 Listed below are Priority Habitats and Species that have been identified from the desk study and field survey as being potentially present within the study area. Where a review of the detailed design of the scheme indicates that any of the below Priority Habitats and Species will potentially be impacted, the corresponding recommended survey should be undertaken.

- Wet woodland - Phase 2 Botanical survey
- Hedgerow - Hedgerow assessment
- Neutral Semi-Improved Grassland - Phase 2 Botanical survey
- Marshy Grassland - Phase 2 Botanical survey
- Cornflower - Specific botanical survey
- *Parmotrema perlatum* (a lichen) - Lichen survey recommended
- Terrestrial & Aquatic Invertebrates - Terrestrial & Aquatic Invertebrate survey
- Fish (including European Eel) - Fish survey (if direct impacts to River Ely)
- Amphibians - Great crested newt survey
- Reptiles - Reptile survey
- Birds - Breeding bird and barn owl survey
- Bats - Bat roost (trees and buildings) and activity surveys
- Hazel Dormouse - Dormouse survey
- Water Vole & Otter - Water Vole and Otter surveys
- Badger - Badger survey
- Polecat, Harvest Mouse, Hedgehog

11 References

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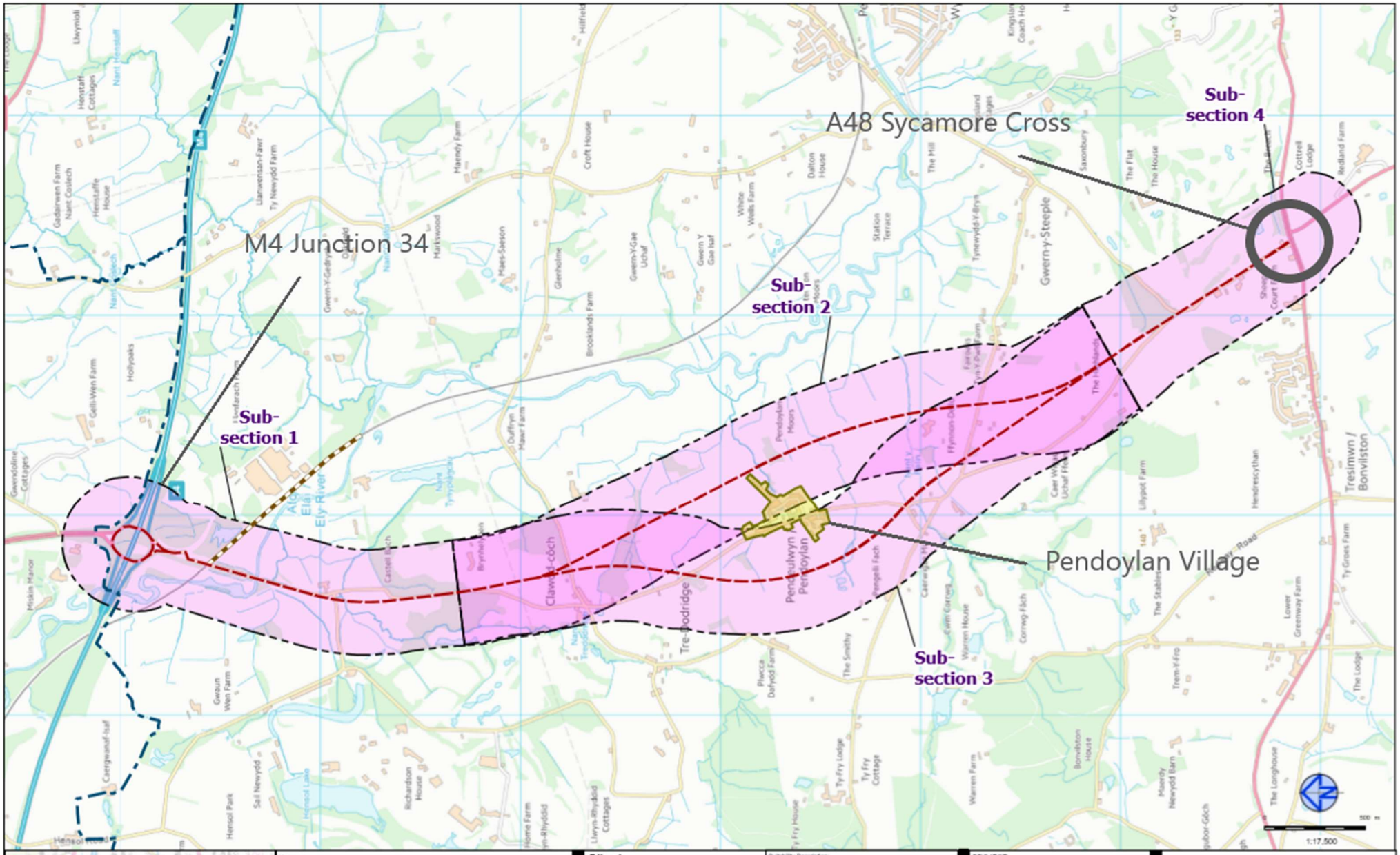
Drawings

Drawing 10028657-ARC-XX-XX-DR-EA-0039-P1	Study Area Overall Sub-Sections
Drawing 10028657-ARC-XX-XX-DR-EC-0057-P1	Ecological Constraints Plan
Drawing 10028657-ARC-XX-XX-DR-EC-0056-P1	Phase 1 Habitat Survey



Notes :
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Legend :

- Proposed route options
- Passing loop
- Sub-sections study area and overall study area
- Unitary Authority Boundaries
- Settlement boundary

REV	Date	Description	Drawn	Check	Approv

Client: Vale of Glamorgan Council

Site

Suitability Description: Issued for information

Designed	M. Azzopardi	Date: 23/APR/2020	Signed:
Drawn	M. Azzopardi	Date: 23/APR/2020	Signed:
Checked	M. Fry	Date: 23/APR/2020	Signed:
Approved	M. Fry	Date: 23/APR/2020	Signed:
Scale:	1:17,500	Datum:	AOD
Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10028657

PROJECT:
M4 Junction 34 to A48
WelTAG Stage Two
- Highway Link Study

TITLE:
Study Area
Overall Sub-Sections

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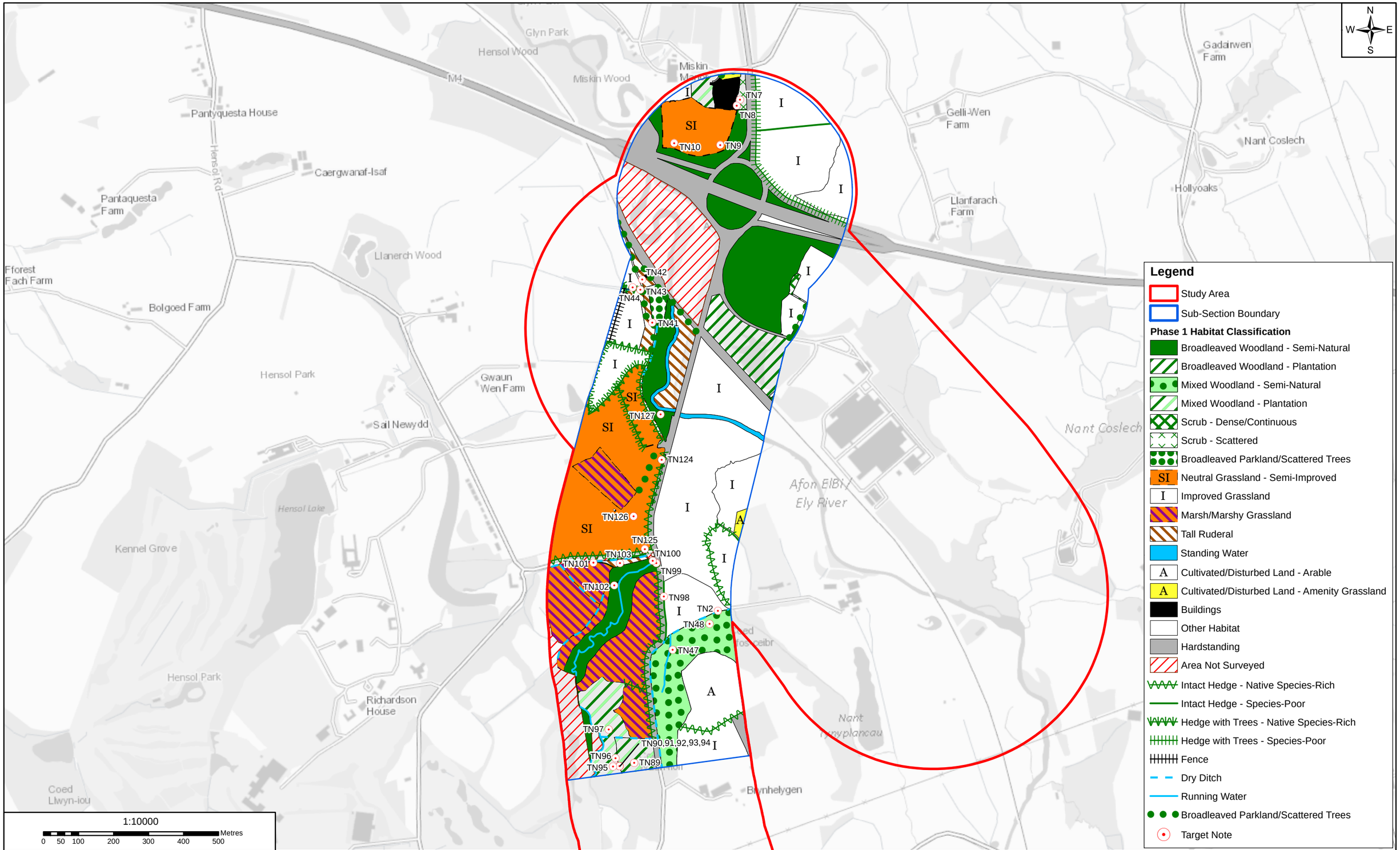
Drawing Number: 10028657-ARC-XX-XX-DR-EA-0059
Revision: P1



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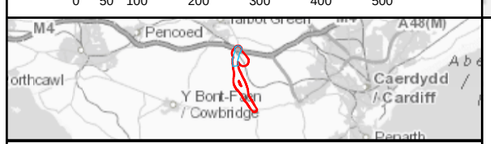

REV	Date	Description	Drawn	Check	Approv
01	10/09/19	Initial Issue	SP	MJ	SH

Client

VALE of GLAMORGAN
BRO MORGANNWG

Site

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Checked	M. James	Date 10SEP19	Signed
Approved	S. Hancock	Date 10SEP19	Signed
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Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10028657

PROJECT:

M4 JUNCTION 34 TO A48
WELTAG STAGE TWO PLUS

TITLE:

Phase 1 Habitat Surveys
Sub-Section 1 of 5

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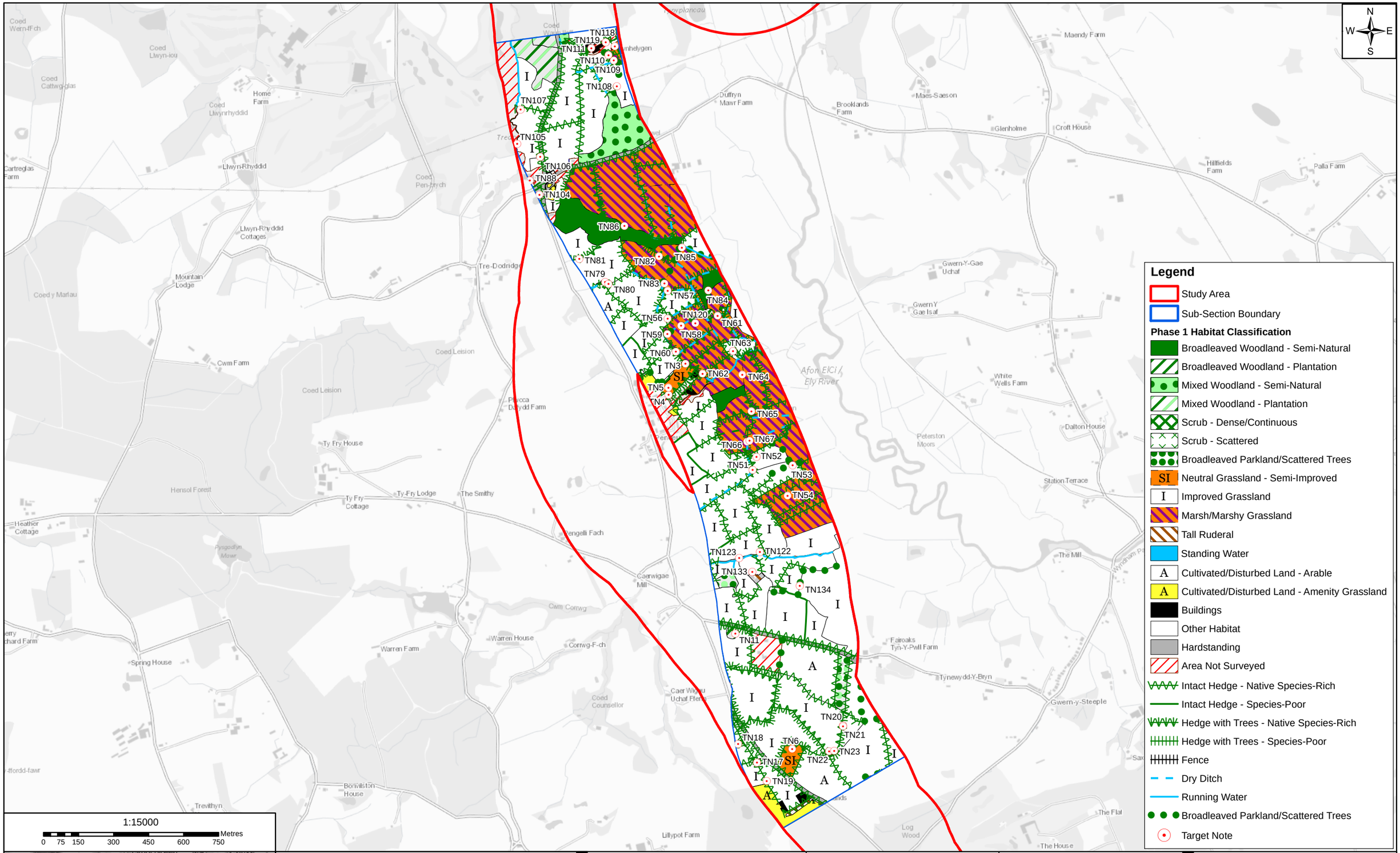

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Checked	M. James	Date 10SEP19	Signed
Approved	S. Hancock	Date 10SEP19	Signed
Scale:	1:15000	Datum:	AOD
Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10028657

PROJECT:

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WELTAG STAGE TWO PLUS

TITLE:

Phase 1 Habitat Surveys
Sub-Section 2 of 5

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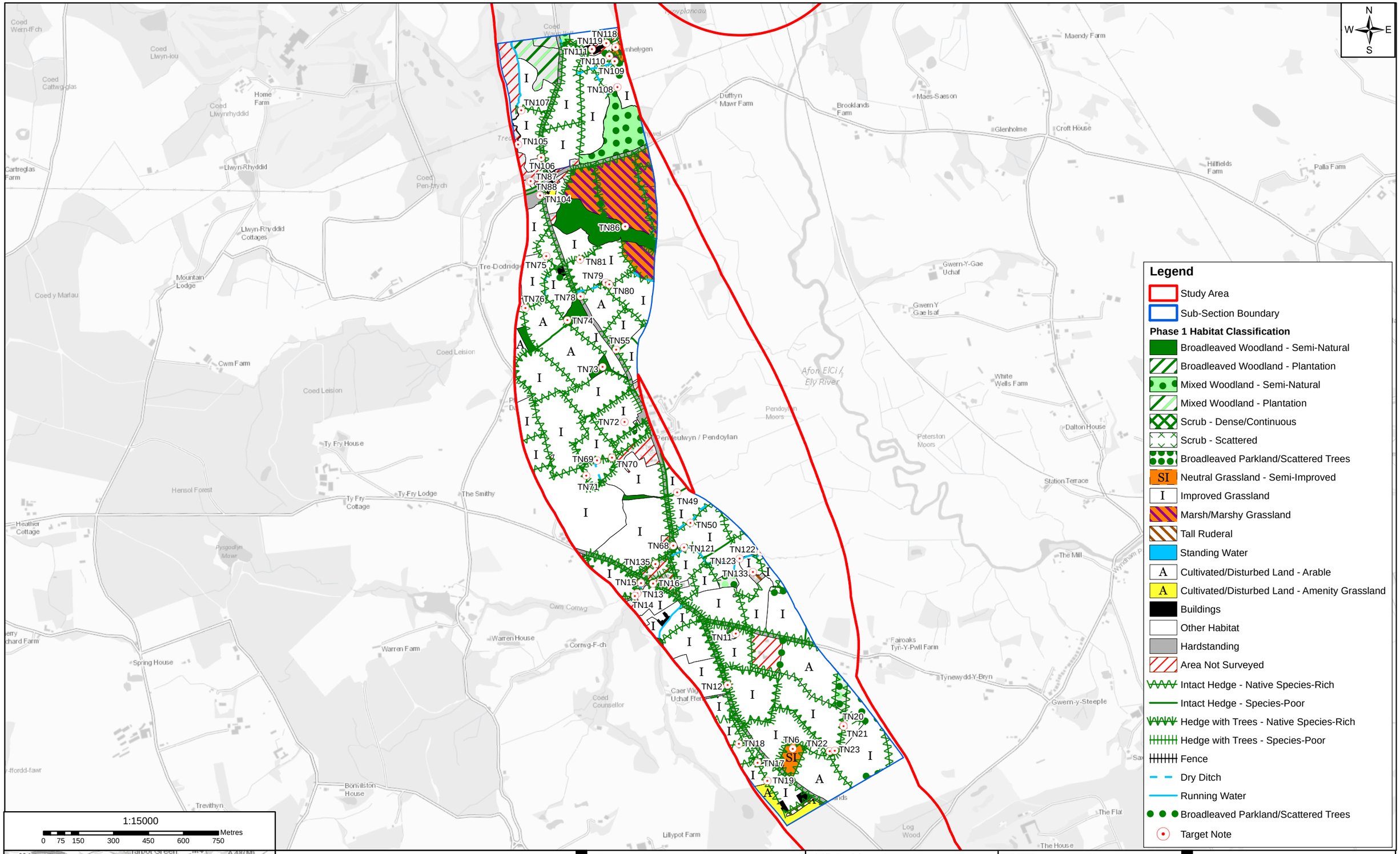

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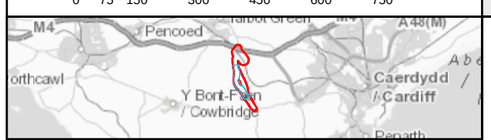

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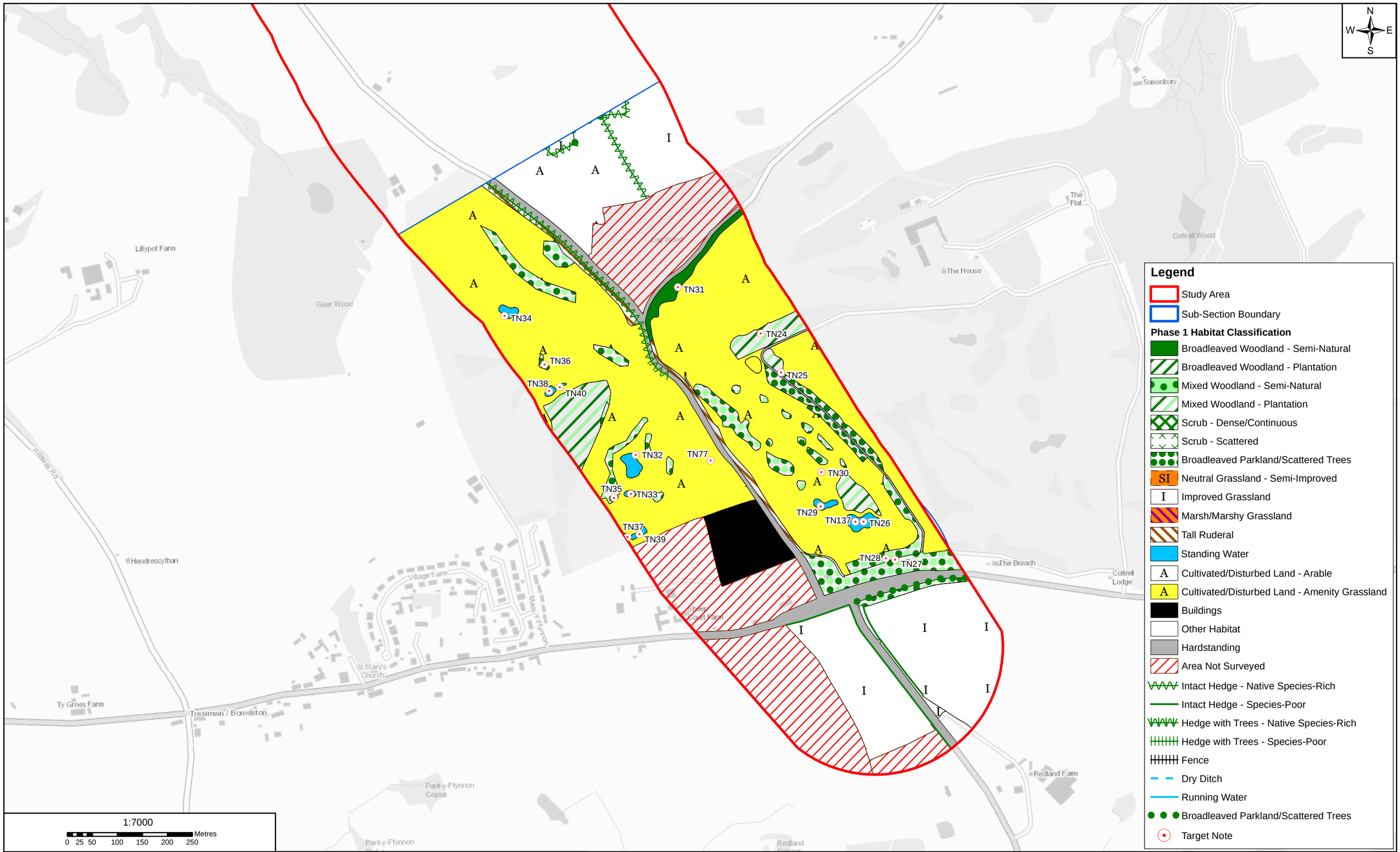

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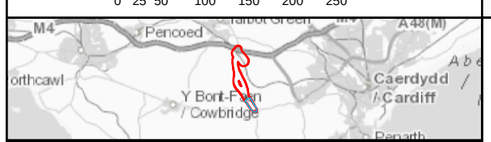

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Scale:	1:7000	Datum:	AOD
Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10028657

PROJECT:

M4 JUNCTION 34 TO A48
WELTAG STAGE TWO PLUS

TITLE:

Phase 1 Habitat Surveys
Sub-Section 4 of 5

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Drawing Number: 10028657-ARC-00-XX-DR-EC-0056-P1

Issue: 01

Legend

- Study Area
- Sub-Section Boundary

Phase 1 Habitat Classification

- Broadleaved Woodland - Semi-Natural
- Broadleaved Woodland - Plantation
- Mixed Woodland - Semi-Natural
- Mixed Woodland - Plantation
- Scrub - Dense/Continuous
- Scrub - Scattered
- Broadleaved Parkland/Scattered Trees
- SI Neutral Grassland - Semi-Improved
- I Improved Grassland
- Marsh/Marshy Grassland
- Tall Ruderal
- Standing Water
- A Cultivated/Disturbed Land - Arable
- A Cultivated/Disturbed Land - Amenity Grassland
- Buildings
- Other Habitat
- Hardstanding
- Area Not Surveyed
- Intact Hedge - Native Species-Rich
- Intact Hedge - Species-Poor
- Hedge with Trees - Native Species-Rich
- Hedge with Trees - Species-Poor
- Fence
- Dry Ditch
- Running Water
- Broadleaved Parkland/Scattered Trees
- Target Note

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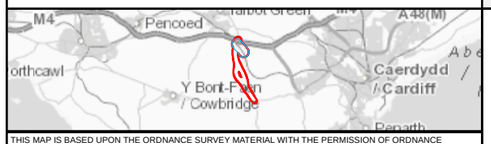

REV	Date	Description	Drawn	Check	Approv
01	10/09/19	Initial Issue	SP	MJ	SH

Client

VALE of GLAMORGAN BRO MORGANNWG

Site

Vale of Glamorgan Council
Barry

Vale of Glamorgan Council

Client

Vale of Glamorgan Council
Civic Offices
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www.valeofglamorgan.gov.uk

Suitability Description: PRELIMINARY/CONFIDENTIAL

Designed	M. James	Date 10SEP19	Signed
Drawn	S. Pradeepa	Date 10SEP19	Signed
Checked	M. James	Date 10SEP19	Signed
Approved	S. Hancock	Date 10SEP19	Signed
Scale:	1:9000	Datum:	AOD
Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10028657

PROJECT:

M4 JUNCTION 34 TO A48
WELTAG STAGE TWO PLUS

TITLE:

Phase 1 Habitat Surveys
Sub-Section 5 of 5

ARCADIS Design & Consultancy for natural and built assets

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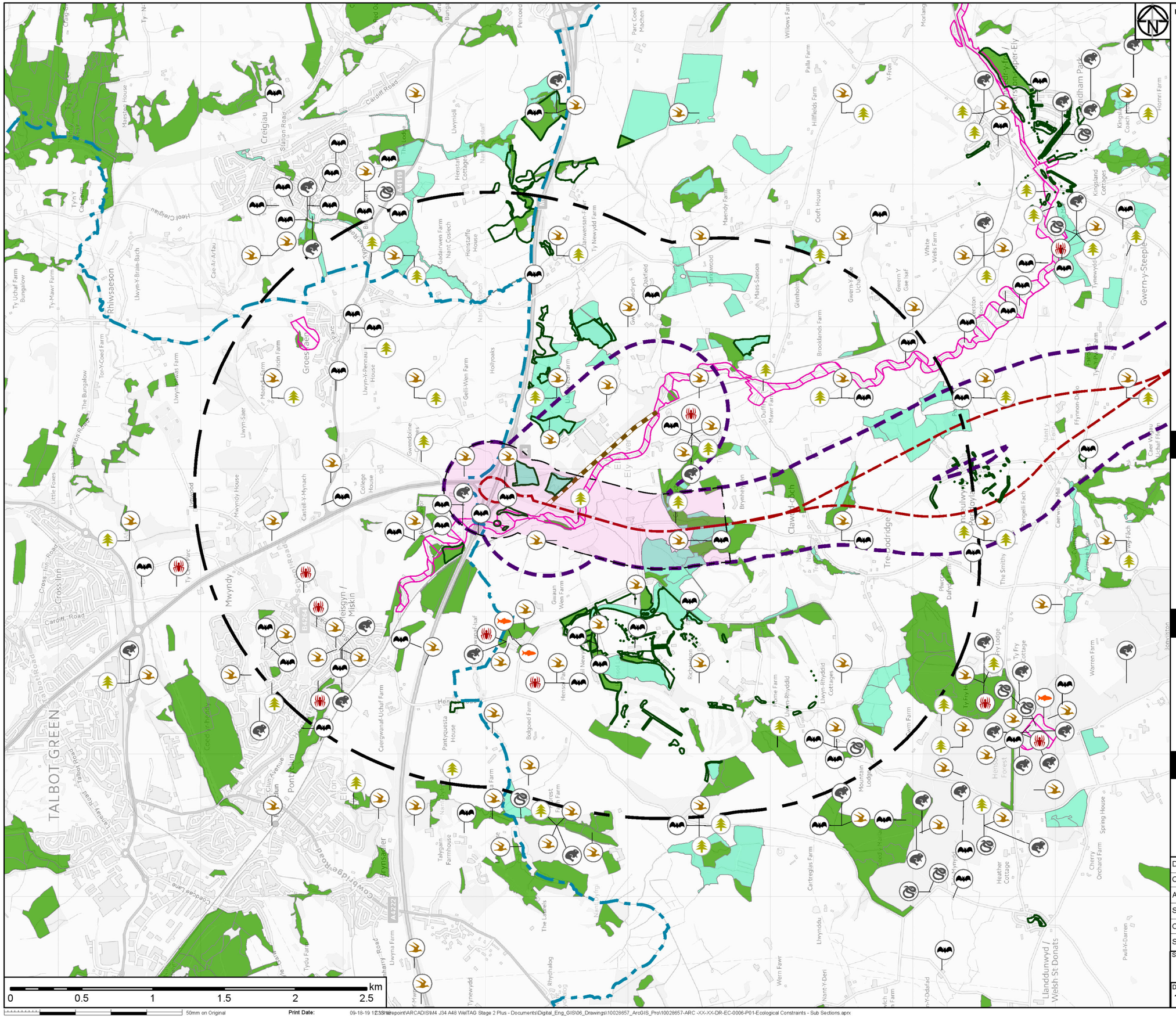

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Legend :

- Sub-section study area
- 2km search area
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- Birds
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- Insects
- Invasive Plants
- Mammals
- Reptiles

Client

VALE of GLAMORGAN
BRO MORGANNWG

Vale of Glamorgan Council

PROJECT:

M4 Junction 34 to A48
WelTAG Stage Two Plus
Environmental Baseline

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Ecological Constraints Plan - Sub-Section 1

Drawn	M. Azzopardi	Date 18SEP19	Signed
Checked	S. Carr	Date 18SEP19	Signed
Approved	S. Hancock	Date 18SEP19	Signed
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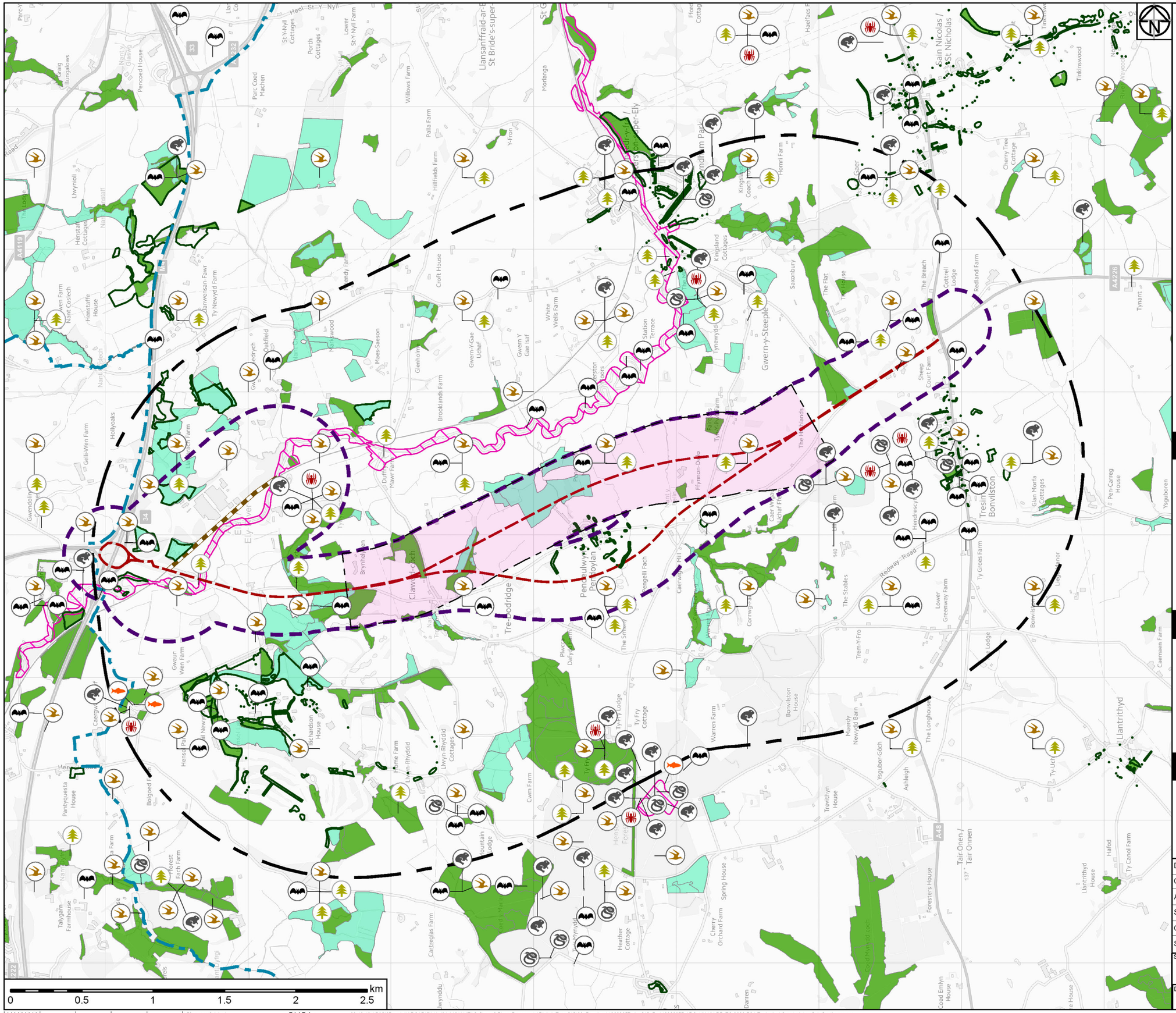

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PROJECT:

M4 Junction 34 to A48 WelTAG Stage Two Plus Environmental Baseline

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Ecological Constraints Plan -

Sub-Section 2

Drawn	M. Azzopardi	Date 18SEP19	Signed
Checked	S. Carr	Date 18SEP19	Signed
Approved	S. Hancock	Date 18SEP19	Signed
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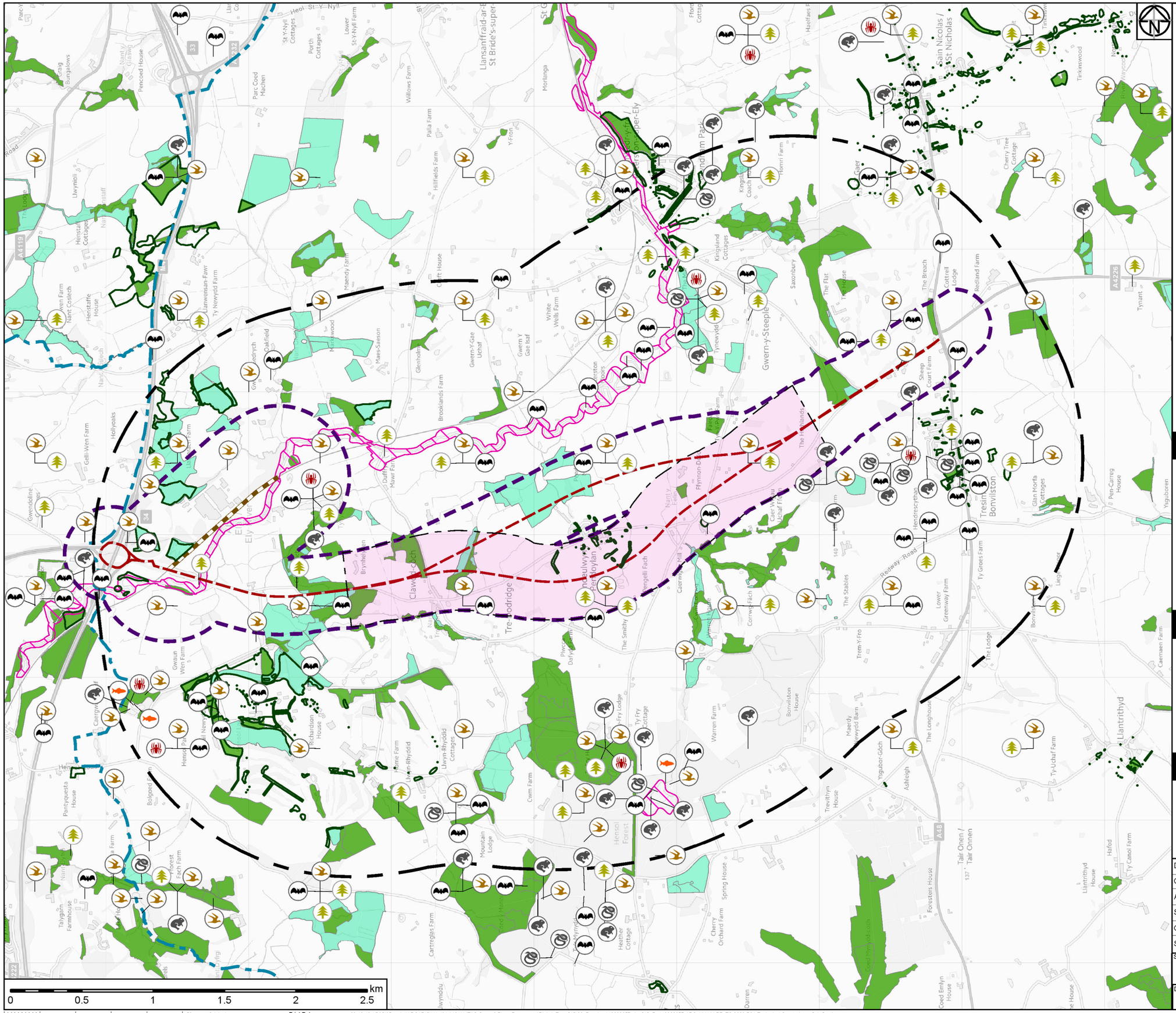

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Client

Vale of Glamorgan Council

PROJECT:

M4 Junction 34 to A48 WelTAG Stage Two Plus Environmental Baseline

Site

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Ecological Constraints Plan -

Sub-Section 3

Drawn	M. Azzopardi	Date 18SEP19	Signed
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Approved	S. Hancock	Date 18SEP19	Signed
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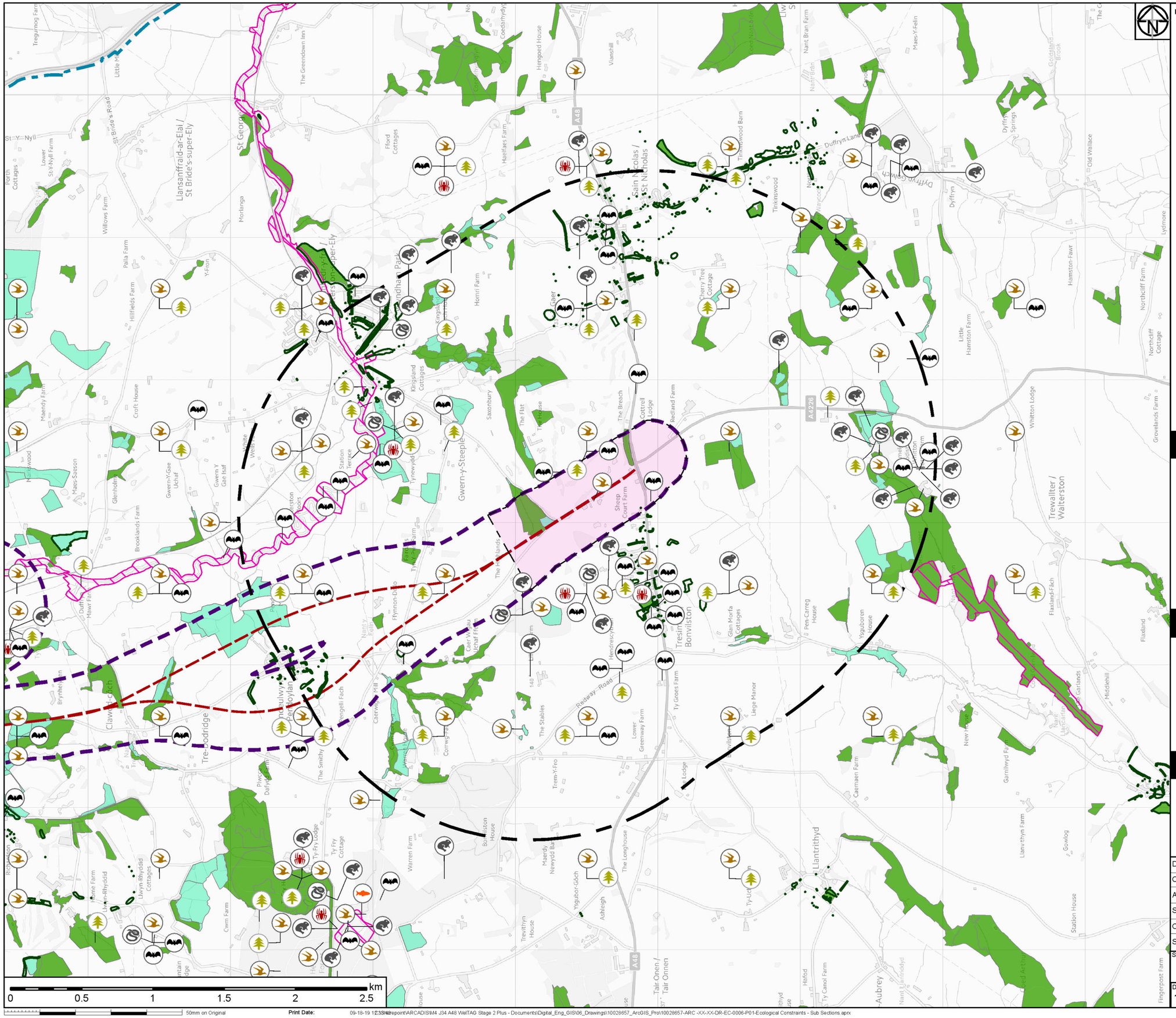

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Client

Vale of Glamorgan Council

PROJECT:

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Drawn	M. Azzopardi	Date 18SEP19	Signed
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- Invasive Plants
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Client

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BRO MORGANNWG

Vale of Glamorgan Council

PROJECT:

M4 Junction 34 to A48 WelTAG Stage Two Plus Environmental Baseline

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Approved	S. Hancock	Date 18SEP19	Signed
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Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10028657

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Revision: P01

Appendix A

Legislation and Policy

Ecological Constraint	Rationale
Nationally Designated Sites (Sites of Special Scientific Interest)	It is a legal requirement to apply for 'assent' from Natural Resources Wales for any works which could potentially damage the flora, fauna or features for which a SSSI is designated (under the Wildlife and Countryside Act (1981) (as amended)).
Non-native invasive Plants (Rhododendron, Giant Hogweed, Japanese Knotweed, certain species of Cotoneaster, Variegated Garden Yellow Archangel, Canadian Waterweed, Japanese Rose, Montbretia, New Zealand Pigmyweed, Virginia Creeper, Water-fern etc.)	It is an offence under Section 14 of Wildlife and Countryside Act 1981 (as amended) to cause plants listed in Schedule 9 of this act to grow in the wild. Material contaminated with these species is classified as controlled waste under the Environmental Protection Act 1990 and should therefore be disposed of in an appropriately licensed landfill site.
European protected species (great crested newts, natterjack toad, sand lizard, smooth snake, bats, dormice, otters)	It is an offence under the Conservation of Habitats and Species Regulations 2017 to deliberately kill or injure a European protected species, to destroy breeding/ resting sites, or to deliberately disturb these species and affect their ability to survive, rear young, breed or hibernate.
Nationally protected species- those listed in Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) (Allis shade, twaite shad, great crested newt, natterjack toad, bats, dormice, otter)	It is an offence under the Wildlife and Countryside Act 1981 (as amended) to intentionally or recklessly disturb a species listed on Schedule 5 whilst it is in a place of shelter, or to obstruct access to a place of shelter.
Reptiles	It is an offence under the Wildlife and Countryside Act 1981 (as amended) to kill or injure common species of reptiles.
Nationally protected bird species- those listed under Schedule 1 of the Wildlife of the Wildlife and Countryside Act 1981 (as amended) (barn owl, peregrine falcon, red kite, kingfisher, firecrest etc.)	All nesting birds are protected whilst nesting as identified below. However, for those listed under Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) it is also an offence to intentionally or recklessly disturb these birds at, on or near an active nest.
Nesting birds	It is an offence under the Wildlife and Countryside Act 1981 (as amended) to damage or destroy a bird's nest whilst it is in use, and to kill or injure a bird or destroy an egg.
Badgers	It is an offence under the Protection of Badgers Act (1992) to damage or destroy a badger sett; obstruct any entrance of a badger sett; and disturb a badger whilst it is occupying a badger sett.
Vale of Glamorgan Local Development Plan 2011-2026 Policy MG20 – Nationally protected Sites and Species	Development likely to have an adverse effect either directly or indirectly on the conservation value of a site of special scientific interest will only be permitted where it is demonstrated that: there is no suitable alternative to the proposed development;

Ecological Constraint	Rationale
	and it can be demonstrated that the benefits from the development clearly outweigh the special interest of the proposed development; and appropriate compensatory measures are secured; or the proposal contributes to the protection, enhancement or positive management of the proposed development. Development proposals likely to affect protected species will only be permitted where it is demonstrated that: the population range and distribution of the species will not be adversely impacted; there is no suitable alternative to the proposed development, the benefits of the development clearly outweigh the adverse impacts on the protected species; and appropriate avoidance, mitigation and compensation measures are provided.
Vale of Glamorgan Local Development Plan 2011-2026 Policy MG21 – Sites of Importance for Nature Conservation, Important Geological and Geomorphological Sites and Priority Habitats and Species	Development proposals likely to have an adverse impact on sites of importance for nature conservation or priority habitats and species will only permitted where it can be demonstrated that: the need for the development clearly outweighs the nature conservation value of the proposed development; the adverse impacts on nature conservation and geological features can be avoided; appropriate and proportionate mitigation and compensation measures can be provided; and the development conserves and where possible enhances biodiversity interests.

Appendix B

Local Record Centre Data

Legislation Abbreviations

BA = Protection of Badgers Act

UKBAP = UK Biodiversity Action Plan Priority Species

UKBAP (R) = UK Biodiversity Action Plan Priority Species (Research only species)

BDir1 = EC Birds Directive Annex 1 Species

BDir21 = EC Birds Directive Annex 2.1 Species

BDir22 = EC Birds Directive Annex 2.2 Species

Bern = The Bern Convention on the Conservation of European Wildlife and Natural Habitats

Bonn = The Bonn Convention on the Conservation of Migratory Species of Wild Animals Species

CITES = Convention on International Trade in Endangered Species

EPS = European Protected Species

HDir = EU Habitats Directive Species

NRW = Natural Resources Wales Priority Species

RD1 (Wales) = Welsh Red Data Book listing based on IUCN guidelines

RD1 (UK) = UK Red Data Book listing based on IUCN guidelines

RD2 (UK) = UK Red Data Book listing not based on IUCN guidelines (Nationally Rare and Scarce)

WBR (RSPB) = RSPB Welsh Red listed birds (not based on IUCN criteria)

WBAm (RSPB) = RSPB Welsh Amber listed birds (not based on IUCN criteria)

UKBR (RSPB) = RSPB UK Red listed birds (not based on IUCN criteria)

UKBAm (RSPB) = RSPB UK Amber listed birds (not based on IUCN criteria)

S42 = Natural Environment and Rural Communities Act 2006 (Section 42)

S7 = Environment Act (Wales) Section 7 Species

WCA1.1 = Wildlife and Countryside Act Schedule 1 Part 1 Species

WCA5 = Wildlife and Countryside Act Schedule 5 Species

WCA8 = Wildlife and Countryside Act Schedule 8 Species

WCA9 = Wildlife and Countryside Act Schedule 9 Species

INNS = Invasive Non-Native Species

WSG.P = Guidelines for the Selection of Wildlife Sites in South Wales - Primary species

WSG.C = Guidelines for the Selection of Wildlife Sites in South Wales - Contributory species

WVP = IUCN Threat Listing of Welsh Vascular Plants

LBAP (xxx) = Local Biodiversity Action Plan Species (see key below)

LI (SEWBReC) = Locally Important Species (as identified by local specialists) in SEWBReC area

LI (BIS) = Locally Important Species (as identified by local specialists) in BIS* area

LI (BRYO-MON) = Locally or nationally scarce or rare bryophyte in Monmouthshire

LI (VC##) = Locally Important Species (as identified by local specialists) in Vice County ##

LI (VC##, LS) = Locally Scarce in Vice County ##

LI (VC##, LR) = Locally Rare in Vice County ##

LI (VC##, EX) = Extinct in Vice County ##

LI (VC##, UR) = Under Recorded in Vice County ##

Scientific Name	Common Name	Status
Acanthis cabaret	Lesser Redpoll	S7, UKBAP, WBR(RSPB), LBAP (CON), LBAP (DEN, POW, VOG), UKBAm(RSPB)
Accipiter gentilis	Goshawk	WCA1.1, WCA9, Bonn, CITES, LBAP (CLY, CON, POW, VOG)
Alauda arvensis	Skylark	BDir22, S7, LBAP (ANG, BBNP, CER, CLY, CON, CRM, DEN, FLI, GWY, PEM, POW, SNP, TRF, VOG), WBAm(RSPB), UKBR(RSPB)
Alcedo atthis	Kingfisher	BDir1, WCA1.1, Bern, LBAP (CLY, CON, DEN, FLI, GWY, POW, TRA), WBAm(RSPB), UKBAm(RSPB)
Anguilla anguilla	European Eel	S7, UKBAP, RD1 (UK), LBAP (CLY, CON, GWY, VOG)
Anguis fragilis	Slow-worm	WCA5, S7, UKBAP, Bern, LBAP (ANG, CLY, CON, DEN, FLI, GWY, POW, SNP, TRA, VOG)
Anthus trivialis	Tree Pipit	S7, UKBAP, Bern, LBAP (CON, DEN, FLI, GWY, POW, VOG), WBAm(RSPB), UKBR(RSPB), UKBAm(RSPB)
Botaurus stellaris	Bittern	BDir1, WCA1.1, S7, UKBAP, Bonn, Bern, LBAP (ANG, BBNP, CER, CON, GWY, POW, VOG), WBAm(RSPB), UKBR(RSPB)
Bufo bufo	Common Toad	WCA5, S7, UKBAP, Bern, LBAP (ANG, CLY, CON, DEN, FLI, GWY, POW, TRA, VOG)
Centaurea cyanus	Cornflower	S7, UKBAP, RD2 (UK), LBAP (CON, GWY, VOG), LI(VC49, LR), LI(VC50, LR), WVP
Chiroptera	Bats	EPS, WCA5, S7, LBAP (ANG, DEN, FLI, RCT, SNP, TRA, TRF)
Circus cyaneus	Hen Harrier	BDir1, S7, Bonn, CITES, WBR(RSPB), LBAP (BBNP, CON, DEN, FLI, GWY, POW, SNP, VOG), LI(VC43), UKBR(RSPB)
Coccothraustes coccothraustes	Hawfinch	S7, UKBAP, Bern, LBAP (CON, DEN, FLI, GWY, POW, VOG), WBAm(RSPB), UKBR(RSPB), UKBAm(RSPB)
Coturnix coturnix	Quail	BDir22, WCA1.1, Bonn, LBAP (ANG, CON, GWY, POW), WBAm(RSPB), LI(VC43), UKBR(RSPB), UKBAm(RSPB)
Cuculus canorus	Cuckoo	S7, UKBAP, WBR(RSPB), LBAP (CON, DEN, FLI, GWY, VOG), UKBR(RSPB), UKBAm(RSPB)

Scientific Name	Common Name	Status
Emberiza citrinella	Yellowhammer	S7, UKBAP, Bern, WBR(RSPB), LBAP (ANG, BBNP, CLY, CON, CRM, DEN, FLI, GWY, PEM, POW, SNP, VOG), UKBR(RSPB)
Emberiza schoeniclus	Reed Bunting	S7, UKBAP, Bern, LBAP (BBNP, CER, CLY, CON, DEN, FLI, GWY, PEM, POW, VOG), WBAm(RSPB), UKBR(RSPB)
Eptesicus serotinus	Serotine	EPS, HDir, WCA5, Bonn, Bern, RD2 (UK), LBAP (GWY, POW, TRA, TRF)
Erinaceus europaeus	West European Hedgehog	S7, UKBAP, Bern, LBAP (ANG, BGW, BRG, CON, FLI, GWY, NEW, POW, RCT, VOG)
Eucera longicornis	Long-horned Bee	S7, RDB2 (UK) - NA, LBAP (VOG)
Falco columbarius		BDir1, WCA1.1, Bonn, Bern, CITES, LBAP (CON, DEN, FLI, GWY, POW), WBAm(RSPB), LI(VC43), UKBAm(RSPB)
Falco peregrinus	Peregrine	BDir1, WCA1.1, Bonn, Bern, CITES, LBAP (ANG, CLY, CON, GWY, PEM, POW, TRF, VOG), LI(VC43), UKBAm(RSPB)
Falco subbuteo	Hobby	WCA1.1, Bonn, Bern, CITES, LBAP (CON, GWY, POW, VOG), WBAm(RSPB), LI(VC43)
Falco tinnunculus	Kestrel	S7, Bonn, Bern, CITES, WBR(RSPB), LBAP (ANG, CLY, CON, DEN, FLI, GWY, PEM, POW, VOG), LI(VC43), UKBAm(RSPB)
Fringilla montifringilla	Brambling	WCA1.1, LBAP (CON)
Hyacinthoides non-scripta	Bluebell	WCA8, LBAP (ANG, CLY, CON, FLI, SNP, TRA, TRF)
Lepus europaeus	Brown Hare	S7, UKBAP, Bern, LBAP (ANG, BBNP, CER, CLY, CON, CRM, DEN, FLI, GWY, PEM, POW, SNP, TRF, VOG)
Linaria cannabina	Linnet	S7, Bern, WBR(RSPB), LBAP (ANG, BBNP, CER, CLY, DEN, FLI, PEM, VOG), LBAP (CON, GWY), UKBR(RSPB)
Lissotriton helveticus	Palmate Newt	WCA5, Bern, LBAP (ANG, CLY, CON, DEN, FLI, POW, TRA), LI(BIS)
Lissotriton vulgaris	Smooth Newt	WCA5, Bern, LBAP (CLY, CON, DEN, FLI, POW, TRA), LI(BIS)
Locustella naevia	Grasshopper Warbler	S7, UKBAP, WBR(RSPB), LBAP (BBNP, CON, DEN, FLI, GWY, POW, VOG), UKBR(RSPB)
Loxia curvirostra	Common Crossbill	WCA1.1, Bern, LBAP (CON, POW), LI(VC43)

Scientific Name	Common Name	Status
Lutra lutra	European Otter	EPS, HDir, WCA5, S7, UKBAP, Bern, CITES, RD1 (UK), RD2 (UK), LBAP (ANG, BBNP, CER, CLY, CON, CRM, DEN, FLI, GWY, PEM, POW, SNP, TRA, TRF, VOG, WRE)
Meles meles	Eurasian Badger	BA, Bern, LBAP (CLY, CON, DEN, FLI, PEM, POW, TRF, WRE)
Meloe proscarabaeus	Black Oil-beetle	S7, UKBAP
Meloe violaceus	Violet Oil-beetle	S7, UKBAP, RD2 (UK)
Micromys minutus	Harvest Mouse	S7, UKBAP, LBAP (BRG, CON, FLI, GWY, VOG), LI(BIS)
Milvus milvus	Red Kite	BDir1, WCA1.1, WCA9, Bonn, CITES, RD1 (UK), LBAP (CON, CRM, GWY, POW), WBAm(RSPB), UKBAm(RSPB)
Muscardinus avellanarius	Hazel Dormouse	EPS, HDir, WCA5, S7, UKBAP, Bern, RD2 (UK), LBAP (BBNP, CER, CLY, CON, CRM, DEN, FLI, GWY, MON, PEM, POW, SNP, TRA, TRF, VOG)
Muscicapa striata	Spotted Flycatcher	S7, UKBAP, Bonn, Bern, WBR(RSPB), LBAP (BBNP, CER, CLY, CON, DEN, FLI, GWY, PEM, POW, VOG), UKBR(RSPB)
Mustela erminea	Stoat	NRW, Bern, LBAP (ANG, BGW, BRG, CON, FLI, NEW, POW)
Mustela nivalis	Weasel	NRW, Bern, LBAP (ANG, BGW, BRG, CON, FLI, NEW, POW)
Mustela putorius	Polecat	HDir, S7, UKBAP, Bern, RD2 (UK), LBAP (BGW, BRG, CON, FLI, GWY, NEW, POW, SNP, VOG)
Myotis	Unidentified Bat	EPS, HDir, WCA5, Bonn, Bern, LBAP (ANG, DEN, FLI, SNP, TRA, TRF)
Myotis brandtii	Brandt's Bat	EPS, HDir, WCA5, Bonn, Bern, RD2 (UK), LBAP (ANG, DEN, FLI, GWY, POW, SNP, TRA, TRF)
Myotis daubentonii	Daubenton's Bat	EPS, HDir, WCA5, Bonn, Bern, RD2 (UK), LBAP (ANG, CLY, CON, DEN, FLI, GWY, POW, SNP, TRA, TRF)
Myotis mystacinus	Whiskered Bat	EPS, HDir, WCA5, Bonn, Bern, RD2 (UK), LBAP (ANG, DEN, FLI, GWY, POW, SNP, TRA, TRF)
Myotis nattereri	Natterer's Bat	EPS, HDir, WCA5, Bonn, Bern, RD2 (UK), LBAP (ANG, CLY, CON, DEN, FLI, GWY, POW, SNP, TRA, TRF)
Natrix helvetica	Grass Snake	WCA5, S7, Bern, LBAP (ANG, CLY, CON, DEN, FLI, GWY, POW, SNP, TRA, VOG), LBAP (ANG, CLY, DEN, FLI, POW, SNP, TRA, VOG)

Scientific Name	Common Name	Status
Nyctalus noctula	Noctule Bat	EPS, HDir, WCA5, S7, UKBAP, Bonn, Bern, RD2 (UK), LBAP (ANG, CLY, CON, DEN, FLI, GWY, POW, SNP, TRA, TRF, VOG)
Pandion haliaetus	Osprey	BDir1, WCA1.1, Bonn, CITES, LBAP (GWY), WBAm(RSPB), UKBAm(RSPB)
Parmotrema perlatum	A lichen	S7, LBAP (CON)
Passer domesticus	House Sparrow	S7, UKBAP, Bern, LBAP (CLY, CON, FLI, GWY, VOG), WBAm(RSPB), UKBR(RSPB)
Perizoma albulata	Grass Rivulet	S7, UKBAP, LBAP (VOG)
Phoenicurus ochruros	Black Redstart	WCA1.1, Bern, LBAP (GWY, VOG), WBAm(RSPB), UKBR(RSPB), UKBAm(RSPB)
Phylloscopus sibilatrix	Wood Warbler	S7, UKBAP, WBR(RSPB), LBAP (CON, GWY, SNP, VOG), UKBR(RSPB), UKBAm(RSPB)
Pipistrellus	Pipistrelle Bat species	EPS, WCA5, LBAP (ANG, DEN, FLI, SNP, TRA, TRF)
Pipistrellus pipistrellus	Common Pipistrelle	EPS, HDir, WCA5, S7, Bonn, Bern, LBAP (ANG, BBNP, CER, CLY, CON, CRM, DEN, FLI, GWY, PEM, POW, SNP, TRA, TRF, VOG)
Pipistrellus pipistrellus agg.	Pipistrelle	EPS, HDir, WCA5, S7, Bonn, Bern, RD2 (UK), LBAP (ANG, BBNP, CER, CLY, CON, CRM, DEN, FLI, GWY, PEM, POW, SNP, TRA, TRF, VOG)
Pipistrellus pygmaeus	Soprano Pipistrelle	EPS, HDir, WCA5, S7, UKBAP, Bonn, Bern, RD2 (UK), LBAP (ANG, BBNP, CLY, DEN, FLI, GWY, PEM, POW, SNP, TRA, TRF, VOG)
Plecotus	Long-eared Bat species	EPS, HDir, WCA5, Bonn, Bern, LBAP (ANG, DEN, FLI, SNP, TRA, TRF)
Plecotus auritus	Brown Long-eared Bat	EPS, HDir, WCA5, S7, UKBAP, Bonn, Bern, RD2 (UK), LBAP (ANG, CLY, CON, DEN, FLI, GWY, POW, SNP, TRA, TRF, VOG)
Poecile palustris	Marsh Tit	S7, UKBAP, Bern, WBR(RSPB), LBAP (BBNP, CON, DEN, FLI, GWY, POW, VOG), UKBR(RSPB)
Prunella modularis	Dunnock	S7, UKBAP, Bern, LBAP (CON, POW, VOG), UKBAm(RSPB)
Pyrrhula pyrrhula	Bullfinch	S7, UKBAP, WBR(RSPB), LBAP (BBNP, CER, CLY, CON, DEN, FLI, GWY, PEM, TRF, VOG), UKBR(RSPB)

Scientific Name	Common Name	Status
Rana temporaria	Common Frog	HDir, WCA5, Bern, LBAP (ANG, CLY, CON, FLI, POW, TRA)
Rhinolophus ferrumequinum	Greater Horseshoe Bat	EPS, HDir, WCA5, S7, UKBAP, Bonn, Bern, RD1 (UK), RD2 (UK), LBAP (ANG, BBNP, CER, CLY, CRM, DEN, FLI, MON, PEM, POW, SNP, TRA, TRF, VOG)
Rhinolophus hipposideros	Lesser Horseshoe Bat	EPS, HDir, WCA5, S7, UKBAP, Bonn, Bern, RD2 (UK), LBAP (ANG, BBNP, CLY, CON, CRM, DEN, FLI, GWY, MON, PEM, POW, SNP, TRA, TRF, VOG, WRE)
Satyrium w-album	White-letter Hairstreak	WCA5, S7, UKBAP, RD1 (UK), RD2 (UK), LBAP (BRG, FLI, NEW, SWN, VOG), LI(BIS), LI(SEWBReC)
Sturnus vulgaris	Starling	BDir22, S7, UKBAP, Bern, WBR(RSPB), LBAP (BBNP, CON, FLI, GWY, VOG), UKBR(RSPB)
Tringa ochropus	Green Sandpiper	WCA1.1, Bonn, Bern, LBAP (CON, VOG), UKBAm(RSPB)
Triturus cristatus	Great Crested Newt	EPS, HDir, WCA5, S7, UKBAP, Bern, RD1 (UK), RD2 (UK), LBAP (ANG, BBNP, CLY, CON, DEN, FLI, MON, POW, SNP, TRA, TRF, VOG, WRE)
Turdus iliacus	Redwing	BDir22, WCA1.1, LBAP (CON, POW), WBAm(RSPB), UKBR(RSPB), UKBAm(RSPB)
Turdus philomelos	Song Thrush	BDir22, S7, UKBAP, Bern, LBAP (ANG, BBNP, CER, CLY, CON, DEN, FLI, GWY, PEM, POW, SNP, TRF, VOG, WRE), WBAm(RSPB), UKBR(RSPB)
Turdus pilaris	Fieldfare	BDir22, WCA1.1, LBAP (CON, POW), WBAm(RSPB), UKBR(RSPB), UKBAm(RSPB)
Tyto alba	Barn Owl	WCA1.1, WCA9, Bern, CITES, LBAP (ANG, CLY, CON, CRM, DEN, FLI, GWY, PEM, POW, SNP, TRA, VOG, WRE), WBAm(RSPB), LI(VC43), UKBAm(RSPB)
Vanellus vanellus	Lapwing	BDir22, S7, UKBAP, Bonn, WBR(RSPB), LBAP (ANG, BBNP, CLY, CON, CRM, DEN, FLI, GWY, MON, PEM, POW, SNP, TRF, VOG), LI(VC43), UKBAm(RSPB)
Vipera berus	Adder	WCA5, S7, UKBAP, Bern, LBAP (ANG, CLY, CON, DEN, FLI, GWY, POW, SNP, TRA, TRF, VOG)
Zootoca vivipara	Common Lizard	WCA5, S7, UKBAP, Bern, LBAP (ANG, CLY, CON, DEN, FLI, GWY, POW, SNP, TRA, TRF, VOG)

List of SINCs within 2km

SINC Id No.	Site Name	Reason for designation
21	Fforest Fach Farm	Two meadows supporting a mosaic of lowland fen, sedge swamp and rush pasture habitats. It consists of UK BAP Priority Habitat – Lowland fens, Purple Moor-grass and rush pastures, Reedbeds.
22	Land West of Llanfarach Farm	Semi-natural broadleaved wet woodland and native woodland. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.
24	Land between M4 and Industrial Estate	Semi-natural broadleaved wet woodland and native woodland. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.
25	Land South of Llanfarach Farm	Series of small wet meadows supporting species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture.
27	North of Gwern-y-Gedrynch	Semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.
26	Land West of Ty Newydd Farm	Two wet meadows supporting species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture.
54	Coed Cattwg-Glas	A large area of semi-natural broadleaved woodland, part of which is ancient woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
59	West of Newydd Stables	Species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.
58	North of Coed Leision	A series of species-rich neutral grasslands with areas of transitional rush pasture. It consists of UK BAP Priority Habitat – Lowland meadows.
57	South East of Llwyn-Rhyddid Cottages	Ancient semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.
56	Coed Llwyn-Rhyddid	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
60	Land near Coed Pen-Brych	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.

SINC Id No.	Site Name	Reason for designation
61	West of Clawdd-Coch Farm	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
62	Coed Waunn-Lloff	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
63	South West of Castell Bach	Ancient semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.
66	Land West of Hensol Mill	A series of wet meadows supporting Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.
64	Land near Hensol Mill	Semi-natural broadleaved wet woodland, part on an ancient woodland site and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.
65	Land South of Hadod Y Wennol	Species-rich Purple Moor-grass and rush pasture with semi-improved neutral grassland margins. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.
67	Hafod Y Wennol	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
70	Coed Ffos-Ceibr	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
71	South West of Dyffryn Bach	Ancient semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.
73	Coed Cadw	A predominantly ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
74	North of Pendoylan Moors	Semi-natural broadleaved wet woodland that is contiguous with an extensive area of rush pasture. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.
75	Land near Gwern y Gae Isaf	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
76	Land North of Brooklands Farm	Semi-natural broadleaved woodland of which half is ancient woodland and native woodlands. It consists of UK

SINC Id No.	Site Name	Reason for designation
		BAP Priority Habitat – Lowland mixed deciduous woodland.
77	West of Markswood	Two semi-natural broadleaved wet woodlands and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.
78	Land South of Oakfield	A series of wet Purple Moor-grass and rush pastures. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.
80	Maendy Farm	Semi-natural broadleaved woodland of which the majority is ancient woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
81	South West of Parc Coed Machen	A large area of lowland neutral grassland. It consists of UK BAP Priority Habitat – Lowland meadow.
82	South West of The Paddocks	Small semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.
83	North West of Hillfields Farm	A series of species-rich neutral grasslands. It consists of UK BAP Priority Habitat – Lowland meadows.
85	North of Palla Farm	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
116	Land West of Hensol Forest	Extensive area of species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.
115	East of Penfford	Species-rich mire and tall-herb fen, contiguous with extensive area of Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Lowland fens, Reedbeds.
117	Land adjacent to Forrester's House	Semi-natural broadleaved woodland with fields signs of use by Common dormouse. Native woodlands and mammals present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
120	West of Warren Mill Farm Park	Species-rich neutral grassland. It consists of UK BAP Priority Habitat – Lowland meadows.
121	Coed Counsellor	Extensive area of part-ancient semi-natural broadleaved woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.

SINC Id No.	Site Name	Reason for designation
125	Gwern-y-Steeple	Semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.
124	North West of Croes-y-Parc Baptist Chapel	Species-rich neutral meadows. It consists of UK BAP Priority Habitat – Lowland meadows.
122	Land at Pendoylan Moors	A complex of many small enclosed meadows supporting species-rich Purple Moor-grass and rush pasture with associated ditches, hedgerows and areas of tall-herb fen. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture, Reedbeds.
128	East of Kingsland	Part ancient semi-natural broadleaved woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
127	Kingsland	Ancient semi-natural broadleaved wet woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland.
129	East of Homri Farm	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
130	East of Glyncory Water Works	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
169	Gaer Wood	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
171	Cottrell Wood	Semi-natural broadleaved woodland on an ancient woodland site and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
172	Coed y Lan	Semi-natural broadleaved woodland on an ancient woodland site and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
173	Redland Wood	Predominantly ancient semi-natural broadleaved woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
174	Betty Lucas Wood	Predominantly ancient semi-natural broadleaved woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.

SINC Id No.	Site Name	Reason for designation
175	Coed y Cwm	Semi-natural broadleaved woodland, part on an ancient woodland site. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
223	Brook Wood	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
176	Land along River Waycock	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
177	Land at Winchpit	Semi-natural broadleaved woodland on an ancient woodland site. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
222	Land North West of Whitton Rosser Farm	Semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
218	North of Coed Quinnet	No data
219	West of Coed Quinnet	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
217	Land South of Ty'n-y-Coed	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
216	Land along Nant Llancarfan	Three fields supporting a species-rich complex of fen and mire communities and associated springs. It consists of UK BAP Priority Habitat – Lowland fens, Purple Moor-grass and rush pastures.
224	Coed Sion Hywel	Predominantly ancient semi-natural broadleaved woodland with areas of mixed plantation on an ancient woodland site. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
225	Coed y Graig	Predominantly ancient semi-natural broadleaved woodland with areas of mixed plantation on an ancient woodland site. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
226	Land North of Little Hamston Farm	A series of ancient semi-natural and seminatural broadleaved woodlands. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.

SINC Id No.	Site Name	Reason for designation
23	Land South West of Llanfarach Farm	Semi-natural broadleaved wet woodland with associated pond. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland, Wet woodland, Ponds.
55	Llwyn-yoy Pond	Pond supporting diverse marginal vegetation and developing wet woodland. It consists of UK BAP Priority Habitat – Ponds, Wet woodland.
72	North West of Duffryn Mawr Farm	Species-rich rush pasture with pond. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.
68	Hensol Lake	A large body of open water with reedbed and wet woodland fringe. It consists of UK BAP Priority Habitat – Ponds, Reedbeds, Wet woodland.
69	Mill Ponds	A linear former mill pond with dense stands of reedbed. It consists of UK BAP Priority Habitat – Ponds, Reedbeds.
118	Mill Pond	Old mill pond supporting diverse vegetation and associated marshy grassland. Mosaic habitats present. It consists of UK BAP Priority Habitat – Ponds.
168	Ravenswood	Series of ponds supporting tall herbs and swamp. It consists of UK BAP Priority Habitat – Ponds, Reedbeds.
221	Land North of Whitton Rosser Farm	Two blocks of predominantly ancient seminatural broadleaved woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
119	Warren Mill Farm Park	Species-rich Purple Moor-grass and rush pasture. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.
79	Land South of Glenholme	Semi-natural broadleaved woodland of which the majority is ancient woodland. Native woodlands present. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
123	East of Ty'n-y-Pwll	Two distinct groups of meadows supporting species-rich mosaic of Purple Moor-grass and rush pasture and mire. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pasture.
170	Log Wood	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
132	Coed Quinnet	Two large fields supporting a mosaic of semi-improved neutral grassland and scrub woodland on a predominantly ancient woodland site. Native woodlands present. It

SINC Id No.	Site Name	Reason for designation
		consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.
220	Land South of Blackland Farm	Species-rich Purple Moor-grass fen meadow. It consists of UK BAP Priority Habitat – Purple Moor-grass and rush pastures.
106	Amelia Trust Woodland Pond	Pond supporting diverse marginal vegetation and amphibian assemblage. It consists of UK BAP Priority Habitat – Ponds.
107	Amelia Trust Dew Pond	Pond supporting breeding Great crested newts. It consists of UK BAP Priority Habitat – Ponds.
363	Coed Uchaf	Ancient semi-natural broadleaved woodland and native woodlands. It consists of UK BAP Priority Habitat – Lowland mixed deciduous woodland.

Appendix C

M4 Junction 34 to A48 Phase 1 Target Notes

Phase 1 Target Notes	
Number	**Description**
1	Indian Balsam
2	Indian Balsam
3	Trees with bat roosting potential
4	Hedgerows with dormouse potential
5	Reptile potential
6	Location suitable for reptiles, dormice, bats and nesting birds
7	Chinese buddleia
8	Location suitable for Invertebrates and reptiles
9	Large mature trees scattered along field boundary with bat roosting potential
10	Indian Balsam
11	Bat roosting potential
12	Bat roosting potential
13	Indian Balsam
14	Old stone building with bat potential
15	Bluebell
16	Indian Balsam
17	A series of mature trees with bat roosting potential
18	Hedgerows with connectivity to woodland – dormice potential
19	Tree with bat roosting potential
20	Indian Balsam
21	Indian Balsam
22	Pond located in the corner of grassland fields and surrounded by semi-mature and mature trees
23	Trees with bat roosting potential
24	Pond in woodland on golf course, surrounded by willow and scrub, abundant leaf litter was present in the pond

Phase 1 Target Notes	
25	Indian Balsam
26	Nuttall's waterweed
27	Trees with bat roosting potential
28	Indian Balsam
29	Pond located on golf course
30	Pond in golf course
31	Newly constructed pond on golf course
32	Pond in golf course
33	Pond in golf course
34	Pond in golf course
35	Dry pond in golf course, may hold water
36	Dry pond in golf course, may hold water
37	Pond in golf course
38	Pond in golf course
39	Pond in golf course
40	Pond in golf course
41	Japanese knotweed
42	Indian Balsam
43	Indian Balsam
44	Mature trees with bat roosting potential
45	Indian Balsam
46	Watercourse with water vole potential
47	Shooting range in woodland – potential H&S concerns
48	Location suitable for dormice, bats and badgers
49	Trees with bat roosting potential
50	Indian Balsam
51	Trees with bat roosting potential

Phase 1 Target Notes	
52	Trees with bat roosting potential
53	Trees with bat roosting potential
54	Very damp grasslands
55	Hedgerows with dormice potential
56	A large mature oak, with lots of cavities – bat roosting potential
57	Location suitable for bats and dormice
58	Mature oak with bat roosting potential
59	Dead mature oak trees – potential for invertebrates and roosting bats
60	Indian Balsam
61	Trees with bat roosting potential
62	Trees with bat roosting potential
63	Dead tree – potential for invertebrates and roosting bats
64	Trees with bat roosting potential
65	Trees with bat roosting potential
66	Trees with bat roosting potential
67	Indian Balsam
68	Old stone building with bat potential
69	Bats, dormice in hedges. Several large mature oaks along hedgerow – bat roosting potential and dormice potential
70	Japanese knotweed
71	Thick intact hedges, with lots of fruiting Hazel, potential for dormice
72	Oak with split in main stem and several tear outs – bat roosting potential
73	Mature Hazel stools with dormice potential
74	Woodland with bat roosting potential and dormice potential
75	Location suitable for roosting bats and dormice
76	Possible pond surrounded by scrub and young tees – no access to it
77	Lots of old barns on the construction site with bat roosting potential
78	Indian balsam

Phase 1 Target Notes	
79	Tree with bat roosting potential
80	Dry pond at time of survey
81	Tree with bat roosting potential
82	Tree with bat roosting potential
83	Earth embankment with rubble – reptile potential
84	Tree with bat roosting potential
85	Tree with bat roosting potential
86	Earth embankment with rubble – reptile potential
87	Indian Balsam
88	Dead wood pile – reptile potential
89	Log and rubble pile – reptile potential
90	Buddleia
91	Buddleia
92	Buddleia
93	Buddleia
94	Buddleia
95	Indian Balsam
96	Indian Balsam
97	Semi-mature trees on northern edge of woodland with bat roosting potential
98	Indian Balsam
99	Indian Balsam
100	Tree with bat roosting potential
101	Tree with bat roosting potential
102	Indian Balsam
103	Indian Balsam
104	Pond surrounded by mature Ash and Oak trees
105	Indian Balsam

Phase 1 Target Notes	
106	Indian Balsam
107	Indian Balsam
108	Mature Oak with hazard beam – bat roosting potential
109	Old well located on farm
110	Trees with bat roosting potential
111	Multiple buildings with slate roofs and missing tiles – bat roosting potential
112	Landowner indicated that a Red Kite and Goshawk had successful nest in 2019 at this location
113	Pond located on edge of woodland
114	Indian Balsam
115	Indian Balsam
116	Indian Balsam
117	Trees with bat roosting potential
118	Trees with bat roosting potential
119	Rubble pile – reptile potential
120	Landowner indicated that Hobbies were present at this location
121	Indian Balsam
122	Indian Balsam
123	Indian Balsam
124	Indian Balsam
125	Dead tree with bat roosting potential
126	Location suitable for invertebrates – lots of damselflies and butterflies seen
127	River Ely had a steady flow, with earth/sand banks, a stone/ cobble bed. Banks are shaded predominately by semi mature and mature trees at this location. Very steep banks, approximately 2m from river. Water was turbid.
128	Trees with bat roosting potential
129	Trees with bat roosting potential
130	Raptor Pellet
131	Indian Balsam

Phase 1 Target Notes	
132	Trees with bat roosting potential
133	Location suitable to support reptiles
134	Trees with bat roosting potential
135	Building with bat roosting potential. Building had cracks in brickwork, missing tiles and access points via the doorway and windows.
136	Farm Pond
137	Pond

Appendix D

Photographs

Photo 1: Semi-natural broadleaved woodland

Photo 2: Semi-natural broadleaved woodland

Photo 3: Mixed semi-natural woodland

Photo 4: Broadleaved plantation woodland

Photo 5: Mixed plantation woodland

Photo 6: Young willow scrub

Photo 7: Scrub

Photo 8: Scattered trees

Photo 9: Treeline

Photo 10: Treeline of mature hazel

Photo 11: Neutral semi-improved grassland

Photo 12: Neutral semi-improved grassland

Photo 13: Improved grassland

Photo 14: Improved grassland

Photo 15: Marshy grassland

Photo 16: Marshy grassland

Photo 17: Tall ruderal vegetation on Cottrell Park Golf Resort

Photo 18: Pond – TN22.

Photo 19: Pond – TN24.

Photo 20: Pond – TN 29

Photo 21: Pond - TN30

Photo 22: Pond – TN31

Photo 23: Pond – TN32

Photo 24: Pond – TN33

Photo 25: Pond – TN34

Photo 26: Pond – TN35

Photo 27: Pond – TN36

Photo 28: Pond – TN37

Photo 29: Pond – TN38

Photo 30: Pond – TN39

Photo 31: Pond – TN76

Photo 32: Pond – TN104

Photo 33: Pond – TN113

Photo 34: Pond – TN137

Photo 35: Pond – TN136

Photo 36: River Ely

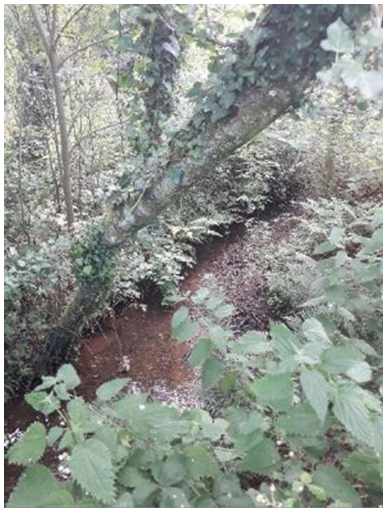

Photo 37: Nant Tredodridge (small stream)

Photo 38: Nant Tredodridge (small stream)

Photo 39: Nant-y-Felin (small stream)

Photo 40: Nant-y-Felin (small stream)

Photo 41: Nant Coslech (small stream)

Photo 42: Dry ditch

Photo 43: Arable field

Photo 44: Amenity grassland on the Cottrell Golf Park Resort

Photo 45: Intact hedgerow – species-rich

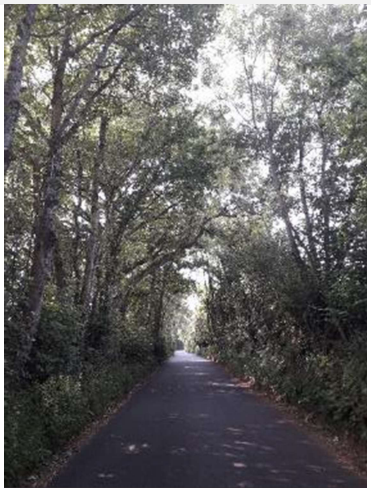

Photo 46: Intact hedge with trees

Photo 47: Tree with bat potential

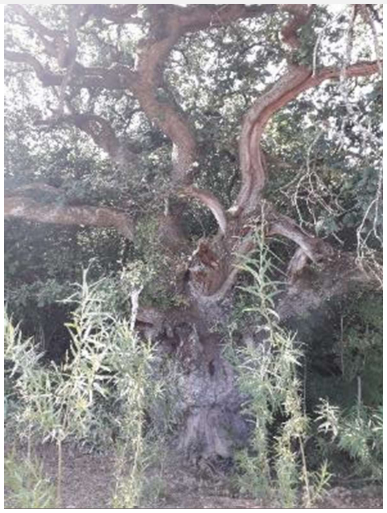

Photo 48: Tree with bat potential

Photo 49: Building with bat potential – TN14

Photo 50: Building with bat potential – TN14

Photo 51: Building with bat potential – TN68

Photo 52: Building with bat potential – TN68

Photo 53: Building with bat potential – TN68

Photo 54: Building with bat potential – TN111

Photo 55: Building with bat potential – TN111

Photo 56: Building with bat potential – TN111

Photo 57: Building with bat potential – TN135

Photo 58: Rubble pile – Reptile potential

Photo 59: Bird of prey pellet

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APPENDIX M

Improving Strategic Transport Encompassing Corridors from M4 Junction 34 to the A48 | Highway Link Study | River Ely Model Review and Proposed Approach | 10028657-ARC-XX-XX-RP-CW-00XX-01 | November 2019

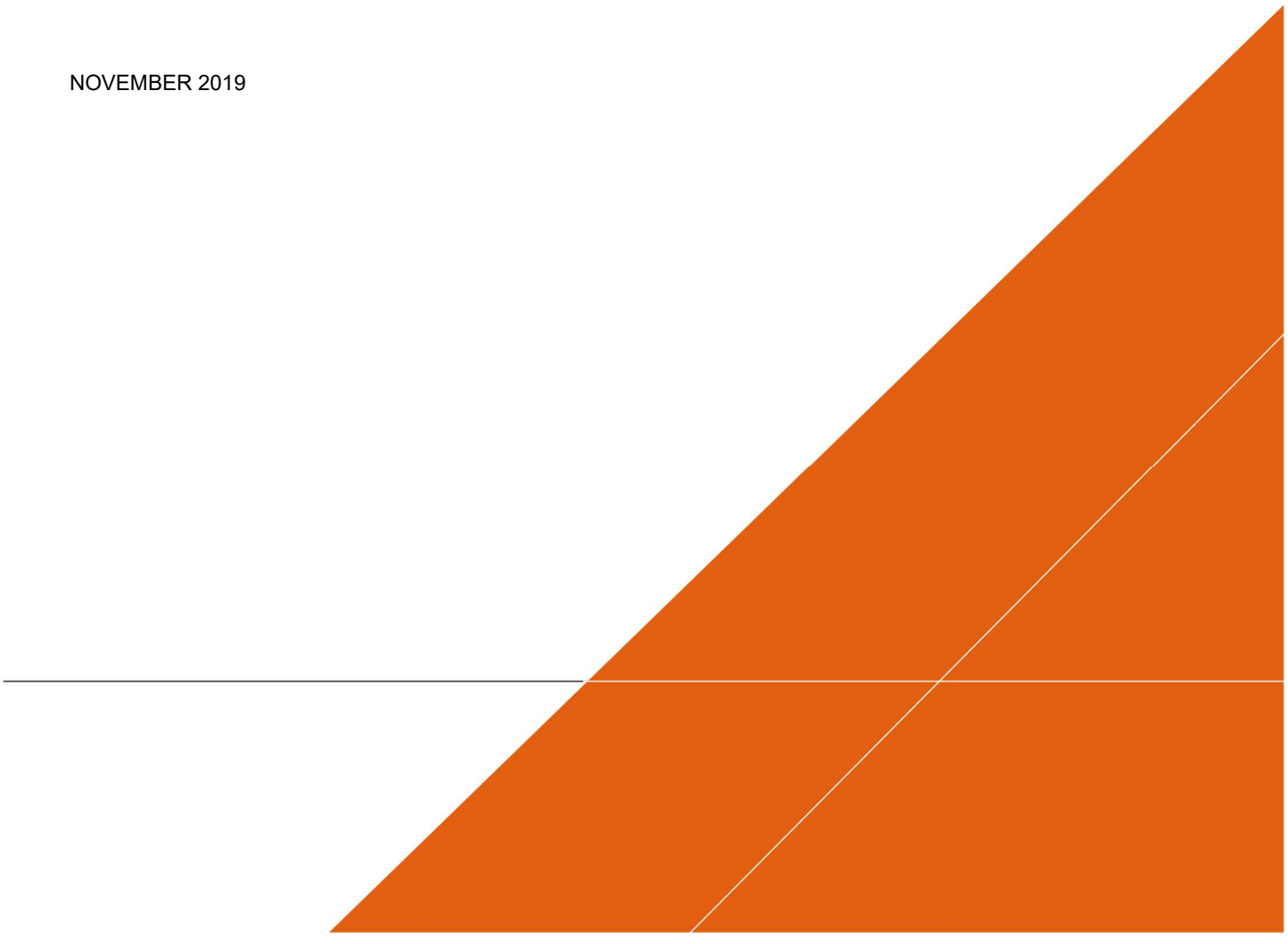
ARCADIS Design & Consultancy for natural and built assets

IMPROVING STRATEGIC TRANSPORT ENCOMPASSING CORRIDORS FROM M4 JUNCTION 34 TO THE A48 | HIGHWAY LINK STUDY

WelTAG Stage Two Plus

River Ely Model Review and Proposed Approach

NOVEMBER 2019



Improving Strategic Transport Encompassing Corridors from M4 Junction 34 to the A48 | Highway Link Study

WelTAG Stage Two Plus

River Ely Model Review and Proposed Approach

Author	MG
Checker	JT
Approver	IJ
Report No	10028657-ARC-XX-XX-RP-CW-00XX-01
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P01	03/09/2019	MG	Final Draft for Review
P02	15/11/2019	MG	Updated for final WelTAG Stage Two Plus report with NRW response attached

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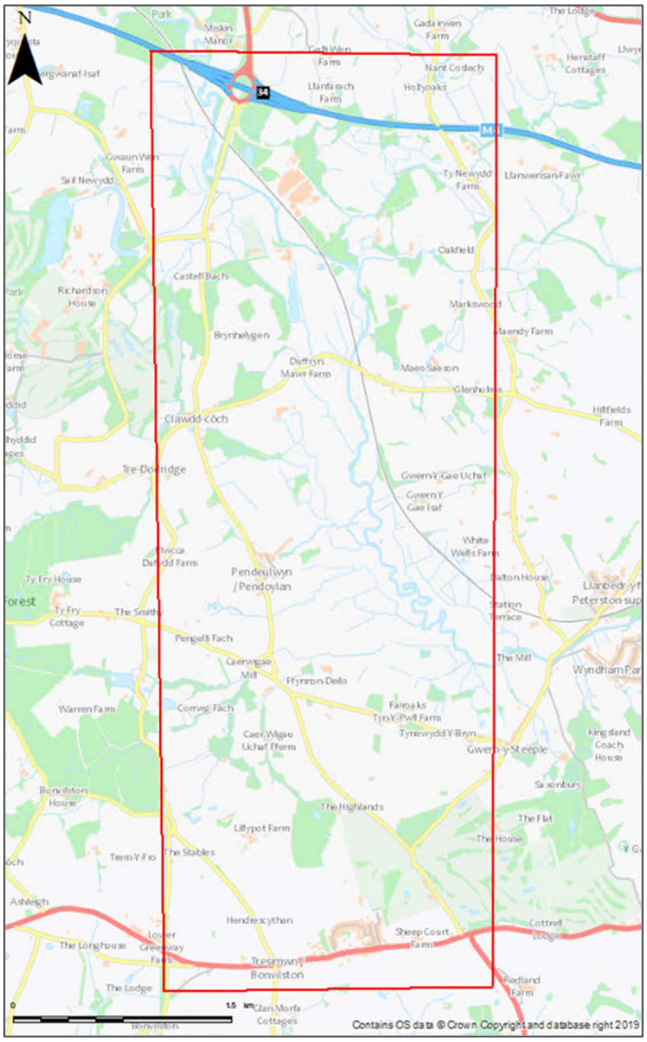
Natural Resources Wales | REVIEW OF DOCUMENT CONTAINING PROPOSED MODELLING APROACH AND REVISED HYDROLOGY IN RELATION TO LINEAR TRANSPORT SCHEME BETWEEN THE M4 JUNCTION 34 AND THE A48 AT THE SYCAMORE CROSS JUNCTION, VALE OF GLAMORGAN | 15th November 2019

1 Introduction

1.1 Background

1.1.1 Arcadis Consulting (UK) Ltd ('Arcadis') were commissioned by the Vale of Glamorgan Council ('the Client') to progress a Welsh Transport Analysis Guidance (WelTAG) Stage Two Plus study for a proposed new link road between the M4 Junction 34 and the A48 at Sycamore Cross, with the area of interest shown in Image 1.

Image 1 Area of Interest



1.1.2 The Scheme crosses the River Ely and intersects its floodplain (Flood Zones B and C2). At present there is no suitable flood model (with appropriate supporting hydrology) to inform the scheme design.

1.1.3 This technical note documents the first part of the study, where the objectives were to:

- Review the flood models of the River Ely and its tributaries that have been provided by Natural Resources Wales (NRW).
- Carry out check survey at specific locations to determine whether additional survey needs to be collected in the study area.
- Set out a modelling approach to develop a flood model that can be used to define baseline flood conditions and assess flood risk to and from the proposed new link road. The updated model will then be used to inform the selection of a preferred option for the scheme.

2 Hydraulic Model Review

2.1 Summary of Existing Models

2.1.1 The previous relevant flood modelling study of the area was undertaken by Atkins in 2010. It included three flood models:

- **Upper Ely 1D model |** On the River Ely the model extends from Tonyrefail at approximate National Grid Reference (NGR) 300940, 188170, to just downstream of the railway bridge in Duffyrn Bach (NGR 306500, 178760). On the River Clun the model extends from Ton Teg (NGR 309320, 185930) to the confluence with the River Ely at Pontyclun (NGR 303630, 181860). The model is a 1D-only ISIS model, completed in December 2012.
- **Lower Ely 1D model |** The Lower model extends from just downstream of the M4 (NGR 305780, 179320) to Cardiff Bay at the downstream extent (NGR 318600, 172670). The model is a 1D-only ISIS model, completed in December 2012.
- **Upper Ely 1D-2D model |** The model extends from near Lanelay Road Industrial Estate (NGR 303440, 182230) on the River Ely and Glamorgan Vale Retail Park just below the A4119 (NGR 304880, 182360) on the River Clun, to just downstream of the railway line to the east of Pontyclun Rugby Football Ground (NGR 303950, 181210). The model is a 1D2D ISIS-TUFLOW model, completed in December 2012.

2.1.2 The 1D Upper and Lower Ely models represent the Rivers Ely, Clun and seven of their tributaries. The models overlap just downstream of the M4 (NGR 306100, 179100). The Upper Ely 1D-2D model covers the complex urban area of Pontyclun and is situated within the area modelled in the Upper Ely 1D model. The area of interest for the scheme extends across all three previous models.

2.1.3 The following section provides a summary of key findings of the review of all three models, which has been used to define a suitable modelling approach, detailed in Section 4. The accompanying modelling report1 has also been reviewed to inform understanding of the three flood models.

2.2 Upper and Lower Ely 1D models

Boundaries

2.2.1 There are 21 inflow boundaries into the Upper Ely 1D model. The downstream boundary of this model is a normal slope boundary with a slope of 1 in 2,000. The origin of this value is unknown, and it does not match the slope of the channel upstream or downstream of the boundary location. The correct inflows have been read into the model for each flood event simulated.

2.2.2 There are nine inflow boundaries into the Lower Ely 1D model, including an upstream flow boundary extracted from the Upper Ely 1D model. A constant stage-time boundary is used at the downstream end of the model to simulate conditions in Cardiff Bay. The correct inflows have been read into the model for each flood event simulated.

2.2.3 As part of this project, new hydrological inflows are being generated, which will supersede the existing inflow boundaries.

Cross-section Geometry

2.2.4 The cross-section geometry has been compared against the survey. Overall, the cross-sections match well, but some potential errors have been identified and changes have been made to some sections, as described below:

- An artificial slot has been created in section ELY20940.
- Sections ELY20520 and ELY20720 have been raised by 1m at every data point in the original survey.
- Survey section ELY2001 is missing from the model.

- At every structure, copies of the surveyed sections have been made and located in between the surveyed faces of the structure. It is assumed that this was intended, to model the structure without losing any of the chainage. However, standard practice is to locate the structure at the upstream section and add any additional chainage required downstream of the structure.
- There is only a single georeferenced point in each section. Comparing the available georeferenced structure sections against OS Mapping suggests that not all sections are in the correct location.
- Some cross sections have not been extended far enough into the floodplain; glass-walling is occurring at high flows. There are also sections connected to reservoir units, which show glass-walling on the opposite banks.

2.2.5 The cross sections have been numbered according to chainage from upstream to downstream, this is unconventional but will have no effect on model results.

2.2.6 The conveyance plots for many of the sections are not appropriate, especially towards the higher elevations for each cross section. While this issue will mainly be eliminated by trimming the sections to the bank tops as part of the integration with a 2D floodplain representation, the sections should still be examined, and additional panel markers added where necessary.

2.2.7 Cross section spacing is generally acceptable based on the slope of the channel but adding interpolates to the model could negate the need for some of the non-standard changes made to the sections above, where these changes were originally intended to aid model stability. When the model is updated to a 1D-2D representation, additional interpolates will be needed anyway to avoid recirculation of water between the nodes.

Floodplain Representation

2.2.8 The floodplain has been represented as a mixture of extended sections and reservoir units. The cross sections have been extended using LiDAR, survey data or copies of other sections located upstream or downstream. The mix of data and approaches used to represent the floodplain can overestimate or underestimate both floodplain storage and conveyance, it is recommended that all sections are trimmed to the channel banks for linking to 2D domain.

2.2.9 No details on the locations and extents of the reservoir units have been provided, therefore it has not been possible to verify the reservoir unit geometry. These units will necessarily be removed when the floodplain is represented in the 2D domain.

Roughness

2.2.10 The report accompanying the models states that roughness values were chosen based on standard values tabulated within Chow2. For the channels in the area of interest the report states that values of 0.035 have been used through Pontyclun and 0.043 has been used at Peterston Super Ely. These roughness values are reasonable for the channel types observed during an Arcadis walkover in July 2019. No values are stated in the report for the area between these two locations. In this area a range of values have been used in the channel from 0.039 to 0.046. Typically, Manning's 'n' roughness values are changed in 0.005 increments due to the uncertainty in estimating the values. Adjusting the values by increments lower than this can imply a false level of accuracy. In-channel roughness values should ideally be revised to typical values.

2.2.11 The same issue is encountered on the floodplain in extended sections with values changing in very small increments. However, if the floodplain is represented in the 2D domain, the roughness will be defined spatially using Mastermap and the NRW standard methodology. Any values remaining on the banks and the floodplain should be reviewed and adjusted to match consistent values for the relevant riverbank and floodplain types.

Structures

2.2.12 OS mapping has been reviewed to check that that all necessary hydraulic structures have been represented in the flood models. In the Upper Ely 1D model there are three footbridges that have not

been surveyed and have therefore not been modelled. In the Lower Ely 1D model, all relevant structures have been represented. The following issues have been noted with the schematisation of structures:

- At every structure, additional sections have been created by copying other sections. This has created very short reaches at each structure which can result in instabilities in the model. The additional sections should be removed, and the missing chainage should be added to the downstream face of the structures as is standard practice.
- At several structures the copied sections are narrow compared to the surveyed sections. This rapid change in conveyance area can result in instabilities in the model.
- Overtopping of the bridge structures has been modelled using a spill unit to represent flow over the top of the structure. However, for some structures the spill unit is narrower than the upstream and downstream sections resulting in the conveyance capacity over the structure being artificially reduced.
- The weir ELY21967W is 20m wide while the section upstream is over 200m wide and the section downstream is 90m wide. This results in a significant loss in conveyance for floodplain flows in the area as the weir effectively stops all floodplain flows. In the 0.1% Annual Exceedance Probability (AEP) event there is a 1.8m drop in stage at this location despite the weir only representing a 0.09m drop in bed level.
- The coefficients of several structures have been altered during the calibration process. However, the model report does not state which structures or what coefficients have been changed. Therefore, given the issues highlighted as part of this review it is recommended that all structure coefficients are restored to their default values, unless evidence is available to justify a departure from these values.

Model Parameters

2.2.13 In both models, the ‘dflood’ value has been raised to 50, this is typically raised to stabilise the model. This should be restored to its default value.

2.2.14 The ‘Automated Preissman slot’ option has been used in the Upper Ely 1D model. This should be deactivated.

Model Stability

2.2.15 Model stability has been assessed by examining the .zzd files. There is one instance of nonconvergence in the Upper Ely 1D model at 12845u in the 0.1% AEP event. Given the number of issues highlighted above this is less than what would be expected for this model, however it may be that the changes to the default parameters and the modifications to the model have been used to reduce the non-convergence.

2.2.16 There are several instances of non-convergence in the lower model which occur at spills between the reservoirs and their associated river sections. Many of these non-convergence issues may be solved by converting the model to a 1D-2D representation.

2.2.17 The FMP model run summary (.bmp), showing the number of iterations/Timestep, Model Convergence and Total Flows has not been provided as part of the model results.

2.3 Upper Ely 1D-2D Model

Boundaries

2.3.1 There are five inflow boundaries into the 1D-2D model. There are boundaries in the 1D domain at the upstream ends of the Rivers Ely and Clun. There are also three boundaries in the 2D domain representing the Nant Dyfrgi, Nant Felin Fach and Nant Melyn. The report does not state how the inflows in these boundary units have been derived. As part of this project, new hydrological inflows are being generated, which will supersede the existing inflow boundaries.

2.3.2 The downstream boundary of the model is a normal depth boundary in the 1D domain. There is no downstream boundary in the 2D domain, resulting in a significant area of glass-walling at this location, as indicated at point '1' in Image 2 on the following page. This erroneous glass-walling causes a significant increase in depths and flood extents in this area.

Image 2 Locations of glass walling in the Upper Ely 1D-2D model

2.3.3 In the 0.1% AEP event there are other locations in the model where the 2D domain glass-walls, as indicated in red in Image 2. As well as the glass-walling at the downstream boundary (1), it occurs at two other locations (2, 3). Other locations where flood extents touch the boundary are where the 2D inflows (4, 5) are currently located (indicated in green).

2.3.4 HX lines have been defined to link the 1D domain to the 2D domain. Comparing the nulled area in 2D to the widths in the 1D sections demonstrates that the nulled area in the 2D domain is consistently 1-2 cells larger than the width of the section in the 1D domain. This will result in the floodplain storage being underestimated throughout the reach.

1D Cross Sections

2.3.5 The report does not state the source of the 1D sections used in the 1D-2D model. The naming convention of the sections suggests that they have been taken directly from the Upper Ely 1D model. 1D sections in the 1D-2D model have been trimmed to bank widths for linking to the 2D domain.

2.3.6 Additional interpolates have been added to the model to aid in linking to the 2D domain. However, the distance between cross sections and interpolates varies considerably in the model from 27.5m to 100m between nodes. Given the cell size and the nature of the area, having nodes at 20-50m spacing would be more appropriate.

Topographic Representation in the 2D Domain

2.3.7 The topography of the 2D domain has been defined using zpts with elevations extracted from LiDAR data. The LiDAR data used is over 10 years old and this method of defining the ground levels is no longer best practice. The 2D domain will need to be extended for the updated model and the most up to date LiDAR will need to be sourced to define the ground levels.

2.3.8 There are several additional zpt layers defining topography in the 2D domain, these are listed below:

- A layer filling in gaps in the LiDAR data.
- Two layers defining the Nant Melyn and Nant Dyfrigi channels. However, no survey has been provided for these channels and it is uncertain how elevations along these watercourses were defined.
- At the locations of the 2D inflow boundaries, a zln layer has traced along the boundaries and has been used to reinforce elevations.
- Two layers define defences through Pontyclun. There is no information in the report detailing the source of this elevation data to represent the defences.
- There are also two layers called ‘instability fix’. The check files indicate a layer has been read into the model, however it has been commented out of the tgc. This suggests that the tgc has been modified following the model run.

2.3.9 It is recommended that none of the existing layers are carried forward for the new model. Utilising the latest LiDAR data should address any previous data gaps, while the updates to the model will negate the need for stability fixes. Given the unknown provenance of the defence elevations, updated defence information should be requested from NRW.

Roughness

2.3.10 Roughness values have been defined spatially using Mastermap data. The values have been chosen based on the 2D Modelling Document formerly produced by the Environment Agency Wales Flood Risk Mapping and Data Management Team. This is now out of date and there are updated values for land use type produced by NRW. Updated Mastermap would be required due to the extension of the 2D domain and the age of the Mastermap data used in the existing model.

Structures

2.3.11 In the Upper Ely 1D-2D model, the representation of structures differs from that in the Upper Ely 1D model:

- Two structures have been removed (09316U and 09365U).
- Bridge 11695U has been changed to be a weir unit.
- The copied sections at 09340U have been removed.
- The copied sections at 08880U have been removed and new ones added to the model.

2.3.12 It is assumed that these structures were altered to stabilise the model, but this has resulted in a potential loss of accuracy. Therefore, it is recommended that all the structures in the model are remodelled using standard practices.

Model Parameters

2.3.13 Several parameters have been changed from default values in the Upper Ely 1D-2D model. These include 'dflood' being raised to 10, 'minitr' being raised to 5 and 'maxitr' being raised to 25. These parameters are typically modified in this way as a blunt force method to stabilise a model. Their use can, however, mask instabilities rather than resolving them. These values should be restored to their default values and any residual instabilities explored and fixed using best practice techniques.

Model Stability

2.3.14 The mass balance of the model has been checked and is acceptable for all events modelled, however the change in volume in the 2D domain shows large oscillations around the peak of the event. This is thought to be due to water oscillating over the 1D-2D links as it ponds behind structures. Image 3 and Image 4 below show the 'dVol' and mass balance plots for the 0.1% AEP event.

Image 3 Plot of 'dVol' for the 0.1% AEP Event

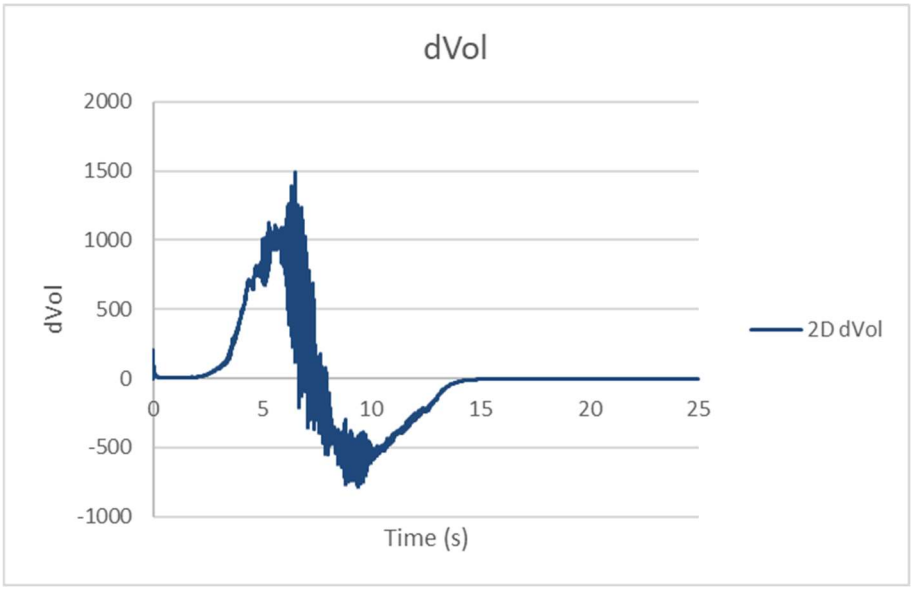
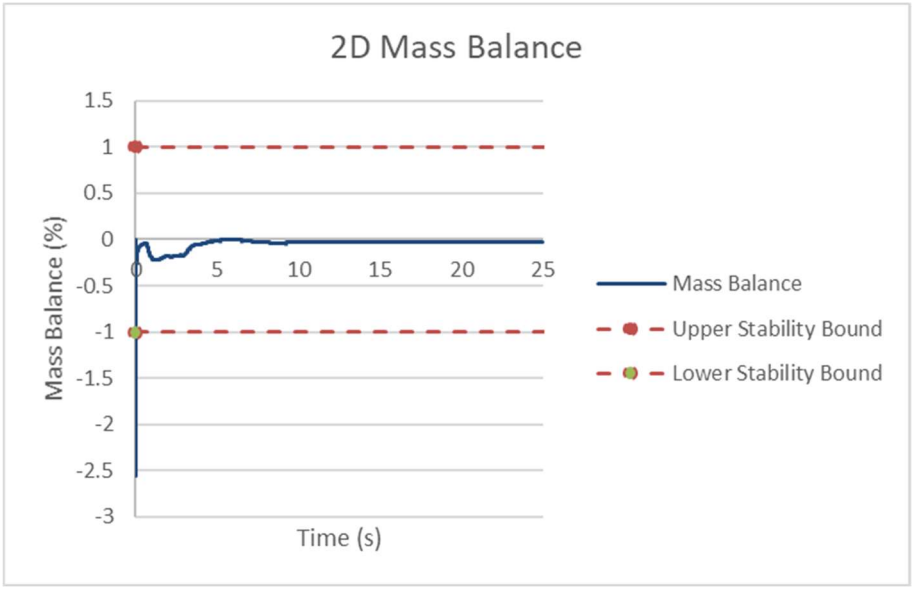


Image 4 Plot showing mass error for the 0.1% AEP event



2.3.15 The model 2D logs have been checked and reported in Table 1.

Table 1 Warnings and Checks reported in Model Log

Item	Comment
148x WARNING - WLL does not cross (2-point WLL only) or snap to 1D channel	This is because there is no nwk line for the wll lines to snap to
2x CHECK 2099 - Ignored repeat application of boundary to 2D cell.	This occurs where one cell is selected by multiple HX lines
WARNING 2991 - Negative U depth at [277;101].	A single negative depth warning is of limited concern. However, as the model is being updated this area will be examined as there is the potential for instability in the area.

2.3.16 There are no PO lines in the model, so it has not been possible to check the flow conservation through the model.

3 Check Survey

3.1.1 Maltby Land Surveys Ltd was commissioned by Arcadis (September 2019) to undertake check survey of the Ely Section 105 survey originally collected in 1996. The commissioning of the check survey was complicated by the absence of photographs, georeferencing data and location plans in the 1996 survey. Therefore, the check survey sections have been taken at the best approximation of the 1996 survey locations.

3.1.2 Four check survey sections were commissioned. The surveyed sections and the corresponding 1996 sections and locations are shown in Table 2 below.

Table 2 Check Survey and Corresponding 1996 Section

Check Survey Section	1996 Section	Location
ELYCHK01	ELY2808	Upstream face of Ynysddu road bridge
ELYCHK02	ELY2209	Downstream face of M4 crossing
ELYCHK03	ELY2008	Downstream face of rail bridge
ELYCHK04	ELY1508	Upstream face of unnamed road/ Gwern-Y-Steeple road bridge

3.1.3 Each of the check survey sections were compared against the corresponding 1996 survey section. The comparisons where undertaken by altering the chainage of the two sections so that the bank and bed locations were roughly aligned. These comparisons are show in Image 5 to Image 8 on the following pages. It can be seen that the bed levels of the check survey and 1996 survey sections are similar.

Image 5 Plot Comparison of ELYCH01 and ELY2808

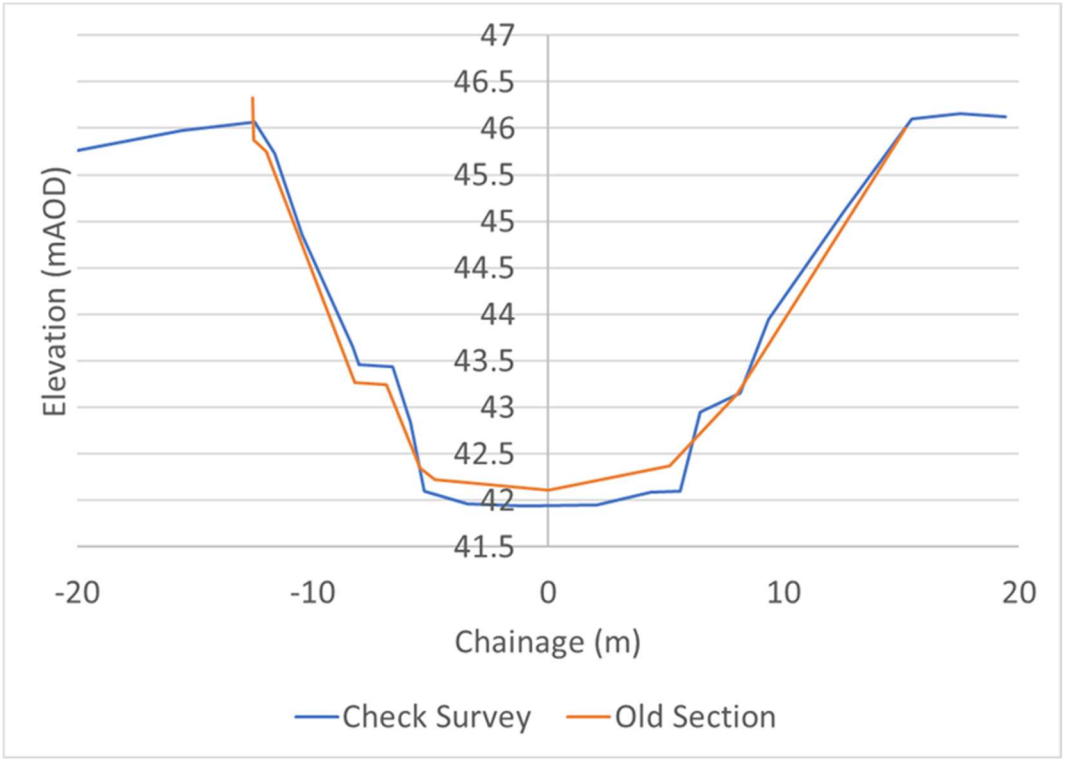


Image 6 Comparison of ELYCH02 and ELY2209

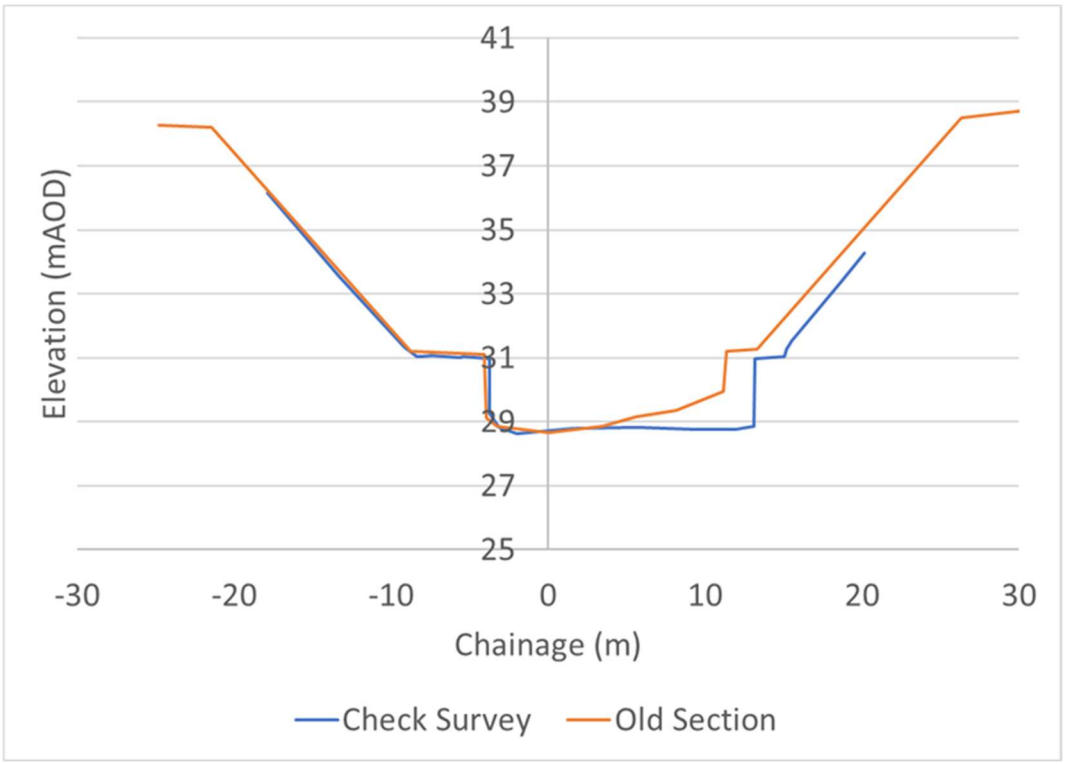


Image 7 Comparison of ELYCH03 and ELY2008

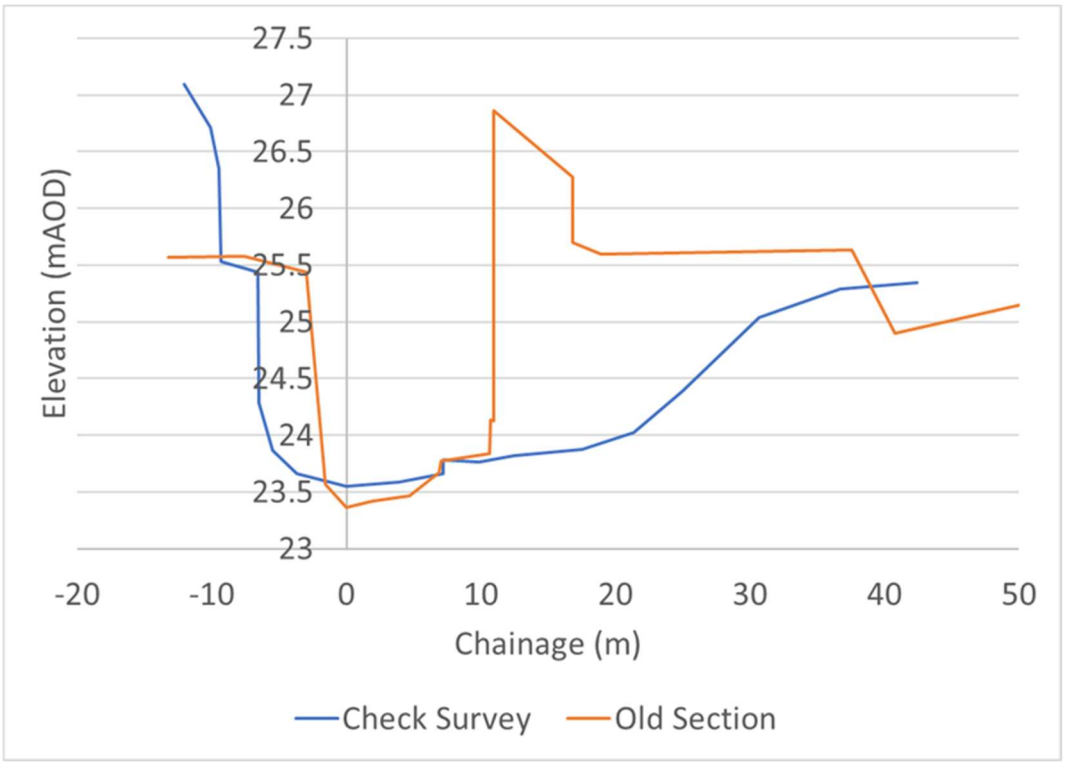
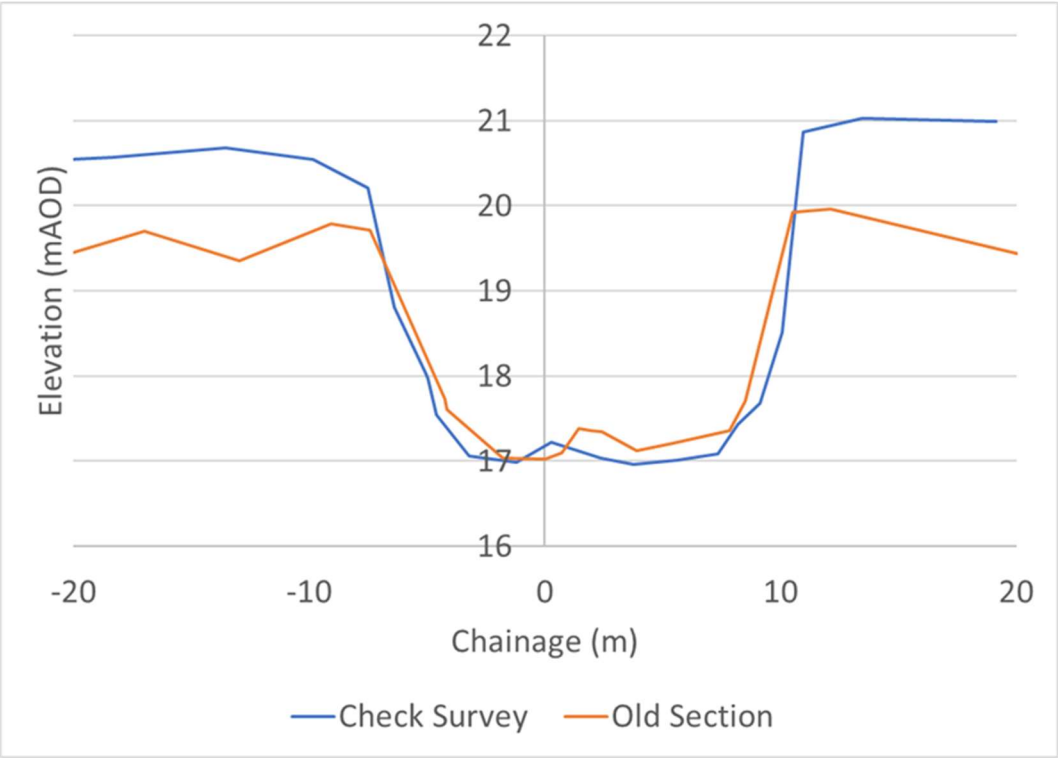


Image 8 Comparison of ELYCH04 and ELY1508



3.1.4 The shapes of the check survey at sections ELYCHK01, ELYCHK02 and ELYCHK04 match the shapes of the corresponding 1996 sections well. The bank levels of ELYCHK04 are above those in ELY1508 but this is thought to be because of uncertainty over the location of the original section. The bank levels drop sharply away from the downstream face of the bridge. This highlights the need to accurately model bank levels over the 1D-2D links where they vary along the banks. To do this the LiDAR will be interrogated along with the surveyed sections to define precise bank levels.

3.1.5 The shapes of ELYCHK03 and ELY2008 do not match very well. On investigating the location of the survey section, ELYCHK03 has been surveyed up the slip ramp into the watercourse, whereas EKY2008 has been surveyed along the face of the bridge. The slip ramp and face of the bridge are shown in Image 9 below.

Image 9 Photograph of Slip Ramp into Watercourse at ELYCHK03/ELY2008

3.1.6 Overall, the good match of the bed levels and general shape of these sections means that re-surveying of the watercourses is not required to develop a suitable model to assess the scheme.

4 Modelling Approach

4.1 Data Requirements

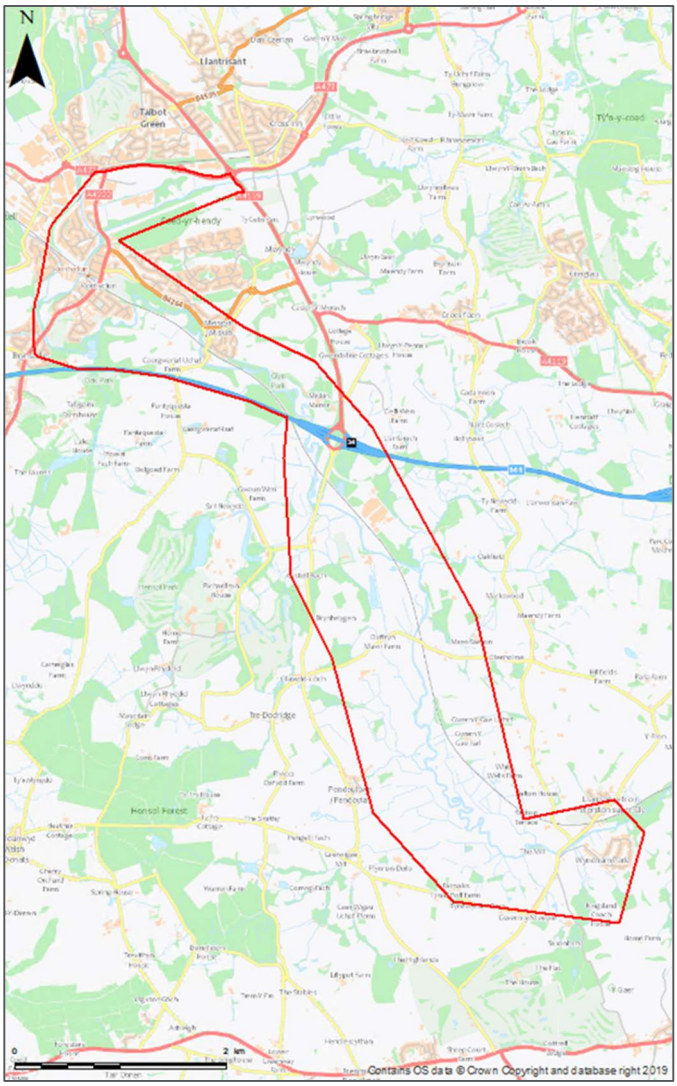
4.1.1 There are several additional data sets which will be required to update the model, including:

- LiDAR data (this was downloaded as part of the review process, from Lle.gov.wales on 25-07-2019).
- OS Mastermap (to be supplied by the Client).
- Defence levels through Pontyclun (to be obtained from NRW).

4.2 Combined Models

4.2.1 Both the 1D models will be combined into a single model and trimmed to the proposed extents of the shown in Image 10 below.

Image 10 Proposed Model Extents



4.2.2 Given the issues highlighted in the review of the existing 1D-2D model and the large change in extents of the 2D floodplain, the existing 1D-2D model will not be carried forward and a new linked 2D domain will be created for the updated 1D-2D model.

4.3 1D Model Domain

Channel

4.3.1 As detailed in the model review, several updates will be required to the 1D model. The updates required are listed below:

- Georeference all river and structure sections.
- Trim sections to bank tops.
- Update roughness values to standard values.
- Add additional panel markers as required.
- Test 1D model stability and accuracy.

Structure Sections

4.3.2 A full review of all the structures to be modelled will be undertaken to check against the survey and confirm a suitable representation is used. The issues identified in the review will also be rectified:

- Copied sections creating short reaches will be removed.
- Narrow sections will be widened to match the average channel section width for the reach.
- Spills over structures will be revised to match the upstream downstream section widths.
- Weir ELY21967W will be modelled at the same width as the channel sections to avoid the sudden narrowing of the channel.

4.4 2D Model Domain

4.4.1 A new 2D domain model will be created using the latest data, LiDAR and Mastermap. The following tasks will need to be undertaken to create the new 2D domain model:

- Combine the latest LiDAR into one grid.
- Define 2D model extents.
- Define roughness using latest Mastermap data and predefined NRW roughness values.
- Check floodplain for any features which need reinforcing.

Linking 1D and 2D Domains

4.4.2 To link the 1D and 2d domains the following tasks will be undertaken:

- Create new HX links and define ZP points along links.
- Add defences to Pontyclun.
- Test 1D-2D model stability and accuracy.

Upstream and Downstream Boundaries

4.4.3 Updated inflow hydrographs have been derived in accordance with current NRW flood estimation guidelines and using the latest hydrometric data records and Flood Estimation Handbook software tools. Details of the calculations are provided in the appended Calculation Record (Appendix A), which has also been issued to NRW for review and approval.

4.4.4 The location of the downstream boundary of the model has been chosen at a location where the 0.1% AEP event is confined to the channel in the existing modelled extents. Should the model show that there is out of bank flooding in this area then an additional boundary will be required in the 2D domain. The downstream boundary will be a normal slope boundary defined by the slope of the channel from the survey sections upstream and downstream of the boundary location. Should a

boundary be required in the 2D floodplain this will be an HQ boundary defined by the slope of the LiDAR locally.

4.5 Validation Model

4.5.1 The model will be validated, subject to data availability, for the March 1981 event. This is one of the largest recorded event in the upper Ely catchment.

4.6 Model Runs

4.6.1 The model will be run for the 1%, 1% with 25% uplift for climate change and 0.1% AEP flood events for all scenarios. The model will be run with default parameters in line with modelling best practice.

4.6.2 There are currently three proposed options. One option comprises online improvements and there are two offline options. The two offline option alignments will be modelled. Feedback will be provided to the design team as to which option is most impactful on baseline flood risk and advice on potential design changes to minimise flood risk impacts will be provided.

4.6.3 To create the proposed (option) models geometry data for the proposed scheme alignments will need to be supplied in a format that can easily be converted to GIS to be read into the model.

4.7 Internal Model Quality Assurance

4.7.1 The modelling will be subject to Arcadis internal QA procedures throughout the model build to ensure that it is constructed appropriately and produces realistic and defendable results.

4.8 Deliverables and Reporting

4.8.1 A technical note, detailing the model build methodology and run results will be produced, supported by relevant figures. This could be used to inform a future FCA for the preferred option.

4.8.2 Baseline conditions will need to be defined and accepted by NRW. Arcadis will liaise with NRW during the model build process to ensure that appropriate required local conditions are captured in the updated model. The model will then be sent to NRW for review and acceptance of the proposed baseline flood extents for the area of interest.

4.8.3 The final proposed design model will also be supplied to NRW for review and acceptance the model outputs and the conclusions drawn from the outputs. This will be undertaken as a pre-application enquiry.

4.8.4 Both model deliveries to NRW will be accompanied by a Model Log document, intended to aid understanding of the model and facilitate the review process.

5 Summary

5.1.1 This technical note has detailed Arcadis' review of existing available flood models relevant to defining flood conditions at the proposed link road between the M4 Junction 34 and the A48. A proposed approach has been presented to combine and update, where necessary, available modelling information to prepare an appropriately detailed flood model to assess scheme impacts and inform design of the scheme. The methodology presented herein has informed separate programme and budget estimates for this proposed work.

APPENDIX A

FEH Calculation Record

Flood estimation calculation record

Introduction

This document is a supporting document to the Natural Resources Wales (NRW) Flood Estimation Technical Guidance Note (GN008). It provides a record of the calculations and decisions made during flood estimation. It will often be complemented by more general hydrological information given in a project report. The information given here should enable the work to be reproduced in the future.

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2. Locations where flood estimates are required 10
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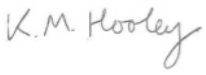
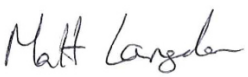
4. Revitalised flood hydrograph (ReFH) method 18
5. Discussion and summary of results 20
6. Annex – supporting information 25

Approval

	Signature	Name and qualifications	For NRW staff: competence level
Calculations prepared by:		Kathryn Hooley (Grad CIWEM)	Level 1
Calculations checked by:		Matt Langdon (C.WEM)	Level 2
Calculations approved by:		Lisa Driscoll (C.WEM)	Level 3

Competence levels:

- level 1 – hydrologist with minimum approved experience in flood estimation
- level 2 – senior hydrologist
- level 3 – senior hydrologist with extensive experience of flood estimation

Abbreviations

AM	Annual maximum
AREA	Catchment area (km^2)
BFI	Base flow index
BFIHOST	Base flow index derived using the HOST soil classification
DPLBAR	Mean drainage path length (km)
DPSBAR	Mean drainage path slope (m/km)
FARL	FEH index of flood attenuation due to reservoirs and lakes
FEH	Flood Estimation Handbook
FPEXT	Floodplain extent
FSR	Flood Studies Report
HOST	Hydrology of soil types
NRFA	National River Flow Archive
NRW	Natural Resources Wales
POT	Peaks over a threshold
QMED	Median annual flood (with return period 2 years)
ReFH	Revitalised flood hydrograph method – used for rainfall runoff method
SAAR	Standard average annual rainfall (mm)
SPR	Standard percentage run-off
SPRHOST	Standard percentage run-off derived using the HOST soil classification
Tp (0)	Time to peak of the instantaneous unit hydrograph
URBAN	Flood Studies Report index of fractional urban extent
URBEXT2000	Revised index of urban extent
WINFAP	Windows Frequency Analysis Package – used for FEH statistical method

1. Method statement

1.1. Overview of requirements for flood estimates

Item	Comments
Give an overview which includes: • purpose of study • approximate number of flood estimates required • peak flows or hydrographs • range of return periods and locations • approximate time available	Flood estimates were required to inform a hydraulic model of the River Ely in the vicinity of Junction 34 of the M4. The hydraulic model is being developed to inform the M4 J34-A48 WelTAG Stage 2 Plus project, which is assessing options to improve the transport network between M4 Junction 34 and the A48. The model is based on existing NRW models produced for the River Ely Velocity Depth Mapping study (2008-2009). These models have been reviewed and updated in line with current best practice and in accordance with NRW advice, new hydrology has also been produced for routing. Four Flow Estimation Points (FEPs) were required for the model at the locations listed here: • Upstream model boundary – 303439, 182214 • Clun, Ely confluence – 303633, 181861 • Bridge over the Ely – 305650, 179350 • Downstream model boundary – 309121, 176660 The location of these FEPs and the local gauging stations are shown in Figure 1 below. Return periods required: 1 in 100 year, 1 in 100 year plus 25% climate change and 1 in 1000 year.

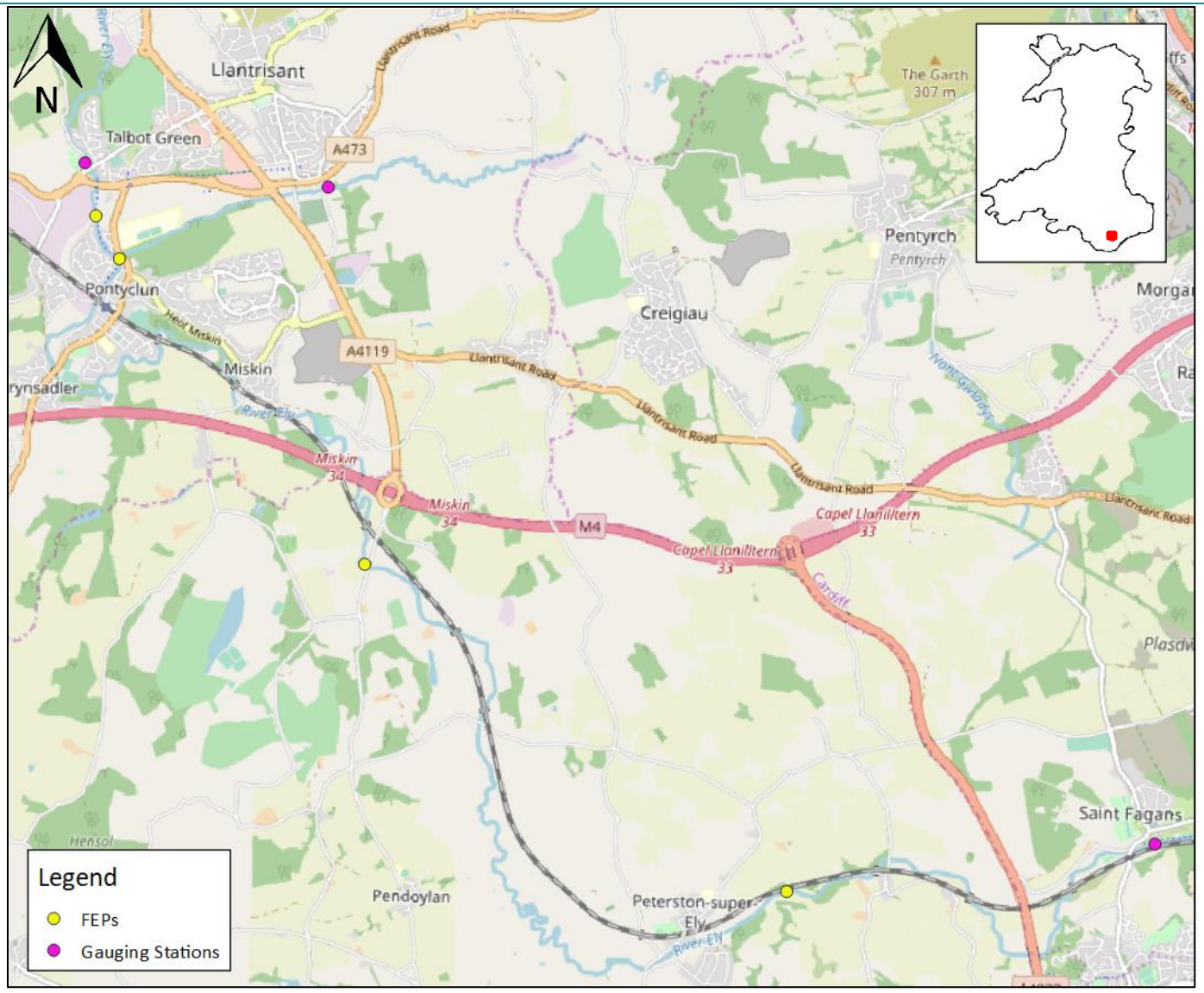


Figure 1: Flow Estimation Point and Gauging Station Locations. (Contains Ordnance Survey data © Crown copyright and database right 2019)

1.2. Overview of catchment

Item	Comments
Brief description of catchment, or reference to section in accompanying report. Include maps where necessary.	The catchment area to the downstream boundary of the model is 121.0 km^2. The upper reaches of the catchment are relatively steep; however, within the study area the River Ely is more consistent with a lowland river with a wide floodplain. The land use consists predominantly of agriculture and grassland with noticeable urban areas within the valley floor, comprising Llantrisant, Talbot Green and Pontyclun.

1.3. Source of flood peak data

Item	Comments
Was the NRFA Peak Flows dataset used? If so, which version? If not, why not? Record any changes made.	Version 7 of the NFRA Peak Flows dataset was used and no changes were made.

1.4. Gauging stations (flow or level)

At the sites of flood estimates or nearby at potential donor sites. Also state gauging authority number where it is different to the NRFA number.

Water course	Station name	NRFA number (used in FEH)	Grid reference	Catchment area (km^2)	BFIHOST	FPEXT	URBEXT 2000
River Ely	Ely at Lanelay	57010	ST033826	38.88	0.455	0.0442	0.0338
River Ely	Ely at St Fagans	57009	ST121770	146.45	0.577	0.0753	0.0461
River Clun	Clun at Cross Inn	57803	ST053824	26.51	0.414	0.0557	0.0841

1.5. Data available at each flow gauging station

Station Name	Start and end date on NRFA	Update for this study?	Suitable for QMED?	Suitable for pooling?	Data quality check needed?	Other comments on station and flow quality e.g. information from NRFA Peak Flows, trends in flood peaks, outliers
Ely at Lanelay	01/12/1979 – 01/10/2017	-	Yes – Gauged above QMED. Rating fits well to available gaugings.	No – Few high flow gaugings. Rating cannot be validated beyond QMED.	-	Flows from 16/10/2010 to 3/11/2010 suspect due to blocking of the inlet pipe. Peak flows from 01/10/1974 to 30/09/1999 rejected because of uncertainty in rating curves due to lack of gauging's in the upper limb.
Ely at St Fagans	01/01/1982 – 01/10/2017	-	Yes – Gauged above QMED. Rating fits well to available gaugings.	Yes – Gauged to within 2% of AMAX3. High confidence model derived rating and validated by check gaugings at 3.64m.	-	Some early (poorer quality) data available (station 57805; 1957-60). Flows from 7/3/2010 to 10/5/2010 suspect due to temporary damming of river at site.
Clun at Cross Inn	27/1/1967 – 29/04/1980	-	No - No gauging's available to validate rating.	No - No gauging's available to validate rating		Station closed in 1980. Recorder was on the u/s side of a single span road bridge which acted as control at high stages. There was also a low flow control bar in the bed d/s.

						No cableway. One peak flow rating applied across period of record. Recommended rating upper limit at bank full (previous limit 2.5m). Rating does not consider out of bank flows and no gauging's found to confirm rating

1.6. Rating equations

Station name	**Type of rating** e.g. theoretical, empirical, degree of extrapolation	**Rating review needed?**	**Reasons** e.g. availability of recent flow gaugings, amount of scatter in the rating
Ely at Lanelay	Unknown	No	
Ely at St Fagans	Unknown	No	
Include a link or reference to any rating reviews carried out			

1.7. Other data available and how it has been obtained

Type of data	**Data relevant to this study?**	**Data available?**	**Source of data and licence reference from NRW**	**Details**
Check flow gaugings (if planned to review ratings)	No	No	-	-
Historic flood data – give link to historic review if carried out	Yes	Yes	NRW Ref 16863a	Approximate outline of the March 1981 event on the River Ely.
Flow data for events	No	No	-	-
Rainfall data for events	No	No	-	-
Results from previous studies	Yes	Yes	River Ely and Tributaries	Method and data considered to be out of

			Model Update and Hazard Mapping (Atkins, 2010)	date but considered useful for comparison only.
Other data or information e.g. groundwater, tides	No	No	-	-

1.8. Initial choice of approach

Item	Comment
Outline the conceptual model. Address questions such as: • Where are the main sites of interest? • What is likely to cause flooding at those locations? (e.g. peak flows, flood volumes, combination of peaks, groundwater, snowmelt, tides) • Might those locations flood from runoff generated on part of the catchment only e.g. downstream of a reservoir?	The main site of interest is the proposed crossing of the A48 over the River Ely south of Junction 34 of the M4. Existing flooding at this location is considered to be caused by river flows backing up behind the existing road embankment that crosses the floodplain at this location.
Any unusual catchment features to take into account? e.g. • highly permeable (BFIHOST> 0.65) – consider permeable catchment adjustment for statistical method if SPRHOST<20% • highly urbanised – consider choice of method carefully; consider method that can account for differing sewer and topographic catchments • pumped watercourse – consider lowland catchment version of rainfall-runoff method • major reservoir influence (FARL<0.90) – consider flood routing • extensive floodplain storage – consider choice of method carefully	The study catchment is not highly permeable, or urbanised and drains by gravity. There is no major reservoir influence. Floodplain storage, which is relatively extensive in the lower reaches of the Ely, has been accounted for in the adopted assessment approach.
Initial choice of method(s) and reasons • Are FEH statistical and/or ReFH appropriate? • If not appropriate, describe why and give details of the other methods to be used. • Will the catchment be split into sub-catchments/intervening areas? If so, how will flows for intervening areas be estimated?	Both methods are deemed appropriate, so flows have been estimated, for comparison, applying both techniques. The catchment has been split to provide suitable inflows to the hydraulic model, as well as to generate a lumped catchment check flow. Sub-catchments are illustrated in Figure 2 below.

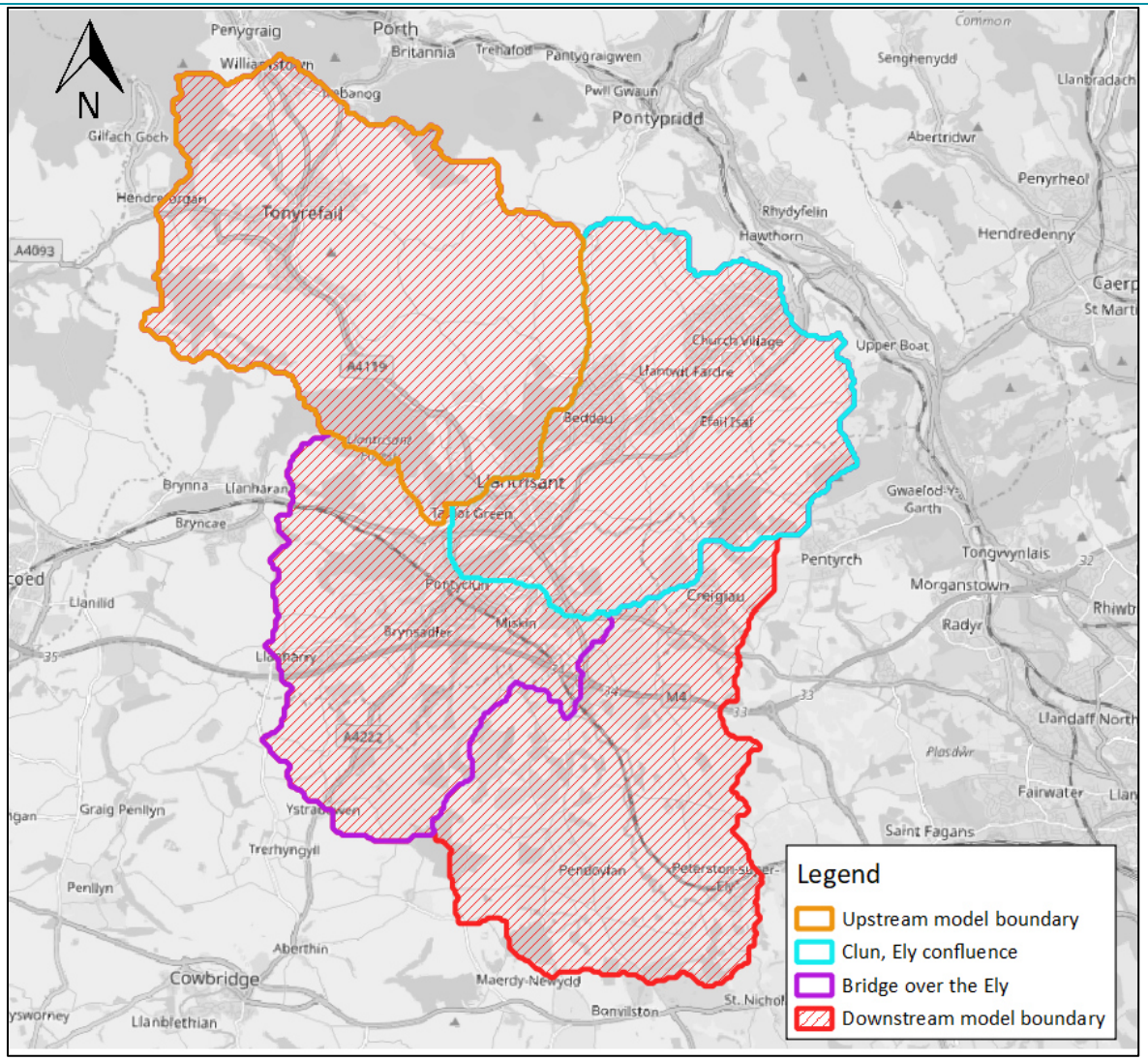


Figure 2: Sub-catchments (Contains Ordnance Survey data © Crown copyright and database right 2019)

Software to be used (with version numbers) edit or delete as applicable, or add others	WINFAP [4] ReFH [2.2]

2. Locations where flood estimates are required

2.1. Summary of subject sites

The table below lists the locations of subject sites. Include site codes in all subsequent tables to save space.

Site code	Watercourse	Site	Easting	Northing	AREA on FEH Web Service (km^2)	Revised AREA if altered
Ely at Lanelay	River Ely	Upstream Model Boundary	303350	182700	38.9	-
Ely-Clun Confluence	River Clun	Confluence of the River Ely and the River Clun	303650	181900	28.9	-
Bridge	River Ely	Existing Bridge over the River Ely	305650	179350	91.6	-
D/s Boundary	River Ely	Downstream Model Boundary	308950	176550	121.0	-
Reasons for choosing above locations	These locations were chosen based on the hydraulic modelling requirements.					

2.2. Important catchment descriptors at each subject site (incorporating any changes made)

Site code	FARL	PROPWET	BFIHOST	DPLBAR (km)	DPSBAR (m/km)	SAAR (mm)	SPRHOST	URBEXT 2000 (*)	FPEXT
Ely at Lanelay	1.000	0.47	0.455	6.51	117.9	1620	39.00	0.0338 (0.0351)	0.0442
Ely-Clun Confluence	0.994	0.47	0.428	6.71	85.1	1371	40.00	0.1017 (0.1057)	0.0667

Bridge	0.990	0.47	0.515	11.91	95.7	1451	36.68	0.0604 (0.0628)	0.0655
D/s Boundary	0.984	0.47	0.550	16.62	85.9	1388	35.67	0.0496 (0.0515)	0.0788

(*) Updated to 2019

2.3. Checking catchment descriptors

Item	Comment
Record how catchment boundary was checked • describe any changes • refer to maps if needed	FEH catchment boundaries were checked using OS contours and no changes were made.
Record how other catchment descriptors were checked, especially soils • describe any changes • include a before and after table if necessary	Soils were checked using a digitised, georeferenced Soil Map from the Soil Survey of England and Wales 1:25,000 series. No changes to FEH descriptors describing soils were necessary. Other features (such as reservoirs/lakes which influence FARL) were checked using OS mapping.
Source of URBEXT / URBAN	URBEXT2000
Method for updating URBEXT / URBAN • Refer to WINFAP4 Urban Adjustment procedures/guidance	URBEXT2000 was adjusted to the present day (i.e. URBEXT2019) according to the procedures published by Kjeldsen 2010.

3. Statistical method

3.1. Search for donor sites for QMED (if applicable)

Note that donor catchments will usually be rural but may be urban provided the data is deurbanised prior to the adjustment process. Please include a map if necessary.

Comment on potential donor sites Mention: • number of potential donor sites available • distances from subject site • similarities in terms of AREA, BFIHOST, FARL and other catchment descriptors • quality of flood peak data	Three gauging stations were identified, two on the River Ely at Lanelay and St Fagans, and one on the River Clun. The Lanelay gauge is located on the subject watercourse at the chosen upstream boundary of the hydraulic model, therefore the flood peak data record from this station is ideal for use in Qmed estimation. The quality of the flood peak data record is deemed unsuitable for forming a flood growth curve by single site analysis. The St Fagans gauge is also located on the subject watercourse, approximately 4km downstream of the limits of the study reach. The quality of the data record is suitable for use in Qmed estimation and pooling. The gauge on the River Clun, whilst suitably located, was closed in 1980 and the data record is both short and of poor quality, making this station an unsuitable donor to inform flow estimates for the River Clun.

3.2. Donor sites chosen and QMED adjustment factors

If using WINFAP3 great caution should be taken in urban catchments that are also highly permeable (BFIHOST>0.65). Further details are provided in the EA Flood Estimation Guidelines.

NRFA number	Reasons for choosing or rejecting	Method (AM or POT)	Adjusted for climatic variation?	QMED from flow data	QMED from flow data with urban	QMEDrural from catchment	Adjustment ratio (A/B)

				(gauged) (m^3/s)	influence removed (A) (m^3/s)	descriptors (B) (m^3/s)	
57010	Immediately upstream of upstream model boundary	AM	No	37.485	36.162	32.270	1.121
57009	Downstream of downstream model boundary	AM	No	53.730	50.518	52.139	0.969
Has the WINFAP4 urban adjustment method (based on Kjeldsen, 2014) been applied? If not, why?				Yes			

3.3. Overview of estimation of QMED at each subject site

Notes for completing this table

- Methods
  - CD: catchment descriptors alone
  - DT: data transfer
  - BCW: catchment descriptors and bankfull channel width
  - FV: flow variability (using flow duration statistics)
- Urban adjustment procedures should be applied regardless of whether the subject site is rural or urban.
- If using WINFAP3, great caution should be taken in urban adjustment of QMED on catchments that are also highly permeable (BFIHOST>0.65).
- The data transfer procedure is from Science Report SC050050. The QMED adjustment factor A/B for each donor site is given in Table 3.2. This is moderated using the power term, a, which is a function of the distance between the centroids of the subject catchment and the donor catchment. The final estimate of QMED is $(A/B)^a$ times the initial estimate from catchment descriptors.
- If more than one donor has been used, use multiple rows for the site and give the weights used in the averaging. Record the weighted average adjustment factor in the table.

Site code	QMEDrural from CDs (m^3/s)	Method	Data transfer: NRFA numbers for donor site/s used (see 3.2)	Data transfer: Distance between centroids d_{ij} (km)	Data transfer: Moderated QMED adjustment factor (A/B)[a]	Data transfer: If more than one donor: Weight (if WINFAP4 method not used)	Data transfer: If more than one donor: Weighted average QMED adjustment factor	Final estimate of QMEDrural (m^3/s)	Final estimate of QMEDurban (m^3/s)
Ely at Lanelay	32.270	AMAX	57010	-	*	-	-	36.162	37.485
Ely-Clun Confluence	20.682	DT	57010	5.83	*	-	-	22.454	24.962
Bridge	45.573	DT	57009	2.93	*	-	0.567	50.751	54.644
			57010	3.06	*		0.557		
D/s Boundary	47.550	DT	57009	1.31	*	-	-	50.871	54.290
Has the Kjeldsen (2014) urban adjustment method (as used in WINFAP4) been applied? If not, why?					Yes				
How are the weights derived?					Automatically done by WINFAP.				
Are the values of QMED consistent, for example at successive points along the watercourse and at confluences?					Yes, values of QMED are consistent, QMED rural values increase moving downstream on the River Ely, however in the lower catchment, the influence of floodplain storage can been seen, with the QMED flow between the Bridge and D/s boundary FEPs being very similar, despite an increase in catchment area.				

** not reported in WINFAP 4*

3.4. Derivation of pooling groups

The composition of pooling groups is given in the Annex. Several subject sites may use the same pooling group.

Name of group	Site code from whose descriptors group was derived	Subject site treated as gauged? (enhanced single site analysis)	**Changes made to default pooling group, with reasons.** Include any sites that were investigated but retained in the group
Ely at Lanelay	57010 Ely @ Lanelay	No	Stations 84020, 47021 and 21030 were investigated due to their relatively high discordancy values but no reason was found to remove these sites. The pooling group has a record length of 530 years and a H2 measure of -1.8639 which indicates that the pooling group is acceptably homogenous, and a review of the pooling group is not required. Note, the Station 57010 is not included in the pooling group due to data quality issues.
Ely-Clun Confluence	57010 Ely @ Lanelay	No	No changes were made to the default pooling group. 47021 was investigated due to its relatively high discordancy value but no reason was found to remove this site. The pooling group has a record length of 519 years and a H2 measure of -1.7362 which indicates that the pooling group is acceptably homogenous, and a review of the pooling group is not required.
Bridge	57009 Ely @ St Fagans 57010 Ely @ Lanelay	No	203033 was discarded due to bounded growth curve. The resulting pooling group has a record length of 514 years and a H2 measure of 2.3539 which indicates that a review of the pooling group is desirable. Following further review, no additional changes to the pooling group were required.
D/s Boundary	57009 Ely @ St Fagans	No	203033 was discarded due to bounded growth curve. The resulting pooling group has a record length of 501 years and a H2 measure of 0.3552 which indicates that the pooling group is acceptably homogenous, and a review of the pooling group is not required.
URBEXT2000 threshold used to create pooling group(s)		Default 0.03 was used in WINFAP 4.	

3.5. Derivation of flood growth curves at subject sites

Notes for completing this table

- Abbreviations for method types
  - SS: single site
  - P: pooled
  - ESS: enhanced single site
  - FH: single site with flood history
- A pooling group (or ESS analysis) derived at one gauge can be applied to estimate growth curves at a number of ungauged sites. Each site may have a different urban adjustment, and therefore different growth curve parameters.
- Urban adjustments to growth curves should use the latest methodologies in WINFAP
- Any relevant frequency plots from WINFAP, particularly showing any comparisons between single-site and pooled growth curves (including flood peak data on the plot) should be shown here or in a project report.

Site code	**Method** (SS, P, ESS, FH)	**If P, ESS, or FH, name of pooling group** (3.4)	**Distribution used and reason for choice**	**Note any urban adjustment or permeable adjustment**	**Parameters of distribution** (location, scale, and shape) after adjustments	**Growth factor for 100-year return period**
Ely at Lanelay	P	Ely at Lanelay	GL – absolute Z value closest to 0	Urbanised Flood Frequency results used	L-CV 0.202 L-SKEW 0.205	2.541
Ely-Clun Confluence	P	Ely-Clun Confluence	GL – absolute Z value closest to 0	Urbanised Flood Frequency results used	L-CV 0.212 L-SKEW 0.218	2.625
Bridge	P	Bridge	GL – considered appropriate and consistent with other FEPs.	Urbanised Flood Frequency results used	L-CV 0.172 L-SKEW 0.143	2.108
D/s Boundary	P	D/s Boundary	GL – absolute Z value closest to 0	Urbanised Flood Frequency results used	L-CV 0.178 L-SKEW 0.197	2.308

3.6. Flood estimates from the statistical method

Site code	Flood peak (m^3/s) for the following return periods (in years)								
	2	5	10	20	50	100	200	500	1000
Ely at Lanelay	37.49	49.63	58.50	68.09	82.56	95.26	109.82	132.45	152.59
Ely-Clun Confluence	24.96	32.97	39.03	45.74	56.14	65.51	76.49	94.00	109.98
Bridge	54.64	68.65	78.38	88.40	102.93	115.18	128.71	148.91	166.16
D/s Boundary	54.29	69.19	80.09	91.87	109.67	125.32	143.26	171.17	196.03

4. Revitalised flood hydrograph (ReFH) method

4.1. Parameters for ReFH model

If parameters are estimated from catchment descriptors, they are easily reproducible, so it is not essential to enter them in the table.

Site code	**Details of method** OPT: optimisation BR: base flow recession fitting CD: catchment descriptors DT: data transfer	**Tp (hours)** Time to peak	**C_{max} (mm) maximum storage capacity**	**BL (hours)** baseflow lag	**BR** baseflow recharge
Ely at Lanelay	CD	2.91	339.43	40.92	1.25
Ely-Clun Confluence	CD	3.29	316.44	39.69	1.17
Bridge	CD	4.4	396.68	50.32	1.45
D/s Boundary	CD	5.51	434.43	56.31	1.56
Brief description of any flood event analysis carried out Provide further details either here or in a project report	No flood event analysis was carried out.				

4.2. Design events for ReFH method

We recommend that the ReFH2 technical guidance should be referred to when completing this table

Site code	**Season of design event (summer or winter)**	**Storm duration (hours)**	**Storm area for ARF (if not catchment area)**	**Source of design rainfall statistic (FEH13 or FEH99)**
Ely at Lanelay	Winter	7.5	0.94	FEH13
Ely-Clun Confluence	Winter	7.5	0.94	FEH13
Bridge	Winter	10.5	0.92	FEH13
D/s Boundary	Winter	13.0	0.92	FEH13
Detail any changes to the default ReFH2 urbanisation model parameters	No changes were made to the default urbanisation model parameters.			

Are the storm durations likely to be changed in the next stage of the study For example by optimisation within a hydraulic model?	Storm duration would potentially be optimised during the next stage of the study to inform an FCA.

4.3. Flood estimates from the ReFH method (urban/rural)

- Please indicate whether you have used urban or rural results
- We recommend that urban results are used regardless of the extent of urbanisation at the subject sites

	Flood peak (m^3/s) or volumes (m^3) for the following return periods (in years)								
Site code	**2**	**5**	**10**	**20**	**50**	**100**	**200**	**500**	**1000**
Ely at Lanelay	27.070	35.147	40.656	46.430	54.754	62.010	71.210	88.775	108.379
Ely-Clun Confluence	17.433	22.577	26.259	30.051	35.722	40.955	47.863	60.785	73.156
Bridge	37.021	47.191	54.418	61.816	72.790	82.838	95.705	120.058	145.024
D/s Boundary	36.680	46.330	53.187	60.434	71.138	81.184	93.885	117.597	141.237

Urban results are used for all sites.

5. Discussion and summary of results

5.1. Comparison of results from different methods

This table compares peak flows from the ReFH method with those from the FEH Statistical method at each site for two key return periods.

	Return period 2 years (QMED)			Return period 100 years		
Site code	**Statistical**	**ReFH**	**Ratio (ReFH / statistical)**	**Statistical**	**ReFH**	**Ratio (ReFH / statistical)**
Ely at Lanelay	37.485	27.070	0.722	95.264	62.010	0.651
Ely-Clun Confluence	24.958	17.433	0.698	65.507	40.955	0.625
Bridge	54.644	37.021	0.677	115.177	82.838	0.751
D/s Boundary	54.290	36.680	0.676	125.317	81.184	0.648

5.2. Final choice of method

Choice of method and reasons Include reference to type of study, nature of catchment, and type of data available	Given the presence of the gauged data records from gauging stations located on the subject watercourse the Statistical method is preferred.

5.3. Assumptions, limitations, and uncertainty

List the main assumptions made specific to the study	It is assumed that use of the Ely at Lanelay and/or Ely at St Fagans gauging stations is appropriate for the sites in this study. It is also assumed that the flow estimation methods used take appropriate account of the effects of floodplain storage in the lower Ely catchment.

Discuss any particular limitations For example applying methods outside the range of catchment types or return periods for which they were developed	None.
Give what information you can on uncertainty in the results For example using the methods detailed in 'Making better use of local and historic data, and estimating uncertainty in FEH design flood estimation (FEH Local) SC130009	FSE for each Flow Estimation Point: Ely at Lanelay: N/A Ely-Clun Confluence: 1.379 Bridge: 1.308 D/s boundary: 1.275
Comment on the suitability of the results for future studies For example at nearby locations or for different purposes	The flow estimation points drain large sub-catchments of the River Ely and could feasibly be used in future studies; however, future analysts should note the point of interest in this study has been the proposed crossing of the River Ely south of Junction 34 of the M4.
Give any other comments on the study For example suggestions for additional work	None.

5.4. Checks

Are the results consistent, for example at confluences?	The flood peaks for the Bridge over the Ely are greater than the flood peaks derived for points further upstream (Ely at Lanelay and Ely-Clun Confluence) as expected. However, the flood peaks at the Bridge are less than the sum of the two points upstream. This could be due to attenuation of water in the floodplain or features which are not taken into account in hydrology calculations such as other structures which may interact with the watercourse (e.g. other bridge crossings).

	The flood peaks at the Downstream Boundary are very similar to, and slightly higher than, those at the Bridge (with the exception of the 2 year return period) which is as expected.
What do the results imply regarding the return periods of floods during the period of record?	Not considered as part of this study.
What is the 100-year growth factor? Is this realistic? (The guidance suggests a typical range of 2.1 - 4.0)	The 100 year growth factor for each Flow Estimation Point is shown below: Ely at Lanelay: 2.541 Ely-Clun Confluence: 2.625 Bridge: 2.108 D/s boundary: 2.308 These are all within the typical range.
If 1000-year flows have been derived, what is the range of ratios for the 1000-year flow over 100-year flow?	The Hybrid Method was used to derive flood peaks for return periods greater than 100 years. The ratios range from 1.740 – 1.786.
What is the range of specific runoffs (l/s/ha)? Are there any inconsistencies?	Ely at Lanelay:

		FEH Stat	ReFH2
l/s/ha	**Q2**	9.636	6.959
	Q100	24.489	15.941

Ely-Clun Confluence:

		FEH Stat	ReFH2
l/s/ha	**Q2**	8.636	6.032
	Q100	22.667	14.171

Bridge:

		FEH Stat	ReFH2
l/s/ha	**Q2**	5.966	4.042
	Q100	12.574	9.043

	D/s Boundary: **l/s/ha** **Q2** 4.487 3.031 **Q100** 10.357 6.709
How did the results compare with those of other studies? Explain any differences and conclude which results should be preferred	The Atkins 2010 study generated similar estimates in QMED, however the derived flood growth curves were less steep than those derived in this study, producing lower flows for equivalent return period event. For example, the 100-year flow in the Atkins 2010 study for the Ely at Lanelay is 69.9m^3/s and is 98.39m^3/s in this study. This is likely to be a result of a change in methods applied and use in this study of more recently available gauge data.
Are the results compatible with the longer-term flood history?	Yes, based on the available information. The design flows for Ely at Lanelay in this study sit well within the AMAX records for the Ely at Lanelay gauging station. The 100-year design flow is very similar to the highest flow recorded at the gauging station over the period of the 44 year record.
Describe any other checks on the results	None

5.5. Final results

Note a climate change allowance has been applied by uplifting the 100 year peak flows by 25%. For return periods up to and including 100 years, the flows from the Statistical method are recommended. For return periods greater than 100 years the hybrid method (using the ReFH2 growth factor) flows are recommended.

	Flood peak (m^3/s) for the following return periods (in years)									
Site code	**2**	**5**	**10**	**20**	**50**	**100**	**100 plus cc**	**200**	**500**	**1000**
Ely at Lanelay	37.49	49.63	58.50	68.09	82.56	95.26	119.080	109.40	136.38	166.50
Ely-Clun Confluence	24.96	32.97	39.03	45.74	56.14	65.51	81.88	76.56	97.23	117.01
Bridge	54.64	68.65	78.38	88.40	102.93	115.18	143.98	133.07	166.93	201.65
D/s Boundary	54.29	69.19	80.09	91.87	109.67	125.32	156.65	144.92	181.53	218.02

If flood hydrographs are needed for the next stage of the study, where are they provided? For example give a name of spreadsheet, name of hydraulic model, or reference to table below	M4_Ely_Inflow_Hydrographs.xlsx

6. Annex – supporting information

Please include details of your pooling group(s)

6.1. Pooling group composition

Site code: Ely at Lanelay

Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordancy
47014 (Walkham @ Horrabridge)	0.306	44	39.635	0.221	0.235	0.172
21017 (Ettrick Water @ Brockhoperig)	0.385	41	60.364	0.203	0.276	0.534
48001 (Fowey @ Trekeivesteps)	0.401	48	17.465	0.22	0.276	0.526
84020 (Glazert Water @ Milton of Campsie)	0.426	37	54.245	0.132	0.075	2.89
76811 (Dacre Beck @ Dacre Bridge)	0.44	17	34.73	0.205	0.241	0.681
72007 (Brock @ Upstream of a6)	0.455	39	28.011	0.202	0.214	0.42
73009 (Sprint @ Sprint Mill)	0.482	48	42.091	0.18	0.199	0.203
46007 (West Dart @ Dunnabridge)	0.483	36	70.117	0.177	0.162	0.279
47009 (Tiddy @ Tideford)	0.513	48	6.825	0.2	0.206	0.106
47021 (Kensey @ Launceston Newport)	0.516	15	13.75	0.265	0.111	3.182
21030 (Megget Water @ Henderland)	0.651	13	77.673	0.216	0.074	3.108
48004 (Warleggan @ Trengoffe)	0.664	48	9.983	0.258	0.257	1.063
54025 (Dulas @ Rhos-y-pentref)	0.682	48	23.24	0.179	0.211	0.268
25012 (Harwood Beck @ Harwood)	0.692	48	32.945	0.191	0.234	0.568

Site code: Ely-Clun Confluence

Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordancy
72007 (Brock @ Upstream of a6)	0.199	39	28.011	0.202	0.214	0.495
76811 (Dacre Beck @ Dacre Bridge)	0.248	17	34.73	0.205	0.241	0.628
72014 (Conder @ Galgate)	0.352	49	16.283	0.22	0.111	1.39
73015 (Keer @ High Keer Weir)	0.357	26	12.285	0.177	0.178	0.523
48004 (Warleggan @ Trengoffe)	0.426	48	9.983	0.258	0.257	0.773

49003 (de Lank @ de Lank)	0.525	51	14.324	0.225	0.206	0.377
47021 (Kensey @ Launceston Newport)	0.575	15	13.75	0.265	0.111	2.922
47009 (Tiddy @ Tideford)	0.617	48	6.825	0.2	0.206	0.172
25012 (Harwood Beck @ Harwood)	0.619	48	32.945	0.191	0.234	0.584
48009 (st Neot @ Craigshill Wood)	0.622	12	8.469	0.245	0.373	1.954
203046 (Rathmore Burn @ Rathmore Bridge)	0.634	35	10.72	0.147	0.144	1.826
27032 (Hebden Beck @ Hebden)	0.638	51	4.052	0.204	0.247	0.484
48001 (Fowey @ Trekeivesteps)	0.648	48	17.465	0.22	0.276	0.273
28041 (Hamps @ Waterhouses)	0.682	32	26.395	0.218	0.301	1.599

Site code: Bridge

Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordancy
78004 (Kinnel Water @ Redhall)	0.273	40	78.224	0.118	0.011	1.195
48003 (Fal @ Tregony)	0.351	54	11.047	0.164	0.269	0.878
47020 (Inny @ Bealsmill)	0.371	33	35.008	0.198	0.135	0.438
203028 (Agivey @ Whitehill)	0.422	45	64.866	0.143	0.208	1.383
46008 (Avon @ Loddiswell)	0.445	37	63.08	0.171	0.069	1.45
47024 (Tavy @ Tavistock Abbey Bridge)	0.469	23	81.8	0.206	0.139	0.647
73011 (Mint @ Mint Bridge)	0.508	48	54.835	0.215	0.303	1.001
46013 (Bovey @ Bovey Parke)	0.512	13	24.74	0.23	0.229	1.39
25006 (Greta @ Rutherford Bridge)	0.557	57	73.659	0.187	0.193	0.102
48012 (Fal @ Trenowth)	0.566	20	10.346	0.155	0.233	2.021
47005 (Ottery @ Werrington Park)	0.581	53	64.06	0.152	0.087	0.262
76014 (Eden @ Kirkby Stephen)	0.602	46	86.78	0.17	-0.026	1.856
16003 (Ruchill Water @ Cultybraggan)	0.629	45	148.085	0.145	0.058	0.377

Site code: D/s Boundary

Station	Distance	Years of data	QMED AM	L-CV	L-SKEW	Discordancy
73008 (Bela @ Beetham)	0.299	48	36.785	0.214	0.309	1.514
203028 (Agivey @ Whitehill)	0.362	45	64.866	0.143	0.208	1.188

72015 (Lune @ Lunes Bridge)	0.462	38	202.095	0.145	0.15	0.989
47005 (Ottery @ Werrington Park)	0.467	53	64.06	0.152	0.087	0.806
48003 (Fal @ Tregony)	0.523	54	11.047	0.164	0.269	1.607
47004 (Lynher @ Pillaton Mill)	0.533	56	44.135	0.218	0.284	1.067
47020 (Inny @ Bealsmill)	0.549	33	35.008	0.198	0.135	0.893
201007 (Burn Dennet @ Burndennet)	0.551	42	84.166	0.188	0.14	0.45
81003 (Luce @ Airyhemming)	0.555	40	164.224	0.166	0.091	0.704
63001 (Ystwyth @ Pont Llolwyn)	0.601	56	93.934	0.186	0.231	0.105
83003 (Ayr @ Catrine)	0.603	36	100.777	0.189	0.229	1.677

6.2. Additional supporting information

APPENDIX B

Natural Resources Wales | REVIEW OF DOCUMENT CONTAINING PROPOSED MODELLING APROACH AND REVISED HYDROLOGY IN RELATION TO LINEAR TRANSPORT SCHEME BETWEEN THE M4 JUNCTION 34 AND THE A48 AT THE SYCAMORE CROSS JUNCTION, VALE OF GLAMORGAN | 15th November 2019

Cyfoeth Naturiol Cymru
Natural Resources Wales

Ein cyf/Our ref: CAS-103532-B5N5
Eich cyf/Your ref: n/a

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FAO: Lisa Driscoll

15 November 2019

Annwyl Syr/Madam / Dear Sir/Madam

DISCRETIONARY PLANNING ADVICE SERVICE

REVIEW OF DOCUMENT CONTAINING PROPOSED MODELLING APROACH AND REVISED HYDROLOGY IN RELATION TO LINEAR TRANSPORT SCHEME BETWEEN THE M4 JUNCTION 34 AND THE A48 AT THE SYCAMORE CROSS JUNCTION, VALE OF GLAMORGAN

Thank you for your request for discretionary planning advice, we received your signed quotation on 28 October 2019. Our advice is outlined below.

The design flood flows for the 4 nodes as contained in the report 'M4 Junction 34 Model Review and Proposed Approach' dated 03/09/19, are all considered suitable for modelling.

We have added our comments to your report, which is attached. Generally, we accept the report and its recommendations although we have the following comments;

- The modeller must ensure that the model boundary extent does not cause glass walling. The NRW Flood Map may be used as an initial guide to help during model setup of the boundary.
- In Section 2.3.2 of the report it states that having nodes at 20-50m spacing would be more appropriate. This appears to suggest that there are insufficient cross sections and that additional survey is required?
- Section 2.3.3 states that using the latest LiDAR should address any previous data gaps. The latest LiDAR available in that area is from 2006 so it is likely that this was used in the 2012 model. Please note that Welsh Government are hoping to collect new LiDAR over the next two winters, once the LiDAR fly programme is available it may be worth considering waiting for this new detailed data to become available.

- Section 2.3.4 notes that there are updated values for land use type produced by NRW, however, currently no guidance document is published by NRW. We are happy to review your suggested Manning's values.
- In Section 3 it noted that four check survey sections were surveyed and concluded that re-surveying of the watercourses is not required. However, NRW's view is that surveying four sections is not sufficient, unless justification is provided.
  - As part of the NRW Ely Catchment model there is additional new survey available from 2017 for previously unsurveyed sections including check survey around Lanelay Gauging Station. Also available is defence crest levels in Pontyclun. We will supply this data under licence on request.
- Recent developments which have had landscaping and ground raising must be included if within the modelled extents of the FCA model such as:
  - Lanelay Housing Estate including new bund (303388, 182580)
  - Ynysddu development including raised/lowered ground (303435, 181819) – NRW recommend that LiDAR is used for the Ynysddu development as it gives a better representation
  - Y Pant Comprehensive School, Talbot Green (303956, 182160)
- When modelling structures, the modeller must consider whether a 2D deck will better represent flood routing than the use of a 1D spill.
- Section 4.5 notes that the 1981 event will be used for validation however, records estimate that the March 1998 event was greater than the 1981 event, although we are lacking valid flow data for these events. NRW recommends the use of more recent event data be more appropriate. Please note that there have been changes in the catchment upstream (new housing development upstream with landscaping and ground raising in 2008) which may affect calibration. Past flood events include;
  - December 2007
  - September 2008
  - January 2011
  - December 2012
  - December 2014
  - November 2015
  - November 2016
  - September 2019 (Data is available for this event, NRW have estimated to be a 10%-3.33% AEP year event)
- Section 4.6 details the model runs. A range of return periods must be run and agreed with NRW. As a minimum the 3.33% AEP, 1.0%AEP, 1.0%+cc AEP and 0.1%AEP events need to be run. Additional AEP's events may be required.

Disclaimer

The applicant acknowledges that the content of any advice or assistance provided by NRW is advisory only and that it shall not be deemed to bind or in any other way restrict NRW in performing its statutory functions.

In particular the recipient acknowledges that:

- any advice given or materials or documentation provided by NRW do not constrain or bind NRW in respect of its statutory functions or its role as a statutory consultee or any decision NRW may make in relation to any application for a licence or permit;

- any advice given by NRW does not bind NRW in respect of any future representations it may make as statutory consultee or any decision NRW may make in relation to any application for a licence or permit;
- any views or opinions expressed by NRW are without prejudice to the consideration NRW may be required to give to any application or any future representations as statutory consultee or any decision NRW may make in relation to any application for a licence or permit;
- the final decision as to any representations made by NRW as statutory consultee will be based on all the relevant information available to NRW at the time it makes such representations;
- NRW cannot and does not give any guarantee as to the representations it may make as statutory consultee; and,
- any advice given by NRW may be overtaken by changes in available information, law, policy and guidance relevant to the subject matter of the advice.

If you have any further queries, please do not hesitate to contact us.

Yn gywir / Yours faithfully

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APPENDIX N

Improving Strategic Transport Encompassing Corridors from M4 Junction 34 to the A48 | Highway Link Study | River Ely Hydraulic Modelling | 10028657-ARC-XX-XX-RP-CW-00XX-02 | March 2020

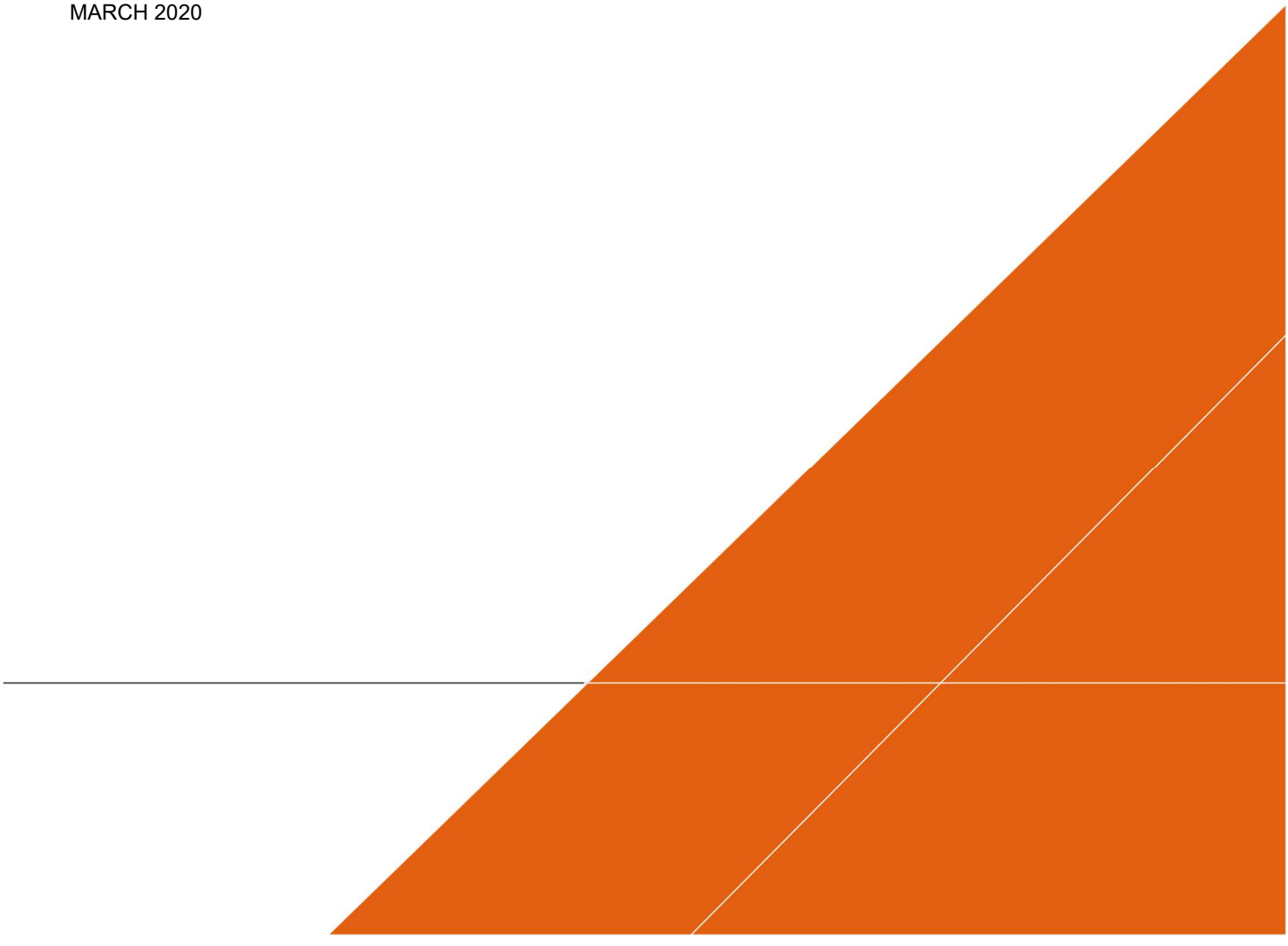
ARCADIS Design & Consultancy for natural and built assets

IMPROVING STRATEGIC TRANSPORT ENCOMPASSING CORRIDORS FROM M4 JUNCTION 34 TO THE A48 | HIGHWAY LINK STUDY

WelTAG Stage Two Plus

River Ely Hydraulic Modelling

MARCH 2020



Improving Strategic Transport Encompassing Corridors from M4 Junction 34 to the A48 | Highway Link Study

River Ely Hydraulic Modelling

Author	MG
Checker	CB
Approver	JT
Report No	10028657-ARC-XX-XX-RP-CW-00XX-02
Date	MARCH 2020

VERSION CONTROL

Version	Date	Author	Changes
P01	03/03/2020	MG	Final draft technical note for review
P02	16/03/2020	MG	Updated following project review

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APPENDIX H

Comparison of modelled 3.33% AEP event outline with observed 1981 flood extents

APPENDIX I

Comparison of baseline and option flood levels for 1% AEP +CC event

1 Introduction

1.1 Background

1.1.1 Arcadis Consulting (UK) Ltd ("Arcadis") was commissioned by the Vale of Glamorgan Council ('the Client') to progress a Welsh Transport Analysis Guidance (WelTAG) Stage Two Plus study for a proposed new link road between the M4 Junction 34 and the A48 at Sycamore Cross, as well to consider proposals for a new Vale of Glamorgan Gateway Station situated on the South Wales Main Line at M4 Junction 34.

1.1.2 This flood modelling exercise focusses on the proposed highway routes that cross the River Ely and intersect its floodplain (Flood Zones B and C2) at two locations and these are therefore the areas of interest for this study as shown in Appendix A, together with the paths of two highway options for the Scheme. There is an existing model for the River Ely, which was reviewed as part of this project[1]; the review of the existing model found that it was not of sufficient quality to inform the Scheme design. Arcadis were therefore commissioned by the Client to develop a model capable of informing baseline flood risk in the area of interest and testing proposed Scheme designs.

1.1.3 This technical note addresses the queries made by Natural Resources Wales (NRW) (following the submission of the Model Review and Proposed Approach technical note by Arcadis, 2019[1]), the model build and Scheme testing, where the objectives were to:

- Review the additional survey and historical data supplied by NRW.
- Update the existing model with the recommendations from the model review.
- Run the model for baseline conditions (for the 3.33%, 1%, 1% +CC and 0.1% AEP events) and validate the results against the observed 1981 flood extents.
- Assess the impact on flood risk of two proposed Scheme alignments.

[1] 10028657-ARC-XX-XX-RP-CW-00XX-01 | River Ely Model Review and Proposed Approach (2019)

2 Data Review

2.1.1 All data which has been made available for this project has been assessed to determine if it is acceptable for use in this project. This is summarised in Table 1 below.

Table 1 Check Data review

Description	Data Type	Source/Author	Dates	Data Quality
River Ely and Tributaries Model Update and Hazard Mapping, 2010	Hydraulic Model and Report	NRW / Atkins	2010	Poor – See model review[1]
Ely Section 105 survey - 1996	Cross sections survey	NRW	1996	Poor – No cross-section plan or photos are available
Clun Section 105 survey - 1998	Cross section survey	NRW	1998	Acceptable – No photos are available
Nant Muchudd and Pontyclun Survey - 2008	Cross section survey	NRW	2008	Acceptable – No photos are available
2017 survey	Cross section survey and topo survey	NRW/ Infomap Surveys	2017	Acceptable
River Ely Check Survey	Cross section survey	Maltby Land Surveys Ltd	2019	Acceptable
LiDAR	DTM	Lle Geo-Portal	2019	Acceptable – 2m resolution coverage of entire model domain, flown in 2006*
Flood Defence data	GIS	Lle Geo-Portal	2019	Acceptable
Mastermap	GIS	Vale of Glamorgan Council	2019	Acceptable – No coverage for Pontyclun, Mastermap data from existing model has been reviewed and covers area in sufficient detail

Description	Data Type	Source/Author	Dates	Data Quality
Historical data	Photographs, Wrack Marks, Anecdotal Evidence	NRW	1981 - 2019	Acceptable – Data does not cover area of interest except for 1981 event. 1981 flood extents downloaded from Lle Geo-Portal

**NRW have stated that new LiDAR will be flown for the catchment over the winters of 2019 and 2020. However, this is beyond the proposed deadlines for this project and it is not thought that the floodplain geometry will have changed significantly in the areas of interest since 2006. Therefore, it has been decided not to wait for new LiDAR to be flown.*

2.2 Survey

2.2.1 A number of survey sources have been provided by NRW to be used to define the River Ely and the floodplain. These survey sources are detailed above and are discussed in the previous technical note (10028657-ARC-XX-XX-RP-CW-00XX-01 | River Ely Model Review and Proposed Approach (2019). Following the submission of the previous technical note, NRW provided new survey data, which included cross sections and topographic survey covering Pontyclun carried out in 2017. The 2017 survey cross sections have been compared against the model cross sections, where they overlap. There is a good match between the 2017 survey sections and model cross sections, therefore no modifications have been made to the model.

2.2.2 The 2017 topographic survey was carried out in two locations, Ynysddu development in Pontyclun and Y Pant School. NRW advised that the LiDAR data for the Ynysddu development in Pontyclun was more accurate than the topographic survey, therefore it was not necessary to use the topographic survey in this area. A comparison of the topographic survey and LiDAR for Y Pant School showed some differences in the area of the sports fields, with the raising and lowering of the land appearing to balance the volume of floodplain being changed. It was concluded that these differences would have no impact on flows and water levels in the area of interest; consequently, this survey data was not added to the model.

2.2.3 Due to the age of the existing data, check survey was commissioned to determine whether the existing surveyed sections were still representative of the River Ely channel. This check survey concentrated on the areas of interest, as detailed in Appendix A. One section was surveyed in Pontyclun, as a reference for this area, and three sections were surveyed at locations through the area of interest. This gave sufficient coverage in the area of interest to determine if the existing survey sections were still representative of the channel. The check survey concluded that it was a good match with the existing survey and therefore there was no requirement to commission any new survey.

2.3 Historical Information

2.3.1 Historical flood information for nine events were provided by NRW for use in verification. These included gauged data and anecdotal evidence for the following flood events:

- December 2007
- September 2008
- January 2011
- December 2012
- December 2014

- November 2015
- November 2016
- September 2019

2.3.2 Historical flood extents were also available for the March 1981 event.

2.3.3 Upon reviewing the gauged data for the events, it was found that none of them exceeded the peak flow for a design 10% AEP event which is below the smallest event (3.33% AEP) modelled for this study. The anecdotal evidence was also reviewed, and no significant flooding was recorded in the areas of interest. The historic flooding recorded in Pontyclun was not significantly out of bank and could not be used to verify any of the flood extents modelled as part of this study.

2.3.4 The only historical event which demonstrated significant out of bank flooding in the areas of interest, was the March 1981 event. Therefore, only the March 1981 event can be used for verification purposes in this study. Further discussion on model validation is given in Section 4.3.

3 Baseline Modelling

3.1 Existing 1D Model Updates

3.1.1 The two existing 1D models have been combined and updated in line with the model review produced during the first phase of this study. The 1D model has been constructed and run in Flood Modeller Pro (FMP) (version 4.5). The following updates were made:

- The upper and lower models were combined into a single combined model.
- The combined model was trimmed, resulting in the following 1D extents (Appendix B):
  - River Ely Upstream: downstream of the disused railway in Pontyclun (FMP node ELY08520, NGR 303440, 182210).
  - River Ely Downstream: section of open channel (ELY23140, NGR 309140, 176670), downstream of the area interest.
  - River Clun Upstream: downstream of the A4119 bridge (CLUN_FP03203, NGR 304840, 182350).
- The 1D floodplain units have been removed and any cross sections which had been extended to include floodplain were trimmed to the bank locations.
- The 1D sections were reviewed and panel markers were added as required at changes in roughness values and sharp changes in geometry. This ensures that the conveyance curves are smooth, and that conveyance increases with increasing water level.
- Cross section chainages and elevations were corrected in over 30 sections where they had been altered from the survey without justification.
- Superfluous copied channel sections have been removed from around structures; in order to maintain the correct channel lengths, the ‘distance to next’ values in the original surveyed cross sections have been updated.
- Interpolates have been added to the model to reduce the distance between cross sections and thus improve the transition of water level information between the 1D and 2D model domains.
- All the structures have been reviewed and the elevations in some of the structures have been corrected.
- There are two footbridges (NGR 303200, 180800 and NGR 303630, 180970) in the Pontyclun area which were not surveyed or modelled previously and have been examined using aerial mapping and have been judged as being too small to have a significant impact on flood flows through the area. Therefore, they have not been surveyed or modelled in this study.
- The weir (ELY21967W) downstream of a footbridge in Peterston-super-Ely has been corrected, representing channel flows in the 1D and floodplain flows in the 2D.
- Structure coefficients have been returned to their default values.
- The definition of overtopping pathways for all structures has been reviewed against survey information. Where modelling of overtopping in 1D is appropriate, FMP spill units have been corrected. Where modelling over overtopping in 2D is appropriate, FMP spill units have been removed and the necessary 2D model files created.
- The M4 crossing has been added to the model using an irregular culvert unit with dimensions taken from survey data.
- The channel sections have been correctly georeferenced and a GXY file created by measuring the distance from the modelled structures. It should be noted that the georeferencing of the model cross sections was based on the best available data and that discrepancies may be encountered as a result.

- Manning's roughness coefficients for channel cross sections were updated using information from the survey and aerial mapping. 'Urban' channel sections, upstream of (and including) ELY09360D were given an in-channel roughness of 0.035. 'Rural' channel sections, downstream of ELY09360D were given an in-channel roughness of 0.040. Any out of channel areas included in the 1D domain were given a roughness coefficient of 0.050, reflecting the vegetated nature of the banks.
- During the model testing phase, it was found that there were two locations where the model was becoming unstable because the width of floodplain modelled in 2D was too narrow; this results in an oscillation of water between the 1D and the 2D. To resolve this, the 1D cross sections were extended using the LiDAR data such that the floodplain is modelled entirely in 1D and the oscillation removed. The sections which have been extended are located on the left bank of the Clun and on the right bank of the Ely just upstream of the M4, from node ELY13970 to ELY14270.
- The Preissman slot option has been deactivated.
- The dflood value has been reset to default (3m) for all events except the 0.1% AEP event, because the water level over the 1D-2D links exceeds 3m at some locations.

3.2 2D Modelling

3.2.1 A new 2D domain has been constructed for the model to encompass the floodplain within and around the areas of interest. The 2D domain has been modelled using TUFLOW (version 2018-03-AE). The extents of the 2D domain are shown in Appendix B. Details of the 2D domain and model build are described below.

- A 4m grid cell size has been used based on the 2m LiDAR flown in 2006 (Table 1).
- OS MasterMap data has been used to define the spatial discretization of the roughness values. MasterMap data supplied by the Client has been used to define the area south of the M4. MasterMap data from the existing 2D model has been used to define the area north of the M4, this data has been assessed against aerial photography of the area and has been found to be representative of the current situation. Table 2 details the roughness values used in the 2D domain.
- ZP points have been used to improve the definition of bank levels along the entire length of the linked 1D 2D model. Elevations have been taken from surveyed bank heights, supplemented with LiDAR where appropriate.
- The flood defences (earth embankment and flood wall) on the right bank of the River Ely in Pontyclun have been added to the model as zshps. Elevations were based on data supplied by NRW (Table 1).
- For the structures where modelling of overtopping is most appropriate in 2D, bridge decks which had been filtered out of the LiDAR have been reinstated using TUFLOW layers.

Table 2 2D Manning's 'n' roughness values

MasterMap Feature Code	Manning's 'n' Value	Description
10021	0.300	Building
10053	0.030	General Surface
10054	0.020	General Surface
10056	0.040	General Surface
10062	0.300	Glasshouse

MasterMap Feature Code	Manning's 'n' Value	Description
10089	0.035	Inland Water
10093	0.040	Landform
10096	0.040	Landform
10099	0.040	Landform
10111	0.100	Natural Environment
10119	0.020	Path
10123	0.020	Path
10167	0.040	Rail
10172	0.020	Road or Track
10183	0.025	Roadside
10185	0.030	Structure
10187	0.030	Structure
10193	0.030	Structure
10217	0.040	Unclassified (devel.)
10203	0.035	Tidal & Foreshore
10210	0.035	Tidal & Foreshore

- Modifications have been made at two locations to smooth the DTM and stabilise the model. Modifications have been made:
  - North of the railway through Pontyclun (NGR 303840, 181280)
  - At Cowbridge Road in Pontyclun (NGR 303160, 181020)
- Two roughness patches with a Manning's n values of 0.1 have been added to the model to improve stability of the mode, these are located:
  - Where water running along the railway line in Pontyclun re-joins the Ely (NGR 303930, 181220). The complex flow regime in this area resulted in oscillations in water levels and instabilities.
  - At the location of several tight meanders (NGR 307200, 176500) towards the downstream end of the model. This meander system resulted in rapid oscillation of flow between the 1D and 2D which caused instabilities in this area.
- The code boundary has been located to ensure that there is no glass walling and ensure both proposed Schemes can be included in the model.

3.3 Upstream and Downstream Boundaries

3.3.1 Two upstream boundaries exist in the model at the upstream ends of the Ely and Clun channels. These boundaries have been generated based on the FEH calculation record created as part of this

project and approved by NRW. Inflows have been generated for the 3.33%, 1%, 1% + Climate Change (CC) and 0.1% Annual Exceedance Probability (AEP) events.

3.3.2 At the downstream extent of the model, the 1D model extends approximately 1.5km downstream of the linked 1D-2D model extent. This approach was taken for stability purposes as the floodplain narrows. It was important that the downstream boundary unit was located sufficiently far downstream of the Gwern-Y-Steeple road bridge (NGR 307960, 176030) such that any backwater impacts from the boundary did not alter the tailwater conditions at the bridge.

3.3.3 The 1D downstream boundary unit is a normal depth boundary based on the slope of the channel as defined by the survey cross sections.

4 Baseline Results and Verification

4.1 Baseline results

4.1.1 The baseline model has been successfully run for the 3.33%, 1%, 1% +CC and 0.1% AEP events. The results in the areas of interest were broadly in line with the previous modelling work albeit with some refinements due to modelling approach. The key exception to this is the inclusion of a new flow path where the proposed Scheme (NGR 305610, 178850) crosses the floodplain, this is shown in Appendix C. This flow pathway is not observed in the 3.33% AEP but is observed in events with a magnitude equal to or greater than the 1% AEP. This flow path was most likely not identified during the previous modelling study due to the more simplistic methodology used to project the 1D modelled water levels across the floodplain.

4.1.2 In this area there are two watercourses which pass under the unnamed road, which is to be replaced/ upgraded as part of the Scheme. The details of the structures potentially providing flow routes under the road were not available for this study, therefore there may be additional flow capacity under the road which has not been included in the model. Details of any structures which pass under the road will need to be obtained for the detailed design phase.

4.2 Sensitivity testing

4.2.1 Sensitivity tests were undertaken to assess the model performance and confirm that assumptions made during the model build were appropriate. Sensitivity testing was undertaken for the following variables:

- Material roughness in the 1D and 2D domains ±20%
- Downstream boundary ±20%

Material roughness

4.2.2 The model sensitivity to roughness was tested by varying the Manning's 'n' values used by ±20%. Increasing the roughness values showed a median 140mm increase in flood levels in the channel, with a maximum increase of 400mm at node ELY13200, downstream of Hensol Road bridge.

4.2.3 In the area of interest where the proposed road replacement/ upgrade crosses the floodplain there is a 0.05m to 0.01m increase in flood levels, as shown in Appendix D.

4.2.4 Decreasing the roughness values results in a median decrease in channel water levels of 150mm, with a maximum decrease in channel water levels of 530mm at node ELY13200, downstream of Hensol Road bridge.

4.2.5 In the area of interest where the Scheme crosses the floodplain there is a reduction in flood levels of more than 0.5m, as shown in Appendix E.

4.2.6 The results of the Manning's 'n' sensitivity test show that the floodplain in the area of interest is relatively insensitive to increases in roughness, resulting in increases in peak flood levels of up to 0.1m for a 20% increase in Manning's 'n' values. However, the floodplain in this area is very sensitive to decrease in roughness; with the new flow path no longer flooding in a 1% AEP event.

4.2.7 Given the results of the sensitivity test it shows that the Manning's 'n' values used are likely to result in a conservative estimate as lowering them has a much greater impact than raising them. This adds confidence that any levels designed from the model will be robust.

Downstream Boundary

4.2.8 The sensitivity of the model to the downstream boundary has been tested by increasing and decreasing the slope of the downstream boundary by 20%. For both scenarios this results in a change at the downstream boundary of approximately 200mm which reduces to insignificant values approximately 3.75km upstream of the downstream boundary at node ELY19290, just upstream of the tight meander system (NGR 307200, 176500) on the Ely. Appendix F and Appendix G show the extents of the changes in water level in the floodplain.

4.2.9 The sensitivity test demonstrates that while the model is sensitive to the values chosen for the slope of the downstream boundary, the downstream boundary is located far enough away from the areas of interest that it will not affect the model results in these areas.

4.3 Model Validation

4.3.1 As discussed in Section 2.3, data for nine historical events were supplied by NRW to support the verification of the model. Both within and away from the areas of interest, only the 1981 historical flood event provides sufficient data for use in validating the modelled flood extents. A comparison of the modelled 3.33% AEP event and the observed March 1981 flood extents is shown in Appendix H. The 3.33% AEP event was chosen for comparison as, after reviewing all the modelled flood extents, this was the event for which modelled flood extents which matched the observed flood extents most closely. As the magnitude of the March 1981 event is unknown, the historical flood outline has been used to sense check flood extents and mechanisms rather than to verify or calibrate absolute levels and depths.

4.3.2 Appendix H shows that the modelled flood extents for the 3.33% AEP match reasonably well with the observed 1981 flood extents. The differences between the two flood extents are most likely to be due to the inaccuracies inherent in the mapping methodologies for the observed event (resulting in a somewhat geometric outline).

4.4 Model Health

4.4.1 The model is considered to be healthy and appropriate for use based on a review of the model outputs discussed below. A focus has been made on the health of the model in the area of interest.

Times.DAT

4.4.2 The TUFLOW Times.dat output from records the time at which each cell reaches its peak water level. If this occurs at the last timestep, the locations should be reviewed, and the model run for longer. The Ely model was run for 30 hours and the times.dat output shows that all the cells recorded a time of peak water level of less than 30 hours, therefore the model was run for the correct length of time.

Flow Progression

4.4.3 PO lines have been added throughout the model to monitor the changes in flows through the floodplain, they are combined with their associated 1D model node to give the total flow at any point in the model. The PO Lines have been checked and confirm that the flow progression through the model is realistic and commensurate with any storage on the floodplain.

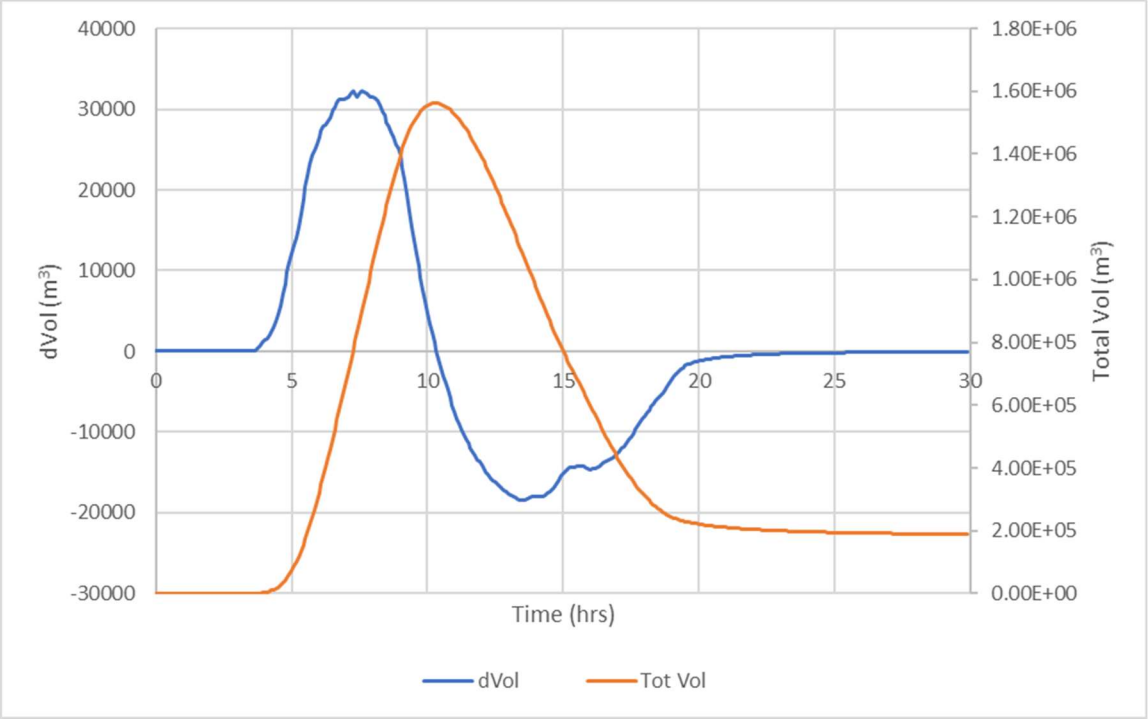
1D-2D Flows

4.4.4 Information on the transfer of flows between 1D FMP and 2D TUFLOW domains has been extracted for each FMP node in order to assess the stability of the 1D 2D links. Generally, the transfer of flow between the 1D and 2D domains is stable with only minor fluctuations. In areas where water is ponding on the 1D-2D links, some oscillation in flow transfer between the domains is observed. These areas have been checked and no instabilities in modelled peak water levels were found. In the areas of interest, transfer of flows between the 1D and 2D domains is stable.

dVol and Vol Err

4.4.5 The changes in volume entering and exiting the 2D domain and total volume in the 2D domain have been checked to assess the volume of water in the 2D domain and ensure that there are no unrealistic gains or losses. Image 1 shows the change in volume (dVol) and total volume (Tot Vol) in the model. There are no significant fluctuations in the data sets, indicating that the model is stable throughout the model run.

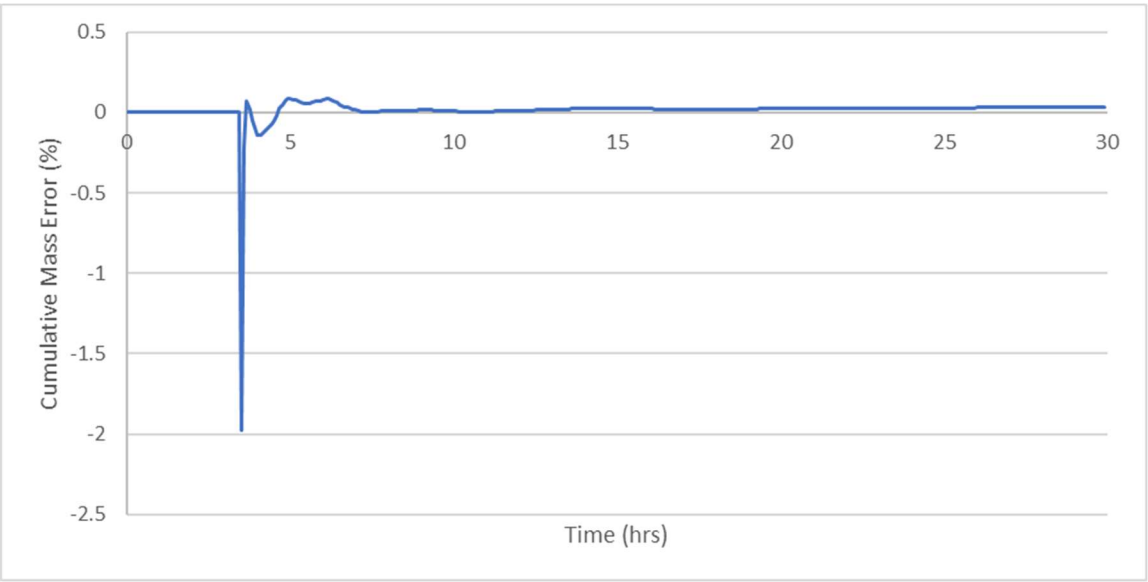
Image 1 dvol and Total Volume for the 1% AEP Event



Cumulative Mass Error

4.4.6 The TUFLOW manual indicates that a TUFLOW hydraulic model is classified as healthy if the Cumulative Mass Error (CME) is between -1% and 1%. Image 2 confirms that this is the case for the majority of the model simulation. The one exception is a sudden drop at around four hours which occurs as water first starts spilling onto the 2D domain. This is a common occurrence in models where a large number of cells become wet very quickly and is acceptable as the CME rapidly settles to within required tolerances as the volume of water on the floodplain increases.

Image 2 Cumulative Mass Error for 1% AEP Event



Checks and Warnings

4.4.7 Four checks and warnings in the TUFLOW messages layer have been reviewed and accepted; these are detailed in Table 3.

Table 3 Checks and Warnings in TUFLOW Domain

Check/ Warning	Comment
CHECK 2077 - Beginning of 3D HX breakline is dangling. CHECK 2078 - End of 3D HX breakline is dangling.	This occurs where HX lines have been extended to ensure that there are no breaks in the 1D-2D links. All checks have been reviewed and are acceptable
CHECK 2231 - No ZP points snapped to HX line. HX line not used to modify Zpts.	At these links elevations from the DTM are used; this is as intended.
WARNING 2117 - Inactive 2D cell made active by 2D SX link.	This occurs at the SX link at the downstream end of the extended sections on the Clun and is as intended.
CHECK 2099 - Ignored repeat application of boundary to 2D cell.	This occurs where HX links for overtopping structures cross the same cell centres as links for the banks, this is acceptable

5 Proposed Scheme Design

5.1.1 Two proposed alignments have been produced for the Scheme, the East and West alignments. The design of the East alignment was input to the model and run for all the events. Only the East alignment was modelled as both the East and West alignments follow the same route in the northern area of interest, and only the East alignment has the potential to impact on the southern area of interest, refer to Appendix A. Outside of the northern area of interest, the West option does not cross the Ely floodplain therefore there is no merit in modelling this separately.

5.1.2 Appendix I shows the change in peak flood level, for the 1% AEP +CC event; only the northern area of interest where both alignments follow the same route is shown. This illustrates how the Scheme causes flood water to pond behind it, increasing water levels in this location by up to 450mm for the 1% AEP +CC event.

5.1.3 For the 1% AEP, peak water levels are increased by up to 550mm and for the 0.1% AEP event, by up to 400mm. The peak flow at the proposed location of the Scheme does not change significantly from the baseline.

5.1.4 The impacts of this predicted increase in flood risk should be reviewed in detail, and options and requirements for mitigation discussed with NRW and the Client in order to inform a Flood Consequence Analysis (FCA) to be undertaken at the detailed design phase. The mitigation options may include flood relief culverts under the proposed road. In addition, the results are likely to be impacted by the inclusion of the two structures which exist under the existing unnamed road (located to east of the proposed road), in the baseline model. Modelling of these structures could potentially change the magnitude of the impact that the Scheme has on water levels in the area.

5.1.5 In the southern area of interest, the East alignment just touches the edge of the floodplain for all modelled events therefore the impact on floodplain storage is negligible. Consequently, there is no impact on flood levels and flows for any event. Due to there being no significant impact in the southern area of interest there is no obvious preference for either alignment from a flood risk perspective.

6 Conclusion and Recommendations

6.1 Conclusions

6.1.1 This model has been created for the purpose of assessing the effects of the proposed alignments of the Scheme and should not be used for any other purposes.

6.1.2 A data review has been undertaken examining the additional survey and historical data supplied by NRW. This has concluded that it is not necessary to use the 2017 survey of Pontyclun as the levels in the cross sections conform to the existing levels in the model. Historical data was also reviewed to determine events to verify the model with. The March 1981 event was the only event which could be used to verify the model for the events modelled and the area of interest.

6.1.3 The River Ely model has been updated in accordance with the recommendations from the model review[1] and has been used to assess the potential impacts of the Scheme on flood risk in the areas of interest. The updated modelling identified a flow route over the route of the Scheme (NGR 305610, 178850) which was not identified by the previous modelling study. The modelled 3.33% AEP event has been verified against the March 1981 flood event, the modelled flood extents match the general shape of the event well, however there are discrepancies which are thought to be due to the mapping methodology used for the March 1981 event.

6.1.4 Although two Scheme alignments are under consideration, only the East option has been modelled due to the similarity of the alignments as they cross the Ely floodplain. Increases in peak flood levels are observed in the northern area of interest, but there are negligible impacts in the southern area of interest.

6.1.5 The results of the modelling carried out to date conclude that there is no preference for either alignment from a flood risk perspective.

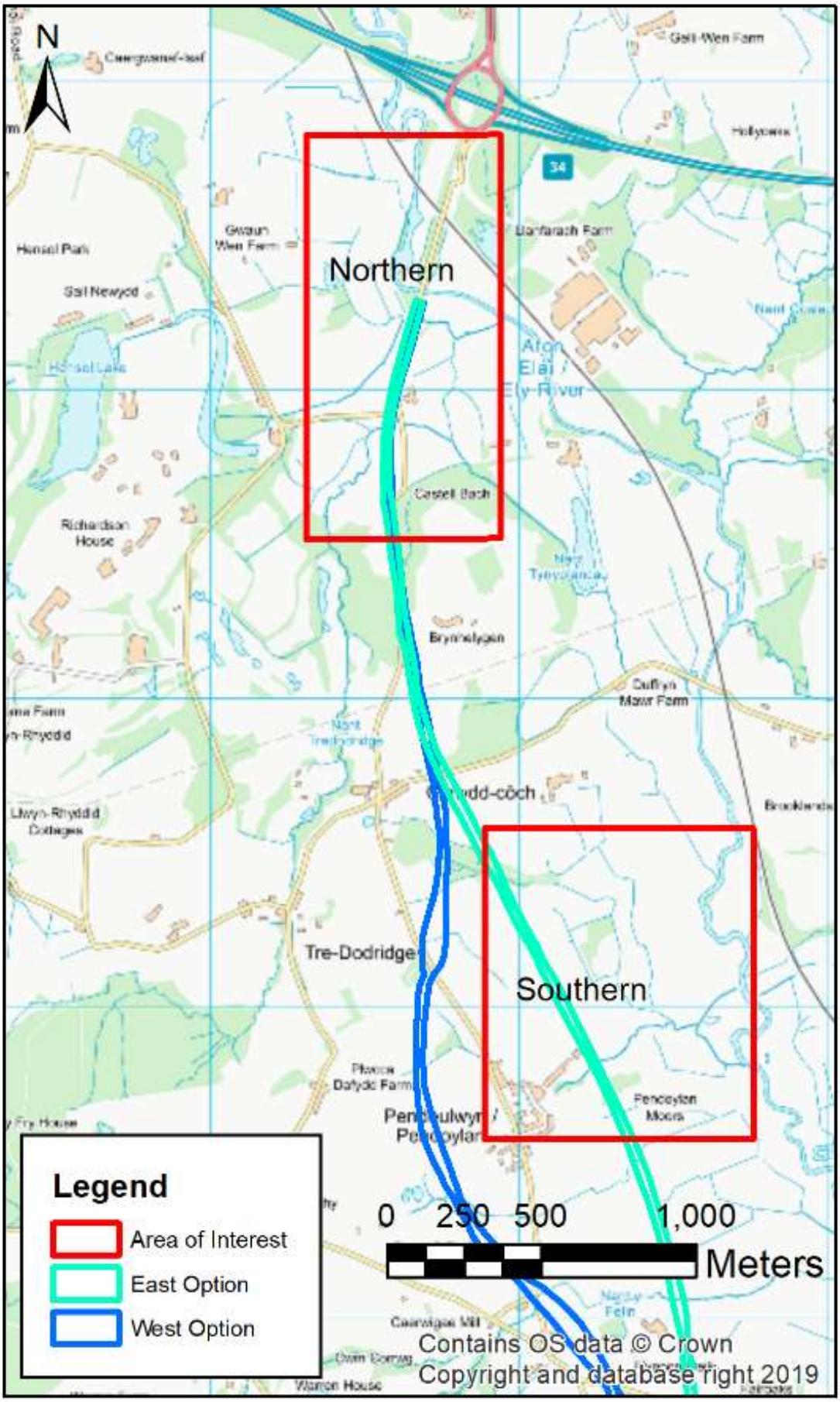
6.2 Recommendations

6.2.1 The following recommendations have been made for future work and use of the model.

- As part of the detailed design stage, additional survey should be collected on the two openings under the existing road to assess their impacts on flood extents.
- At the detailed design phase mitigation measures should be considered in order to maintain the existing flood levels and extents where the Scheme crosses the flood flow route.

APPENDIX A

Areas of Interest


N
Northern
Southern
Legend
Area of Interest
East Option
West Option
0 250 500 1,000
Meters
Contains OS data © Crown
Copyright and database right 2019

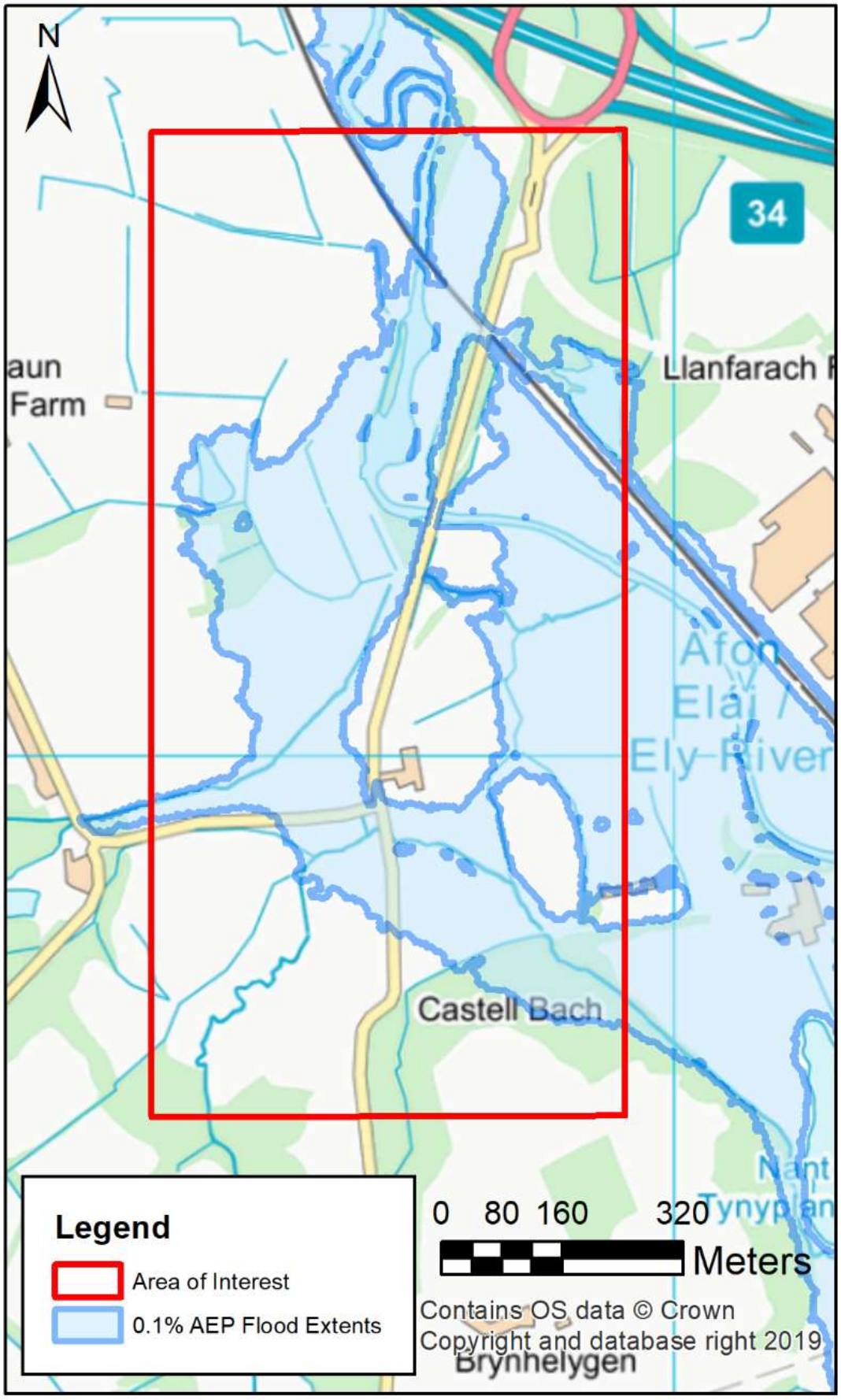
APPENDIX B

Model Extents


N
LLANTRISANT
TALBOT GREEN
Y Pant comprehensive
Ynysddu
Pontyclun
Legend
1D Nodes
2D Extents
0 0.3 0.6 1.2 1.8 2.4
Kilometers
Contains OS data © Crown Copyright and database right 2019

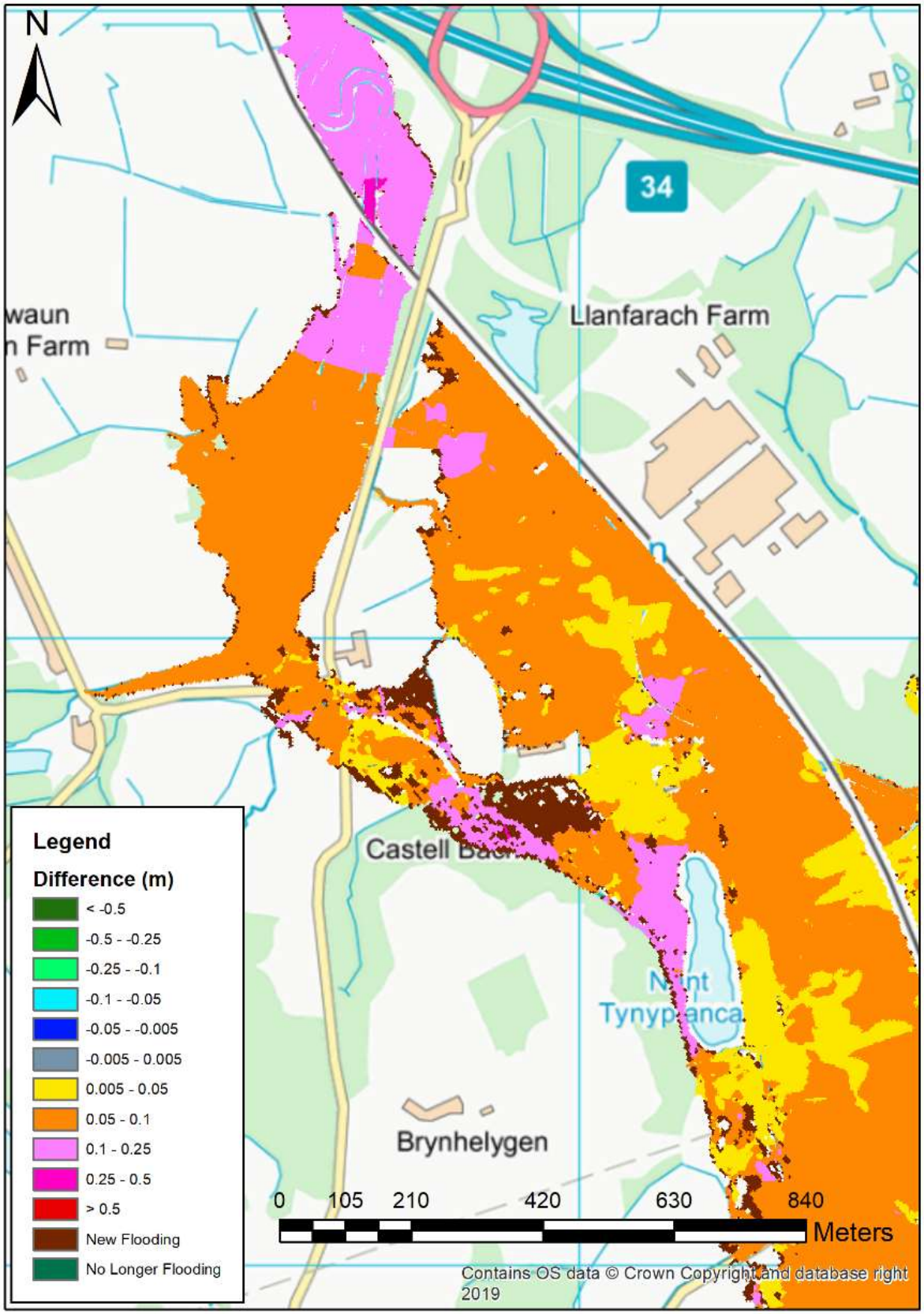
APPENDIX C

Location of New Flowpath


N
34
aun
Farm
Llanfarach
Afon
Elái /
Ely River
Castell Bach
Nant
Tynyplan
Brynhelygen
Legend
Area of Interest
0.1% AEP Flood Extents
0 80 160 320
Meters
Contains OS data © Crown
Copyright and database right 2019

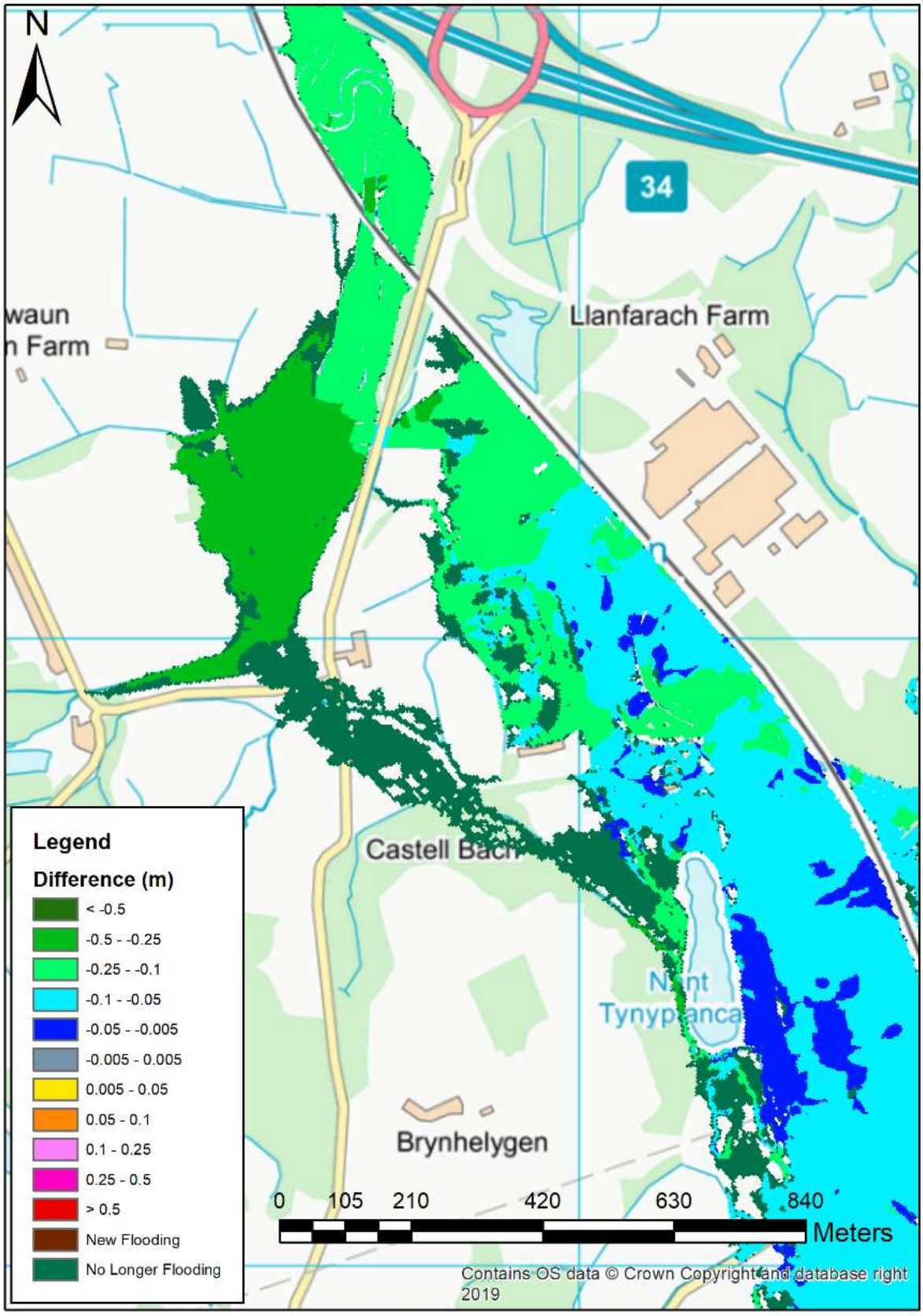
APPENDIX D

Change in flood levels for Mn+20% sensitivity test, 0.1% AEP event


N
34
Llanfarach Farm
Brynhelygen
Legend
Difference (m)
< -0.5
-0.5 - -0.25
-0.25 - -0.1
-0.1 - -0.05
-0.05 - -0.005
-0.005 - 0.005
0.005 - 0.05
0.05 - 0.1
0.1 - 0.25
0.25 - 0.5
> 0.5
New Flooding
No Longer Flooding
0 105 210 420 630 840
Meters
Contains OS data © Crown Copyright and database right 2019

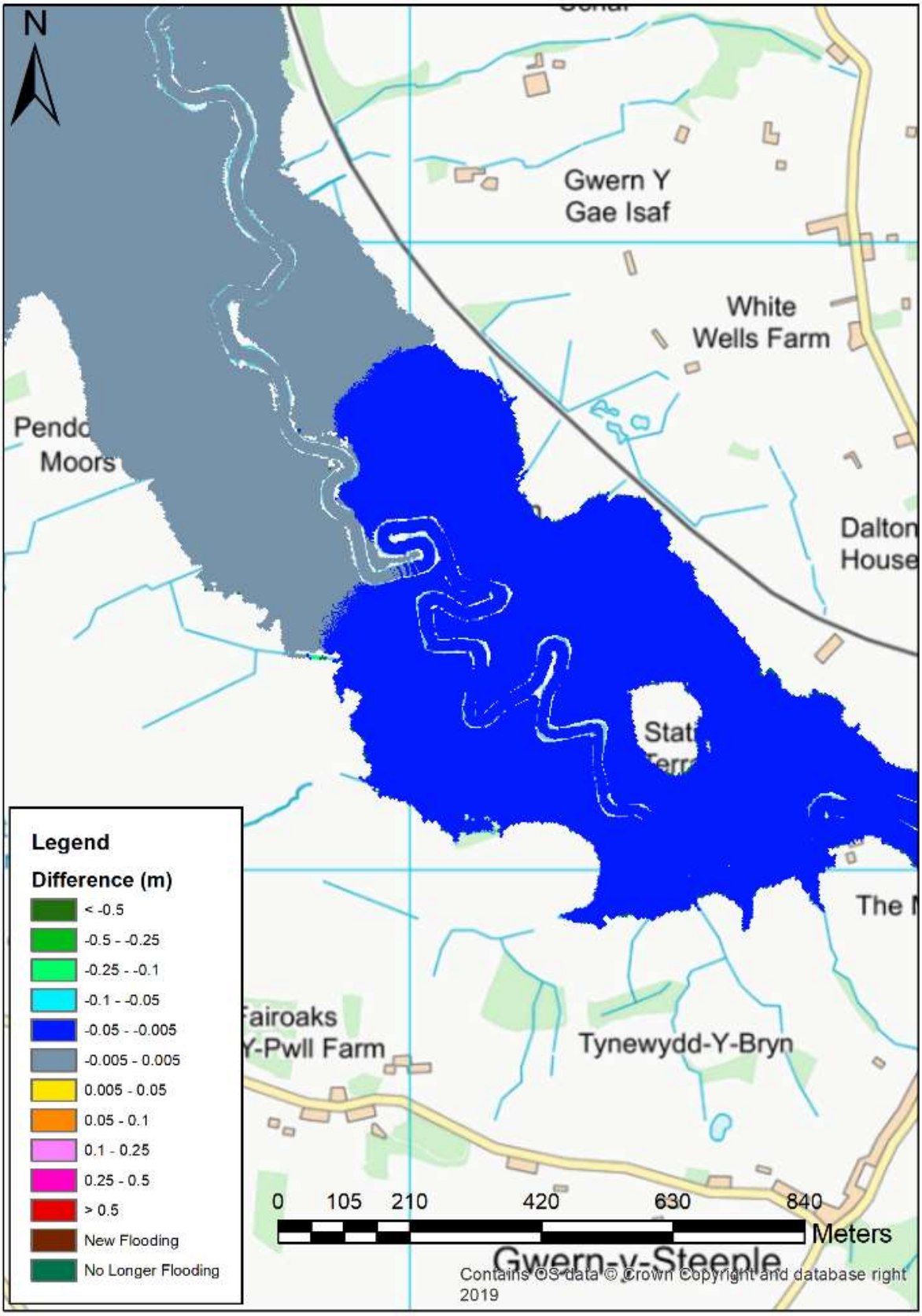
APPENDIX E

Change in flood levels for Mn-20% sensitivity test, 0.1% AEP event


N
34
Llanfarach Farm
Castell Bach
Brynhelygen
Legend
Difference (m)
< -0.5
-0.5 - -0.25
-0.25 - -0.1
-0.1 - -0.05
-0.05 - -0.005
-0.005 - 0.005
0.005 - 0.05
0.05 - 0.1
0.1 - 0.25
0.25 - 0.5
> 0.5
New Flooding
No Longer Flooding
0 105 210 420 630 840
Meters
Contains OS data © Crown Copyright and database right 2019

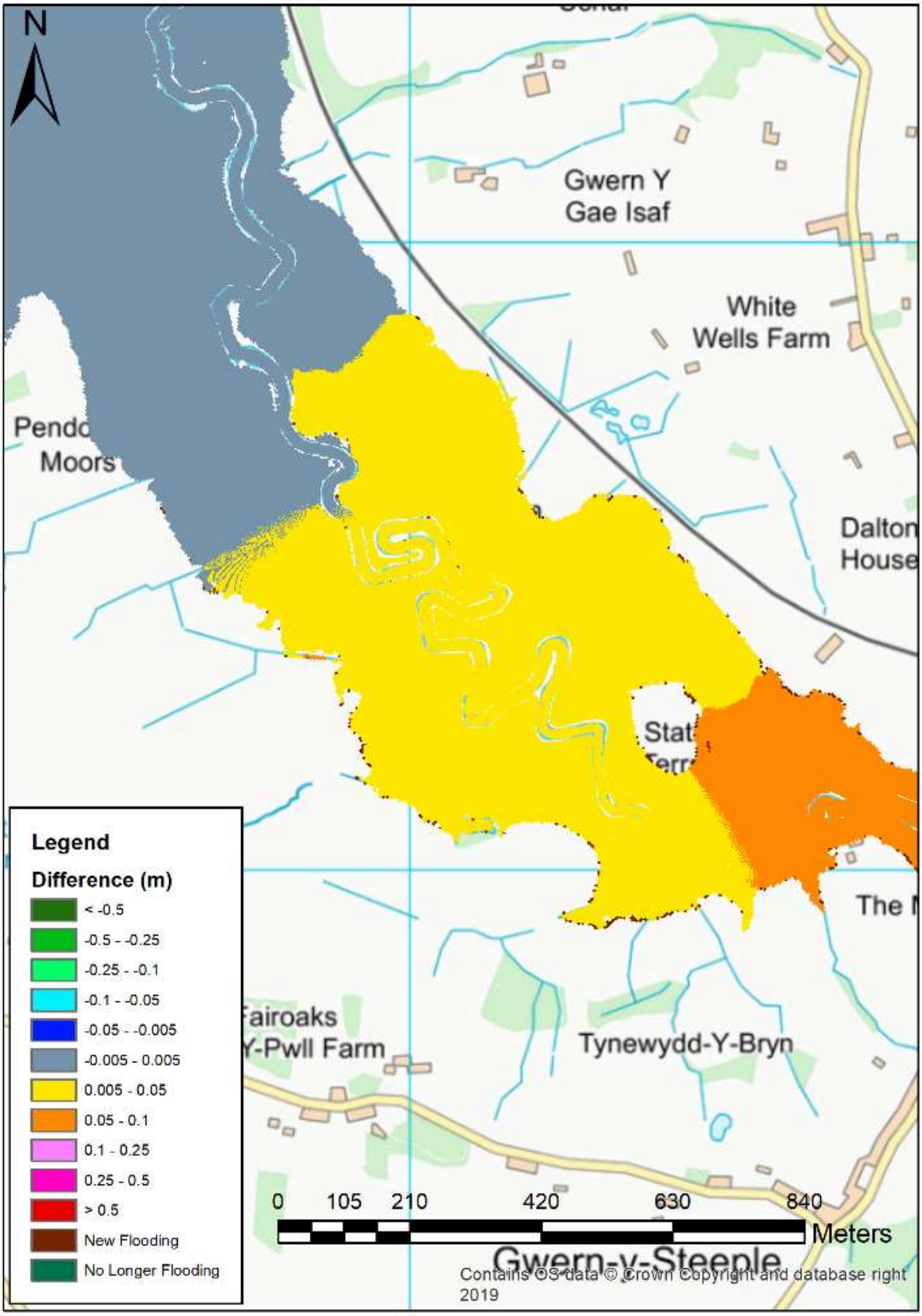
APPENDIX F

Change in flood levels for DSBDY+20% sensitivity test, 0.1% AEP event


N
Gwern Y
Gae Isaf
White
Wells Farm
Pendo
Moors
Dalton
House
Stat
Ferr
The M
airoaks
Y-Pwll Farm
Tynewydd-Y-Bryn
Gwern-y-Steeple
Legend
Difference (m)
< -0.5
-0.5 - -0.25
-0.25 - -0.1
-0.1 - -0.05
-0.05 - -0.005
-0.005 - 0.005
0.005 - 0.05
0.05 - 0.1
0.1 - 0.25
0.25 - 0.5
> 0.5
New Flooding
No Longer Flooding
0 105 210 420 630 840
Meters
Contains OS data © Crown Copyright and database right 2019

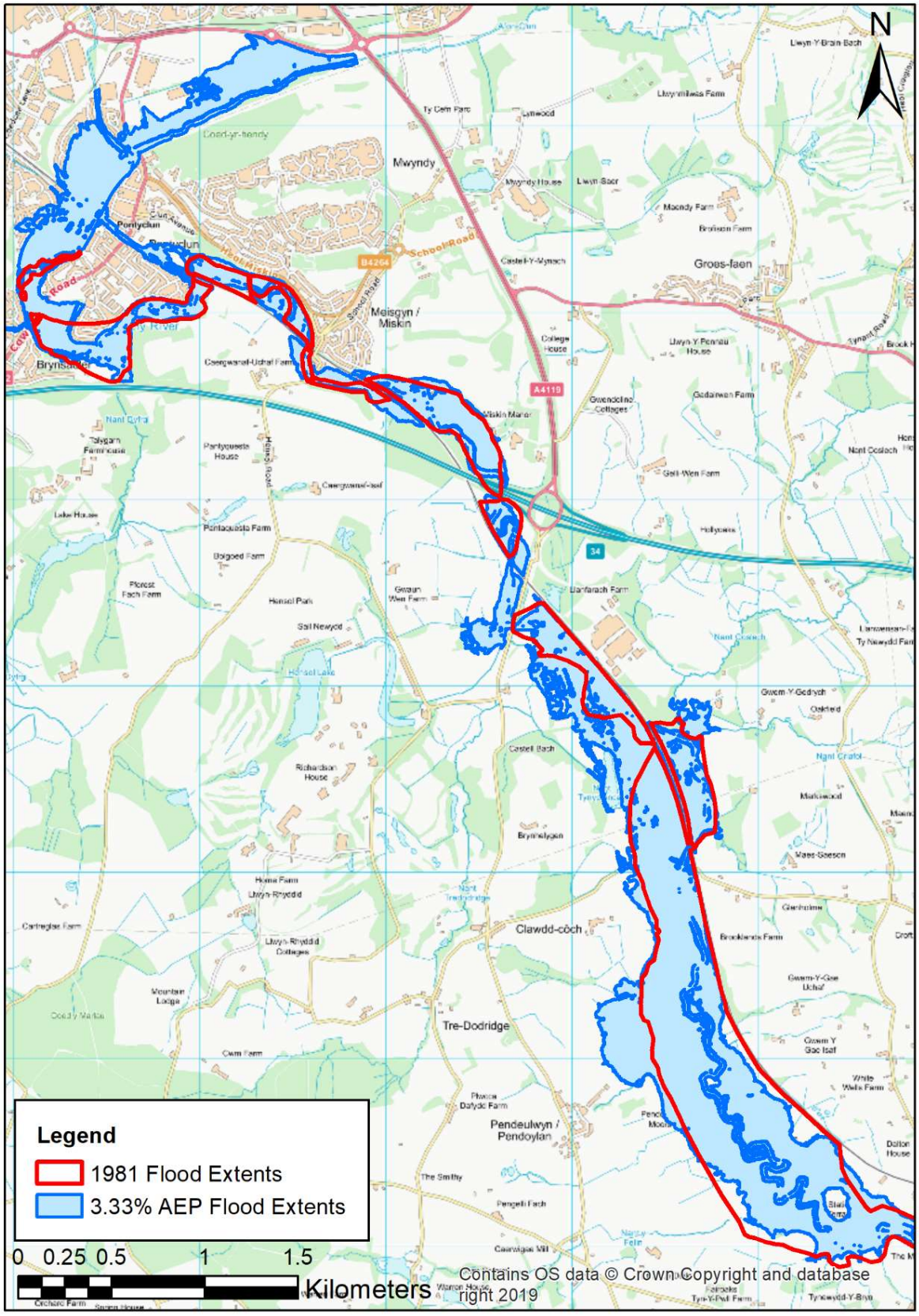
APPENDIX G

Change in flood levels for DSBDY-20% sensitivity test, 0.1% AEP event


N
Gwern Y
Gae Isaf
White
Wells Farm
Pendo
Moors
Dalton
House
Stat
The
Fairoaks
Y-Pwll Farm
Tynewydd-Y-Bryn
Gwern-y-Steeple
Legend
Difference (m)
< -0.5
-0.5 - -0.25
-0.25 - -0.1
-0.1 - -0.05
-0.05 - -0.005
-0.005 - 0.005
0.005 - 0.05
0.05 - 0.1
0.1 - 0.25
0.25 - 0.5
> 0.5
New Flooding
No Longer Flooding
0 105 210 420 630 840
Meters
Contains OS data © Crown Copyright and database right 2019

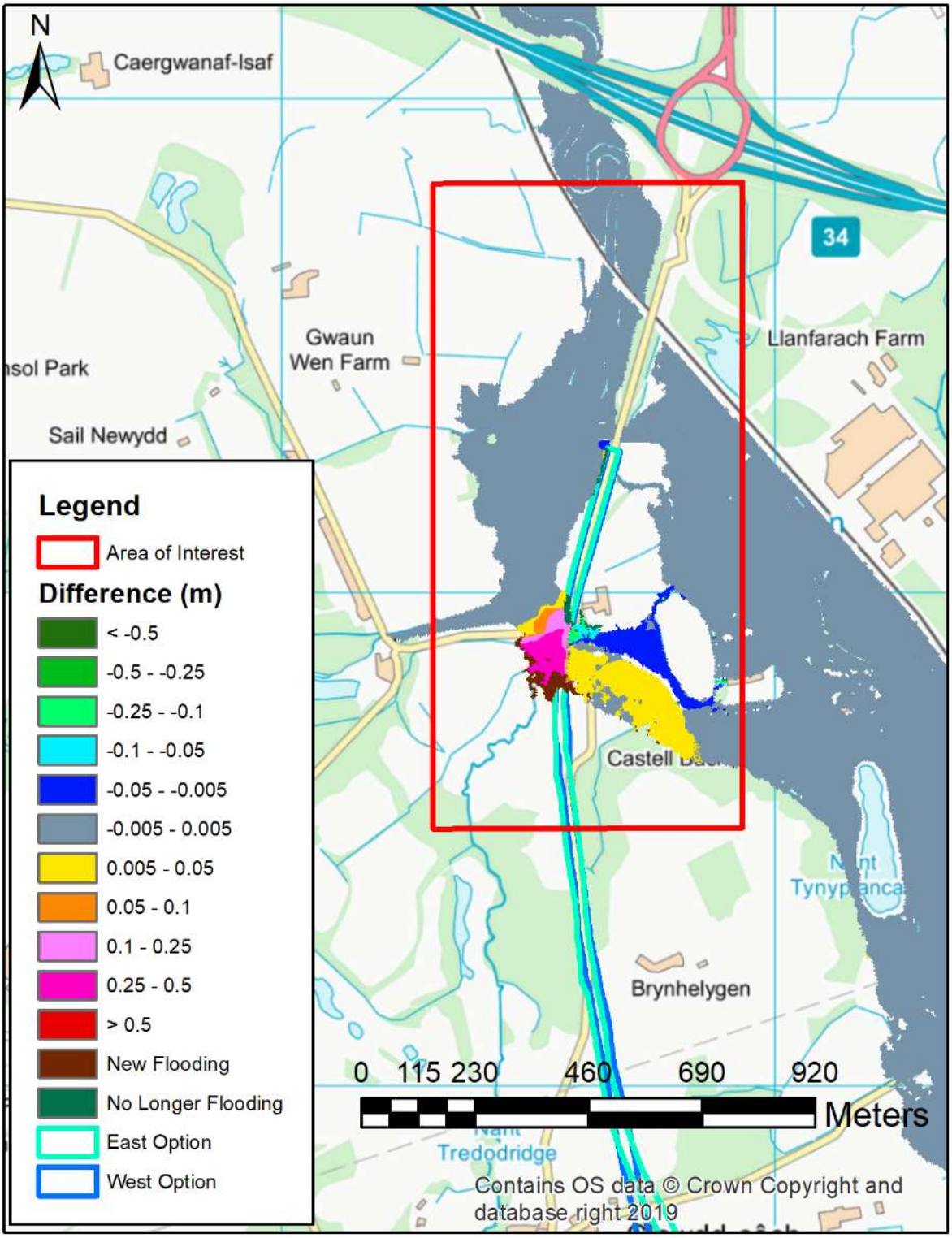
APPENDIX H

Comparison of modelled 3.33% AEP event outline with observed 1981 flood extents


N
Legend
1981 Flood Extents
3.33% AEP Flood Extents
0 0.25 0.5 1 1.5
Kilometers
Contains OS data © Crown Copyright and database right 2019
Mwyndy
Groes-faen
Meisgyn / Miskin
Clawdd-côch
Tre-Dodridge
Pendeulwyn / Pendoylan
B4264
A4119
34

APPENDIX I

Comparison of baseline and option flood levels for 1% AEP +CC event


N
Caergwanaf-Isaf
34
Gwaun
Wen Farm
Llanfarach Farm
Sail Newydd
Legend
Area of Interest
Difference (m)
< -0.5
-0.5 - -0.25
-0.25 - -0.1
-0.1 - -0.05
-0.05 - -0.005
-0.005 - 0.005
0.005 - 0.05
0.05 - 0.1
0.1 - 0.25
0.25 - 0.5
> 0.5
New Flooding
No Longer Flooding
East Option
West Option
Brynhelygen
0 115 230 460 690 920
Meters
Tredodridge
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arcadis.com

APPENDIX O

WelTAG Stage Two | Cultural Heritage Desk-Based Assessment Report

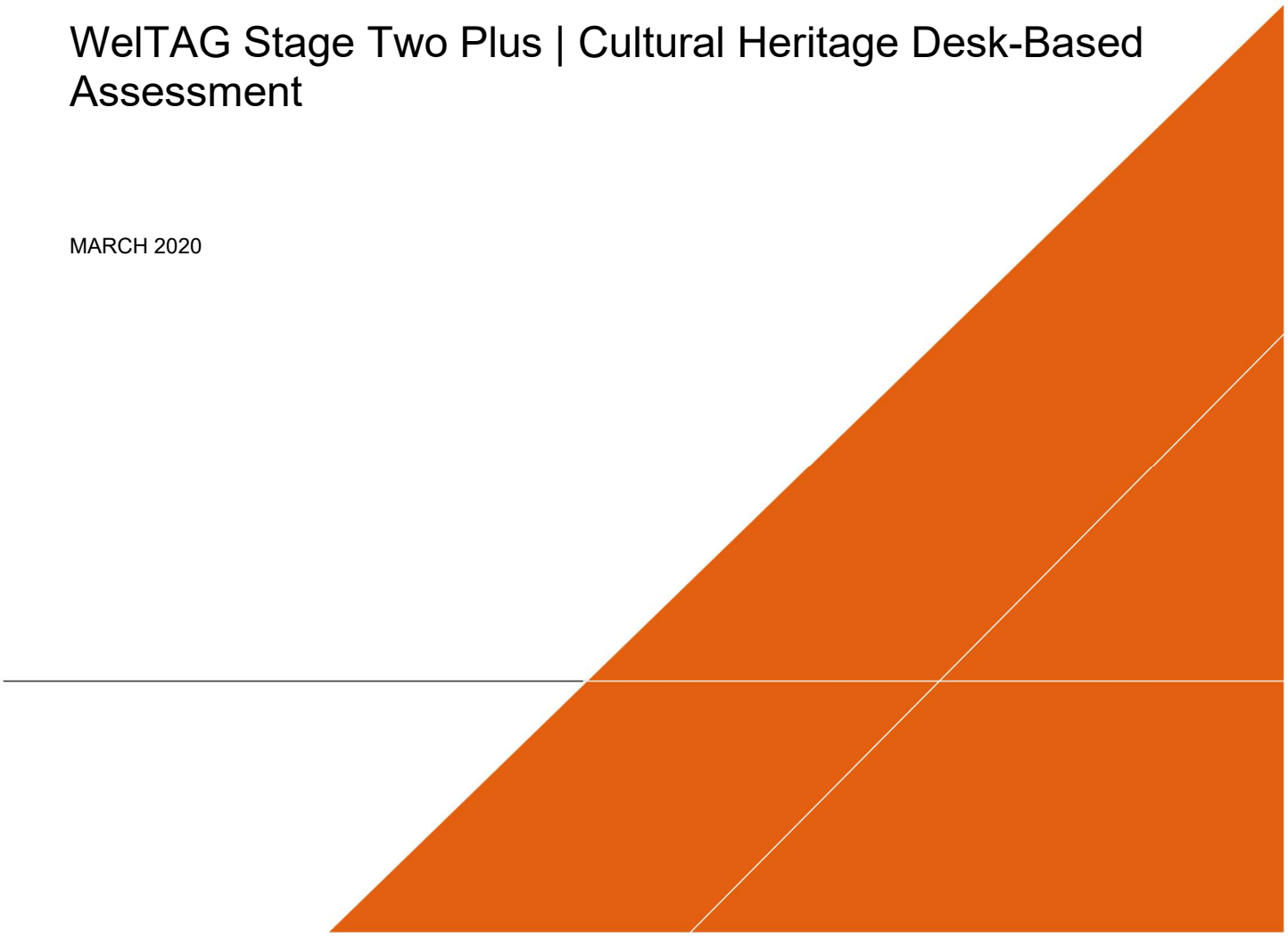
ARCADIS Design & Consultancy for natural and built assets

IMPROVING STRATEGIC TRANSPORT ENCOMPASSING CORRIDORS FROM M4 JUNCTION 34 TO THE A48 | HIGHWAY LINK STUDY

VALE OF GLAMORGAN GATEWAY STATION

WelTAG Stage Two Plus | Cultural Heritage Desk-Based Assessment

MARCH 2020



Improving Strategic Transport Encompassing Corridors from M4 Junction 34 to the A48 | Highway Link Study

Vale of Glamorgan Gateway Station

WelTAG Stage Two Plus | Cultural Heritage Desk-Based Assessment

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Executive Summary

Arcadis Consulting (UK) Ltd ('Arcadis') has been commissioned by the Vale of Glamorgan Council to develop and appraise potential options for improving the strategic transport network encompassing corridors from M4 Junction 34 to the A48 (Five Mile Lane), including the Pendoylan Corridor (or alternative). The appraisal of options has been undertaken in accordance with the Welsh Government's latest version of WelTAG (December 2017) including advice on the appraisal in relation to the Future Generations of Wales (2015) Act Well-being Goals.

The WelTAG Stage Two Plus options subject to appraisal are as follows:

- M4 Junction 34 to A48 Highway Route East of Pendoylan
- M4 Junction 34 to A48 Highway Route West of Pendoylan
- Vale of Glamorgan Gateway Station (formerly Parkway Station) with Park and Ride facility and bus integration near to the M4 Junction 34

Following further recommendations made by the Vale of Glamorgan Council Environment and Regeneration Committee and Cabinet, the WelTAG Stage Two Plus study is now considering the following four highway options, in comparison to the Do Minimum without a highway link improvement:

- **M4 Junction 34 to A48 | Option A – Highway Route East of Pendoylan**
- **M4 Junction 34 to A48 | Option B – Highway Route West of Pendoylan**
- **M4 Junction 34 to A48 | Option C1 – Existing Infrastructure (Online) Enhancement**
- **M4 Junction 34 to A48 | Option C2 – Existing Infrastructure (Online) Enhancement**

This report has focussed on the two online options in line with the original commission. However, as the online route is fully encompassed within the study area, this report has been used to complete the WelTAG Stage Two Plus assessment and supporting WebTAG appraisals for historic environment which can be referenced separately.

This report presents the findings of the Desk-based Assessment (DBA) to support the WelTAG Stage Two Plus appraisal and has been prepared to determine, as far as possible with existing information, the nature, extent and significance of the identified cultural heritage assets and to assess the potential impact of the proposed development on these assets. Data for all designated assets were provided by Cadw through the Lle online portal and non-designated asset data was provided by the Glamorgan and Gwent Archaeological Trust Historic Environment Record (GGAT HER).

The study area has been divided into five Sub-Sections to cover the three options. Sub-Sections 1 to 4 encompass the highway route options and Sub-Section 5 encompasses the Vale of Glamorgan Gateway Station option.

Sub-Section 1

The northernmost Sub-Section encompasses the M4 junction 34 and a c. 1.5km route to the south. The proposed development in this section would comprise online works to improve the existing road alignment.

Within the 250m buffer surrounding the route option in Sub-Section 1 is one park and its associated garden, Miskin Manor (57) located north west of the M4 junction 34. On the basis of current design information there would be no physical impact to this designated heritage asset. Given the proximity of the asset to the proposed development there is potential for a change to its setting that affects its significance, but this is unlikely to be a major impact given the presence of an existing motorway junction in this location. There is one Scheduled Monument, eight Grade II Listed Buildings and one park between the 250m buffer and 500m study area of the Site. None of these assets would be physically impacted by the proposed development as they are beyond the extent of any physical works. There would also be no change to their setting as they are screened from view of the road by well-established vegetation. Consequently, they would experience no change to their significance.

The non-designated assets within the 250m buffer and 500m study area indicate low potential for prehistoric and roman remains. Remains from the medieval and post medieval periods were more prevalent with the field layouts, built heritage and archaeological features. The archaeological event record is weak within this part of the Site and offered little further information to inform archaeological potential. The walkover survey identified several assets such as remains of non-extant field boundaries presumably removed to create larger fields. There was also a possible leat or water channel located close to a non-extant farm. It is not clear specifically what this feature was used for or which period it dates to. All the non-designated heritage assets, either identified by the GGAT HER or through walkover survey, would not be impacted by the Site as they are either non-extant or are outside the area of physical works in Sub-Section 1.

A review of historical maps revealed that the Site has been severely impacted by the creation of the M4 motorway, junction 34, the railway and the northern extension to the road to Pendoylan. Any archaeological remains that previously existed under the current road and railway alignments will have been severely impacted by this previous construction activity and no significant remains are likely to survive beneath this infrastructure.

Sub-Section 2

Sub-Section 2 comprises the central eastern proposed route option around the settlement of Pendoylan. This route option is c. 3km in length and aligned north-northwest to south-southeast. This option would comprise construction of a new road alignment offline from the existing road.

There is one Grade II Listed Building and one Conservation Area within the 250m buffer for the route option in this Sub-Section. There would be no physical impact to either of these designated heritage assets. There are two Scheduled Monuments, four Grade II and one Grade II* Listed Buildings and one park within the 500m study area. The key eastern, south eastern and southern views from the Pendoylan Conservation Area would be impacted by this option, with the introduction of modern infrastructure into these currently rural views. The Conservation Area, Listed Buildings and non-designated assets within the area would also be impacted by an increase in noise caused by increased and faster moving traffic on the proposed option.

The non-designated assets within the 250m buffer and 500m study area indicate low potential for prehistoric and roman remains. However, the lack of artefacts and features reflect the lack of previous archaeological investigation in this area, limiting the opportunity to recover and record such remains. The archaeological event record is weak within this part of the Site and offers little further information to inform our understanding of archaeological potential. The medieval and post medieval period is more apparent with the field layouts, built heritage and archaeological remains. Several assets were identified during the walkover survey which could indicate archaeological features or historic landscape features.

A review of historical maps revealed that there have been no modern changes to the landscape in this part of the Site. The majority of the field boundaries within this area have remained unchanged since the 1840’s tithe map. The exercise identified many thin strip fields, of probable medieval date, to the east of Pendoylan that would be impacted by this proposed option.

Sub-Section 3

Sub-Section 3 comprises the central western proposed route option around the settlement of Pendoylan. This route option is c.3.2km in length, curving in a north to south west and then south eastern direction. This option would comprise construction of a new road alignment offline from the existing road.

There is one Grade II Listed Building and one Conservation Area within the 250m buffer for the route option in this Sub-Section. There would be no physical impact to either of these designated heritage assets. There are two Scheduled Monuments, four Grade II and one Grade II* Listed Buildings and one park within the 500m study area of the Site. The Conservation Area, Listed Buildings and non-designated assets within the area would also be impacted by an increase in noise caused by increased and faster moving traffic on the proposed option.

The non-designated assets within the 250m buffer and 500m study area indicate a low potential for roman remains. However, the lack of artefacts and features of this date may reflect the lack of previous archaeological investigation in this area, limiting the opportunity to recover and record such remains. The prehistoric, medieval and post medieval periods are much more apparent. The prehistoric period is

represented by artefacts and archaeology, however, most of these are located far from the Site within the periphery of the 500m study area. The medieval and post medieval periods are more prominent with evidence in the form of field layouts, built heritage and archaeological remains. There are several assets which would be directly impacted by this proposed option, a lime kiln, quarry and two non-extant field boundaries. The past archaeological event record is weak within this part of the Site and offers little further information to inform our understanding of archaeological potential.

A review of historical maps revealed that there have been no modern changes to the landscape in this part of the Site. The majority of the field boundaries within this area have remained unchanged since the 1840's tithe map. This indicates that any below ground archaeological remains could survive well due to the lack of recent disturbance.

Sub-Section 4

The southernmost segment of the route aligned north-northwest to south-southeast is c. 1.2km long. The proposed development in this section would predominantly comprise online works to improve the existing road alignment.

There is one Conservation Area within the 250m buffer of the Site in Sub-Section 4. There would be no physical impact to this designated asset. There are three Scheduled Monuments, two Grade II Listed Buildings, and one registered historic landscape within the 500m study area of the Site. None of these assets would be impacted by the Site as they are beyond the extent of any physical works and screened from view by well-established vegetation, with consequently no change to their significance through changes to their settings.

The non-designated assets within the 250m buffer and 500m study area indicate activity dating from the prehistoric to post medieval periods. However, the prehistoric remains are all located on the periphery of the study area indicating a low potential for such remains to be present within the Site. There is high potential for archaeological remains of roman date to be present close to the Site, due to the presence of a roman road in close proximity to the Site on the route of the modern A48. The medieval and post medieval periods are visible within the landscape through the field layout, extant and non-extant buildings and recorded through archaeological remains. The archaeological events which occurred within the study area offer little further information to inform understanding of the archaeological potential of the Site.

A review of historic maps and the walkover survey identified that the northern part of the Site in Sub-Section 4 is unchanged by modern impacts. The southern part has been greatly altered by a golf course, modern housing estate and utilities alongside the existing road alignment. Any archaeological remains that were present in this part of the Site will have been impacted by this modern development.

Sub-Section 5

Sub-Section 5 is located at the northern end of the Site and follows the railway in a north west to south east direction for c.950m. The proposed development in this section would comprise a parkway-type railway station on the existing railway line, with associated road access.

There is one Scheduled Monument and one park within the 250m buffer. There would be no physical impact to these designated assets. In the 500m study area there are nine Grade II Listed Buildings and one park. The Scheduled Monument views and setting to the south could be impacted by the proposed development, however the asset's surroundings have already been altered by the railway and adjoining industrial park. All the other designated assets would be not impacted by the proposed development as they are beyond the extent of any physical works and screened from view, with consequently no change to their significance through changes to their settings.

The non-designated assets within the 250m buffer and 500m study area indicate low potential for prehistoric and roman remains. However, the lack of artefacts and features may reflect the lack of previous archaeological investigation in this area, limiting the opportunity to recover and record such remains. The archaeological event record is weak within this part of the Site and offers little further information to inform our understanding of archaeological potential. The medieval and post medieval period is better represented with the scheduled medieval motte, built heritage and archaeological remains. The walkover survey identified several assets such as non-extant field boundaries which were removed to create larger fields and a leat or

water channel located close to a non-extant farm. All the features within this area would not be impacted by the Site as they are either non-extant or are beyond the extent of any physical works.

A review of historic maps revealed that the Site in this Sub-Section has been greatly altered by the creation of the M4 motorway, junction 34, the railway, the northern extension to the road to Pendoylan and the creation of the industrial park. Any archaeological remains that previously existed in these areas will have been severely impacted by this previous construction activity and no significant remains are likely to survive beneath this infrastructure and modern development.

Recommendations

Highway Links

On the basis of the information obtained through desk-based assessment and walkover survey it is concluded that there are no major constraints to the proposed development in Sub-Sections 1 and 4, where the works would be predominantly online improvements to the current road alignment.

Of the eastern and western options in Sub-Sections 2 and 3 the conclusion is that the western option (Sub-Section 3) would have the lesser impact on cultural heritage. The eastern option (Sub-Section 2) would impact the medieval strip fields and a greater number of key views from the Pendoylan Conservation Area. The western option (Sub-Section 3) would impact known non-designated assets (a lime kiln, a quarry and two non-extant field boundaries) but would have less impact on extant historic landscape features and on the setting of designated heritage assets.

In order to produce a detailed assessment to support any planning application it is recommended that a programme of detailed archaeological assessment is undertaken at WelTAG Stage Three. This will provide greater certainty on the risk of currently unrecorded archaeology to be present within the Site, which will both inform the determination of any planning application and allow for accurate planning of any archaeological mitigation that may be required following planning consent in advance of construction.

Further consultation with the planning advice team at GGAT (as advisors to the local authority) will be necessary to determine the precise scope of this but this is likely to require a review of aerial photographs held at the Central Registry of Aerial Photography for Wales (CRAPW), geophysical survey and trial trenching. The scope of this work would need to be agreed through production of a Written Scheme of Investigation (WSI) submitted to the planning advice team at GGAT.

Vale of Glamorgan Gateway Station

Assessment at GRIP Stage 3 Option Selection | Transport for Wales Plan of Works Stage B as part of an enhanced WelTAG Stage Two Plus appraisal will need to consider output stemming from this DBA report to inform development of the proposed options. It is recommended that a programme of detailed archaeology should then be considered for WelTAG Stage Three development, likely to encompass GRIP Stage 4 Single Option Development and GRIP Stage 5 Detailed Design (Transport for Wales Plan of Works Stages C, D and E).

1 Introduction

1.1 Background

1.1.1 Arcadis has been commissioned by the Vale of Glamorgan Council to develop and appraise potential options for improving the strategic transport network encompassing corridors from M4 Junction 34 to the A48 (Five Mile Lane), including the Pendoylan Corridor (or alternative). The appraisal of options has been undertaken in accordance with the Welsh Government's latest version of WelTAG (December 2017) including advice on the appraisal in relation to the Future Generations of Wales (2015) Act Well-being Goals.

1.1.2 This report presents the findings of the Desk-based Assessment (DBA) to support the WelTAG Stage Two Plus appraisal and has been prepared to determine, as far as possible with existing information, the nature, extent and significance of the identified cultural heritage assets and to assess the potential impact of the proposed development on these assets.

1.2 Context | WelTAG Stage Two Appraisal

1.2.1 A first WelTAG Stage Two report was prepared by Arcadis and presented to the project Review Group on 2nd October 2018. The report appraised the following three options:

- M4 Junction 34 to A48 Highway Route East of Pendoylan
- M4 Junction 34 to A48 Highway Route West of Pendoylan
- Vale of Glamorgan Gateway Station (formerly Parkway Station) with Park and Ride facility and bus integration near to the M4 Junction 34

1.2.2 Following consideration of the initial WelTAG Stage Two report, several recommendations were agreed by the Review Group for completion at Stage Two including a programme of early stage environmental surveys and investigations (to include completion of a DBA), more detailed development of the highway link concept designs and completion of Vale of Glamorgan Gateway Station GRIP Stage 1 and GRIP Stage 2 studies. The proposals for additional Stage Two assessment (referred to as Stage Two Plus) were considered and agreed by the Vale of Glamorgan Council Environment and Regeneration Scrutiny Committee and Vale of Glamorgan Council Cabinet over several meetings.

1.2.3 **Following further recommendations made by the Vale of Glamorgan Council Environment and Regeneration Committee and Cabinet, the WelTAG Stage Two Plus study is now considering the following four highway options, in comparison to the Do Minimum without a highway link improvement:**

- **M4 Junction 34 to A48 | Option A – Highway Route East of Pendoylan**
- **M4 Junction 34 to A48 | Option B – Highway Route West of Pendoylan**
- **M4 Junction 34 to A48 | Option C1 – Existing Infrastructure (Online) Enhancement**
- **M4 Junction 34 to A48 | Option C2 – Existing Infrastructure (Online) Enhancement**

1.2.4 **This report has focussed on the two online options in line with the original commission. However, as the online route is fully encompassed within the study area, this report has been used to complete the WelTAG Stage Two Plus assessment and supporting WebTAG appraisals for historic environment which can be referenced separately.**

1.3 Scheme Location

1.3.1 There are two WelTAG Stage Two Plus route options, known as the east and west alignments around the settlement of Pendoylan. Each route option shares the same proposed alignment to the north and south of Pendoylan, where the proposal mostly follows the existing road alignment and would primarily consist of online improvements. Throughout this report 'the Site' is used to refer to the proposed route option alignments. A 250m buffer around the Site is also considered to allow

flexibility in the development of any future design and ensure potential impacts from any construction activity are considered as part of the options selection process. The DBA focuses on 6.01 km length of road between NGR ST058800 and ST073741.

1.3.2 Also considered within this report are WelTAG Stage Two Plus proposals for a Vale of Glamorgan Gateway Station, located south-east of the M4 Junction 34 and on the South Wales Main Line. A 500m buffer surrounding the existing Miskin passing Loops has been applied for this appraisal.

1.3.3 For ease of reporting **five Sub-Sections have been created:**

- **Sub-Section 1 |** The northern Sub-Section comprises of the M4 junction 34 roundabout and a c.1490m stretch of road to the south. The route mainly follows the present alignment of the road to Pendoylan except within the centre part where the proposed route will straighten a dog leg in the road.
- **Sub-Section 2 |** Starts of at the southern end of Sub-Section 1. From here the route takes an eastern direction away from Pendoylan and carries on in a roughly south eastern direction until it ends a short distance to the east of the current road from Pendoylan. It is roughly 3050m in length and passes through agricultural land within the low-lying area of the Ely Valley.
- **Sub-Section 3 |** Starts of at the southern end of Sub-Section 1. From here the route takes a western direction away from Pendoylan over and along a natural ridge. The route takes a south western direction at the northern end and the curves round to the south east at the southern. It is roughly 3200m in length and passes through agricultural land.
- **Sub-Section 4 |** Starts where Sub-Sections 2 and 3 ends. Its northern end is located within farmland to the east of the current road alignment while its central and southern parts follow the alignment of the existing road from Pendoylan. It measures c.1260m in length, its northern end is located on a natural ridge while the southern end is relatively flat and surrounded by a gold course and new housing estate to the west. The southern end is located along an east to west ridge which overlooks an area to the south.
- **Sub-Section 5 |** Is located within the northern part of the Site near to Sub-Section 1. The options for the station are located around the existing South Wales Main Line, between where the road to Pendoylan and the railway line meet and along the railway in a south eastern direction for c.950m.

1.4 Location, Topography and Geology

1.4.1 The Site primarily lies within the Vale of Glamorgan with a small area in Rhondda Cynon Taff at the northern end. The Vale of Glamorgan is relatively low lying and the Site is located within the Ely Valley. At the northern end of the Site the topography is fairly flat and as the Site progresses to the south the natural geology becomes steeper and valley-like until it reaches the Bonvilston area which is located on a natural ridge with views down to the south. The Site lies primarily within an area of agricultural land with manufacturing near the railway at the northern end and residential areas within the central area and adjacent to the southern end. At its southern end is a recreational golf course.

1.4.2 The bedrock underlying the Site varies. The northernmost bedrock of the Vale of Glamorgan and Rhonnda Cynon Taff is Llanishen Conglomerate which is made up of interbedded conglomerate and sandstone (BSG 2019). Just south of this is a band of Mary's Well Bay Member which is made up of interbedded limestone and mudstone. The bedrock around Pendoylan is Mercia Mudstone Group and south of this towards Bonvilston and St Nicholas are thin varying bands of bedrock:

- Castell Coch limestone Formation – limestone and ooidal.
- Cwmyniscoy Mudstone Formation – interbedded limestone and mudstone.
- Barry Harbour Limestone Formation – limestone.
- Brofiscin Oolite Formation – limestone and ooidal.
- Friars Point Limestone Formation – limestone.

- Friars Point Limestone Formation – dolomitised limestone and dolomite.

1.4.3 The site has superficial geological deposits of a Devensian Till which is a diamicton deposit with interspersed Alluvium sediments of clay, silt, sand and gravel in the northern and central part of the area.

1.4.4 Numerous boreholes have been conducted around the M4 junction 34, an area just to the south and at the Bonvilston junction of the A48. No colluvium or alluvium was identified, and the results of the boreholes correspond with the geological descriptions above.

1.5 Aims and Objectives

1.5.1 The aim of this DBA was to assess the archaeological, built heritage and historic landscape resource within a defined study area centred on the site. This was achieved through the collation and analysis of available written, cartographic, photographic and electronic information within the public domain.

1.5.2 The assessment objectives were:

- To identify known designated and non-designated heritage assets within the site.
- To assess the significance of those identified heritage assets (including archaeological remains, built heritage and historic landscape features).
- To determine the potential impact of the scheme upon the significance of those identified heritage assets.
- To identify the potential for unknown and buried archaeological remains, their likely significance and the possible impact of the scheme upon them.
- To assess the impact of any previous intrusive activities within the site upon the known and potential heritage resource.
- To determine the necessity for any further investigative works and recommend a programme of appropriate fieldwork in response to this.

2 Methodology

2.1 Background

2.1.1 This document will assess the archaeological and heritage potential of the Site and the study area. As part of this heritage of different periods, landscape, and history of places will be assessed to show how they contribute to or detract from the interest of heritage assets. This approach considers the present character of these assets based on the chronological sequence of events that produced them and allows management strategies to be developed that sustain and enhance the interest of heritage assets.

2.2 Study Area

2.2.1 In addition to the 250m and 500m buffer areas surrounding the Site, a further 500m study area has been applied from the buffer areas to inform the assessment in this report. This was created to assess any potential impacts to views to or from heritage assets, to assess the settings of heritage assets that may be affected by the proposed development, to provide an understanding of the historical context of archaeological activity within the Site and to inform the understanding of archaeological potential.

2.3 Consultation

2.3.1 Consultation has been undertaken with the planning advice team at GGAT, who provide archaeological planning advice to local authorities in south east Wales. Responses received in March 2019 agreed that the proposed 500m study area was appropriate, as was the cartographic analysis and walkover survey. The response also advised that monument setting should be assessed as part of the options selection process and identified specific designated assets to be considered. These are all included in the DBA and setting is considered as part of the assessment. It was also advised that the DBA would need to conform with *Guidance for the Submission of Data to the Welsh Historic Environment Records (HERs)*, which has been taken into account in the production of this report.

2.3.2 It was also recommended that a review of aerial photographs held by the Central Registry of Aerial Photography for Wales (CRAPW) should be conducted, ideally at options selection stage. However, this was outside the current scope and it is therefore a recommendation of this report that this be undertaken at WelTAG Stage 3 should the Client decide to proceed. In addition, a WSI for the DBA will need to be agreed with GGAT prior to submission of any planning application.

2.3.3 Consultation has been undertaken with Cadw in August 2019, on the subject of designated heritage assets potentially affect by the proposed development. Their response specified that the DBA should be undertaken in line with the standards and guidance provided by the Chartered Institute for Archaeologists and that the scope of work should be agreed with the planning advice team at GGAT, as advisors to the local authority, all of which is in line with the approach taken in the preparation of this DBA. The responses also stated that '*it is also expected that the person carrying out the assessment should fully understand the regional archaeology of Southeast Wales, in particular understanding the limitations of artefact recovery as long periods, especially in the early medieval period, but also partly in the Iron Age and Roman periods, are aceramic*'. The team working on this assessment have previous experience of working in this area of Wales and have consulted the regional research agenda.

2.3.4 The response from Cadw recommended a 3km study area for designated heritage assets in order to assess impacts arising from changes to setting and highlighted that registered historic parks and gardens should be considered as part of this assessment. This DBA considers all designated heritage assets, including registered parks and gardens. Although the study area does not extend to 3km the 500m has been agreed with GGAT and should the client decide to proceed with a planning application it is recommended that the study area for designated heritage assets is increased to 3km from the proposed development.

2.3.5 The Cadw response stated that although the registered Lancarfan Landscape of Special Historic Interest is within the study area the likely impact of the proposed development would not be sufficient to require an ASIDOHL assessment to be carried out.

2.3.6 The Conservation Officer for Vale of Glamorgan has also been contacted but no response has been received to date.

2.3.7 The Commemoration and Licensing depart of the Ministry of Defence (MOD) were contacted in March 2019 in connection with the Spitfire crash site in Bonvilston. We were advised that if the crash site were to be disturbed then a license from the Joint Casualty and Compassionate Centre would be required before work began. However, due to the potential presence of human remains we were advised that it is considered unlikely that a licence would be given.

2.4 Assessment Criteria

2.4.1 Current guidance on the assessment of the significance of heritage assets is provided by Cadw. Significance of heritage assets is described by Cadw as *'Their physical remains and surviving fabric, pictorial and documentary records that help us understand them, their capacity to illuminate aspects of the past and connect us to it, their aesthetic qualities, the value they have to the people who relate to them.'*

2.4.2 In this assessment due weight has been given to the Conservation Principles for the Sustainable Management of the Historic Environment in Wales (Cadw 2011) in which significance is weighed by consideration of the potential for the asset to demonstrate the following criteria:

- *Evidential Value*: Deriving from the potential of a place to yield evidence about past human activity. This is sometimes called evidential or research value. There will be archaeological interest in a heritage asset if it holds, or potentially may hold, evidence of past human activity that could be revealed through investigation. Archaeological interest in this context includes above-ground structures, earthworks and buried or submerged remains. Evidential value can be gained from documentary sources, pictorial records and archaeological archives or museum collections. The unrecorded loss of historic fabric represents the destruction of the primary evidence.
- *Historical Value:* Deriving from the ways in which past people, events and aspects of life can be connected through a place to the present. It tends to be illustrative or associative. The functions of a heritage asset are likely to change over time and so the full range of changing historical values may not become clear until all the evidential values have gathered. Historical values are not so easily diminished by change as evidential values and are only harmed to the extent that they have been obliterated or concealed.
- *Aesthetic Value:* This derives from the sensory and intellectual stimulation people draw from a heritage asset. This may include the form of an asset, its external appearance and how it sits within its setting. This can be due to conscious design including artistic endeavour or technical innovation, or fortuitous outcome of the way in which a place has evolved and been used or both. Inevitably understanding the aesthetic value of an historic asset will be more subjective than the study of its evidential and historical values. Much of it will involve trying to express the aesthetic qualities or the relative value of different parts of its form or design. It is important to seek the views of others with a knowledge and appreciation of the historic asset on what they consider to be the significant aesthetic values.
- *Communal Value*: This derives from the meaning of a place to the people who relate to it, or for whom it figures in their collective experience or memory. It is closely linked to historical and aesthetic values but tends to have additional or specific aspects. Communal value might be commemorative or symbolic. Such values often change over time and they may be important for remembering both positive and uncomfortable events, attitudes or periods in Wales's history. Historic assets can also have social value, acting as a source of social interaction, distinctiveness or coherence; economic value, providing a valuable source of income or employment; or they may have spiritual value, emanating from religious beliefs or modern perceptions of the spirit of a place.

2.4.3 To understand the level of impact that a development may have on a heritage asset, an understanding of the significance of that asset needs to be achieved. Guidelines for determining the significance of an asset are outlined in Table 1. In the absence of any heritage-specific guidance relevant to this type of development this terminology (Table 1) has been developed using professional judgement, the outcomes of research and in line with best practice from Cadw.

Table 1 Heritage Asset Significance

Significance	Criteria for assessing the significance of heritage assets
Very High	World Heritage Sites Assets of recognised international importance Assets that contribute to international research goals
High	Scheduled monuments Grade I and Grade II* Listed Buildings Grade I and Grade II* Registered Parks and Gardens Non-designated Assets of the quality and importance to be designated Assets that contribute to national research agendas Landscapes of outstanding or special historic interest
Medium	Grade II Listed Buildings Grade II Registered Parks and Gardens Assets that contribute to regional research goals
Low	Locally Listed Buildings Landscapes of special value Assets compromised by poor preservation and/or poor contextual associations Assets with importance to local interest groups Assets that contribute to local research goals
Negligible	Assets with little or no archaeological/historical interest
Unknown	The importance of the asset has not been ascertained from available evidence

2.5 Sources

2.5.1 A range of sources have been consulted to inform this assessment, in line with best practice guidance as outlined under Conservation Principles (Cadw 2011), the Chartered Institute for Archaeologists (CIfA) guidance and relevant legislation and policy. A variety of sources were consulted to obtain information for analysis during the preparation of this assessment. They included:

- Glamorgan-Gwent Archaeological Trust (GGAT) Historic Environment Record (HER) for heritage assets and events data.
- Cadw for information on designated assets within the study area.
- Historic Wales online portal for further information about heritage assets within the study area.

- The British Geological Survey website, for information on the prevailing geological conditions in the vicinity of the site.
- Glamorgan Archives, for supplementary information on the known archaeological and historical background of the study area and historic mapping.
- National Library of Scotland's online catalogue for historical Ordnance Survey (OS) maps of the Site.
- The National Library of Wales website for tithe maps.
- Rhondda Cynon Taff Council website, for planning policy information.
- Vale of Glamorgan Council website for planning policy information and the Pendoylan Conservation Area Appraisal and Management Plan and the Bonvilston Conservation Area Appraisal and Management Plan.

2.6 Site Walkover

2.6.1 A walkover survey was undertaken as part of this assessment. The objectives of the survey were to:

- Assess and describe the current ground conditions within the Site.
- Identify evidence and/or potential for the survival of buried archaeological remains within the Site.
- Confirm the presence, location and condition of known above-ground archaeological remains.
- Identify any unknown above-ground built heritage assets not recorded elsewhere.
- Identify any areas where previous modern activities may already have impacted upon known and/or potential heritage assets.
- Consider the potential impact of the proposed development upon the setting of built and buried heritage assets within the study area.

3 Regional Research Framework

3.1 Background

3.1.1 Since 2001 a series of regional research frameworks have been produced throughout four regions of Wales (Archaeoleg 2019); the north west, north east, south west and south east. The Site is located within the south eastern framework area. These areas each have their own research agendas organised by time period:

- The Prehistoric period – which is then sub divided into the Paleolithic and Mesolithic (250,000 BC - 4,000 BC), the Neolithic and Early Bronze Age (4,000 BC - 1,500 BC) and Later Bronze Age and Iron Age (1500 BC – AD 43)
- The Roman period (AD 43 – AD 410)
- Early Medieval (410 – 1100)
- Medieval (1100 - 1539)
- Post Medieval (1539 – 1750)
- Industrial and Modern Period (1750 – present)

3.1.2 All archaeological bodies working in Wales i.e. Cadw, Royal Commission on the Ancient and Historical Monuments in Wales, National Museums and Galleries of Wales, the Welsh Trusts, University Archaeology Departments, National Park Archaeologists and voluntary groups work together to formulate strategies for understanding the Welsh archaeological record.

3.1.3 Each time period raises its own questions with the aim to better understand and improve the knowledge of that era in Welsh history. The content and research approach can include;

- Large scale developer led projects – these need to maintain the ambition to contribute to major research questions and to achieve the highest standards of investigation and reporting. These projects tent to cover large areas and can continue on for longer periods of time.
- Small scale developer led projects – these are often small, fragmentary and unevenly spaced investigations which only require basic level events and recordings. In many cases, the full potential of developer led research may only be achieved if it is linked to wider research programmes.

3.1.4 This DBA has considered the information gathered in light of the research framework for south east Wales.

3.2 Prehistoric Period

3.2.1 Specific questions asked in the framework for this period are:

- What is the character of the Middle Bronze Age in this region and how is it different from preceding and subsequent periods?
- For how long did ritual practices continue to be undertaken within earlier Neolithic and Early Bronze Age monumental landscapes?
- When were hillforts and settlements first enclosed and defined? Are there palisaded enclosures or open settlements beneath hillforts?
- How artefact poor is the Early and Middle Iron Age of south east Wales? If so, why?
- How common were open settlements within later prehistory? Where and when and what they say about social relations.
- What is the evidence for increasing social hierarchies, identities and economic specialisation during the Iron Age? When does this become visible by comparison with other regions of Britain?

- What arenas of display are represented within the Late Iron Age material culture of this region? What does the settlement and material culture evidence of the Late Iron Age and Conquest period say about the character of interactions with the Roman world?
- How influential were cultural ties with other neighbouring regions bordered by land and sea? How is this represented in the material culture of this part of Wales?
- Are there Late Iron Age temples and shrines in south Wales?

3.3 Roman Period

Army/ Native Inter-Relationship

3.3.1 The Roman military bases and adjacent civilian settlements (canabae or vici) form an extensive high-quality data resource that has seen varying degrees of investigation in the past. Whilst the forts are well-protected and investigated, this is not true of the adjacent militarily controlled settlements. The focus of previous investigations has focused on the colonial (imperial) views of romanisation and dominated by focusing on forts and their occupation, how the army was organised and military material culture. The new topics of investigation include the army's economic, social, political, cultural and technical impact on the surrounding environment and native population.

Land Use

3.3.2 Some attempts have been made to define land use in the past, but these have been limited in scope. If some understanding of how land was owned, managed and used, this may in turn inform political, military, socio-economic and cultural narratives.

3.3.3 There is a limited understanding of how land was apportioned after the conquest, the framework questions if there is any evidence of the land being retained by the indigenous population. It is believed that some land ownership remained in native hands, but some would have been given to Roman elite, the framework questions whether Roman estates can be identified.

Communications & Trade

3.3.4 The framework agenda here looks at the impact of new communication and trade routes on the indigenous culture. This includes how did the road and water networks affect or improve trade; how did the new towns affect the way the population traded. Is it possible to detect how imperial, military, pollical and social communications were conducted, are there any physical remains?

3.3.5 Trade and exchange of goods can easily be seen in the archaeological record, but can small or large industries be detected, and their distribution of goods be mapped. Can the range of artefacts identify the form, function and status of or differences between settlements?

Environs

3.3.6 Exploring the relationship of sites to their environs can produce better contexts for achieving understanding of function and change. Studying the periphery of an occupation site can sometimes be more informative than investigating its core. The key questions asked by the framework are; how did the settlements interact with the rural environment? How did large- and small-scale settlements interrelate? Is there any evidence to support this interaction? How did these settlements cease to exist? Why did some occupation sites continue on in the Medieval period and beyond?

Rural sites and economy

3.3.7 In the past excavations and research have just focused on rural elite houses or built environment of settlements and not how these properties interreacted with their surrounding environment. The framework wishes to see if there is any evidence of this relationship. There is little knowledge of the organisation of the countryside and less so for areas to the east and west of the Vale of Glamorgan.

Humans

3.3.8 Some literary, epigraphic and archaeological evidence is available for this topic but relatively little is known about the people who inhabited south east Wales. Key questions to be asked are; what was the ethnic make-up and did this change? Can changes in populace and social or ethnic groups be

assessed to any degree of success? Can any gender, age or class be detected in regional biases or patterns? What drives and or dictates different consumption patterns i.e. foodstuffs, clothes, tools, household?

Religious practice

3.3.9 Apart from the temple at Caerwent no religious centres have been excavated, evidence is restricted to chance finds, writings and burial practice. More opportunities to study these practices and identity religious sites are required.

3.4 Early Medieval

Settlement and earthworks

3.4.1 The piecemeal nature of settlements in this time period makes site identification difficult. Many earthworks are threatened by erosion either natural, weather, animal or from agriculture. New techniques and reporting such as metal detecting finds and the portable antiquities scheme have helped to identify new rural settlement sites. However, these sites are only identified through surface finds and not by intrusive means.

3.4.2 Some of the framework questions posed are:

- Is there any evidence of the transition from the Roman and into the Early Medieval period?
- Is there a comparative characterisation of land use and settlements, can land units or estate boundaries and their relationship to settlements merit further investigation?
- Can the location and nature of hillfort settlements be established, how have their earthworks created or re-used earthworks?
- Some sites show evidence that suggests that they were complex, often multi-period, with ecclesiastical associations. Examination of these sites can enable investigators to place the evidence within a broader chronological and topographic pattern.

Ecclesiastical Sites and Cemeteries

3.4.3 Only small-scale investigations have so far been conducted into these types of sites. The dereliction and deconsecrating of churches or churchyards has posed a threat to this category. Early Medieval inscribed stones at many sites have a lack of protection and are under threat of damage from natural or human action. Identification of these sites and recommendations on how to preserve them is required. Investigations into known and newly discovered sites can help strengthen the knowledge of these sites and help to put them in a wider ecclesiastical context. New technologies such as geophysical surveys, aerial photography and Lidar can help with these investigations.

Economy, Land-Use, Natural Resources

3.4.4 The knowledge for Early Medieval Wales is based on archaeological evidence, but little is known about the character of 5th century settlement and life. More knowledge is required to strengthen the knowledge on; the impact on settlement during the transition from the Roman to the Early Medieval period, the character and development of agriculture and land-use, the nature of 'industrial' processes and resource exploitation, the layout and development of early ecclesiastical centres, settlement types, development, location, continuity, and status and the material culture of Early Medieval Wales, its regional patterning, and cultural identities.

Castles and Defensive Structures

3.4.5 Over the years many studies have been conducted to identify key defensive sites and castles, these include; the Glamorgan Inventory (1991 and 2000), King (1983), John Kenyon (1978, 1983 and 1990) and, more recently, the Castle Studies Group. However, there have been limited studies or archaeological intervention on these castle sites. The framework aims to enhance the knowledge on; the ceremonial and spatial use of castles, to examine associated features i.e. gardens, and to consider the landscapes within which the castles are to be found. Investigations into moated sites,

town walls, strong houses, fortified manor houses, fortified churches and defended monastic sites can also improve the frameworks and historic environment record.

Material Culture

3.4.6 Pottery and metal finds have often dominated the material culture of this time period and is often the primary source of dating evidence. Few kiln or blacksmith sites have been identified and investigated; these sites can help to reconstruct trade patterns. However, in recent years there has been little opportunity for the publication of research findings. The once weighty Archaeologia Cambrensis now seems to appear two or three years behind schedule and whilst attempts are being made to resolve the situation, this has had serious consequences for authors, readers and the dissemination of findings.

3.5 Post Medieval

Settlement & Housing

3.5.1 Vernacular houses dominate this time period and dendrochronology (tree-ring) chronology has been vital in the identification of such buildings. However, this study has not covered farm buildings, 17th century industrial settlements or seasonal use dwellings. Few archaeological excavations have been conducted on such sites. Any improvement to the knowledge of this time period and its buildings is greatly sort after.

Land Use and Enclosure

3.5.2 The richness of hedgerows along with lynchets which can indicate where land was used for ploughing is an under used resource. However, the land-use as a whole is largely a blank canvas, many studies into this topic have failed to identify a clear chronology and the deforestation associated with the large-scale introduction of charcoal-fuelled ironworks is little understood. A typology of field boundary types is needed to establish the phasing of boundaries and to date encroachment. This can lead to identification of areas for high archaeological potential for land-use remains in landscape studies

Natural Resources

3.5.3 Very little is known about; the coppicing of woodlands, the early bloomer furnaces, the operation of areas of iron-ore scouring, the evolution of the mid-18th copper rolling-mill and the change in copper smelting from part blast-furnace to complete reverberatory furnace. Any opportunity to further the knowledge and record of such practise should be embraced.

3.5.4 The linking of place name evidence with archaeology may help to identify early industrial locations used for scouring, opencast, etc.

Religious or Non-Secular Archaeology

3.5.5 There is a discrepancy between research and recording of gravestones, sculptures and holy wells, most conducted by Family History Groups, and the dissemination of this knowledge into the public forum or reported to the HER. Any information gleamed from excavations or assessments is required to further the knowledge of this topic. The study of the use of holy wells in the Post Medieval period is deemed key to understanding early and significant nonconformist chapels and is a vital but under used resource.

4 Legalisation, Policy and Guidance

4.1 Legislation

4.1.1 The relevant parliamentary act which provides the legislation framework for development and archaeology is the Town and Country Planning Act 1990. This assessment has also taken into account the Planning (Listed Buildings and Conservation Areas) Act 1990, the Ancient Monuments and Archaeological Areas Act 1979 and Historic Environment (Wales) Bill 2016. National policy relating to the archaeological resource is outlined in Planning Policy Wales Section 6.1 Recognising the Special Character of Places: The Historic Environment (2018). Local policy is outlined in the Vale of Glamorgan Local Development Plan 2011 – 2026 and the Rhondda Cynon Taff Local Development Plan 2006 – 2021.

Ancient Monument and Archaeological Areas Act 1979

4.1.2 The Ancient Monuments and Archaeological Areas Act 1979 gives statutory protection to any structure, building or work which is considered to be of particular historic or archaeological interest and regulates any activities which may affect such areas. Under the Act any work that is carried out on a Scheduled Ancient Monument must first obtain Scheduled Monument consent.

Planning (Listed Buildings and Conservation Areas) Act 1990

4.1.3 The Planning (Listed Buildings and Conservation Areas) Act 1990 applies special protection to buildings and areas of special architectural or historic interest. Section 66 (1) of the act states that 'In considering whether to grant planning permission for development which affects a Listed Building or its setting, the local planning authority or, as the case may be, the Secretary of State shall have special regard to the desirability of preserving the building or its setting or any features of special architectural or historic interest which it possesses.'

Well Being of Future Generations (Wales) Act 2015

4.1.4 Under the Act, public bodies now have a duty to use sustainable development to shape everything they do, how it is done, and how it is communicated (via reporting), to show how they are contributing to the achievement of the well-being goals. This means that each public body must work to improve the four aspects of well-being in Wales: economic, social, environmental and cultural.

Historic Environment (Wales) Act 2016

4.1.5 This legislation makes improvements to existing legal provisions for the Welsh historic environment. It provides amendments to the Ancient Monuments and Archaeological Areas Act 1979 and the Planning (Listed Buildings and Conservation Areas) Act 1990. It also makes provision for the compilation of a list of historic place names in Wales, the compilation of a historic environment record for each local authority area in Wales and the establishment, constitution and functions of the Advisory Panel for the Welsh Historic Environment.

4.2 National Policy

Planning Policy Wales: Edition 10 (2018)

4.2.1 Section 6.1 'Recognising the Special Character of Places: The Historic Environment' provides the national planning policy framework for the consideration of the historic environment in Wales, and sets out the Welsh Government's objectives in this field as:

- Protect, conserve, promote and enhance the historic environment as a resource for the general well-being of present and future generations. The historic environment contributes to economic vitality and culture, civic pride, local distinctiveness and the quality of Welsh life.
- Protect the Outstanding Universal Value of the World Heritage Sites.
- Conserve archaeological remains, both for their own sake and for their role in education, leisure and the economy.

- Safeguard the character of historic buildings and manage change so that their special architectural and historic interest is preserved.
- Preserve or enhance the character or appearance of conservation areas, whilst the same time helping them remain vibrant and prosperous.
- Preserve the special interest of sites on the register of historic parks and gardens.
- Protect areas on the register of historic landscapes in Wales.

4.2.2 It states that change to heritage assets through the planning system should also consider the setting of an asset, which may extend beyond its curtilage, and it is the responsibility of all those involved in the planning system, including developers, to appropriately care for the historic environment in their area. Planning Policy Wales identifies that Cadw is the historic environment division of Welsh Government and '*has responsibility for protecting, conserving and promoting an appreciation of the historic environment of Wales*.'

4.3 Local Policy

Vale of Glamorgan Adopted Local Development Plan (LDP) 2011- 2026

4.3.1 The Vale of Glamorgan LDP 2011 – 2026 was adopted on the 28 June 2017, superseding the previous adopted Unitary Development Plan. The LDP will be the basis for decisions on land use planning in the Vale of Glamorgan and will be used by the Council to guide and manage new development proposals. The plan has been written with regard to the need to regenerate and support communities and in doing so seeks to achieve a balance between economic growth, social cohesion and impact on the historic environment.

4.3.2 Policy SP10 states '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:

- The architectural and/or historic qualities of buildings or conservation areas, including locally listed buildings.
- Historic landscapes, parks and gardens.
- Special Landscape Areas (SLA).
- The Glamorgan Heritage Coast.
- Sites designated for their local, national and European nature conservation importance.
- Important archaeological and geological features.

4.3.3 Policy MD8 states that '*Historic Environment – Development proposals must protect the qualities of the built and historic environment of the Vale of Glamorgan*.' Preservation and enhancement of the area's historic environment, which includes the setting of heritage assets, is the responsibility of the Council. This responsibility will add weight to the Council's decision-making process for new developments. For designated assets, such as listed buildings, the Council recognises the assets setting contributes to the wider area and to the asset itself. Any new development proposals should take this into account along with the need to preserve or enhance the asset and/or its setting.

4.3.4 The Council has identified buildings and structures within the Vale which are considered to have special local architectural or historical interest. These are known as 'County Treasures', these assets are not designated but are of significance to the local community and deserve protection and preservation. New developments should reflect this and preserve or enhance the assets, their character and settings.

4.3.5 Archaeological assets can have considerable bearing on the feasibility of new developments. Where archaeological features are known or suspected, an archaeological field evaluation should take place at the earliest opportunity and the results be submitted along with the planning application. Where a new development affects an important archaeological site, designated or non-designated,

or its setting the Council will favour preservation. Where appropriate this can include removal of the asset from site. If the assets are unable to be removed the remains should be preserved and or sensitively incorporated into the new development. Advice should be sort from the Glamorgan and Gwent Archaeological Trust before such decisions or designs have been submitted.

Rhondda Cynon Taff Local Development Plan 2006 – 2021

4.3.6 The Rhondda Cynon Taff Local Development Plan (LDP) was adopted in March 2011. Policy AW 7 - Protection and Enhancement of the Built Environment, states that *'Development proposals which impact upon sites of architectural and / or historical merit and sites of archaeological importance will only be permitted where it can be demonstrated that the proposal would preserve or enhance the character and appearance of the site*.'

4.3.7 Paragraph 5.49 of the policy identifies the nature of the historic environment, including 86 scheduled monuments, 366 listed buildings, 16 conservation areas, 1 registered historic landscape and 5 registered historic parks and gardens. These features are integral to the quality of the County Borough's environment and trace the development of the area over time. Over the plan period the council will seek to implement enhancement and management schemes to improve the character, quality and appearance of these features. Paragraph 5.50 also recognises that in addition to formally recognised buildings and areas there are individual buildings, groups of buildings and features, which are not subject to formal recognition but make an important contribution to the character and appearance of local communities and the policy will ensure that these features are protected and enhanced.

4.3.8 The LDP is supported by supplementary planning guidance documents, which are a material consideration in the planning process. The Historic Built Environment document includes guidance on development affecting listed buildings, conservation areas, scheduled monuments, archaeology, historic parks and gardens and historic landscapes. It summarises the issues affecting these features and details planning objectives and requirements. The following extracts are of particular relevance to this assessment.

4.3.9 Regarding listed buildings paragraph 4.1.5 states '*Development should not be detrimental to the setting of the building and the integrity of the building should not be unduly compromised in any other way*.' Regarding conservation areas paragraph 4.2.8 states '*Local views, landmarks and topographical features, either within or adjacent to the conservation area, particularly key vehicular or pedestrian approaches and gateways, should be protected, having regard to the policies and local views identified in any local Conservation Area Appraisal'*.

4.3.10 Regarding archaeology paragraph 4.3.2 states '*Where an archaeological site is identified as present, consideration will be given to the extent, nature, condition and importance of any such site. Sufficient information should be made available to determine the impact of the proposed development on the archaeological resource'* and 4.3.3 '*Where appropriate, conditions will be placed on planning permissions to ensure the archaeological resource is appropriately surveyed, preserved and recorded. Mitigation measures should also be put in place where appropriate*.'

4.3.11 Regarding the historic landscape paragraph 4.5.2 states *'Any planning application that has more than a local impact on the historic landscape should be accompanied by an evaluation of its impacts. Proposals should not have an adverse impact on the special historic landscape areas*.' In addition, paragraph 4.5.3 states '*When developments that require EIA are proposed within a registered historic landscape area, an assessment is required at the scoping stage to identify the significance of its likely impacts. This should be undertaken using the ASIDOHL (Assessment of the Significance of the Impact of Development on Historic Landscapes) methodology, as set out in the Technical Annex to the Guide to Good Practice on using the Register of Landscapes of Historic Interest in Wales in the Planning and Development Process.'*

4.4 Guidance and Advice

4.4.1 This DBA was undertaken with regard to all relevant industry guidance, principally the Chartered Institute for Archaeologists 'Code of Conduct' (2014), 'Standard and guidance for historic

environment desk-based assessment' (2017) and 'Standard and guidance for commissioning work or providing consultancy advice on archaeology and the historic environment' (2014).

Conservation Principles for the Sustainable Management of the Historic Environment in Wales (Cadw 2011)

4.4.2 This guidance sets out six conservation principles and an approach for making decisions about all aspects of the historic environment

4.4.3 **Principle 1** - Historic assets will be managed to sustain their values:

- To be sustainable, investment in the conservation of the historic environment should bring social and economic benefits. On the other hand, investment in social and economic programmes should bring environmental benefits.
- All heritage conservation actions lead to interventions. These must be justified by demonstrating that the benefits in protecting, increasing the understanding and sustaining the heritage values of the historic asset decisively outweigh the losses and harm caused.
- New work must respect the setting and significance of the historic assets affected. The quality of design and execution must add value to that site and its setting, both now and in the future.

4.4.4 **Principle 2** - Understanding the significance of historic assets is vital:

- Understanding and articulating the values of an historic asset is necessary to inform the decisions about its future. The degree of significance determines what, if any, protection, including statutory designation, is appropriate under law and policy.

4.4.5 **Principle 3** - The historic environment is a shared resource:

- There is a strong public interest in the heritage values of different places, whatever their ownership. The use of law, public policy and investment is justified to protect that interest. The legal procedures needed to obtain planning, listed building and scheduled monument consents provide the mechanisms for arbitrating between private and public interests.

4.4.6 **Principle 4** - Everyone will be able to participate in sustaining the historic environment:

- People should not carry out work on an historic asset unless they have the appropriate skills or qualifications to undertake the work.

4.4.7 **Principle 5** - Decisions about change must be reasonable, transparent and consistent:

- Owners and managers of historic assets will be encouraged to seek advice and examples of good practice in preparing their proposals for change.
- Public authorities will make decisions about changes to the historic environment by applying expertise, experience and judgement, in a consistent and transparent process guided by law and policy.
- Public authorities, within the resources available to them, will undertake sufficient assessment and public engagement to inform and justify the decisions they make.
- When considering change, public authorities will give due importance to the heritage values of a site when considering the sustainability of proposals submitted to them.

4.4.8 **Principle 6** - Documenting and learning from decisions is essential

- The information and documentation gathered in understanding and assessing the significance of an historic asset should be retained by the owner and manager of that place, and a copy be placed in a public archive. This will ensure that future generations will benefit from the knowledge gained.
- The records of the justification for decisions, which affect an historic asset and the actions that follow, will be maintained as an accessible and cumulative account.

- In the unusual event that all or part of an historic asset is to be lost as a result of a decision or inevitable natural process, the opportunity to extract the information that it holds about the past must be taken. This loss will require recording, investigation and analysis, followed by archiving and dissemination of the results, all to a level that reflects its significance.
- Where such a loss is the direct result of human intervention, the costs of this work should be borne by those who benefit from the change, or whose role it is to initiate such change in the public interest.

Technical Advice Note 24 (2017)

4.4.9 This document supersedes the former Welsh Office Circulars 60/96 Planning. The purpose of the Technical Advice Note (TAN) is to provide guidance on how the historic environment is considered during the planning and decision-making process, this includes listed building consent applications. The TAN provides specific guidance on how the following aspects of the historic environment should be considered:

- World Heritage Sites
- Scheduled Monuments
- Archaeological Remains
- Listed Buildings
- Conservation Areas
- Historic Parks and Gardens
- Historic Landscapes
- Historic Assets of Special Local Interest

Historic Environment Records in Wales: Compilation and Use (2017)

4.4.10 Under Part 4 of the Historic Environment (Wales) Act 2016 local authorities in Wales, National Park authorities in Wales and Natural Resources Wales all have a duty to compile and provide access and guidance to use of HERs. They must all pay regard to this statutory guidance on the compilation and use of HERs in Wales. These public bodies have an important role in the management and conservation of the historic environment and the way in which it is promoted, accessed and appreciated by the public.

5 Sub-Section 1

5.1 Cultural Heritage Baseline

5.1.1 For ease of reference in this document each heritage asset, unless otherwise stated, has been given a project identification (project ID) number. For all designated assets with statutory protection their identification number begins with an **SM** for Scheduled Monuments and **LB** for Listed Buildings, each are then followed by a sequential number where required. Other designated heritage assets and all non-designated heritage assets have been given a sequential number and all archaeological events have been prefix with an **EV** followed by a sequential number. All assets and events can be found in the Gazetteer in Appendix A. All heritage assets are shown on Figure 2.

5.2 Designated Assets

5.2.1 There is one Scheduled Monument, eight Listed Buildings and two registered parks within the study area. Only one asset, a park (**57**), is located within the 250m buffer, all the rest are within the 500m study area.

Scheduled Monuments

Felin Isaf Castle Mound (SM3)

5.2.2 The asset comprises a motte and ditch of a castle which date to the Medieval period (c. 1066 – 1540AD) located c.370m to the east of the Site. A motte is a large conical or pyramidal mound of soil and/or stone with a tower constructed of timber or stone on top. Around the base of the motte was usually either a wet or dry ditch. The Felin Isaf motte measures c.4m high and the ditch, which survives best on the eastern side, measures c.8.5m wide and 0.6m deep. The monument is located on the northern side of an old riverbed of the Ely. Today it is located within an industrial park owned by Renishaw and surrounded by trees to the north west, a road to the north east and the railway to the south west.

5.2.3 The monument is of high significance for its evidential value concerning medieval defence practices. It is a well-preserved monument and an important part of the medieval landscape. It has strong archaeological potential and evidential value and can contribute to regional research framework aims.

Listed Buildings

5.2.4 Within the north western part of the 500m study area is a collection of six Grade II Listed Buildings (**LB7, LB14, LB12, LB13, LB15, LB16**) located within the registered historic parkland of Miskin Manor (**57**). All of these assets individually have medium value but as a group, Listed Buildings and park, they contribute to one another significance and as a group they have high significance. Each asset has architectural or artist and historical value.

5.2.5 The two other Grade II Listed Buildings (**LB4, LB6**) are located the registered historic park of Hensol Castle (**58**). The Listed Buildings and the park add significance to one another, individually they have medium significance but as a group they have high significance. Each asset has architectural or artist and historical value.

Miskin Manor (LB7)

5.2.6 Miskin Manor (**LB7**) is located in extensive grounds accessed by a private drive c.290m to the north west of the Site. The manor was designed in the Tudor-Gothic style in the 19th century and it retains this character. The exterior is snecked with rock-faced sandstone in the front and rubble stone in the rear. The interior of the property was severely damaged due to a fire in 1952, however the main hall, drawing room and dining room retain their original Tudor-Gothic style. There is a coach house connected to the manor and it is included in the listing. This building is an early feature in the manor complex and has been altered for residential purposes.

5.2.7 The asset has architectural value due to its relatively unaltered state and survival of internal features. The building has potential archaeological value as the current manor replaced a pre-existing building and a structure has known to been present at this location since the 11th century.

Upper Terrace Wall and Pavilion (LB12)

5.2.8 The upper wall and pavilion (**LB12**) on the western side of Miskin Manor (**LB7**) were built in the late 19th century. The terrace wall consists of a long-buttressed revetment wall with rock faced snecked stone cladding and flat freestone coping detail. The side and rear walls of the asset are of rubble stone and it has a stone tile roof.

Lower Terrace Wall (LB13)

5.2.9 To the south west of the upper terrace (**LB12**) and pavilion is the lower terrace (**LB13**). The asset was built in the early 20th century and consists of a revetment wall in two parallel sections of rubble stone with flat copings that terminate with square piers and ball finials. At the northern end the walls are linked with wide stone steps to the lower terrace.

Kitchen Garden Walls (LB14)

5.2.10 Located on the northern side of Miskin Manor (**LB7**) is the kitchen garden walls (**LB14**). They were built in the mid to late 19th century and were altered to incorporate a gate screen in the early 20th century. The walled garden is rectangular in shape and the walls measure 3.5m tall, the walls were constructed of buttressed brick and the northern wall has an outer face of rubble stone. Inside the garden is a central brick-lined channel aligned north to south. Against the northern wall is a former lean-to greenhouse which retains its curved iron trusses and a late 19th century brick propagating house. Several other original and later buildings are located along the exterior walls.

Pair of Beasts at West (LB15) and East (LB16) Entrance to Miskin Manor

5.2.11 Two listed sculptures flank the east (**LB15**) and west (**LB16**) doorway of Miskin Manor (**LB7**). The pair are Tudor-style king's beasts, heraldic dragons standing on tall pedestals, made of reconstituted stone. They are likely to be early 20th century in date and are of a style similar to those at St Donats Castle.

Hensol Park

Hafod Lodge to Hensol Castle (LB4)

5.2.12 The Lodge (**LB4**), also known as Bottoms Lodge, is located c.500m to the west of the Site. It is a mid-19th century structure built at the same time as extensive renovations were conducted at Hensol Castle, in the grounds of which the asset stands and provides entrance to. The renovations were conducted by T H Wyatt and D Brandon in the Tudor-Gothic style which is reflected in the Lodge. The asset is single storey with attics and clad in scribed stucco with monumental stone finials in the front.

Bridge to Hensol Castle (LB6)

5.2.13 The listed bridge (**LB6**), c.500m to the west of the Site, is located near the north eastern end of the main drive to Hensol Castle, near to Hafod Lodge (**LB4**). The asset is contemporary with the renovations of Hensol Castle and construction of the Lodge in the mid- 19th century. The structure is broad with four stone arches, it is built of coursed rubble with part-balustrade parapets along the roadside.

Parks

Hensol Park

5.2.14 Hensol Park (**58**) is grade II listed and surrounds the 17th century stately home that the park takes its name from. The asset is located c.340m to the west of the Site. The original property within the park was a castle which was in existence by at least 1419 when it was owned by Judge David Jenkins and family. Later in the 1700's the Talbot family owned the property. William Talbot was responsible for laying out and starting the landscaping of the grounds. In 1824 the estate was passed onto the

Crawshay family. William Crawshay improved the walled garden and extended the deer park as well as improvements to the lake and grounds. In 1838 Rowland Fothergill bought the estate and remodelled the castle into a stately home. In the 20th century the house and parkland were used by Glamorgan County Council as a hospital for men and women with learning disabilities. In 2004 the property was yet again sold and is now used as a golf course, wedding and conference venue.

5.2.15 Cadw have recognised that the park has an essential setting, which is protected, on its western and northern sides. This essential setting is an area outside of the designated park area but recognised for its sensitivity to the park.

5.2.16 The park has been designated by Cadw for its medium significance, it has evidential value for its long history and communal and historic value for its use by the public and residents. The park also has aesthetic value for its designed and pleasant layout.

5.2.17 The park also contains a kitchen garden (**61**) located to the south of the castle. It is not clear when these gardens were laid out. This asset is part of the designated area of the overall park and adds to the significance and value of the park.

Miskin Manor

5.2.18 Miskin Manor park (**57**) is grade II listed and located c.50m to the north west of the Site. It contains landscaped Victorian pleasure grounds located within a well-preserved Edwardian terraced garden. The house which the park surrounds is Tudor-Gothic in style and dates to the 19th century. The original name for the park and manor house was 'Maen Cun' or 'Lovely Plain'. The park has been recognised by Cadw for its medium significance and for its aesthetic and historical value.

5.2.19 Cadw have identified two significant views from the park and from the manor house. One to the south and one to the west. The organisation has also recognised that the park has an essential setting to the north east and west.

5.2.20 Included in the parkland are two kitchen gardens (**59, 60**) which are located close to the manor house on the north eastern side. It not clear which period these assets date to but they are probably contemporary with the re-development of the property and parkland either in the Victorian or modern period. These assets are part of the designated area of the overall park and they contribute to the significance and value of the park.

5.3 Non-designated Assets

Prehistoric

5.3.1 There is only one asset which dates to the prehistoric period located within the 500m study area c.500m to the north of the Site. The Standing Stone at Miskin Manor (**3**) is a Bronze Age monument which comprised of a slab of sandstone with a rounded top, wider than it is tall and set into the ground facing north west and south east. It contains an inscription dated to the early 20th century: 'AT LAST OCT 30 1919 RW'. The stone originally stood 16.5m north west of its current location and was relocated after excavation in advance of construction of the A4119 in 1976. An archaeological excavation (**EV4**) was conducted in 1976 which revealed an oval area of compacted stone covering a semi-circular shallow pit to the north of the stone which contained a whetstone and secondary worked flint. The socket of the standing stone contained another whetstone and a large slab of Pennant sandstone which braced the standing stone from the rear. It is likely that this piece had broken off from the standing stone and was secondarily used in the socket. This asset has medium significance as it could contribute to regional research goals into prehistoric ritual monuments. It has evidential value and archaeological potential.

Roman

5.3.2 There are no assets which date to this period within the study area.

Medieval

5.3.3 There is one group of assets, four lynchets (**1**) located within the buffer c.175m to the north east of the Site, which date to this period. Lynchets are a type of field system, usually formed or created by

the action of ploughing on slopes, the assets were aligned north to south along the valley slope. Potsherds dating from the 12-14th centuries cover the area and indicate that the land has been cultivated since the medieval period. The assets are of medium significance and have evidential value, they can contribute to the regional research framework questions into medieval farming practices.

Post Medieval

5.3.4 A potential pottery Kiln (**2**) was located in the study area c.500m to the east of the Site within Llanfarach farmstead. The asset consisted of several pottery wasters, burnt brick fragments, slipware sherds and glazed ridge tiles all of which suggests the presence of a non-extant kiln. The close proximity of the farmstead to the kiln could mean that the farm occupants were the sole users of the asset or that they supplemented their income by producing pottery for the local area. Similar kilns were found in Ewenny, to the south west of the Site, so these local industries are not unusual in the post medieval period. The asset is of medium significance and has evidential value as it could contribute to research questions in the regional research framework.

5.3.5 Within Hensol Park (**58**) are several assets identified on the first edition of the OS map of the area, Hensol Mill (**9**), the mill pond (**43**) and a possible water course (**10**) with a weir (**11**) at its western end. All are located within the study area c.350m east of the Site. The mill (**9**) was used for grinding corn but its function has changed from industrial to residential, it is unclear when this occurred. The 'L' shaped range of white buildings currently at the mill vary in age, the oldest is the long northern arm of the 'L'. The asset has been modernised but still retains its heritage value. The mill pond (**43**) is still partially extant but no longer reaches the mill. The distinctive 'S' shape of the pond can still be seen in the landscape and on aerial photographs. The water course (**10**) and weir (**11**) could not be seen and are potentially non-extant. Both would have served the mill and the pond. All these assets have group value and add significance to each other and the park. Overall their significance is low, and they all have evidential and historical value.

Modern

5.3.6 There are three assets located along the railway line to the west of the Site which are in close proximity to Felin Isaf (**SM3**). The first is a pond (**12**), within the buffer area c.100m to the west of the Site, the second was a watercourse (**13**), c.350m from the Site, and an earthwork pond (**14**), c.255m from the Site both were found within the 500m study area.

5.3.7 The large pond (**12**) is still extant as is the earthwork pond (**14**) but it is not clear if the watercourse (**13**) is still extant. The watercourse (**13**) and pond (**14**) were created due to the removal of the northern arm of the River Ely prior to 1888 due to the creation of the railway. The 1847 Pendoylan and 1843 Llantrisant tithe maps do not show these features but do show the sinuous northern arm of the river. By the 1st edition OS map of the area the river has been moved and the features (**12, 13, 14**) have been created. These assets are of low significance and have historical value.

Unknown

5.3.8 A field system (**47**), located within the study area c.500m north of the Site, was identified from 1940s aerial photographs. The asset predates the current field lay out which is potentially post medieval in date. The asset is of medium significance and has historical value and can assist with regional research framework questions.

5.3.9 During the walkover survey a possible mound formed of dump material (**72**) was observed c.250m to the east of the Site. Its function and date are unknown but as it was located close to the River Ely it may be associated with some sort of river defence. Alternatively, as the asset was located within a field it could be agricultural in origin. The asset is of unknown significance and has historical value.

5.3.10 Also identified during the walkover survey were two non-extant field boundaries (**63, 64**), located within the buffer area c.230m to the west of the Site. One of the boundaries (**64**), aligned north to south, was removed in the modern period for the installation of a power cable. Today it can be seen as a raised bank with shallow ditches on either side. The second (**63**) was aligned east to west, its western end stopped when it reached the north to south boundary (**64**). This feature was seen as a

slight depression in the landscape. It was removed to create a bigger field. The asset is of low significance and has historical value.

5.3.11 A possible old channel or leat (**79**) associated with a non-extant farmstead known locally as Moat Farm was located within the study area c.500m to the west of the Site. It was noted during the walkover survey as a long sinuous linear aligned nearly north to south. The asset predated the current field layout as a well-established field boundary now crosses the potential leat or channel. It is possible that Moat Farm had some sort of water course associated with it, hence the name, which required a water source. It is also possible that the farm had a mill which required waterpower. There is a HER asset (**5**) located within this area where a non-extant farm, Maendy Bach, is located and it is possible that these two assets are connected. However, historical maps of the area do not show any water courses near to Maendy Bach. In close proximity to this potential channel or leat was a semi-circular ditch (**5**), located within the study area c.800m to the east of the Site. It is not clear if these features are contemporary or even connected. They are both of low significance and have evidential value.

5.4 Previous Archaeological Events

5.4.1 Several archaeological events have taken place within the 250m buffer and 500m study area. However, the results of these events offer little additional information to inform the understanding of archaeological potential for the Site.

5.4.2 A survey (**EV5**) was conducted to the west of the Site by the Royal Commission on the Ancient and Historical Monuments of Wales, at Felin Isaf (**SM3**) in 1976. No information was provided concerning this event.

5.4.3 In 1976, a partial excavation (**EV4**) was conducted at the Standing Stone at Miskin Manor (**3**) which was located along the east side of the access road, to the north west of the Site. The excavation revealed that the stone had broken from a larger slab and disproved a theory that the stone had been moved. A scatter of Post Medieval artefacts surrounding the asset indicated that the area had been landscaped during that period.

5.4.4 Four events have taken place at Hensol Park to the east of the Site; a desk-based assessment (**EV25**), a watching brief (**EV29**), a landscape case study (**EV19**) and a site visit (**EV9**).

5.4.5 The desk-based assessment (**EV25**) was conducted in 1992 in reference to an extension to the Golf club at Hensol Park. The report was limited to known archaeological remains; however, they did not specify what these remains were, and recommended that further archaeological mitigation would be required on the site prior to any ground works.

5.4.6 In 2001, GGAT undertook a watching brief during the construction of a covered training facility (**EV29**). Some modern drainage and levelling features were encountered along with a later post medieval ceramic and a prehistoric flint waste flake.

5.4.7 In 2010, a case study and landscape interpretation project (**EV19**) was undertaken. This project aimed to create a predictive model of the Romano-British and early medieval settlements in Wales and to help identify new sites. The study examined the relationship between settlements and landscape characteristics.

5.4.8 In 2012, GGAT visited Hensol Mill (**9, EV9**), as part of a project funded by Cadw. The project aimed to assess mills and their waterpower within the Glamorgan and Gwent area. The building was found to be in good condition and very well kept. However, it had been altered and it was unclear how many original features survive.

5.5 Historical Map Regression

5.5.1 A historic map regression exercise was undertaken to identify any heritage assets not recorded by other sources, to inform the understanding of the time-depth of the historic landscape and to establish if there had been any previous modern impacts to the Site which could affect its archaeological potential. Analysis and assessment of the available mapping for the Site and surrounding area was carried out using OS mapping provided by the Library of Scotland's online

catalogue and tithe maps accessed from The National Library of Wales website. The results of the exercise are summarised below in chronological order:

5.5.2 The earliest maps the Site appears on are the 1843 Llantrisant tithe map and 1847 Pendoylan tithe map. The northern part of the Site, around the M4 Junction 34 appear on the 1843 Llantrisant tithe map. This part of the Site was owned by Anne Saunderson and shown as being part of a large meadow field with a road aligned north east to south west, there are two other meadow fields to the east. Further to the east are several small thin fields which could be the remains of medieval strip fields. As the Site progresses south it crosses through more meadow fields and over the Ely River, here the waterway has nearly created an oxbow lake. This is where the 1843 Llantrisant tithe map ends and the 1847 Pendoylan tithe map begins. At the northern end of the 1847 Pendoylan tithe map a nearly north to south road can be seen, its northern end curves to the west and then round to the north where it probably joins the north east to south west road seen in the 1843 Llantrisant tithe map. The north to south road on the 1847 Pendoylan tithe map remains the same today as do many of the field boundaries. According to the tithe accord the fields here were either arable, pasture or meadow with some woodland within the central part of this section. The dominate landowners here were Sir Thomas Aubrey, Rowland Fothergill and John Saunderson.

5.5.3 By the 1st edition OS map of the area in 1888-1913 the small strip fields at the north eastern end of the Site have been removed to create a larger field. The large and smaller field meadows and the north east to south west road are still extant but the Great Western Railway has been established on a north west to south east alignment. To the south of this the river has realigned itself and an oxbow lake has been established. The north to south road and surrounding fields have not altered since the tithe map. What is depicted on this map and not on the tithe maps are footpaths and track ways between farms and their land. This is especially apparent within the Bryn Helygen (**23**) farm to the south east of the Site and Castell-cwli immediately west of the central part of the Site.

5.5.4 There are no significant changes to the land, except for the occasional removal or addition of a field boundary, between 1913 to until 1974 when the M4 motorway and junction 34 are created. This had a major impact on the landscape. The fields around Miskin Manor (**LB7**) have been altered with the creation of the north to south aligned A4119 and the trackway has now been removed. To the south of the new junction a new northern segment of the road to Pendoylan has been created. Those fields in close proximity, particularly to the east, have been altered and were either removed or made smaller.

5.5.5 The only change from this 1974 map to the present, with the exception of a few field boundaries being removed, is the creation of a golf driving range to the east of the Site.

5.6 Walkover Survey

5.6.1 The results of the walkover for Sub-Section 1 are described from north to south, covering land to the east and west of the proposed route. The area covers land parcels in the north part of the study area where the M4 junction 34 meets the route of the existing Pendoylan road. A main railway line runs north west to south east and crosses the River Ely; the river flows south until a sudden change of course to the east. The area consists of field systems, divided by the major infrastructure corridors of the M4 and the railway.

5.6.2 Three large adjoining fields situated north east of the M4 junction 34 were visited. The land was comprised of pasture fields bounded by managed agricultural hedgerows and established tree lines. Some access was restricted due to grazing livestock. The field furthest north contained an archaeological feature in the form of lynchets (**47**, Plate 1).

5.6.3 There were no further archaeological earthworks or remains within the other fields.

Plate 1 Lynchets (47) looking north

5.6.4 Miskin Manor (Plate 2) was visited, located on the northern perimeter of Sub-Section 1 and the 500m study area. The asset comprises five listed buildings (**LB7**, **LB12**, **LB13**, **LB14**, **LB15**), two registered gardens (**59, 60**), and a registered park (**57**). A well-maintained hay meadow adjacent to the east side of the building was observed but no archaeological features were visible. The surrounding area is screened by dense tree growth which lies between the grounds and the M4 junction 34 (Plate 3).

5.6.5 Therefore, there would be no change to the visual aspects of the setting of Miskin Manor and its park from the proposed development to the south.

Plate 2 East view of Mishkin Manor (LB7) exterior

Plate 3 South east view of screening from M4

5.6.6 South of the M4, two sub-rectangular fields were visited on the eastern perimeter of the Sub-Section. The land lies 200m east of the proposed development and sits on a gentle northern incline. The terrain was comprised of agricultural land covered by pasture and scrub surrounded by a dense band of trees which screens the M4 from the landscape and may reduce some noise. No archaeological earthworks or remains were observed. An unusual group of boulders (Plate 4) was noted on the east bank of the River Ely approximately 65m east of the proposed development. It is unclear if their current location is due to natural causes or past human activity. There is no obvious evidence of human intervention in the location, but they appear out of character with the surrounding topography and there is a lack of similar features in the area.

Plate 4 Boulders on east bank of River Ely with proposed road on west side

5.6.7 An irregular shaped field 280m west of the Renishaw site was visited. The terrain consisted of scrub with an area of waterlogged ground towards the centre of the field. The area of water was likely

related to the adjacent watercourse. A possible archaeological feature (**14**) was detected along the southern edge of the field in the form of a raised mound (Plate 5) and may have been related to past dumping activity. There is believed to be no connection between this asset at that of Felin Isaf (**SM3**) located c.110m to the north east of the asset (**14**). Unsuitable ground conditions and the presence of livestock caused some restricted access within the field.

Plate 5 An unknown mound (14) possibly an overgrown dumping area, view to south west

5.6.8 A land parcel approximately 250m east of the proposed road was assessed. This included a walkover of a local driving range (Plate 6). The ground was flat and heavily landscaped which will have severely impacted preservation of archaeological remains. The surrounding fields to the east and west were a mixture of improved pasture and arable. The fields were divided by mature hedgerows and trees. No evidence of archaeology was found. However, it should be noted that fields containing scrub were difficult to assess for reasons of ground visibility.

Plate 6 Heavily landscaped driving range, view to north

5.7 Conclusion

5.7.1 Within the 250m buffer surrounding the route option in Sub-Section 1 is one park and its associated gardens, Miskin Manor (**57**), located north west of the M4 junction 34. On the basis of current design information there would be no physical impact to this designated heritage asset. Given the proximity of the asset to the proposed development there is very small potential for a change to its setting that affects its significance, but this is unlikely to be a major impact given the presence of an existing motorway junction in this location. There is one Scheduled Monument, eight Grade II Listed Buildings and one park between the 250m buffer and 500m study area of the Site. None of these assets would be physically impacted by the proposed development as they are beyond the extent of any physical works. There would also be no change to their setting as they are screened from view of the road by well-established vegetation. Consequently, they would experience no change to their significance.

5.7.2 The non-designated assets within the 250m buffer and 500m study area indicate low potential for prehistoric and roman remains. Remains from the medieval and post medieval periods were more prevalent with the field layouts, built heritage and archaeological features. The archaeological event record is weak within this part of the Site and offered little further information to inform archaeological potential. The walkover survey identified several assets, such as remains of non-extant field boundaries presumably removed to create larger fields. There was also a possible leat or water channel located close to a non-extant farm. It is not clear specifically what this feature was used for or which period it dates to. All the non-designated heritage assets, either identified by the GGAT HER or through walkover survey, would not be impacted by the Site as they are either non-extant or are outside the area of physical works in Sub-Section 1.

5.7.3 A review of historical maps revealed that the Site has been severely impacted by the creation of the M4 motorway, junction 34, the railway and the northern extension to the road to Pendoylan. Any archaeological remains that previously existed under the current road and railway alignments will have been severely impacted by this previous construction activity and no significant remains are likely to survive beneath this infrastructure.

6 Sub-Section 2

6.1 Cultural Heritage Baseline

6.1.1 For ease of reference in this document each heritage asset, unless otherwise stated, has been given a project identification (project ID) number. For all designated assets with statutory protection their identification number begins with an **SM** for Scheduled Monuments, **LB** for Listed Buildings and **CA** for Conservation Area, each are then followed by a sequential number where required. Other designated heritage assets and all non-designated heritage assets have been given a sequential number and all archaeological events have been prefix with an EV followed by a sequential number. All assets and events can be found in the Gazetteer in Appendix A. All heritage assets are shown on Figure 2.

6.2 Designated Assets

6.2.1 There are two Scheduled Monuments, five Grade II Listed Buildings, one Grade II* Listed Building, one park and one Conservation Area located within the 500m study area. Of these one Grade II Listed Building and one Conservation Area are located within the 250m buffer for the route option in this Sub-Section.

Scheduled Monuments

Y Gaer (SM1)

6.2.2 Y Gaer (**SM1**) is the remains of an Iron Age (800BC – AD74) defended enclosure, located within the study area c.475m to the west of the Site. It is made up of two oval concentric enclosures separated by an interior space of 10m. Each enclosure is defended by a single bank which has been reduced to a scarp. In the centre of the monument is a stony hollow which is likely to be the remains of a building. The monument is of high significance and has evidential value for its chronology, building techniques and representation of social organisation during the Iron Age. It can also contribute to discussion of regional research framework questions.

Two Cooking Mounds East of Ty'n-y-Pwll (SM4)

6.2.3 This monument is the remains of two burnt mounds (**SM4**) that likely date to the Bronze Age (2,300BC – 800BC), located within the study area c.500m to the east of the Site. They consist of an accumulation of burnt stones, ash and charcoal which are usually found next to a body of water with a feature capable of holding water within the mound or next to it. The monuments are of high significance for their evidential value to contribute to our knowledge of prehistoric ritual practices. They retain archaeological potential and may be associated with archaeological features of a similar date in the wider area.

Listed Buildings

Cae'rwigau Uchaf (LB1)

6.2.4 The listed farmhouse (**LB1**) is located within the study area c.500m to the west of the Site, set within open countryside and built upon a platformed area to the east of the Cae'rwigau moated site (**33**). The asset was constructed in the 16th to 17th century's and was probably part of the Llewlyn manor estate. The building is one and a half storeys tall with exposed rubble stone walls with a steep pitched roof which would have originally been thatched. The building would have started out as a single roomed dwelling, but it has been extended over the years in a sympathetic manner. The interior retains several original features such as the main fireplace and rare beehive stone oven. The asset is of medium significance and has aesthetic and historical value despite its alterations.

Dyffryn Mawr Farmhouse (LB2)

6.2.5 The farmhouse (**LB2**) is located within the study area c.500m east of the Site, it is situated in open countryside to the north west of Pendoylan village. This two-storey farmhouse has origins in the first half of the 17th century. The exterior is limewashed rubble and was re-fenestrated in the 19th century. The building has also been extended to the rear with additional work to the eaves and roof. The

interior contains several original features including an unusual mid-17th century spiral stone staircase and there are two substantial rubble open fireplaces with heavy timber bressumers. There is a possible 'priest's hole' in the rear of the kitchen fireplace which is a rare feature. All these features add to the medium significance of the property. The building has aesthetic and potential historic value.

Telephone Call-Box (LB3)

6.2.6 The asset is a K6 type cast iron red kiosk (**LB3**) located within the study area c.295m west of the Site. It is located within a grassy bank at the entrance to the 'garden village' area of Pendoylan (**CA1**). It is built to the design set by Giles Gilbert Scott which was introduced by the GPO in 1936. It consists of a domed roof with four lunettes which are embossed with crowns over red lettered opals and slits for ventilation. Its foundry plate is inscribed 'Carron Company, Stirlingshire'. It is of medium significance and has aesthetic value, it also adds value to the Pendoylan conservation area (**CA1**).

Pendoylan Cottages (LB5)

6.2.7 A row of listed cottages (**LB5**), located within the study area c.270m west of the Site, are set on a slope immediately to the north of St Cadoc Church (**LB9**). They were originally alms houses for Pendoylan village and date to the 19th century. The row consists of five houses, all are two storeys tall with a single window on each level on the front elevation. They are built of rubble stone with lime rendering. They are all of medium value with aesthetic, historic and group value with the church and add value to the Pendoylan conservation area (**CA1**).

Cae'rwigau Isaf (LB8)

6.2.8 The listed farmhouse (**LB8**) is located within the study area c.500m west of the Site, is set in the countryside south of Pendoylan village (**CA1**). The asset is a good example of a small 16th century yeoman farmhouse. When it was constructed it was occupied by the Llewelyn family who were patrons of the Glamorgan poet, Dafydd Benwyn. The building is two and a half storeys tall with limewashed rubble walls and gabled tile roof. The front elevation has dressed Pennant sandstone mullioned windows with hood moulds which are an original feature. The interior of the building retains many of its original 16th century features. The asset is of medium significance and has aesthetic and historical value.

Church of St Cadoc (LB9)

6.2.9 The Grade II* church (**LB9**), also known as St Cattwg, is located in the centre of Pendoylan village (**CA1**) c.250m west of the Site. It was constructed in the 14th century but was substantially rebuilt in 1855 and 1893. The building style is Gothic, and it is constructed out of course local rubble stone with slate cladding on the roof. The building has coped parapets and a Celtic wheelcross finial at the eastern end. The western door has a sharply pointed arch and door head which is potentially 16th century in date, a filled in 15th century doorway with sandstone surrounds can also be seen. The interior of the property contains the chancel arch which is an original 14th century feature and another potentially contemporary feature is a doorway. The church is of high significance with aesthetic and historic value. The asset also has group value with the Pendoylan Conservation Area (**CA1**) and other Listed Buildings within the area.

Parks

Hensol Park

6.2.10 Hensol Park (**58**) is Grade II Listed and surrounds the 17th century stately home that the park takes its name from. The asset is located c.340m to the west of the Site. The original property within the park was a castle which was in existence by at least 1419 when it was owned by Judge David Jenkins and family. Later in the 1700's the Talbot family owned the property. William Talbot was responsible for laying out and starting the landscaping of the grounds. In 1824 the estate was passed onto the Crawshay family. William Crawshay improved the walled garden and extended the deer park as well as improvements to the lake and grounds. In 1838 Rowland Fothergill bought the estate and remodelled the castle into a stately home. In the 20th century the house and parkland were used by Glamorgan County Council as a hospital for men and women with learning disabilities.

In 2004 the property was yet again sold and is now used as a golf course, wedding and conference venue.

6.2.11 Cadw have recognised that the park has an essential setting, which is protected, on its western and northern sides. This essential setting is an area outside of the designated park area but recognised for its sensitivity to the park.

6.2.12 The park has been designated by Cadw for its medium significance, it has evidential value for its long history and communal and historic value for its use by the public and residents. The park also has aesthetic value for its designed and pleasant layout.

Conservation Area

Pendoylan Conservation Area (CA1)

6.2.13 Pendoylan Conservation Area (**CA1**) is located within the buffer are c.195m west of the Site. It is a small village located in the Ely Valley and Ridge Slopes Special Landscape Area. It was designated as a conservation area in 1970 due to its special architectural and historic interest. The boundary of the conservation area comprises both the historic and modern (post 1950) development. The historic settlement pattern of the pre-1950 village consisted of five large buildings laid out in a linear form on both sides of the main road. The village was made up of a school, a row of cottages, church, public house and mansion. After the 1950s expansion, the village consisted of a housing estate of 19 houses, vicarage, two pensioners' bungalows and two private developments. The solely residential settlement has a strong community life centred on the church, chapel, pub and village hall. The asset has medium significance, with communal, historical and aesthetic value.

6.2.14 The Conservation Area Appraisal identifies a number of important views within and looking out from the Conservation Area. These views include:

- From Heol St. Cattwg, just to the east of the Church looking east.
- From the southern edge of the village green looking south and south east.
- Near to the junction of Heol St. Cattwg and the road to Pendoylan looking south east
- From the pathway opposite the Red Lion Public House looking north to the Church.
- A lane opposite the Church looking west.
- From the top of the Conservation Area looking south east towards the Church.

6.3 Non-designated Assets

Prehistoric

6.3.1 Only one asset dates to this time period, a polished thin-butted Neolithic axe head (**36**) which was likely part of a group of eight found while ploughing in a field half a mile south east of Caerwigau-Uchaf. This findspot is located within the buffer area c.175m to the west of the Site. This asset has the potential to assist with the regional research framework and is of medium significance. It has inherent evidential value but lacks contextual associations.

Roman

6.3.2 There are no assets which date to this period within the study area.

Medieval

6.3.3 Ffynnon Deilo (**17**), located within the buffer area c.200m west of the Site, is a nearly intact Jones' Class A well, meaning it bears the names of saints, trinity, God, Holy Innocents or Easter. It consists of a spring enclosed by a 0.6m high and 0.5m wide ashlar wall, externally embanked with earth and stone. The well chamber has no datable features and is incorporated in an ornamental garden. Originally the well would have been of high value to both local inhabitants, visitors and pilgrims and was likely associated with healing. It has evidential value due to its potential to reveal more about the

construction and use of medieval wells. The asset is of medium significance and may contribute to discussion of regional research framework questions.

6.3.4 A deserted medieval settlement (**33**) at Caerwigau is located within the study area 500m to the west of the Site. Little is known about the settlement but what is known is there was a church (**34**) located here in the early-13th century but it was demolished by the middle of that century. The church is potentially commemorated by the field name Chapel Close. The assets are of low significance, but they can help with regional research framework questions. They both have evidential value and high archaeological potential.

6.3.5 A farmhouse named Maes yr Haul (**31**) is located within the buffer area c.70m west of the Site and is still extant. The property is two stories tall with a gabled roof clad in slate. The property appears to have been modernised but still retains its historical significance. The farmhouse sits within its original farmland and is accessed via a long driveway. The asset is included in the Vale of Glamorgan Council's List of County Treasures. It is of medium significance but could potentially assist with regional research framework questions. It has evidential and historical value.

6.3.6 The site of a house (**37**) is located within the study area c.450m west of the Site. The asset is no longer extant and is not visible in air photographs and no trace could be found in the recorded location. It is not recorded on historic maps, which either suggests it was no longer standing prior to the 1847 tithe map or that it was constructed and demolished in between map recordings. It is also possible that the recorded location is incorrect. The asset is of low significance and has the potential for evidential value, if there are any buried remains in the recorded location.

6.3.7 In the mid-19th century a cross-base (**39**) is reported to have been found in a field called 'Dwyr Capel' in the 1847 tithe apportionment. As the asset is a findspot it is non-extant. It is located within the buffer area c.175m to the west of the Site. The asset is of low significance and has inherent evidential value.

6.3.8 There are a group of three assets that are located in the Pendoylan Conservation Area (**CA1**) within the study area c.235m to the west of the Site; Ffynnon Gattwg (**25**), St Cadoc's churchyard (**40**) and a churchyard cross (**41**). Ffynnon Gattwg (**25**) is a holy well located near to and possibly associated with St Gattwg's Church (**LB9**). It is one of Jones' Class A wells, meaning it bears the names of saints, trinity, God, Holy Innocents or Easter. The area has been drained and there is no trace of the well or water source. The second asset is St Cadoc's churchyard (**40**) which is quadrangular in shape with a coursed rubble wall. The 1847 Pendoylan tithe map shows that originally the northern side was curved. The churchyard contains a cross (**41**) which is nearly intact and consists of a socket stone mounted on a square block of stone to the north of the church. All three assets add group value to each other and the Listed Buildings and Conservation Area of Pendoylan. They are of medium significance but can help with regional research framework questions. They have historical and evidential value

6.3.9 The boundary of Talfyn Deer Park (**6**) was identified within the study area c.500m west of the Site. The deer park dates to the 13th century and was noted for its atypical ditch form. However, it is possible that this ditch is actually related to agricultural activities. The asset is of low significance and has evidential value.

Post Medieval

6.3.10 Bryn Helygen (**23**) farmhouse is located within open farmland within the buffer zone c.215m to the east of the Site. It is a two-story building with a hipped tiled roof. It appears to have been modernised but still retains some heritage value. It is of low significance and has historical value.

6.3.11 Trehedyn House (**35**), is located within the study area c.365m east of the Site. Originally the building was two structures, but they now have been amalgamated into one. The overall style of the combined property is Queen Anne, it has now been painted white and modernised with a large conservatory. One of the properties was the birthplace in 1761 of the independent minister and hymn writer Thomas William. The asset is included on Vale of Glamorgan Council's List of County Treasures. The house is of low significance and has aesthetic and historical value.

6.3.12 Tre Dodridge Lime Kiln (**8**) is located within the study area c.350m to the west of the Site within a dense patch of trees. Such a kiln would be necessary for the production of lime for use in building and for agricultural purposes, which was a widely used product. Settlements would have had their own local supply, the close proximity of Pendoylan and its main road suggests that the kiln served this village. Later map evidence shows that the kiln was potentially in use when a surrounding quarry was established. The two were probably used in conjunction with one another. It is of low significance and has evidential and historical value.

6.3.13 Pendoylan Cottages (**50-55**) are a row of cottages located within the study area c.360m to the west of the Site. The buildings are now no longer extant and there is no evidence for them on any historical maps. They could have been demolished before the 1847 tithe map or they could be recorded in the wrong location. They are of low significance and have evidential value.

6.3.14 Clawdd Coch Farmhouse (**48**) is located within the small settlement from which the asset takes its name, within the buffer area c.220m to the west of the Site. The property is a 17th century Welsh long house which retains many of its external historical features. However, its roof has attic conversions. It is two-storeys tall with a hipped slate roof. It currently operates as a guest house with a working farm behind. It is of low significance and has historical and aesthetic value.

6.3.15 Within Hensol Park (**58**) is a mill (**9**) identified on the 1st OS map of the area, located within the study area c.500m north west of the Site. The mill (**9**) was used for grinding corn, the mill's function has changed from industrial to residential, but it is unclear when this occurred. The 'L' shaped range of white building currently at the mill vary in age, the oldest is the long northern arm of the 'L'. The asset has been modernised but still retains its heritage value. The building has a low significance, with evidential and historical value.

6.3.16 Caerwigae Mill (**16**) and mill pond (**18**) are located within the study area c.500m west of the Site. The pond (**18**) is non-extant, the mill (**16**) is a partially extant but located within a dense patch of vegetation and is in a dilapidated state. The mill leat is still functioning. Both assets are of low significance for their evidential and historical value.

Modern

6.3.17 Pendoylan War Memorial Village Hall (**49**) is located within the study area c.335m to the west of the Site along the road to Pendoylan. The single storey metal building with green sides and a red or pink roof is located to the north of the settlement from which it takes its name along the main road. The building was constructed in the 1930s as a memorial to those who died in the First World War. It is of low significance and has aesthetic, historical and communal value.

Unknown

6.3.18 A pond (**19**) is located within the study area c.400m to the south west of the Site close to Y Gaer (**SM1**). It is not clear how old the pond is or if it has a relationship with the Scheduled Monument. It is first recorded on the 1875 OS map of the area and is still extant today. It is of unknown significance and has historical value.

6.3.19 Tynewydd-y-Bryn (**20**), within the study area c.500m to the east of the Site, is an earthwork enclosure c.40m square with rounded corners. It is possible that this asset is prehistoric in origin but there is little evidence to confirm this. There is a potential rectangular house platform in the north west corner. The date and function of this feature is unknown but there is a spatial relationship between this feature and the enclosure. It is of unknown significance and has historical value.

6.3.20 A possible mound, almost a platform, with a dip to the north, and a curving edge to the south and west (**78**) was located within the buffer area c.190m east of the Site. It is not clear what this feature is or what period it is attributed to. It could be natural in origin. It is of unknown significance and has evidential value.

6.3.21 During the walkover survey a possible mound formed of dump material (**73**) was found within the buffer area c.55m to the east of the Site. Its function and date are unknown but as it was located within an area which showed evidence of water runoff it could be natural in origin or used to block

the water flow down the slope. Alternatively, as the asset was located within in a field it could be agricultural in origin. It is of unknown significance and has evidential value.

6.3.22 Two brick pillars (**74, 75**) were located within the buffer area c.130m to the east of the Site. They were found close to a stream and were hollow inside and lined with cement. It is probable that these features were once used for water management, evidence for this came in the form of old plastic pipes located nearby, the close proximity of the water course and the concrete lining of the posts which could have been used as waterproofing the pillars. They are both of low significance and have evidential value.

6.3.23 A possible quarry pit (**76**) is located within the study area c.390m to the west of the Site within Pendoylan (**CA1**). The asset is now covered in vegetation and has a large tree planted in the centre. The height/age of the tree suggests the feature is not of recent origin. It is of low significance and has evidential value.

6.3.24 A ruined farm building or cottage (**77**) is located within the study area c.425m to the west of the Site at the southern end of Pendoylan (**CA1**). The property may be medieval or post medieval in origin, but it was updated and extended in the modern period which makes dating the asset problematic. It is also unclear how long the property has been derelict for. The asset is located along the road to Pendoylan and set in open fields. It was potentially a farmer's cottage or used for agricultural purposes. It is of low significance and has historical value.

6.3.25 Non-extant or removed field boundaries (**63-71**) represent the widening of fields, they are located within the study and buffer areas. This probably occurred due to modern farming techniques and use of machinery. Two non-extant field boundaries (**63, 64**), were found c.205m to the east of the Site. One of the boundaries (**64**), aligned north to south, was removed in the modern period for the installation of a power cable. Today it can be seen as a raised bank with shallow ditches on either side. The second (**63**) was aligned east to west, its western end stopped when it reached the north to south boundary (**64**). Two former boundaries (**66, 67**) were located c.165m to the east of the Site and may have been used to funnel water off the fields. The large field in which the assets sit slopes gently down to a stream. An 'L' shaped field boundary (**65**) is located c.105m to the east of the Site near to the eastern side of Pendoylan (**CA1**). The asset marks a distinctive step in the field, possibly a lynchet, and it can be seen from aerial photography. Two linear boundaries (**68, 69**), aligned north east to south west, were identified to the south of Pendoylan (**CA1**), c.50m and c.225m respectively. A further two north east to south west boundaries (**70, 71**) were located to the south west of Pendoylan (**CA1**), c.470m and c.420m respectively. All are low significance and have evidential value associated with the agricultural use of the landscape.

6.4 Previous Archaeological Events

6.4.1 Several previous archaeological events have taken place within the 250m buffer and 500m study area. However, the results of these events offer little additional information to inform the understanding of archaeological potential for the Site.

6.4.2 Two events occurred (**EV1, EV2**), c.500m to the east of the Site, at the burnt mound Scheduled Monuments (**SM4**) and were undertaken by GGAT in 2006. A field visit was conducted as part of a project that was assessing known burnt mounds in south east Wales. The aim of the project was to enhance the interpretation and understanding of the monuments which would enable the better recognition of the assets in their different states of preservation.

6.4.3 A part of a large Mains Refurbishment Scheme, Border Archaeology conducted a watching brief from Pendoylan to Welsh St Donats (**EV7**) in 2007, c.355m to the west of the Site. Only a small amount of post medieval ceramic building material was found at an extraction pit at West Tair Onen.

6.4.4 In 2012, GGAT visited Caerwigae Mill (**EV8**) as part of a project funded by Cadw, c.500m to the west of the Site. The project aimed at assessing mills and waterpower in the Glamorgan and Gwent area. The building was found in a state of disrepair with a tree growing within the ruins.

6.4.5 As part of their 'Medieval and Post Medieval Wells in Glamorgan and Gwent' project GGAT visited Ffynnon Delio (**EV12**) c.190m to the west of the Site. The report found that the well was easily accessible and was located on the edge of a pond.

6.4.6 As part of the 'Prehistoric Defended Enclosures of Glamorgan' project by GGAT a site visit (**EV16**) was conducted at Tynewydd-y-Bryn by GGAT in 2006, c.500m to the east of the Site. The project aimed to identify form, current condition and current threats to the assets.

6.4.7 A study was conducted at Bishopston (**EV20**), covering the southern part of the Site and study area, in 2015 by the University of Reading and Cotswold Archaeology for their 'Rural Settlement of Roman Britain' project. The aim of the project was to create a resource which would bring together excavation evidence and grey literature reports on rural settlements and countryside in the Romano-British period.

6.4.8 Cottrell Park watching brief (**EV23**), c.500m to the east of the Site, was conducted in 2001 by Cambrian Archaeological Projects. The area that the event covered is recognised by the HER for this high archaeological potential. However, the events did not reveal any archaeological remains or artefacts.

6.4.9 At Hensol Castle a watching brief on the playing fields (**EV21**), c.500m to the west of the Site, was conducted in 2006 by GGAT. The event took place during the renewal of the playing fields. An 18th or 19th century stone lined drain or culvert was uncovered. Finds recovered included ceramic and glass from the 19th century.

6.4.10 A proposed extension to the Vale of Glamorgan Golf Club required a desk-based assessment (**EV24**) which was conducted in 2000 by GGAT. The study area for the report covered the southern part of the Site. The report identified five assets which would require archaeological mitigation, but no information was available on what these assets were or which time period they dated to.

6.4.11 Another desk-based assessment was conducted at Hensol Park (**EV25**) in 1992, c.500m to the north west of the Site. The report identified five assets which would require archaeological mitigation, but no information was available on what these assets were or which time period they belonged to.

6.4.12 In 2001 at Hensol Park, c.500m to the north west of the Site, GGAT undertook a watching brief (**EV29**) during the construction of a covered training facility. Some modern drainage and levelling features were encountered along with a later post medieval ceramic and a prehistoric flint waste flake.

6.5 Historic Map Regression

6.5.1 A historic map regression exercise was undertaken to identify any heritage assets not recorded by other sources, to inform the understanding of the time-depth of the historic landscape and to establish if there had been any previous modern impacts to the Site which could affect its archaeological potential. Analysis and assessment of the available mapping for the Site and surrounding area was carried out using OS mapping provided by the National Library of Scotland's online catalogue and tithe maps accessed from The National Library of Wales website. The results of the exercise are summarised below in chronological order:

6.5.2 The first map on which the Site is depicted is the 1847 Pendoylan tithe map. The northern part of the Site is part of the road to Pendoylan, the fields on either side of the road are pasture and owned by Sir Thomas Aubrey. As the Site progresses south eastwards it crosses several arable fields owned by Sir Thomas Aubrey. There is a small wooded area, known as Howell Bushwood, where the Site meets an east to west road to the east of Clawydd Coch. As the Site progress it passes through meadow, arable and pasture fields owned by Sir Aubrey. Just to the north east of Pendoylan the Site passes through a series of small thin medieval strip fields which are recorded on the tithe map as meadows. Pendoylan is recorded as a small settlement which straddles the main road. The Church (**LB9**) is established as are the alms houses (**LB5**). To the south west of Pendoylan the Site continues to pass through meadow, arable and pasture fields and a road or trackway aligned north east to south west. To the south of this trackway the landowner changes to Fanny Williams but the land remains a mixture of pasture, meadows and arable. The Site then crosses an east to west road

and curves to the south. The landownership changes to Mary Anne Thomas, Sir George Tyler, William Rees and Edward Llewellyn. The land is either pasture or arable.

6.5.3 The 1st edition OS map of the area is dated to 1888-1913, there are no great changes to the northern part of the Site with the exception of an altered field boundary to the east near to Bryn Farm. To the south west of the farm the Site cuts through an area of marsh and trees. Originally this was one large field on the tithe map but by this date it has been separated into four small fields with a path or track way leading from Bryn Farm to the main road to Pendoylan in a north east to south west direction. The small thin medieval strip fields are still extant. A track or road can be seen going through these fields from Pendoylan in a north east to south west direction. A school can be seen in Pendoylan and the holy well (**25**) is now noted. There are few changes to the fields to the south east of Pendoylan but a new east to west road can be seen and the holy well (**17**) is now depicted as well as several footpaths or trackways which surround the Maes yr Haul (**31**) farm. At the southern end of the Site a footpath can be seen aligned north east to south west as well as a spring.

6.5.4 There are few changes between this map and the present day with the exception of a small number of boundaries being removed to create larger fields. The medieval strip fields to the east of Pendoylan are still shown within the landscape but some of the east to west route ways are now shows as footpaths. Pendoylan itself has grown with the addition of houses and a large extension to the school. Near to the southern end of the Site new residential properties have been built, they are set back from the east to west road.

6.6 Walkover Survey

6.6.1 The results of the walkover for Sub-Section 2 are described from north to south through the Clawdd Coch area and the village of Pendoylan. The Sub-Section comprises the proposed eastern route option and covers land to the east of Pendoylan. The area is characterised by a large valley with scenic upland views across to Pendoylan.

6.6.2 A ditch and bank (**64**), most likely an old field boundary, was noted in a large pasture field 150m east of the proposed route (Plate 7). It was noted that the original boundary may have been removed when overhead powerlines were installed.

Plate 7 Ditch and bank (64) of an old field boundary

6.6.3 The hamlet of Clawdd Coch was visited. It lies at a crossroads approximately 175m west of the proposed eastern route of the scheme. For a small area, it has a wealth of historic character including a 17th century long house (**48**, Plate 8), and an old chapel barn (Plate 9).

Plate 8 North west face of a 17th century longhouse (48) in Clawdd Coch

Plate 9 Barn chapel in Clawdd Coch, view to east

6.6.4 There were some stone stiles along a boundary wall to a row of houses (Plate 10). The hamlet would not be directly impacted by the proposed scheme, its setting is enclosed by a large band of trees to the west.

Plate 10 Stone features along boundary wall

6.6.5 An unrecorded mound (**73**) was noted 515m south east of Clawdd Coch (Plate 11). The feature is located 55m east of the proposed eastern route within a large pasture field with some patches of scrub. From the visible above-ground features of the mound (**73**) it was not possible to identify its nature or date. Due to the close proximity of the mound to the proposed eastern route, further investigation may be required in the event of development.

Plate 11 North view of unrecorded mound (73)

6.6.6 An area of pasture and arable fields located east of Pendoylan would be directly impacted by the proposed eastern route. Noted was an improved pasture field with a possible former land division (**66, 67,** Plate 12), represented by a shallow north west to south east linear ditch. The feature demonstrates past change to the layout of the agricultural landscape.

Plate 12 North view of field with possible land division (66, 67)

6.6.7 A system of strip field likely to be medieval or post medieval would be directly impacted by the proposed eastern route. The fields are bounded by trees and contain overgrown scrub (Plate 13). Due to the overgrown nature of the ground cover there was poor visibility of the details of the topography and any potential archaeological features. Therefore, further investigation may be required in the event of development.

Plate 13 Overgrown scrub contained in Medieval or Post Medieval strip fields

6.6.8 The Pendoylan Conservation Area (**CA1**) was visited. The setting of the asset is within a quite rural valley with a steep slope to the west and open fields to the east over the River Ely. The land surrounding the Conservation Area is either pasture, agricultural or scrub. The Conservation Area contains several Listed Building including the Pendoylan Cottages (**LB5**, Plate 14).

Plate 14 Pendoylan Cottages (LB5), view to west

6.6.9 An arable field located at the southern end of Sub-Section 2 was visited. The height of the crop meant that potential archaeological features were not visible (Plate 15). However, far reaching views towards the proposed eastern route were observed. There may be some visual impact from the proposed development however this is limited due to the well-established vegetation.

Plate 15 Crop field with far reaching view towards proposed eastern route

6.6.10 Land parcels to the south west of Pendoylan contained a mixture of improved pasture, arable and scrub. These would not be impacted by the proposed eastern route option. Further south, fields located on the east elevation of the Ely valley had far reaching views towards the north west. A large band of trees may provide screening in the case of development. However, a scenic view towards Pendoylan from a field located 45m east of the proposed eastern route and 65m east of the proposed western route would likely be impacted by the development (Plate 16).

Plate 16 North west view towards Pendoylan which may be visually impacted by the proposed scheme

6.7 Conclusion

6.7.1 Sub-Section 2 comprises the eastern proposed route option around the settlement of Pendoylan. This route option is c.3km in length and aligned north-northwest to south-southeast. This option would comprise construction of a new road alignment offline from the existing road.

6.7.2 There is one Grade II Listed Building and one Conservation Area within the 250m buffer for the route option in this Sub-Section. There would be no physical impact to either of these designated heritage assets. There are two Scheduled Monuments, four Grade II and one Grade II* Listed Buildings and one park within the 500m study area. The key eastern, south eastern and southern views from the Pendoylan Conservation Area would be impacted by this option, with the introduction of modern infrastructure into these currently rural views. The Conservation Area, and the Listed Buildings and non-designated assets located within it, would also be impacted by an increase in noise caused by increased and faster moving traffic on the proposed option.

6.7.3 The non-designated assets within the 250m buffer and 500m study area indicate low potential for prehistoric and roman remains. However, the lack of artefacts and features reflect the lack of previous archaeological investigation in this area, limiting the opportunity to recover and record such remains. The archaeological event record is weak within this part of the Site and offers little further information to inform our understanding of archaeological potential. The medieval and post medieval period is more apparent with the field layouts, built heritage and archaeological remains. Several assets were identified during the walkover survey which could indicate archaeological features or historic landscape features.

6.7.4 A review of historical maps revealed that there have been no modern changes to the landscape in this part of the Site. The majority of the field boundaries within this area have remained unchanged since the 1840's tithe map. The exercise identified many thin strip fields, of probable medieval date, to the east of Pendoylan that would be impacted by this proposed option.

7 Sub-Section 3

7.1 Cultural Heritage Baseline

7.1.1 For ease of reference in this document each heritage asset, unless otherwise stated, has been given a project identification (project ID) number. For all designated assets with statutory protection their identification number begins with an **SM** for Scheduled Monuments, **LB** for Listed Buildings and **CA** Conservation Area, each are then followed by a sequential number where required. Other designated heritage assets and all non-designated heritage assets have been given a sequential number and all archaeological events have been prefix with an **EV** followed by a sequential number. All assets and events can be found in the Gazetteer in Appendix A. All heritage assets are shown on Figure 2.

7.2 Designated Assets

7.2.1 There are two Scheduled Monuments, five Grade II Listed Buildings, one Grade II* Listed Building, one Conservation Area and one park in the buffer and study area for this Sub-Section. Two designated assets (a Grade II Listed Building and the Conservation Area) are located within the 250m buffer, all the rest are found within the 500m study area.

Scheduled Monuments

Y Gaer (SM1)

7.2.2 Y Gaer (**SM1**) is the remains of an Iron Age (800BC – AD74) defended enclosure, located within the study area c.475m to the west of the Site. It is made up of two oval concentric enclosures separated by an interior space of 10m. Each enclosure is defended by a single bank which has been reduced to a scarp. In the centre of the monument is a stony hollow which is likely to be the remains of a building. The monument is of high significance for its evidential value regarding for its chronology, building techniques and representation of social organisation during the Iron Age. The asset can contribute to discussion of the aims of the regional research framework.

Two Cooking Mounds East of Ty'n-y-Pwll (SM4)

7.2.3 This monument is the remains of two burnt mounds (**SM4**) that likely date to the Bronze Age (2,300BC – 800BC), located within the study area c.500m to the east of the Site. They consist of an accumulation of burnt stones, ash and charcoal which are usually found next to a body of water with a feature capable of holding water within the mound or next to it. The monuments are of high significance for their evidential value to contribute to our knowledge of prehistoric ritual practices. They retain archaeological potential and may be associated with archaeological features of a similar date in the wider area.

Listed Buildings

Cae'rwigau Uchaf (LB1)

7.2.4 The listed farmhouse (**LB1**) is located within the study area c.380m to the west of the Site, set within open countryside and built upon a platformed area to the east of the Cae'rwigau moated site (**33**). The asset was constructed in the 16th to 17th century's and was probably part of the Llewlyn manor estate. The building is one and a half storeys tall with exposed rubble stone walls with a steep pitched roof which would have originally been thatched. The building would have started out as a single roomed dwelling, but it has been extended over the years in a sympathetic manner. The interior retains several medieval features such as the main fireplace and rare beehive stone oven. The asset is of medium significance and has aesthetic and historical value despite its alterations.

Dyffryn Mawr Farmhouse (LB2)

7.2.5 The farmhouse (**LB2**), located within the study area c.500m east of the Site, is situated in open countryside to the northwest of Pendoylan village. This two-storey farmhouse has origins in the first half of the 17th century. The exterior is limewashed rubble and was re-fenestrated in the 19th century. The building has also been extended to the rear with additional work to the eaves and roof. The

interior contains several original features including an unusual mid-17th century spiral stone staircase and two substantial rubble open fireplaces with heavy timber bressumers. There is a possible 'priest's hole' in the rear of the kitchen fireplace which is a rare feature. All these features add to the medium significance of the property. The building has aesthetic and potential historic value.

Telephone Call-Box (LB3)

7.2.6 The asset is a K6 type cast iron red kiosk (**LB3**), located within the study area c.300m east of the Site, located within a grassy bank at the entrance to the 'garden village' area of Pendoylan (**CA1**). It is built to the design set by Giles Gilbert Scott which was introduced by the GPO in 1936. It consists of a domed roof with four lunettes which are embossed with crowns over red lettered opals and slits for ventilation. Its foundry plate is inscribed 'Carron Company, Stirlingshire'. It is of medium significance and has aesthetic value, it also adds value to the Pendoylan conservation area (**CA1**).

Pendoylan Cottages (LB5)

7.2.7 A row of listed cottages (**LB5**), located within the study area c.305m east of the Site, are set on a slope immediately to the north of St Cadoc Church (**LB9**). They were originally alms houses for the Pendoylan village and date to the 19th century. The row consists of five houses, all are two storeys tall with a single window on each level on the front elevation. They were built out of rubble stone with lime rendering. They are all of medium value with aesthetic, historic and group value with the church and add value to the Pendoylan conservation area (**CA1**).

Cae'rwigau Isaf (LB8)

7.2.8 The listed farmhouse (**LB8**) located within the buffer area c.226m to the west of the Site, is set in the countryside south of Pendoylan village (**CA1**). The asset is a good example of a small 16th century yeoman farmhouse. When it was constructed it was occupied by the Llewelyn family who were patrons of the Glamorgan poet, Dafydd Benwyn. The building is two and a half storeys tall with limewashed rubble walls and gabled tile roof. The front elevation has dressed Pennant sandstone mullioned windows with hood moulds which are an original feature. The interior of the building retains many of its original 16th century features. The asset is of medium significance and has aesthetic and historical value.

Church of St Cadoc (LB9)

7.2.9 The Grade II* listed building (**LB9**), also known as St Cattwg, is located within the study area c.255m east of the Site in the centre of Pendoylan village (**CA1**). It was constructed in the 14th century but was substantially rebuilt in 1855 and 1893. The building style is Gothic, and it is constructed of course local rubble stone with slate cladding on the roof. The building has coped parapets and a Celtic wheel cross finial at the eastern end. The western door has a sharply pointed arch and door head which is potentially 16th century in date, a blocked off 15th century door with sandstone surrounds can also be seen. The interior of the building contains the chancel arch which is an original 14th century feature, another potentially contemporary feature is a doorway. The church is of high value with aesthetic and historic value. The asset also has group value with the Pendoylan Conservation Area (**CA1**) and other Listed Buildings within the area.

Parks

Hensol Park

7.2.10 Hensol Park (**58**) is Grade II Listed and surrounds the 17th century stately home that the park takes its name from. The asset is located c.500m to the north west of the Site. The original property within the park was a castle which was in existence by at least 1419 when it was owned by Judge David Jenkins and family. Later in the 1700's the Talbot family owned the property. William Talbot was responsible for laying out and starting the landscaping of the grounds. In 1824 the estate was passed onto the Crawshay family. William Crawshay improved the walled garden and extended the deer park as well as improvements to the lake and grounds. In 1838 Rowland Fothergill bought the estate and remodelled the castle into a stately home. In the 20th century the house and parkland were used by Glamorgan County Council as a hospital for men and women with learning disabilities.

In 2004 the property was yet again sold and is now used as a golf course, wedding and conference venue.

7.2.11 Cadw have recognised that the park has an essential setting, which is protected, on its western and northern sides. This essential setting is an area outside of the designated park area but recognised for its sensitivity to the park.

7.2.12 The park has been designated by Cadw for its medium significance, it has evidential value for its long history and communal and historic value for its use by the public and residents. The park also has aesthetic value for its designed and pleasant layout.

Conservation Area

Pendoylan Conservation Area (CA1)

7.2.13 Pendoylan Conservation Area (**CA1**) is located within the buffer area c.130m east of the Site. It is a small village located in the Ely Valley and Ridge Slopes Special Landscape Area. It was designated as a conservation area in 1970 due to its special architectural and historic interest. The boundary of the conservation area comprises both the historic and modern (post 1950) development. The historic settlement pattern of the pre-1950 village consisted of five large buildings laid out in a linear form on both sides of the main road.

7.2.14 The village was made up of a school, a row of cottages, church, public house and mansion. After the 1950s expansion the village consisted of a housing estate of 19 houses, vicarage, two pensioners' bungalows and two private developments. The solely residential settlement has a strong community life centred on the church, chapel, pub and village hall. The asset has medium significance, with communal, historical and aesthetic value.

7.2.15 The Conservation Area Appraisal identifies a number of important views within and looking out from the Conservation Area. These views include:

- From Heol St. Cattwg, just to the east of the Church looking east.
- From the southern edge of the village green looking south and south east.
- Near to the junction of Heol St. Cattwg and the road to Pendoylan looking south east.
- From the pathway opposite the Red Lion Public House looking north to the Church.
- A lane opposite the Church looking west.
- From the top of the Conservation Area looking south east towards the Church.

7.3 Non-designated Assets

Prehistoric

7.3.1 Three assets date to this time period. The first find spot was a polished thin-butted Neolithic axe head (**36**) which was likely part of a group of eight found while ploughing in a field half a mile south east of Caerwigau-Uchaf. This findspot was located within the buffer area c.150m to the west of the Site. The second was a bronze barbed Bronze Age spearhead (**26**), found within the study area c.500m west of the Site in 1856 when a drain was cut.

7.3.2 The third is Pendoylan round barrow (**4**), located within the study area c.500m to the west of the Site. The asset dates to the Bronze Age and is a burial mound. The HER records that the mound had four associated disc-barrows but there is no evidence for these other monuments.

7.3.3 The two findspots have inherent evidential value but lack contextual associations and are therefore of low significance. The barrow is of medium significance as it can contribute to regional research agenda framework aims, it also has evidential value.

Roman

7.3.4 There are no assets which date to this period recoded within the study area.

Medieval

7.3.5 Ffynnon Deilo (**17**), located within the buffer area c.105m east of the Site, is a nearly intact Jones' Class A well, meaning it bears the names of saints, trinity, God, Holy Innocents or Easter. It consists of a spring enclosed by a 0.6m high and 0.5m wide ashlar wall, externally embanked with earth and stone. The well chamber has no datable features and is incorporated in an ornamental garden. Originally the well would have been of high value to both local inhabitants, visitors and pilgrims and was likely associated with healing. It has evidential value due to its potential to reveal more about the construction and use of medieval wells. The asset is of medium significance and can assist with regional research framework questions.

7.3.6 A deserted medieval settlement (**33**) at Caerwigau is located within the study area c.380m to the west of the Site. Little is known about the settlement but what is known is there was a church (**34**) located here in the early-13th century but it was demolished by the middle of that century. The church is potentially commemorated by the field name Chapel Close. The assets are of medium significance and can contribute to the discussion around regional research framework questions. They both have evidential value and high archaeological potential.

7.3.7 The site of a house (**37**) is located within the study area c.60m east of the Site. The asset is no longer extant and is not visible in air photographs and no trace could be found in the recorded location. It is not recorded on historic maps, which either suggests it was no longer standing prior to the 1847 tithe map or that it was constructed and demolished in between map recordings. It is also possible that the recorded location is incorrect. The asset is of low significance and has the potential for evidential value, if there are any buried remains in the recorded location.

7.3.8 In the mid-19th century a cross-base (**39**) is reported to have been found in a field called.'Dwyr Capel' in the 1847 tithe apportionment. As the asset is a findspot it is non-extant. It is located within the buffer area c.140m to the west of the Site. The asset is of low significance and has inherent evidential value.

7.3.9 There are a group of three assets that are located in the Pendoylan Conservation Area (**CA1**) located within the study area c.290m to the east of the Site; Ffynnon Gattwg (**25**), St Cadoc's churchyard (**40**) and a churchyard cross (**41**). Ffynnon Gattwg (**25**) is a holy well located near to and possibly associated with St Gattwg's church (**LB9**). It is one of Jones' Class A wells, meaning it bears the names of saints, trinity, God, Holy Innocents or Easter. The area has been drained and there is no trace of the well or water source.

7.3.10 The second asset is St Cadoc's churchyard (**40**) which is quadrangular in shape with a course rubble wall. The 1847 Pendoylan tithe map shows that originally the northern side was curved. The churchyard contains a cross (**41**) which is nearly intact and consists of a socket stone mounted on a square block of stone to the north of the church. All three assets add group value to each other and the Listed Buildings and Conservation Area of Pendoylan. They are of medium significance but can help with regional research framework questions. They have historical and evidential value.

7.3.11 The boundary of Talfyn Deer Park (**6**) was identified within the buffer area c.170m west of the Site. The deer park deer park dates to the 13th century and was noted for its atypical ditch form. However, it is possible that this ditch is related to agricultural activities instead. The asset is of low significance and has evidential value.

7.3.12 Silver coins (**24**) were located within the study area c.500m to the west of the Site. Little is known about this asset, for instance the context of the find and number of coins but they do add evidential value to the area. They are of low significance.

7.3.13 The remains of a moated homestead (**7**) were located within the buffer area c.450m west of the Site. The asset consists of the remains of a moated homestead measuring c.45m square and is surrounded by a wet moat. The moat has steep sides and is flat bottomed. No visible building remains on site. This asset can contribute to discussion of questions in the regional research framework and is of medium significance and has evidential value.

Post Medieval

7.3.14 Bryn Helygen (**23**) farmhouse is located within open farmland within the buffer area c.215m to the east of the Site. It is a two-storey building with a hipped tiled roof. It appears to have been modernised but still retains some heritage value. It is of low significance and has historical value.

7.3.15 A farmhouse named Maes yr Haul (**31**) is located within the buffer area c.240m east of the Site and is still extant. The property is two stories tall with a gabled roof clad in slate. The property appears to have been modernised but still retains some historical significance. The farmhouse sits within its original farmland and is accessed via a long driveway. The asset is included in the Vale of Glamorgan Council's List of County Treasures. It is of medium significance but could potentially assist with regional research framework questions. It has evidential value and historical value.

7.3.16 Trehedyn House (**35**), is located within the study area c.500m east of the Site. Originally the building was two structures, but they have now been amalgamated into one. The overall style of the combined property is Queen Anne, but it has been painted white and modernised with a large conservatory. One of the properties was the birthplace in 1761 of the independent minister and hymn writer Thomas William. The asset is included on Vale of Glamorgan Council's List of County Treasures. The house is of low significance and has aesthetic and historical value.

7.3.17 Tre Dodridge Lime Kiln (**8**) is located along the route of the Site within a dense patch of trees. Such a kiln would be necessary for the production of lime for use in building and for agricultural purposes, which was a widely used product. Settlements would have had their own local supply, the close proximity of Pendoylan and its main road suggests that the kiln served this village. Later map evidence shows that the kiln was potentially in use when a surrounding quarry was established. The two were probably used in conjunction with one another. It is of low significance and has evidential and historical value.

7.3.18 Pendoylan Cottages (**50-55**) are a row of cottages located within the buffer area c.225m to the east of the Site. The buildings are now no longer extant, there is no evidence for them on any historical maps. They are of low significance and have historic value.

7.3.19 Clawdd Coch Farmhouse (**48**) is located within the small settlement from which the asset takes its name, within the buffer area c.190m to the west of the Site. The property is a 17th century Welsh long house which retains many of its external historical features. However, its roof has attic conversions. It is two-storey's tall with a hipped slate roof. It currently operates as a guest house with a working farm behind. It is of low significance and has historical and aesthetic value.

7.3.20 Within Hensol Park (**58**) is a mill (**9**) identified on the 1st OS map of the area, located within the study area c.500m north west of the Site. The mill (**9**) was used for grinding corn but its function has changed from industrial to residential. It is unclear when this occurred. The 'L' shaped range of white buildings currently at the mill vary in age, the oldest is the long northern arm of the 'L'. The asset has been modernised but still retains its heritage value. The building has a low significance, but it has evidential and historical value.

7.3.21 Caerwigae Mill (**16**) and mill pond (**18**) are located within the buffer area c.215m west of the Site. It. The pond (**18**) is non-extant, but the mill (**16**) is a partially extant but located within a dense patch of vegetation and is in a dilapidated state. The mill leat is still functioning. Both assets are of low significance, with some evidential and historical value.

7.3.22 Two properties, Carrwg-Fach (**27**) and Carrwg-Fawr (**32**), both located within the study area c.500m to the west of the Site, are houses recorded as in near dilapidated condition. However, recent aerial photography could not detect either property so they both may now be non-extant. The HER records that Carrwg-Fach (**27**) had an internal chimney and lobby entry. Carrwg-Fawr (**32**) contained a byre with a winding staircase. There are both of low significance and have historic value.

7.3.23 A possible quarry (**44**) near Bryncoch is located within the study area c.500m west of the Site. It was identified from the 1st edition OS of the area but cannot be seen today. It is of low significance and has evidential value.

Modern

7.3.24 Pendoylan War Memorial Village Hall (**49**) is located within the buffer area c.190m to the west of the Site along the road to Pendoylan. The single storey metal building with green sides and a red or pink roof is located to the north of the settlement of Pendoylan along the main road. The building was constructed in the 1930s as a memorial to those who died in the First World War. It is of low significance and has aesthetic, historical and communal value.

Unknown

7.3.25 A pond in Gaer Wood (**19**) is located within the study area c.500m to the south west of the Site close to Y Gaer (SM1). It is not clear how old the pond is or if it is connected to the Scheduled Monument. It is first recorded on the 1875 OS map of the area and is still extant today. It is of unknown significance and has historical value.

7.3.26 Tynewydd-y-Bryn (**20**), located within the study area c.500m to the east of the Site, is an earthwork enclosure c.40m square with rounded corners. It is possible that this asset is prehistoric in origin but there is little evidence to confirm this. There is a potential rectangular house platform in the north west corner. The date and function of this feature is unknown but there is a spatial relationship between this feature and the enclosure. It is of unknown significance and has evidential value.

7.3.27 A possible mound, almost a platform, with a dip to the north, and a curving edge to the south and west (**78**) was located within the buffer area c.190m east of the Site. It is not clear what this feature is or what period it is attributed to. It could be natural in origin. It is of low significance and has evidential value.

7.3.28 During the walkover survey a possible mound formed of dump material (**73**) was located within the study area c.340m to the east of the Site. Its function and date are unknown but as it was located within an area which showed evidence of water runoff it could be natural in origin or used to block the water flow down the slope. Alternatively, as the asset was located within a field it could be agricultural in origin. It is of unknown significance and has evidential value.

7.3.29 Two brick pillars (**74, 75**) were located within the study area c.350m to the east of the Site. They were found close to a stream and were hollow inside and lined with cement. It is probable that these features were once used for water management, evidence for this came in the form of old plastic pipes located nearby, the close proximity of the water course and the concrete lining of the posts which could have been used as waterproofing for the pillars. They are both of low significance and have evidential value.

7.3.30 A possible quarry pit (**76**) is located within the buffer area c.205m to the east of the Site within Pendoylan (**CA1**). The asset is now covered in vegetation and has a large tree planted in the centre. The height/age of the tree suggests the feature is not of recent origin. It is of low significance and has evidential value.

7.3.31 A ruined farm building or cottage (**77**) is located within the buffer study area c.45m to the east of the Site at the southern end of Pendoylan (**CA1**). The property may have medieval or post medieval origins, but it was updated and extended in the modern period which makes dating the asset problematic. It is also unclear how long the property has been derelict for. The asset is located along the road to Pendoylan and set in open fields. It was probably a farmer's cottage or used for agricultural purposes. It is of low significance and has historical value.

7.3.32 Non-extant or removed field boundaries (**63-71**) representing the widening of fields were located within the study and buffer areas. This probably occurred due to modern farming techniques and use of machinery. Two non-extant field boundaries (**63, 64**) were found c.205m to the east of the Site. One of the boundaries (**64**), aligned north to south, was removed in the modern period for the installation of a power cable. Today it can be seen as a raised bank with shallow ditches on either side. The second (**63**) was aligned east to west, its western end stopped when it reached the north to south boundary (**64**). Two former boundaries (**66, 67**) located c.25m to the east of the Site may have been used to funnel water of the fields. The large field in which the assets sit slopes gently down to a stream. An 'L' shaped field boundary (**65**) is located c.480m to the east of the Site near to

the eastern side of Pendoylan (**CA1**). The asset marks a distinctive step in the field, potentially a lynchet, and it can be seen from aerial photography. Two former linear boundaries (**68, 69**), aligned north east to south west, were identified to the south of Pendoylan (**CA1**), c.425m and c.280m respectively. A further two former north east to south west boundaries (**70, 71**) were located to the south west of Pendoylan (**CA1**), both are intersected by the Site. All are low significance and have evidential value associated with the agricultural use of the landscape.

7.4 Previous Archaeological Events

7.4.1 Several previous archaeological events have taken place within the 250m buffer and 500m study area. However, the results of these events offer little additional information to inform the understanding of archaeological potential for the Site.

7.4.2 Two events occurred (**EV1, EV2**), c.500m to the east of the Site, at the burnt mound Scheduled Monuments (**SM4**) by GGAT in 2006. A field visit was conducted as part of a project that was assessing known burnt mounds in south east Wales. The aim of the project was to enhance the interpretation and understanding of the monuments which would enable the better recognition of the assets in their different states of preservation.

7.4.3 As part of their 'Medieval and Post Medieval Wells in Glamorgan and Gwent' project GGAT visited Ffynnon Delio (**EV12**) c.105m to the east of the Site. The report found that the well was easily accessible and was located on the edge of a pond.

7.4.4 As part of the 'Prehistoric Defended Enclosures of Glamorgan' project a site visit (**EV16**) was conducted in 2006 at Tynewydd-y-Bryn by GGAT, c.500m to the east of the Site. The project aimed to identify form, current condition and current threats to the assets.

7.4.5 The Cottrell Park watching brief (**EV23**), c.500m to the east of the Site, was conducted in 2001 by Cambrian Archaeological Projects. The area that the event covered is recognised by the HER for this high archaeological potential. However, the events did not reveal any archaeological remains or artefacts.

7.4.6 A proposed extension to the Vale of Glamorgan Golf Club required a desk-based assessment (**EV24**) which was conducted in 2000 by GGAT. The study area for the report covered the southern part of the Site. The report identified five assets which would require archaeological mitigation, but no information was available on what these assets were or which time period they belonged to.

7.4.7 In 2012, GGAT visited Caerwigae Mill (**EV8**) as part of a project funded by Cadw, c.500m to the west of the Site. The project aimed at assessing mills and waterpower in the Glamorgan and Gwent area. The building was found in a state of disrepair with a tree growing within the ruins. Another visit was conducted as part of this project to Hensol Mill (**EV9**), c.500m, north west of the Site. The building was found to be in good condition and very well kept. However, it had been altered and it is unclear how many original features survive.

7.4.8 A survey was conducted in 1977 by the Royal Commission on the Ancient and Historical Monuments of Wales, at the moated homestead in Caerwigau (**EV17**) c.500m to the west of the Site. No information was provided by the HER concerning this event.

7.4.9 A study was conducted at Bishopston (**EV20**) in 2015 by the University of Reading and Cotswold Archaeology for their 'Rural Settlement of Roman Britain' project, it covered the southern part of the Site and study area. The aim of the project was to create a resource which would bring together excavation evidence and grey literature reports on rural settlements and countryside in the Romano-British period.

7.4.10 At Hensol Castle a watching brief on the playing fields (**EV21**), c.500m to the west of the Site, was conducted in 2006 by GGAT. The event took place during the renewal of the playing fields. An 18th or 19th century stone lined drain or culvert was uncovered. Finds recovered included ceramic and glass from the 19th century.

7.4.11 A desk-based assessment was conducted at Hensol Park (**EV25**) in 1992, c.500m to the north west of the Site. The report identified five assets which would require archaeological mitigation, but no information was available on what these assets were or which time period they belonged to.

7.4.12 In 2001 at Hensol Park, c.500m to the north west of the Site, GGAT undertook a watching brief (**EV29**) during the construction of a covered training facility. Some modern drainage and levelling features were encountered along with a later post medieval ceramic and a prehistoric flint waste flake.

7.5 Historic Map Regression

7.5.1 A historic map regression exercise was undertaken to identify any heritage assets not recorded by other sources, to inform the understanding of the time-depth of the historic landscape and to establish if there had been any previous modern impacts to the Site which could affect its archaeological potential. Analysis and assessment of the available mapping for the Site and surrounding area was carried out using OS mapping provided by the National Library of Scotland's online catalogue and tithe maps accessed from The National Library of Wales website. The results of the exercise are summarised below in chronological order:

7.5.2 The first map on which the Site is depicted is the 1847 Pendoylan tithe map. The northern part of the Site is part of the road to Pendoylan, the fields on either side of the road are pasture and owned by Sir Thomas Aubrey. As the Site progressed south eastwards it crosses several arable fields owned by Sir Thomas Aubrey. There is a small wooded area, known as Howell Bushwood, where the Site meets an east to west road to the east of Clawydd Coch. From here the Site takes a south western direction and passes through meadow, arable and pasture fields owned by Sir Thomas Aubrey. The Site then crosses the road to Pendoylan and through an area owned by Lord Talbot where there is a known lime kiln (**8**). The tithe apportionment records that there is a quarry here. As the Site progresses south it passes through arable and pasture owned by Sir Thomas Aubrey. Where the Site is parallel with Pendoylan the landownership changes to Elizabeth Evans, but the land use remains the same. Pendoylan is recorded as a small settlement which straddles the main road. The Church (**LB9**) is established as are the alms houses (**LB5**). To the south west of Pendoylan the land changes back to the ownership of Sir Thomas Aubrey but the use remains the same. The Site then crosses the road to Pendoylan at a distinctive 'Y' junction. The land here is still arable and pasture but owned by Evan Jones and Fanny Williams. The Site progresses in a south eastern direction through land owned by Fanny Williams, with the land use remaining the same. The Site then crosses an east to west road and continues through arable and pasture owned by Mary Anne Thomas, Sir George Tyler, William Rees and Edward Llewellyn.

7.5.3 The 1st edition OS map of the area is dated to 1888-1913, shows that there are no great changes to the northern part of the Site with the exception of an altered field boundary to the east near to the Bryn Farm. As the Site heads in a south western direction it cuts through a wooded area which the tithe map showed as being several fields. The boundaries to these fields can no longer been seen or have been amalgamated into the wooded area. As the Site crosses the road to Pendoylan it encounters a wooded area where the quarry and lime kiln (**8**) are located. There is a footpath just to the south of the assets aligned north west to south east. As the Site progresses southwards, the fields remain largely the same but one close to Pendoylan is marked with an old coal pit. To the south west of Pendoylan several field boundaries have been lost to create larger fields. There are also several footpaths which crisscross the land here as well as a new east to west route way. The fields surrounding the 'Y' junction remain the same as do most of the fields at the southern end of Site.

7.5.4 There are few changes between this map and the present day with the exception of a few boundaries being removed to create larger fields. Pendoylan has grown with the addition of houses and a large extension to the school. Near to the southern end of the Site new residential properties have been built along the road to Pendoylan and the east to west road.

7.6 Walkover Survey

7.6.1 The results of the walkover for Sub-Section 3 are described along the proposed route from north to south through the Clawdd Coch area and the village of Pendoylan. The Sub-Section considers the proposed western route option and covers land to the west of Pendoylan. The area is characterised by the Ely Valley and scenic upland views.

7.6.2 A ditch and bank (**64**) likely to be an old field boundary was noted in a large pasture field 150m east of the proposed route (Plate 17). It was observed that the original boundary may have been removed when overhead powerlines were installed.

Plate 17 Ditch and bank (64) of an old field boundary

7.6.3 The hamlet of Clawdd Coch was visited. It lies at a crossroads approximately 175m west from the proposed western route of the scheme. For a small area, it has a wealth of historic character including a 17th century long house (**48**, Plate 18), and an old chapel barn (Plate 19).

Plate 18 North west view of 17th century longhouse (48)

Plate 19 Barn chapel, view to east

7.6.4 There were some stone stiles along a boundary wall to a row of houses (Plate 20). The hamlet would not be directly impacted by the proposed scheme, its setting is enclosed by a large band of trees to the west.

Plate 20 Stone features along boundary wall

7.6.5 An unrecorded mound (**73**) was noted 515m south east of Clawdd Coch (Plate 21). The feature is located 330m east of the proposed western route within a large pasture field with some patches of scrub. From the visible above-ground features of the mound it was not possible to identify its nature or date. Due to the close proximity of the mound to the proposed western route, further investigation may be required in the event of development.

Plate 21 North view of unknown mound (73)

7.6.6 An area of pasture and arable fields north east of the Pendoylan would not be directly impacted by the proposed western route. However, an improved pasture field containing a possible former land division was noted (**66, 67**, Plate 22), represented by a shallow north west to south east linear ditch. The feature demonstrates past change to the layout of the agricultural landscape.

Plate 22 North view of field with possible land division (66, 67)

7.6.7 The Pendoylan Conservation Area (**CA1**) was visited. Although it would not be directly impacted by the proposed route option, the setting of the village was considered.

7.6.8 Views of the proposed western route would be largely screened by a raised bank with tall trees running along the west side of the Pendoylan road (Plate 23). Adjacent scrub fields to the west of the road are situated on an elevation; the proposed route would likely be obscured by a dip beyond a field boundary. Therefore, the setting of the Conservation Area would not be noticeably impacted in the event of development.

Plate 23 Raised bank and screen of trees along Pendoylan road, view to south west.

7.6.9 The Church of St Cadoc (**LB9**) (Plate 24) is a Listed Building located within the Conservation Area (**CA1**). It was noted that views from the church towards the west were screened by vegetation and would not be visually impacted by the proposed development. A telephone callbox (**LB3**) (Plate 25) was also visited. It was concluded that the asset would not be visually impacted due to the built-up nature of the immediate surroundings.

Plate 24 The Church of St Cadoc (LB9), view to east

Plate 25 A listed telephone callbox (LB3), view to north east

7.6.10 A viewing location from Heol Ty Mawr in Pendoylan towards the proposed western route was observed (Plate 26). The location lies 180m east of the proposed route and the view may be visually impacted if development of the western route were to go ahead.

Plate 26 East view from Heol Ty Mawr towards the proposed western route

7.6.11 Land parcels to the south west of Pendoylan contained a mixture of improved pasture, arable and scrub. These would not be impacted by the proposed scheme. Further south, fields located on the east elevation of the Ely valley had far reaching views towards the north west. A large band of trees may provide screening in the case of development. However, a scenic view towards Pendoylan from a field located 45m east of the proposed eastern route and 65m east of the proposed western route would likely be impacted by the development (Plate 27). It is recommended that the view is considered in terms of its historic setting which would have been open agricultural fields.

Plate 27 North west view towards Pendoylan which may be visually impacted by the proposed scheme.

7.6.12 An arable field located at the southern end of Sub-Section 3 was visited. The height of the crop meant that potential archaeological features were not visible (Plate 28). However, far reaching views towards the proposed western route were observed (Plate 28). There may be some visual impact in the event of development, although this would be limited by the screening of trees and vegetation.

Plate 28 Arable field with far reaching view towards proposed western route

7.7 Conclusion

7.7.1 Sub-Section 3 comprises the western proposed route option around the settlement of Pendoylan. This route option is c.3.2km in length, curving in a north to south west and then south eastern direction. This option would comprise construction of a new road alignment offline from the existing road.

7.7.2 There is one Grade II Listed Building and one Conservation Area within the 250m buffer for the route option in this Sub-Section. There would be no physical impact to either of these designated heritage assets. There are two Scheduled Monuments, four Grade II and one Grade II* Listed Buildings and one park within the 500m study area of the Site. Pendoylan Conservation Area would be impacted by an increase in noise caused by increased and faster moving traffic and the key western view from

the Conservation Area would be impacted by the introduction of modern infrastructure into this currently rural view. The Listed Buildings and non-designated assets located within the Conservation Area would also be impacted by an increase in noise caused by increased and faster moving traffic on the proposed option.

7.7.3 The non-designated assets within the 250m buffer and 500m study area indicate a low potential for roman remains. However, the lack of artefacts and features of this date may reflect the lack of previous archaeological investigation in this area, limiting the opportunity to recover and record such remains. The prehistoric, medieval and post medieval periods are much more apparent. The prehistoric period is represented by artefacts and archaeology, however, most of these are located far from the Site within the outer periphery of the 500m study area. The medieval and post medieval periods are more prominent with evidence in the form of field layouts, built heritage and archaeological remains. There are several assets which would be directly impacted by this proposed option, a lime kiln, quarry and two non-extant field boundaries. The past archaeological event record is weak within this part of the Site and offers little further information to inform our understanding of archaeological potential.

7.7.4 A review of historical maps revealed that there have been no modern changes to the landscape in this part of the Site. The majority of the field boundaries within this area have remained unchanged since the 1840’s tithe map. This indicates that any below ground archaeological remains could survive well due to the lack of recent disturbance.

8 Sub-Section 4

8.1 Cultural Heritage Baseline

8.1.1 For ease of reference in this document each heritage asset, unless otherwise stated, has been given a project identification (project ID) number. For all designated assets with statutory protection their identification number begins with an **SM** for Scheduled Monuments, **LB** for Listed Buildings and **CA** for Conservation Area, each are then followed by a sequential number where required. Other designated heritage assets and all non-designated heritage assets have been given a sequential number and all archaeological events have been prefix with an **EV** followed by a sequential number. All assets and events can be found in the Gazetteer in Appendix A. All heritage assets are shown on Figure 2.

8.2 Designated Assets

8.2.1 There are three Scheduled Monuments, two Grade II Listed Buildings, one Conservation Area and one historic landscape. Only the Conservation Area is located within the 250m buffer area all the rest of the assets are in the 500m study area.

Scheduled Monuments

Y Gaer (SM1)

8.2.2 Y Gaer (**SM1**) is the remains of an Iron Age (800BC – AD74) defended enclosure, located with the study area c.470m to the west of the Site. It is made up of two oval concentric enclosures separated by an interior space of 10m. Each enclosure is defended by a single bank which has been reduced to a scarp. In the centre of the monument is a stony hollow which is likely to be the remains of a building. The monument is of high significance for its evidential value regarding for its chronology, building techniques and representation of social organisation during the Iron Age. The asset can also contribute to discussion of the regional research framework questions.

Coed-y-Cwm Chambered Cairn (SM2)

8.2.3 This chambered cairn or tomb (**SM2**) dates to the Neolithic period (c. 4400 – 2900 BC) and is located within the study area c.500m to the south east of the Site. Chambered tombs were built and used by the first farming communities in Britain and have been demonstrated to have been in use for varying periods of time in the earlier 3rd millennium BC. There are many regional traditions and variations in shape and construction. The burial chamber in this monument consists of one large and two smaller stones. The larger stone is pitted and measures, c.2.7m in length and c.1m wide, it currently tilts slightly towards the southwest. On its north eastern side it is propped up by small stones beneath it. The monument is of high significance for its evidential value to enhance our knowledge of prehistoric burial, ritual and funerary activity and the ritual landscape. It retains significant archaeological potential and it is likely that there is an intact burial, ritual deposits and environmental and structural evidence including a prehistoric land surface.

Two Cooking Mounds East of Ty'n-y-Pwll (SM4)

8.2.4 This monument is the remains of two burnt mounds (**SM4**) that likely date to the Bronze Age (2,300BC – 800BC), located within the study area c.500m to the north east of the Site. They consist of an accumulation of burnt stones, ash and charcoal which are usually found next to a body of water with a feature capable of holding water within the mound or next to it. The monuments are of high significance for their evidential value to contribute to our knowledge of prehistoric ritual practices. They retain archaeological potential and may be associated with archaeological features of a similar date in the wider area.

Listed Buildings

Village Farmhouse (LB10)

8.2.5 Within the eastern part of Bonvilston village (**CA2**) is a listed farmhouse (**LB10**) located within the study area c.500m west of the Site. It was constructed in the 18th century in the vernacular style with

limewashed limestone and rubble walls and a thatched roof. The building has been altered in the 19th and 20th centuries. Internally the building retains its 18th century exposed roof. The asset is of medium significance and has aesthetic and historical value and adds group value to the Bonvilston conservation area (**CA2**).

Cottrell Lodge (LB11)

8.2.6 The listed Lodge, located within the study area c.500m to the east of the Site, is located at the entrance to Cottrell Park. Cottrell Park is now a golf club. The Lodge has 17th century origins but has recently undergone alteration with a large extension to the sides and rear. Originally the building was constructed in the local vernacular style with a single cell room with a gable end. The one and half storey tall Lodge was constructed of coursed limestone rubble with a long straw thatched roof, the new additions are in keeping with this style. The asset is of medium significance and has aesthetic and historical value and adds value to Cottrell Park.

Conservation Area

Bonvilston Conservation Area (CA2)

8.2.7 Bonvilston, located within the buffer area c.50m west of the Site, is a low density, linear rural village with no village centre. It sits within gently undulating countryside along a natural ridge which overlooks farmland to the south. The A48 runs through the heart of the settlement and its construction required the removal of some of the original buildings in the Conservation Area, which negatively affected the significance of this asset.

8.2.8 The Conservation Area is made up of a mixture of larger houses, worker's cottages and agricultural buildings which have now mostly been converted into residential use. The character of the village is of detached or terraced properties set back slightly from the road with substantial stone walls and groups of mature trees. There are a number of Listed Buildings, only one (**LB10**) is within the 500m study area, as well as a large number of unlisted buildings which are 19th century in date. The defining spatial feature of Bonvilston is the wide main road.

8.2.9 The name Bonvilston is derived from the early Norman landholders, the de Bonvilles. Their stronghold was likely located just south of St Mary's Church, at the heart to the settlement. Various archaeological features, like Neolithic Tinkinswood Burial Chamber to the south west (not in the study area and therefore not part of this assessment), indicate that there has been settlement in the area since Prehistoric times.

8.2.10 The asset has medium significance and has communal, historical and aesthetic value.

Landscape

Lancarfan Historic Landscape (62)

8.2.11 The large designated landscape is located with the study area c.500m to the south west of the Site. The area has been recognised due to its atypical settlement pattern including the large churches, which is a pattern more likely to be seen in England than in Wales. The ancient settlement and secluded valley of Llancarfan, situated in the central plateau of the vale, is one of the best surviving and most complete examples of this type of historic landscape in the Vale of Glamorgan. The setting of the ancient church at Llancarfan is within a picturesque, nucleated village. It has strong monastic and Anglo-Norman influences which is illustrative of early Welsh Christianity. The asset is of medium significance and has evidential and historical value. It can also contribute to discussion of regional research framework questions.

8.3 Non-designated Assets

Prehistoric

8.3.1 Four assets date to this time period; two standing stones (**29, 15**), one findspot (**36**) and a potential cist burial (**42**).

8.3.2 A standing stone (**29**) at Redland Farm is located within the study area c.500m south east of the Site. It has been recorded on several occasions throughout the 20th century but there is no longer any visible above-ground evidence of this asset. Another standing stone (**15**) can be found in Cottrell Park, c.500m to the east of the Site. It was originally located opposite the entrance to the Park but was moved, possibly for the widening of the A48. The asset consists of a large, weathered limestone slab measuring 2.9m long, 0.6m thick and 2.3m high. Both assets are of medium significance and have evidential value, they can also contribute to the aims of the regional research framework.

8.3.3 Also of prehistoric date is a polished thin-butted Neolithic axe head (**36**), located within the study area c.330m to the north west of the Site. This was likely part of a group of eight found while ploughing in a field half a mile south east of Caerwigau-Uchaf. This asset has the potential to contribute to discussions around the regional research framework and is of medium significance and has inherent evidential value.

8.3.4 The last asset of prehistoric date is a cist burial at Cotterell Park (**42**) located with the study area c.500m to the east of the Site. However, it is not clear if this asset ever existed as the evidence for the asset is a dubious account from 1976 recording the presence of a possible capstone to a cist burial. During a later site visit no trace of the asset could be was found. However, the location of the burial is within a landscaped golf course and it is entirely possible that the asset was lost during the creation of the fairways. Due to the uncertainty regarding the survival of this asset it is of low significance for potential evidential value.

Roman

8.3.5 There is one asset, a Roman Road (**22**), aligned east to west along a natural ridge just to the south of the Site, which dates to this time period. Little is known about this road, but it probably connected the fort at Cowbridge to the ports and forts in Cardiff and Caerleon. The present A48 follows its alignment. The road has medium significance, evidential value and it can also contribute to discussion of regional research framework questions.

Medieval

8.3.6 Little is known about the deserted medieval settlement at Caerwigau (outside of the study area) but what is known is that there was a church (**34**) located here in the early-13th century but it was demolished by the middle of that century. The site of the church is located within the study area c.142m to the west of the Site. The church is potentially commemorated by the field name Chapel Close. The assets are of low significance, but they can help with regional research framework questions. They both have evidential value and high archaeological potential.

8.3.7 Coed yr Abad Grange (**38**) is a woodland located within the study area c.500m to the south southwest of the Site. The asset was previously known as Coed yr Abers and originally it was called Coed yr Abbot. The Royal Commission on the Ancient and Historical Monuments of Wales connected this asset, through a 17th century reference by Lhuyd to Abbot's Castle, with Greendon Grange (Margam Abbey). This grange is known to have been connected with Bonvilston (**CA2**) to the north west of this asset. The woodland is of low significance and has historical value.

8.3.8 In the mid-19th century a cross-base (**39**) is reported to have been found in a field called.'Dwyr Capel' in the 1847 tithe apportionment. As the asset is a findspot it is non-extant. It is located within the buffer area c.142m to the north west of the Site. The asset is of low significance and has inherent evidential value.

Post Medieval

8.3.9 Bonvilston House (**28**) was located within the Conservation Area with which it shares its name (**CA2**). The site of the property was located within the study area c.500m to the west of the Site. The House, also referred to as a mansion, was the property of the ancient family of Basset. Originally it was the wing of Old Beaupre Castle. The site of the house is of low significance, as the building is no longer extant, but has historical value. At present a new housing estate has been built over its location and therefore it is unlikely that any below ground remains of this asset, or of the earlier castle, survive.

8.3.10 A collection of 17th century coins (**30**) were located along the A48 within the study area c.410m to the east of the Site. Little information on the coins was recorded on the HER and therefore it is unknown how they were found, how many there were and what were their denominations. They are of low significance and have historical value.

8.3.11 Trehedyn House (**35**), is located within the study area c.500m north east of the Site. Originally the building was two structures, but they have now been amalgamated into one. The overall style of the combined property is Queen Anne, but it has now been painted white and modernised with a large conservatory. One of the properties was the birthplace in 1761 of the independent minister and hymn writer Thomas William. The asset is included on Vale of Glamorgan Council's List of County Treasures. The house is of low significance and has aesthetic and historical value.

8.3.12 Redlands Farm barn (**21**) is located within the study area c.500m to the south of the Site. The asset is now partly converted for residential purposes. However, it does retain several original features such as an uncommon external end staircase and hayloft. It is of low significance, despite its conversions, and has historical and potentially aesthetic value.

8.3.13 Caerwigae Mill and mill pond (**18**) are located within the study area c.500m north west of the Site. The pond (**18**) is non-extant and the mill is partially extant but located within a dense patch of vegetation and is in a dilapidated state. The mill leat is still functioning. Both assets are of low significance, with some evidential and historical value.

Modern

8.3.14 There is one asset which dates to this period, the site of a crashed Supermarine Spitfire N3221 (**45**). It is located within the study area c.500m to the west of the Site within the Bonvilston Conservation Area (**CA2**). The crash occurred at 10.35am on the 6th of February 1943 and involved pilot officer Neville Alexander Thomas Fleming from Australian regiment RAAF AUS 414217, No 53 OTU Squadron. Fleming was taking part in a non-operational formation training flight when he crashed prior to landing. The aircraft was classed as category E (write-off) following accident. Sadly, Fleming did not survive the crash and his body was recovered. The Commemorations and Licensing department of the Ministry of Defence (MOD) have advised that the asset is protected under the Protection of Military Remains Act 1986 and any disturbance to the asset would require a permit from the MOD. However, the department have advised as there is potential for human remains to be present it is unlikely such licence would be given. The site of the crash is of medium significance due to its historical value and illustration of the regional connection with military activity during the Second World War. It also has potential evidential value.

Unknown

8.3.15 Tynewydd-y-Bryn (**20**), located with the study area c.500m to the north east of the Site, is an earthwork enclosure c.40m square with rounded corners. It is possible that this asset is prehistoric in origin but there is little evidence to confirm this. There is a potential rectangular house platform in the north west corner. The date and function of this feature is unknown but there is a spatial relationship between this feature and the enclosure. It is of unknown significance and has evidential value.

8.3.16 A possible mound, almost a platform, with a dip to the north, and a curving edge to the south and west (**78**) was located with the buffer area c.205m north east of the Site. It is not clear what this feature is or what period it is attributed to. It could be natural in origin. It is of unknown significance and has evidential value.

8.4 Previous Archaeological Events

8.4.1 Several previous archaeological events have taken place within the 250m buffer and 500m study area. However, the results of these events offer little additional information to inform the understanding of archaeological potential for the Site.

8.4.2 Two events were undertaken by GGAT on 2006 (**EV1, EV2**) at the burnt mound Scheduled Monuments (**SM4**), c.500m to the north east of the Site. The field visit was conducted as part of a project that was assessing known burnt mounds in south east Wales. The aim of the project was to

enhance the interpretation and understanding of the monuments which would enable the better recognition of the assets in their different states of preservation.

8.4.3 Two partial excavations are recorded in this area. One at Coed Y Cwm (**EV6**) in 1936, c.500m to the south east of the Site, and the second at Cottrell Park standing stone (**15**, **EV18**), c.500m to the east of the Site, in 1934. The HER had no information on the results of either of the events.

8.4.4 As part of the 'Prehistoric Defended Enclosures of Glamorgan' project a site visit (**EV16**) was conducted at Tynewydd-y-Bryn by GGAT in 2006, c.500m to the north east of the Site. This project aimed to identify form, current condition and current threats to the assets.

8.4.5 A watching brief was undertaken at Cottrell Park (**EV23**), the event covered the entirety of the study area and was conducted in 2001 by Cambrian Archaeological Projects. The area that the event covered is recognised by the HER for this high archaeological potential. However, the events did not reveal any archaeological remains or artefacts.

8.4.6 In 2010 Cardiff Archaeological Consultants conducted a watching brief at Woodlands Lodge (**EV28**), c.500m south west of the Site in Bonvilston (**CA2**). The event was for the groundworks for a side extension at the Lodge. A potential 19th century circular rubbish pit or soak away was identified along with a cobbled path.

8.4.7 Two desk-based assessments (**EV26, EV27**) were conducted c.500m south of the Site. The assessments found that the proposed developments were within an area of archaeological interest but did not specify the details of which period or what type of features were recorded of for which there was potential.

8.4.8 A proposed extension to the Vale of Glamorgan Golf Club required a desk-based assessment (**EV24**) which was conducted in 2000 by GGAT. The study area for the report covered the entirety of the study area. The report identified five assets which would require archaeological mitigation, but no information was available on what these assets were or which time period they belonged to.

8.4.9 A study was conducted at Bishopston (**EV20**) in 2015 by the University of Reading and Cotswold Archaeology for their 'Rural Settlement of Roman Britain' project. The aim of the project was to create a resource which would bring together excavation evidence and grey literature reports on rural settlements and countryside in the Romano-British period.

8.4.10 Several events have taken place at Redlands Farm. These include three site visits (**EV13, EV14, EV15**) and a landscape management scheme (**EV11, EV10**). The two site visits were conducted at the standing stone (**29**) c.500m south east of the Site, one in 1950 (**EV13**) and one in 1970 (**EV14**). The conclusion of either site visit is not known. In 2003, GGAT visited the standing stone as part of their 'Prehistoric Funerary and Ritual Site' project (**EV15**). The project aimed to assess the condition and preservation of the asset and to ensure its continued conservation. A landscape management plan was created for Redlands Farm (**EV11**) by GGAT in 2000. The event included a report and a site visit for the Countryside Council for Wales as part of the Tir Gofal scheme (**EV10**). The plan and the results of the site visit are not known.

8.5 Historic Map Regression

8.5.1 A historic map regression exercise was undertaken to identify any heritage assets not recorded by other sources, to inform the understanding of the time-depth of the historic landscape and to establish if there had been any previous modern impacts to the Site which could affect its archaeological potential. Analysis and assessment of the available mapping for the Site and surrounding area was carried out using OS mapping provided by the National Library of Scotland's online catalogue and tithe maps accessed from The National Library of Wales website. The results of the exercise are summarised below in chronological order:

8.5.2 The northern part of the Site is on the 1847 Pendoylan tithe map and the southern on the 1841 Bonvilston tithe map. The northern part of the Site is located within the 1847 Pendoylan tithe map arable which records that land use as pasture and owned by Mary Anne Thomas, Sir George Tyler, William Rees, Richard Bassett and Edward Llewellyn. As the Site progresses south and into the 1841 Bonvilston tithe map the land is solely owned by Sir George Tyler but the land use remains the

same. The Site enters a 'Y' shaped junction and continues on along the existing north west to south east road, however it does pass into two arable fields owned by Sir George Tyler. On the eastern side of the road there are large fields owned by Sir George Tyler with smaller fields closer to the road, these are pasture and meadow fields. To the west of the road area much smaller fields which are a mix of meadows, arable and pasture with one small garden. At the southern end of the Site is a junction between the north south and east west roads, along the northern side of the east to west roads area a series of roadside properties are set within small land parcels. To the south east is a large meadow and to the south west are several smaller fields which are a garden, arable and meadow fields. All are owned by Sir George Tyler.

8.5.3 The 1888-1913 OS map of the area shows no change within the northern part of the Site, except that the fields along the northern side of the eastern 'Y' road are now depicted as woodland with a footpath aligned east to west. Two more footpaths can be seen either side of the head of the 'Y' junction. The eastern one leads off in an eastern direction, while the western path leads in a south western direction. The eastern fields remain the same except for a north east to south west footpath near to the road junction as the southern end of the Site. Several of the western fields have lost their boundaries, this has created two larger fields next to the road to Pendoylan. The field to the south east of the Site remains the same but those within the south western side have lost many of their boundaries.

8.5.4 There are few changes from 1913 until 1990, with the exception of some field boundaries being removed to create larger fields. Several houses have been built on the western side of the road to Pendoylan and Bonvilston has also gained new residential properties.

8.5.5 Post 1990 the Cottrell Park golf course has been created and this altered the fields either side of the road to Pendoylan. Most of the fields have been removed but some of the boundaries have been kept and amalgamated into the course. In 2019 a new housing estate is being constructed on the western side of the road to Pendoylan near to the southern end of the Site. This estate required the road to be dug up for new piping to be laid. This would have had a severe impact on any below-ground archaeological remains.

8.6 Walkover Survey

8.6.1 The results of the walkover for Sub-Section 4 are described from north to south and covers land in the south of the study area where the current Pendoylan corridor meets the A48. This is comprised mainly of a large golf course that straddles the road, agricultural land parcels to the north and south, and a section of the Bonvilston Conservation Area (**CA2**).

8.6.2 An arable field immediately east of the corridor was viewed. The field is bounded by managed hedges along its western edge which border the road corridor. To the south east is a copse of trees which lie between the field and a large golf course. There were no earthworks or remains identified within the field.

8.6.3 The golf course occupies land to the east and west of the Pendoylan road. Although it would not be impacted by the proposed scheme the land was surveyed for potential archaeology. As expected, the ground had been heavily landscaped meaning that any archaeological remains that were previously present are likely to have been disturbed by the creation of the golf course (Plate 29).

Plate 29 Golf course looking north

8.6.4 A scheduled monument, Y Gaer (**SM1**) lies approximately 140m west of the golf course and was observed from afar (Plate 30).

Plate 30 Y Gaer (SM1) view to west

8.6.5 The west and east sides of the golf course are linked by a pedestrianised tunnel which runs underneath the road (Plate 31). The tunnel was used to access land on the eastern side of the course.

Plate 31 Tunnel under the road linking east and west sides of the golf course

8.6.6 The east side of the golf course was comprised of landscaped grass with sparse areas of trees and vegetation with undulating topography. Although there was low potential for archaeology, it was noted that views across to the west and south west were largely screened by treelines (Plate 32) and would not be compromised by the proposed route.

Plate 32 View to south west of golf course

8.6.7 Cottrell Lodge (**LB11**, Plate 33), located to the east of the proposed route, was visited. Although the asset lies towards the periphery of the study area there is potential for a visual impact from the proposed development. However, it was determined that tree cover and the rising topography of the surrounding golf course would largely obscure the proposed route if developed.

Plate 33 Cottrel Lodge (LB11), view to north

8.7 Conclusion

8.7.1 The southernmost segment of the route aligned north-northwest to south-southeast is c.1.2km long. The proposed development in this section would predominantly comprise online works to improve the existing road alignment.

8.7.2 There is one Conservation Area within the 250m buffer of the Site in Sub-Section 4. There would be no physical impact to this designated asset. There are three Scheduled Monuments, two Grade II Listed Buildings, and one registered historic landscape within the 500m study area of the Site. None of these assets would be impacted by the Site as they are beyond the extent of any physical works and screened from view by well-established vegetation, with consequently no change to their significance through changes to their settings.

8.7.3 The non-designated assets within the 250m buffer and 500m study area indicate activity dating from the prehistoric to post medieval periods. However, the prehistoric remains are all located on the periphery of the study area indicating a low potential for such remains to be present within the Site. There is high potential for archaeological remains of roman date to be present close to the Site, due to the presence of a roman road in close proximity to the Site on the route of the modern A48. The medieval and post medieval periods are visible within the landscape through the field layout, extant and non-extant buildings and recorded through archaeological remains. The archaeological events which occurred within the study area offer little further information to inform understanding of the archaeological potential of the Site.

8.7.4 A review of historic maps and the walkover survey identified that the northern part of the Site in Sub-Section 4 is unchanged by modern impacts. The southern part has been greatly altered by a golf course, modern housing estate and utilities alongside the existing road alignment. Any archaeological remains that were present in this part of the Site will have been impacted by this modern development.

9 Sub-Section 5

9.1 Cultural Heritage Baseline

9.1.1 For ease of reference in this document each heritage asset, unless otherwise stated, has been given a project identification (project ID) number. For all designated assets with statutory protection their identification number begins with an **SM** for Scheduled Monuments and **LB** for Listed Buildings, each are then followed by a sequential number where required. Other designated heritage assets and all non-designated heritage assets have been given a sequential number and all archaeological events have been prefix with an **EV** followed by a sequential number. All assets and events can be found in the Gazetteer in Appendix A. All heritage assets are shown on Figure 2.

9.2 Designated Assets

9.2.1 There is one Scheduled Monument located close to the Site and nine Grade II Listed Buildings and two parks all within the 500m study area.

Scheduled Monuments

Felin Isaf Castle Mound (SM3)

9.2.2 The asset comprises a motte and ditch of a castle which date to the medieval period (c.1066 – 1540AD) located within the buffer area c.10m of the north of the Site. A motte is a large conical or pyramidal mound of soil and/or stone with a tower constructed of timber or stone on top. Around the base of the motte was usually either a wet or dry ditch. The Felin Isaf motte measures c.4m high, the ditch, which survives best on the eastern side, measures c.8.5m wide and 0.6m deep. There is no visible evidence of an outer bailey. The monument is located on the northern side of the old riverbed of the Ely. Today it is located within an industrial park surrounded by trees to the north west, a road to the north east and the railway to the south west.

9.2.3 The monument is of high significance for its evidential value concerning medieval defence practices. It is a well-preserved monument and an important part of the medieval landscape. It retains strong archaeological potential for both structural evidence and intact associated deposits. The asset can contribute to the regional research framework aims.

Listed Buildings

9.2.4 Within the north western part of the 500m study area is a collection of six Grade II Listed Buildings (**LB7, LB14, LB12, LB13, LB15, LB16**) located within the registered historic parkland of Miskin Manor (**57**). All of these assets individually have medium value but as a group, Listed Buildings and park, they contribute to one another significance and as a group they have high significance. Each asset has architectural or artist and historical value.

9.2.5 Two other Grade II Listed Buildings (**LB4, LB6**) are located in the historic park of Hensol Castle (**58**). The Listed Buildings and the park add significance to one another, individually they have medium significance but as a group they have high significance. Each asset has architectural or artist and historical value.

9.2.6 The last Listed Building (**LB2**) is not located within either of these two historic parks and is discussed first below.

Dyffryn Mawr Farmhouse (LB2)

9.2.7 This listed farmhouse (**LB2**) is situated in open countryside to the northwest of Pendoylan village (**CA1**), located within the study area c.500m south of the Site. This two-storey farmhouse has origins in the first half of the 17th century. The exterior is limewashed rubble. It was re-fenestrated in the 19th century, the building has also been extended to the rear with additional work done to the eaves and roof. The interior contains several original features including a mid-17th century spiral stone staircase. There are two substantial rubble open fireplaces with heavy timber bressumers. There is a possible ‘priest’s hole’ in the rear of the kitchen fireplace which is a rare feature. All these assets add

to the value to the medium significance of the property. The building has aesthetic and potential historic value.

Miskin Manor (LB7)

9.2.8 Miskin Manor (**LB7**) is located in extensive grounds accessed by a private drive within the study area c.500m to the north west of the Site. The manor was designed in the Tudor-Gothic style in the 19th century and it retains this character. The exterior is snecked with rock-faced sandstone in the front and rubble stone in the rear. The interior of the property was severely damaged due to a fire in 1952, however the main hall, drawing room and dining room retain their original Tudor-Gothic and Jacobean style. There is a coach house connected to the manor which is included in the listing. This building is an early feature in the manor complex and has been altered for residential purposes.

9.2.9 The asset has architectural value due to its relatively unaltered state and survival of internal features. The building has potential archaeological interest as the current manor replaced a pre-existing building and a structure has been present at this location since the 11th century.

Upper Terrace Wall and Pavilion (LB12)

9.2.10 The upper wall and pavilion (**LB12**) on the western side of Miskin Manor (**LB7**) were built in the late 19th century. The terrace wall consists of a long-buttressed revetment wall with rock faced snecked stone cladding and flat freestone coping detail. The side and rear walls of the asset are of rubble stone and it has a stone lined roof.

Lower Terrace Wall (LB13)

9.2.11 To the south west of the upper terrace and pavilion (**LB12**) is the lower terrace wall (**LB13**). The asset was built in the early 20th century and consists of a revetment wall in two parallel rubble stone with flat coping that terminates with square piers and ball finials. At the northern end the walls are linked with wide stone steps to the lower terrace.

Kitchen Garden Walls (LB14)

9.2.12 Located on the northern side of Miskin Manor (**LB7**) is the kitchen garden walls (**LB14**). They were built in the mid to late 19th century and were altered to incorporate a gate screen in the early 20th century. The walled garden is rectangular in shape and the walls measure 3.5m tall. The walls were constructed of buttressed brick and the northern wall which has an outer face of rubble stone. Inside the garden is a central brick-lined channel aligned north to south. Against the northern wall is a former lean-to greenhouse which retains its curved iron trusses and a late 19th century brick propagating house. Several other original and later buildings are located along the exterior walls.

Pair of Beasts at West (LB15) and East (LB16) Entrance to Miskin Manor

9.2.13 Two listed sculptures flank the east (**LB15**) and west (**LB16**) doorway of Miskin Manor (**LB7**). The pair are Tudor-style king's beasts, heraldic dragons standing on tall pedestals, made of reconstituted stone. They are likely to be early 20th century in date and are of a style similar to those at St Donats Castle.

Hensol Park

Hafod Lodge to Hensol Castle (LB4)

9.2.14 The Lodge (**LB4**), also known as Bottoms Lodge, is located within the study area c.500m to the west of the Site. It is a mid-19th century structure built at the same time as extensive renovations were conducted at Hensol Castle, in the grounds of which the asset stands and give entrance to. The renovations were conducted by T H Wyatt and D Brandon in the Tudor-Gothic style which is reflected in the Lodge. The asset is single storey with attics and clad in scribed stucco with monumental stone finials in the front.

Bridge to Hensol Castle (LB6)

9.2.15 The listed bridge (**LB6**), located within the study area c.500m to the west of the Site, is located near the north eastern end of the main drive to Hensol Castle, close to Hafod Lodge (**LB4**). The asset is

contemporary with the renovations of Hensol Castle and construction of the Lodge in the mid- 19th century. The structure is broad with four stone arches, it is built out of coursed rubble with part-balustrade parapets along the roadside.

Parks

Hensol Park

9.2.16 Hensol Park (**58**) is grade II listed and surrounds the 17th century stately home that the park takes its name from. The asset is located c.340m to the west of the Site. The original property within the park was a castle which was in existence by at least 1419 when it was owned by Judge David Jenkins and family. Later in the 1700's the Talbot family owned the property. William Talbot was responsible for laying out and starting the landscaping of the grounds. In 1824 the estate was passed onto the Crawshay family. William Crawshay improved the walled garden and extended the deer park as well as improvements to the lake and grounds. In 1838 Rowland Fothergill bought the estate and remodelled the castle into a stately home. In the 20th century the house and parkland were used by Glamorgan County Council as a hospital for men and women with learning disabilities. In 2004 the property was yet again sold and is now used as a golf course, wedding and conference venue.

9.2.17 Cadw have recognised that the park has an essential setting, which is protected, on its western and northern sides. This essential setting is an area outside of the designated park area but recognised for its sensitivity to the park.

9.2.18 The park has been designated by Cadw for its medium significance, it has evidential value for its long history and communal and historic value for its use by the public and residents. The park also has aesthetic value for its designed and pleasant layout.

9.2.19 The park also contains a kitchen garden (**61**) located to the south of the castle. It is not clear when these gardens were laid out. This asset is part of the designated area of the overall park and adds to the significance and value of the park.

Miskin Manor

9.2.20 Miskin Manor park (**57**) is grade II listed and located within the study area c.500m to the north west of the Site. It contains landscaped Victorian pleasure grounds located within a well-preserved Edwardian terraced garden. The house that the park surrounds is Tudor-Gothic in style and dates to the 19th century. The original name for the park and manor house was 'Maen Cun' or 'Lovely Plain'. The park has medium significance and has been designated by Cadw for its aesthetic and historical value.

9.2.21 Cadw have identified two significant views from the park and from the manor house. One to the south and one to the west. The organisation has also recognised that the park has an essential setting to the north east and west.

9.2.22 Included in the parkland are two kitchen gardens (**59, 60**) which are located close to the manor house on the north eastern side. It not clear which period these assets date to but they are probably contemporary with the re-development of the property and parkland either in the Victorian or modern period. These assets are part of the designated area of the overall park and they contribute to the significance and value of the park.

9.3 Non-designated Assets

Prehistoric

9.3.1 There are no assets recorded within the study area for this period.

Roman

9.3.2 There are no assets recorded within the study area for this period.

Medieval

9.3.3 There is one asset which dates to the medieval period, a group of four lynchets (**1**) located within the study area c.500m of the north of the Site. Lynchets are a type of field system, usually formed or created by the action of ploughing on slopes, and these examples are aligned north to south along the valley slope. Potsherds dating from the 12-14th centuries cover the area and indicate that the land has been cultivated since the medieval period. The asset contains evidential value as it has archaeological potential to reveal more about medieval farming in the area and is of medium significance.

Post Medieval

9.3.4 A potential pottery Kiln (**2**) is located within the study area c.500m to the north of the Site within Llanfarach farmstead. The asset consists of several post medieval pottery wasters, burnt brick fragments, slipware sherds and glazed ridge tiles all of which suggests the former presence of a kiln. The close proximity of the farmstead to the kiln could mean that the farm occupants were the sole users of the asset or that they supplemented their income by producing pottery for the local area. Similar kilns were found in Ewenny so these local industries are not unusual in the post medieval period. The asset is of medium significance and has evidential value as it could contribute to discussion of some regional research framework questions.

9.3.5 Within Hensol Park (**58**) are several assets identified on the first edition of the OS map of the area, Hensol Mill (**9**), the mill pond (**43**) and a possible water course (**10**) with a weir (**11**) at its western end. All are located within the study area c.500m west of the Site. The mill (**9**) was used for grinding corn but its function has changed from industrial to residential, it is unclear when this occurred. The 'L' shaped range of white buildings currently at the mill vary in age, the oldest is the long northern arm of the 'L'. The asset has been modernised but still retains its heritage value. The mill pond (**43**) is still partially extant but no longer reaches the mill. The distinctive 'S' shape of the pond can still be seen in the landscape and on aerial photographs. The water course (**10**) and weir (**11**) could not be seen and are potentially non-extant. Both would have served the mill and the pond. All these assets have group value and add significance to each other and the park. Overall their significance is low, and they all have evidential and historical value.

9.3.6 Bryn Helygen (**23**) farmhouse is located within open farmland within the study area c.500m to the south of the Site. It is a two-storey building with a hipped tiled roof. It appears to have been modernised but still retains some heritage value. It is of low significance and has historical value.

9.3.7 A footbridge (**56**) over the Nant Coslach (stream) is located at Redlands Farm, within the buffer area c.210m to the south east of the Site. It was first recorded on the 1st edition OS map of the area but appears to now be non-extant. The asset is of low significance and has historical interest.

Modern

9.3.8 There are three assets located along the railway line to the west of the Site which are in close proximity to Felin Isaf Castle Mound (**SM3**) and to the Site. The first is a pond (**12**), the second a watercourse (**13**) and the third is an earth work pond (**14**). All are located within the buffer area.

9.3.9 The large pond (**12**) is still extant as is the earthwork pond (**14**) but it is not clear if the watercourse (**13**) is still extant. The watercourse (**13**) and pond (**14**) were created due to the removal of the northern arm of the River Ely prior to 1888 due to the creation of the railway. The 1847 Pendoylan and 1843 Llantrisant tithe maps do not show these features but do show the sinuous northern arm of the river, by the 1st edition OS map of the area of the river has been moved and the features (**12, 13, 14**) have been created. These assets are of low significance and have historical value.

Unknown

9.3.10 A sunken trackway (**46**) was located within the study area c.500m north of the Site. It was identified during a survey of the M4 in the 1970s but cannot be seen on any historical maps or aerial photography. The asset is of low significance and has historical value.

9.3.11 A field system (**47**), located within the study area c.500m north of the Site, was identified from 1940s aerial photographs. The asset predates the current field layout which is potentially post medieval in date. The asset is of medium significance and has historical value and can assist with regional research framework questions.

9.3.12 During the walkover survey a possible mound formed of dump material (**72**) was located within the buffer area c.60m to the south of the Site. Its function and date are unknown but as it was located close to the River Ely it may be associated with some form of river defence. Alternatively, as the asset was located within in a field it could be agricultural in origin. This asset is of unknown significance and has evidential value.

9.3.13 Also identified during the walkover survey were two non-extant field boundaries (**63, 64**), located within the study area c.500m to the south west of the Site. One of the boundaries (**64**), aligned north to south, was removed in the modern period for the installation of a power cable. Today it can be seen as a raised bank with shallow ditches on either side. The second (**63**) was aligned east to west, its western end stopped when it reached the north to south boundary (**64**). This feature was seen as a slight depression in the landscape. It was removed to create a larger field. They are both of low significance and have evidential value.

9.3.14 A possible old channel or leat (**79**) associated with a non-extant farmstead known locally as Moat Farm was located within the buffer area c.100m to the south west of the Site. It was noted during the walkover survey as a long sinuous linear feature aligned nearly north to south. The asset predated the current field layout as a well-established field boundary now crosses the potential leat or channel. It is possible that Moat Farm had some sort of water course associated with it, hence the name, which required a water source. It is also possible that the farm had a mill which required waterpower. There is a HER asset (**5**) located within this area called Maendy Bach which is a non-extant farm and it is possible that these two assets are connected. However, historical maps of the area do not show any water courses near to Maendy Bach. In close proximity to this potential channel or leat was a semi-circular ditch (**5**), located within the study area c.280m to the south of the Site. It is not clear if these features are contemporary or even connected. They are both of low significance and have evidential value.

9.4 Previous Archaeological Events

9.4.1 Several archaeological events have taken place within the 250m buffer and 500m study area. However, the results of these events offer little additional information to inform the understanding of archaeological potential for the Site.

9.4.2 A survey (**EV5**) was conducted in 1976 10m to the north of the Site by the Royal Commission on the Ancient and Historical Monuments of Wales, at Felin Isaf Mound (**SM3**). Another similar survey was conducted at Maendy Bach (**EV3**) in 1977, c.280m to the south of the Site. No information was provided concerning either event.

9.4.3 A desk-based assessment (**EV25**) was conducted in 1992 in reference to an extension to the Vale of Glamorgan Golf club, c.500m west of the Site. The report was limited to known archaeological remains. However, they did not specify what these remains were, and recommended that further archaeological mitigation would be required on the site prior to any ground works.

9.4.4 In 2012 GGAT visited Hensol Mill (**9, EV9**) c.500m west of the Site, as part of a project funded by Cadw. The project aimed to assess mills and their waterpower within the Glamorgan and Gwent area. The building was found to be in good condition and very well kept. However, it had been altered and it was unclear how many original features survive.

9.5 Historical Map Regression

9.5.1 A historic map regression exercise was undertaken to identify any heritage assets not recorded by other sources, to inform the understanding of the time-depth of the historic landscape and to establish if there had been any previous modern impacts to the Site which could affect its archaeological potential. Analysis and assessment of the available mapping for the Site and surrounding area was carried out using OS mapping provided by the National Library of Scotland's

online catalogue and tithe maps accessed from The National Library of Wales website. The results of the exercise are summarised below in chronological order:

9.5.2 There are two tithe maps that cover the area of the Site; the 1843 Llantrisant tithe map and 1847 Pendoylan tithe map. The north western part of the Site, where the railway line meets the road to Pendoylan is shown at the southern end of the 1843 Llantrisant tithe map. Here the Site is shown as being part of a small arable field owned by The Honourable Robert Henry Clive. The surrounding fields to the north are meadows owned by Anne Saunderson, the fields to the south are owned by John Saunderson and The Honourable Robert Henry Clive and are a mix of pasture and arable. As the Site progresses to the south east it crosses the Ely River. To the south the river has nearly created an oxbow lake and there are several arable land parcels owned by the Reverend William Lewis, Catherine Edwards and Lord Dynevor. The lands to the north are on the 1843 Llantrisant tithe map and are a mix of arable and meadow owned by the Reverend, Edwards and Lord Dynevor. The fields to the south are on the 1847 Pendoylan tithe map and are a mixture of arable, pasture and meadow. The dominant landowners here are John Saunderson and Sir Thomas Aubrey. Felin Isaf (**SM3**) can be seen as a horseshoe shaped field boundary with its south western edge located along the northern arm of the River Ely which divides into two branches at this point.

9.5.3 By the 1st edition OS map of the area in 1888-1913 the Great Western Railway has been established on a north west to south east alignment. This has resulted in alterations to several of the fields along its length. The first alteration is at the north western end of the Site in this Sub-Section, where only the northern and part of the eastern boundary survive. This has also resulted in the field immediately south becoming larger. A small arable field has been completely removed and the field immediately north now appears to be a marsh with a pond (**12**) to the south. The River Ely here formerly had two branches, but the northern arm has now been removed and a small pond (**14**) can be seen. Felin Isaf (**SM3**) can be seen as a circular mound located next to a narrow water course (**13**). This is potentially the remains of the northern arm of the River Ely. The field to the south east of the Scheduled Monument has now been lost and a larger field has been created with a north west to south east footpath, this footpath continues along the railway line until it reaches the River Ely and heads eastwards. The fields to the north and south have lost their boundaries and are now much larger fields. Where the Site meets the River Ely the water course has been altered to allow for a rail bridge. This has resulted in an oxbow lake being formed on the eastern side of the Site and a small tributary on the western side. The farm Maendy Bach on the western side has lost several field boundaries on the eastern and western sides of the railway line, this has resulted in larger fields. A footpath and trackway can be seen from Meandy Bach which connects the farm to its field and to the road network to the north west.

9.5.4 There are no significant changes to the land, except for the occasional removal or addition of a field boundary, between 1913 until 1974 when the M4 motorway and junction 34 are created. This had a major impact on the landscape. The fields around Miskin Manor (**LB7**) have been altered with the creation of the A4119 and the trackway has now been removed. To the south of the new junction a new northern section of the road to Pendoylan has been created. Those fields in close proximity, particularly to the east, have been altered and are either non-extant or have been made smaller.

9.5.5 The only change from this 1974 map to the present, with the exception of a few field boundaries being removed, is the creation of a golf driving range to the east of the Site and the creation of the Renishaw estate immediately north of the Site.

9.6 Walkover Survey

9.6.1 The results of the walkover for Sub-Section 5 are described from the M4 intersection, through the land parcels east and west of the Pendoylan road and the Renishaw industrial site and surrounding land. A main railway line runs north west to south east and crosses the River Ely; the river flows south until a sudden change of course to the east.

9.6.2 A series of fields to the west of the proposed route were viewed as part of the survey. Several of the fields contained dense overgrown scrub making archaeological assessment of the ground difficult (Plate 34). A large improved pasture field was accessed but contained no archaeology.

Plate 34 Overgrown terrain limiting the view of potential archaeology

9.6.3 A visit was made to the Renishaw industrial site which lies approximately 340m south of the M4. The industrial site contains a scheduled monument, Felin Isaf (**SM3**), in the western corner (Plate 35, Plate 36). The asset is a medieval motte which survives as earthwork remains. One half of the mound was concealed by overgrown scrub. However, the other half of the earthwork was clearly visible. A large ditch (Plate 37), although much overgrown, was present on the south eastern side adjacent to the railway line.

Plate 35 South view of Felin Isaf (SM3) motte

Plate 36 Felin Isaf (SM3) motte view to east

Plate 37 North view towards a possible ditch associated with the motte (SM3)

9.6.4 An irregularly shaped field located 280m west of the Renishaw site was visited. The terrain consisted of scrub with an area of boggy ground towards the centre of the field. The waterlogged ground and presence of livestock caused some restriction to the survey. The waterlogged area was likely related to the adjacent watercourse. A possible archaeological feature (**72**) was detected along the northern edge of the field. It appeared to be a raised mound (Plate 38) and may have been related to past

dumping activity. It is considered unlikely that this feature is connected with Felin Isaf (**SM3**) located c.110m of the north east of the mound (**72**).

Plate 38 An unknown mound (72) possibly an overgrown dumping area, view to south west

9.6.5 An unusual group of boulders (Plate 39) was noted on the east bank of the River Ely approximately 65m east of the proposed development. It is unclear if their current location is due to natural causes or past human activity. There is no obvious evidence of human intervention in the location, but they appear out of character with the surrounding topography and there are a lack of similar features in the area.

Plate 39 Boulders on east bank of River Ely with proposed road on west side

9.6.6 A land parcel approximately 250m east of the proposed road was accessed. This included a driving range (Plate 40). The ground was flat and heavily landscaped. It is concluded that any archaeology that was present will have been severely truncated by the landscaping. The surrounding fields to the

east and west were a mixture of improved pasture and arable. The fields were divided by mature hedgerows and trees. No evidence of archaeology was observed. However, it should be noted that fields containing scrub were difficult to assess for reasons of ground visibility.

Plate 40 Heavily landscaped driving range, view to north

9.6.7 The landowner provided information that a medieval farm once existed in a field located just south of the River Ely. The field lies approximately 80m west of the railway line and 600m east of the proposed route option. A visual assessment of the land was impaired by overgrown grass, making it difficult to identify archaeological remains (Plate 41). However, the field is located beyond the proposed development area and would not be physically impacted.

Plate 41 Location of possible medieval farm, view to south

9.6.8 Evidence of a possible leat (**79**) was noted in a scrub field located 200m west of the railway and 720m east of the proposed route (Plate 42). These remains would not be directly impacted by the proposed development, but they may indicate the existence of further associated archaeological features in the surrounding area.

Plate 42 North view of possible leat (72) in scrub field

9.7 Conclusion

9.7.1 Sub-Section 5 is located at the northern end of the Site and follows the railway in a north west to south east direction for c.950m. The proposed development in this section would comprise a parkway-type railway station on the existing railway line, with associated road access.

9.7.2 There is one Scheduled Monument and one park within the 250m buffer. There would be no physical impact to these designated assets. In the 500m study area there are nine Grade II Listed Buildings and one park. The Scheduled Monument views and setting to the south could be impacted or changed by the proposed development, however the asset's surroundings have already been altered by the railway and adjoining industrial park. All the other designated assets would be not impacted by the proposed development as they are beyond the extent of any physical works and screened from view, with consequently no change to their significance through changes to their settings.

9.7.3 The non-designated assets within the 250m buffer and 500m study area indicate low potential for prehistoric and roman remains. However, the lack of artefacts and features may reflect the lack of previous archaeological investigation in this area, limiting the opportunity to recover and record such remains. The archaeological event record is weak within this part of the Site and offers little further information to inform our understanding of archaeological potential. The medieval and post medieval period is better represented with the scheduled medieval motte, built heritage and archaeological remains. The walkover survey identified several assets such as non-extant field boundaries which were removed to create larger fields and a leat or water channel located close to a non-extant farm. All the features within this area would not be impacted by the Site as they are either non-extant or are beyond the extent of any physical works.

9.7.4 A review of historic maps revealed that the Site in this Sub-Section has been greatly altered by the creation of the M4 motorway, junction 34, the railway, the northern extension to the road to Pendoylan and the creation of the industrial park. Any archaeological remains that previously existed in these areas will have been severely impacted by this previous construction activity and no significant remains are likely to survive beneath this infrastructure and modern development.

10 Recommendations

10.1 Highway Links

10.1.1 On the basis of the information obtained through desk-based assessment and walkover survey it is concluded that there are no major constraints to the proposed development in Sub-Sections 1 and 4, where the works would be predominantly online improvements to the current road alignment.

10.1.2 Of the eastern and western options in Sub-Sections 2 and 3, the conclusion is that the western option (Sub-Section 3) would have the lesser impact on cultural heritage. The eastern option (Sub-Section 2) would impact the medieval strip fields and interrupt a greater number of key views from the Pendoylan Conservation Area. The western option (Sub-Section 3) would impact known non-designated assets (a lime kiln, a quarry and two non-extant field boundaries) but would have less impact on extant historic landscape features and on the setting of designated heritage assets.

10.1.3 In order to produce a detailed assessment to support any planning application it is recommended that a programme of detailed archaeological assessment is undertaken at WelTAG Stage Three. This will provide greater certainty on the risk of currently unrecorded archaeology to be present within the Site, which will both inform the determination of any planning application and allow for accurate planning of any archaeological mitigation that may be required following planning consent in advance of construction.

10.1.4 Further consultation with the planning advice team at GGAT (as advisors to the local authority) will be necessary to determine the precise scope of this but this is likely to require a review of aerial photographs held at the Central Registry of Aerial Photography for Wales (CRAPW), geophysical survey and trial trenching. The scope of this work would need to be agreed through production of a Written Scheme of Investigation (WSI) submitted to the planning advice team at GGAT.

10.2 Vale of Glamorgan Gateway Station

10.2.1 Assessment at GRIP Stage 3 Option Selection | Transport for Wales Plan of Works Stage B as part of an enhanced WelTAG Stage Two Plus appraisal will need to consider output stemming from this DBA report to inform development of the proposed options. It is recommended that a programme of detailed archaeology should then be considered for WelTAG Stage Three development, likely to encompass GRIP Stage 4 Single Option Development and GRIP Stage 5 Detailed Design (Transport for Wales Plan of Works Stages C, D and E).

References

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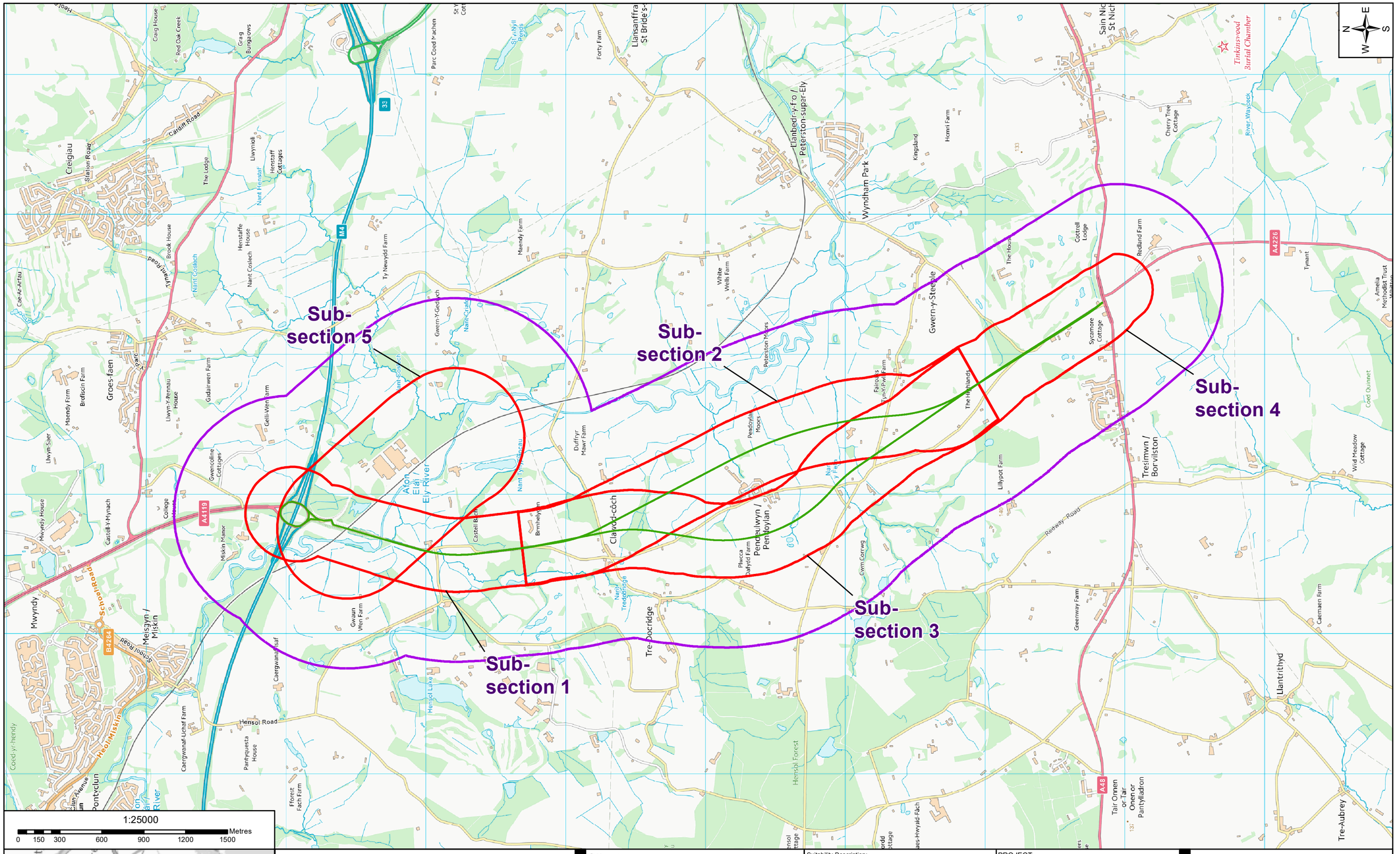
Figures



REV	Date	Description	Drawn	Check	Approv
01	23/08/19	Initial Issue	NG	JN	AL

LEGEND

- Route Options
- Sub-Section 250m Buffer
- Sub-Sections 500m Study Area

Client

VALE of GLAMORGAN BRO MORGANNWG

Site

Vale of Glamorgan Council
Barry

Vale of Glamorgan Council

Client

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Suitability Description:

PRELIMINARY/CONFIDENTIAL

Designed	XXX	Date 23AUG19	Signed
Drawn	G. Natarajan	Date 23AUG19	Signed
Checked	J. Norman	Date 23AUG19	Signed
Approved	A. Latham	Date 23AUG19	Signed
Scale:	1:25000	Datum:	AOD
Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10028657

PROJECT:

M4 JUNCTION 34 TO A48
WELTAG STAGE TWO PLUS

TITLE:

Figure 1: Sites Subsections

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Issue 01

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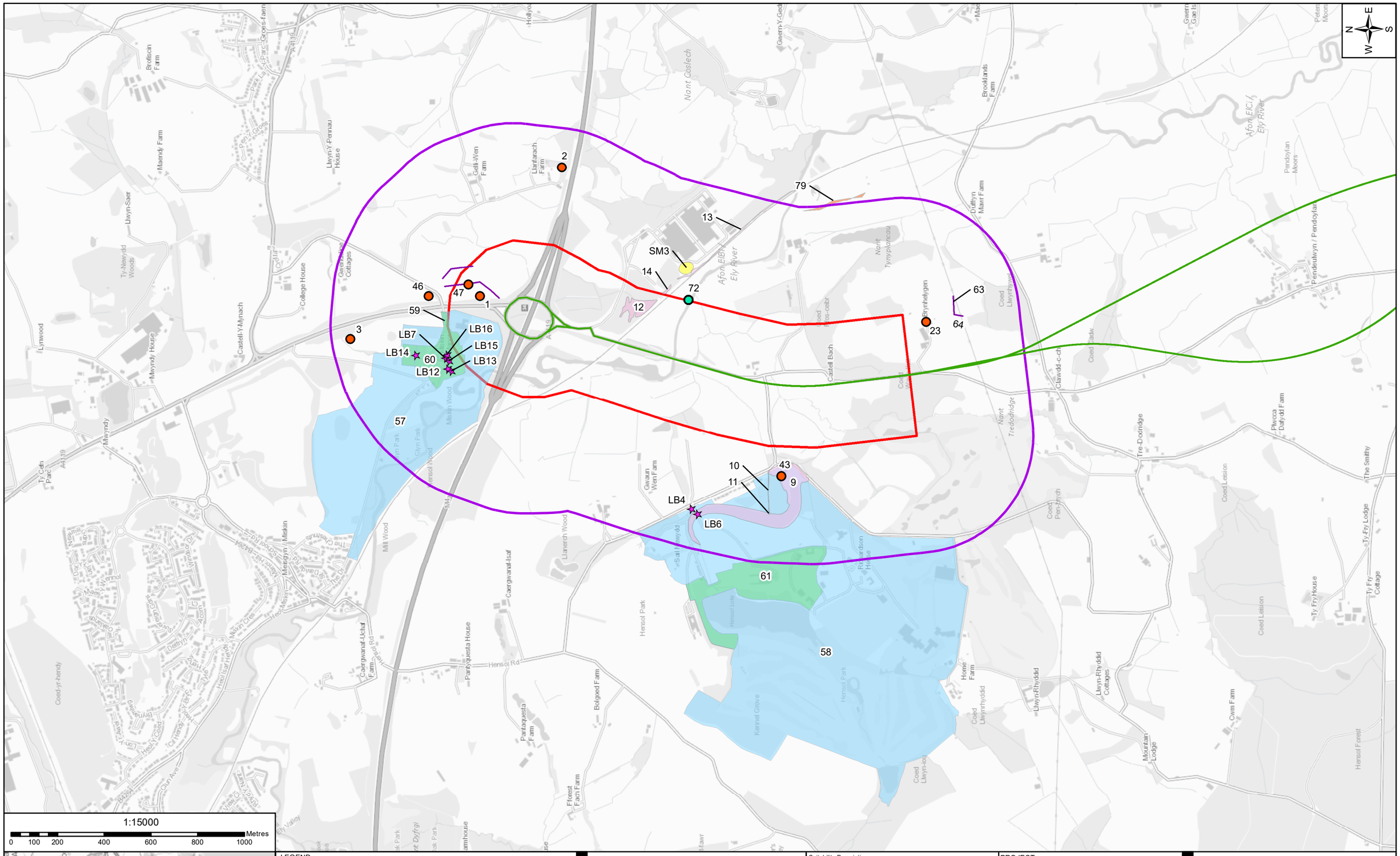

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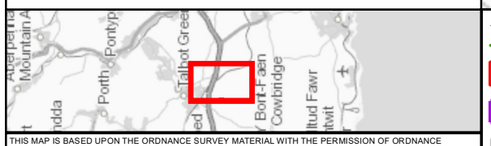

REV	Date	Description	Drawn	Check	Approv
01	28/08/19	Initial Issue	NG	JN	AL

LEGEND

- Route Options
- Sub-Section 1 250m Buffer
- Sub-Section 1 500m Study Area
- Scheduled Monuments
- Listed Buildings
- Parks
- Gardens and Kitchens

Non-Designated Hertiage Asset

- Points
- Polygons

Walkover Survey Asset

- Points
- Lines
- Polygons

Client

Vale of Glamorgan Council

Site

Vale of Glamorgan Council
Barry

Client

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Approved	A. Latham	Date 28AUG19	Signed
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Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10028657

PROJECT:

M4 JUNCTION 34 TO A48
WELTAG STAGE TWO PLUS

TITLE:

Figure 2:
Page 1:
Heritage Assets Sub-Section 1

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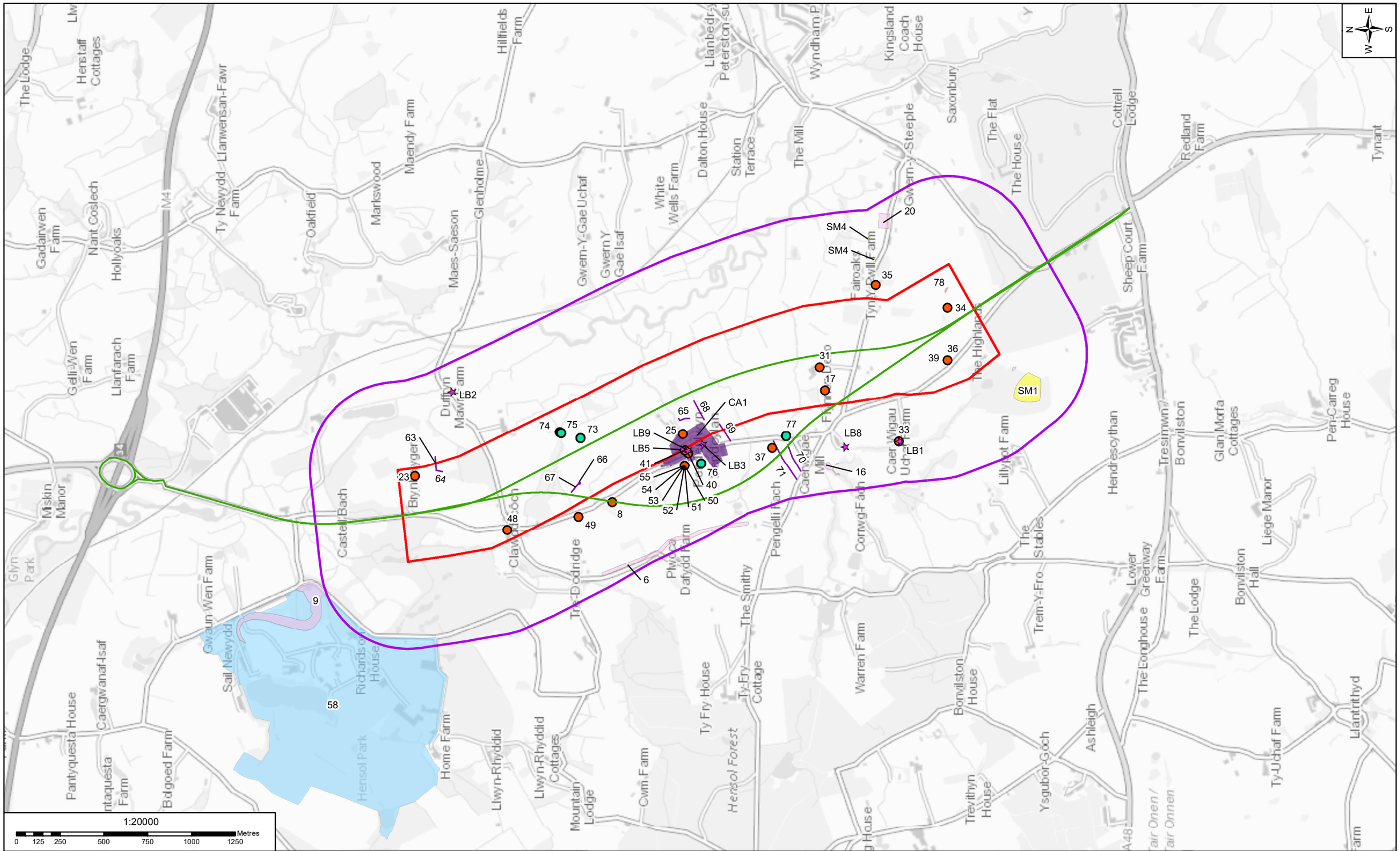

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LEGEND

- Route Options
- Sub-Section 2 250m Buffer
- Sub-Section 2 500m Study Area
- Scheduled Monuments
- Listed Buildings
- Parks
- Conservation Area

Non-Designated Hertiage Asset

- Points
- Polygons

Walkover Survey Asset

- Points
- Lines
- Polygons

Client

Vale of Glamorgan Council

Site

Vale of Glamorgan Council
Barry

Client

Vale of Glamorgan Council
Civic Offices
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www.valeofglamorgan.gov.uk

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Designed	XXX	Date 28AUG19	Signed
Drawn	G. Natarajan	Date 28AUG19	Signed
Checked	J. Norman	Date 28AUG19	Signed
Approved	A. Latham	Date 28AUG19	Signed
Scale:	1:20000	Datum:	AOD
Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10028657

PROJECT:

M4 JUNCTION 34 TO A48
WELTAG STAGE TWO PLUS

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Heritage Assets Sub-Section 2

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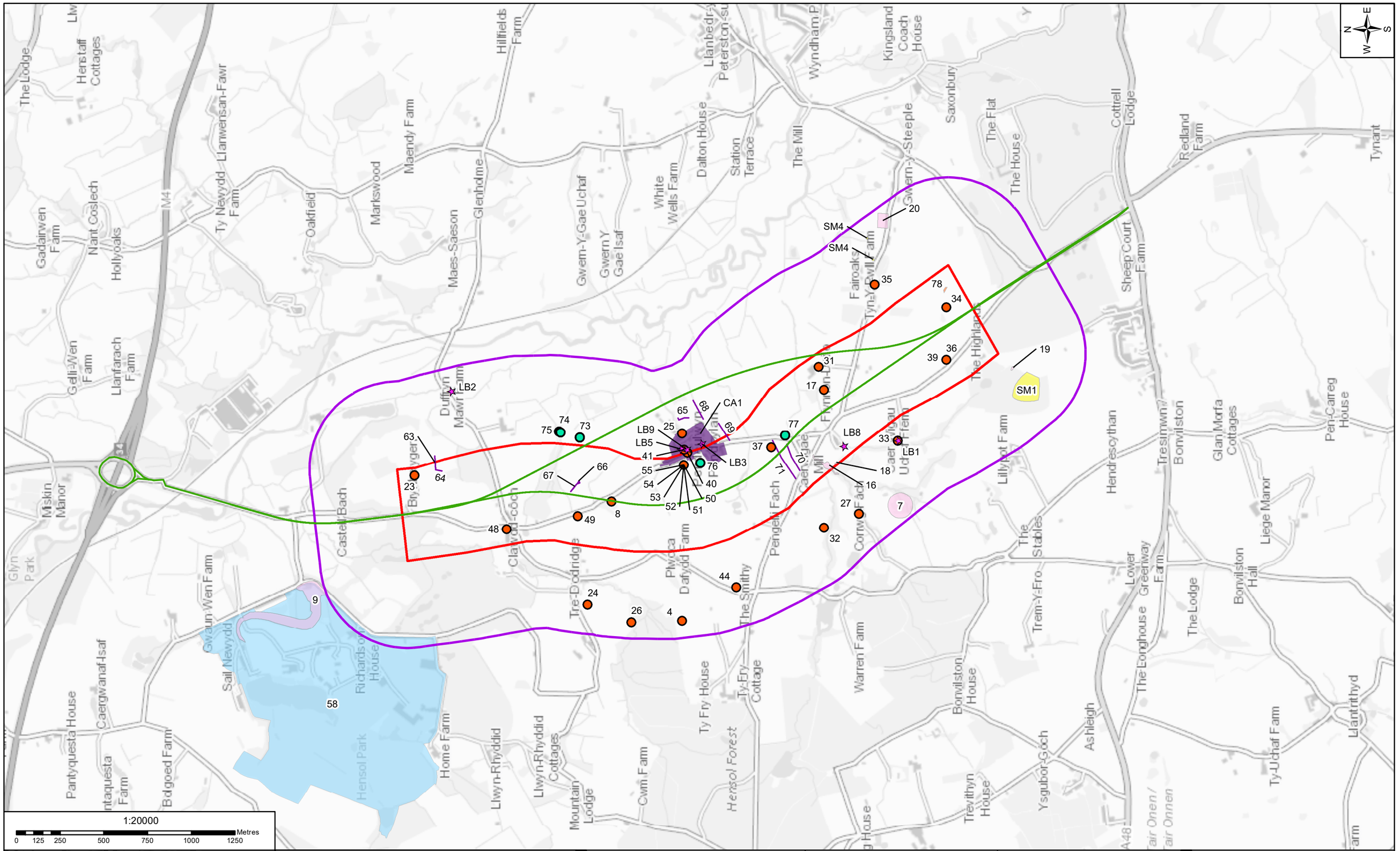

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LEGEND

- Route Options
- Sub-Section 3 250m Buffer
- Sub-Section 3 500m Study Area
- Scheduled Monuments
- Listed Buildings
- Parks
- Conservation Area

Non-Designated Hertiage Asset

- Points
- Polygons

Walkover Survey Asset

- Points
- Lines
- Polygons

Client

VALE of GLAMORGAN
BRO MORGANNWG

Site

Vale of Glamorgan Council Barry

Vale of Glamorgan Council

Client

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Suitability Code:	S2	Project Number:	10028657

PROJECT:

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WELTAG STAGE TWO PLUS

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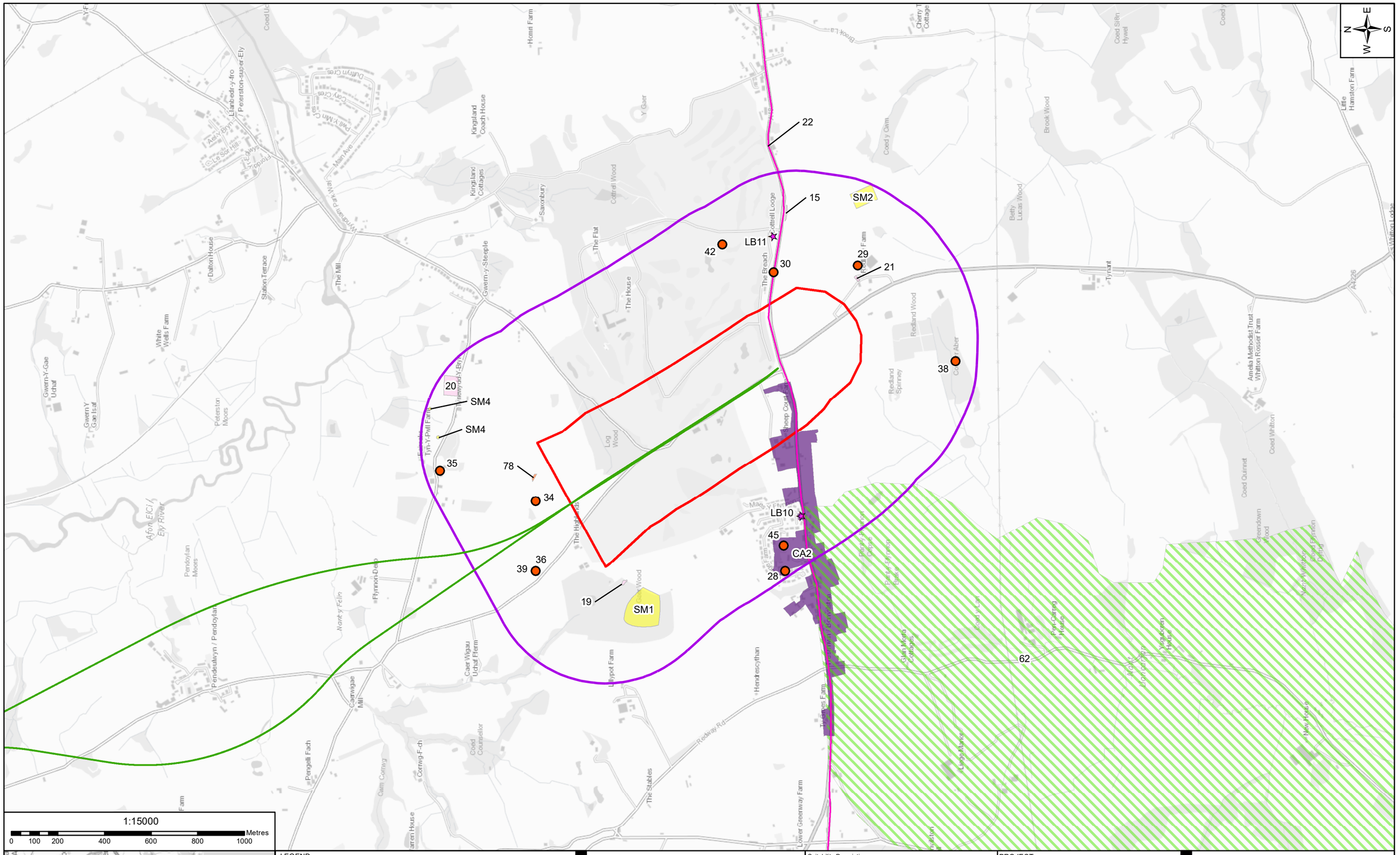

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01	28/08/19	Initial Issue	NG	JN	AL

LEGEND

- Route Options
- Sub-Section 4 250m Buffer
- Sub-Section 4 500m Study Area
- Scheduled Monuments
- Listed Buildings
- Historic Landscape
- Conservation Area

Non-Designated Hertiage Asset

- Points
- Lines
- Polygons

Walkover Survey Asset

- Polygons

Client

VALE of GLAMORGAN
BRO MORGANNWG

Site

Vale of Glamorgan Council
Barry

Vale of Glamorgan Council

Client

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Scale:	1:15000	Datum:	AOD
Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10028657

PROJECT:

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WELTAG STAGE TWO PLUS

TITLE:

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Heritage Assets Sub-Section 4

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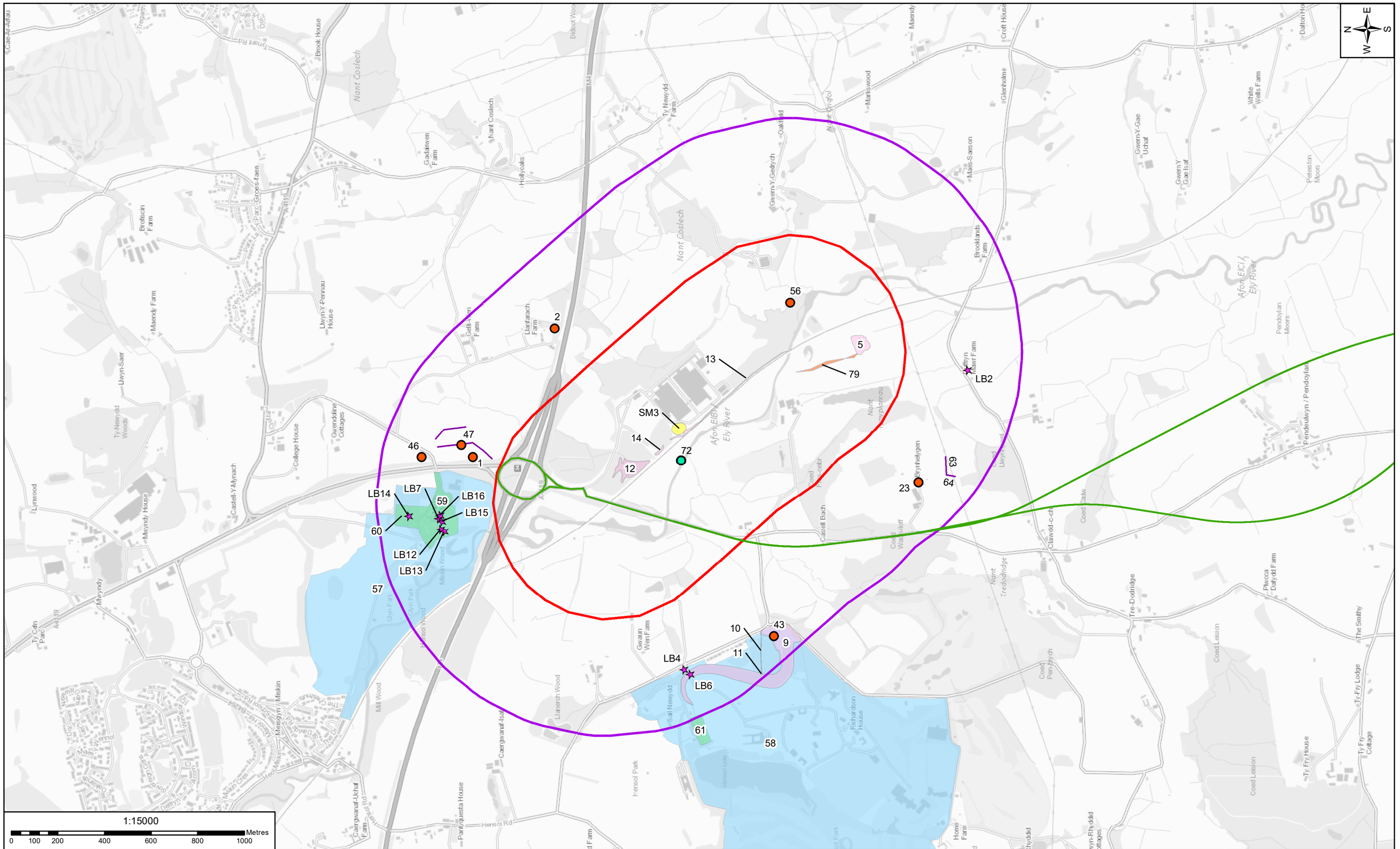

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LEGEND

- Route Options
- Sub-Section 5 500m Buffer
- Sub-Section 5 500m Study Area
- Scheduled Monuments
- Listed Buildings
- Parks
- Gardens and Kitchens

Non-Designated Hertiage Asset
- Points
- Polygons

Walkover Survey Asset
- Points
- Lines
- Polygons

Client

VALE of GLAMORGAN BRO MORGANNWG

Site
Vale of Glamorgan Council
Barry

Vale of Glamorgan Council

Client
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Suitability Code:	S2	Project Number:	10028657

PROJECT:
M4 JUNCTION 34 TO A48
WELTAG STAGE TWO PLUS

TITLE:
Figure 2:
Page 5:
Heritage Assets Sub-Section 5

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APPENDIX A

Heritage Asset Gazetteer

Designated Assets

Project ID	List Entry No.	Name	Grade	Easting	Northing
Scheduled Monuments					
SM1	GM079	Y Gaer	-	306337	174738
SM2	GM116	Coed-y-Cwm Chambered Cairn	-	308104	173794
SM3	GM370	Felin Isaf Castle Mound	-	306071	179267
SM4	GM365	Two Cooking Mounds E of Ty'n-y-Pwll	-	307129	175634
Listed Buildings					
LB1	2211	Cae'rwigau Uchaf	II	306038	175477
LB2	2212	Dyffryn Mawr Farmhouse	II	306321	178031
LB3	13454	Telephone Call-box	II	306020	176599
LB4	13467	Hafod Lodge to Hensol Castle (AKA Bottom Lodge)	II	305038	179247
LB5	13473	Pendoylan Cottages	II	305990	176718
LB6	13483	Bridge on main drive to Hensol Castle	II	305017	179221
LB7	13502	Miskin Manor, including one-storey range to N	II	305685	180299
LB8	13596	Cae'rwigau Isaf	II	306006	175788
LB9	13613	Church of St Cadoc (St Cattwg)	II*	305988	176685
LB10	16321	Village Farmhouse	II	306736	174065
LB11	16327	Cottrell Lodge	II	307934	174185
LB12	23923	Upper terrace wall and pavilion on W side of Miskin Manor	II	305638	180290
LB13	23924	Lower terrace wall on W side of Miskin Manor	II	305629	180275
LB14	23925	Kitchen garden walls N of Miskin Manor	II	305696	180427
LB15	23927	Pair of King's Beasts at W entrance to Miskin Manor	II	305672	180285
LB16	23928	Pair of King's Beasts at E entrance of Miskin Manor	II	305698	180292

Project ID	List Entry No.	Name	Grade	Easting	Northing
Conservation Areas					
CA1	-	Pendoylan	-	306007	176641
CA2	-	Bonvilston	-	306581	174037
Parks					
57	GM9	Miskin Manor	II	305421	180489
58	GM41	Hensol Castle	II	304545	178696
Garden and kitchen					
59	GM9	Miskin Manor	-	305693	180312
60	GM9	Miskin Manor	-	305698	180455
61	GM41	Hensol Castle	-	304718	178933
Historical Landscape					
62	HLW (SG) 1	Lancarfan	-	305336	171374

Non-Designated Assets

Project ID	GGAT HER No.	Name	Date	Type	Easting	Northing
1	01287m	4 lynchets	Medieval	Field systems	305950	180150
2	01076m	Finds of Post Medieval kiln	Post-Medieval	Kiln	306500	179800
3	01071m	Slab of sandstone	Bronze Age	Standing Stone	305766	180705
4	00929s	Pendoylan Round Barrow	Bronze Age	Barrow	305009	176710
5	01480s	MAENDY BACH	Medieval	Homestead	306400	178500
6	01294.0s	'TALYFAN' DEER PARK	Medieval	Park	305540	176330
7	00714s	MOATED HOMESTEAD	Medieval	Homestead	305650	175490
8	04050s	Tre Dodridge Lime Kiln	Post-Medieval	Kiln	305689	177114

Project ID	GGAT HER No.	Name	Date	Type	Easting	Northing
9	03972s	Hensol Mill	Post-Medieval	Mill	305180	178860
10	04408s	Watercourse, Hensol	Unknown	Watercourse	305111	178915
11	04401s	Weir, Hensol	Unknown	Weir	305021	178913
12	04389s	Pond, Melin Isaf	Unknown	Pond	305902	179477
13	04388.0s	Watercourse, Felin Isaf	Unknown	Watercourse	306193	1790783
14	04318s	Earthwork Pond	Unknown	Earthwork	305973	179350
15	00372s	Cottrell Park Standing Stone	Bronze Age	Standing Stone	308045	174124
16	03975s	CAERWIGAE MILL	Post-Medieval	Mill	305885	175873
17	00165s	Ffynnon Deilo	Medieval	Well	306330	175900
18	04397s	Pond, Cae'r-wigan Mill	Unknown	Pond	305909	175830
19	04396s	Pond, Gaer Wood	Unknown	Pond	306452	174821
20	04007s	Tynewydd-y-Bryn	Unknown	Enclosure	307295	175563
21	3870s	Redlands Farm	Post Medieval	Barn	307760	173820
22	RR60c-01	Roman Road	Roman	Road	305489	173938
23	00161s	Bryn Helygen	Post-Medieval	Farmhouse	305840	178240
24	00162s	Silver Coins Findspot, Pendoylan	Medieval	Coin	305100	177250
25	00163s	Ffynnon Gattwg	Medieval	Holy well	306080	176710
26	00167s	Findspot	Bronze Age	Spear	305000	177000
27	00178s	Carrwg-Fach	Post-Medieval	House	305620	175700
28	00360s	Bonvilston House	Post-Medieval	House	306500	174130
29	00370s	Redland Standing Stone	Bronze Age	Standing stone	307810	173820
30	00373s	Findspot	Post-Medieval	Coin hoard	307780	174180

Project ID	GGAT HER No.	Name	Date	Type	Easting	Northing
31	00650s	Maes yr Haul	Post-Medieval	House	306460	175930
32	00651s	Carrwg-Fawr	Post-Medieval	House	305540	175900
33	00711s	Caerwigau	Medieval	Deserted rural settlement	306038	175477
34	00712s	CAIRWIGAU CHURCH	Medieval	Chapel	306800	175200
35	00713s	TREHEDYN HOUSE	Post-Medieval	Country house	306930	175610
36	00814s	CAERWIGAU-UCHAF	Neolithic	Axe	306500	175200
37	00928s	House	Medieval	House	306000	176200
38	03717s	Coed yr Abad Grange	Medieval	Grange	307400	173400
39	03718s	Dwyr Capel, Caerwigau	Medieval	Chapel	306500	175200
40	03756s	Pendoylan Churchyard	Medieval	Churchyard	305970	176680
41	03782s	Pendoylan Churchyard Cross	Medieval	Churchyard cross	305987	176699
42	03822s	COTTERELL PARK	Unknown	Cist	307900	174400
43	03973s	Hensol Mill Pond	Post-Medieval	Mill pond	305180	178860
44	03974s	POSSIBLE QUARRY NEAR BRYNCOCH	Post-Medieval	Quarry	305200	176400
45	05143s	Supermarine Spitfire N3221 crash site	Modern	Air crash site	306609	174137
46	04262.0m	Trackway	Unknown	Transport	305950	180370
47	04822m	AP FEATURE	Unknown	Agriculture and subsistence	306000	180200
48	05688s	Clawdd Coch Farmhouse	Post-Medieval	Farmhouse	305531	177713
49	05692s	Pendoylan War Memorial Hall	Modern	Village Hall	305607	177307
50	02305s	Pendoylan Cottage no.1	Post-Medieval	Alms house	305900	176700

Project ID	GGAT HER No.	Name	Date	Type	Easting	Northing
51	02306s	Pendoylan Cottage no.2	Post-Medieval	Alms house	305900	176700
52	02307s	Pendoylan Cottage no.3	Post-Medieval	Alms house	305900	176700
53	02308s	Pendoylan Cottage no.4	Post-Medieval	Alms house	305900	176700
54	02309s	Pendoylan Cottage no.5	Post-Medieval	Alms house	305900	176700
55	02310s	Pendoylan Cottage no.6	Post-Medieval	Alms house	305900	176700
56	04097s	Footbridge, Redlands Farm	Post-Medieval	Footbridge	306610	178790
63	-	Possible old field boundary	Unknown	Linear	305911	178122
64	-	Old field boundary ditch	Unknown	Linear	305869	178102
65	-	Possible old field boundary, forms an almost north to south step in field	Unknown	Linear	306166	176708
66	-	Possible land division	Unknown	Linear	305801	177306
67	-	Possible land division	Unknown	Linear	305766	177334
68	-	Removed field boundary, now a bigger field	Unknown	Linear	306216	176618
69	-	Removed hedge line, can still be seen as a linear depression in landscape with a tree	Unknown	Linear	306089	176472
70	-	Removed field boundary	Unknown	Linear	305940	176082
71	-	Removed field boundary	Unknown	Linear	305928	176135
72	-	Possible mound from dumping	Unknown	Mound	305934	179257
73	-	Unknown mound	Unknown	Mound	306056	177295
74	-	Brick pillar	Unknown	Structure	306091	177414
75	-	Brick pillar west, hollow with lining	Unknown	Structure	306086	177405
76	-	Hole in ground with trees	Unknown	Depression	305911	176605
77	-	Ruined/abandoned building	Unknown	Building	306068	176121

Project ID	GGAT HER No.	Name	Date	Type	Easting	Northing
78	-	Possible mound / platform	Unknown	Mound	306903	175208
79	-	Possible old channel or leat	Unknown	Linear	306349	178630

Previous Archaeological Events

Project ID	GGAT HER No.	Name	Easting	Northing
EV1	E001206	Field visit COOKING MOUND EAST OF TY'N-Y-PWLL	307170	175650
EV2	E001205	Field visit COOKING MOUND EAST OF TY'N-Y-PWLL	307070	175610
EV3	E000857	MAENDY BACH, SURVEY, 1977?	306400	178500
EV4	E000550	STANDING STONE, MISKIN MENHIR, PARTIAL EXCAVATION	305766	180705
EV5	E000766	FELIN ISAF MOUND, SURVEY, 1976	306060	179260
EV6	E000738	COED Y CWM, PARTIAL EXCAVATION, 1936	308108	173779
EV7	E005859	Vale of Glamorgan Mains Refurbishment Scheme Phase 1, 2007	302800	176000
EV8	E004259	Field Visit to Caerwigae Mill, 2012	305885	175873
EV9	E004258	Field Visit to Hensol Mill, Pendoylan, 2012	305180	178860
EV10	E002632	Redlands Farm, Bonvilston. Tir Gofal MP – Field Visit, 2000	308280	173660
EV11	E002631	Redlands Farm, Bonvilston. Tir Gofal MP – Management Plan Landscape, 2000	308280	173660
EV12	E003242	Field Visit to Ffynnon Deilo – Field Visit, 2010	306330	175900
EV13	E001962	Field Visit Redland Standing Stone, 1950	307810	173820
EV14	E001963	Field Visit Redland Standing Stone, 1970	307810	173820
EV15	E001953	Field Visit Redland Standing Stone, 2003	307810	173820
EV16	E001610	Field visit to Tynewydd-y-Bryn, 2006	307280	175600
EV17	E000783	MOATED HOMESTEAD, CAERWIGAU, SURVEY, 1977	305650	175490
EV18	E000739	COTTRELL PARK STANDING STONE, PARTIAL EXCAVATION	308045	174124
EV19	E005443	A Predictive Model of Early Medieval Settlement Location – Landscape Interpretation, 2010	308572	171113
EV20	E005431	The Rural Settlement of Roman Britain - Project, 2015	258585	187907

Project ID	GGAT HER No.	Name	Easting	Northing
EV21	E005611	Hensol Castle Playing Fields, Miskin – Watching Brief, 2006	304910	178820
EV22	E002560	Cottrell Park Golf Club - Evaluation, 2001	306991	174362
EV23	E002542	Cottrell Park Golf Club, Watching Brief, 2001	306991	174362
EV24	E002972	Extension to the Vale of Glamorgan Golf Club, DBA, 2000	304400	178350
EV25	E003774	Archaeology Within and Around the Parc Dyffryn Development, DBA	307969	173820
EV26	E001481	Archaeological Assessment of Bonvilston and St Nicholas – DBA	308000	173000
EV27	E003082	Woodlands Lodge Watching Brief, 2010	306570	174045
EV28	E003082	Woodlands Lodge	306565	174055
EV29	E002547	Hensol Park, Mid Glamorgan Watching Brief, 2001	304779	178192

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APPENDIX P

Landscape and Visual Assessment | Impacts Appraisal

Impacts | Option A – Highway Route East of Pendoylan

Background

The proposals for the new road will involve the creation of a corridor of disturbance running from the M4 Junction 34 to A38. Most of the route is common to both Option A and Option B, however Option A passes to the east of Pendoylan. All will require the felling of trees and the removal of hedgerows, together with some disruption of the field pattern. It is assumed that replacement tree and hedgerow planting will be an integral part of the proposal. In terms of the effect on landscape character there is little to differentiate between the two offline options. The potential impacts on the specific landscape elements are:

- Undulating landform rising to the A48 ridge | Some significant new landforms are proposed – e.g. the cutting south of Pendoylan Nursery and the embankments associated with bridge abutments. However, these are generally of a scale that will not alter the overall characteristic undulating landform.
- Extensive hedgerows outlining small irregular fields that are predominately managed as pasture | All options will lead to loss of hedgerows that will require to be replaced. The field pattern will be disrupted locally by the works. Introducing a strong linear feature into the existing landscape pattern will be disruptive initially, however with appropriate mitigation the impact can be reduced over time. The existing mainline railway is generally well absorbed into the landscape.
- Individual trees within hedgerows | There will be some loss of mature hedgerow trees, although new tree planting would ensure no change to this character element in the longer term.
- Significant number of small woodlands | Both options would impact on existing small woods. Replacement woodland to maintain the landscape character would be an essential mitigation item.

The greatest impacts will be during the construction stage but will be of relatively short duration. Once mitigation/ replacement planting is established any impacts on the landscape are likely to be minimal.

Visual Assessment

The study area includes a range of visual receptors and there are some extensive views across and along the Ely Valley. The visual amenity of the area is an important characteristic.

The following sensitive receptors are likely to experience significant adverse visual effects.

- Residential properties near Clawdd-Coch | These are close to the line of the proposed road [~50m] - the west and east options are the same at this point and are likely to generate significant visual impacts. The loss of existing mature trees in this location will exacerbate this effect, which can be partially mitigated in the long term through new tree planting.
- Residential Properties on the East side of Heol St Cattwg Pendoylan | The Eastern option passes within 200m of these properties – although partially screened by existing hedgerows and woodland, some properties are likely to experience major adverse effects during construction. These are likely to reduce over time if screening vegetation is planted between the new road and the houses.
- Residential and Farm Property South of Pendoylan | There are house and farm buildings immediately adjacent to the Eastern option alignment which is on a slight embankment at this point. The location will experience very large adverse impacts both during construction and operation, it is unlikely that these can be significantly mitigated.
- Residential Properties south of Trehedyn Lane | Some properties are close to the line of the proposed road [~50m] for both the west and east options which will generate significant visual impact during construction and operation. It is unlikely that these can be significantly mitigated.

Several Public Rights of Way will be impacted by the proposed road – both with the east or west option. The impacts are likely to be significant.

Impacts | Option B – Highway Route West of Pendoylan

The proposals for the new road will involve the creation of a corridor of disturbance running from the M4 Junction 34 to A38. Most of the route is common to both Option A and Option B, however Option B passes to the west of Pendoylan. All will require the felling of trees and the removal of hedgerows, together with some

disruption of the field pattern. It is assumed that replacement tree and hedgerow planting will be an integral part of the proposal. In terms of the effect on landscape character there is little to differentiate between the two offline options. The potential impacts on the specific landscape elements are:

- **Undulating landform rising to the A48 ridge |** Some significant new landforms are proposed - e.g. the cutting south of Pendoylan Nursery and the embankments associated with bridge abutments. However, these are generally of a scale that will not alter the overall characteristic undulating landform.
- **Extensive hedgerows outlining small irregular fields – predominately managed as pasture |** All options will lead to loss of hedgerows that will require to be replaced. The field pattern will be disrupted locally by the works. Introducing a strong linear feature into the existing landscape pattern will be disruptive initially, however with appropriate mitigation the impact can be reduced over time. The existing mainline railway is generally well absorbed into the landscape.
- **Individual trees within hedgerows |** There will be some loss of mature hedgerow trees however new tree planting would ensure no change to this character element in the longer term.
- **Significant number of small woodlands |** Both options would impact on existing small woods. Replacement woodland to maintain the landscape character would be an essential mitigation item.

The greatest impacts will be during the construction stage but will be of relatively short duration. Once mitigation/ replacement planting is established any impacts on the landscape are likely to be minimal.

Visual Assessment

The study area includes a range of visual receptors and there are some extensive views across and along the Ely Valley.

The following sensitive receptors are likely to experience significant adverse visual effects.

- **Residential properties in Clawdd-Coch |** There are properties close to the line of the proposed road [~50m] – the west and east options are the same at this point and will generate significant visual impact. The loss of existing mature trees will exacerbate this impact, which can be partially mitigated in the long term through new tree planting
- **Residential Properties south of Pendoylan |** These houses lie immediately adjacent to the proposed route for the Western alignment. At this point the new road will be on embankment as it approaches the bridge over the existing road. The properties are likely to experience very large adverse impact both during construction and operation. It is unlikely that these can be significantly mitigated.
- **Residential Properties south of Trehedyn lane |** These are both close to the line of the proposed road [~50m] for both the west and east options which will generate significant visual impact during construction and operation. It is unlikely that these can be significantly mitigated.

Several Public Rights of Way will be impacted by the proposed road – both with the east or west option. The impacts are likely to be significant

Impacts | Options C1 and C2 – Online Alignments

The proposals are for the new road will involve a creation of a corridor of disturbance running from the M4 Junction 34 to A38. Two online options are considered as part of this assessment. Most of the route is common to both, however:

- Option C1 includes a 3.5m segregated foot/ cycle way (the new section of road is compliant to DMRB standards).
- Option C2 is narrower – with no foot/ cycleway (the new section of road is non-compliant to DMRB standards).

Neither of the online option proposes any works through Pendoylan itself with this section remaining non-compliant to DMRB standards.

Both online options will require extensive felling of trees and the removal of hedgerows adjoining the existing road together with some disruption of the field pattern. It is assumed that replacement tree and hedgerow

planting will be an integral part of the proposal for both options. There are likely to be some impacts on driveways and farm access points and some significant effects within Clawdd-Coch.

The landscape character impacts of both proposal options are of a small scale in the overall landscape context. The greatest impacts will be during the construction stage the but will be of relatively short duration. In the long term, once mitigation/ replacement planting is established any impacts on the landscape will be less significant.

The potential impacts on the specific landscape elements are:

- **Undulating landform rising to the A48 ridge |** Some significant new landforms are proposed. However, these are generally of a scale that will not alter the overall characteristic undulating landform.
- **Extensive hedgerows outlining small irregular fields – predominately managed as pasture |** Both options will lead to loss of hedgerows adjoining the that will require to be replaced, The field pattern will be disrupted locally by the works, however this will just reinforce the line of the existing road rather than introducing a new strong linear feature into the existing landscape . With appropriate mitigation the impact can be reduced over time. The existing mainline railway is generally well absorbed into the landscape
- **Individual trees within hedgerows |** There will be significant loss of roadside mature hedgerow trees however new tree planting would ensure no change to this character element in the longer term
- **Significant number of small woodlands |** Neither option would impact greatly on existing small woods - replacement woodland to maintain the landscape character would be an essential mitigation item.

In terms of the overall effect on the local landscape character there is little to differentiate the two options. However, Option C1 with its wider footprint and greater earthworks has a greater impact on the landscape. In terms of vegetation loss there is probably not a great deal of difference. Once the roadside field boundaries have been removed further encroachment is generally into open fields.

Option C1 also has greater impact on the woodland at Coed Waun-Lloff north of Clawdd-Coch.

Visual Assessment

The study area includes a range of visual receptors and there are some extensive views across and along the Ely Valley. The main visual impacts will, however, be limited to the properties adjoining the existing road. It is likely that the impacts will be similar for both online options, however, the detailed effects cannot be fully ascertained until more advanced design stages.

The following sensitive receptors are likely to experience significant adverse visual effects.

- **Residential properties in and south of Clawdd-Coch |** There are several properties close to the existing road that will experience significant visual impact.
- **Residential Properties south of Pendoylan |** There are semi-detached and detached houses which lie immediately adjacent to the existing road.
- **Residential Properties 'The Cherries' and 'The Highlands' |** These properties are both situated close to the existing road.

Several Public Rights of Way which link to the existing road will be impacted - particularly during the construction phase.

APPENDIX Q

WelTAG Stage Two | Geotechnical Feasibility Study

ARCADIS Design & Consultancy for natural and built assets

IMPROVING STRATEGIC TRANSPORT ENCOMPASSING CORRIDORS FROM M4 JUNCTION 34 TO THE A48 | HIGHWAY LINK STUDY

VALE OF GLAMORGAN GATEWAY STATION

WelTAG Stage Two Plus | Geotechnical Feasibility Desk Study

MARCH 2020

Improving Strategic Transport Encompassing Corridors from M4 Junction 34 to the A48 | Highway Link Study

Vale of Glamorgan Gateway Station

WelTAG Stage Two Plus

Geotechnical Feasibility Desk Study Report

Author	HC
Checker	DG
Approver	JC
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Executive Summary

Background

Arcadis has been commissioned by the Vale of Glamorgan Council to develop and appraise potential options for improving the strategic transport network encompassing corridors from M4 Junction 34 to the A48 (Five Mile Lane), including the Pendoylan Corridor (or alternative). The appraisal of options has been undertaken in accordance with the Welsh Government's latest version of WelTAG (December 2017) including advice on the appraisal in relation to the Future Generations of Wales (2015) Act Well-being Goals. This geotechnical feasibility report presents the findings of a high-level desk-based review of publicly available information.

The WelTAG Stage Two Plus options subject to appraisal are as follows:

- M4 Junction 34 to A48 Highway Route East of Pendoylan
- M4 Junction 34 to A48 Highway Route West of Pendoylan
- Vale of Glamorgan Gateway Station (formerly Parkway Station) with Park and Ride facility and bus integration near to the M4 Junction 34

Following further recommendations made by the Vale of Glamorgan Council Environment and Regeneration Committee and Cabinet, the WelTAG Stage Two Plus study is now considering the following four highway options, in comparison to the Do Minimum without a highway link improvement:

- **M4 Junction 34 to A48 | Option A – Highway Route East of Pendoylan**
- **M4 Junction 34 to A48 | Option B – Highway Route West of Pendoylan**
- **M4 Junction 34 to A48 | Option C1 – Existing Infrastructure (Online) Enhancement**
- **M4 Junction 34 to A48 | Option C2 – Existing Infrastructure (Online) Enhancement**

This report has focussed on the two online options in line with the original commission. However, as the online route is fully encompassed within the study area, this report has been used to inform the WelTAG Stage Two Plus assessment which can be referenced separately.

The study area has been divided into five Sub-Sections to cover the three options. Sub-Sections 1 to 4 encompass the highway route options and Sub-Section 5 encompasses the Vale of Glamorgan Gateway Station option. The overall proposed study area and the boundaries of each Sub-Section are shown in Appendix A.

A brief summary of the findings for the entire 6km route is outlined below:

Land Use

The topography across the proposed site covered in this report varies from +28mAOD to +130mAOD. A large portion of the land within the study Sub-Section areas consist of agricultural land, with some residential and business buildings spread sporadically in the vicinity of the proposed route area. The large Renishaw factory is the prominent development situated within Sub-Section 5. Some woodland areas are present close to the proposed areas, notably towards the northern part in Sub-Section 1 where the proposed route is either very close or within the woodland areas. A review of historical maps finds that much of the study area has remained as agricultural land and a number of quarries are found to be within approximately 200m of the proposed route.

Mining

No coal mining is identified in any of the Sub-Section areas in this report.

Radon

Public Health England indicates most of the sub section areas are in an area where 10-30% of properties are at or exceed the Radon action level.

Unexploded Ordnance

The Zetica Risk Map indicates the study area is located in an area designated as having ‘Low’ (15 bombs per 1000 acres or less) risk of UXO.

Hydrology

There are many surface-water ponds spread sporadically through the proposed route as well as the Ely river running east of the route and crossing it near the northern boundary approximately 500m south of the M4 roundabout. There are many smaller secondary streams located throughout the proposed route area.

Geology

The ground conditions along the route are likely to comprise superficial deposits of Head, Alluvium and Glacial Till. These materials may provide low bearing capacity and may pose a long-term settlement risk to proposed foundations. Further assessment is required.

1 Introduction

1.1 Background

1.1.1 Arcadis has been commissioned by the Vale of Glamorgan Council to develop and appraise potential options for improving the strategic transport network encompassing corridors from M4 Junction 34 to the A48 (Five Mile Lane), including the Pendoylan Corridor (or alternative). The appraisal of options has been undertaken in accordance with the Welsh Government's latest version of WelTAG (December 2017) including advice on the appraisal in relation to the Future Generations of Wales (2015) Act Well-being Goals.

1.1.2 This geotechnical feasibility report presents the findings of a high-level desk-based review of publicly available information. The overall proposed study area and the boundaries of each Sub-Section are shown in Appendix A.

1.2 Context | WelTAG Stage Two Appraisal

1.2.1 A first WelTAG Stage Two report was prepared by Arcadis and presented to the project Review Group on 2nd October 2018. The report appraised the following three options:

- M4 Junction 34 to A48 Highway Route East of Pendoylan
- M4 Junction 34 to A48 Highway Route West of Pendoylan
- Vale of Glamorgan Gateway Station (formerly Parkway Station) with Park and Ride facility and bus integration near to the M4 Junction 34

1.2.2 Following consideration of the initial WelTAG Stage Two report, several recommendations were agreed by the Review Group for completion at Stage Two including a programme of early stage environmental surveys and investigations, more detailed development of the highway link concept designs and completion of Vale of Glamorgan Gateway Station GRIP Stage 1 and GRIP Stage 2 studies. The proposals for additional Stage Two assessment (referred to as Stage Two Plus) were considered and agreed by the Vale of Glamorgan Council Environment and Regeneration Scrutiny Committee and Vale of Glamorgan Council Cabinet over several meetings.

1.2.3 **Following further recommendations made by the Vale of Glamorgan Council Environment and Regeneration Committee and Cabinet, the WelTAG Stage Two Plus study is now considering the following four highway options, in comparison to the Do Minimum without a highway link improvement:**

- **M4 Junction 34 to A48 | Option A – Highway Route East of Pendoylan**
- **M4 Junction 34 to A48 | Option B – Highway Route West of Pendoylan**
- **M4 Junction 34 to A48 | Option C1 – Existing Infrastructure (Online) Enhancement**
- **M4 Junction 34 to A48 | Option C2 – Existing Infrastructure (Online) Enhancement**

1.2.4 **This report has focussed on the two online options in line with the original commission. However, as the online route is fully encompassed within the study area, this report has been used to inform the WelTAG Stage Two Plus assessment which can be referenced separately.**

1.2.5 It should be noted that in agreement with Welsh Government, a decision has been made by the Vale of Glamorgan Council to separate the WelTAG assessment of the Vale of Glamorgan Gateway Station option from the M4 Junction 34 to A48 highway link options, although for the purposes of this WelTAG Stage Two Plus Geotechnical Feasibility assessment, all information has been retained within the same report.

1.3 Proposed Site Location and Description

1.3.1 Five Sub-Sections have been created to cover the study area and the associated scheme options.

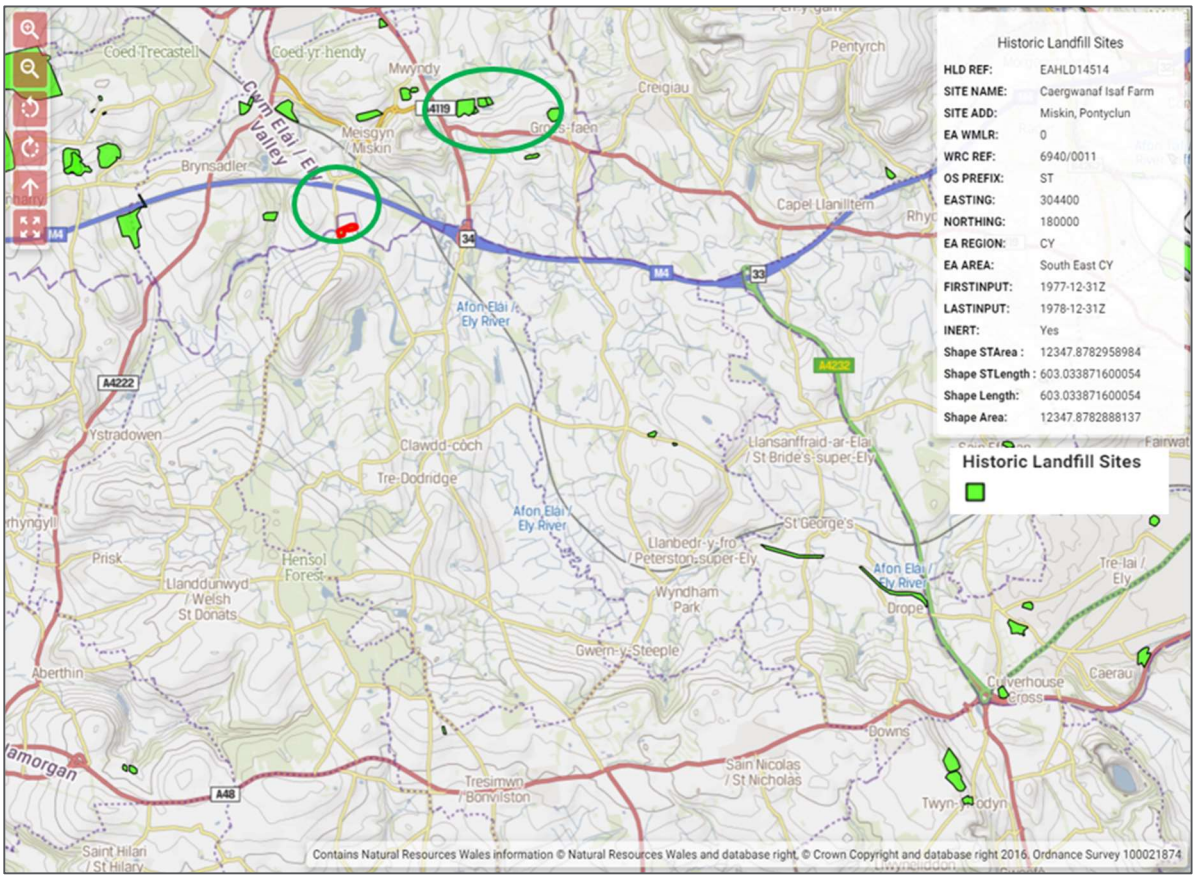
M4 Junction 34 to A48 Highway Route Options East and West of Pendoylan

1.3.2 **Sub-Section 1 |** The M4 junction roundabout is situated within the northern boundary of the proposed study area, with Ely River crossing the area in a NW-SE orientation, just south of the roundabout. A few secondary river networks running across the existing southern road from the M4, west to south-east orientation. There are a few businesses located 300m-550m to the east of the proposed Sub-Section area. Historical landfill sites have been identified (figure 1) approximately 1km north and west of the Sub-Section 1 boundaries.

1.3.3 Approximately 1km north of the Sub-Section 1 boundary non-coaling mine plan extents are identified from BGS records (http://mapapps2.bgs.ac.uk/mineplans/home.html) (figure 2).

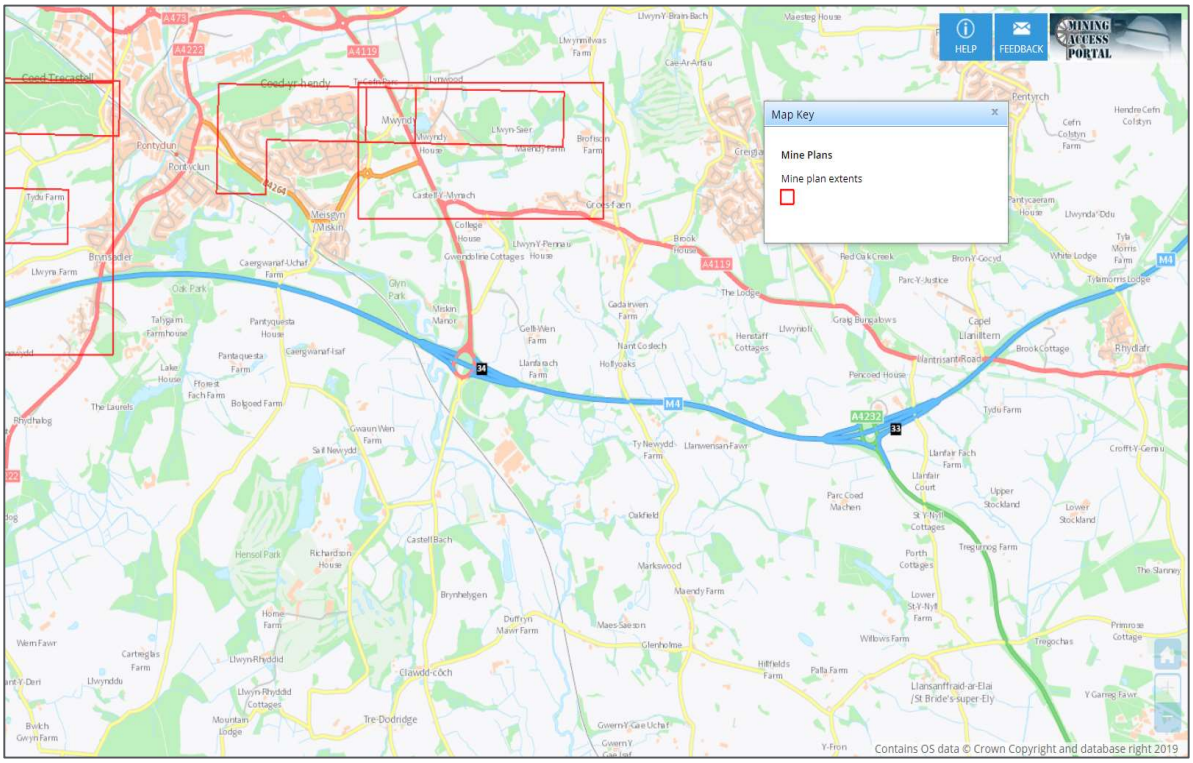
1.3.4 The National Grid Reference for the approximate centre of the study area is ST056790. The extents of the study area (approximately 2.24km2) covered by this high-level desk study are shown on drawing 10028657_ARC_XX_XX_DR_EA_0039_P1.

Figure 1 Historic Landfill Sites[1]



[1] https://data.gov.uk/dataset/17edf94f-6de3-4034-b66b-004ebd0dd010/historic-landfill-sites

Figure 2 Non-Coal Mining Plans



1.3.5 **Sub-Section 2 |** The proposed site is located east of the Pendoylan Village, 13km west of Cardiff, with a number of minor river networks running on a west to east direction throughout the area. Peterston-super-Ely is a village located approximately 1km east of the Sub-Section area. Ely River runs north-south, east of the area, with minor river networks running throughout the proposed area. The proposed road crosses through a wooded region on the north side of the area as well as a small road running east-west on the northern boundary of the area.

1.3.6 The National Grid Reference for the approximate centre of the study area is ST063764.

1.3.7 The extents of the study area (approximately 1.52km^2) covered by this high-level desk study are shown on drawing 10028657_ARC_XX_XX_DR_EA_0039_P1.

1.3.8 **Sub-Section 3 |** The area is located west of the Pendoylan Village and south of Clawdd-Coch with minor river networks running on a west to east orientation. Multiple minor roads cross the area in a general north-south direction. The proposed road scheme would pass west of Pendoylan and join Sub-Section 1 of proposed road east of Clawdd-Coch in the north and join Sub-Section 4 near The Highlands in the south.

1.3.9 The National Grid Reference for the approximate centre of the study area is ST057763.

1.3.10 The extents of the study area (approximately 1.57km^2) covered by this high-level desk study are shown on drawing 10028657_ARC_XX_XX_DR_EA_0039_P1.

1.3.11 **Sub-Section 4 |** The study area is north of the A48/A4226, extending from The Highlands to Sheep Court Farm merging onto the A48. Two unnamed minor roads feed into the proposed area from the south-west and north-east directions. Surface water features such as ponds and minor rivers are located along the eastern and western boundary of the proposed study area.

1.3.12 Residential buildings are location at the centre of the proposed study section on the western side, followed by small paths leading from the minor roads to the residential area.

1.3.13 The village of Bonvilston lies approximately 550m west from the southern boundary of the Sub-Section area, with settlements spreading into the western boundary. The Cottrell Park Golf Resort

lies approximately 500m east from the centre of the Sub-Section area, with the fields of the resort likely to be falling within the eastern boundary.

1.3.14 The National Grid Reference for the approximate centre of the study area is ST071745.

1.3.15 The extents of the study area (approximately 1.60km^2) covered by this high-level desk study are shown on drawing 10028657_ARC_XX_XX_DR_EA_0039_P1.

Vale of Glamorgan Gateway Station

1.3.16 **Sub-Section 5 |** Sub-Section 5 is located at the northern end of the Site and follows the South Wales Main Line in a north west to south east direction for c.950m. The proposed development in this section would comprise a parkway-type railway station on the existing railway line, with associated road access.

1.3.17 There are several agricultural buildings located within the Sub-Section, although the principal development is the large Renishaw factory that is situated adjacent to the South Wales Main Line.

1.3.18 The M4 Junction 34 included within this Sub-Section with its southern arm interconnecting with Renishaws. A further road heads southward towards the villages of Pendoylan and Clawdd Coch and provides the existing connectivity to the A48 at the Sycamore Cross junction.

1.3.19 The National Grid Reference for the approximate centre of the study area is ST062790.

1.3.20 The extents of the study area covered by this high-level desk study are shown on drawing 10028657_ARC_XX_XX_DR_EA_0039_P1.

2 Sub-Section 1

2.1 Physical Setting

Topography

2.1.1 The ground level increases from +30m AOD to approximately +50m AOD from M4 Jn 34 towards the south at Clawdd Coch. The highest point in the area is +60m AOD on the south-eastern boundary. The northern central part of the area is relatively flat at +30m AOD, rising up to the west towards Llanerch Wood at +50m AOD. 100m north of the roundabout the topography slopes more steeply up to the north, reaching 69m 450m north of the roundabout.

Land Use

Current

2.1.2 Most of the study area consists of agricultural land, with the railway running across the proposed study area in a NW-SE orientation. The village of Hensol lies to the west of the area, residential housing starts on the road leading to the village. Sewage Works on the western central side of the area,

2.1.3 Industrial buildings (Renishaw Manufacturers), a golf club and veterinary farm are located on the east of the proposed study area. A few farms are located on the south boundary of the area. Llanerch Vineyard Hotel is located 0.5km south-west of the roundabout. Glyn Park and Miskin Manor Hotel are located 200m north-west of the roundabout.

Historic

2.1.4 A review of publicly available historical Ordnance Survey maps (https://www.old-maps.co.uk) dated 1877 to 1994 has been undertaken. The maps indicate that the study has remained predominantly as agricultural land since the first available published map.

2.1.5 A sewage treatment system is located approximately 300m west of the proposed alignment. This is visible from the map dated 1942.

2.2 Geological Setting

2.2.1 The British Geological Survey Onshore GeoIndex Website was used to view the 1:50,000 Bedrock and Superficial Geological maps (Sheets 261&262 England and Wales) to assess the anticipated geology (Ref. 1).

2.2.2 The bedrock geology predominantly consists of Llanishen Conglomerate Formation (interbedded sandstone, conglomerate and siltstone) and changing to Mercia Mudstone Group (brown and red-brown, calcareous clays and mudstones, with occasional beds of impersistent green siltstone and fine-grained sandstone) towards the Clawdd Coch Junction. The Llanishen Formation dips to the north between 30 and 50°. A fault runs NW-SE through the north-west side of the area, bringing younger Devonian bedrock next to the Llanishen and the Upper Devonian Old red sandstone and Lower Limestone Shale Group overlie this unconformably on the north and west of the area. A longer fault runs NE-SW south of Clawdd Coch and the beds on the south side of this, dip southwards between 10 and 30°.

2.2.3 The superficial geology underlying the area changes from Estuarine Alluvial deposits associated with the River Ely (Clay, silt, sand and gravel) to Glacial Till (Boulder Clay) deposits towards the Clawdd Coch Junction. Geological map extracts from the BGS can be found in Figure 3. A cross section segment east of the area is shown in Figure 4. Additional geological maps are shown in Appendix E.

Figure 3 BGS cross section (1: 50 000), Pentyrch to St Brides-super-Ely, east of area, map sheet 263[2]

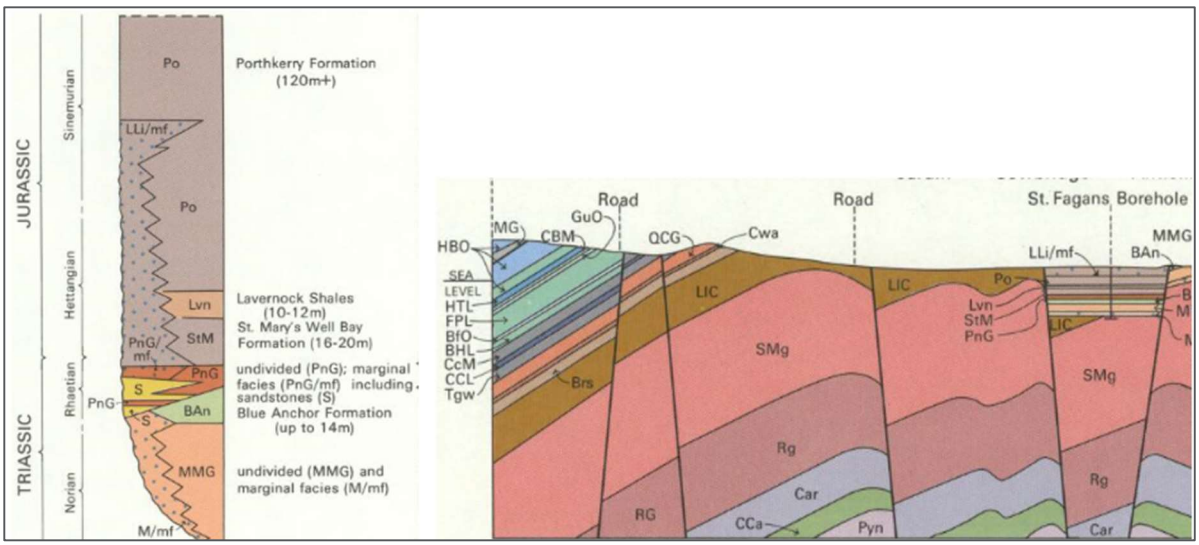
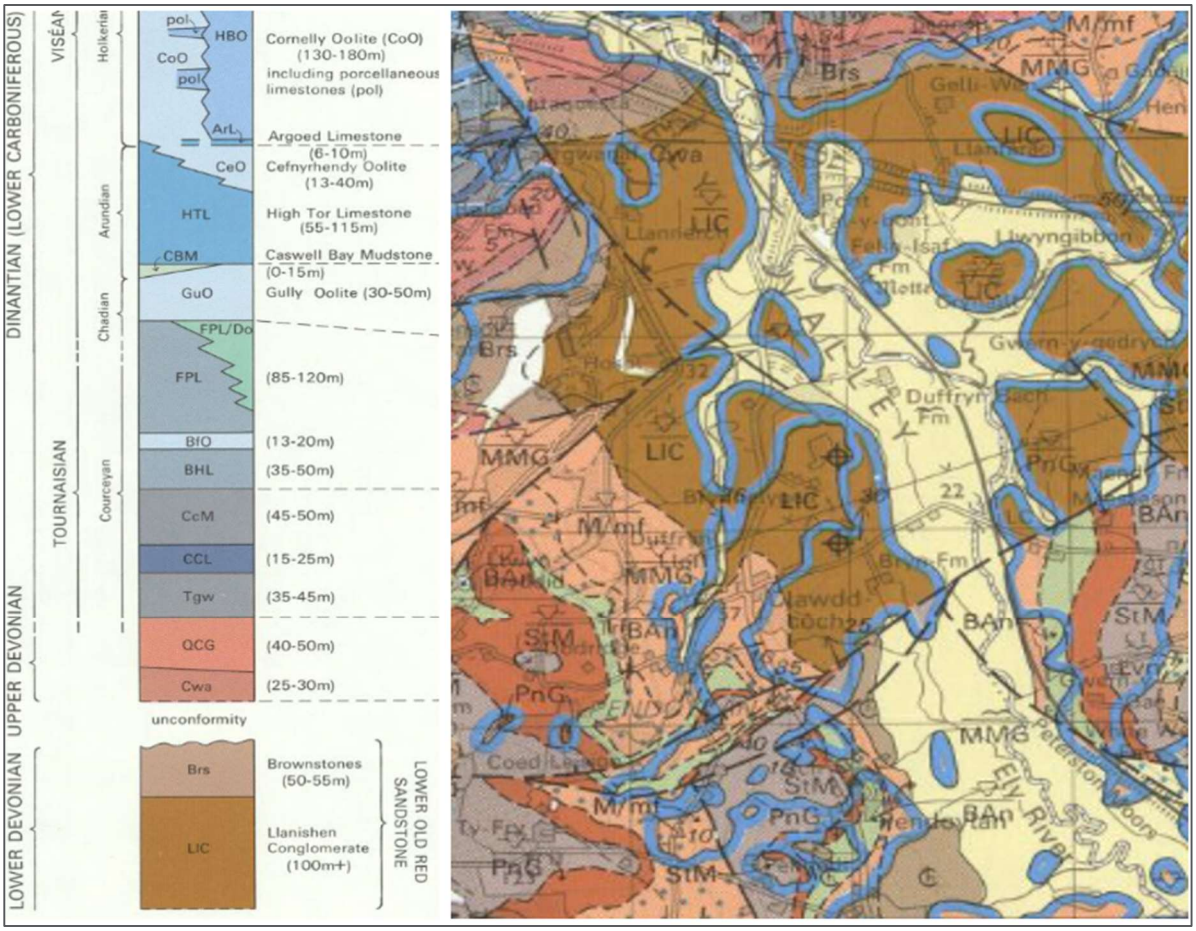


Figure 4 BGS geological map (1:50 000), map sheet 262[3]



[2] Contains British Geological Survey materials © NERC 2019

[3] Contains British Geological Survey materials © NERC 2019

Coal Mining

2.2.4 None identified at the proposed site.

Radon

2.2.5 The Public Health England website (https://www.ukradon.org/information/ukmaps) indicates the study area is within an area where 3 to 5% of properties are at or exceed the Radon Action Level. However, this changed to 10-30% towards the Clawdd Coch Junction.

Unexploded Ordnance

2.2.6 The Zetica Risk Map (https://zeticauxo.com/downloads-and-resources/risk-maps/) indicates the study area is located in an area designated as having 'Low' (15 bombs per 1000 acres or less) risk of UXO (Appendix B).

2.3 Environmental Setting

Hydrogeology

2.3.1 The BGS website identifies the superficial and bedrock geology as both Secondary A aquifers. These are defined as 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. These are generally aquifers formerly classified as minor aquifers.

2.3.2 The superficial aquifer changed to Secondary (undifferentiated) at Clawdd Coch Junction.

Hydrology

2.3.3 Ely River runs along the western boundary of the proposed study area, in a north to south orientation with a few secondary river networks running through the proposed alignment in a west to east orientation. The Ely River then follows topography south-east.

2.3.4 Multiple surface-water features lie within the area, including many small ponds in the golf course in the south-west corner of the area, a larger pond in the western central edge of the area and a pond/bog under the tree cover north of the railway, east of the road. These indicate the groundwater most likely rests at a shallow level.

2.4 Ground Conditions

2.4.1 The BGS GeoIndex Onshore website (http://mapapps2.bgs.ac.uk/geoindex/home.html) indicates that there are 75No. exploratory holes located within 0.5km radius of the study area.

2.4.2 The plan showing the exploratory holes in this area are shown in Appendix C. The borehole logs are shown in Appendix D.

Table 1 Sub-Section 1 Ground Conditions Summary from Available Exploratory Holes

Top Depth (m bgl)	Thickness (m)	Stratum Name	Typical Stratum Description
GL	0.10-1.50	Topsoil	TOPSOIL
0.10-12.00	0.25-9.30	Glacial Till (cohesive)	Soft to firm silty CLAY with occasional gravel
1.20-8.50	0.40-9.50	Glacial Till (Granular)	Compact mixed SAND, GRAVEL and COBBLE.
GL-13.50	0.30-12.00	Alluvium (Cohesive)	Silty sandy gravelly CLAY

Top Depth (m bgl)	Thickness (m)	Stratum Name	Typical Stratum Description
0.20-14.00	0.30-15.00	Alluvium (Granular)	Compact to very compact SAND and mix GRAVEL.
5.40-16.40	>0.12-7.60	Bedrock	Red CONGLOMERATE formation

2.4.3 The ground conditions recorded in the available exploratory holes are in general similar to that shown on the geological mapping.

2.4.4 The historic exploratory hole suggests the groundwater ranged from GL to 13.90m bgl.

2.5 Conclusion

2.5.1 The following potential constraints have been identified from the desk-based review:

- The land within the study area is mainly agricultural and has not been subject to historical development except the existing M4 junction 34 and Renishaw industrial unit. The construction of the existing road and industrial buildings may have impacted the land quality.
- Ground conditions at the site are likely to comprise Alluvium and Glacial Till. This material is likely to provide low bearing capacity and may pose a long-term settlement risk to proposed foundations. For re-use as an earthworks material It is highly variable in terms of granular and cohesive content.
- Groundwater in some areas are likely to be at ground level. Perched ground water tables are possible given the glacial till superficial material.
- High groundwater is possible near steeper valley sides, posing ground stability hazard.

3 Sub-Section 2

3.1 Physical Setting

Topography

3.1.1 The ground levels across the study area range from approximately +30m AOD increasing to approximately +70m AOD towards the south-west. The overall topography is dipping to the east. The main road south to Pendoylan sites at approximately +50m AOD. Between East-Pendoylan and the railway track is approximately flat.

Land Use

Current

3.1.2 Most of the study area consists of agricultural land, with the Pendoylan village situated west of the proposed alignment option. A couple of farms in the south and north of the area, east of proposed alignment. The existing road runs north-south though Pendoylan to the A48, with two junctions to east-west crossing roads, one on the northern boundary of the area and one in the south of the area.

3.1.3 Secondary river network runs through the proposed alignment in a west to east orientation.

Historic

3.1.4 A review of publicly available historical Ordnance Survey maps (https://www.old-maps.co.uk) dated 1879 to 1984 has been undertaken. The maps indicate that the study has remained predominantly as agricultural land since the first available published map.

3.1.5 An old quarry is located 400m north of the Pendoylan village and is positioned west of the proposed alignment. This quarry is shown from the earliest published map of 1879 and is shown as having an old Limekiln on site, the geology is limestone, so this is mostly likely the quarried material.

3.2 Geological Setting

3.2.1 The British Geological Survey Onshore GeoIndex Website was used to view the 1:50,000 Bedrock and Superficial Geological maps (Sheets 262&263 England and Wales) to assess the anticipated geology.

3.2.2 The bedrock formation varied west to east of the proposed alignment between St. Mary's Well Bay Member (interbedded limestone and mudstone) to Blue Anchor Mudstone Formation (green-grey, dolomitic silty mudstones and siltstones) to Mercia Mudstone Group (brown and red-brown, calcareous clays and mudstones, with occasional beds of impersistent green siltstone and fine-grained sandstone) further east. The northern boundary bedrock geology is the Llanishan Conglomerate, with a fault running NE-SW just south of the Clawdd Coch road with Triassic (Penarth Group and Mercia Mudstone) and Jurassic (Lower Lias shelly limestones) rocks lying south of the fault. The Penarth group is characterised by grey to black mudstones with subordinate limestones and sandstones and the Llanishan Conglomerate is characterised by an alternation of conglomerate, siltstone, sandstone and rare pedogenic limestone beds. The Llanishan Conglomerate in the north dips shallowly to the north, and the younger rocks in the south dip to the south ~30°.

3.2.3 The superficial geology underlying the site is identified as Devensian till (clay, sands and gravels), changing to Head Deposits (Clay, silt, sand and gravel) towards the southeast. There is also Estuarine Alluvium deposits associated with Ely River along the east side of the area. The geology is shown in Figure 5. Further geological maps are shown in Appendix E. Cross section segments east of the area are shown in Figure 6.

Figure 5 BGS extract (1:50 000), map sheet 262[4]

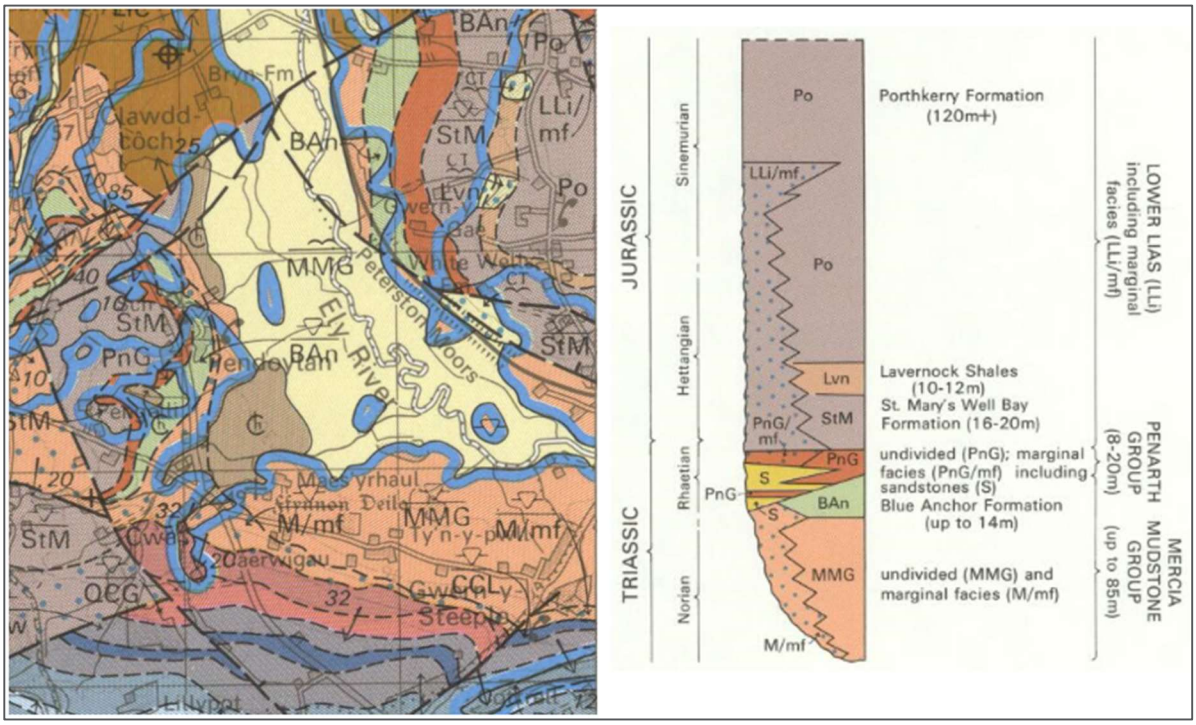
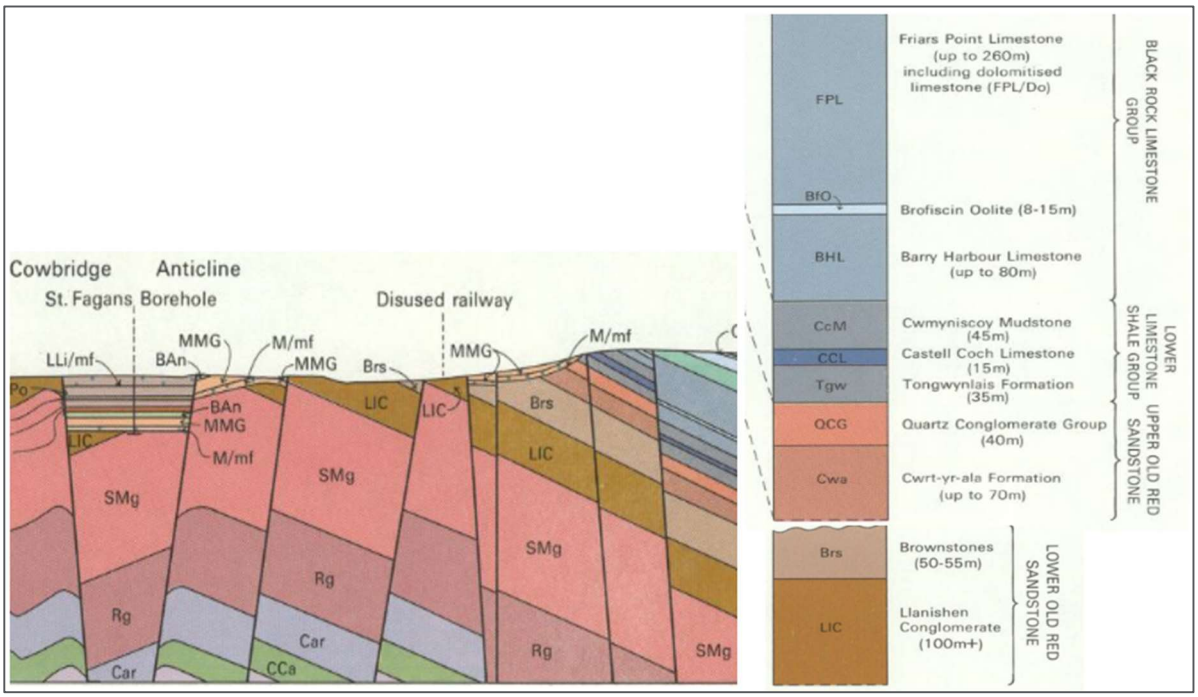


Figure 6 BGS cross section (1:50 000), Radyr to St Lythans, east of the area, map sheet 263[5]



[4] Contains British Geological Survey materials © NERC 2019

[5] Contains British Geological Survey materials © NERC 2019

Coal Mining

3.2.4 None identified at the proposed site.

Radon

3.2.5 The Public Health England website (https://www.ukradon.org/information/ukmaps) indicates the study area is within an area where 10 to 30% of properties are at or exceed the Radon Action Level.

Unexploded Ordnance

3.2.6 The Zetica Risk Map (https://zeticauxo.com/downloads-and-resources/risk-maps/) indicates the study area is located in an area designated as having 'Low' (15 bombs per 1000 acres or less) risk of UXO (Appendix B).

3.3 Environmental Setting

Hydrogeology

3.3.1 The BGS website identifies the both superficial and bedrock geology as Secondary A. These are defined as 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. These are generally aquifers formerly classified as minor aquifers.

Hydrology

3.3.2 All rivers and streams in the area run approximately west to east and head towards Ely River which then flows south-east. A secondary set of smaller streams run north-south in the northern half of the area. Hence groundwater is likely to flow east over the majority of the area and south-east generally.

3.4 Ground Conditions

3.4.1 The BGS GeoIndex Onshore website (http://mapapps2.bgs.ac.uk/geoindex/home.html) indicates that there are 2No. exploratory holes located within 1km radius of the study area. The plan showing the exploratory holes in this area are shown in Appendix C. The borehole logs are shown in Appendix D.

3.4.2 Table 1 summarises the ground conditions revealed in the available exploratory holes.

Table 2 Sub-Section 2 Ground Conditions Summary from Available Exploratory Holes

Top Depth (m bgl)	Base Depth to (m bgl)	Thickness (m)	Stratum Name	Typical Stratum Description
GL	0.10-0.30	0.10-0.30	Topsoil	Soft to firm brown sandy CLAY and PEAT
0.30-4.27	2.13-8.07	1.83-3.81	Glacial Till (cohesive)	Firm to stiff clayey sandy SILT
2.13-3.66	3.66-4.27	0.61-1.53	Glacial Till (Granular)	Silty SAND with gravel

3.4.3 The ground conditions recorded in the available exploratory holes are in general similar to that shown on the geological mapping. The borehole located more than 1km away suggests the groundwater is approximately 2.10m bgl. No groundwater data is available near this section of the route however, River Ely is located near the eastern side of the proposed alignment. A few secondary rivers run along the proposed study area so groundwater can be present at shallow depths.

3.5 Conclusion

3.5.1 The following potential constraints have been identified from the desk-based review:

- The land within the study area is mainly agricultural and has not been subject to historical development except the existing Pendoylan Village and the old quarry. Though mainly agricultural, construction of the exiting minor road and the Pendoylan Village may have impacted the land quality.
- Ground conditions at the site are likely to comprise Head deposits and Glacial Till. This material is likely to provide low bearing capacity and may pose a long-term settlement risk to proposed foundations. For re-use as an earthworks material It is highly variable in terms of granular and cohesive content.
- Peat is recorded at shallow depths; this is possibly localised topsoil material with poor drainage.
- No Groundwater within close proximity of the area has been recorded. Perched ground water tables are possible given the glacial till superficial material.
- High groundwater is possible near steeper valley sides, posing ground stability hazard.

4 Sub-Section 3

4.1 Physical Setting

Topography

4.1.1 The topography increases south and west across the study area ranging from approximately +50m AOD along the main road increasing to approximately +100m AOD in the south. The topography dips towards the minor river networks. North of Plwca Dafydd, topography decreases to the north-west corner from +80m AOD to +50m AOD.

Land Use

Current

4.1.2 Most of the study area consists of agricultural land, with the Pendoylan village situated east of the proposed alignment option. Multiple farms are located predominantly in the south of the area. The proposed scheme will run through a wooded area in the north. Tre-Dodridge in the north, is a settlement of approximately 15 houses.

4.1.3 Secondary river network runs through the proposed alignment in a west to east orientation.

Historic

4.1.4 A review of publicly available historical Ordnance Survey maps (https://www.old-maps.co.uk) dated 1879 to 1984 has been undertaken. The maps indicate that the study has remained predominantly as agricultural land since the first available published map.

4.1.5 An old quarry is located 400m north of the Pendoylan village and is positioned east of the proposed alignment. This quarry is shown from the earliest published map of 1879 and is shown as having an old Limekiln on site, the geology is limestone, so this is mostly likely the quarried material.

4.2 Geological Setting

4.2.1 The British Geological Survey Onshore GeoIndex Website was used to view the 1:50,000 Bedrock and Superficial Geological maps (Sheets 262&263 England and Wales) to assess the anticipated geology (Ref. 1).

4.2.2 The bedrock geology consists of St. Mary's Well Bay Member (interbedded limestone and mudstone). Moving towards the south, the bedrock changes to Penarth Mudstone Group (grey to black mudstones with subordinate limestones and sandstones) to Blue Anchor Mudstone Group (green-grey, dolomitic silty mudstones and siltstones). Multiple faults orientated NE-SW in the north of the area leads to repeated outcrops of the Triassic sequences. The south-west of the area is dominated by Mercia Mudstone (conglomerate), separated from the west of the area by a second fault orientation (north/ south) which brings Jurassic Blue Lias (shelly limestone) in contact with Devonian formations south of the area. East of the fault the beds dips at approximately 30° to the south-west, the west side dips more shallowly to the south.

4.2.3 The superficial geology underlying the site is identified as Devensian till (clay, sands and gravels). A small outcrop of Head Deposits (clay, silt, sand and gravel). Geological map extracts from the BGS are shown in Figure 7. A cross section segment from east of the area is shown in Figure 8. Additional geological maps are shown in Appendix E.

Figure 7 BGS geological map (1:50 000), map sheet 262[6]

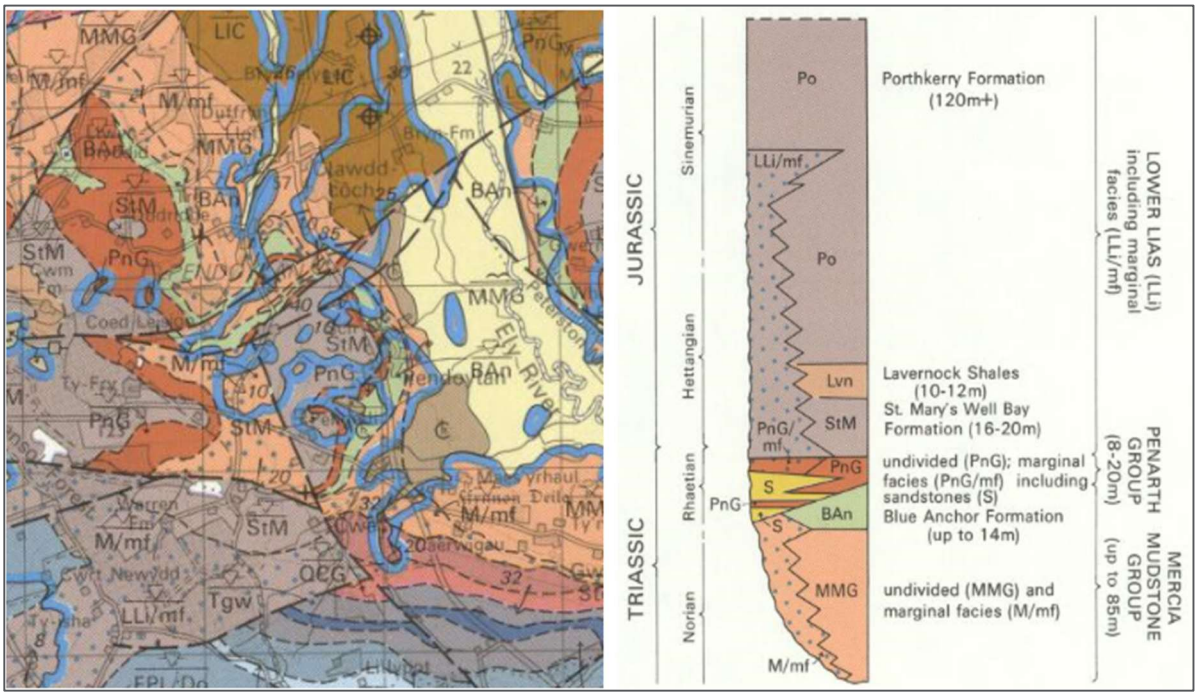
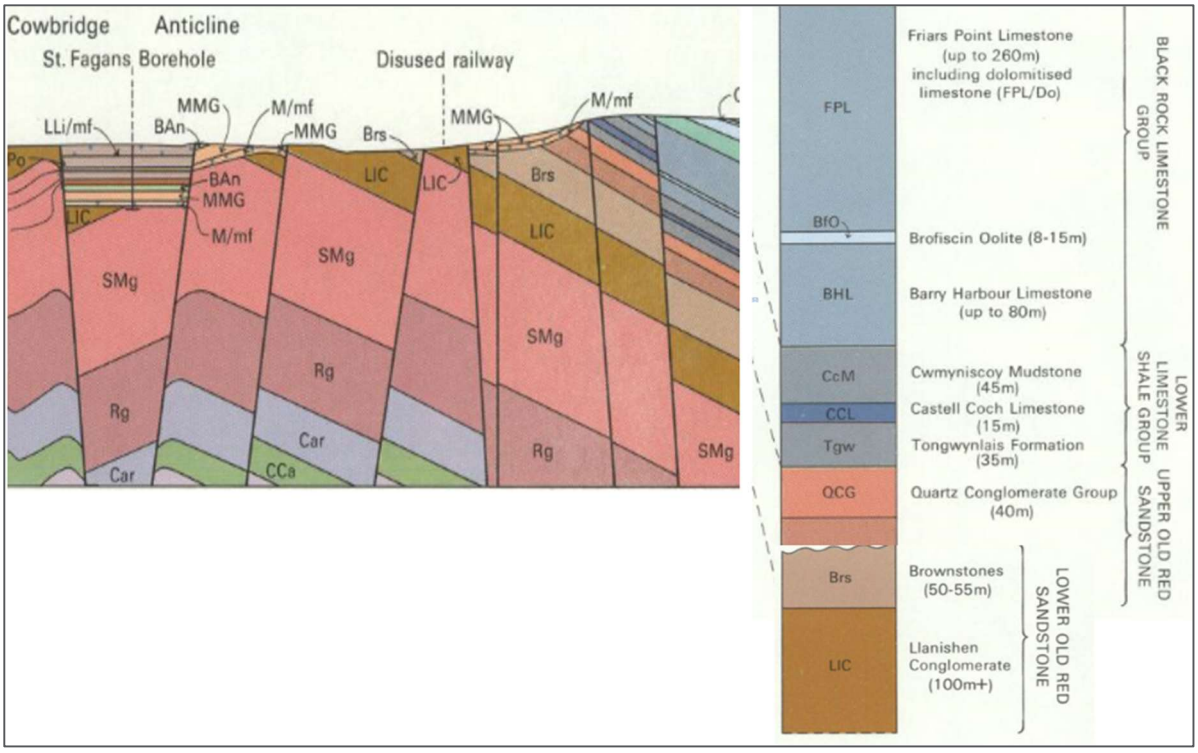


Figure 8 BGS cross section (1:50 000), Radyr to St Lythans, east of area, map sheet 263[7]



[6] Contains British Geological Survey materials © NERC 2019

[7] Contains British Geological Survey materials © NERC 2019

Coal Mining

4.2.4 None identified at the proposed site.

Radon

4.2.5 The Public Health England website (https://www.ukradon.org/information/ukmaps) indicates the study area is within an area where 10 to 30% of properties are at or exceed the Radon Action Level.

Unexploded Ordnance

4.2.6 The Zetica Risk Map (https://zeticauxo.com/downloads-and-resources/risk-maps/) indicates the study area is located in an area designated as having 'Low' (15 bombs per 1000 acres or less) risk of UXO (Appendix B).

4.3 Environmental Setting

Hydrogeology

4.3.1 The BGS website identifies that both the superficial and bedrock geology are Secondary A Aquifers. These are defined as 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. These are generally aquifers formerly classified as minor aquifers.

Hydrology

4.3.2 River networks run in a predominantly east-west direction. With some SW-NE orientated rivers in the north-east and south-east corners. Some small surface water features are visible in the east, and a slightly larger pond at Warren Mill Farm indicates the possibility of shallow groundwater.

4.4 Ground Conditions

4.4.1 The BGS GeoIndex Onshore website (http://mapapps2.bgs.ac.uk/geoindex/home.html) indicates that there are 1No. exploratory holes located within 1km radius of the study area. This borehole is located approximately 700m north of the proposed study area.

4.4.2 The plan showing the exploratory holes in this area are shown in Appendix C. The borehole logs are shown in Appendix D.

Table 3 Sub-Section 3 Ground Conditions Summary from Available Exploratory Holes

Top Depth (m bgl)	Base Depth (m bgl)	Thickness (m)	Stratum Name	Typical Stratum Description
GL	0.10-0.30	0.10-0.30	Topsoil	Soft to firm brown sandy CLAY and PEAT.
0.30-4.27	2.13-8.07	1.83-3.81	Glacial Till (cohesive)	Firm to stiff clayey sandy SILT.
2.13-3.66	3.66-4.27	0.61-1.53	Glacial Till (Granular)	Silty SAND with gravel.

4.4.3 The ground conditions recorded in the available exploratory holes are in general similar to that shown on the geological mapping.

4.4.4 The historic exploratory hole suggests the groundwater is approximately 2.10m bgl. No groundwater data is available near this section of the route however, River Ely is located near the eastern side of

the proposed alignment. A number of secondary rivers run along the proposed study area so groundwater can be present at shallow depths.

4.5 Conclusion

4.5.1 The following potential constraints have been identified from the desk-based review:

- The land within the study area is mainly agricultural and has not been subject to historical development except the existing Pendoylan Village and the old quarry. It is not clear if the historic quarry has been backfilled. Though mainly agricultural, construction of the existing minor road and the Pendoylan Village may have impacted the land quality.
- Ground conditions at the site are likely to comprise Alluvium and Glacial Till. This material is likely to provide low bearing capacity and may pose a long-term settlement risk to proposed foundations. For re-use as an earthworks material It is highly variable in terms of granular and cohesive content.
- Peat is recorded at shallow depths; this is possibly localised topsoil material with poor drainage.
- No Groundwater within the area has been recorded. Perched ground water tables are possible given the glacial till superficial material.
- High groundwater is possible near steeper valley sides, posing ground stability hazard.

5 Sub-Section 4

5.1 Physical Setting

Topography

5.1.1 The topography of the study area is lowest in the north at approximately +45m AOD at Ty'n-y-pwll rising to +130m AOD in the western centre at Lillypot Farm, then falling to approximately +80m AOD south of the A48. The A48 in this area sits at between +90m and 100m AOD. There is a fork in the small unnamed road towards the centre, within the golf course land, which sits at +119m AOD.

Land Use

Current

5.1.2 Most of the north side of the study area consists of agricultural land, and Sheep Court Farm is situated near the A48 junction, south of the study area. Cottrell Golf resort makes up a large proportion of the south of the area with the buildings on the east boundary edge, hence many of the surface water features in the area may be man-made ponds for use on the golf course. A woodland area exists in the centre with the proposed road scheme passing to the west of this. The proposed scheme passes multiple farm buildings along the north-east minor road.

Historic

5.1.3 A review of publicly available historical Ordnance Survey maps (https://www.old-maps.co.uk) dated 1879 to 1984 has been undertaken. The maps indicate that the study has remained predominantly as agricultural land since the first available published map.

5.1.4 An old quarry is located in the centre of the area, west of the woodland and within the limestone bedrock and next to a fault. This is on the proposed road scheme route. Three other quarries are located within 200m of the proposed alignment. All of the quarries are shown from the earliest published map of 1878. It is likely that all of these are Lime Quarries however, this must be confirmed if required. The surface water ponds are visible from the earliest published map from 1878. Overhead cables cross the A48 and continue on the A4226.

5.2 Geological Setting

5.2.1 The British Geological Survey Onshore GeoIndex Website was used to view the 1:50,000 Bedrock and Superficial Geological maps (Sheets 262&263 England and Wales) to assess the anticipated geology (Ref. 1).

5.2.2 The bedrock sequence changes from north to south in the following order; Mercia Mudstone Group (brown and red-brown, calcareous clays and mudstones), Cwrt-yr-ala Formation and Quartz Conglomerate Group (Upper Old Red Sandstone), Tongwynlais Formation and Castell Coch Limestone Formation and Cwmyniscoy Mudstone Formation (Lower Limestone Shale Group), Barry Harbour Formation (Limestone, gradational contact with Cwmyniscoy) and Friars Point Limestone (dark grey to black, skeletal packstones with subordinate thin beds of mudstone). The bedrock geology generally dips to the south getting less steep further south. Hence, the bedrock changes from younger (Triassic) to older (Devonian) from north to south, before the A48 where an erosional contact brings the Triassic back (seen east and west of the area where Mercia Mudstone and Penarth Group outcrop). There are two major faults in the area, that intersect to the west of the proposed scheme.

5.2.3 The superficial geology underlying the site is identified as Devensian till (clay, sands and gravels). The composition of the till reflects the bedrock geology over which the glacier has flowed, namely the Old Red Sandstone Supergroup, the Marros Group, and Pennant Sandstone Formation. The lithologies of the rock units have imparted a sandy and gravelly character to the till. Geological map extracts from the BGS are shown in Figure 9. Cross section segments from east and west of the area are shown in Figure 10 and 11 respectively. Additional geological maps are shown in Appendix E.

Figure 9 BGS extract (1:50 000), map sheet 262[8]

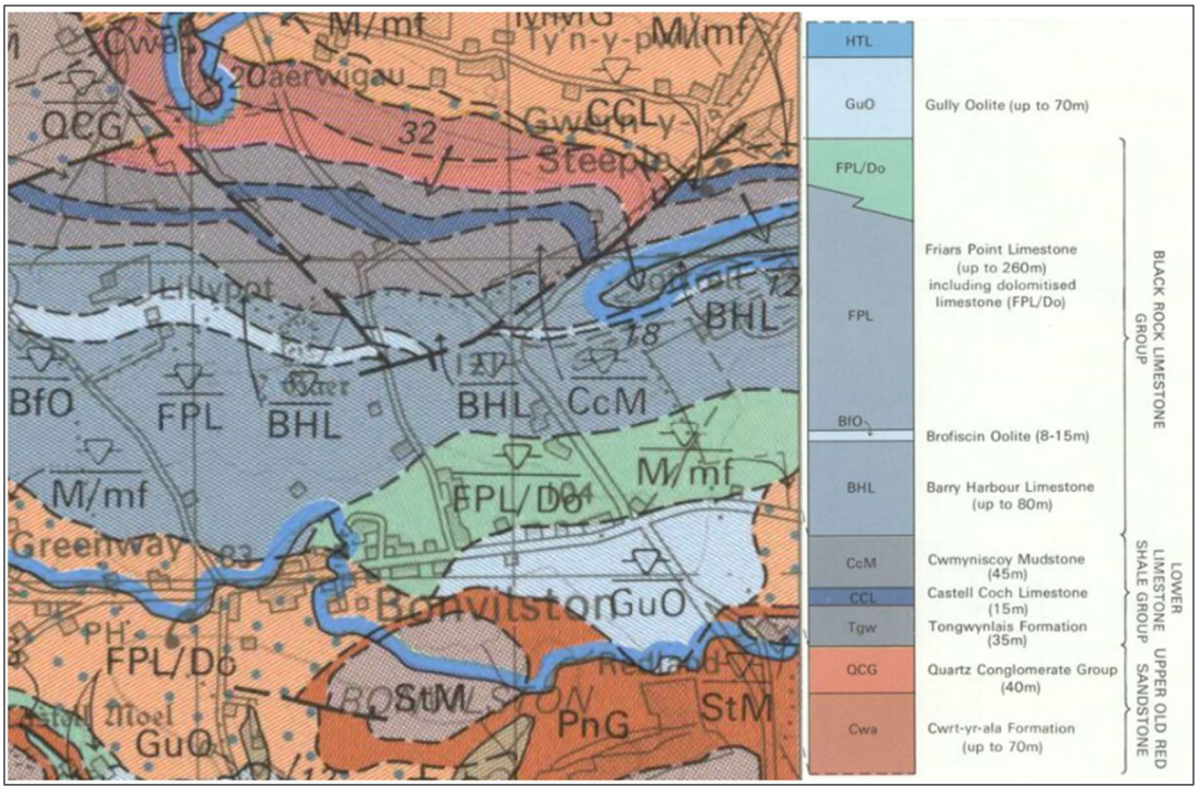
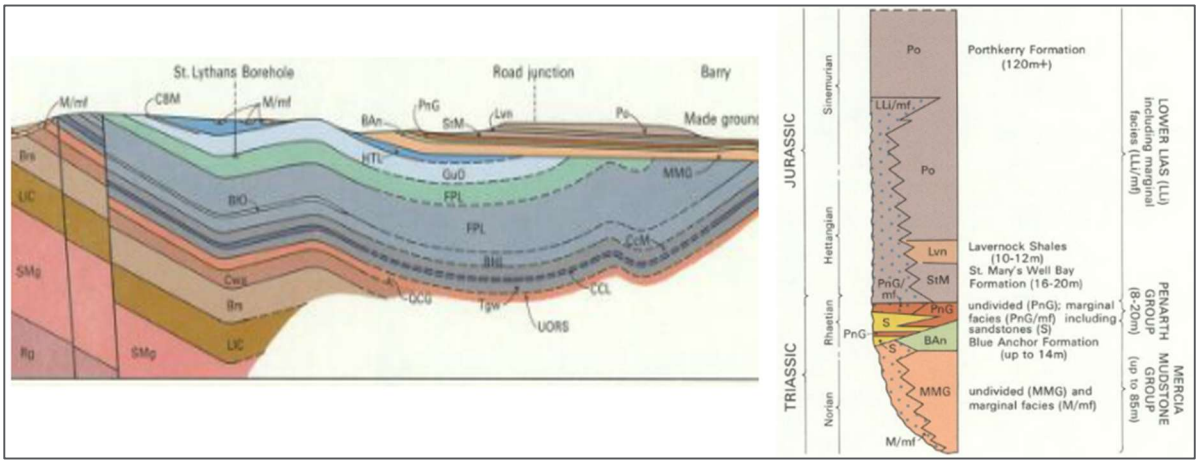


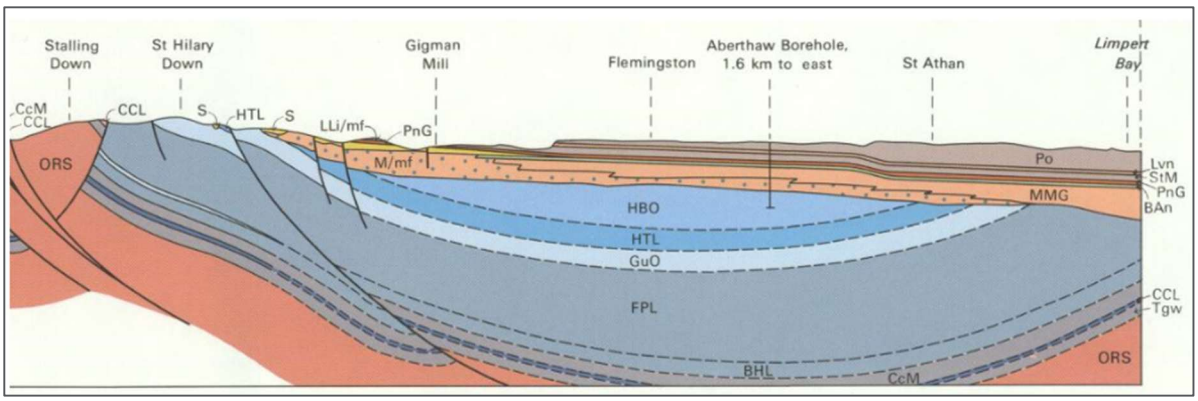
Figure 10 BGS cross section (1:50 000), St George to Barry, east of the area, map sheet 263[9]



[8] Contains British Geological Survey materials © NERC 2019

[9] Contains British Geological Survey materials © NERC 2019

Figure 11 BGS cross section (1:50 000), Stalling Down to Limpert Bay, west of the area, map sheet 262[10]



Coal Mining

5.2.4 None identified at the proposed site.

Radon

5.2.5 The Public Health England website (https://www.ukradon.org/information/ukmaps) indicates the study area is within an area where 10 to 30% of properties are at or exceed the Radon Action Level.

Unexploded Ordnance

5.2.6 The Zetica Risk Map (https://zeticauxo.com/downloads-and-resources/risk-maps/) indicates the study area is located in an area designated as having 'Low' (15 bombs per 1000 acres or less) risk of UXO (Appendix B).

5.3 Environmental Setting

Hydrogeology

5.3.1 The BGS website identifies the bedrock geology as Principal. These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

5.3.2 The superficial aquifer is identified as Secondary undifferentiated. These have been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

Hydrology

5.3.3 A few surface-water ponds have been located near the A48 junction, within the golf course especially. A small river through the woodland in the central northern part of the area. Another surface water feature in the north-west corner within more woodland is connected to a north-south minor river. Although there are few river networks within the area, groundwater likely flows northwards north of the A48 and southwards south of Bonvilston.

5.4 Ground Conditions

5.4.1 The BGS GeoIndex Onshore website (http://mapapps2.bgs.ac.uk/geoindex/home.html) indicates that there are 3No. exploratory holes located within 1km radius of the study area. These boreholes are used for aquifer investigation and pumping tests purposes and therefore don't provide a detailed geological sequence.

[10] Contains British Geological Survey materials © NERC 2019

5.4.2 The boreholes suggest glacial till is from ground level (GL) to 7m bgl and bedrock is between 7m and 50m bgl (depth not proven).

5.4.3 The plan showing the exploratory holes in this area are shown in Appendix C. The logs for these boreholes can be found in Appendix D.

5.4.4 The general ground conditions recorded in the available exploratory holes are in general similar to that shown on the geological mapping.

5.4.5 The borehole located more than 1km away suggests the groundwater is approximately 21.46m bgl. No groundwater data is available near this section of the route however, the surface water ponds suggests groundwater can be present at shallow depths.

5.5 Conclusion

5.5.1 The following potential constraints have been identified from the desk-based review:

- The land within the study area is mainly agricultural and has not been subject to historical development except the existing Pendoylan Village, farms and the old quarry. Though mainly agricultural, construction of the existing roads and villages may have impacted the land quality.
- Ground conditions at the site are likely to comprise Head deposits and Glacial Till. This material is likely to provide low bearing capacity and may pose a long-term settlement risk to proposed foundations. For re-use as an earthworks material It is highly variable in terms of granular and cohesive content.
- No Groundwater within close proximity of the area has been recorded. Ground water is likely to be higher in the centre of the valley. Perched ground water tables are possible given the glacial till superficial material.
- High groundwater is possible near steeper valley sides, posing ground stability hazards.

6 Sub-Section 5

6.1 Physical Setting

Topography

6.1.1 Ground levels across the study area range from approximately +28m to +32m Above Ordnance Datum (AOD), with the land to the west of the existing railway line being lower than the east.

Historical Land Use

6.1.2 A review of historical Ordnance Survey maps available on the Old Maps Website[11] has been completed. The available maps (dated 1877 through to 1992) indicates that the study area has remained agricultural land since the first available published map. The railway was shown present on the first available published map (1877). The sewage works, located approximately 300m west of the study area is first shown on the 1942 map while the M4 motorway, located approximately 300m north of the study area, is first shown on the 1974 map. The industrial site present to the east of the railway is first shown on the 1992 map.

6.2 Geological Setting

6.2.1 The 1:50,000 scale British Geological Survey (BGS) Geological Map (Sheet No. 262) for Bridgend indicates most of the study area is underlain by Superficial Deposits of Alluvium (comprising clay, silt, sand and gravel). The area northeast of the railway line is shown to be underlain by Glacial Till. The map further indicates that the solid geology underlying the study area is the Llanishen Conglomerate (comprising Conglomerate interbedded with Sandstone). A fault, trending northeast to southwest, is located approximately 500m west of the study area and coincides with the axis of the Ely Valley.

Coal Mining

6.2.2 The study area is not located within a Coal Mining Reporting Area. There is no evidence of historical mines or quarries located in the study area on the available historical maps.

Radon

6.2.3 The Public Health England website indicates the study area is in an area where 3 to 5% of properties are at or exceed the Radon Action Level[12].

Unexploded Ordnance

6.2.4 The Zetica Risk Map indicates the study area is located in an area designated as having 'Low' (15 bombs per 1000 acres or less) risk of Unexploded ordnance (UXO) [13].

6.3 Ground Conditions

6.3.1 The BGS Geoindex Onshore website indicates that there are 4No. exploratory holes located within the study area[14]. The ground conditions recorded in the available exploratory holes are in general similar to that shown on the geological mapping. No groundwater data is presented on the available exploratory hole records. Noting that the site is located adjacent to the River Ely and that there are many areas of standing water visible on the available aerial imagery it is likely that groundwater is present at shallow depth beneath the ground surface and at a similar level to the River Ely.

[11] Old Maps Website 2019 – https://www.old-maps.co.uk

[12] UK maps of radon 2019 – https://www.ukradon.org/information/ukmaps

[13] Zetica Risk Map 2019 – https://zeticauxo.com/downloads-and-resources/risk-maps/

[14] British Geological Survey – Geoindex Onshore 2019 - http://mapapps2.bgs.ac.uk/geoindex/home.html

Table 4 Sub-Section 5 Ground Conditions Summary from Available Exploratory Holes

Top Depth (m bgl)	Base Depth to (m bgl)	Thickness (m)	Stratum Name	Typical Stratum Description
GL	0.30	0.30	Topsoil	Soft to firm brown sandy CLAY.
0.30	1.50-5.10	1.20-4.80	Alluvium (Cohesive)	Soft sandy CLAY
1.50-5.10	5.10 – 10.00	3.00-8.10	Alluvium (Granular)	SAND or GRAVEL with boulders.
5.10-10.00	7.60->11.2	>2.4 (base not proven)	Glacial Deposits (Cohesive)	Stiff to hard sandy CLAY, locally with boulders.

6.4 Conclusion

6.4.1 The following potential constraints have been identified from the desk-based review:

- The land within the study area is mainly agricultural and has not been subject to historical development except the existing railway and industrial site (i.e. Renishaw). Though mainly agricultural, the existing railway and industrial site may have impacted the land quality. The M4 located to the north (and upstream) of the study area may also have impacted land quality.
- Ground conditions at the site comprise Alluvium and Glacial Till. The upper Alluvium comprises soft clay which extends to depths of approximately 5m below existing ground level. This material is likely to provide low bearing capacity and may pose a long-term settlement risk to proposed foundations.
- Groundwater within the study area is likely to be shallow (circa 1-2m below existing ground level).

7 Recommendations

7.1 Sub-Sections 1 to 4 | Highway Route

7.1.1 With regard to a preference of alignment at this stage for the offline route proposals, the ground conditions on the Western route around Pendoylan are more favourable being Glacial Till rather than less favourable Alluvium on the Eastern route. The Western route is also further away from the River Ely, associated tributaries and river valley itself which is more favourable topographical and from a groundwater interaction perspective.

7.1.2 It is recommended that a detailed geotechnical and geo-environmental desk study is undertaken at WelTAG Stage Three for the route assessed in this report, with a walkover and geomorphology mapping to appropriately scope an intrusive ground investigation for the preliminary optioneering of the road scheme.

7.1.3 A detailed desk study and ground investigation should be designed for the preferred route in accordance with CD 622 Managing Geotechnical Risk and specified to provide more information on the re-use of material, location of any proposed structures and baseline testing for geo-environmental conditions.

7.2 Sub-Section 5 | Vale of Glamorgan Gateway Station

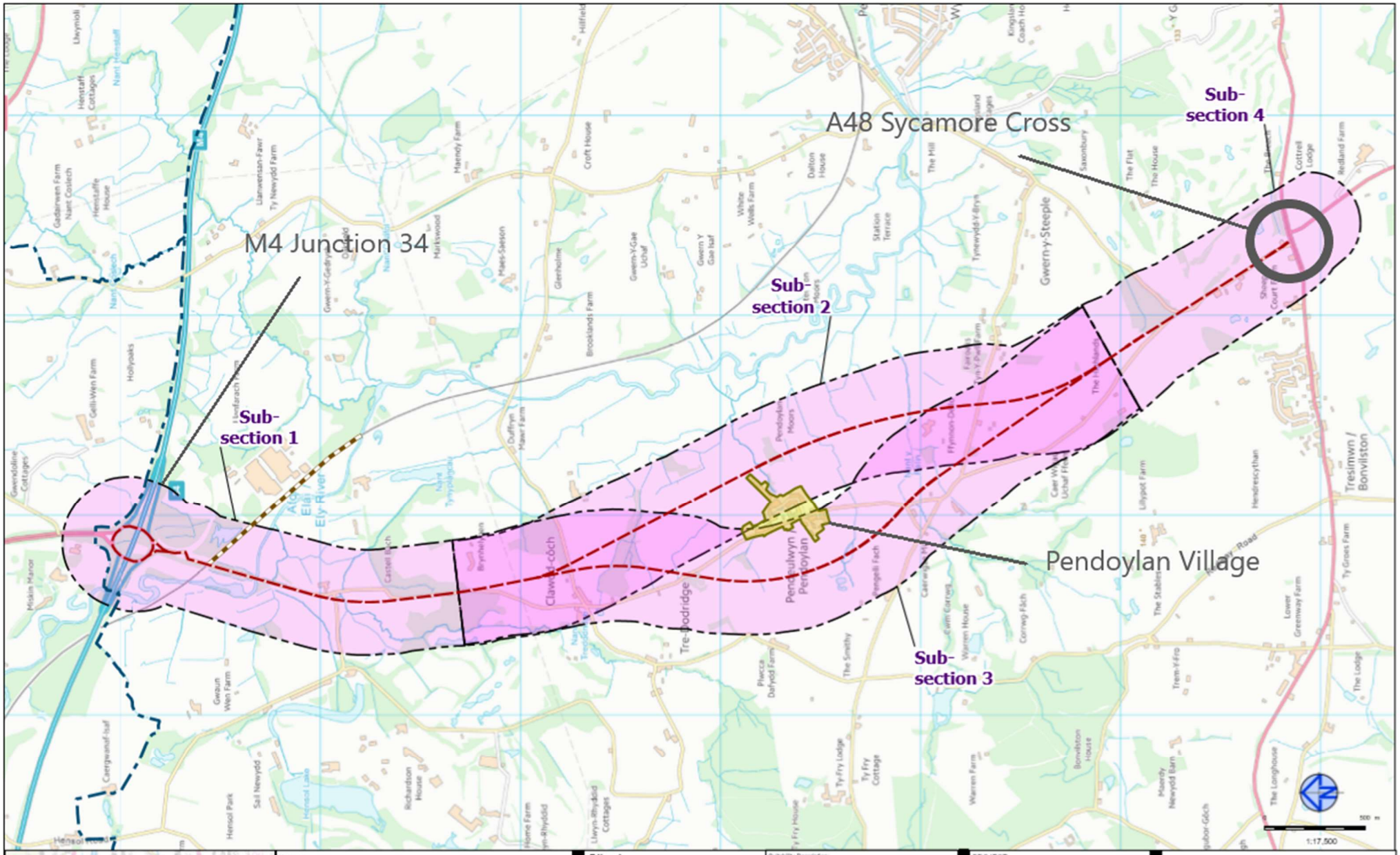
7.2.1 It is recommended that a detailed geotechnical and geo-environmental desk study is undertaken, followed by appropriate intrusive ground investigation and assessment is undertaken early in the design of the proposed station (WelTAG Stage Three) to identify any further ground related constraints and provide a suitable basis for design.

8 References

1. British Geological Survey 1:50,000 scale map sheet, 262&263, England and Wales, Solid & Drift
2. https://naturalresources.wales/evidence-and-data/maps/long-term-flood-risk/?lang=en Last accessed February 2019.
3. Old-Maps Website: https://www.old-maps.co.uk Last accessed February 2019
4. Zetica UXO Risk Maps. https://zeticauxo.com/downloads-and-resources/risk-maps/ Last accessed February 2019
5. British Geological Survey, Hydrogeological Map of England and Wales accessed on Geoindex: https://www.bgs.ac.uk/geoindex/ Last accessed February 2018
6. Lle – Map Browser
7. http://lle.gov.wales/map#m=-2.99365,51.67293,13&l=809;290;774h;&b=europa Last accessed February 2019
8. Coal Authority Viewer: http://mapapps2.bgs.ac.uk/coalauthority/home.html Last accessed February 2019
9. Public Health England, Radon atlas of the UK. http://www.ukradon.org/information/ukmaps Last accessed February 2019
10. Google Earth Software Last accessed February 2019
11. Street Map OS maps: http://www.streetmap.co.uk/map Last Accessed April 2019
12. British Geological Survey, Non-Coal Mining Plans: http://mapapps2.bgs.ac.uk/mineplans/home.html Last accessed September 2019
13. Data.gov.uk. Historic Landfill Sites: https://data.gov.uk/dataset/17edf94f-6de3-4034-b66b-004ebd0dd010/historic-landfill-sites Last Accessed September 2019

Appendix A

Section Plan



Notes :
Contains OS data © Crown Copyright OS VectorMap® District 2020

Legend :

- Proposed route options
- Passing loop
- Sub-sections study area and overall study area
- Unitary Authority Boundaries
- Settlement boundary

REV	Date	Description	Drawn	Check	Approv

Client: Vale of Glamorgan Council

Site

Suitability Description: Issued for information

Designed	M. Azzopardi	Date: 23/APR/2020	Signed:
Drawn	M. Azzopardi	Date: 23/APR/2020	Signed:
Checked	M. Fry	Date: 23/APR/2020	Signed:
Approved	M. Fry	Date: 23/APR/2020	Signed:
Scale:	1:17,500	Datum:	AOD
Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10028657

PROJECT:
M4 Junction 34 to A48
WelTAG Stage Two
- Highway Link Study

TITLE:
Study Area
Overall Sub-Sections

ARCADIS Design & Consultancy for natural and built assets

Drawing Number: 10028657-ARC-XX-XX-DR-EA-0059
Revision: P1

Appendix B

Zetica Risk Map

UNEXPLODED BOMB RISK MAP

SITE LOCATION

Map Centre: 307380,174141

LEGEND

- **High:** Areas indicated as having a bombing density of 50 bombs per 1000acre or higher.
- **Moderate:** Areas indicated as having a bombing density of 15 to 49 bombs per 1000acre.
- **Low:** Areas indicated as having 15 bombs per 1000acre or less.

miltary **industry** **UXO find**
transport **dock** **Luftwaffe targets**
utilities **other**

How to use your Unexploded Bomb (UXB) risk map?

The map indicates the potential for Unexploded Bombs (UXB) to be present as a result of World War Two (WWII) bombing.

You can incorporate the map into your preliminary risk assessment* for potential Unexploded Ordnance (UXO) for a site. Using this map, you can make an informed decision as to whether more in-depth detailed risk assessment* is necessary.

What do I do if my site is in a moderate or high risk area?

Generally, we recommend that a detailed UXO desk study and risk assessment is undertaken for sites in a moderate or high UXB risk area.

More often than not, this further detailed research will conclude that the potential for a significant UXO hazard to be present on your site is actually low.

Never plan site work or undertake a risk assessment using these maps alone. More detail is required, particularly where there may be a source of UXO from other military operations which are not reflected on these maps.

If my site is in a low risk area, do I need to do anything?

If both the map and other research confirms that there is a low potential for UXO to be present on your site then, subject to your own comfort and risk tolerance, works can proceed with no special precautions.

A low risk really means that there is no greater probability of encountering UXO than anywhere else in the UK.

If you are unsure whether other sources of UXO may be present, you can ask for one of our **pre-desk study assessments (PDSA)**

If I have any questions, who do I contact?

tel: **+44 (0) 1993 886682**

email: **uxo@zetica.com**

web: **www.zeticauxo.com**

The information in this UXB risk map is derived from a number of sources and should be used in conjunction with the accompanying notes on our website: **(https://zeticauxo.com/downloads-and-resources/risk-maps/)**

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UNEXPLODED BOMB RISK MAP

SITE LOCATION

Map Centre: 305534,177665

LEGEND

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miltary | **industry** | **UXO find**
transport | **dock** | **Luftwaffe targets**
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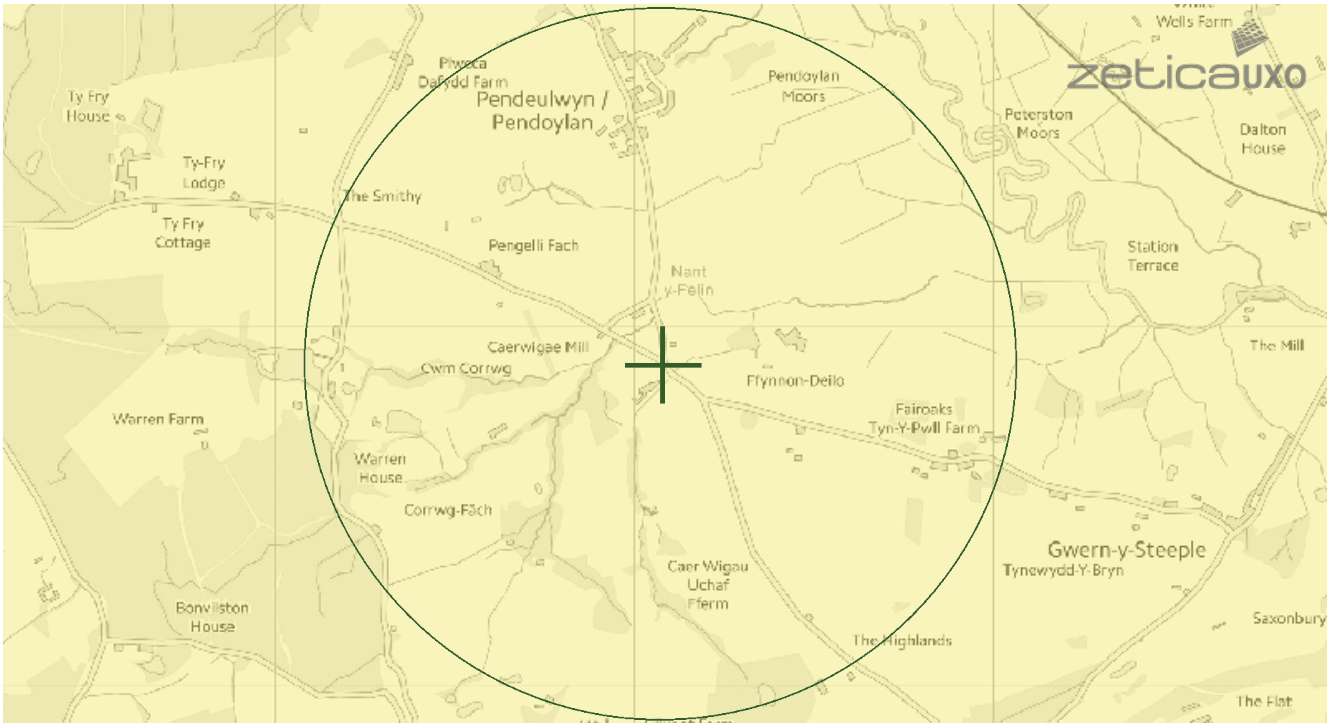
UNEXPLODED BOMB RISK MAP

SITE LOCATION

Map Centre: 306084,175895



LEGEND

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- **Low:** Areas indicated as having 15 bombs per 1000acre or less.

miltary | **industry** | **UXO find**

transport | **dock** | **Luftwaffe targets**

utilities | **other**

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UNEXPLODED BOMB RISK MAP

SITE LOCATION

Map Centre: 305850,179941

LEGEND

- **High:** Areas indicated as having a bombing density of 50 bombs per 1000acre or higher.
- **Moderate:** Areas indicated as having a bombing density of 15 to 49 bombs per 1000acre.
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transport | **dock** | **Luftwaffe targets**
utilities | **other**

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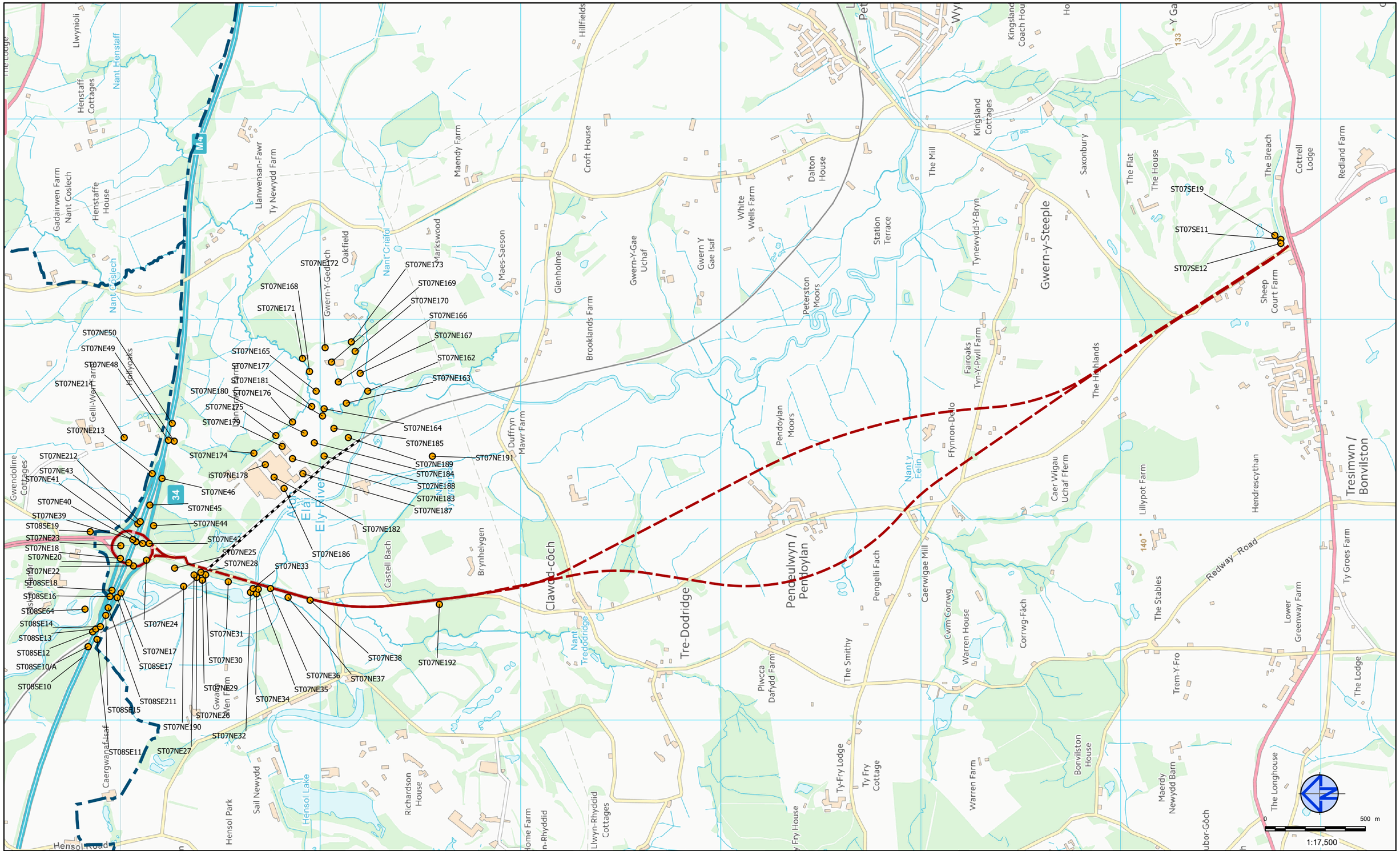
Appendix C

Historic Borehole Location Plan



REV	Date	Description	Drawn	Check	Approv
P01	27-02-19	For Information	RG	TS	LW

50mm on Original

Notes :

Contains OS data © Crown Copyright OS VectorMap® District 2019

Legend :

- Proposed route options
- Unitary Authority Boundaries
- Jn34 - A485 Historic Exploratory Holes

Print Date : 13-03-19 16:43:41

C:\Sharepoint\ARCADIS\M4 J34 A48 WelTAG Stage 2 Plus - Documents\Digital_Eng_GIS\6_Drawings\10028657_ArcGIS_Pro\10028657_Historic Exploratory Holes .aprx

Client

VALE of GLAMORGAN
BRO MORGANNWG

Site
Address
City

Vale of Glamorgan Council

Vale of Glamorgan Council
Civic Offices
Holton Road
Barry
CF63 4RU
01446 700111
www.valeofglamorgan.gov.uk

Suitability Description:
Issued for information

Designed	T.Sirati	Date 27 FEB 2019	Signed
Drawn	R.Grubb	Date 27 FEB 2019	Signed
Checked	T.Sirati	Date 27 FEB 2019	Signed
Approved	L. Walker	Date 27 FEB 2019	Signed
Scale:	As Shown	Datum:	AOD
Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10028657

PROJECT:

M4 Junction 34 to A48
WelTAG Stage Two Plus

TITLE:

Historic Exploratory Holes
Sheet 1 of 2

ARCADIS
Design & Consultancy for natural and built assets

Registered office:
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34 York Way,
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www.arcadis.com

Drawing Number:
10028657-ARC -XX-XX-DR-EA-0006

Revision:
P01

Appendix D

Historic Borehole Logs

BOREHOLE LOG

STONE / ~~202~~ 17

N·C-R· 0566

LOCATION	S.2070	PENCOED 7999	BOREHOLE No. 202
CLIENT		Glamorgan County Council	FIG. 20·1
DRILLING METHOD		Shell and Auger (6·6m); Drilling (6·6m –15·0m)	
GROUND LEVEL		31·25m AOD.	
DATE		13th October 1970, 24th–26th November 1970.	
SCALE 1 :		100	
DIAMETER		200 mm & 75 mm	SAMPLE HOLE

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / ϕ
TOPSOIL	1 C		0.2m					
LOOSE fine to medium brown clayey SAND, very CLAYEY at base	2 D 3 D		2.0m				4	
MODERATELY COMPACT fine to medium brown SAND and mixed GRAVEL and COBBLES	W 4 D		1.7m				8 I20	
STIFF red/brown SANDY gritty CLAY mixed GRAVEL and COBBLES	5 D 6 D		6.3m	9			I50 (200mm penetration only) I78 I59 (100 mm penetration only I61 (100mm penetration only)	

Note: Ground water was encountered at 2.5 m and was sealed off by casing tubes at 4.8 m below ground level
Final water level 24 hours after completion of soft ground boring was 2.1 m below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE
I UNDISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE/18

LOCATION	S.2070	PENCOED	N G R 0583 7499
CLIENT		Glamorgan County Council	
DRILLING METHOD		Shell and Auger	
GROUND LEVEL		39·59m AOD.	
DATE		17th-20th October 1970	
SCALE 1 :		100	
DIAMETER		200 mm	

BOREHOLE No. 203

FIG. 205

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / φ
TOPSOIL	1		0.3m					
SOFT brown sandy silty CLAY	2		1.0m	16				
STIFF brown very SANDY silty CLAY, some mixed GRAVEL	3			12	23	17		130/9°
	4			11				
	5			20				
	6		5.1m				55	
GRAVEL, COBBLES and BOULDERS	7							
	8		6.0m				59 (100 mm penetration only)	
STIFF brown very SANDY silty CLAY and mixed GRAVEL and COBBLES, few BOULDERS	9							
	10						71	
	11							
	12						121(130 mm penetration only)	
	W 13							
	14			7			71	
	15		12.0m					
END OF BOREHOLE								

Note: Ground water was encountered at 10.0 m and was sealed off by casing tubes at 10.4 m below ground level.
Final water level 24 hours after completion of borehole and withdrawal of casing tubes was 5.0 m below ground level (Borehole collapsed to 8.0 m)

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

BOREHOLE LOG

ST07NE/20

NGR 0580 7996

BOREHOLE No. 205

FIG. 206

LOCATION S.2070. PENCOED.

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.(8·5m) Rotary Drilling (8·5- 13-75m)

GROUND LEVEL 38·67m AOD.

DATE 23rd-25th October 1970. 2nd December 1970

SCALE 1 : 100

DIAMETER 200, 150 mm & 75mm

SAMPLE HOLE

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C/ϕ
TOPSOIL.	1		0·2m					
FIRM brown friable very SILTY CLAY	2		1·0m	38				
STIFF brown friable sandy silty CLAY, some mixed GRAVEL, COBBLES and BOULDERS, very SANDY in places	3			12				
	4			11	24	19		UNTESTABLE
→ SOFT	5			14				
	6			18				35/0°
N.B. Rock-roller bits used from 8·5 to 12·0m. Core-barrel used from 12·0 to 13·75m, but cobbles only recovered.	7						64	
	8			12			73	
	9			8			80	
	11			9				
	12			10				
	13			10				
	14			11				
	25 %							
END OF BOREHOLE.								

Note: No ground water was encountered in the borehole.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

RECORD OF BOREHOLE No: 18

Location : BRIDGEND – M4
Contract No. : 448
Type of Boring : Shell & Auger
Date (started) : 17·6·69

GRID REF EASTING : 306,010m
Borehole Dia : 0·15m
Casing :
Ground Level : 30·081m

Time	Depth of Casing	Water Level	SAMPLES Depth	Type	No.	STRATA Legend	Depth	Thickness	DESCRIPTION OF STRATA
							0·15m	0·15m	TOPSOIL
			0·31m	U	1				Firm grey/yellow mottled silty sandy CLAY, with traces of wood & vegetation
			0·76m	D	2			1·07m	
			1·22m	U	3		1·22m		
			1·52	W	10				
			1·68m (N=6)	D	4			1·68m	Loose grey silty SAND with gravel
9.30 18·6·69	2·59m	DRY	2·44m	D	5		2·90m		
9.30	2·59m	1·52m	3·05m	U	6				
			3·66m	B	7				
			4·57m (N=54)	D	8			5·18m	Hard red sandy silty CLAY with boulders
			5·33m	D	9				
			6·10m (N=140)	D	11				
			6·86m	D	12				
			7·62m (N=238)	D	13		8·08m		
									Borehole Complete

REMARKS:

SCALE 1 : 50

Foundation Engineering Ltd.

RECORD OF BOREHOLE No: 19

Location : BRIDGEND - M4
Contract No. : 448
Type of Boring : Shell & Auger
Date (started) : 15·6·69

GRID REF EASTING : 306,320m
Borehole Dia : 0·15m
Casing : 3·51m of 0·15m
Ground Level : 3.4.101m

Time	Depth of Casing	Water Level	SAMPLES Depth	Type	No.	STRATA Legend	Depth	Thickness	DESCRIPTION OF STRATA
								0.46m	TOPSOIL
			0·61m	U	1		0·46m	0.61m	Firm brown/yellow sandy silty CLAY.
			1·07m	D	2		1·07m		
			1·22m	U	3			0·62m	Med. dense grey clayey sandy GRAVEL
			1·68m	D	4		1·69m		
			1·98m	U	5		2·13m	0.44m	Firm grey sandy silty CLAY
			2·44m	D	6				
			2·59m	B	7				
14.00 (16.6.69)	3.5m	DRY	3·20m (N=90)	D	8			3·05m	Hard grey sandy silty CLAY with boulders.
9.30	3.51m	DRY							
			3·96m	D	9				
			4·72m (N=73)	D	10				
			5·18m	W	11		5·18m		
									Borehole Complete

REMARKS: Groundwater first encountered at 2.44m. BGL

SCALE 1 : 50

Foundation Engineering Ltd.

BOREHOLE LOG

ST 01NE/22

N.G.R. 0579 7993

BOREHOLE No. 207

FIG. 207

LOCATION S.2070 PENCOED

CLIENT Glamorgan County Council

DRILLING METHOD Shell and Auger

GROUND LEVEL 37·55m AOD.

DATE 20th-23rd October 1970

SCALE 1 : 100

DIAMETER 200 mm

SAMPLE HOLE

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / ϕ
TOPSOIL	1		0.2m					
SOFT to FIRM brown sandy silty CLAY, little mixed GRAVEL	2			21				
	3		1.5m	16	28	19		7°/1°
STIFF, becoming HARD with depth, brown sandy silty CLAY, very SILTY in places, and mixed GRAVEL and COBBLES.	4			9				
	5							
	6			18	20	14	UNTESTABLE	
	7			9				
	W							
	8			8				
	9			11				
	10							
	11		9.5m	9			80	
END OF BOREHOLE								

Note: Ground water was encountered at 7.0 m, did not rise, and was sealed off by casing tubes at 7.2 m below ground level.
Final water level 24 hours after completion of borehole and withdrawal of casing tubes was 6.2 m below ground level (Hole collapsed to 7.0 m below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE /23.

N.G.R. 0559 7999

BOREHOLE No. 208

FIG. 209

LOCATION S. 2070 PENCOED.

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 31·79m AOD

DATE 26th-27th October 1970

SCALE 1 : 100

DIAMETER 200 mm

SAMPLE HOLE

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / ϕ
TOPSOIL.	1		0·25m					
FIRM brown sandy silty CLAY, some mixed GRAVEL and COBBLES abundant gravel and very SANDY in places.	2			23				
	3			15	26	22		60/5°
	4			14				
	5			18				
	W 6			19	25	16		60/6°
	7			14				
	8		1·5m	12			I 48	
STIFF red/brown sandy silty CLAY some mixed GRAVEL.	9						(100 mm penetration)	
	10		5·5m					
FIRM red laminated silty CLAY.	11		6·0m	14			I 149	
STIFF red sandy silty CLAY, some GRAVEL.	12		6·6m	7			(280 mm penetration)	
	13						I 50	
MEDIUM STRONG fine to medium red SANDSTONE.	14		7·6m				(100 mm penetration only)	
END OF BOREHOLE.								

Note: Ground water was encountered at 3·95 and rose quickly to 3·1m below ground level. On boring to 5·0m water level rose overnight from 4·2m to 2·15 m below ground level. Final water level 24 hrs after completion of borehole and withdrawal of casing tubes was 0·95 m below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

BOREHOLE LOG

NGR ST 07 NE/24 0582 7985

BOREHOLE No. 242

FIG. 249

LOCATION S.2070 PENCOED.

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 35·43m AOD

DATE 11th-13th December 1970.

SCALE 1 :100

DIAMETER 200 mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C/φ
	1 ●		0·1m					
TOPSOIL								
SOFT to FIRM yellowish brown sandy silty CLAY, gravel traces.	2 ●			23				
	3 |			18	25	10		UNTESTABLE.
	4 ●		2·0m	20				
STIFF brown sandy silty CLAY, some mixed GRAVEL and COBBLES, very SANDY and very SILTY in places.	5 ●			18				
	6 ● W							
	7 ●							
	8 ●							
	9 |			11				
	10 ●							
	11 ●		6·0m					
END OF BOREHOLE.								

Note: Ground water was encountered at 5·75 and rose quickly to 5·7m below ground level. Final water level 24 hrs after completion of hole was 2·5m below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE
| UNDISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE/25

NGR 0518 7982

BOREHOLE No. 243

FIG. 250

LOCATION S.2070 PENCOED.

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 32·84m AOD

DATE 13th December 1970.

SCALE 1 : 100

DIAMETER 200 mm

PROVING HOLE.

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C/ϕ
TOPSOIL	1 ●		0·25m					
SOFT to FIRM brown friable sandy silty CLAY, very SANDY at base.	2 ●			16				
	3 ●			15				
	4 ● W		2·9m	13				
Very STIFF brown very SANDY very SILTY CLAY, some mixed GRAVEL.	5 ●			9				
	6 ●			9				
	7 ●			9				
	8 ●		6·0m					
END OF BOREHOLE.								

Note: Ground water was encountered at 5·5m and rose quickly to 5·4m below ground level, Final water level 24 hrs after completion of hole was 2·85m below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE
UNDISTURBED SAMPLE

BOREHOLE LOG

SI 07 NE/26

LOCATION S.2070 PENCOED. NGR. 0513 7962 BOREHOLE No. 244

FIG. 251

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger. (12·0m) Rotary Drilling (12·0 - 16·0m)

GROUND LEVEL 29·61m AOD

DATE 10th-12th November 1970. 3rd-4th December 1970

SCALE 1 :100

DIAMETER 200 mm & 75mm

SAMPLE HOLE

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / φ
TOPSOIL.	1		0·2m					
SOFT yellow brown sandy silty CLAY	2		1·0m	28				
MODERATELY COMPACT mixed brown SAND, mixed GRAVEL and COBBLES.	W						14	
	3		4·0m				15	
Grey/brown sandy silty CLAY and abundant mixed GRAVEL and COBBLES.	4			12	21	15	25	
							49 (150 mm penetration)	
			7·2m					
MODERATELY COMPACT brown clayey SAND. Some mixed GRAVEL.	5		7·5m				12	
Grey/brown sandy silty CLAY and abundant mixed GRAVEL and COBBLES few BOULDERS.	6			12	20	18	71	
							78	
	7						93	
N.B. Rock roller bits used from 12·0 - 15·5m, no recovery; Core barrel used from 15·5 - 16·0m but cobbles only recovered.							91	
	80%		16·0m					
END OF BOREHOLE								

Note: Ground water was encountered at 1·0 m and was sealed off by casing tubes at 4·0 m below ground level. Final water level 24 hrs after completion of borehole and withdrawal of casing tubes was 6·2 m below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

BOREHOLE LOG

ST07NE/27

BOREHOLE No. 244A

FIG. 252

LOCATION S. 2070. PENCOED. N.G.R 0575 7963.

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 29·89m AOD

DATE 15th November 1970.

SCALE 1 : 100

DIAMETER 200 mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	SAMPLE HOLE N	SAMPLE HOLE C/φ
TOPSOIL.	1		0·2m					
SOFT brown sandy silty CLAY.	W 2		1·0m	34				
MODERATELY COMPACT mixed brown SAND, mixed GRAVEL and COBBLES.	3		1·0m				I 11	
							I 17	
STIFF brown sandy silty CLAY, some mixed GRAVEL, COBBLES, BOULDERS	4			9				
	5			9	20	15		UNTESTABLE
	6		6·0m				I 64	
END OF BOREHOLE.								

Note: Ground water was encountered at 1·0m On boring to 1·5m water rose to Ground Level. Water was sealed off by casing tubes at 4·3m below ground level. Final water level 24 hrs after completion of borehole and withdrawal of casing tubes was at ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE
I UNDISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE / 28

BOREHOLE No. 245

FIG. 253

LOCATION S.2070 PENCOED. N G R · 0516 7959

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 29·45m AOD

DATE 13th-14th November 1970.

SCALE 1 : 100

DIAMETER 200 mm

SAMPLE HOLE

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / φ
TOPSOIL	1		0·2m					
SOFT brown sandy silty CLAY.	W 2		1·0m	21				
MODERATELY COMPACT mixed brown SAND, mixed GRAVEL and COBBLES.	3						17	
							22	
			1·0m					
STIFF brown sandy silty CLAY, some mixed GRAVEL, COBBLES.	4			8	19	14		UNTESTABLE
	5						58	
			8·0m				71	
END OF BOREHOLE.								

Note: Ground water was encountered at 1·0m. On boring to 1·5m water rose to 0·5m below ground level. Water was sealed off at 4·3m below ground level. Final water level 24 hrs after completion of hole was at ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE/29

LOCATION S.2070 PENCOED. NGR. 0572 7959

BOREHOLE No. 246

FIG. 254

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 29·50m AOD

DATE 19th–25th November 1970

SCALE 1 : 100

DIAMETER 200 mm

SAMPLE HOLE

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / φ
SOFT yellow/brown very SANDY silty CLAY, little mixed GRAVEL.	1 ●			30				
	W ●2		1·5m	28	32	23		UNTESTABLE
MODERATELY COMPACT mixed GRAVEL and COBBLES, little brown SAND.	3 ●		5·0m				120	
							20	
HARD brown sandy silty CLAY, some mixed GRAVEL and COBBLES, abundant in places.	4 ●			6			31	
							86	
	5 ●						51 (150 mm penetration)	
	6 ●		12·0m				87	
							60 (100 mm penetration only)	
		END OF BOREHOLE.						

Note: Ground water was encountered at 1·5m rose quickly to 1·0m and was sealed off at 5·0m below ground level. Final water level 24 hrs after completion of hole was 1·0m below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE/30.

LOCATION S.2070. PENCOED. N.G.R 0574 7957 BOREHOLE No. 247

FIG. 255

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 29·04m AOD.

DATE 16th-18th November 1970.

SCALE 1 : 100

DIAMETER 200 mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	SAMPLE HOLE N	SAMPLE HOLE C/φ
TOPSOIL.	1		0·5m					
MODERATELY COMPACT mixed brown SAND and mixed GRAVEL and COBBLES.	2						15	
							18	
	3		4·5m					
Fine to medium brown clayey SAND.			5·0m					
Brown sandy silty CLAY, mixed GRAVEL and COBBLES, BOULDER at 5·0 to 5·5m very COMPACT in-situ.	4						81	
	W							
	5			10	20	15	89	
	6						80	
			10·5m					
END OF BOREHOLE.								

Note: Ground water was encountered at 0·6m and did not rise. On boring to 1·5m water rose to Ground level, water was sealed off at 4·6m below ground level. Final water level 24hrs after completion of borehole was at ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE/31

NGR 0571 7946

BOREHOLE No. 248

FIG. 256

LOCATION S. 2070 PENCOED.

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 29• 25m AOD

DATE 2nd-3rd December 1970.

SCALE 1 : 100

DIAMETER 200mm

SAMPLE HOLE

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / φ
TOPSOIL.	1 ●		0•3m					
SOFT brown very SANDY silty CLAY	2 ●			30				
	3 |			36	37	29		UNTESTABLE
	4 ●		2•0m	35				
MODERATELY COMPACT to COMPACT mixed brown clayey SAND, mixed GRAVEL and COBBLES.	5 ●						32	
	6 ●		5•5m	7			27	
							54	
STIFF brown very SANDY very SILTY CLAY, some mixed GRAVEL.	7 |			9	15	14		UNTESTABLE
	8 ●		8•0m				51	
							70	
		END OF BOREHOLE.						

Note: Ground water was encountered at 1•7m and was sealed off at 5•0m below ground level. Final water level after completion of hole was 2•0m below ground level.

G.K.N. FOUNDATIONS LTD.,

● DISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE /32.

LOCATION S. 2070 PENCOED. NGR 0566 7935

BOREHOLE No. 249

FIG. 257

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 29• 18m AOD.

DATE 26th-28th November 1970.

SCALE 1 : 100

DIAMETER 200mm

SAMPLE HOLE

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / φ
TOPSOIL.	1		0•2m					
LOOSE fine to medium brown SAND	2 W		2•0m				5	
MODERATELY COMPACT mixed brown SAND, mixed GRAVEL and COBBLES.	3		5•0m				15 25 30	
STIFF brown sandy silty CLAY, some mixed GRAVEL and COBBLES, abundant in places.	4 5 6 7		10 11•5m.				26 31 85 70 51(No penetration) 60(No penetration) 69(100mm penetration only) 95 (100mm penetration only)	
END OF BOREHOLE								

Note: Ground water was encountered at 1•5m and was sealed off at 5•0m below ground level. Final water level after completion of hole was 2•0m below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE / 33 ·

NGR ~~0565~~ 7434 BOREHOLE No. 250

FIG. 258

LOCATION S.2070. PENCOED.

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 29·17m AOD

DATE 28th November - 2nd December 1970.

SCALE 1 : 100

DIAMETER 200 mm

SAMPLE HOLE

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / φ
TOPSOIL.	1 ●		0·4m					
SOFT brown very SANDY silty CLAY	2 ●			28				
	3 ●		2·0m				6	
COMPACT mixed GRAVEL and COBBLES, little mixed brown SAND.	4 ●						41	
			5·0m				35	
STIFF brown sandy silty CLAY, some mixed GRAVEL and COBBLES. abundant in places; very SANDY in places.	5 ●						49	
							48	
	6 ●						46 (150mm penetration)	
							70	
	7 ●						69 (100mm penetration only)	
			14·0m				159 (50mm penetration only)	
END OF BOREHOLE.								

Note: Ground water was encountered at 2·0m and was sealed off at 6·0m below ground level. Final water level 24 hrs after completion of hole was 3·0m below ground level.

G.K.N. FOUNDATIONS LTD.,

● DISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE/34

LOCATION S.2070 PENCOED. NGR. 056 793 2 BOREHOLE No. 251

FIG. 259

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 29·34m AOD

DATE 4th-5th December 1970.

SCALE 1 : 100

DIAMETER 200 mm

SAMPLE HOLE.

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C/ϕ
TOPSOIL.	1 ●		0·3m					
SOFT yellow/brown silty CLAY.	2 ●			37				
	3 |		1·3m	23	35	28		UNTESTABLE.
MODERATELY COMPACT mixed brown clayey SAND and mixed GRAVEL.	W 4 ●						I 14	
			4·5m				I 14	
STIFF brown very SANDY very SILTY CLAY, some mixed GRAVEL and COBBLES, abundant in places.	5 ●						I 26	
							I 64	
	6 ●							
							I 73	
	7 ●							
							I 91	
	8 |			8				UNTESTABLE
	9 ●			8				
			14·0m				I 115	
END OF BOREHOLE.							(200mm penetration only)	

Note: Ground water was encountered at 3·0m and was sealed off at 3·2m below ground level. Water was again encountered at 4·0m and was sealed off at 4·7m below ground level. Final water level 24 hrs after completion of hole was 1·3m below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE/35

N G R 0567 7931

BOREHOLE No. 252

FIG. 260

LOCATION S.2070. PENCOED.

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 29• 32m AOD

DATE 7th-8th December 1970.

SCALE 1 : 100

DIAMETER 200mm

SAMPLE HOLE

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C/ϕ
TOPSOIL.	1		0•5m					
SOFT brown sandy silty CLAY.	2		1•0m	43				
Fine to medium brown silty SAND.	3		1•5m					
SOFT brown sandy silty CLAY.	W 1		2•0m	31				
MODERATELY COMPACT mixed GRAVEL and COBBLES, little SAND and clay traces.	5		4•5m				14 / 15	
STIFF brown very SANDY silty CLAY, some mixed GRAVEL, COBBLES and BOULDERS.	6			9			55	
	7						58	
	8						61	
			9•5m				77	
END OF BOREHOLE.								

Note: Ground water was encountered at 1•7m and was sealed off at 2•3m below ground level. Water was again encountered at 3•0m and was sealed off at 4•5m below ground level. Final water level 24 hrs after completion of hole was 1•3m below ground level.

G.K.N. FOUNDATIONS LTD.,

● DISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE / 36.

NGR 0568 7924

BOREHOLE No. 252A

FIG. 261

LOCATION S. 2070 PENCOED.

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 28·63m AOD

DATE 8th December 1970

SCALE 1 : 100

DIAMETER 200mm

SAMPLE
HOLE

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / φ
SOFT brown sandy silty CLAY.	1 ●			30				
	● W 2 ●		1·5m	30				
MODERATELY COMPACT mixed GRAVEL and COBBLES, little mixed brown CLAYEY SAND.	3 ●						11	
							16	
			4·5m					
STIFF brown sandy silty CLAY, some mixed GRAVEL and COBBLES.	4 ●						89	
			6·5m				79	
END OF BOREHOLE.								

Note: Ground water was encountered at 1·2m and was sealed off at 2·0m below ground level. Water was again encountered at 4·0m and was sealed off at 4·6m below ground level. Final water level 24 hrs after completion of hole was 1·0m below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

BOREHOLE LOG

ST 01 NE/37.

N.G.R. 0563 7916

LOCATION S.2070 PENCOED.

BOREHOLE No. 253

FIG. 262

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 31•13m AOD

DATE 9th December 1970.

SCALE 1 : 100

DIAMETER 200 mm

DESCRIPTION OF STRATA	SAMPLE / HOLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / φ
TOPSOIL.			0•3m					
SOFT brown friable very SILTY CLAY	1 ●			39				
	2		1•5m	28				
MODERATELY COMPACT fine to medium brown SAND, gravel traces.	3 ●		2•7m				12	
Very STIFF brown very SANDY very SILTY CLAY, some mixed GRAVEL.	4 ●						20	
	5		4•0m	8	20	14		20/27°
END OF BOREHOLE.								

Note: Ground water was encountered at 1•0m and was sealed off at 1•2m below ground level. On withdrawal of casing tubes hole collapsed to 3•0m and was dry 24 hrs later.

G.K.N. FOUNDATIONS LTD.,

SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE /38

LOCATION S. 2070. PENCOED. NGR 0562 7904

BOREHOLE No. 254

FIG. 263

CLIENT Glamorgan County Council.

DRILLING METHOD Trial Pit by mechanical excavator.

GROUND LEVEL 30·01m AOD

DATE 16th October 1970.

SCALE 1 : 25

DIAMETER 3·0m x 0·6m

TRIAL PIT

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C/ϕ
TOPSOIL.			0·3m					
FIRM brown, slightly sandy silty CLAY, little mixed GRAVEL.			0·9m					
Brown clayey mixed SAND and mixed GRAVEL, few BOULDERS.	1		1·2m					
FIRM to STIFF mottled grey/brown very SANDY silty CLAY.			1·5m					
		END OF TRIAL PIT.						

Note: Ground water was encountered at 1·0m below ground level. After 15 mins. 300 mm of water was present in base of pit. CBR samples were taken.

G.K.N. FOUNDATIONS LTD.,

● DISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE/39

N.G.R 0592 7993

LOCATION S.2070 PENCOED.

BOREHOLE No. 255

FIG. 264

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 29·80 m AOD

DATE 22nd October - 26th November 1970.

SCALE 1 : 100

DIAMETER 200 mm

SAMPLE
HOLE

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / ϕ
SOFT brown & grey silty CLAY becoming very SILTY with depth.	1			21				
	2			20	24	18		19/1°
	3			23				
	4			25				UNTESTABLE
	5W 6		4·0m	20				
MODERATELY COMPACT to COMPACT fine to medium brown SAND and mixed GRAVEL.	7						30	
	8 11							
	9						41	
	10		8·5m				15	
Fine to medium brown SAND.	12							
	13		13·5m					
SOFT red/brown & grey laminated silty CLAY.	14							
	17			32				
	18			23	51	32		303/0°
	19			19			16	
			17·5m					
	CONTINUED ON FIG. 265							

Note: SAND formation was 'blowing' in the borehole.

G.K.N. FOUNDATIONS LTD.,

● DISTURBED SAMPLE

BOREHOLE LOG

SJ 07 NE/39.

LOCATION S.2070 PENCOED.

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 29•80m AOD

DATE 22nd October - 24th November 1970.

SCALE 1 : 100

DIAMETER 200 mm

BOREHOLE No. 255

FIG. 26

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	SAMPLE HOLE N	SAMPLE HOLE C/φ
STIFF brown sandy silty CLAY, some mixed GRAVEL	20		17•53m	9				
Grey fine grained SANDSTONE.	21		12•6m 13•7m				100 (100mm penetration only)	
			END OF BOREHOLE.					

Note: Ground water was encountered at 3•15m and rose quickly to ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION [illegible]

BOREHOLE LOG

ST 07 NE/40

N.G.R. 0592 7992

BOREHOLE No. 257

FIG. 266

LOCATION S. 2070 PENCOED.

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 29·45m AOD

DATE 1st-2nd November 1970.

SCALE 1 : 100

DIAMETER 200 mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	SAMPLE HOLE N	C/φ
TOPSOIL.	1		0·25m					
SOFT brown and grey silty CLAY.	W 2							
	3		2·0m					
SOFT grey very SILTY CLAY.	4			23	27	23		
	5		3·4m				I 85 (150 mm pretration only)	
Very COMPACT mixed brown SAND, mixed GRAVEL and COBBLES.	6						I 57 (25 mm penetration only)	
	7		5·0m				I 65 (50 mm penetration only)	
END OF BOREHOLE.								

Note: On boring to 3·4m, water entered borehole overnight and rose to 2·3m below ground level. Water level 24 hrs after completion of soft ground boring was 0·15m below ground level.

G.K.N. FOUNDATIONS LTD.,

● DISTURBED SAMPLE

BOREHOLE LOG

LOCATION S.2070. PENCOED.

BOREHOLE No. 257A

FIG. 267

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

ST07NE/40

GROUND LEVEL 29·45m AOD

DATE 26th November - 3rd December 1970.

SCALE 1 :100

SAMPLE
HOLE

DIAMETER 200 mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / ϕ
TOPSOIL.			0·3m					
SOFT grey silty CLAY.	W		5·0m					
COMPACT mixed brown SAND and mixed GRAVEL.	1 2 3		11·0m				41 58 34 42	
FIRM grey laminated silty CLAY	4 5		12·6m	30	57	30		57/0°
MODERATELY COMPACT red SAND.	6		13·2m				25	
STIFF red/brown sandy silty CLAY, some mixed GRAVEL.	7		14·0m				28	
Mixed grey clayey SAND and mixed GRAVEL.	8		15·0m					
Very COMPACT mixed red SAND, gravel traces.	9		16·1m				52	
Red sandy CLAY and GRAVEL.	10		16·3m				50	
STRONG red & grey CONGLOMERATE	11		16·6m				(No penetration)	
	END OF BOREHOLE.							

Note: Ground water was encountered at 5·0m and rose quickly to 2·7m below ground level. Final water level 24 hrs after completion of hole was 0·95m below ground level. Initial 5·0m of this hole is given by B.H. 257, terminated on a boulder.

G.K.N. FOUNDATIONS LTD.,

● DISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE/41

N·G·R 0590 7989

LOCATION S. 2070. PENCOED.

BOREHOLE No. 258

FIG. 268

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 29·46m AOD.

DATE 8th-26th November 1970.

SCALE 1 : 100

DIAMETER 200 mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	SAMPLE HOLE N	C / ϕ
TOPSOIL.	1		0·8m					
SOFT to FIRM grey SILTY CLAY.	2 W 3 4		3·8m	19	28	18		90/5°
COMPACT to very COMPACT fine to medium brown SAND, mixed GRAVEL and COBBLES, becoming clayey with depth.	5 6 7 8 9 10		11·5m				57 34 25 86 39 50	
Very COMPACT fine to medium red/brown SAND.	11		12·9m				55	
			CONTINUED ON FIG.					

G.K.N. FOUNDATIONS LTD.,

● DISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE/42

BOREHOLE No. 258A

FIG. 270

NGR 0591 7986

LOCATION S.2070 PENCOED.

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 29·61m AOD

DATE 5th-7th December 1970.

SCALE 1 : 100

DIAMETER 200mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	SAMPLE HOLE N	SAMPLE HOLE C/φ
TOPSOIL.	1		0·25m					
SOFT yellow sandy silty CLAY.	2		1·0m	25				
FIRM to STIFF brown very SANDY silty CLAY, gravel traces.	W 3		1·85m	19	26	20		UNTESTABLE
MODERATELY COMPACT mixed brown clayey SAND and abundant mixed GRAVEL.	4		2·9m				I 21	
STIFF red/brown sandy silty CLAY, some mixed GRAVEL, few COBBLES.	5			11			I 69	
	6						I 68 (150 mm penetration only)	
	7							
	8							
	9		6·2m				I 56 (100 mm penetration)	
END OF BOREHOLE.								

Note: Ground water was encountered at 1·9m below ground level. Final water level 24 hrs after completion of hole was 1·2m below ground level.

G K N FOUNDATIONS LTD.,

● DISTURBED SAMPLE
I UNDISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE / 43

BOREHOLE No. 260A

FIG. 271

LOCATION S.2070 PENCOED

N & R 0600 7991

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 30•21 m AOD

DATE 8th December 1970.

SCALE 1 : 100

DIAMETER 150mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	SAMPLE HOLE N	SAMPLE HOLE C/φ
TOPSOIL.	1		0•25m					
Very SOFT brown sandy silty CLAY.	2			50				
	3			26	31	24		UNTESTABLE
	4		2•85m					
Mixed brown SAND, some mixed GRAVEL.	W 5		4•1m				20	
STIFF brown very SILTY CLAY, little mixed GRAVEL.	7 6		5•5m	14	25	18		UNTESTABLE
END OF BOREHOLE.								

Note: Ground water was encountered at 3•1m and rose quickly to 3•0m below ground level. Final water level 24 hrs after completion of hole was 2•35m below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

BOREHOLE LOG

ST07 NE/44

BOREHOLE No. 260B

FIG. 272

LOCATION S.2070 PENCOED. N.G.R. 0600 7984

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 29·17 m AOD

DATE 9th-10th December 1970.

SCALE 1 : 100

DIAMETER 150 mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	SAMPLE HOLE N	C / φ
TOPSOIL.	1		0·25m					
SOFT brown & grey silty CLAY.	2 W 3 4			41 21	29	23		21/0°
COMPACT mixed brown SAND and mixed GRAVEL.	5 6		3·0m 6·85m				36 40 18	
STIFF brown very SANDY silty CLAY and mixed GRAVEL and COBBLES.	7 9 8		8·8m				84 (150 mm penetration) 88 (150mm penetration)	
END OF BOREHOLE.								

Note: Ground water was encountered at 1·5m below ground level. Final water level 24 hrs after completion of hole was 1·3 below ground level.

G.K.N. FOUNDATIONS LTD.,

● DISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE/45

LOCATION S. 2070. PENCOED. NGR. 0609 7985 BOREHOLE No. 261

FIG. 273

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 29·96m AOD.

DATE 28th–29th October 1970.

SCALE 1 : 100

DIAMETER 200 mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	SAMPLE HOLE N	C / φ
TOPSOIL	1		0·3m					
SOFT brown & grey silty CLAY, very SILTY at base.	2 W 3 4		2·1m	39 24 22	30	19		
SOFT grey very SILTY CLAY.	5		3·5m				10 (Tool sank under hammer weight)	
Brown friable very SANDY silty CLAY mixed GRAVEL and COBBLES.	6		5·4m				18	
MODERATELY COMPACT fine to medium brown SAND, grey below 8·35m	7 8		9·8m				14 18 13	
COMPACT fine to medium brown clayey SAND and mixed GRAVEL.	9 10		11·5m				43 48	
			END OF BOREHOLE.					

Note: Ground water was encountered at 1·5 m and rose quickly to 1·0 m below ground level. Final water level 24 hrs after completion of hole and wirhdrawal of casing tubes was 0·25m below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

BOREHOLE LOG

STONE/46

LOCATION S.2070 PENCOED. N.G.R. 0622 7979 BOREHOLE No. 262

FIG. 274

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 38·80m AOD.

DATE 20th-27th November 1970.

SCALE 1 : 100

DIAMETER 150mm

DESCRIPTION OF STRATA	SAMPLE / HOLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C/φ
TOPSOIL.	1 ●		0·15m					
SOFT to FIRM red/brown sandy silty CLAY, little mixed GRAVEL.	2 ●			22				
	3 |		1·5m	17	27	19		UNTESTABLE
STIFF brown sandy silty CLAY and mixed GRAVEL, COBBLES and BOULDERS, very SANDY and abundant GRAVEL in places.	4 ●			13				
	5 ●			9			| 63	
	6 ●							
	7 ●			10			| 90 (80 mm penetration only)	
	8 ●							
	9 ●						| 60	
	10 ●			13				
	11 ●							
	12 ●			10				
	13 |			2	27	17	| 61	UNTESTABLE
	14 ●		8·75m	9			| 57	
END OF BOREHOLE.								

Note: No ground water was encountered in the borehole.

G.K.N. FOUNDATIONS LTD.,

BOREHOLE LOG

ST 07 NE/48

LOCATION S.2070 PENCOED. N.G.R. 0642 7975

CLIENT Glamorgan County Council.

BOREHOLE No. 265

FIG. 276

DRILLING METHOD Shell & Auger.

GROUND LEVEL 36·12m AOD

DATE 30th November - 2nd December 1970.

SCALE 1 : 100

DIAMETER 150 mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	SAMPLE HOLE N	SAMPLE HOLE C/φ
TOPSOIL.	1		0·2m					
SOFT to FIRM brown sandy silty CLAY, little mixed GRAVEL.	2			22				
	3			21	30	20		UNTESTABLE
	4			17				
	5			16				
	6		3·2m	19				
STIFF grey sandy silty CLAY and mixed GRAVEL, abundant in places.	7			15				
	W							
	8			14				
	9			16	26	19	41	
	10			13				
	11			17				
	12							
	13		3·0m	10			66	
END OF BOREHOLE.								

Note: Ground water was encountered at 4·2m and rose quickly to 3·1m below ground level. Final water level 24 hrs after completion of hole was 2·2m below ground level.

G.K.N. FOUNDATIONS LTD.,

BOREHOLE LOG

ST 07 NE / 49

N.G.R. 0641 7973

LOCATION S.2070 PENCOED.

BOREHOLE No. 267

FIG. 277

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 33·58m AOD.

DATE 2nd-5th December 1970.

SCALE 1 : 100

DIAMETER 150 mm

SAMPLE HOLE

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / ϕ
TOPSOIL.	1 ●		0·3m					
SOFT to FIRM brown sandy silty CLAY, some mixed GRAVEL.	2 |			18	26	19		UNTESTABLE
	3 ●			18				
			2·5m					
FIRM to STIFF brown sandy silty CLAY, some mixed GRAVEL.	4 |			14	28	18		UNTESTABLE
	5 ●		3·5m	17				
STIFF brown and grey/brown sandy silty CLAY, very SILTY in places, some mixed GRAVEL and COBBLES.	6 ●			10				
	7 |			13				
	8 ●			11				
	9 |			9	22	18		88/0°
	10 ●			13				
	11 | W			11				
	12 ●			10				
	13 ●		9·5m	10			75 (112mm penetration only)	
	END OF BOREHOLE.							

Note: No ground water was encountered during boring, and hole was dry on completion. 24 hrs after completion of hole, water was 7·2m below ground level.

G.K.N. FOUNDATIONS LTD.,

● DISTURBED SAMPLE

BOREHOLE LOG

ST 07 NE/50

LOCATION S.2070 PENCOED. N & R. 0650 7973

BOREHOLE No. 269

FIG. 278

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 29·95m AOD.

DATE 8th December 1970.

SCALE 1 : 100

DIAMETER 150 mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N (SAMPLE HOLE)	C / φ
SOFT brown sandy silty CLAY.	1 ●			29				
	2 ●		1·5m	29				
SOFT brown sandy silty CLAY, very SANDY in places, and mixed GRAVEL	3 ●			31				
	4 ●						16	
	5 ●			21	25	16		
			4·5m					
STIFF brown sandy silty CLAY, some mixed GRAVEL.	6 ●			8			84	
	7 ●		5·5m	11			70	
			END OF BOREHOLE.				(150mm penetration only)	

Note: Ground water was encountered at 1·4m and was sealed off by casing at 2·0m below ground level. Water was again encountered 2·6m and was sealed off by casing. Final water level 24 hrs after completion of hole was 1·2m below ground level.

G.K.N. FOUNDATIONS LTD.,

● DISTURBED SAMPLE

BOREHOLE LOG

ST 08 SE/10

LOCATION S.2070 PENCOED. NGR. 0538 8016

BOREHOLE No. 194

FIG. 19-1

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 39·09m AOD

DATE 19th-20th January 1971.

SCALE 1 : 100

DIAMETER 200 mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	SAMPLE HOLE N	SAMPLE HOLE C / ϕ
TOPSOIL	1		0·2m					
SOFT yellow/brown & brown sandy silty CLAY, some mixed GRAVEL.	2			19				
	3		2·0m					
STIFF brown sandy silty CLAY, some mixed GRAVEL and COBBLES.	4			12	20	14		100/5°
	5							
	6			11			I 94	
			5·2m					
END OF BOREHOLE.								

N.B. Borehole was terminated on large BOULDER at 5·2m below ground level; Borehole position was re-positioned 15 feet away, and re-bored as No.194 A.

Note: Ground water was encountered at 0·8m and rose quickly to 0·75m below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE
I UNDISTURBED SAMPLE

BOREHOLE LOG

ST 08 SE/10A

LOCATION S.2070 PENCOED. NGR 0539 8014 BOREHOLE No. 194A

FIG. 195

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 39·00m AOD

DATE 21st-26th January 1971.

SCALE 1 : 100

DIAMETER 200 mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / φ
			0·2m					
TOPSOIL.								
SOFT yellow/brown and brown sandy silty CLAY, some mixed GRAVEL.	● W		2·0m					
STIFF brown sandy silty CLAY, some mixed GRAVEL and COBBLES.	7A							
	7			10			74	
	8							
→ green sandstone COBBLES and BOULDERS.	9		8·5m				52	
COMPACT mixed brown clayey SAND and mixed GRAVEL and COBBLES.	10							
	11						44	
	12		11·5m					
Red sandy silty CLAY and abundant mixed rounded GRAVEL.	13		11·75m	17			82	
	14		12·0m				(150mm penetration only)	
Red sandy CONGLOMERATE. (? BOULDER)		END OF BOREHOLE.						

N.B. See B.H.194 for initial samples and tests.

Note: Ground water was encountered at 0·5m below ground level. Water was again encountered at 9·0m and rose quickly to 6·4m below ground level. Water level 24 hrs after completion of hole was 0·75m below ground level.

G.K.N. FOUNDATIONS LTD.,

● DISTURBED SAMPLE

BOREHOLE LOG

ST 08 SE/11

BOREHOLE No. 195

FIG. 196

LOCATION S.2070 PENCOED. NGR C541 8012

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 37·99m AOD.

DATE 13th-17th January 1971.

SCALE 1 : 100

DIAMETER 200 mm

SAMPLE HOLE.

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / φ
TOPSOIL.	1 ●		0·2m					
FIRM reddish brown silty CLAY, little GRAVEL, grey fissured.	2 ●			15				
	3 |		1·75m	16	24	16		56/0°
SOFT brown sandy silty CLAY, little mixed GRAVEL.	4 ●		2·5m	15				
Very STIFF brown sandy silty CLAY, some mixed GRAVEL and COBBLES.	●5 | W			10	20	16		110/24°
	6 ●							
	7 ●			13			52	
	8 ●							
	9 ●			12			63	
	10 ●		7·6m					
Mixed rounded GRAVEL.	11 ●		8·0m					
Red sandy silty CLAY & sandstone GRAVEL.	12 ●		8·5m				111	
Very COMPACT mixed brown SAND and mixed rounded and subangular GRAVEL.	13 ●		12·0m				92	
STIFF red/brown sandy silty CLAY and mixed GRAVEL.	14 ●			9			94	
	15 ●			6				
	16 ●		14·0m				107 (150mm penetration only)	
	END OF BOREHOLE.							

Note: Ground water was encountered at 2·8 and rose quickly to 2·65m below ground level. Casing tubes were inserted to 13·5m, but no seal was obtained. Final water level 24hrs after completion of hole was 0·75m below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE
! UNDISTURBED SAMPLE

BOREHOLE LOG

ST 08 SE/12

NGR 0545 3014

BOREHOLE No. 196

FIG. 197

LOCATION S. 2070. PENCOED.

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.(10·5m); Rotary Drilling (10·5 - 16·0m)

GROUND LEVEL 36·05m AOD.

DATE 1st-3rd November 1970. 10th-11th December 1970.

SCALE 1 :100

DIAMETER 200 mm & 75mm

SAMPLE HOLE.

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C/ϕ
FILL,ash,clay & gravel.	1		0·8m					
Very STIFF brown friable very SANDY silty CLAY,some mixed GRAVEL	2 3		2·7m	6			I 30 (150mm penetration)	
STIFF grey sandy silty CLAY,some mixed GRAVEL and COBBLES.	W 4		5p8m				I 98 I 67	
MODERATELY COMPACT mixed brown SAND,mixed GRAVEL and COBBLES.	5		8·8m				I 18 I 30	
STIFF red/brown sandy silty CLAY and mixed GRAVEL and COBBLES, abundant in places,few SAND pockets and lenses.	6 7 8 10 % 9			10 7	26	18	I 64 (100mm penetration only) I 50 (50 mm penetration only)	UNTESTABLE
N.B. Sandstone cobbles only recovered during coring from 10·5 - 12·5m; Rock roller bits used from 12·5 - 16·0m and bottle samples only recovered.	10 11		16·0m					
END OF BOREHOLE.								

Note: Ground water was encountered at 6·0m and rose to 4·0m below ground level in two minutes; On boring to 7·5m water rose immediately to Ground level.Water was temporarily sealed off in red/brown clay at 8·8m below ground level.Final water level 24 hrs after completion of borehole and withdrawal of casing tubes was at ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

BOREHOLE LOG

ST 08 SE/13.

LOCATION S. 2070. PENCOED. NGR. 0546 8012

BOREHOLE No. 196A

FIG. 198

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 36·01m AOD.

DATE 4th-5th November 1970.

SCALE 1 : 100

DIAMETER 200 mm

SAMPLE HOLE.

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / φ
FILL, ash, gravel.	1		1·0m					
Brown friable sandy silty CLAY, some mixed GRAVEL and COBBLES (Very COMPACT in-situ)	2		2·7m				I 80	
Very STIFF grey sandy silty CLAY, some mixed GRAVEL and COBBLES.	3 4 5 6		5·7m	12 10 11	25	19	I 52	UNTESTABLE
MODERATELY COMPACT mixed GRAVEL and COBBLES, some mixed brown SAND	W 7		9·0m				I 24 I 29	
	END OF BOREHOLE.							
N.B. Borehole terminated on red/ brown boulder CLAY.								

Note: Ground water was encountered at 5·8m and rose quickly to 4·9m below ground level. On boring to 8·7m water rose to ground level. Final water level 24 hrs after completion of borehole and withdrawal of casing tubes was at ground level

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE
I UNDISTURBED SAMPLE

BOREHOLE LOG

ST 08 SE/14

BOREHOLE No. 197

FIG. 199

LOCATION S. 2070. PENCOED. N G R. 0547 3010

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger. (10·0,) Rotary Drilling (10·0 - 16·0m)

GROUND LEVEL 35·60m AOD.

DATE 29th-31st October 1970. 15th-16th December 1970.

SCALE 1 : 100

DIAMETER 200 mm. & 75 mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	SAMPLE HOLE N	SAMPLE HOLE C / φ
LOOSE FILL, grey SAND, ash, gravel, cobbles.	1		1·5m				12	
SOFT brown sandy silty CLAY, some mixed GRAVEL.	2		3·0m				15	
MODERATELY COMPACT mixed brown SAND, mixed GRAVEL and COBBLES, clayey in places.	W 3 4 5		9·0m				21 15 12 14 20	
STIFF red/brown sandy silty CLAY and abundant mixed GRAVEL and COBBLES.	6 10 7 8 0%		16·0m				107 157 (100m penetration only)	
N.B. Core barrel was used from 10·0 - 10·7 and 14·0 to 16·0m ans cobbles of sandstone only were recovered; Rock roller bits were used from 10·7 to 14·0m, and jar samples only recovered.								
END OF BOREHOLE.								

Note: Ground water was encountered at 3·1m and was sealed off at 4·0m below ground level. Water again entered hole at 5·1m and rose to 3·1m in two minutes. Water was sealed off at 9·0m below ground level. Final water level 24 hrs after completion of borehole and withdrawal of casing tubes was 1·5m below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

BOREHOLE LOG

ST 03 SE/15.

LOCATION S.2070 PENCOED

N & R 0553 3008

BOREHOLE No. 198

FIG. 200

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 31·462m AOD.

DATE 7th-9th October 1970.

SCALE 1 :100

DIAMETER 200 mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C/φ
TOPSOIL	1		0.2m					
SOFT dark brown sandy silty CLAY	2		1.2m	13				
Fine to medium yellow and green SAND	3							
	4		2.0m					
LOOSE fine to medium brown clayey SAND, mixed GRAVEL and COBBLES	W 5		1.0m				10	
STIFF red/brown sandy silty CLAY, some mixed GRAVEL	6			7			1 69	
	7							
	8			7			1 72 (100mm penetration only)	
	9			9				
	10		7.5m				1 110 (50mm penetration only)	
END OF BOREHOLE.								

SAMPLE HOLE.

Note: Ground water was encountered at 1.1 m and was sealed off at 4.0 m below ground level.
Final water level 24 hours after completion ofborehole and withdrawal of casing tubes was 2.4 m below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

BOREHOLE LOG

ST 08 SE/16.

N G R. 0563 3006

BOREHOLE No. 199

FIG. 201

LOCATION S.2070 PENCOED

CLIENT Glamorgan County Council

DRILLING METHOD Shell and Auger

GROUND LEVEL 31·307m AOD.

DATE 3rd-4th October 1970

SCALE 1 : 100

DIAMETER 200 mm

SAMPLE HOLE.

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C / ϕ
TOPSOIL	1		0.2m					
LOOSE fine to medium brown clayey silty SAND	2		1.5m				4	
MODERATELY COMPACT fine to medium brown clayey SAND and mixed GRAVEL	B 3		1.5m				17	
							23	
STIFF red/brown silty CLAY and mixed rounded GRAVEL and COBBLES abundant towards base.	4 5		7.0m				64	
MEDIUM HARD dark red/brown MARLSTONE	6		7·5m				61 (50mm penetration only)	
END OF BOREHOLE.								

Note: Ground water was encountered at 2.5 m and was sealed at 4.6 m below ground level.
Final water level 24 hours after completion of borehole and withdrawal of casing tubes was 2.5 m below ground level

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE
! UNDISTURBED SAMPLE

BOREHOLE LOG

ST 08 SE/17

NGR 0562 8002

BOREHOLE No. 200

FIG. 202

LOCATION S.2070 PENCODED

CLIENT Glamorgan County Council

DRILLING METHOD Shell and Auger

GROUND LEVEL 30·765m AOD.

DATE 5th-6th October, 1970

SCALE 1 : 100

DIAMETER 200 mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	SAMPLE HOLE N	SAMPLE HOLE C/ϕ
TOPSOIL	1		0.2m					
LOOSE fine to medium grey SAND, brown at surface.	2 3 W		2.5m				6	
MODERATELY COMPACT mixed GRAVEL and COBBLES, little mixed grey SAND	4		4.2m				14	
STIFF red/brown silty CLAY and mixed GRAVEL and COBBLES	5		5.4m				68	
Strong dark reddish brown CONGLOMERATE	6 7 8		7.0m				● 75 (No penetration) ● 70 (No penetration)	
	END OF BOREHOLE							

Note: Ground water was encountered at 2.0m and was sealed at 4.3m below ground level.
Final water level 24 hours after completion of borehole was 1.8 m. below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

BOREHOLE LOG

ST 08 SE/18

BOREHOLE No. 201

FIG. 203

LOCATION S.2070 PENCOED

CLIENT Glamorgan County Council

N G R. 0566 8005

DRILLING METHOD Shell and Auger

GROUND LEVEL 31·30m AOD

DATE 14th-16th October 1970

SCALE 1 : 100

DIAMETER 200 mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	C/φ
TOPSOIL	1		0.3m					
SOFT brown loamy CLAY	2		1.0m	24				
LOOSE fine to medium dark brown silty SAND	3						5	
	W		2.6m					
MODERATELY COMPACT mixed GRAVEL and COBBLES, with CLAY	4						25	
	5		4.1m	12				
STIFF red/brown sandy silty CLAY and mixed GRAVEL, abundant in places, some COBBLES.	6						67	
	7						70	
	8							
	9							
	10							
	11		9.0m				85 (200mm penetration only)	
END OF BOREHOLE								

SAMPLE HOLE.

Note: Ground water was encountered at 2.7 m, rose quickly to 2.6 m, and was sealed off by casing tubes at 4.2 m below ground level.
Final water level after completion of hole and withdrawal of casing tubes was 2.1 m below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

BOREHOLE LOG

ST 08 SE 19

NGR 0594 8015

BOREHOLE No. 209

FIG. 210

LOCATION S.2070 PENCOED.

CLIENT Glamorgan County Council.

DRILLING METHOD Shell & Auger.

GROUND LEVEL 37·79m AOD.

DATE 13th-15th December 1970

SCALE 1 : 100

DIAMETER 150 mm

DESCRIPTION OF STRATA	SAMPLE	LEGEND	DEPTH	M/C	L.L.	P.L.	N	SAMPLE HOLE C / φ
TOPSOIL.	1		0·2m					
SOFT brown sandy silty CLAY and mixed GRAVEL, very SANDY at base.	2			21				
	3			15	22	17		35/0°
	W							
	4		2·9m					
Very COMPACT mixed GRAVEL and COBBLES.	5			28			I 50 (150mm penetration)	
	6		3·7m					
STIFF brown sandy silty CLAY, some mixed GRAVEL and COBBLES.	7			12			I 50 (150mm penetration)	
	8			15				
	9		5·0m	14			I 50 (100 mm penetration only)	
	END OF BOREHOLE.							

Note: Ground water was encountered at 2·0m and rose quickly to 1·5m below ground level. Final water level 24 hrs after completion of borehole was 0·5m below ground level.

G.K.N. FOUNDATIONS LTD.,
SITE INVESTIGATION DEPARTMENT

● DISTURBED SAMPLE

RECORD OF BOREHOLE No: 16

Location : BRIDGEND ~ M4
Contract No. : 448
Type of Boring : Shella Auger
Date (started) : 11.6.'69

GRID REF EASTING : 305,580m
Borehole Dia : 0·15m
Casing :
Ground Level : 31·017 m

Time	Depth of Casing	Water Level	SAMPLES Depth	Type	No.	STRATA Legend	Depth	Thickness	DESCRIPTION OF STRATA
								0·46m	TOPSOIL
			0·46m	U	1		0·46m		
			0·91m	D	2				Firm yellow / brown silty sandy
			1·22m	D	3			1·67m	CLAY
			1·98m	U	4		2·13m		
			2·44m	D	5				Med. dense grey clayey
			2·74m	D	6				sandy GRAVEL
			3·05 (N=19)	D	7			2·44m	
			3·81m	D	8				
			4·57m (N=240)	D	9		4·57m		
			4·88	W	11				Hard red sandy silty CLAY,
			5·33m	D	10			1·68m	with boulders
			6·10m (N=180)	D	12		6·25m		
									Borehole complete

REMARKS: Ground water first encountered at 4·27m B.G.L.

SCALE 1 : 50

Foundation Engineering Ltd.

MATERIALS LABORATORY

STONE/191

BOREHOLE LOG

Name of Job: London - South Wales Motorway Route M.4 Capel Llanilterne Pencoed Section alternative southern route

Borehole No. 1 Date started 13th December 1969 Date finished 15th December 1969

Location of Hole: See attached plan

Ground Level: Chainage:

DEPTH From ft.	DEPTH From in.	DEPTH To ft.	DEPTH To in.	THICKNESS ft.	THICKNESS in.	DESCRIPTION OF STRATA	DEPTH BELOW SURFACE ft.	DEPTH BELOW SURFACE in.	NMC	LL	PL	PI	SPT
0	0	0	4	0	4	Peaty TOPSOIL							
0	4	7	0	6	8	SPONGY fibrous PEAT	0	4 to 1	554				
							1	10	650				
							to 7	0					
							6	9					12
							to 7	9					
7	0	11	10	4	10	MODERATELY COMPACT GRAVEL with some sand	10	8					16
							to 11	8					
11	10	35	0	23	2	LOOSE medium SAND	16	0					14*
							to 17	0					

It was found impossible to prevent the sand from rising up inside the casing during drilling. The depth penetrated is the depth of the casing and at 35'0" below ground level there was 12'0" of sand in the casing.

Ground water entered at 7'0" below ground level. At the completion of the drilling the water level was 11'6" below ground level.

* It should be noted that this S.P.T. was carried out when the casing was at a depth of 15'0" below ground level but there was 3'0" of sand inside the casing which could not be cleaned out.

NMC - Natural Moisture Content LL - Liquid Limit

MATERIALS LABORATORY

SHEET 1 of 2

BOREHOLE LOG

192 STONE/192

Name of Job London - South Wales Motorway Route M.4. Capel Llanilterne-Pencoed Section. Alternative Southern Route

Borehole No. 4 Date started 2nd January, 1970 Date finished 6th January, 1970

Location of Hole See attached plan

Ground Level ..... Chainage .....

DEPTH From ft.	DEPTH From in.	DEPTH To ft.	DEPTH To in.	THICKNESS ft.	THICKNESS in.	DESCRIPTION OF STRATA	DEPTH BELOW SURFACE ft.	DEPTH BELOW SURFACE in.	NMC	LL	PL	PI	SPT
0	0	1	0	1	0	Clayey TOPSOIL	0 to 1	0 to 0	25				
1	0	7	0	6	0	FIRM mottled yellowish-brown and light grey sandy clayey SILT with a little gravel	1 to 3	0 to 3	16				
							4 to 6	9 to 3	16	24	16	8	
7	0	12	0	5	0	VERY LOOSE reddish-brown clayey SAND with a trace of gravel	7 to 8	6 to 6					2
							7 to 12	0 to 0		18	14	4	
12	0	14	0	2	0	Reddish-brown slightly silty SAND							
14	0	26	6	12	6	STIFF to VERY STIFF reddish-brown very clayey SILT with occasional small pockets of sand	14 to 15	6 to 6					19
							16 to 17	4 to 10	14	31	16	15	
							21 to 26	6 to 6		26	15	11	
							22 to 23	0 to 0					25

STGTNE/192

MATERIALS LABORATORY

BOREHOLE LOG

Name of Job: London - South Wales Motorway Route M.4. Capel Llanilterne - Pencoed Section. Alternative Southern Route

Borehole No.: 4 Date started: 2nd January, 1970 Date finished: 6th January, 1970

Location of Hole: See attached plan

Ground Level: Chainage:

DEPTH From ft.	DEPTH From in.	DEPTH To ft.	DEPTH To in.	THICKNESS ft.	THICKNESS in.	DESCRIPTION OF STRATA	DEPTH BELOW SURFACE ft.	DEPTH BELOW SURFACE in.	NMC	LL	PL	PI	SPT
26	6	28	6	2	0 penetrated	STIFF mottled dark grey and yellowish-brown organic silty CLAY with a little gravel	26 to 27	6 0		42	28	14	
							27 to 28	6 6					28

Ground water was not observed to enter the borehole down to a depth of 5'6" where drilling ceased that day. The following morning the ground water was found at a depth of 2'6" below ground level. At completion of the drilling the ground water was at a depth of 10'6".

Welsh NRA
Welsh L.S.

ST07/7

NRA (WELSH REGION) BOREHOLE RECORD

93

261+262

ST07SE/11

NATIONAL RIVERS AUTHORITY	
Letter No. 958	
File Ref.	
REC'D 20 JUN 1994	
PASSED TO	
CIRC.	
FILE	
OFFICER	SIGNED

SITE LOCATION DETAILS

Borehole drilled for..... WILLIAM POWELL & SONS

At..... SHEEP COURT FARM

Town..... BONVILSTON

County..... SOUTH GLAMORGAN

National Grid Reference..... ST 0740 7420

Borehole drilled by..... W.B & A.D MORGAN. PRESTEIGNE

Date of drilling..... MAY 1994

CONSTRUCTION DETAILS

Borehole datum description..... GROUND LEVEL
ground level/flange/dip tube/other

Borehole drilled diameter.....	250	mm from	0	to 100	m/depth
		mm from		to	m/depth
		mm from		to	m/depth
Casing material UPVC diameter	103	mm from	0	to	m/depth
SCREEN	103	mm from		to	m/depth
CASING	103	mm from		to	m/depth

TEST PUMPING DETAILS

Water struck at depths of..... metres below datum (mbd)

Rest water level in borehole on completion..... mbd

Pump suction depth..... mbd

Pumping water level..... mbd after hours / days pumping

Pump rate..... l/s:m³/d:gph

Recovery to rest level in..... mins:hrs:days
(from end of pumping)

Date of measurements.....

DRY HOLE TO 100 MTR

Cman/175

ST07|7

GRID REFERENCE : ST 0740 7420

STRATIGRAPHICAL LOG

DESCRIPTION OF STRATA (i.e. colour, grain size & lithology)		THICKNESS M	DEPTH M
OVER BURDEN / RED / SOFT	Weathered till	7	7
LIMESTONE / GREY / HARD	Frars Point Limestone (locally dolomitised)	28	35
LIMESTONE / PINK / HARD		35	70
LIMESTONE / GREY / HARD		10	80
LIMESTONE / THIN BANDS /MUDSTONE/PINK/HARD		10	90

Classified
D Wilson
9/8/94
-Dinantian

:man/175

Welsh NRA
Welsh L.S.

ST07/7A

93

NRA (WELSH REGION) BOREHOLE RECORD

261+262 ST07SE/11

NATIONAL RIVERS AUTHORITY
Letter No. 958
File Ref.
REC'D 20 JUN 1994
PASSED TO
COPY TO CIRC.
FILE
OFFICER | SIGNED

SITE LOCATION DETAILS

Borehole drilled for..... WILLIAM POWELL & SONS

At..... SHEEP COURT FARM

Town..... BONVILSTON

County..... SOUTH GLAMORGAN

National Grid Reference..... ST 0740 7420

Borehole drilled by..... W.B & A.D MORGAN. PRESTEIGNE

Date of drilling..... MAY 1994

CONSTRUCTION DETAILS

Borehole datum description..... GROUND LEVEL
ground level/flange/dip tube/other

Borehole drilled diameter.....		250	mm	from	0	to 100	m/depth
			mm	from		to	m/depth
			mm	from		to	m/depth
Casing material	UPVC diameter	103	mm	from	0	to	m/depth
	SCREEN	103	mm	from		to	m/depth
	CASING	103	mm	from		to	m/depth

TEST PUMPING DETAILS

Water struck at depths of..... metres below datum (mbd)

Rest water level in borehole on completion..... mbd

Pump suction depth..... mbd

Pumping water level..... mbd after hours / days pumping

Pump rate..... l/s:m³/d:gph

Recovery to rest level in..... mins:hrs:days
(from end of pumping)

Date of measurements..... DRY HOLE TO 100 MTR

for Completely dry borehole to entire 90m depth

Cman/175

ST07/7A

GRID REFERENCE : ST 0740 7420

STRATIGRAPHICAL LOG

DESCRIPTION OF STRATA (i.e. colour, grain size & lithology)		THICKNESS M	DEPTH M
OVER BURDEN / RED / SOFT	WEATHERED TILL	7	7
LIMESTONE / GREY / HARD	FRARS POINT LIMESTONE - LOCALLY DOLOMITIZED (DINANTIAN)	28	35
LIMESTONE / PINK / HARD		35	70
LIMESTONE / GREY / HARD		10	80
LIMESTONE / THIN BANDS /MUDSTONE/PINK/HARD		10	90

CLASSIFIED D. WILSON
9/8/94
man/175

Welsh NRA
Welsh LS.

ST07/7B

National Rivers Authority
..... Region
BOREHOLE RECORD

NRA No. L2.14/94(SE38)

261+262 ST07SE/12

A. SITE DETAILS

Borehole drilled for	William Powell & Sons
Location	Sheepcourt Farm, Cottrell Park, Bonvilston
NGR (8 fig.)	ST0738 7420 — Please attach site plan
Ground Level (if known) ..	
Drilling Company	Towy Valley Plant
Date of drilling	Commenced: 14/2/95 Completed: 17/2/95

B. CONSTRUCTION DETAILS

Borehole datum (if not ground level)..... Top Of Pipe — above / m below GL
(point from which all measurements of depth are taken eg flange, edge of chamber, etc)

Borehole drilled diameter ..165..mm ____mm from 0 to 4m m/depth

113 mm ____mm from 4 to 150 m/depth

____mm from ____ to ____ m/depth

Casing material Plastic diameter 165 mm from 0 to 4 m/depth
and type (eg plain steel, plastic slotted)

Plastic Solid diameter 113 mm from 4 to 130 m/depth

PlasticSlotted diameter 113 mm from 130 to 150 m/depth

____ diameter ____mm from ____ to ____ m/depth

Grouting details .....

Water struck at ..120..... ____ m (depth below datum - mbd)

150 ____ m (depth below datum - mbd)

Rest water Level on completion ..... ____ mbd

C. TEST PUMPING SUMMARY (Please supply full details on Forms WR-39)

Test Pumping Datum Not done as Yet — above / m below borehole datum (mbd)
(if different from borehole datum)

Pump Suction Depth ..... ____ mbd

Water Level (Start of Test) ..... ____ mbd

Water Level (End of Test) ..... ____ mbd

Pumping rate ..... ____ m^3/d : l/s

for ____ days/hours

Recovery to ..... ____ mbd in ____ mins : hrs : days
(from end of pumping)

Date(s) of measurements ..... ____

Please Supply Chemical Analysis If Available

Forms/85

RETURN TO N.R.A.

FORM WR-39/3

ST07/7B

National River Authority
Welsh Region
PUMPING TEST DATA

OBSERVED SOURCE

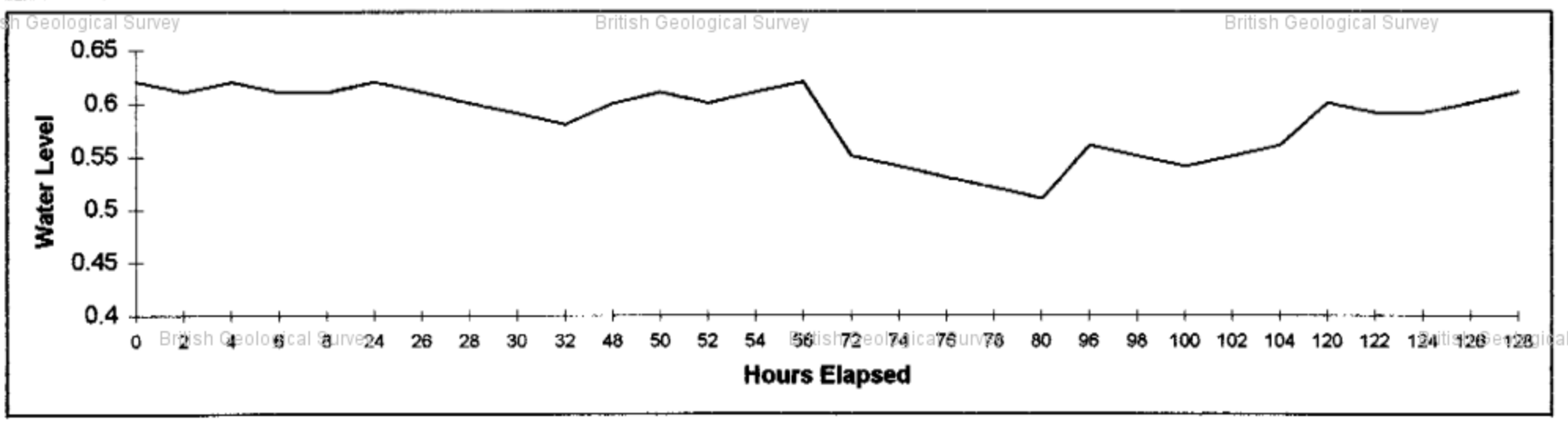
CONSENT NO.	SE/38 REVISION B
Pumping test at	COTTRELL PARK
NGR	ST 0738 7420
Observation from	COTTRELL LODGE
NGR	ST 0795 7421

Description of datum point from which measurements were made (e.g. ground level, flange, dip tube/other)

GROUND LEVEL

Height above ground level (meters):

Date	Time	Hours Elapsed	Depth of Water M	Change in Water Level		Comments
04.01.96	9.15	0	0.62	0		Dry
04.01.96	11.15	2	0.61	0.01		Dry
04.01.96	13.15	4	0.62	-0.01		Dry
04.01.96	15.15	6	0.61	0.01		Dry
04.01.96	17.15	8	0.61	0		Dry
05.01.96	9.15	24	0.62	-0.01		Dry
05.01.96	11.15	26	0.61	0.01		Light Rain
05.01.96	13.15	28	0.6	0.01		Light Rain
05.01.96	15.15	30	0.59	0.01		Dry
05.01.96	17.15	32	0.58	0.01		Dry
06.01.96	9.15	48	0.6	-0.02		Dry
06.01.96	11.15	50	0.61	-0.01		Light Rain
06.01.96	13.15	52	0.6	0.01		Light Rain
06.01.96	15.15	54	0.61	-0.01		Dry
06.01.96	17.15	56	0.62	-0.01		Dry
07.01.96	9.15	72	0.55	0.07		Heavy Rain
07.01.96	11.15	74	0.54	0.01		Heavy Rain
07.01.96	13.15	76	0.53	0.01		Heavy Rain
07.01.96	15.15	78	0.52	0.01		Medium Rain
07.01.96	17.15	80	0.51	0.01		Medium Rain
08.01.96	9.15	96	0.56	-0.05		Medium Rain
08.01.96	11.15	98	0.55	0.01		Medium Rain
08.01.96	13.15	100	0.54	0.01		Medium Rain
08.01.97	15.15	102	0.55	-0.01		Medium Rain
08.01.96	17.15	104	0.56	-0.02		Medium Rain
09.01.96	9.15	120	0.6	-0.04		Dry
09.01.96	11.15	122	0.59	0.01		Dry
09.01.96	13.15	124	0.59	0		Dry
09.01.96	15.15	126	0.6	-0.01		Dry
09.01.96	17.15	128	0.61	-0.01		Dry



ST07/7B

FORM WR-39/3

National River Authority
Welsh Region
PUMPING TEST DATA

OBSERVED SOURCE

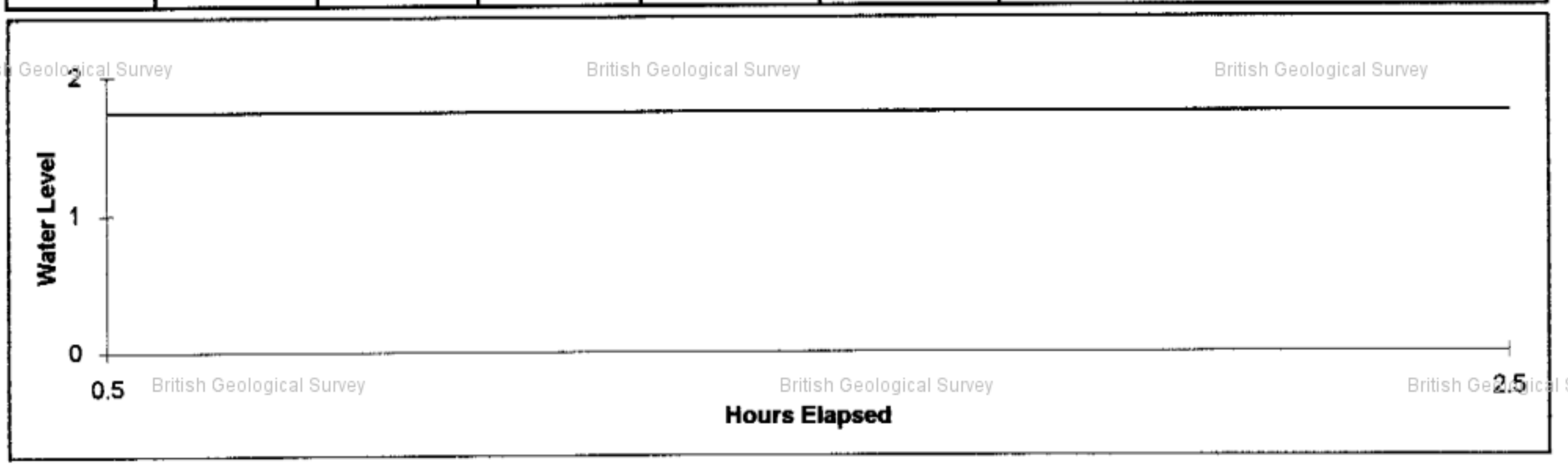
CONSENT NO.	SE/38 REVISION B
Pumping test at	COTTRELL PARK
NGR	ST 0738 7420
Observation from	Gardener's Cottage
NGR	ST 0762 7480

Description of datum point from which measurements were made (e.g. ground level, flange, dip tube/other)

GROUND LEVEL

Height above ground level (meters):

Date	Time	Hours Elapsed	Depth of Water M	Change in Water Level		Comments
04.01.96	9.30	0.5	1.74	0		Dry
04.01.96	11.30	2.5	1.74	0		Well in fact a tank to catch surface
						water off Gardener's Cottage -
						no further dipping necessary



ST07/7B

ST07 SE/12

Towy Valley Plant Ltd.

Water Well Drilling

Brynhyfryd,
Bronwydd Arms,
Carmarthen,
Dyfed. SA33 6HT
Tel / Fax: (0267) 236700
Mobile (0831) 450270 / 381912

DRILLERS BOREHOLE LOG

Contract No.

Rig H,E

Driller H JONES

Date

Site SHEEP COURT FARM
COTTRELL PARK
BONVILSTON.

CASING USED

Size	165		113
Depth to	4M		150M

WATER STRIKES

Depth	110M	150M
Inflow (Fast Med Seepage)	MED	FAST

WATER LEVELS

Borehole depth		
Casing depth solid	130M	
Casing depth slotted	20M	

Borehole No.

Borehole Dia. 160

Type of flush AIR

REMARKS

Strata Description	Strata From	Strata To
RED Soil	0	-8
SHALE	-8	3M
RED SAND STONE	3M	10M
BROWN SAND STONE	10M	50M
LIME STONE	50M	100M
LIME STONE	100M	150M

SIGNED (Driller) H Jones

SIGNED (for Client)

ST07/7B

ST07 SE/12

M WR-38 (cont.)

NRA No.	L2.14/94(SE38)

(Please Type)

NGR (8fig) ST..... 073 8 7420

D. STRATA LOG

Geological Classification (BGS only)	Description of strata	Thickness m	Depth m
	Red Soil	0.8	0.8
	Shale	2.2	3.0
	Red Sand Stone	7m	10.0
	Brown Sand Stone	40.0	50.0
	Limestone	50.0	100.0
	Limestone	50.0	150.0
	(continue on separate page if necessary)		
	Other Comments (eg gas encountered, saline water intercepted, etc)		

FOR OFFICIAL USE ONLY

FILE ..... CONSENT NO ..... BGS REF NO .....
LICENCE NO ..... USE OF BH .....

Welsh NRA
Welsh HS.

ST07/7B

National Rivers Authority
..... Region
BOREHOLE RECORD

NRA No. L2.14/94(SE38)

261+262 ST07SE

A. SITE DETAILS

Borehole drilled for ..... William Powell & Sons

Location ..... Sheepcourt Farm, Cottrell Park, Bonvilston

NGR (8 fig.) ST0738 7420 Please attach site plan

Ground Level (if known) ..

Drilling Company ..... Towy Valley Plant

Date of drilling ..... Commenced: 14/2/95 Completed: 17/2/95

B. CONSTRUCTION DETAILS

Borehole datum (if not ground level)..... ~~Top Of Pipe~~ above / m below GL
(point from which all measurements of depth are taken eg flange, edge of chamber, etc)

Borehole drilled diameter ..165...mm ____mm from 0 to 4m m/depth

113 mm ____mm from 4 to 150 m/depth

____mm from ____ to ____ m/depth

Casing material Plastic diameter 165 mm from 0 to 4 m/depth
and type (eg plain steel, plastic slotted)

Plastic Solid diameter 113 mm from 4 to 130 m/depth

PlasticSlotted diameter 113 mm from 130 to 150 m/depth

____ diameter ____mm from ____ to ____ m/depth

Grouting details .....

Water struck at ..120..... ____ m (depth below datum - mbd)

150 ____ m (depth below datum - mbd)

Rest water Level on completion ..... ____ mbd

C. TEST PUMPING SUMMARY (Please supply full details on Forms WR-39)

Test Pumping Datum (if different from borehole datum) Not done as Yet above / m below borehole datum (mbd)

Pump Suction Depth ..... ____ mbd

Water Level (Start of Test) ..... ____ mbd

Water Level (End of Test) ..... ____ mbd

Pumping rate ..... ____ m^3/d : l/s

for ____ days/hours

Recovery to ..... ____mbd in ____ mins : hrs : days
(from end of pumping)

Date(s) of measurements .....

Please Supply Chemical Analysis If Available

Forms/85

RETURN TO N.R.A.

ST07/7B

Towy Valley Plant Ltd.

Water Well Drilling

Brynhyfryd,
Bronwydd Arms,
Carmarthen,
Dyfed. SA33 6HT
Tel / Fax: (0267) 236700
Mobile (0831) 450270 / 381912

DRILLERS BOREHOLE LOG

Contract No.
Rig H.E
Driller H JONES
Date

Site SHEEP COURT FARM
COTTRELL PARK
BONVILSTON.

CASING USED

Size	165		113
Depth to	4M		150M

WATER STRIKES

Depth	110M	150M
Inflow (Fast Med Seepage)	MED	FAST

WATER LEVELS

Borehole depth	
Casing depth solid	130M
Casing depth slotted	20M

Borehole No.
Borehole Dia. 160
Type of flush AIR
REMARKS

Strata Description	Strata From	Strata To
RED Soil	0	-8
SHALE	-8	3M
RED SAND STONE	3M	10M
BROWN SAND STONE	10M	50M
LIME STONE	50M	100M
LIME STONE	100M	150M

SIGNED (Driller) H Jones
SIGNED (for Client)

ST07/7B

M WR-38 (cont.)

NRA No.	L2.14/94(SE38)

(Please Type)

NGR (8fig) ST.....|073| 8 7420

D. STRATA LOG

Geological Classification	Description of strata	Thickness	Depth
(BGS only)		m	m
	Red Soil	0.8	0.8
	Shale	2.2	3.0
	Red Sand Stone	7m	10.0
	Brown Sand Stone	40.0	50.0
	Limestone	50.0	100.0
	Limestone	50.0	150.0
	(continue on separate page if necessary)		
	Other Comments (eg gas encountered, saline water intercepted, etc)		

FOR OFFICIAL USE ONLY

FILE ..... CONSENT NO ..... BGS REF NO .....

LICENCE NO ..... USE OF BH .....

ST07/7B

FORM WR-39/2

National River Authority
Welsh Region
PUMPING TEST DATA

CONSTANT RATE PUMPING TEST - RECOVERY

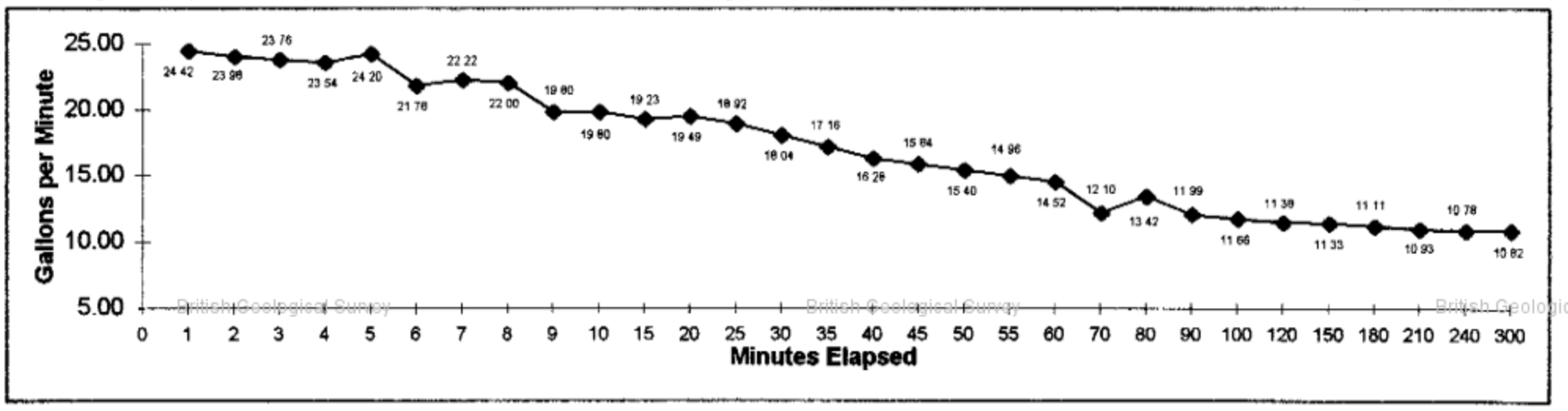
CONSENT NO.	SE/38 REVISION B
Pumping test at	COTTRELL PARK
NGR	ST 0738 7420
Observation from	BOREHOLE
NGR	ST 0738 7420

Description of datum point from which measurements were made (e.g. ground level, flange, dip tube/other)

GROUND LEVEL

Height above ground level (meters):

Date	Time	Minutes Elapsed	Depth of Water M	Drawdown Cu Meters	Meter Reading	Comments
04.01.96	9.00	0	11	0	4816.935	Dry all Day
04.01.96	9.01	1		0.111	4817.046	Dry all Day
04.01.96	9.02	2		0.109	4817.155	Dry all Day
04.01.96	9.03	3	20	0.108	4817.263	Dry all Day
04.01.96	9.04	4		0.107	4817.37	Dry all Day
04.01.96	9.05	5		0.11	4817.48	Dry all Day
04.01.96	9.06	6		0.099	4817.579	Dry all Day
04.01.96	9.07	7	30	0.101	4817.68	Dry all Day
04.01.96	9.08	8		0.1	4817.78	Dry all Day
04.01.96	9.09	9		0.09	4817.87	Dry all Day
04.01.96	9.10	10	38	0.09	4817.96	Dry all Day
04.01.96	9.15	15		0.437	4818.397	Dry all Day
04.01.96	9.20	20		0.443	4818.84	Dry all Day
04.01.96	9.25	25	77	0.43	4819.27	Dry all Day
04.01.96	9.30	30		0.41	4819.68	Dry all Day
04.01.96	9.35	35	80	0.39	4820.07	Dry all Day
04.01.96	9.40	40		0.37	4820.44	Dry all Day
04.01.96	9.45	45	83	0.36	4820.8	Dry all Day
04.01.96	9.50	50		0.35	4821.15	Dry all Day
04.01.96	9.55	55		0.34	4821.49	Dry all Day
04.01.96	10.00	60	92	0.33	4821.82	Dry all Day
04.01.96	10.10	70	96	0.55	4822.37	Dry all Day
04.01.96	10.20	80	100	0.61	4822.98	Dry all Day
04.01.96	10.30	90	101	0.545	4823.525	Dry all Day
04.01.96	10.40	100	103	0.53	4824.055	Dry all Day
04.01.96	11.00	120	106	1.035	4825.09	Dry all Day
04.01.96	11.30	150	119	1.545	4826.635	Dry all Day
04.01.96	12.00	180	121	1.515	4828.15	Dry all Day
04.01.96	12.30	210	121	1.49	4829.64	Dry all Day
04.01.96	13.00	240	121	1.47	4831.11	Dry all Day
04.01.96	14.00	300	121	2.95	4834.06	Dry all Day



ST07/7B

FORM WR-39/4

National River Authority
Welsh Region
PUMPING TEST DATA

CONTINUATION SHEET

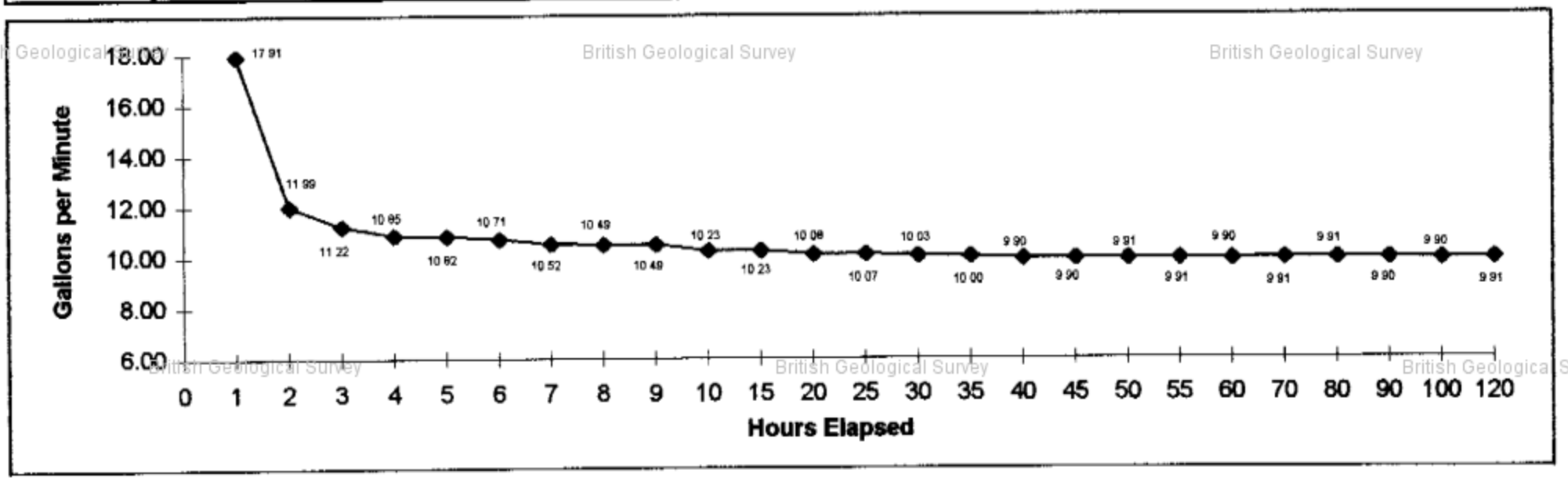
CONSENT NO	SE/38 REVISION B
Pumping test at	COTTRELL PARK
NGR	ST 0738 7420
Observation from	BOREHOLE
NGR	ST 0738 7420

Description of datum point from which measurements were made (e.g. ground level, flange, dip tube/other)

GROUND LEVEL

Height above ground level (meters):

Date	Time	Hours Elapsed	Depth of Water M	Drawdown Cu Meters	Meter Reading	Comments
04.01.96	9.00	0	11	0	4816.935	Dry
04.01.96	10.00	1	92	4.885	4821.82	Dry
04.01.96	11.00	2	106	3.27	4825.09	Dry
04.01.96	12.00	3	121	3.06	4828.15	Dry
04.01.96	13.00	4	121	2.96	4831.11	Dry
04.01.96	14.00	5	121	2.95	4834.06	Dry
04.01.96	15.00	6	121	2.92	4836.98	Dry
04.01.96	16.00	7	121	2.87	4839.85	Dry
04.01.96	17.00	8	121	2.86	4842.71	Dry
04.01.96	18.00	9	121	2.86	4845.57	Dry
04.01.96	19.00	10	121	2.79	4848.36	Dry
04.01.96	24.00	15	121	13.95	4862.31	Dry
05.01.96	5.00	20	121	13.75	4876.06	Light Rain
05.01.96	10.00	25	121	13.735	4889.795	Dry
05.01.96	15.00	30	121	13.675	4903.47	Dry
05.01.96	20.00	35	121	13.63	4917.1	Dry
06.01.96	1.00	40	121	13.505	4930.605	Light Rain
06.01.96	6.00	45	121	13.505	4944.11	Dry
06.01.96	11.00	50	121	13.515	4957.625	Light Rain
06.01.96	16.00	55	121	13.51	4971.135	Dry
06.01.96	21.00	60	121	13.495	4984.63	Dry
07.01.96	7.00	70	121	27.03	5011.66	Heavy Rain
07.01.96	17.00	80	121	27.02	5038.68	Medium Rain
08.01.96	3.00	90	121	27.012	5065.692	Medium Rain
08.01.96	13.00	100	121	26.988	5092.68	Medium Rain
09.01.96	9.00	120	121	54.077	5146.757	Dry



ST07/7B

FORM WR-39/3

National River Authority
Welsh Region
PUMPING TEST DATA

OBSERVED SOURCE

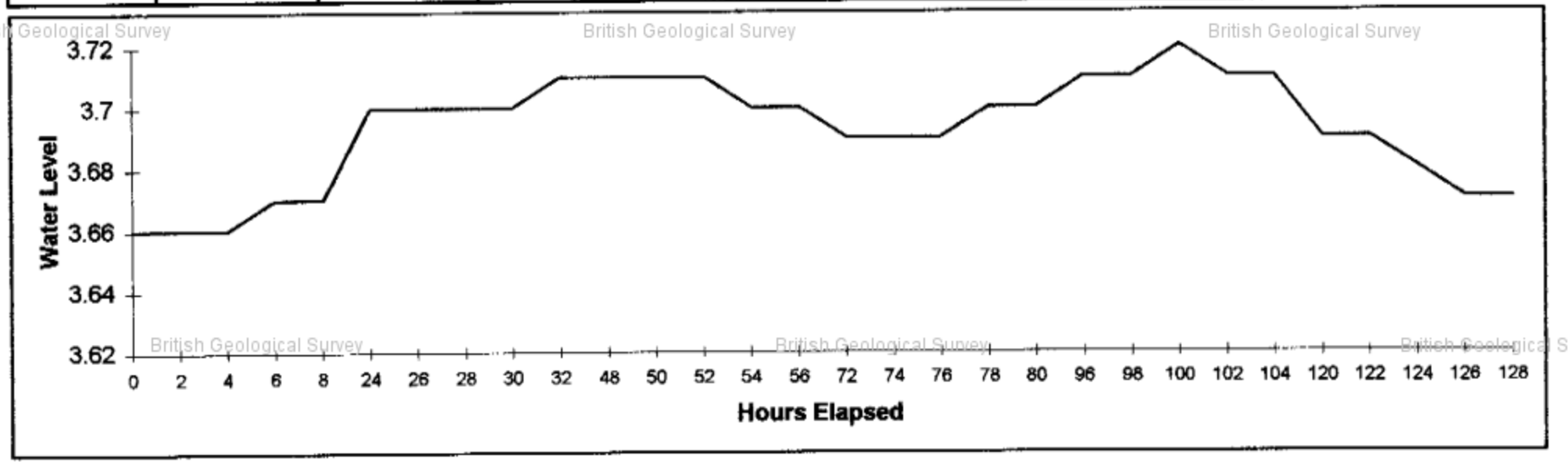
CONSENT NO.	SE/38 REVISION B
Pumping test at	COTTRELL PARK
NGR	ST 0738 7420
Observation from	SHEEPCOURT FARM
NGR	ST 0707 7412

Description of datum point from which measurements were made (e.g. ground level, flange, dip tube/other)

GROUND LEVEL

Height above ground level (meters):

Date	Time	Hours Elapsed	Depth of Water M	Change in Water Level		Comments
04.01.96	9.00	0	3.66	0		Dry
04.01.96	11.00	2	3.66	0		Dry
04.01.96	13.00	4	3.66	0		Dry
04.01.96	15.00	6	3.67	-0.01		Dry
04.01.96	17.00	8	3.67	0		Dry
05.01.96	9.00	24	3.7	-0.03		Dry
05.01.96	11.00	26	3.7	0		Light Rain
05.01.96	13.00	28	3.7	0		Light Rain
05.01.96	15.00	30	3.7	0		Dry
05.01.96	17.00	32	3.71	-0.01		Dry
06.01.96	9.00	48	3.71	0		Dry
06.01.96	11.00	50	3.71	0		Light Rain
06.01.96	13.00	52	3.71	0		Light Rain
06.01.96	15.00	54	3.7	0.01		Dry
06.01.96	17.00	56	3.7	0		Dry
07.01.96	9.00	72	3.69	0.01		Heavy Rain
07.01.96	11.00	74	3.69	0		Heavy Rain
07.01.96	13.00	76	3.69	0		Heavy Rain
07.01.96	15.00	78	3.7	-0.01		Medium Rain
07.01.96	17.00	80	3.7	0		Medium Rain
08.01.96	9.00	96	3.71	-0.01		Medium Rain
08.01.96	11.00	98	3.71	0		Medium Rain
08.01.96	13.00	100	3.72	-0.01		Medium Rain
08.01.96	15.00	102	3.71	0.01		Medium Rain
08.01.97	17.00	104	3.71	0		Medium Rain
09.01.96	9.00	120	3.69	0.02		Dry
09.01.96	11.00	122	3.69	0		Dry
09.01.96	13.00	124	3.68	0.01		Dry
09.01.96	15.00	126	3.67	0.01		Dry
09.01.96	17.00	128	3.67	0		Dry



British Geological Survey
Hydrogeology Group - Wallingford
Logging Record

BGS Registration Number : ST 07 SE 15.

Archive Record Number :

Borehole Name : Sycamore Cross

National Grid Reference : ST 07580 73940

Date Drilled :

Date Visited : 02/03/95

Datum Used : Top Of Casing, 0.40m bGL

OD Elevation (GL) : 105.77m

Drilled Diameter : 200mm (8")

Total Depth (bGL) : 82.98m

Water Level (bGL) : 21.46m

Total Casing Depth (bGL) : 13m

Logs Run :

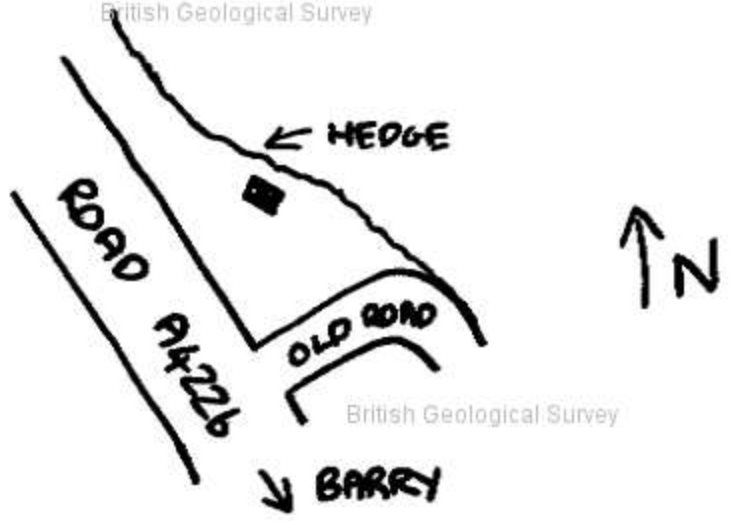
- Conductivity
- Temperature
- Impeller Flow
- Caliper
- Point Resistance
- Spontaneous Potential
- Natural Gamma

Data Manager : D K Gamma

Operator : J C Talbot

Notes : Spontaneous Potential data bad

Site Plan :



Signature and Date :

Talbot 23/3/95

Welsh NRA

FORM WR-38 Welsh LS.

National Rivers Authority
~~Welsh~~.... Region
BOREHOLE RECORD

ST07/9
261+262

NRA No.	

(Please type)

ST07SE

A. SITE DETAILS

Borehole drilled for	NRA (WELSH REGION)
Location	SYCAMORE CROSS
NGR (8 fig.)	0758 7394 ~~ST 0760 7390~~ Please attach site plan
Ground Level (If known) ..	109.7mOD
Drilling Company	WB + AD MORGAN
Date of drilling	Commenced: 10/1/94 Completed: 16/1/94

B. CONSTRUCTION DETAILS

Borehole datum (If not ground level)..... above / m below GL
(point from which all measurements of depth are taken eg flange, edge of chamber, etc)

Borehole drilled diameter ..... 317 mm from 0 to 13 m/depth
203 mm from 13 to 81 m/depth
____ mm from ____ to ____ m/depth

Casing material PLAIN STEEL diameter 203 mm from 0 to 13 m/depth
and type (eg plain steel, plastic slotted)
____ diameter ____ mm from ____ to ____ m/depth
____ diameter ____ mm from ____ to ____ m/depth
____ diameter ____ mm from ____ to ____ m/depth

Grouting details ..... GROUTED 0 - 13m depth

Water struck at ..... 24 m (depth below datum - mbd)
63 and 80 m (depth below datum - mbd)

Rest water Level on completion ..... 18.64 (26/1/94) mbd

C. TEST PUMPING SUMMARY (Please supply full details on Forms WR-39)

Test Pumping Datum (if different from borehole datum) 0.48m above / m below borehole datum (mbd)

Pump Suction Depth ..... 53 mbd

Water Level (Start of Test) ..... 18.64 mbd

Water Level (End of Test) ..... 22.06 mbd

Pumping rate ..... 13.5 m^3/hr m^3/d : l/s

for 240 minutes days/hours

Recovery to ..... 18.94 mbd in 30 mins : ~~hrs : days~~
(from end of pumping)

Date(s) of measurements .....

Please Supply Chemical Analysis If Available

Forms/85

ST07/9

FORM WR-38 (cont.)

NRA No.	

(Please type)

D. STRATA LOG

Geological Classification (BGS only)	Description of strata	Thickness m	Depth m
	RED/BROWN CLAYEY SOIL	2	2
	MODERATELY WEATHERED LIGHT GREY LIMESTONE	11	5 10
	SLIGHTLY WEATHERED → FRESH LIGHT GREY LIMESTONE	13	13
	FRESH LIGHT GREY LIMESTONE	25	20 25
	GREY LIMESTONE WITH FREE CALCITE. BECOMING DARKER WITH DEPTH	47	30 35 40 45
	BLACK LIMESTONE. SOME FREE CALCITE PINK/RED STAINING →	53	50 55
	WEATHERED, BUFF LIMESTONE + AMORPHUS CALCITE INFILL	61	60
	BLACK LIMESTONE RED STAINING → MINOR FREE CALCITE	63	65
	BLACK/RED LIMESTONE, INCREASING RED + CLAY INFILL WITH DEPTH	66	
	LIGHT GREY LIMESTONE WITH MUCH FREE CALCITE BELOW 78 m	70	70
	WEATHERED LIMESTONE WITH BUFF/RED/ ORANGE CLAY INFILL	73	75
	[continue on separate page if necessary]	78	78
		79 81	80

Other Comments (eg gas encountered, saline water intercepted, etc)

FOR OFFICIAL USE ONLY

FILE ..... CONSENT NO ..... BGS REF NO .....

LICENCE NO ..... USE OF BH ..... NGR .....

Forms/85

DRILLING LOG

SITE: SYCAMORE CROSS NRA No:

CONTRACTOR: WB + AD MORGAN TECHNIQUE: DTH HAMMER (AIR FLUSH)

SUPERVISED BY: J E DODDS (GRK [UK] Ltd)

DATE: JANUARY 1994

LOG PREPARED: 19/1/94

ST07/9

PENETRATION RATE (mins/m) 4 8 12 16

BLOW OUT YIELD L/S 2 4 6 8 10

CONSTRUCTION

LOG

COMMENTS

0 Rod | BROWN CLAYEY SOIL

MODERATELY WEATHERED LIGHT GREY LIMESTONE

5

10 SLIGHTLY WEATHERED FRESH LIGHT GREY LIMESTONE

15

DAMP

16/1/94

20 FRESH LIGHT GREY LIMESTONE

0.03 L/S

0.38 L/S

25

GREY LIMESTONE WITH FREE CALCITE. BECOMING DARKER WITH DEPTH

30

35

Gully Oolite

40

45

50 BLACK LIMESTONE. SOME FREE CALCITE

← PINK | RED CHIPS

55

Friars Point Limestone

60 BUFF. WEATHERED LIMESTONE

5 L/S

V. WEATHERED LIMESTONE + AMORPHOUS CALCITE INFILLING

65 ← RED | BLACK CHIPS

BLACK LIMESTONE MINOR FREE CALCITE

70

BLACK | RED LIMESTONE, INCREASING RED AND CLAY INFILL WITH DEPTH

75 LIGHT GREY LIMESTONE

9.5 L/S

80 LIGHT GREY LIMESTONE. MUCH FREE CALCITE WEATHERED LIMESTONE. BUFF | RED | ORANGE CLAY INFILL

Static water level

Wk with date

85

90

95

100

105

110

115

120

FILE: CT|6|06bb6|57

NGR: ST 0767 39

CONSENT: SEE FILE

ELEVATION (GL): 105.77 mAOD

ELEVATION (TOC): mAOD

Welsh NRA
Welsh L.S.

ST07/9

British Geological Survey
Hydrogeology Group - Wallingford
Logging Record

ST07SE

261+262

BGS Registration Number :

Archive Record Number : ST07/9

Borehole Name : Sycamore Cross

National Grid Reference : ST 07580 73940

Date Drilled :

Date Visited : 02/03/95

Datum Used : Top Of Casing, 0.40m bGL

OD Elevation (GL) : 105.77m

Drilled Diameter : 200mm (8")

Total Depth (bGL) : ~~82.98m~~ 81m.

Water Level (bGL) : 21.46m

Total Casing Depth (bGL) : 13m

Logs Run :

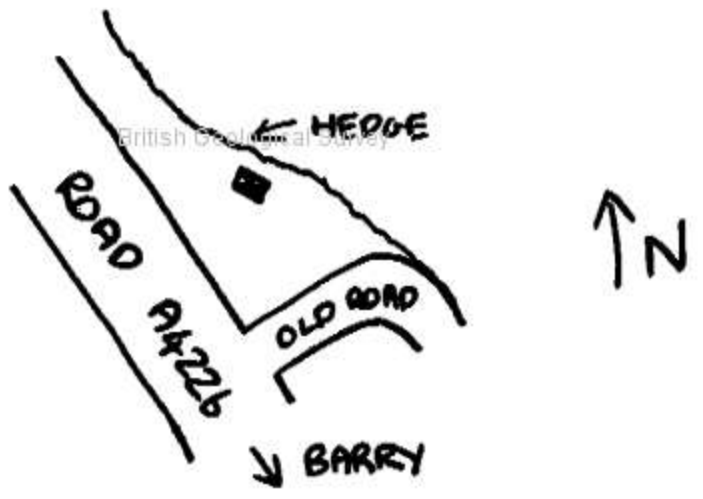
- Conductivity
- Temperature
- Impeller Flow
- Caliper
- Point Resistance
- Spontaneous Potential
- Natural Gamma

Data Manager : D K ~~Gamma~~ Buckley

Operator : J C Talbot

Notes : Spontaneous Potential data bad

Site Plan :



Signature and Date :

Talbot 23/3/95

DATA ACQUISITION SHEET

MJB/D/1966

MJB 1/112

NRA region: Welsh

File Number:

Pump Well Identification:

NRA id No:

BGS (WL) No: ST07/9

NGR: ST 0758 7394

Elevation: 105.77m AoD

Measuring Point: 0.48m AGL (Top of dip tube)

Site Name: Sycamore Cross Bonvilston

Locality: ~~Monkgolum~~ Cowbridge Glamorgan

Well details:

depth of pumping well: 81m

diameter: 0-13m 317mm / 13-81m 203mm

casing details: 0-13m 203mm Plain, grouted
13-81m open hole

☒ observation boreholes

number of obs bhs:

obs bh details:

Aquifer Details:

confined / semi-confined / unconfined confining layer:

Borehole Stratigraphy	from	to	thick	units
Superficial Deposits (Red/Brown clayey soil)	0	2	2	m
(weathered)	2	10	8	m
Carb. Limestone				
Gully oolite penetrated	at 47			m
~~Black~~ Friars Point Limestone (Black)	at 34			m

Highly weathered zones at 61 and 80m

According to log these are the other way round!

Pumping Test Details:

date of test: ~~26~~ 26 Jan 1994

length of test: 4 hours

RWL: 18.64 mbd
max DD after 4 hours of 3.42m

PWL: 22.06mbd

pumping rate: 13.5 m^3/hr

Additional Well Information:

☐ Well Loss Data: B..... C..... Efficiency.....

☐ Well Acidified

☐ Flow Logs

☐ Other Geophysical Logs

☐ Fissure Information: major inflows from.....to.....
from.....to.....
from.....to.....

Aquifer Parameters:

Analysis Type	Transmissivity	Storativity
Jacob { Pumping (0-20 mins); Recovery	74 m²/d 108 m²/d | Better fit. (k = 1.12 m/day)	T increased during ppg after c. 20 min ? developing ?

Confidence:

excellent ☐ ☐ ☑ ☐ ☐ very poor

Notes: "Damp rock" at 18m

water struck at 23m (0.03 l/s)
24m (0.38 l/s)
61m (5 l/s)
81m (9.5 l/s)
} Total (cumulative) flow rates.

DATA ACQUISITION SHEET

LJB/D/999.

S707/16

LJB1/91

S707SE/9

NRA region: Welsh.

File Number: GA/SE/38

Pump Well Identification:

NRA id No:

BGS (WL) No: S707/16

NGR: ST 0742 7423.

Elevation:

Measuring Point:

Site Name: Cottrell Park.

Locality:

Well details:

depth of pumping well: 140m

diameter: 250mm.

casing details:

☐ observation boreholes

number of obs bhs:

obs bh details:

Aquifer Details:

confined / semi-confined / unconfined confining layer:

Borehole Stratigraphy	from	to	thick	units
S+g + clay.	0	10		
Las lmst / mdstone	10	33		m
grey lmst	33	130		
black shale / lmst	130	140.		

Pumping Test Details:

date of test: SE/38

length of test: 5 day.

RWL: 11m bgl.

PWL: dd = 121m.

pumping rate: 144m³/d → 65m³/d.
aw = 65.9m³/d.

Additional Well Information:

☐ Well Loss Data: B..... C..... Efficiency.....

☐ Well Acidified

☐ Flow Logs

☐ Other Geophysical Logs

☐ Fissure Information: major inflows from.....to.....
from.....to.....
from.....to.....

Aquifer Parameters:

Analysis Type	Transmissivity	Storativity
Jacob (dd)	$0.18\ m^2/d$	

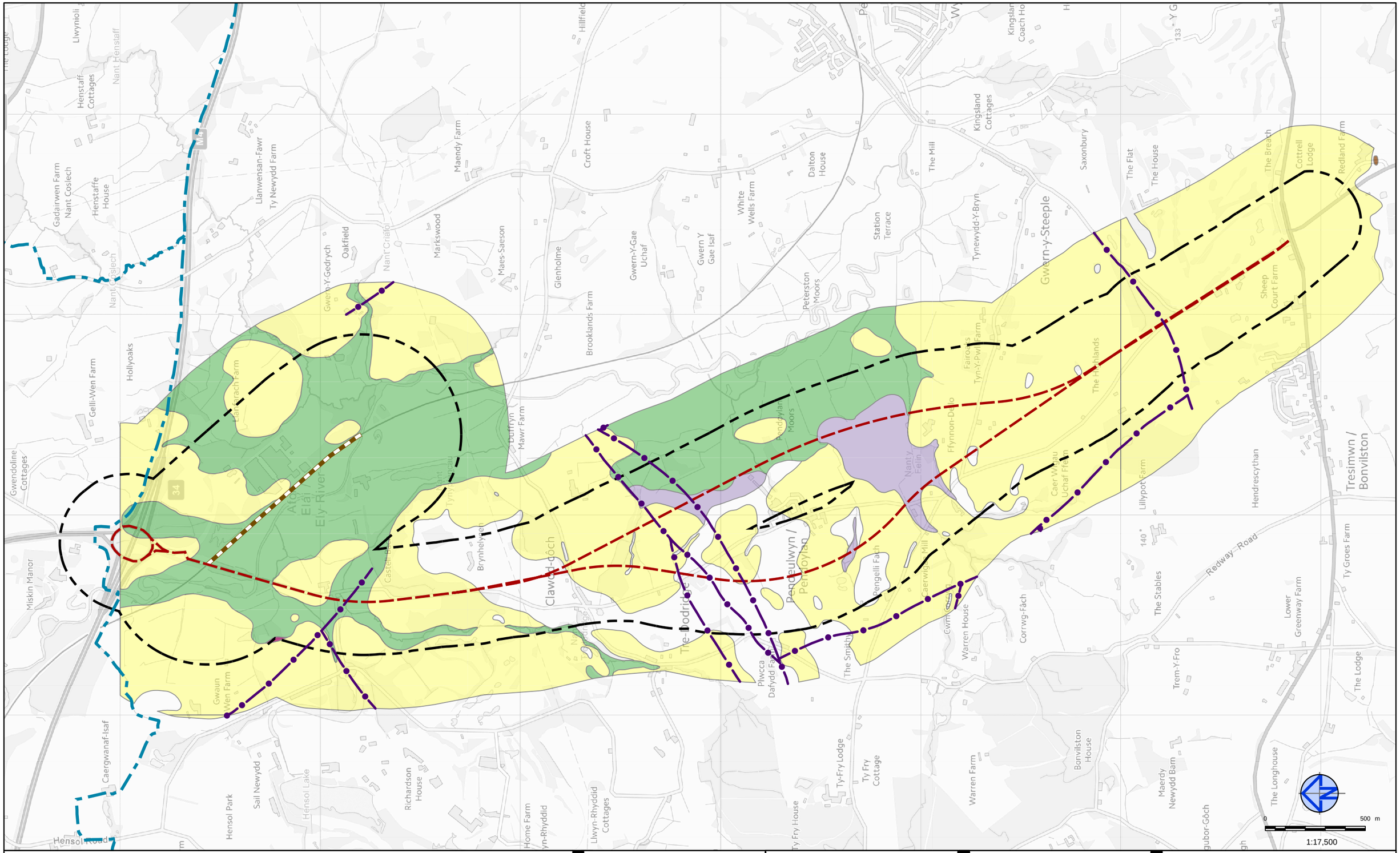
Confidence:

excellent ☐ ☐ ☐ ☐ ☐ very poor

Notes:

Appendix E

Geological Maps



Legend :

- Study area
- Proposed route options
- Passing loop
- Unitary Authority Boundaries
- BGS Geology Faults and Rock Segments

BGS Geology - Artificial

- Made Ground (Undivided) - Artificial Deposit

BGS Geology - Mass Movement

- Landslide Deposit,Unknown/ Unclassified Entry

BGS Geology - Superficial

- Alluvium,Clay, Silt, Sand and Gravel
- Head,Clay, Silt, Sand and Gravel
- Superficial Deposits,Unknown/ Unclassified Entry
- Till, Devensian,Diamicton

Notes :
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Client

Vale of Glamorgan Council

Vale of Glamorgan Council
Civic Offices
Holton Road
Barry
CF63 4RU
01446 700111
www.valeofglamorgan.gov.uk

Site
Address
City

Suitability Description: Issued for information

Designed	M. Azzopardi	Date 12 Apr 2019	Signed
Drawn	M. Azzopardi	Date 12 Apr 2019	Signed
Checked	S. Price	Date 12 Apr 2019	Signed
Approved	L. Walker	Date 12 Apr 2019	Signed
Scale:	17,500	Datum:	AOD
Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10028657

PROJECT:
M4 Junction 34 to A48
WelTAG Stage Two Plus
Environmental Baseline

TITLE:
Ground Conditions
- Artificial and Superficial

ARCADIS Design & Consultancy for natural and built assets

Registered office: Arcadis House, 34 York Way, London N1 9AB
Coordinating office: Arcadis Cymru House, Fortran Road, St Mellons, Cardiff CF3 0EY

www.arcadis.com

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Revision: P1

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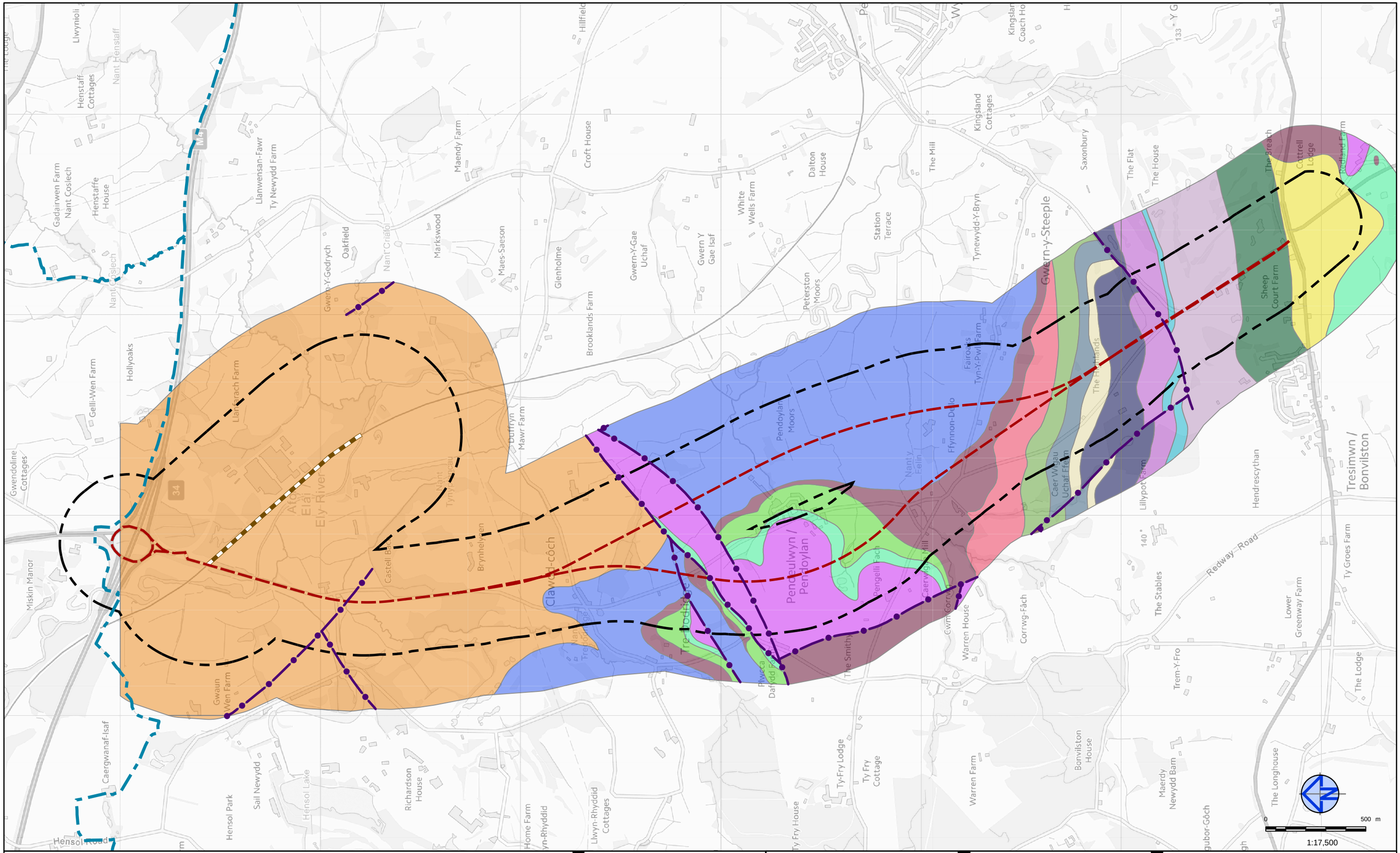

Legend :

- Unitary Authority Boundaries
- BGS Geology Faults and Rock Segments
- Study area
- Proposed route options
- Passing loop

BGS Geology - Bedrock

- Barry Harbour Limestone Formation,Limestone
- Blue Anchor Formation,Mudstone
- Blue Lias Formation (Marginal Facies),Conglomerate
- Brofiscin Oolite Formation,Limestone, Ooidal
- Castell Coch Limestone Formation,Limestone, Ooidal
- Cwmyniscoy Mudstone Formation,Mudstone and Limestone, Interbedded
- Cwrt-Yr-Ala Formation,Sandstone and Siltstone, Interbedded
- Friars Point Limestone Formation,Dolomitised Limestone and Dolomite
- Friars Point Limestone Formation,Limestone
- Gully Oolite Formation,Limestone, Ooidal
- Llanishen Conglomerate,Conglomerate and [Subequal/Subordinate] Sandstone, Interbedded
- Mercia Mudstone Group,Mudstone
- Mercia Mudstone Group (Marginal Facies),Conglomerate
- Penarth Group,Mudstone and Limestone, Interbedded
- Quartz Conglomerate Group (South Wales),Sandstone and Conglomerate, Interbedded
- St Mary's Well Bay Member,Limestone and Mudstone, Interbedded
- Tongwynlais Formation,Limestone and Mudstone, Interbedded

Notes :
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Client

VALE of GLAMORGAN
BRO MORGANNWG

Site
Address
City

Vale of Glamorgan Council
Civic Offices
Holton Road
Barry
CF63 4RU
01446 700111
www.valeofglamorgan.gov.uk

Suitability Description:
Issued for information

Designed	M. Azzopardi	Date 12 Apr 2019	Signed
Drawn	M. Azzopardi	Date 12 Apr 2019	Signed
Checked	S. Price	Date 12 Apr 2019	Signed
Approved	L. Walker	Date 12 Apr 2019	Signed
Scale:	17,500	Datum:	AOD
Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10028657

PROJECT:
M4 Junction 34 to A48
WelTAG Stage Two Plus
Environmental Baseline

TITLE:
Ground Conditions
- Bedrock

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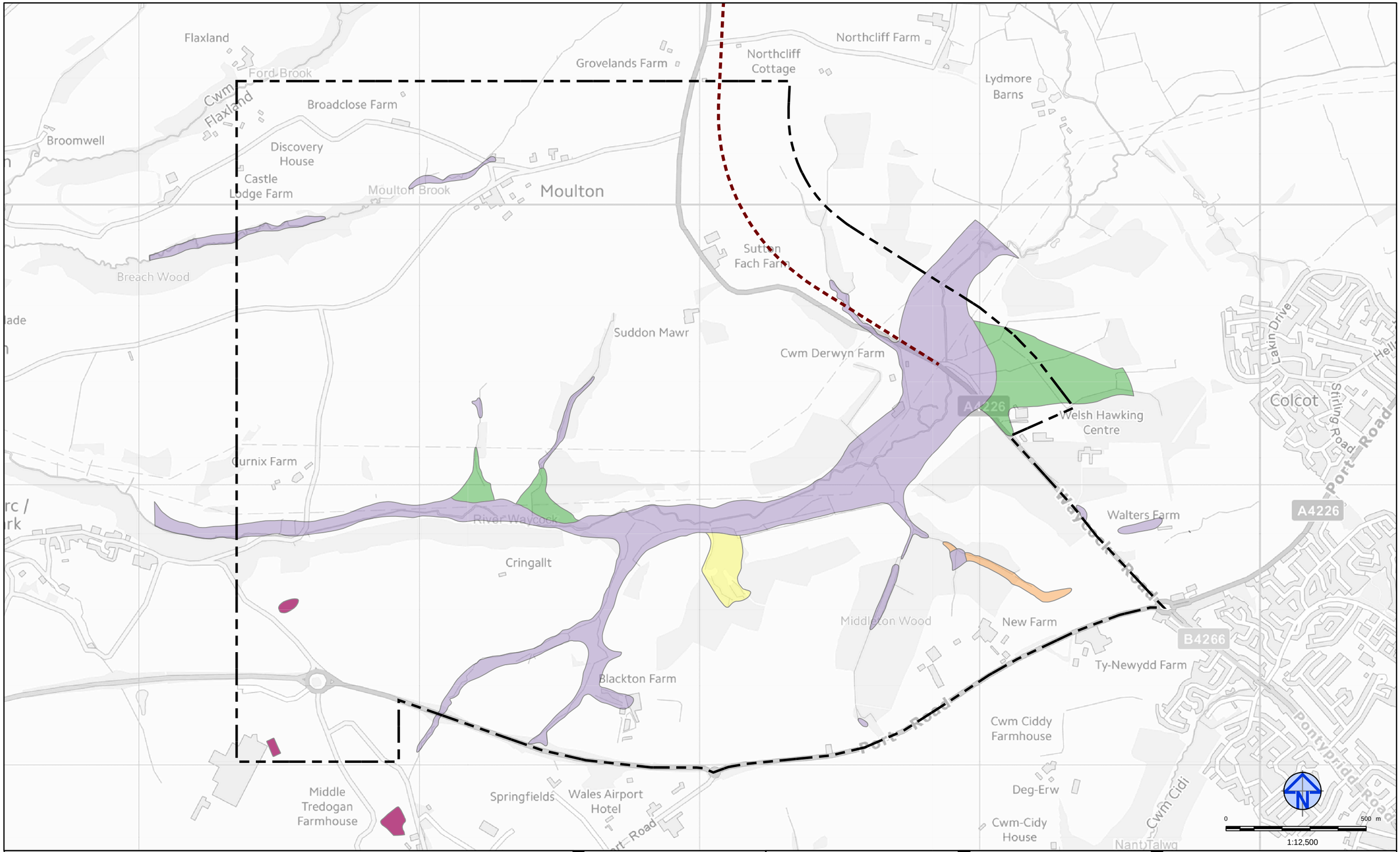

Legend :

- Study area
- A4226 Improvement Scheme

BGS Geology - Artificial

- Made Ground (Undivided),Artificial Deposit

BGS Geology - Superficial

- Alluvial Fan Deposits,Clay, Gravelly [Unlithified Deposits Coding Scheme]
- Alluvium,Clay, Silt, Sand and Gravel
- Head,Clay, Silt, Sand and Gravel
- Tufa,Tufa - Calcareous

Notes :
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Client

Vale of Glamorgan Council

Site
Address
City

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Drawn	M. Azzopardi	Date 12 Apr 2019	Signed
Checked	S. Price	Date 12 Apr 2019	Signed
Approved	L. Walker	Date 12 Apr 2019	Signed
Scale:	12,500	Datum:	AOD
Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10028657

PROJECT:
A4226:
Waycock Cross:
Feasibility Study

TITLE:
Ground Conditions
- Artificial and Superficial

ARCADIS Design & Consultancy for natural and built assets

Registered office: Arcadis House, 34 York Way, London, N1 9AB
Coordinating office: Arcadis Cymru House, Fortran Road, St Mellons, Cardiff, CF3 0EY

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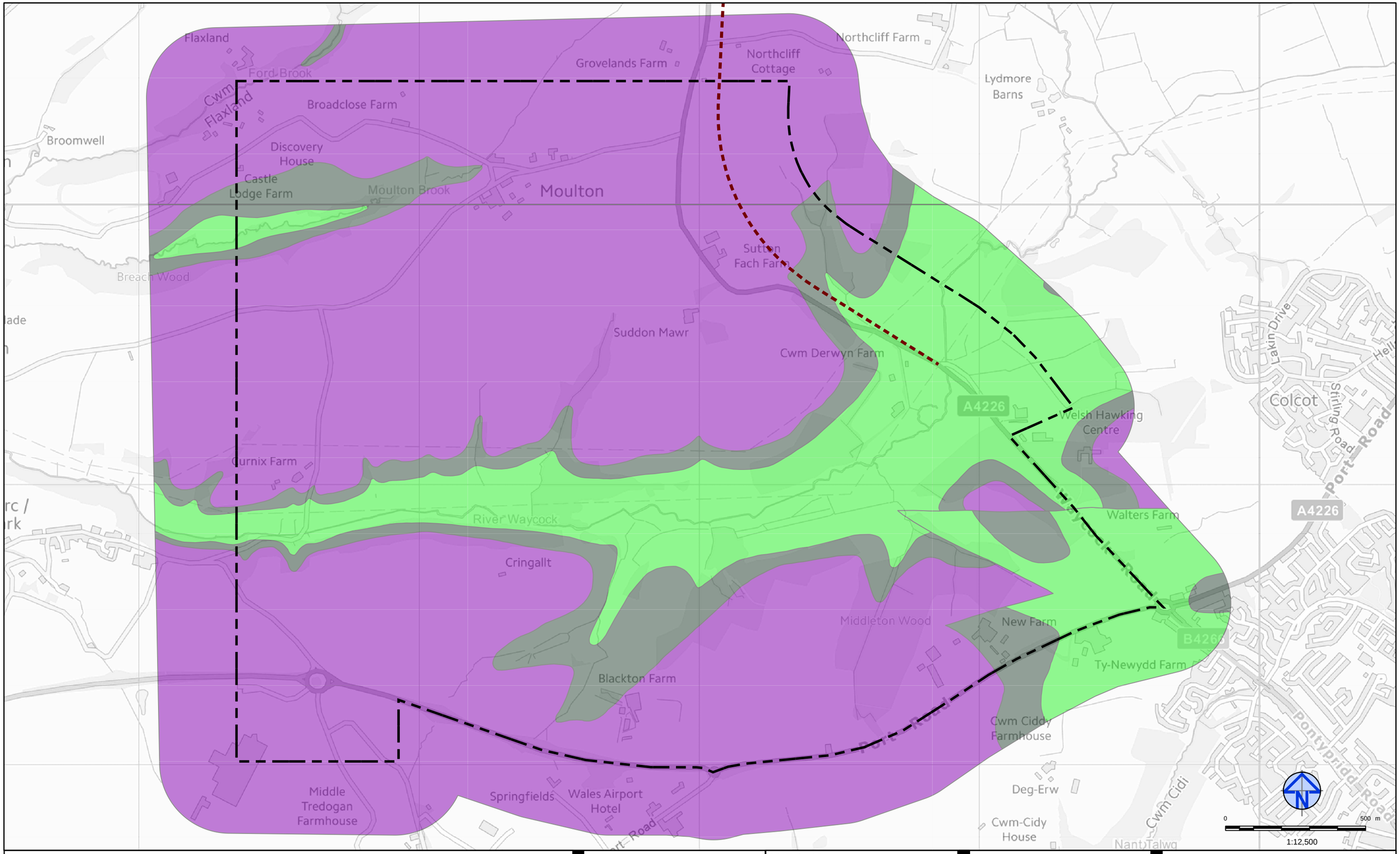
Revision: P1



Legend :

- A4226 Improvement Scheme
- Study area

BGS Geology - Bedrock

- Lavernock Shales Member,Mudstone and Limestone, Interbedded
- Porthkerry Member,Limestone and Mudstone, Interbedded
- St Mary's Well Bay Member,Limestone and Mudstone, Interbedded

Notes :
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OS VectorMap® District 2019

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Client

VALE of GLAMORGAN
BRO MORGANNWG

Site

Address
City

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Scale:	12,500	Datum:	AOD
Original Size:	A3	Grid:	OS
Suitability Code:	S2	Project Number:	10028657

PROJECT:
A4226:
Waycock Cross:
Feasibility Study

TITLE:
Ground Conditions
- Bedrock

ARCADIS Design & Consultancy for natural and built assets

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Revision: P1

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United Kingdom

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APPENDIX R

WebTAG Appraisal Worksheets

TAG Biodiversity Impacts Worksheet | East Alignment

Step 2		Step 3				Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Cardiff Beech Woods Special Area of Conservation (SAC)	One of the largest concentrations of *Asperulo-Fagetum* beech forest in Wales, located approximately 6km north-east of the scheme.	International	Qualifying feature of a internationally designated site so very high importance	4 of 5 qualifying features favourable, 1 feature unfavourable	Very high	Neutral No impact predicted due to distance from site	Neutral
Severn Estuary Ramsar	Annex I habitats (including estuaries, Atlantic salt meadows and mudflats and sandflats not covered by seawater at low tide), its migratory fish populations (including salmon, sea trout and sea lamprey) and for its internationally important assemblage of waterfowl (including gadwall, dunlin and redshank). Located approximately 12km south-east of the	International	Qualifying feature of a internationally designated site so very high importance	Water quality improving. Quality of saltmarsh threatened. Water fowl population status varies but overall assemblage has declined from approx. 81,000 to 66,000 between 1992/93 and	Very high	Neutral No impact predicted due to distance from site	Neutral
Severn Estuary Special Protection Area (SPA)	Internationally important bird populations (including the Annex I species Bewick's swan over winter as well as ringed plover, dunlin, pintail, redshank and curlew) and for regularly supporting at least 20,000 waterfowl. Located approx. 12km south-	International	Qualifying feature of a internationally designated site so very high importance	Water fowl population status varies but overall assemblage has declined from approx. 81,000 to 66,000 between 1992/93 and	Very high	Neutral No impact predicted due to distance from site	Neutral
Severn Estuary SAC	Annex I habitats (including estuaries, Atlantic salt meadows and mudflats and sandflats not covered by seawater at low tide) and Annex II species (including sea lamprey, river lamprey and twaite shad). Located approx. 12km south-east of the	International	Qualifying feature of a internationally designated site so very high importance	Water quality improving. Quality of saltmarsh threatened.	Very high	Neutral No impact predicted due to distance from site	Neutral
Pysgodlyn Mawr Site of Special Scientific Interest (SSSI)	Small area of wetland which supports a wide range of habitats from open water, to reed swamp, to heath and bog, which are very unusual in the lowland Vale area, nationally scarce downy emerald dragonfly and hairy dragonfly, only Glamorgan record for Pillwort. Located 1.5km west of the west	National	Qualifying feature of a nationally designated site so high importance	Habitats static with active management but pillwort lost from site.	High	Neutral No impact predicted due to distance from site	Neutral
Ely Valley SSSI	Supports the largest known population of the nationally scarce plant Monk's-hood. Immediately adjacent to northern point of scheme.	National	Qualifying feature of a nationally designated site so high importance	Static with minimal management	High	Minor negative Potential loss of habitat suitable to support Monk's -hood tbc by further surveys however can be mitigated for by implementing buffer zones around important	Slight adverse
Nant Whitton Woods SSSI	Limestone woodland supporting nationally uncommon Herb-paris and Adder's-tongue fern. Located approx. 2.2km south of the scheme.	National	Qualifying feature of a nationally designated site so high importance	Static with active management	High	Neutral No impact predicted due to distance from site	Neutral
Sites of Interest for Nature Conservations (SINCs)	Various SINCs within 2km of the scheme. The route crosses four SINCs.	County	Designated at Local Authority Level	Unknown, dependent on further information on SINC designations	Medium	Intermediate negative Potential indirect and direct impacts predicted TBC on further information and	Moderate adverse
Ancient Woodland	Broad-leaved woodland. The route passes through four areas of woodland.	Regional	Habitat of principal importance	In decline	High	Major negative Potential direct impacts predicted. Ancient woodland habitat can not be recreated or	Very Large adverse
Tree Preservation Orders (TPO)	Notable individual and groups of trees. No TPOs identified on east route option, west option crosses or passes close to one TPO.	County	Designated at Local Authority Level	Static	Low	Minor negative Potential indirect impacts predicted however can be mitigated for with the implementation of	Slight adverse
Priority Habitats	Running and standing open water, hedgerows, woodland, marshy grassland are crossed or are adjacent to both route options.	County	Potential habitat of principal importance under Environment (Wales) Act 2016	In decline	Up to Medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Other natural habitats	Scrub, tall ruderals, improved grassland, arable fields are present along or adjacent to both route options	Local	Common habitats of some local biodiversity interest	Static	Low	Minor negative Potential habitat loss however can be mitigated for through compensatory planting within the scheme	Slight adverse
Hard structures	Roads, buildings are present along or adjacent to both route options	Local	Common habitats with no nature conservation value (unless bat roost present - see bats)	N/A	Negligible	Minor negative Potential loss of bat roost if present within buildings tbc by further surveys however this could be compensated for by the provision of a	Neutral
Amphibians	Records and potential breeding habitat in ponds within 500m of route options and terrestrial foraging habitat. 63 waterbodies within 500m of east route option and 55 within 500m of west route option.	At least local, dependent on further survey work	Species of principal importance (great crested newt are European Protected Species)	Declining	Up to medium (if great crested newt present)	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Badgers	Potential for setts in woodland and hedgerows and foraging habitat available	At least local, dependent on further survey work	Protected under Protection of Badgers Act 1992	Static / maybe increasing	Low	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Bats	Records and foraging and commuting habitat identified and potential for roosts in mature trees and buildings	At least local, dependent on further survey work	European and UK protected species	Varies with species	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Birds	Records and suitable breeding habitat for both tree and ground nesting species. A variety of suitable foraging habitats.	At least local, dependent on further survey work	Protected during breeding season	Varies with species. Wintering birds are doing well but farmland birds are decreasing.	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Dormouse	Records and suitable habitat within hedgerows and woodland for breeding, feeding and hibernating individuals	At least local, dependent on further survey work	European and UK protected species	In decline but decline may be levelling off	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present

Fish	Fish have been recorded in the River Ely and may be present in the smaller watercourses depending on their characteristics	At least local, dependent on further survey work	Species of principal importance	Varies with species	Low	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Hedgehog	Suitable habitat within hedgerows, woodland and field margins	Local	Species of principal importance	Uncertain but considered to be in decline	Low	Minor negative Potential loss of suitable habitat however this could be mitigated for with compensatory habitat creation	Slight adverse
Invertebrates	Records for notable species and a variety of habitats will suit both aquatic and terrestrial species.	At least local, dependent on further survey work	Species of principal importance	Varies with species, but 21% species listed as Welsh priorities were declining, 25% were improving and 54% showed little change	Low	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Otter	Otter recorded in River Ely and may use the smaller watercourses for commuting and/or dispersing	At least local, dependent on further survey work	European and UK Protected species	Increasing nationally	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Reptiles	Suitable habitat for grass snake (*Natrix helvetica)* , slow-worm (*Anguis fragilis)* and common lizard (*Zootoca vivipara)* within hedgerows and field margins. No potential for adder (*Vipera berus)* identified at this stage.	At least local, dependent on further survey work	UK protected species	Declining	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Water vole	Water vole recorded in the River Ely, smaller watercourses may also be suitable depending on conditions. The River Ely, Nant Tredodridge and Nant-y-Felin which were less shaded by the woodland were considered to be suitable to support water vole.	At least local, dependent on further survey work	UK protected species	Declining	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
EWA Section 7 Plants (Priority Species)	Bluebell (*Hyacinthoides non-scripta*) was recorded in the broadleaved semi-natural woodland areas located at the north and centre of the survey area. Habitats may support some other EWA Section 7 species.	At least local, dependent on further survey work	Species of principal importance	Varies with species, but 53% flowering plants are declining whilst 43% are increasing.	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
WCA Schedule 9 Plants (Non-native Invasive Species)	Japanese Knotweed and Indian Balsam was observed and there is potential for other WCA Schedule 9 species especially along the water courses	Local	Non-Native Invasive Species	Varies with species.	Low	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Other	A number of habitats present within the survey area were assessed as suitable to support the following species; brown hare (*Lepus europaeus*), polecat (*Mustela putorius*), weasel (*Mustela nivalis*), stoat Mustela erminea and harvest mouse (*Micromys minutus*).	Local	Species of principal importance	Declining	Low	Minor negative Potential loss of suitable habitat however this could be mitigated for with compensatory habitat creation	Slight adverse

Reference Sources

Wales Biodiversity Partnership (2016) Species Action Plans for dormouse, otter, water vole, brown hare, hedgehog, reptiles and amphibians. Available online at: http://biodiversitywales.org.uk/Species-in-Wales [accessed online February 2018]
Environment Agency England and Wales (2012) Non-native Species records v1.
Tir Cynnal and Tir Gofal Monitoring and Evaluation Programme: Arable plant survey
UK Butterfly Monitoring Scheme (UKBMS)
Dragonfly records from the British Dragonfly Society's Dragonfly Recording Network for the period up to 2014
UK Ladybird Survey data from iRecord
Bruchidae and Chrysomelidae beetle data from iRecord
Soldierflies and Allies Recording Scheme - data verified via iRecord
Caddisfly (Trichoptera) records from Britain and Ireland, via iRecord
Longhorn beetle (Cerambycidae) data from iRecord
RHS berberis sawfly (Arge berberidis) monitoring Mammal records captured from licence returns submitted to Natural Resources Wales
Tir Cynnal and Tir Gofal Monitoring and Evaluation Programme: Field survey; farm scale survey for noctule, common pipistrelle and soprano pipistrelle
Roost count (Bat Conservation Trust)
Field Survey (Bat Conservation Trust)
Woodland Survey and Roost Count (Bat Conservation Trust)
Tir Cynnal and Tir Gofal Monitoring and Evaluation Programme: Field-scale winter surveys of yellowhammers.
RSPB Big Garden Birdwatch winter sightings in the UK in 2009
Tir Cynnal and Tir Gofal Monitoring and Evaluation Programme: Whole-farm surveys for yellowhammer and curlew.
Ad-hoc Bat Records from Across Wales.
Rare and Protected Species Records Across Wales 1975 to 2012
Mammal records captured from Licence Returns submitted to Natural Resources Wales.
Judge, J. et al (2014) Density and abundance of badger social groups in England and Wales in 2011 -2013. Nature, 4, 3809 doi:10.1038/srep03809
Natural Resources Wales (2016) The State of Natural Resources Report (SoNaRR): Assessment of the Sustainable Management of Natural Resources. Technical Report. Chapter 3. Summary of extent, condition and trends of natural resources and ecosystems in Wales
Natural Resources Wales (2009) The Severn Estuary European Marine Site
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Natural Resources Wales, 2011. Ancient Woodland Inventory 2011 Data Set. Accessed Online in October 2017. http://lle.gov.wales/map#m=-4.83334,51.90838,14&b=europa&l=60
Wildlife in Vale of Glamorgan: A Biodiversity Action Plan (2017) Available from https://www.valeofglamorgan.gov.uk/Documents/Living/Environment/Biodiversity-Action-Plan-Wildlife-in-the-Vale.pdf [accessed online December 2017)
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Highways Agency (2010) Design Manual for Roads and Bridges http://www.dmrb.net/ha/standards/ [Accessed online in December 2017]
Highways Agency (2010) Interim Advice Note 130/10 Ecology and Nature Conservation: Criteria for Impact Assessment
CIEEM (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland. CIEEM, Hampshire
Welsh Assembly Government (2008) Welsh Transport Planning and Appraisal Guidance. WAG, Cardiff
The Hedgerows Regulations, 1997. HMSO
Vale of Glamorgan (2017) Great Crested Newts. Available from: https://www.valeofglamorgan.gov.uk/en/enjoying/Coast-and-Countryside/Habitats-and-Wildlife/Great-Crested-Newts.aspx [accessed online February 208]

Summary Assessment Score

Up to moderate adverse impacts anticipated this stage.

Qualitative Comments

At this stage there is little to differentiate the routes except that the east route may impact one more SINC than the west route, the west route may impact one TPO and the east route impacts more marshy grassland (a priority habitat). Impacts on Ely Valley will depend on the results of surveys for Monk's-hood along the river bank and the exact proposals at this location. It is likely that any Monk's-hood could be translocated to reduce impacts. Aerial photography, ground truthing exercise and a Phase 1 survey identified the potential for both important hedgerows and priority habitats including marshy grassland but this would need to be verified through a Phase 2 Botanical survey. Although impacts on ancient woodland are considered moderate it should be noted that this habitat cannot be recreated and therefore impacts will be permanent. Further data including protected species surveys are required and potential mitigation activities should be recommended in an Ecological Impact Assessment.

TAG Historic Environment Impacts Worksheet | East Alignment

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Form	The historic resource of the study area is characterised predominately by agricultural land, comprising both arable and pasture. There is one Registered Park and Garden (Grade II), two Conservation Areas, five Listed Buildings (2 Grade II* and 3 Grade II) located within 500m of the proposed alignments. No Scheduled Monuments, World Heritage Sites or Registered Battlefields have been identified within 500m of the proposed alignments. The designated heritage assets are mainly associated with domestic buildings. There are multiple archaeological sites (Medieval and Post Medieval features) located within close proximity to the proposed alignments. There is potential for as yet unidentified buried archaeolgical assets to be present within the proposed alignment footprint.	The protection and enhancement of heritage assets is of national concern as set out in the Planning Policy Wales, which sets out to conserve heritage assets in a manner appropriate to their significance.	The Grade II* Listed Building is of National Significance. The Grade II Listed Buildings and the Registered Park and Garden (Grade II) are of Regional Signifcance. There is potential for unidentified buried archaeological features of unknown signifcance.	The Listed Buildings and Registered Parks and Garden are fairly common. The rarity of the remaining 'unknown' buried archaeological resources are judged to be unknown.	The proposed alignments have the potential to have an 'adverse' impact on 'unknown' non-designated heritate assets.The proposed alignments have the potential to directly impact on buried archaeological remains which could result in the permanent and irreverisble loss of assets.
Survival	NYA	The protection and enhancement of heritage assets is of national concern as set out in the Planning Policy Wales, which sets out to conserve heritage assets in a manner appropriate to their significance. The survival of heritage assets is a contributing factor to its significance	The Grade II* Listed Buildings are of National Significance. The Grade II Listed Buildings and the Registered Park and Garden (Grade II) are of Regional Significance. There is potential for unidentified buried archaeological assets of unknown significance	NYA	The proposed alignments would not have an effect on the survival of the designated assets. The proposed alignments may have an adverse effect on the survival of unidentified buried archaeological remains within the route of the scheme, however, this is not quantifable at this stage.
Condition	NYA	The protection and enhancement of heritage assets is of national concern as set out in the Planning Policy Wales, which sets out to conserve heritage assets in a manner of appropriate to their significance. The condition of heritage assets contributes to their signifcance and sensitvity to impacts.	The condition of designated and non-designated assets is important as, if in good condiiton, they can inform our understanding of the history of the region and contribute to the economic wellbeing of the local area.	NYA	NYA
Complexity	Three of the Listed Buildings lie within the Pendoylan Conservation Area. The remaining designated assets (Listed Buildings) are not overly complex and represent residential buildings.	The protection and enhancement of heritage assets is of national concern as set out in the Planning Policy Wales, which sets out to conserve heritage assets in a manner appropriate to their signficance. The complexity of assets, including indvidually complex assets or groups of assets contributes to their significance.	NYA	NYA	NYA
Context	Three of the Listed Buildings lie within the Pendoylan Conservation Area. The remaining designated assets are not overly complex and represent residential buildings.	The context and setting of most cultural heritage assets is a material consideration at the local and national policy level.	The context of Listed Buildings, Conservation Area and the Registered Park and Garden is regionally significant. The context of the archaeological features both 'known' and 'unknown' has not been assessed and the significance is therefore unkown.	NYA	The effect on the context of the Registered Park and Garden and Listed Building is likely to be neutral. The effect on the context of the Conservation Area has the potential to be slight beneficial due to diverting traffic from travelling through the centre of Pendoylan. Due to the lack of assessment on the archaeological features the effect of the alignments on the non-designated archaeological features 'known' and 'unknown' is unknown.
Period	The Church of St Cadoc (Grade II*) is of a Medieval date. The remaining Listed Buildings and the Registered Park and Garden are of a Post Medieval date. Non-designated archaeological features within 500m of the routes are range primarily of Bronze Age to the Medieval period.	Period does not necessarily determine the importance of the historic resource although, it can affect it. Policies within the Local and Regional Plans make reference to the safeguarding and enhancement of cultural heritage assets. The protection of designated assets and areas regardless of their period is of national concern as set out in the Planning Policy Wales.	The range of periods of the designated heritage assets are primarily of a Post Medieval date. The non-designated buried archaeological features within the area are important in understanding the development of the surrounding area on a local and regional level.	NYA	The proposed alignments would not have an affect on the periods of heritage assets and areas.

Reference Sources

Historic Wales, Archwilio , Vale of Glamorgan Interactive Constraints Map, Vale of Glamorgan Website

Step 5 - Summary Assessment Score

Slight adverse

Qualitative Comments

At this stage there is little to differentiate the Eastern and Western Alignments impact on the Historic Environment due to both routes having an identical north and south profile, with the main difference being the alignment of the route to the west or east of Pendoylan.

Of the eastern and western options in Sub-Sections 2 and 3, the conclusion is that the western option (Sub-Section 3) would have the lesser impact on cultural heritage. The eastern option (Sub-Section 2) would impact the medieval strip fields and interrupt a greater number of key views from the Pendoylan Conservation Area. The western option (Sub-Section 3) would impact known non-designated assets (a lime kiln, a quarry and two non-extant field boundaries) but would have less impact on extant historic landscape features and on the setting of designated heritage assets.

Slight adverse impact on the buried archaeological features located along either Alignment. Neutral impacts on the settings of the Listed Buildings and Registered Park and Garden. Slight beneficial impact on the Conservation Area as a result of the Eastern and Western Alignment diverting traffic from the centre of Pendoylan, however there is potential for a Slight adverse impact on the setting of the Conservation Area as a result of the development, potential for this to be mitigated through design.

TAG Landscape Impacts Worksheet | Eastern Alignment						
	Step 2	**Step 3**				**Step 4**
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Impact**
Pattern	Undulating topography, various field sizes, hedges framing fields and roads, large numbers of hedgerow trees and mature woodland pockets	local level	local level - this landscape is typical of the Vale	Medium importance locally	Difficult in short term but repairable in the long term	**Moderate adverse**: field patterns and open spaces will be disrupted, and there will be some loss of hedges. Existing narrow lanes will be interrupted. New road will create cuttings and embankments. Mitigation should reinstate the landscape pattern but this will take time to reduce impacts
Tranquillity	Moderately tranquil landscape with M4 to the north, main rail line nearby, minor roads and PRoWs , some secluded areas, short distance views through the landscape, which is mostly unlit at night.	local level	not rare locally	Medium importance	Reduction in tranquillity , short distance views interrupted	**Minor adverse:** traffic on road will reduce tranquillity. **Mitigation:** Good landscape (screening) and lighting design to minimise night time landscape disruption impact.
Cultural	Historic building settings, fields and hedges, dense and mature woodland pockets	local level	not rare locally	moderate importance	Increased traffic will have negative impact. Loss of woods and hedgerows can be partially replaced in long term	**Slight adverse:** setting of historic buildings will be slightly impacted, loss of hedges and some woodland **Mitigation:** Landscape design along route, retain and plant new hedges.
Landcover	Farmland and , hedges, woodland,	local level	not rare locally	Low importance	Farmland will be lost to the road together with some woodland	**Minor adverse:** loss of fields, fields will be divided and made smaller, loss of hedges and woodland **Mitigation:** Landscape design along route, retain or plant new hedges and woodland habitats
Summary of character	Farmland, hedges and historic buildings in undulating land with attractive views	local level	local level - this landscape is typical of the Vale	Medium importance	Difficult in short term due to time necessary to establish vegetation cover, increased traffic and new feature in undulating land	**Moderate adverse**: road infrastructure will reduce tranquillity, traffic will increase, farmland will be lost, previously unlit landscape will be lit, short distance views will be interrupted. **Additional mitigation:** Landscape design along route, retain or planting of new hedges, design of road sympathetic to local landscape character. Good landscape design (screening) and lighting design to minimise night time landscape impact.
Reference Sources						
Site visit January 2018 and November 2019						
Step 5 - Summary Assessment Score						
Moderate adverse						
Qualitative Comments						
The proposed Eastern option of road infrastructure through undulating land will degrade the existing landscape character and will generate some significant impacts on short distance views from some residential properties, which will also experience negative effects on night time setting. The offline options both have significant impacts and would both therefore have moderate adverse impact overall. This could reduce to minor/slight in the long term with substantial mitigation. In comparison, the online options would have less earthworks and would not be introducing a new feature into the landscape – however the extent of hedgerows and roadside trees lost would be greater so it would still be moderate adverse impact. Again with new tree and hedge planting this could be reduced to minor/slight in the very long term once all the new replacement tree planting has matured. The greatest impacts for all options will be during the construction stage but will be of relatively short duration.						

TAG Journey Quality Impacts Worksheet | Eastern Alignment

Factor	Sub-factor	Better	Neutral	Worse
Traveller Care	Cleanliness			
	Facilities			
	Information			
	Environment			
Travellers' Views	-			
Traveller Stress	Frustration			
	Fear of potential accidents			
	Route uncertainty			

Reference Source

10013270-ARC-XX-XX-DR-HE-0001 - East Alignment
10013270-ARC-XX-XX-DR-HE-0002 - East Alignment with Env Cons
10013270-ARC-XX-XX-DR-HE-0003 - East Alignment with Flood Zones
10013270-ARC-XX-XX-DR-HE-0004 - East Alignment Longsection
20180223_DemFlowDiff_ACVvsACU_2036
DMRB 11.3.9.2 (travellers' views) and 11.3.9.3 (traveller stress)

Summary Assessment Score

High (more than 10,000 users per day affacted).

Qualitative Comments

See the Stage Two Outline Business Case report.

TAG Security Impacts Worksheet | Eastern Alignment

Security Indicator	Relative importance	Without scheme	With scheme
	(High/Medium/Low)	(Poor/Moderate/High)	(Poor/Moderate/High)
Site perimeters	Low	Poor	Moderate
Entrances and exits	n/a	n/a	n/a
Formal surveillance	Low	Poor	Poor
Informal surveillance	High	Poor	Moderate
Landscaping	Medium	Poor	Moderate
Lighting and visibility	Medium	Poor	Moderate
			(High for cyclists/ pedestrians)
Emergency call	Medium	Poor	Poor

Approximate Number of Users Affected

More than 10,000.

Reference Source

10013270-ARC-XX-XX-RP-HE-0001 - M4 J34 - A48 WelTAG Study Stage 2

Summary Assessment Score

Moderate beneficial

Qualitative Comments

The above assessment is applicable to both drivers and cyclists/ pedestrians unless otherwise stated.
See Outline Business Case report.

TAG Severance Impacts Worksheet | Eastern Alignment

Change in Severance	Population Affected			
	PENDOYLAN	CLAWDD COCH		Total Affected
Large negative				
Moderate negative				
Slight negative				
Neutral				
Slight positive	127	35		162
Moderate positive				
Large positive				

Reference Source

Google Maps
10013270-ARC-XX-XX-RP-HE-0001 - M4 J34 - A48 WelTAG Study Stage 2
DMRB 11.3.8

Summary Assessment Score

Slight positive

Qualitative Comments

See Outline Business Case report.

TAG Townscape Impacts Worksheet | Eastern Alignment							
	Step 2	**Step 3**					**Step 4**
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Changes in Without-scheme case**	**Impact**
Layout	The area of townscape is characterised around the compact village of Pendoylan which lies at the approximate centre of the Pendoylan corridor 3km south of the M4 and 3km north of the A48. The residential areas of Pendoylan are laid out around cul de sac roads making them free of through traffic. Pendoylan lies within the Ely Valley and Ridge Slopes Special Landscape Area. There are isolated individual properties located within the surrounding agricultural landscape.	Local scale.	NYA	Locally Important. Pendoylan Conservation Area to be considered as Regionally Important.	Heritage buildings could not be substituted.	Further adverse affects forecast as the traffic volumes along the Pendoylan Corridor strategic network between the M4 Junction 34 and the A48 would continue to increase.	As the proposed Eastern and Western alignment are both linear and by-pass the village of Pendoylan. The Western and Eastern alignment would not result in a significant change in the layout of the townscape. **Neutral effect**
Density and mix	Buildings in the townscape are residential buildings. Residential buildings are predominately located in the compact village of Pendoylan. There are isolated residential buildings within the surrounding landscape, with the surrounding landscape being predominately composed of agricultural land and parks and gardens, which reduce the density of development.	Local scale.	NYA	Locally Important. Pendoylan Conservation Area to be considered as Regionally Important.	Heritage buildings could not be substituted.	Further adverse affects forecast as the traffic volumes along the Pendoylan Corridor strategic network between the M4 Junction 34 and the A48 would continue to increase.	As the proposed Eastern and Western alignment are both linear and by-pass the village of Pendoylan. The Western and Eastern alignment would not result in a significant change in the density and mix of the townscape. **Neutral effect**
Scale	The built up area is predominatly composed of residential housing which is considered of small scale. Within the surrounding area there are isolated properities with large grounds, open agricultural land and recreational areas.	Local scale.	NYA	Locally Important. Pendoylan Conservation Area to be considered as Regionally Important.	Heritage buildings could not be substituted.	Further adverse affects forecast as the traffic volumes along the Pendoylan Corridor strategic network between the M4 Junction 34 and the A48 would continue to increase.	As the proposed Eastern and Western alignment are both linear and by-pass the village of Pendoylan. The Western and Eastern alignment would not result in a significant change in the scale of the townscape. **Neutral effect**
Appearance	The Pendoylan Conservation Area is notable for its roadside stone walls, including the stone retaining wall running along the west side of the main road and surrounding the churchyard. There are small items that add to the area's local distinctiveness (e.g. red telephone box (Grade II listed)). The characteristic historic building materials in the Pendoylan Conservation Area are local limestone and slate. Trees, hedges and other greenery soften the townscape and add to the area's rural appearance.	Local scale.	NYA	Locally Important. Pendoylan Conservation Area to be considered as Regionally Important.	Heritage buildings could not be substituted.	Further adverse affects forecast as the traffic volumes along the Pendoylan Corridor strategic network between the M4 Junction 34 and the A48 would continue to increase.	As the proposed Eastern and Western alignment are both linear and by-pass the village of Pendoylan. The Western and Eastern alignment would not result in a significant change in the appearance of the townscape. **Neutral effect**
Human interaction	Pendoylan village is a mainly residential area bisected by the road that runs through the centre of the village. Amentities include the Pendoylan Church In Wales Primary School to the north of the village, the 'Red Lion' village pub within the centre and St. Cattwg's Church (Grade II* listed). Pendoylan has some benches carefully placed beside open spaces.	Local scale.	NYA	Locally Important. Pendoylan Conservation Area to be considered as Regionally Important.	Heritage buildings could not be substituted.	Further adverse affects forecast as the traffic volumes along the Pendoylan Corridor strategic network between the M4 Junction 34 and the A48 would continue to increase.	As the proposed Eastern and Western alignment are both linear and and by-pass the village of Pendoylan. The Western and Eastern alignment would not result in a significant change in the human interaction of the townscape. **Netural effect**
Cultural	The historical buildings within Pendoylan contribute to the heritage feel of the Pendoylan Conservation Area. The surrounding area has isolated Scheduled Monuments, Listed Buildings and Registered Parks and Gardens within the surrounding agricultural landscape, contributing to the historical heritage feel of the area.	Local scale.	NYA	Locally Important. Pendoylan Conservation Area to be considered as Regionally Important.	Heritage buildings could not be substituted.	Further adverse affects forecast as the traffic volumes along the Pendoylan Corridor strategic network between the M4 Junction 34 and the A48 would continue to increase.	As the proposed Eastern and Western alignment are both linear and by-pass the village of Pendoylan. The Western and Eastern alignment would not result in a significant change in the cultural aspect of the townscape. However, with the alignment by-passing Pendoylan, this would divert traffic away from the village which would enhance its overall heritage feel. **Slight beneficial effect**
Land use	Land use is mainly agricultural land, comprising both arable and pasture. The village of Pendoylan is located along the Pendoylan Corridor, there are a number of hamlets within the surrounding area including Hensol, Tredodridge and Clawdd Coch. There are areas for recreation including a golf course, vineyard and hotel.	Local scale.	NYA	Locally Important. Pendoylan Conservation Area to be considered as Regionally Important.	Heritage buildings could not be substituted.	Further adverse affects forecast as the traffic volumes along the Pendoylan Corridor strategic network between the M4 Junction 34 and the A48 would continue to increase.	As the proposed Eastern and Western alignment are both linear and by-pass the village of Pendoylan. The Western and Eastern alignment would not result in a significant change in the land use of the townscape. **Neutral effect**
Summary of character	The primary features of the townscape are roads and the residential area of Pendoylan Conservation Area and the surrounding hamlets. There are built designated heritage assets within Pendoylan and the surrounding area.	Local scale.	NYA	Locally Important. Pendoylan Conservation Area to be considered as Regionally Important.	Heritage buildings could not be substituted.	Further adverse affects forecast as the traffic volumes along the Pendoylan Corridor strategic network between the M4 Junction 34 and the A48 would continue to increase.	As the proposed Eastern and Western alignment are both linear and by-pass the village of Pendoylan. The Western and Eastern alignment would not result in a significant change in the townscape character. However, with the alignment by-passing Pendoylan, this would divert traffic away from the village which would enhance its overall heritage feel **Slight beneficial effect**
Reference Sources							
Google Earth aerial photography; OS maps; Vale of Glamorgan Local Development Plan Interactive Map (2017), WelTAG Stage Two M4 J34 to A48 Outline Buisness Case Report D01, Vale of Glamorgan - Pendoylan Conservation Area Appraisal and Management Plan (2009)							
Step 5 - Summary Assessment Score							
Neutral to Slight beneficial effect							
Qualitative Comments							
Area assessed; Pendoylan village using the Vale of Glamorgan Pendoylan Conservation Area Appraisal and Management Plan (2009). Both the Eastern and Western alignment utilise the existing strategic network both to the north and south. Both routes by-pass the largest built up area (Pendoylan) and thus is unlikely to have any direct and indirect impacts on the townscape of the village. Either alignment would divert traffic away from Pendoylan by providing a route that would by-pass the village, this would have a beneficial impact on the setting of the village as traffic would be taken away from the rural settlement. This would help in keeping with the heritage feel of the village. Should there be intervisibility of the alignment from Pendoylan this could have adverse impact to the setting of the townscape.							

TAG Water Environment Impacts Worksheet | Eastern Alignment

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitutability	Importance	Magnitude	Significance
Surface Water									
Study area: The proposed development consists of a new road alignment between the M4 J34, in the north, to the A48, in the south. This proposed route option follows an eastern alignment to avoid the town of Pendoylan. The study area consists of a 500m envelope surrounding the new alignment and this study area is entirely contained within the catchment of the River Ely (a designated Main River). A number of tributaries of the Ely, including ordinary watercourses and designated Main Rivers also flow through the study area.	River Ely and tributaries	Water Quality - construction impacts	River Ely, confluence Nant Clun to Allot Gardens (WFD Ref GB109057027260), designated with WFD Bad overall status, from Bad ecological status and Failed chemical status. Unknown quality for smaller watercourses and tributaries but assumed to share similar qualities to the Ely.	Regional	Typical	Not practicable for the River Ely, but is feasible for minor tributaries.	Medium	**Minor Adverse** Construction of the new alignment requires works over and in proximity to the River Ely and its tributaries. After the application of mitigation measures and following best practice guidelines, a *Minor Adverse* magnitude of impact is predicted.	Insignificant
Surface Water Potential Impacts: Construction phase: Pollution (silt, oils, fuels etc…) of surface water. Increase in impermeable land cover causing change to existing infiltration and land drainage patterns, with potential to increase flood risk. Operational phase: Pollution of surface water from accidental spillages and discharges of routine runoff from the highway. New watercourse crossings required (8 No.), with potential for effects on flow conveyance, hydromorphology and flood risk. Also potential for losses of fluvial floodplain storage.		Water Quality - routine runoff		Regional	Typical	Not practicable for the River Ely, but is feasible for minor tributaries.	Medium	Negligible Given drainage design in accordance with best practice a Negligible magnitude of impact is predicted	Insignificant
		Water Quality - accidental spillage		Regional	Typical	Not practicable for the River Ely, but is feasible for minor tributaries.	Medium	**Minor Adverse** Given drainage design in accordance with best practice, the potential for serious pollution incidents occurring would be limited. A *Minor Adverse* magnitude of impact is predicted in the unlikley event of a spillage related	Insignificant
		Flood risk, land drainage and hydromorphology	The Eastern Alignment crosses eight watercourses, consisting of four Main Rivers (including the River Ely) as defined by the NRW Flood Risk Map and four unnamed ordinary watercourses. Areas in proximity to the River Ely and other Main Rivers, in particular around the crossing of the River Ely in the north and areas east of Pendoylan, are generally designated as Flood Zone 3 or 2 (high or medium flood risk). Areas remote from watercourses are generally designated as Flood Zone 1 (low flood risk).	Regional	Typical	Not practicable for the River Ely, some potential for reproviding floodplain storage and minor tributaries	Medium/High	Minor Adverse Following further detailed assessment mitigation measures would be designed to reduce impacts to a Minor Adverse magnitude.	Insignificant / Low Signficance
		Recreation and value to the economy	No commercial fisheries or navigation, limited leisure uses and riverside development	Local	Low	Not practicable for the River Ely, but is feasible for minor tributaries.	Low	**Minor Adverse**	Insignificant

Groundwater									
Groundwater Potential Impacts: Construction phase: Pollution (silt, oils, fuels etc…) of groundwater. Increase in impermeable land cover causing change to existing groundwater recharge patterns. Operation: Pollution of groundwater. Deterioration of the integrity of existing licenced abstractions or derogation of private water supplies due to pollution or dewatering. Increase in impermeable land cover causing change to existing groundwater recharge patterns.	Southeast valleys Southern Devonian Old Red Sandston and Triassic Mercia Mudstone	Water Quality - construction impacts	Southeast Valleys Southern Devonian Old Red Sandstone & Triassic Mercia Mudstone, (WFD reference GB40902G201500), designated with Good overall status, with good quantitative and chemical conditions. Underlying bedrock aquifer designated as Principal and Secondary A/B, with potential for water supply on regional level and an important source of baseflow to watercourses.	Regional	High	Not practicable	Medium	**Minor Adverse** Potential risks associated with construction phase such as entrainment of suspended solids derived from working areas. Following the application of mitigation measures and best practice, including implementation of pollution control measures, a *Minor Adverse* magnitude of impact is predicted.	Insignificant
		Water Quality - routine runoff		Regional	High	Not practicable	Medium	**Negligible** No significant impacts are envisaged following the implementation of best practice drainage design and mitigation measures; a *Negligible* magnitude of impact is therefore predicted.	Insignificant
		Water Quality - accidental spillage		Regional	High	Not practicable	Medium	Minor Adverse The implementation of best practice drainage design and mitigation measures would limit the potential for adverse impacts, but cannot eliminate the potential a spillage related pollution incident; a Minor Adverse magnitude of impact is therefore predicted.	Insignificant
		Water Supply		Regional	High	Not practicable	Medium	**Minor Adverse** The implementation of best practice drainage design and construction phase pollution prevention would limit the potential for adverse impacts on water supplies. A Minor Adverse to Negligible magnitude of impact is therefore predicted.	Insignificant

Reference Sources

Water Watch Wales, Natural Resources Wales (2020),
Natural Resources Wales, Cycle 2 Rivers and Waterbodies WFD Data (2018),
Natural Resources Wales, Flood Risk Map (2018)
MAGIC, Defra (2018),
Department for Transport (DfT) Transport Appraisal Guidance (TAG) Unit A3 - Environmental Impact Appraisal (2017)

Summary Assessment Score

Eastern Alignment - Slight Adverse to Negligible, considered Insignificant overall.

Qualitative Comments

The potential impacts concern a possible accidental spillage, construction phase pollution risks and changes to the land drainage regime in terms of runoff quality and quantity. A construction environmental management plan should be put in place to outline how the risk of pollution of watercourses during construction would be minimised. A suitable drainage design, as well as appropraite watercourse crossings would also be required.
The proposed development is located in proximity to areas at high to medium flood risk, and should be subject to a flood risk and consequences assessment to qualify flood risk and any necessary mitigation measures. The Eastern alignment has closer proximity to the River Ely and its tributaries and floodplain but crosses fewer watercourses than the western option alignment.

TAG Biodiversity Impacts Worksheet | Online Alignments							
Step 2		Step 3				Step 4	Step 5
Area	Description of feature/ attribute	Scale (at which attribute matters)	Importance (of attribute)	Trend (in relation to target)	Biodiversity and earth heritage value	Magnitude of impact	Assessment Score
Cardiff Beech Woods Special Area of Conservation (SAC)	One of the largest concentrations of Asperulo-Fagetum beech forest in Wales, located approximately 6km north-east of the scheme.	International	Qualifying feature of a internationally designated site so very high importance	4 of 5 qualifying features favourable, 1 feature unfavourable	Very high	"Neutral No impact predicted due to distance from site"	Neutral
Severn Estuary Ramsar	Annex I habitats (including estuaries, Atlantic salt meadows and mudflats and sandflats not covered by seawater at low tide), its migratory fish populations (including salmon, sea trout and sea lamprey) and for its internationally important assemblage of waterfowl (including gadwall, dunlin and redshank). Located approximately 12km south-east of the scheme.	International	Qualifying feature of a internationally designated site so very high importance	Water quality improving. Quality of saltmarsh threatened. Water fowl population status varies but overall assemblage has declined from approx. 81,000 to 66,000 between 1992/93 and 2006/7	Very high	"Neutral No impact predicted due to distance from site"	Neutral
Severn Estuary Special Protection Area (SPA)	Internationally important bird populations (including the Annex I species Bewick's swan over winter as well as ringed plover, dunlin, pintail, redshank and curlew) and for regularly supporting at least 20,000 waterfowl. Located approx. 12km south-east of the scheme.	International	Qualifying feature of a internationally designated site so very high importance	Water fowl population status varies but overall assemblage has declined from approx. 81,000 to 66,000 between 1992/93 and 2006/7	Very high	"Neutral No impact predicted due to distance from site"	Neutral
Severn Estuary SAC	Annex I habitats (including estuaries, Atlantic salt meadows and mudflats and sandflats not covered by seawater at low tide) and Annex II species (including sea lamprey, river lamprey and twaite shad). Located approx. 12km south-east of the scheme	International	Qualifying feature of a internationally designated site so very high importance	Water quality improving. Quality of saltmarsh threatened.	Very high	"Neutral No impact predicted due to distance from site"	Neutral
Pysgodlyn Mawr Site of Special Scientific Interest (SSSI)	Small area of wetland which supports a wide range of habitats from open water, to reed swamp, to heath and bog, which are very unusual in the lowland Vale area, nationally scarce downy emerald dragonfly and hairy dragonfly, only Glamorgan record for Pillwort. Located over 1km west of the existing road.	National	Qualifying feature of a nationally designated site so high importance	Habitats static with active management but pillwort lost from site.	High	"Neutral No impact predicted due to distance from site"	Neutral
Ely Valley SSSI	Supports the largest known population of the nationally scarce plant Monk's-hood. Immediately adjacent to northern point of scheme.	National	Qualifying feature of a nationally designated site so high importance	Static with minimal management	High	"Minor negative Potential loss of habitat suitable to support Monk's - hood tbc by further surveys however can be mitigated for by implementing buffer zones around important areas of habitat"	Slight adverse
Nant Whitton Woods SSSI	Limestone woodland supporting nationally uncommon Herb-paris and Adder's-tongue fern. Located approx. 2.2km south of the scheme.	National	Qualifying feature of a nationally designated site so high importance	Static with active management	High	"Neutral No impact predicted due to distance from site"	Neutral
Sites of Interest for Nature Conservations (SINCs)	Various SINCs within 2km of the scheme. The existing road runs adjacent to three SINCs.	County	Designated at Local Authority Level	Unknown, dependent on further information on SINC designations	Medium	"Minor negative Potential indirect and direct impacts predicted TBC on further information and surveys. "	Slight adverse
Ancient Woodland	Broad-leaved woodland. The existing road runs adjacent to three areas of ancient woodland.	Regional	Habitat of principal importance	In decline	High	"Intermediate negative Potential direct impacts predicted. Ancient woodland habitat can not be recreated or substituted. "	Large adverse
Tree Preservation Orders (TPO)	Notable individual and groups of trees. No TPOs identified along existing road.	County	Designated at Local Authority Level	Static	Low	Neutral	Neutral
Priority Habitats	Running and standing open water, hedgerows, woodland, marshy grassland are adjacent to the existing road.	County	Potential habitat of principal importance under Environment (Wales) Act 2016	In decline	Medium	Intermediate adverse for the loss of hedgerow along the route.	Moderate adverse
Other natural habitats	Scrub, tall ruderals, improved grassland, arable fields are present adjacent to the existing road.	Local	Common habitats of some local biodiversity interest	Static	Low	"Minor negative Potential habitat loss however can be mitigated for through compensatory planting within the scheme design"	Slight adverse
Hard structures	Roads, buildings are present along or adjacent to both route options	Local	Common habitats with no nature conservation value (unless bat roost present - see bats)	N/A	Negligible	Neutral as no buildings are due to be demolished by either option.	Neutral
Amphibians	Records and potential breeding habitat in ponds within 500m of existing road and terrestrial foraging habitat along road.	At least local, dependent on further survey work	Species of principal importance (great crested newt are European Protected Species)	Declining	Up to medium (if great crested newt present)	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if GCN present and using hedgerows along route.
Badgers	Potential for setts in woodland and hedgerows and foraging habitat available	At least local, dependent on further survey work	Protected under Protection of Badgers Act 1992	Static / maybe increasing	Low	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if using hedgerows along route for setts.
Bats	Records and foraging and commuting habitat identified and potential for roosts in mature trees and buildings.	At least local, dependent on further survey work	European and UK protected species	Varies with species	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present and using hedgerows and trees along route for commuting, foraging or roosting.
Birds	Records and suitable breeding habitat for both tree and ground nesting species. A variety of suitable foraging habitats.	At least local, dependent on further survey work	Protected during breeding season	Varies with species. Wintering birds are doing well but farmland birds are decreasing.	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if GCN present and using hedgerows and trees along route. Ground nesting birds unlikely to be affected.
Dormouse	Records and suitable habitat within hedgerows and woodland for breeding, feeding and hibernating individuals	At least local, dependent on further survey work	European and UK protected species	In decline but decline may be levelling off	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present and using hedgerows and trees along route.
Fish	Fish have been recorded in the River Ely and may be present in the smaller watercourses depending on their characteristics	At least local, dependent on further survey work	Species of principal importance	Varies with species	Low	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present and watercourses are affected by the road widening.

Hedgehog	Suitable habitat within hedgerows, woodland and field margins	Local	Species of principal importance	Uncertain but considered to be in decline	Low	"Minor negative Potential loss of suitable habitat (hedgerows) however this could be mitigated for with compensatory habitat creation"	Slight adverse
Invertebrates	Records for notable species and a variety of habitats will suit both aquatic and terrestrial species.	At least local, dependent on further survey work	Species of principal importance	Varies with species, but 21% species listed as Welsh priorities were declining, 25% were improving and 54% showed little change	Low	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present due to loss of hedgerow habitat.
Otter	Otter recorded in River Ely and may use the smaller watercourses for commuting and/or dispersing	At least local, dependent on further survey work	European and UK Protected species	Increasing nationally	Up to medium	Minor negative during construction, neutral during operation	Dependent on further survey, likely to be slight adverse if present
Reptiles	Suitable habitat for grass snake (Natrix helvetica), slow-worm (Anguis fragilis) and common lizard (Zootoca vivipara) within hedgerows and field margins. No potential for adder (Vipera berus) identified at this stage.	At least local, dependent on further survey work	UK protected species	Declining	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present due to loss of hedgerow habitat.
Water vole	Water vole recorded in the River Ely, smaller watercourses may also be suitable depending on conditions. The River Ely, Nant Tredodridge and Nant-y-Felin which were less shaded by the woodland were considered to be suitable to support water vole.	At least local, dependent on further survey work	UK protected species	Declining	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
EWA Section 7 Plants (Priority Species)	Bluebell (Hyacinthoides non-scripta) was recorded in the broadleaved semi-natural woodland areas located at the north and centre of the survey area. Habitats may support some other EWA Section 7 species.	At least local, dependent on further survey work	Species of principal importance	Varies with species, but 53% flowering plants are declining whilst 43% are increasing.	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present within hedgerows and woods affected by the widening.
WCA Schedule 9 Plants (Non-native Invasive Species)	Japanese Knotweed and Indian Balsam was observed and there is potential for other WCA Schedule 9 species especially along the water courses.	Local	Non-Native Invasive Species	Varies with species.	Low	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Other	A number of habitats present within the survey area were assessed as suitable to support the following species; brown hare (Lepus europaeus), polecat (Mustela putorius), weasel (Mustela nivalis), stoat Mustela erminea and harvest mouse (Micromys minutus).	Local	Species of principal importance	Declining	Low	"Minor negative Potential loss of suitable habitat however this could be mitigated for with compensatory habitat creation"	Slight adverse
Reference Sources							

"Wales Biodiversity Partnership (2016) Species Action Plans for dormouse, otter, water vole, brown hare, hedgehog, reptiles and amphibians. Available online at: http://biodiversitywales.org.uk/Species-in-Wales [accessed online February 2018] Environment Agency England and Wales (2012) Non-native Species records v1. Tir Cynnal and Tir Gofal Monitoring and Evaluation Programme: Arable plant survey UK Butterfly Monitoring Scheme (UKBMS) Dragonfly records from the British Dragonfly Society's Dragonfly Recording Network for the period up to 2014 UK Ladybird Survey data from iRecord Bruchidae and Chrysomelidae beetle data from iRecord Soldierflies and Allies Recording Scheme - data verified via iRecord Caddisfly (Trichoptera) records from Britain and Ireland, via iRecord Longhorn beetle (Cerambycidae) data from iRecord RHS berberis sawfly (Arge berberidis) monitoring Mammal records captured from licence returns submitted to Natural Resources Wales Tir Cynnal and Tir Gofal Monitoring and Evaluation Programme: Field survey; farm scale survey for noctule, common pipistrelle and soprano pipistrelle Roost count (Bat Conservation Trust) Field Survey (Bat Conservation Trust) Woodland Survey and Roost Count (Bat Conservation Trust) Tir Cynnal and Tir Gofal Monitoring and Evaluation Programme: Field-scale winter surveys of yellowhammers. RSPB Big Garden Birdwatch winter sightings in the UK in 2009 Tir Cynnal and Tir Gofal Monitoring and Evaluation Programme: Whole-farm surveys for yellowhammer and curlew. Ad-hoc Bat Records from Across Wales. Rare and Protected Species Records Across Wales 1975 to 2012 Mammal records captured from Licence Returns submitted to Natural Resources Wales. Judge, J. et al (2014) Density and abundance of badger social groups in England and Wales in 2011 -2013. Nature, 4, 3809 doi:10.1038/srep03809 Natural Resources Wales (2016) The State of Natural Resources Report (SoNaRR): Assessment of the Sustainable Management of Natural Resources. Technical Report. Chapter 3. Summary of extent, condition and trends of natural resources and ecosystems in Wales Natural Resources Wales (2009) The Severn Estuary European Marine Site Natural Resources Wales Nant Whitton Woodland SSSI Your Site and Its Future Natural Resources Wales Ely Valley Woodland SSSI Your Site and Its Future Natural Resources Wales Pysgodlyn Mawr Woodland SSSI Your Site and Its Future MAGIC, 2014: Magic Interactive Mapping Application. Available from http://www.magic.gov.uk/MagicMap.aspx [Accessed online in October 2017] NBN Atlas: National Biodiversity Network. Available from https://nbnatlas.org/ [accessed online in December 2017] Natural Resources Wales, 2011. Ancient Woodland Inventory 2011 Data Set. Accessed Online in October 2017. http://lle.gov.wales/map#fm=-4.83334,51.90838,14&b=europa&l=60 Wildlife in Vale of Glamorgan: A Biodiversity Action Plan (2017) Available from https://www.valeofglamorgan.gov.uk/Documents/Living/Environment/Biodiversity-Action-Plan-Wildlife-in-the-Vale.pdf [accessed online December 2017) Google Maps 2017. Available from https://www.google.co.uk/maps/ [accessed online December 2017] Highways Agency (2010) Design Manual for Roads and Bridges http://www.dmrb.net/ha/standards/ [Accessed online in December 2017] Highways Agency (2010) Interim Advice Note 130/10 Ecology and Nature Conservation: Criteria for Impact Assessment CIEEM (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland. CIEEM, Hampshire Welsh Assembly Government (2008) Welsh Transport Planning and Appraisal Guidance. WAG, Cardiff The Hedgerows Regulations, 1997. HMSO Vale of Glamorgan (2017) Great Crested Newts. Available from: https://www.valeofglamorgan.gov.uk/en/enjoying/Coast-and-Countryside/Habitats-and-Wildlife/Great-Crested-Newts.aspx [accessed online February 208] Strachan, R. (2015) Otter Survey of Wales 2009-2010, Natural Resources Wales "

Summary Assessment Score							

Up to moderate adverse impacts anticipated this stage due to loss of ancient hedgerows.

Qualitative Comments							

The main impact of the proposed widening would be removal of ancient and species rich hedgerows. However, hedgerows can be successfully translocated and re-planted so long term impacts are not anicipated. The online option will have considerably less ecological impact than the offline route options as habitats in the vicinity of the road will already be disturbed by the road and there is less direct habitat loss. Further data including protected species surveys are required and potential mitigation activities should be recommended in an Ecological Impact Assessment.

TAG Historic Environment Impacts Worksheet | Online Alignments

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Form	The historic resource of the study area is characterised predominately by agricultural land, comprising both arable and pasture. There is one Registered Park and Garden (Grade II), two Conservation Areas, five Listed Buildings (2 Grade II* and 3 Grade II) located within 500m of the proposed online options. No Scheduled Monuments, World Heritage Sites or Registered Battlefields have been identified within 500m of the proposed alignments. The designated heritage assets are mainly associated with domestic buildings. There are multiple archaelogical sites (Medieval and Post Medieval features) located within close proximity to the proposed works for both online options. There is potential for as yet unidentified buried archaeolgical assets to be present within the proposed works footprint.	The protection and enhancement of heritage assets is of national concern as set out in the Planning Policy Wales, which sets out to conserve heritage assets in a manner appropriate to their significance.	The Grade II* Listed Building is of National Significance. The Grade II Listed Buildings and the Registered Park and Garden (Grade II) are of Regional Signifcance. There is potential for unidentified buried archaeological features of unknown signifcance.	The Listed Buildings and Registered Parks and Garden are fairly common. The rarity of the remaining 'unknown' buried archaelogical resources are judged to be unknown.	Both the proposed alignments have the potential to have an 'adverse' impact on 'unknown' non-designated heritate assets.The proposed alignments have the potential to directly impact on buried archaelogical remains which could result in the permanent and irreverisble loss of assets. Online Sub Option 1 involves more ground intrusive works which would therefore increase the potential for impact on unknown archaeological remains.
Survival	NYA	The protection and enhancement of heritage assets is of national concern as set out in the Planning Policy Wales, which sets out to conserve heritage assets in a manner appropriate to their significance. The survival of heritage assets is a contributing factor to its significance	The Grade II* Listed Buildings are of National Significance. The Grade II Listed Buildings and the Registered Park and Garden (Grade II) are of Regional Significance. There is potential for unidentified buried archaeological assets of unknown significance	NYA	The proposed alignments would not have an effect on the survival of the designated assets. The proposed alignments may have an adverse effect on the survival of unidentified buried archaelogical remains within the route of the scheme, however, this is not quantifable at this stage.
Condition	NYA	The protection and enhancement of heritage assets is of national concern as set out in the Planning Policy Wales, which sets out to conserve heritage assets in a manner of appropriate to their significance. The condition of heritage assets contributes to their signifcance and sensitvity to impacts.	The condition of designated and non-designated assets is important as, if in good condiiton, they can inform our understanding of the history of the region and contribute to the economic wellbeing of the local area.	NYA	NYA
Complexity	Three of the Listed Buildings lie within the Pendoylan Conservation Area. The remaining designated assets (Listed Buildings) are not overly complex and represent residential buildings.	The protection and enhancement of heritage assets is of national concern as set out in the Planning Policy Wales, which sets out to conserve heritage assets in a manner appropriate to their signficance. The complexity of assets, including indvidually complex assets or groups of assets contributes to their significance.	NYA	NYA	NYA
Context	Three of the Listed Buildings lie within the Pendoylan Conservation Area. The remaining designated assets are not overly complex and represent residential buildings.	The context and setting of most cultural heritage assets is a material consideration at the local and national policy level.	The context of Listed Buildings, Conservation Area and the Registered Park and Garden is regionally significant. The context of the archaelogical features both 'known' and 'unknown' has not been assessed and the significance is therefore unkown.	NYA	The effect on the context of the Registered Park and Garden and Listed Building is likely to be neutral. Due to the lack of assessment on the archaelogical features the effect of the alignments on the non-designated archaelogical features 'known' and 'unknown' is unknown.
Period	The Church of St Cadoc (Grade II*) is of a Medieval date. The remaining Listed Buildings and the Registered Park and Garden are of a Post Medieval date. Non-designated archaelogical features within 500m of the route are range primarily of Bronze Age to the Medieval period.	Period does not necessarily determine the importance of the historic resource although, it can affect it. Policies within the Local and Regional Plans make reference to the safeguarding and enhancement of cultural heritage assets. The protection of designated assets and areas regardless of their period is of national concern as set out in the Planning Policy Wales.	The range of periods of the designated heritage assets are primarily of a Post Medieval date. The non-designated buried archaelogical features within the area are important in understanding the development of the surrounding area on a local and regional level.	NYA	The proposed alignments would not have an affect on the periods of heritage assets and areas.

Reference Sources

Historic Wales, Archwilio , Vale of Glamorgan Interactive Constraints Map, Vale of Glamorgan Website

Step 5 - Summary Assessment Score

Slight Adverse

Qualitative Comments

Online Sub Option 1 has more ground intrusive works in the form of cuttings due to the road being widened. Slight adverse impact on the buried archaeological features located along the alignment of the road. Neutral impact on the settings of the Listed Buildings and Registered Park and Garden. There is potential for a slight adverse impact on the setting of the Conservation Area as a result of the development, potential for this to be mitigated through design.

TAG Landscape Impacts Worksheet | Online Alignments						
	Step 2	**Step 3**				**Step 4**
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Impact**
Pattern	Undulating topography, various field sizes, hedges framing fields and roads, large numbers of hedgerow trees and mature woodland pockets	local level	local level - this landscape is typical of the Vale	Medium importance locally	Difficult in short term but repairable in the long term	**Slight adverse**: field patterns and open spaces will be slightly disrupted, and there will be some loss of hedges. Existing narrow lanes will be interrupted. There will be some new earthworks required. Mitigation should reinstate the landscape pattern but this will take time to reduce impacts
Tranquillity	Moderately tranquil landscape with M4 to the north, main rail line nearby, minor roads and PRoWs , some secluded areas, short distance views through the landscape, which is mostly unlit at night.	local level	not rare locally	Medium importance	Reduction in tranquillity , short distance views interrupted	**Moderate adverse:** increased traffic on road will reduce tranquillity. Lighting on cycle way will reduce visual tranquillity Mitigation: Good landscape (screening) and lighting design to minimise night time landscape disruption impact.
Cultural	Historic building settings, fields and hedges, dense and mature woodland pockets	local level	not rare locally	moderate importance	Increased traffic will have negative impact. Loss of woods and hedgerows can be partially replaced in long term	**Moderate adverse:** setting of historic buildings will be slightly impacted, loss of hedges and some woodland **Mitigation:** Landscape design along route, retain existing hedgerows and roadside trees wherever possible and plant new
Landcover	Farmland and , hedges, woodland,	local level	not rare locally	Low importance	Farmland will be lost to the road together with some woodland	**Minor adverse:** loss of fields, fields will be divided and made smaller, loss of hedges and woodland Mitigation**:** Landscape design along route, retain existing hedgerows and roadside trees wherever possible or plant new hedges and woodland habitats
Summary of character	Farmland, hedges and historic buildings in undulating land with attractive views	local level	local level - this landscape is typical of the Vale	Medium importance	Difficult in short term due to time necessary to establish vegetation cover, increased traffic and new features in undulating landscape	**Slight adverse**: road infrastructure will reduce tranquillity, traffic will increase, loss of roadside trees and hedgerows. Introduction of lighting on cycleway will urbanise a rural location. Additional mitigation**:** Landscape design along route, planting of new hedges, . Good landscape design (screening)
Reference Sources						
Site visit January 2018 and November 2019						
Step 5 - Summary Assessment Score						
Moderate Adverse						
Qualitative Comments						
The proposed online option of road infrastructure through undulating land will degrade the existing landscape character through the loss of existing hedgerows and roadside trees and will generate some significant impacts on short distance views from some residential properties. Mitigation to encompass landscape design along the route to reduce impact would encompass planting of new hedges and good landscape design (screening). The online options would have less earthworks than the offline options and would not be introducing a new feature into the landscape. However, the extent of hedgerows and roadside trees lost would be greater so it would still be moderate adverse impact. With new tree and hedge planting this could be reduced to minor/slight in the very long term once all the new replacement tree planting has matured. In comparison, the offline options both have significant impacts and would both therefore have moderate adverse impact overall. This could reduce to minor/slight in the long term with substantial mitigation. The greatest impacts for all options will be during the construction stage but will be of relatively short duration. In terms of the overall effect on the local landscape character there is little to differentiate between the two online options. However, Online Alignment Option C1 with its wider footprint and greater earthworks has a greater impact on the landscape. In terms of vegetation loss there is also little difference, although Online Alignment Option C1 also has greater impact on the woodland at Coed Waun-Lloff north of Clawdd-Coch.						

TAG Journey Quality Impacts Worksheet | Online Alignments

Factor	Sub-factor	Better	Neutral	Worse
Traveller Care	Cleanliness			
	Facilities			
	Information			
	Environment			
Travellers' Views	-			
Traveller Stress	Frustration			
	Fear of potential accidents			
	Route uncertainty			

Reference Source

Refer to drawings number 10028657-ARC-XX-XX-DR-HE-0020, 0021, 0022 and 0023.
DMRB 11.3.9.2 (travellers' views) and 11.3.9.3 (traveller stress)

Summary Assessment Score

C1 Moderate (more than 500 users and less than 10,000 users per day affacted).
C2 Slight (more than 500 users and less than 10,000 users per day affacted) due to implemetation of road below DMRB standard.

See the Stage Two Outline Business Case report.

TAG Security Impacts Worksheet | Online Alignments

Security Indicator	Relative importance	Without scheme	With scheme
	(High/Medium/Low)	(Poor/Moderate/High)	(Poor/Moderate/High)
Site perimeters,	Low	Poor	Moderate
entrances and exits	n/a	n/a	n/a
Formal surveillance	Low	Poor	Poor
Informal surveillance	High	Poor	Poor
Landscaping	Medium	Poor	Moderate
Lighting and visibility	Medium	Poor	Moderate
			(High for cyclists/ pedestrians)
Emergency call	Medium	Poor	Poor

Approximate Number of Users Affected

More than 500, less than 10,000 users

Reference Source

Improving Strategic Transport Encompassing Corridors from M4 Junction 34 to the A48 | Highway Link Study
WelTAG Stage Two: Outline Business Case
10013270-ARC-XX-XX-RP-TP-0001

Summary Assessment Score

Slight beneficial

Qualitative Comments

The above assessment is applicable to both drivers and cyclists/ pedestrians unless otherwise stated.
See Outline Business Case report.

TAG Severance Impacts Worksheet | Online Alignments

Change in Severance	Population Affected			
	location *a*	location *b*	location.....	Total Affected
Large negative				
Moderate negative				
Slight negative	127	35		162
Neutral				
Slight positive				
Moderate positive				
Large positive				

Reference Source

Google Maps
10013270-ARC-XX-XX-RP-TP-0001 - WelTAG Study Stage 2
DMRB 11.3.8

Summary Assessment Score

Slight Adverse

Qualitative Comments

See Outline Business Case report.

TAG Water Environment Impacts Worksheet | Online Alignments

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitutability	Importance	Magnitude	Significance
Surface Water									
Study area: The proposed development consists of an online alignment (existing route enhancement) between the M4 J34, in the north, to the A48, in the south. This single route enhancement option is split into sub options 1 and 2 which are considered together in this worksheet . The study area consists of a 500m envelope surrounding the route and this study area is predominantly contained within the catchment of the River Ely (a designated Main River). A number of tributaries of the Ely, including ordinary watercourses and designated Main Rivers also flow through the study	River Ely and tributaries	Water Quality - construction impacts	River Ely, confluence Nant Clun to Allot Gardens (WFD reference GB109057027260) designated with WFD Bad overall status, from Bad ecological status and Failed chemical status. Unknown quality for smaller watercourses and tributaries but assumed to share similar qualities to the Ely. (Although a small part of the scheme is located in the River Llancarfan catchment (WFD reference GB110058021000) it is not included as the scheme is remote from watercourses within this catchment.)	Regional	Typical	Not practicable for the River Ely, but is feasible for minor tributaries.	Medium	**Minor Adverse** Construction of the online alignment requires work in proximity to the River Ely and in proximity to and over its tributaries. After the application of mitigation measures and following best practice guidelines, a *Minor Adverse* magnitude of impact is predicted.	Insignificant
Surface Water Potential Impacts: Construction phase: Pollution (silt, oils, fuels etc…) of surface water. Increase in impermeable land cover causing change to existing infiltration and land drainage patterns, with potential to increase flood risk. Operational phase: Pollution of surface water from accidental spillages and discharges of routine runoff from the highway. Increase in impermeable land cover causing change to existing infiltration and land drainage patterns, with potential to increase flood risk.		Water Quality - routine runoff		Regional	Typical	Not practicable for the River Ely, but is feasible for minor tributaries.	Medium	**Negligible** Given drainage design in accordance with best practice a *Negligible* magnitude of impact is predicted.	Insignificant
		Water Quality - accidental spillage		Regional	Typical	Not practicable for the River Ely, but is feasible for minor tributaries.	Medium	**Minor Adverse** Given drainage design in accordance with best practice, the potential for serious pollution incidents occurring would be limited. A *Minor Adverse* magnitude of impact is predicted in the unlikely event of a spillage related pollution incident.	Insignificant
		Flood risk, land drainage and hydromorphology	The River Ely and some of its tributaries are designated as Main Rivers by the NRW Flood Risk Map. The online alignment does not include any new crossings of the River Ely or its tributaries. Areas in proximity to the River Ely and other Main Rivers are generally designated as Flood Zone 3 or 2 (high or medium flood risk). Areas remote from watercourses are generally designated as Flood Zone 1 (low flood risk). The online alignment does not encroach into Flood Zones 2 or 3 any more than the existing road.	Regional	Typical	Not practicable for the River Ely, some potential for reproviding floodplain storage and minor tributaries.	Medium/High	**Minor Adverse** Given that the online alignment does not require any new watercourse crossings, does not encroach into Flood Zones 2 and 3 and that drainage will be designed in accordance with best practice, a *Minor Adverse* magnitude of impact is predicted.	Insignificant / Low Significance
		Recreation and value to the economy	No commercial fisheries or navigation, limited leisure uses and riverside development	Local	Low	Not practicable for the River Ely, but is feasible for minor tributaries.	Low	**Negligible**	Insignificant

Ground Water									
Groundwater Potential Impacts: Construction phase: Pollution (silt, oils, fuels etc…) of groundwater. Increase in impermeable land cover causing change to existing groundwater recharge patterns. Operation: Pollution of groundwater. Deterioration of the integrity of existing licenced abstractions or derogation of private water supplies due to pollution or dewatering. Increase in impermeable land cover causing change to existing groundwater recharge patterns.	Southeast valleys Southern Devonian Old Red Sandston and Triassic Mercia Mudstone & Thaw & Cadoxtan Carboniferous Limestone	Water Quality - construction impacts	Southeast Valleys Southern Devonian Old Red Sandstone & Triassic Mercia Mudstone (WFD reference GB40902G201500) designated with Good overall status, with good quantitative and chemical conditions. Thaw & Cadoxtan Carboniferous Limestone (WFD reference GB41002G201600) designated with Good overall status, with good quantitative and chemical conditions. Underlying bedrock aquifer designated as Principal and Secondary A/B, with potential for water supply on regional level and an important source of baseflow to watercourses.	Regional	High	Not practicable	Medium	**Minor Adverse** Potential risks associated with construction phase such as entrainment of suspended solids derived from working areas. Following the application of mitigation measures and best practice, including implementation of pollution control measures, a *Minor Adverse* magnitude of impact is predicted.	Insignificant
		Water Quality - routine runoff		Regional	High	Not practicable	Medium	**Negligible** No significant impacts are envisaged following the implementation of best practice drainage design and mitigation measures; a *Negligible* magnitude of impact is therefore predicted.	Insignificant
		Water Quality - accidental spillage		Regional	High	Not practicable	Medium	**Minor Adverse** The implementation of best practice drainage design and mitigation measures would limit the potential for adverse impacts, but cannot eliminate the potential for a spillage related pollution incident; a *Minor Adverse* magnitude of impact is therefore predicted.	Insignificant
		Water Supply		Regional	High	Not practicable	Medium	**Minor Adverse** The implementation of best practice drainage design and construction phase pollution prevention would limit the potential for adverse impacts on water supplies. A *Minor Adverse* to *Negligible* magnitude of impact is therefore predicted.	Insignificant

Water Watch Wales, Natural Resources Wales (2020),
Natural Resources Wales, Cycle 2 Rivers and Waterbodies WFD Data (2018),
Natural Resources Wales, Flood Risk Map (2019),
MAGIC, Defra (2018),
Department for Transport (DfT) Transport Appraisal Guidance (TAG) Unit A3 - Environmental Impact Appraisal (2017)

Summary Assessment Score

Online Alignment (Sub Options 1 and 2) - Slight Adverse to Negligible, considered Insignificant overall.

Qualitative Comments

The potential impacts concern a possible accidental spillage, construction phase pollution risks and changes to the land drainage regime in terms of runoff quality and quantity. A construction environmental management plan should be put in place to outline how the risk of pollution of watercourses during construction would be minimised. A suitable drainage design would also be required.
There is very little difference between sub options 1 and 2 for the online alignment with regards to surface water and groundwater. The only minor difference is that sub option 1 is located slightly closer to Flood Zones 2 and 3, south of Pendoylan, than option 2, although neither sub option encroaches into Flood Zones 2 and 3 more than the existing road.

TAG Biodiversity Impacts Worksheet | Western Alignment

Step 2		Step 3				Step 4	Step 5
Area	**Description of feature/ attribute**	**Scale (at which attribute matters)**	**Importance (of attribute)**	**Trend (in relation to target)**	**Biodiversity and earth heritage value**	**Magnitude of impact**	**Assessment Score**
Cardiff Beech Woods Special Area of Conservation (SAC)	One of the largest concentrations of *Asperulo-Fagetum* beech forest in Wales, located approximately 6km north-east of the scheme.	International	Qualifying feature of a internationally designated site so very high importance	4 of 5 qualifying features favourable, 1 feature unfavourable	Very high	Neutral No impact predicted due to distance from site	Neutral
Severn Estuary Ramsar	Annex I habitats (including estuaries, Atlantic salt meadows and mudflats and sandflats not covered by seawater at low tide), its migratory fish populations (including salmon, sea trout and sea lamprey) and for its internationally important assemblage of waterfowl (including gadwall, dunlin and redshank). Located approximately 12km south-east of the	International	Qualifying feature of a internationally designated site so very high importance	Water quality improving. Quality of saltmarsh threatened. Water fowl population status varies but overall assemblage has declined from approx. 81,000 to 66,000 between 1992/93 and 2006/7	Very high	Neutral No impact predicted due to distance from site	Neutral
Severn Estuary Special Protection Area (SPA)	Internationally important bird populations (including the Annex I species Bewick's swan over winter as well as ringed plover, dunlin, pintail, redshank and curlew) and for regularly supporting at least 20,000 waterfowl. Located approx. 12km south-east of the scheme.	International	Qualifying feature of a internationally designated site so very high importance	Water fowl population status varies but overall assemblage has declined from approx. 81,000 to 66,000 between 1992/93 and 2006/7	Very high	Neutral No impact predicted due to distance from site	Neutral
Severn Estuary SAC	Annex I habitats (including estuaries, Atlantic salt meadows and mudflats and sandflats not covered by seawater at low tide) and Annex II species (including sea lamprey, river lamprey and twaite shad). Located approx. 12km south-east of the	International	Qualifying feature of a internationally designated site so very high importance	Water quality improving. Quality of saltmarsh threatened.	Very high	Neutral No impact predicted due to distance from site	Neutral
Pysgodlyn Mawr Site of Special Scientific Interest (SSSI)	Small area of wetland which supports a wide range of habitats from open water, to reed swamp, to heath and bog, which are very unusual in the lowland Vale area, nationally scarce downy emerald dragonfly and hairy dragonfly, only Glamorgan record for Pillwort. Located 1.5km west of the west route and 2km west of the east route	National	Qualifying feature of a nationally designated site so high importance	Habitats static with active management but pillwort lost from site.	High	Neutral No impact predicted due to distance from site	Neutral
Ely Valley SSSI	Supports the largest known population of the nationally scarce plant Monk's-hood. Immediately adjacent to northern point of scheme.	National	Qualifying feature of a nationally designated site so high importance	Static with minimal management	High	Minor negative Potential loss of habitat suitable to support Monk's -hood tbc by further surveys however can be mitigated for by implementing buffer zones around important	Slight adverse
Nant Whitton Woods SSSI	Limestone woodland supporting nationally uncommon Herb-paris and Adder's-tongue fern. Located approx. 2.2km south of the scheme.	National	Qualifying feature of a nationally designated site so high importance	Static with active management	High	Neutral No impact predicted due to distance from site	Neutral
Sites of Interest for Nature Conservation (SINCs)	Various SINCs within 2km of the scheme. The route crosses three SINCs.	County	Designated at Local Authority Level	Unknown, dependent on further information on SINC designations	Medium	Intermediate negative Potential indirect and direct impacts predicted TBC on further information and	Moderate adverse
Ancient Woodland	Broad-leaved woodland. The route passes through four areas of woodland.	Regional	Habitat of principal importance	In decline	High	Major negative Potential direct impacts predicted. Ancient woodland habitat can not be recreated or	Very Large adverse
Tree Preservation Orders (TPO)	Notable individual and groups of trees. No TPOs identified on east route option, west option crosses or passes close to one TPO.	County	Designated at Local Authority Level	Static	Low	Minor negative Potential indirect impacts predicted however can be mitigated for with the implementation of buffer zones	Slight adverse
Priority Habitats	Running and standing open water, hedgerows, woodland, marshy grassland are crossed or are adjacent to both route options.	County	Potential habitat of principal importance under Environment (Wales) Act 2016	In decline	Up to Medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Other natural habitats	Scrub, tall ruderals, improved grassland, arable fields are present along or adjacent to both route options	Local	Common habitats of some local biodiversity interest	Static	Low	Minor negative Potential habitat loss however can be mitigated for through compensatory planting within the scheme	Slight adverse
Hard structures	Roads, buildings are present along or adjacent to both route options	Local	Common habitats with no nature conservation value (unless bat roost present - see bats)	N/A	Negligible	Minor negative Potential loss of bat roost if present within buildings tbc by further surveys however this could be compensated for by the provision of a	Neutral
Amphibians	Records and potential breeding habitat in ponds within 500m of route options and terrestrial foraging habitat. 63 waterbodies within 500m of east route option and 55 within 500m of west route option.	At least local, dependent on further survey work	Species of principal importance (great crested newt are European Protected Species)	Declining	Up to medium (if great crested newt present)	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Badgers	Potential for setts in woodland and hedgerows and foraging habitat available	At least local, dependent on further survey work	Protected under Protection of Badgers Act 1992	Static / maybe increasing	Low	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Bats	Records and foraging and commuting habitat identified and potential for roosts in mature trees and buildings	At least local, dependent on further survey work	European and UK protected species	Varies with species	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Birds	Records and suitable breeding habitat for both tree and ground nesting species. A variety of suitable foraging habitats.	At least local, dependent on further survey work	Protected during breeding season	Varies with species. Wintering brids are doing well but farmland birds are decreasing.	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Dormouse	Records and suitable habitat within hedgerows and woodland for breeding, feeding and hibernating individuals	At least local, dependent on further survey work	European and UK protected species	In decline but decline may be levelling off	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present

Fish	Fish have been recorded in the River Ely and may be present in the smaller watercourses depending on their characteristics	At least local, dependent on further survey work	Species of principal importance	Varies with species	Low	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Hedgehog	Suitable habitat within hedgerows, woodland and field margins	Local	Species of principal importance	Uncertain but considered to be in decline	Low	Minor negative Potential loss of suitable habitat however this could be mitigated for with compensatory habitat creation	Slight adverse
Invertebrates	Records for notable species and a variety of habitats will suit both aquatic and terrestrial species	At least local, dependent on further survey work	Species of principal importance	Varies with species, but 21% species listed as Welsh priorities were declining, 25% were improving and 54% showed little change	Low	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Otter	Otter recorded in River Ely and may use the smaller watercourses for commuting and/or dispersing.	At least local, dependent on further survey work	European and UK Protected species	Increasing nationally	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Reptiles	Suitable habitat for grass snake (*Natrix helvetica)* , slow-worm (*Anguis fragilis)* and common lizard (*Zootoca vivipara)* within hedgerows and field margins. No potential for adder (*Vipera berus)* identified at this stage.	At least local, dependent on further survey work	UK protected species	Declining	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Water vole	Water vole recorded in the River Ely, smaller watercourses may also be suitable depending on conditions. The River Ely, Nant Tredodridge and Nant-y-Felin which were less shaded by the woodland were considered to be suitable to support water vole.	At least local, dependent on further survey work	UK protected species	Declining	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
EWA Section 7 Plants (Priority Species)	Bluebell (*Hyacinthoides non-scripta*) was recorded in the broadleaved semi-natural woodland areas located at the north east of the survey area. Habitats may support some other EWA Section 7 species.	At least local, dependent on further survey work	Species of principal importance	Varies with species, but 53% flowering plants are declining whilst 43% are increasing.	Up to medium	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
WCA Schedule 9 Plants (Non-native Invasive Species)	Japanese Knotweed and Indian Balsam was observed and there is potential for other WCA Schedule 9 species especially along the water courses	Local	Non-Native Invasive Species	Varies with species.	Low	Uncertainty remains pending further survey work	Dependent on further survey, likely to be slight adverse if present
Other	A number of habitats present within the survey area were assessed as suitable to support the following species brown hare (*Lepus europaeus*), polecat (*Mustela putorius*), weasel (*Mustela nivalis*), stoat (*Mustela erminea*) and harvest mouse (*Micromys minutus*).	Local	Species of principal importance	Declining	Low	Minor negative Potential loss of suitable habitat however this could be mitigated for with compensatory habitat creation	Slight adverse

Reference Sources

Wales Biodiversity Partnership (2016) Species Action Plans for dormouse, otter, water vole, brown hare, hedgehog, reptiles and amphibians. Available online at: http://biodiversitywales.org.uk/Species-in-Wales [accessed online February 2018]
Environment Agency England and Wales (2012) Non-native Species records v1.
Tir Cynnal and Tir Gofal Monitoring and Evaluation Programme: Arable plant survey
UK Butterfly Monitoring Scheme (UKBMS)
Dragonfly records from the British Dragonfly Society's Dragonfly Recording Network for the period up to 2014
UK Ladybird Survey data from iRecord
Bruchidae and Chrysomelidae beetle data from iRecord
Soldierflies and Allies Recording Scheme - data verified via iRecord
Caddisfly (Trichoptera) records from Britain and Ireland, via iRecord
Longhorn beetle (Cerambycidae) data from iRecord
RHS berberis sawfly (Arge berberidis) monitoring Mammal records captured from licence returns submitted to Natural Resources Wales
Tir Cynnal and Tir Gofal Monitoring and Evaluation Programme: Field survey; farm scale survey for noctule, common pipistrelle and soprano pipistrelle
Roost count (Bat Conservation Trust)
Field Survey (Bat Conservation Trust)
Woodland Survey and Roost Count (Bat Conservation Trust)
Tir Cynnal and Tir Gofal Monitoring and Evaluation Programme: Field-scale winter surveys of yellowhammers.
RSPB Big Garden Birdwatch winter sightings in the UK in 2009
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Welsh Assembly Government (2008) Welsh Transport Planning and Appraisal Guidance. WAG, Cardiff
The Hedgerows Regulations, 1997. HMSO
Vale of Glamorgan (2017) Great Crested Newts. Available from: https://www.valeofglamorgan.gov.uk/en/enjoying/Coast-and-Countryside/Habitats-and-Wildlife/Great-Crested-Newts.aspx [accessed online February 208]

Summary Assessment Score

Up to moderate adverse impacts anticipated this stage.

Qualitative Comments

At this stage there is little to differentiate the routes except that the east route may impact one more SINC than the west route, the west route may impact one TPO and the east route impacts more marshy grassland (a priority habitat). Impacts on Ely Valley will depend on the results of surveys for Monk's-hood along the river bank and the exact proposals at this location. It is likely that any Monk's-hood could be translocated to reduce impacts. Aerial photography, a ground truthing exercise and a Phase 1 survey identified the potential for both important hedgerows and priority habitats including marshy grassland but this would need to be verified through a Phase 2 botanical survey. Although impacts on ancient woodland are considered moderate it should be noted that this habitat cannot be recreated and therefore impacts will be permanent. Further data including protected species surveys are required and potential mitigation activities should be recommended in an Ecological Impact Assessment.

TAG Historic Environment Impacts Worksheet | Western Alignment

Step 2		Step 3			Step 4
Feature	**Description**	**Scale it matters**	**Significance**	**Rarity**	**Impact**
Form	The historic resource of the study area is characterised predominately by agricultural land, comprising both arable and pasture. There is one Registered Park and Garden (Grade II), two Conservation Areas, five Listed Buildings (2 Grade II* and 3 Grade II) located within 500m of the proposed alignments. No Scheduled Monuments, World Heritage Sites or Registered Battlefields have been identified within 500m of the proposed alignments. The designated heritage assets are mainly associated with domestic buildings. There are multiple archaelogical sites (Medieval and Post Medieval features) located within close proximity to the proposed alignments. There is potential for as yet unidentified buried archaeolgical assets to be present within the proposed alignment footprint.	The protection and enhancement of heritage assets is of national concern as set out in the Planning Policy Wales, which sets out to conserve heritage assets in a manner appropriate to their significance.	The Grade II* Listed Building is of National Significance. The Grade II Listed Buildings and the Registered Park and Garden (Grade II) are of Regional Signifcance. There is potential for unidentified buried archaelogical features of unknown signifcance.	The Listed Buildings and Registered Parks and Garden are fairly common. The rarity of the remaining 'unknown' buried archaelogical resources are judged to be unknown.	The proposed alignments have the potential to have an 'adverse' impact on 'unknown' non-designated heritate assets.The proposed alignments have the potential to directly impact on buried archaelogical remains which could result in the permanent and irreverisble loss of assets.
Survival	NYA	The protection and enhancement of heritage assets is of national concern as set out in the Planning Policy Wales, which sets out to conserve heritage assets in a manner appropriate to their significance. The survival of heritage assets is a contributing factor to its significance	The Grade II* Listed Buildings are of National Significance. The Grade II Listed Buildings and the Registered Park and Garden (Grade II) are of Regional Significance. There is potential for unidentified buried archaeological assets of unknown significance	NYA	The proposed alignments would not have an effect on the survival of the designated assets. The proposed alignments may have an adverse effect on the survival of unidentified buried archaelogical remains within the route of the scheme, however, this is not quantifable at this stage.
Condition	NYA	The protection and enhancement of heritage assets is of national concern as set out in the Planning Policy Wales, which sets out to conserve heritage assets in a manner of appropriate to their significance. The condition of heritage assets contributes to their signifcance and sensitvity to impacts.	The condition of designated and non-designated assets is important as, if in good condiiton, they can inform our understanding of the history of the region and contribute to the economic wellbeing of the local area.	NYA	NYA
Complexity	Three of the Listed Buildings lie within the Pendoylan Conservation Area. The remaining designated assets (Listed Buildings) are not overly complex and represent residential buildings.	The protection and enhancement of heritage assets is of national concern as set out in the Planning Policy Wales, which sets out to conserve heritage assets in a manner appropriate to their signficance. The complexity of assets, including indvidually complex assets or groups of assets contributes to their significance.	NYA	NYA	NYA
Context	Three of the Listed Buildings lie within the Pendoylan Conservation Area. The remaining designated assets are not overly complex and represent residential buildings.	The context and setting of most cultural heritage assets is a material consideration at the local and national policy level.	The context of Listed Buildings, Conservation Area and the Registered Park and Garden is regionally significant. The context of the archaelogical features both 'known' and 'unknown' has not been assessed and the significance is therefore unkown.	NYA	The effect on the context of the Registered Park and Garden and Listed Building is likely to be neutral. The effect on the context of the Conservation Area has the potential to be slight beneficial due to diverting traffic from travelling through the centre of Pendoylan. Due to the lack of assessment on the archaelogical features the effect of the alignments on the non-designated archaelogical features 'known' and 'unknown' is unknown.
Period	The Church of St Cadoc (Grade II*) is of a Medieval date. The remaining Listed Buildings and the Registered Park and Garden are of a Post Medieval date. Non-designated archaelogical features within 500m of the routes are range primarily of Bronze Age to the Medieval period.	Period does not necessarily determine the importance of the historic resource although, it can affect it. Policies within the Local and Regional Plans make reference to the safeguarding and enhancement of cultural heritage assets. The protection of designated assets and areas regardless of their period is of national concern as set out in the Planning Policy Wales.	The range of periods of the designated heritage assets are primarily of a Post Medieval date. The non-designated buried archaelogical features within the area are important in understanding the development of the surrounding area on a local and regional level.	NYA	The proposed alignments would not have an affect on the periods of heritage assets and areas.

Reference Sources

Historic Wales, Archwilio , Vale of Glamorgan Interactive Constraints Map, Vale of Glamorgan Website

Step 5 - Summary Assessment Score

Slight adverse

Qualitative Comments

At this stage there is little to differentiate the Eastern and Western Alignments impact on the Historic Environment due to both routes having an identical north and south profile, with the main difference being the alignment of the route to the west or east of Pendoylan. Slight adverse impact on the buried archaelogical features located along either Alignment. Neutral impacts on the settings of the Listed Buildings and Registered Park and Garden. Slight beneficial impact on the Conservation Area as a result of the Eastern and Western Alignment diverting traffic from the centre of Pendoylan, however there is potential for a Slight adverse impact on the setting of the Conservation Area as a result of the development, potential for this to be mitigated through design.

TAG Landscape Impacts Worksheet | Western Alignment						
	Step 2	**Step 3**				**Step 4**
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Impact**
Pattern	Undulating topography, various field sizes, hedges framing fields and roads, large numbers of hedgerow trees and mature woodland pockets	local level	local level - this landscape is typical of the Vale	Medium importance locally	Difficult in short term but repairable in the long term	Moderate adverse: field patterns and open spaces will be disrupted, and there will be some loss of hedges. Existing narrow lanes will be interupted. New road will create cuttings and embankments. Mitigation should reinstate the landscape pattern but this will take time to reduce impacts
Tranquillity	Moderately tranquil landscape with M4 to the northy, main rail line nearby, minor roads and PRoWs , some secluded areas, short distance views through the landscape, which is mostly unlit at night.	local level	not rare locally	Medium importance	Reduction in tranquility , short distance views interrupted	Minor adverse: traffic on road will reduce tranquillity. Mitigation: Good landscape (screening) and lighting design to minimise night time landscape disruption impact.
Cultural	Historic building settings, fields and hedges, dense and mature woodland pockets	local level	not rare locally	moderate importance	Increased traffic will have negative impact. Loss of woods and hedgerows can be partially replaced in long term	Slight adverse: setting of historic buildings will be slightly impacted, loss of hedges and some woodland Mitigation: Landscape design along route, retain and plant new hedges.
Landcover	Farmland and , hedges, woodland,	local level	not rare locally	Low importance	Farmland will be lost to the road together with some woodland	Minor adverse: loss of fields, fields will be divided and made smaller, loss of hedges and woodland Mitigation: Landscape design along route, retain or plant new hedges and woodland habitats
Summary of character	Farmland, hedges and historic buildings in undulating land with attractive views	local level	local level - this landscape is typical of the Vale	Medium importance	Difficult in short term due to time necessary to establish vegetation cover, increased traffic and new feature in undulating land	Moderate adverse: road infrastructure will reduce tranquillity, traffic will increase, farmland will be lost, previously unlit landscape will be lit, short distance views will be interrupted. Additional mitigation: Landscape design along route, retain or planting of new hedges, design of road sympathetic to local landscape character. Good landscape design (screening) and lighting design to minimise night time landscape impact.
Reference Sources						
Site visit January 2018 and November 2019						
Step 5 - Summary Assessment Score						
Moderate adverse						
Qualitative Comments						
The proposed Western option of road infrastructure through undulating land will degrade the existing landscape character and will gerate some significant impacts on short distance views from some residential properties, which will also experience negative effects on night time setting. The offline options both have significant impacts and would both therefore have moderate adverse impact overall. This could reduce to minor/slight in the long term with substantial mitigation. In comparison, the online options would have less earthworks and would not be introducing a new feature into the landscape – however the extent of hedgerows and roadside trees lost would be greater so it would still be moderate adverse impact. Again with new tree and hedge planting this could be reduced to minor/slight in the very long term once all the new replacement tree planting has matured. The greatest impacts for all options will be during the construction stage but will be of relatively short duration.						

TAG Journey Quality Impacts Worksheet | Western Alignment

Factor	Sub-factor	Better	Neutral	Worse
Traveller Care	Cleanliness			
	Facilities			
	Information			
	Environment			
Travellers' Views	-			
Traveller Stress	Frustration			
	Fear of potential accidents			
	Route uncertainty			

Reference Source

10013270-ARC-XX-XX-DR-HE-0001 - East Alignment
10013270-ARC-XX-XX-DR-HE-0002 - East Alignment with Env Cons
10013270-ARC-XX-XX-DR-HE-0003 - East Alignment with Flood Zones
10013270-ARC-XX-XX-DR-HE-0004 - East Alignment Longsection
20180223_DemFlowDiff_ACVvsACU_2036
DMRB 11.3.9.2 (travellers' views) and 11.3.9.3 (traveller stress)

Summary Assessment Score

High (more than 10,000 users per day affacted).

Qualitative Comments

See the Stage Two Outline Business Case report.

TAG Security Impacts Worksheet | Western Alignment

Security Indicator	Relative importance	Without scheme	With scheme
	(High/Medium/Low)	(Poor/Moderate/High)	(Poor/Moderate/High)
Site perimeters	Low	Poor	Moderate
Entrances and exits	n/a	n/a	n/a
Formal surveillance	Low	Poor	Poor
Informal surveillance	High	Poor	Moderate
Landscaping	Medium	Poor	Moderate
Lighting and visibility	Medium	Poor	Moderate
			(High for cyclists/ pedestrians)
Emergency call	Medium	Poor	Poor

Approximate Number of Users Affected

More than 10,000.

Reference Source

10013270-ARC-XX-XX-RP-HE-0001 - M4 J34 - A48 WelTAG Study Stage 2

Summary Assessment Score

Moderate beneficial

Qualitative Comments

The above assessment is applicable to both drivers and cyclists/ pedestrians unless otherwise stated.
See Outline Business Case report.

TAG Severance Impacts Worksheet | Western Alignment

Change in Severance	Population Affected			
	PENDOYLAN	CLAWDD COCH		Total Affected
Large negative				
Moderate negative				
Slight negative				
Neutral				
Slight positive	127	35		162
Moderate positive				
Large positive				

Reference Source

Google Maps
10013270-ARC-XX-XX-RP-HE-0001 - M4 J34 - A48 WelTAG Study Stage 2
DMRB 11.3.8

Summary Assessment Score

Slight positive

Qualitative Comments

See Outline Business Case report.

TAG Townscape Impacts Worksheet | Western Alignment							
	Step 2	Step 3					Step 4
Features	**Description**	**Scale it matters**	**Rarity**	**Importance**	**Substitutability**	**Changes in Without-scheme case**	**Impact**
Layout	The area of townscape is characterised around the compact village of Pendoylan which lies at the approximate centre of the Pendoylan corridor 3km south of the M4 and 3km north of the A48. The residential areas of Pendoylan are laid out around cul de sac roads making them free of through traffic. Pendoylan lies within the Ely Valley and Ridge Slopes Special Landscape Area. There are isolated individual properties located within the surrounding agricultural landscape.	Local scale.	NYA	Locally Important. Pendoylan Conservation Area to be considered as Regionally Important.	Heritage buildings could not be substituted.	Further adverse affects forecast as the traffic volumes along the Pendoylan Corridor strategic network between the M4 Junction 34 and the A48 would continue to increase.	As the proposed Eastern and Western alignment are both linear and by-pass the village of Pendoylan. The Western and Eastern alignment would not result in a significant change in the layout of the townscape. **Neutral effect**
Density and mix	Buildings in the townscape are residential buildings. Residential buildings are predominately located in the compact village of Pendoylan. There are isolated residential buildings within the surrounding landscape, with the surrounding landscape being predominately composed of agricultural land and parks and gardens, which reduce the density of development.	Local scale.	NYA	Locally Important. Pendoylan Conservation Area to be considered as Regionally Important.	Heritage buildings could not be substituted.	Further adverse affects forecast as the traffic volumes along the Pendoylan Corridor strategic network between the M4 Junction 34 and the A48 would continue to increase.	As the proposed Eastern and Western alignment are both linear and by-pass the village of Pendoylan. The Western and Eastern alignment would not result in a significant change in the density and mix of the townscape. **Neutral effect**
Scale	The built up area is predominatly composed of residential housing which is considered of small scale. Within the surrounding area there are isolated properities with large grounds, open agricultural land and recreational areas.	Local scale.	NYA	Locally Important. Pendoylan Conservation Area to be considered as Regionally Important.	Heritage buildings could not be substituted.	Further adverse affects forecast as the traffic volumes along the Pendoylan Corridor strategic network between the M4 Junction 34 and the A48 would continue to increase.	As the proposed Eastern and Western alignment are both linear and by-pass the village of Pendoylan. The Western and Eastern alignment would not result in a significant change in the scale of the townscape. **Neutral effect**
Appearance	The Pendoylan Conservation Area is notable for its roadside stone walls, including the stone retaining wall running along the west side of the main road and surrounding the churchyard. There are small items that add to the area's local distinctiveness (e.g. red telephone box (Grade II listed)). The characteristic historic building materials in the Pendoylan Conservation Area are local limestone and slate. Trees, hedges and other greenery soften the townscape and add to the area's rural appearance.	Local scale.	NYA	Locally Important. Pendoylan Conservation Area to be considered as Regionally Important.	Heritage buildings could not be substituted.	Further adverse affects forecast as the traffic volumes along the Pendoylan Corridor strategic network between the M4 Junction 34 and the A48 would continue to increase.	As the proposed Eastern and Western alignment are both linear and by-pass the village of Pendoylan. The Western and Eastern alignment would not result in a significant change in the appearance of the townscape. **Neutral effect**
Human interaction	Pendoylan village is a mainly residential area bisected by the road that runs through the centre of the village. Amentities include the Pendoylan Church In Wales Primary School to the north of the village, the 'Red Lion' village pub within the centre and St. Cattwg's Church (Grade II* listed). Pendoylan has some benches carefully placed beside open spaces.	Local scale.	NYA	Locally Important. Pendoylan Conservation Area to be considered as Regionally Important.	Heritage buildings could not be substituted.	Further adverse affects forecast as the traffic volumes along the Pendoylan Corridor strategic network between the M4 Junction 34 and the A48 would continue to increase.	As the proposed Eastern and Western alignment are both linear and and by-pass the village of Pendoylan. The Western and Eastern alignment would not result in a significant change in the human interaction of the townscape. **Netural effect**
Cultural	The historical buildings within Pendoylan contribute to the heritage feel of the Pendoylan Conservation Area. The surrounding area has isolated Scheduled Monuments, Listed Buildings and Registered Parks and Gardens within the surrounding agricultural landscape, contributing to the historical heritage feel of the area.	Local scale.	NYA	Locally Important. Pendoylan Conservation Area to be considered as Regionally Important.	Heritage buildings could not be substituted.	Further adverse affects forecast as the traffic volumes along the Pendoylan Corridor strategic network between the M4 Junction 34 and the A48 would continue to increase.	As the proposed Eastern and Western alignment are both linear and by-pass the village of Pendoylan. The Western and Eastern alignment would not result in a significant change in the cultural aspect of the townscape. However, with the alignment by-passing Pendoylan, this would divert traffic away from the village which would enhance its overall heritage feel. **Slight beneficial effect**
Land use	Land use is mainly agricultural land, comprising both arable and pasture. The village of Pendoylan is located along the Pendoylan Corridor, there are a number of hamlets within the surrounding area including Hensol, Tredodridge and Clawdd Coch. There are areas for recreation including a golf course, vineyard and hotel.	Local scale.	NYA	Locally Important. Pendoylan Conservation Area to be considered as Regionally Important.	Heritage buildings could not be substituted.	Further adverse affects forecast as the traffic volumes along the Pendoylan Corridor strategic network between the M4 Junction 34 and the A48 would continue to increase.	As the proposed Eastern and Western alignment are both linear and by-pass the village of Pendoylan. The Western and Eastern alignment would not result in a significant change in the land use of the townscape. **Neutral effect**
Summary of character	The primary features of the townscape are roads and the residential area of Pendoylan Conservation Area and the surrounding hamlets. There are built designated heritage assets within Pendoylan and the surrounding area.	Local scale.	NYA	Locally Important. Pendoylan Conservation Area to be considered as Regionally Important.	Heritage buildings could not be substituted.	Further adverse affects forecast as the traffic volumes along the Pendoylan Corridor strategic network between the M4 Junction 34 and the A48 would continue to increase.	As the proposed Eastern and Western alignment are both linear and by-pass the village of Pendoylan. The Western and Eastern alignment would not result in a significant change in the townscape character. However, with the alignment by-passing Pendoylan, this would divert traffic away from the village which would enhance its overall heritage feel **Slight beneficial effect**
Reference Sources							
Google Earth aerial photography; OS maps; Vale of Glamorgan Local Development Plan Interactive Map (2017), WelTAG Stage Two M4 J34 to A48 Outline Buisness Case Report D01, Vale of Glamorgan - Pendoylan Conservation Area Appraisal and Management Plan (2009)							
Step 5 - Summary Assessment Score							
Neutral to Slight beneficial effect							
Qualitative Comments							
Area assessed; Pendoylan village using the Vale of Glamorgan Pendoylan Conservation Area Appraisal and Management Plan (2009). Both the Eastern and Western alignment utilise the existing strategic network both to the north and south. Both routes by-pass the largest built up area (Pendoylan) and thus is unlikely to have any direct and indirect impacts on the townscape of the village. Either alignment would divert traffic away from Pendoylan by providing a route that would by-pass the village, this would have a beneficial impact on the setting of the village as traffic would be taken away from the rural settlement. This would help in keeping with the heritage feel of the village. Should there be intervisibility of the alignment from Pendoylan this could have adverse impact to the setting of the townscape.							

TAG Water Environment Impacts Worksheet | Western Alignment

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitutability	Importance	Magnitude	Significance
Surface Water									
Study area: The proposed Development consists of a new road alignment between the M4 J34, in the north, to the A48, in the south. At the centre of proposed Development, the proposed route follows a western alignment to avoid the town of Pendoylan. The study area consists of a 500m envelope surrounding the new alignment. The study area is entirely contained within the catchment of the River Ely (a designated Main River), which includes a number of smaller tributaries, including ordinary watercourses and designated Main Rivers.	River Ely and tributaries	Water Quality - construction impacts	River Ely, confluence Nant Clun to Allot Gardens (WFD Ref GB109057027260), designated with WFD Bad overall status, from Bad ecological status and Failed chemical status. Unknown quality for smaller watercourses and tributaries.	Regional	Typical	Not practicable for the River Ely, but is feasible for minor tributaries.	medium	**Minor Adverse** Construction of the new alignment requires works over and in proximity to the River Ely and its tributaries. After the application of mitigation measures and following best practice guidelines, the potential pollution associated with these works means a *Minor Adverse* magnitude of impact is predicted.	Insignificant
Surface Water Potential Impacts: Construction phase: Pollution (silt, oils, fuels etc…) of surface water. Increase in impermeable land cover causing change to existing infiltration and land drainage patterns, with potential to increase flood risk. Operational phase: Pollution to surface water from accidental spillages and discharges of routine runoff. New watercourse crossings required (12 No.), with potential for effects on flow conveyance, hydromorphology and flood risk. Also potential for losses of fluvial floodplain storage.		Water Quality - routine runoff		Regional	Typical	Not practicable for the River Ely, but is feasible for minor tributaries.	medium	**Negligible** Given drainage design in accordance with best practice, a *Negligible* magnitude of impact is predicted	Insignificant
		Water Quality - accidental spillage		Regional	Typical	Not practicable for the River Ely, but is feasible for minor tributaries.	medium	**Minor Adverse** Drainage design in accordance with best practice would limit the potential for adverse impacts, but cannot eliminate the potential a spillage related pollution incident; a Minor Adverse magnitude of impact is therefore predicted	Insignificant
		Flood risk, land drainage and hydromorphology	The Western Alignment crosses 12 watercourse, consisting of four Main Rivers (including the River Ely) as defined by the NRW Flood Risk Map and eight unnamed ordinary watercourses consisting of small watercourses and ditches. Areas in proximity to the River Ely and other Main Rivers, in particular around the crossing of the River Ely in the north, are generally designated as Flood Zone 3 or 2 (high or medium flood risk). Areas remote from watercourses are generally designated as Flood Zone 1 (low flood risk).	Regional	Typical	Not practicable for the River Ely, but is feasible for minor tributaries and wider floodplain.	medium/high	**Minor Adverse** Following further detailed assessment mitigation measures would be designed to reduce impacts to a Minor Adverse magnitude	Insignificant / Low Significance
		Recreation and Value to the economy	No commercial fisheries or navigation, limited leisure uses and riverside development	Local	Low	Not practicable for the River Ely, but is feasible for minor tributaries.	Low	**Minor Adverse** Construction of the new alignment may result in slight adverse changes to flow conveyance, water quality and the landscape character and following the implementation of best practice and mitigation measures, there is potential for a *Minor Adverse* magnitude of impact.	Insignificant

Groundwater									
Groundwater Potential Impacts: Construction phase: Pollution (silt, oils, fuels etc…) of groundwater. Increase in impermeable land cover causing change to existing groundwater recharge patterns. Operation: Pollution of groundwater. Deterioration of the integrity of existing licenced abstractions or derogation of private water supplies due to pollution or dewatering. Increase in impermeable land cover causing change to existing groundwater recharge patterns.	Southeast valleys Southern Devonian Old Red Sandston and Triassic Mercia Mudstone	Water Quality - construction impacts	Southeast Valleys Southern Devonian Old Red Sandstone & Triassic Mercia Mudstone, (WFD reference GB40902G201500), designated with Good overall status, with good quantitative and chemical conditions. Underlying bedrock aquifer designated as Principal and Secondary A/B, with potential for water supply on regional level and an important source of baseflow to watercourses.	Regional	High	Not practicable	Medium	**Minor Adverse** Potential risks associated with construction phase such as entrainment of suspended solids derived from working areas. Following the application of mitigation measures and best practice, including implementation of pollution control measures, a *Minor Adverse* magnitude of impact is predicted.	Insignificant
		Water Quality - routine runoff		Regional	High	Not practicable	Medium	**Negligible** No significant impacts are envisaged following the implementation of best practise drainage design and mitigation measures; a *Negligible* magnitude of impact is therefore predicted.	Insignificant
		Water Quality - accidental spillage		Regional	High	Not practicable	Medium	**Minor Adverse** The implementation of best practice drainage design and mitigation measures would limit the potential for adverse impacts, but cannot eliminate the potential a spillage related pollution incident; a Minor Adverse magnitude of impact is therefore predicted	Insignificant
		Water Supply		Regional	High	Not practicable	Medium	**Minor Adverse** The implementation of best practice drainage design and mitigation measures would limit the potential for adverse impacts, but cannot eliminate the potential for serious pollution incidents to pollute groundwater; a *Minor Adverse* magnitude of impact is therefore predicted.	Insignificant

Reference Sources

Water Watch Wales, Natural Resources Wales (2020),
Natural Resources Wales, Cycle 2 Rivers and Waterbodies WFD Data (2018),
Natural Resources Wales, Flood Risk Map (2018)
MAGIC, Defra (2018),
Department for Transport (DfT) Transport Appraisal Guidance (TAG) Unit A3 - Environmental Impact Appraisal (2017)

Summary Assessment Score

Western Alignment - Minor Adverse to Negligible impacts considered Insignificant overall.

Qualitative Comments

The potential impacts concern a possible accidental spillage, construction phase pollution risks and changes to the land drainage regime in terms of runoff quality and quantity. A construction environmental management plan should be put in place to outline how the risk of pollution of watercourses during construction would be minimised. A suitable drainage design, as well as appropraite watercourse crossings would also be required.
The proposed development is located in proximity to areas at high to medium flood risk, and should be subject to a flood risk and consequences assessment to qualify flood risk and any necessary mitigation measures.
Overall, the Western Alignment is more remote from the River Ely and its tributaries and floodplain but crosses a larger number of watercourses.

APPENDIX S

Value for Money Assessment

Transport User Benefits and indicative BCR

Project	**M4 Junction 34 to A48 WelTAG Stage Two Plus**	Date	**27/04/2020**
Subject	**Transport user benefits and indicative BCR**	Ref	**Version 1.1**

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Prepared by	Adam Robinson/ Shaista Farooq	Date	14/03/2018
Checked by	Claire Bond	Date	16/03/2018
Approved by	Janice Hughes	Date	22/03/2018

Revision Status	Amendments	Date
v1.0	First draft	22/03/2018
v1.1	Updated costs for Stage 2 plus	27/04/2020

1 Introduction

1.1 Purpose of the Technical Note

1.1.1 Arcadis has been commissioned by Vale of Glamorgan Council to develop and appraise potential options for improving the strategic transport network encompassing corridors from M4 Junction 34 to the A48 (Five Mile Lane) including the Pendoylan Corridor (or alternative).

1.1.2 For the Stage 2 of the WelTAG Study, two alignments have been considered:

- East Alignment – This alignment passes the village of Pendoylan to the east although utilises a section of existing road at the northern end in order to minimise the impacts on Ancient Woodland.
- West Alignment - This alignment passes the village of Pendoylan to the west although shares the same route at the northern end as the East Alignment.

1.1.3 This technical note sets out the appraisal undertaken for the two options for the M4 Junction 34 – A48 Stage 2. The appraisal of options has been undertaken in accordance with the Welsh Government's latest version of WelTAG (December 2017)[1].

2 Economic Appraisal

2.1 Introduction

2.1.1 The tools used to arrive at the initial benefit-cost ratio (BCR), based on direct benefits, are:

- The DfT's Transport User Benefits Appraisal Tool version 1.9.9 was used to estimate the direct user and provider benefits in terms of travel time savings and vehicle operating costs.
- The accident benefits have been calculated using DfT's computer program COBALT (COst and Benefit to Accidents-Light Touch) version 2013.2.

2.2 Travel time and vehicle operating cost savings

2.2.1 TUBA provides a complete set of default economic parameters in its 'Standard Economics File'. This contains values of time, vehicle operating cost data, tax rates, economic growth rates and a range of other economic parameter values.

2.2.2 The scheme parameters are largely determined by the parameters used in the traffic forecasting model, which are as follows:

- Base year - 2015
- Current Year – 2017
- Scheme Opening – 2023
- Modelled Year – 2036
- Horizon Year – 2082

2.2.3 The 'Horizon Year' has been set at the end of 2082 with the appraisal period taken as 60 years from the scheme opening in line with WebTAG (Unit A1.1 Section 2.3, Appraisal Periods)

2.2.4 Traffic model outputs have been generated for 2036, this diverges from a standard economic appraisal which will be run with a minimum of two modelled years. For this reason, the standard interpolation and extrapolation process in TUBA has been altered to reflect the necessary conditions of the scheme.

[1] https://beta.gov.wales/sites/default/files/publications/2017-12/welsh-transport-appraisal-guidance.pdf

Interpolation and extrapolation assumptions for TUBA benefits

2.2.5 The standard approach to interpolation and extrapolation in TUBA is set out in Section 9 of the TUBA General Guidance and Advice document. This involves the linear interpolation between two modelled years and the extrapolation of data after the final modelled year following a horizontal line. A graphical representation of TUBA's interpolation and extrapolation process is provided in Figure 2-1.

2.2.6 The TUBA approach to interpolation and extrapolation has not been achievable with the model outputs generated for this scheme. A single modelled year has been provided for the estimation of benefits leading to a necessary change away from the appraisal assumptions that are used in TUBA. As a second model year is not available to interpolate through, it has been assumed that the traffic model outputs for 2036 are extrapolated for all modelled years. This methodology is likely to **overestimate** the benefits but has been taken forward in the absence of a more robust alternative. A graphical example of this alternative methodology is provided in Figure 2-2.

Figure 2-1 - TUBA standard interpolation and extrapolation

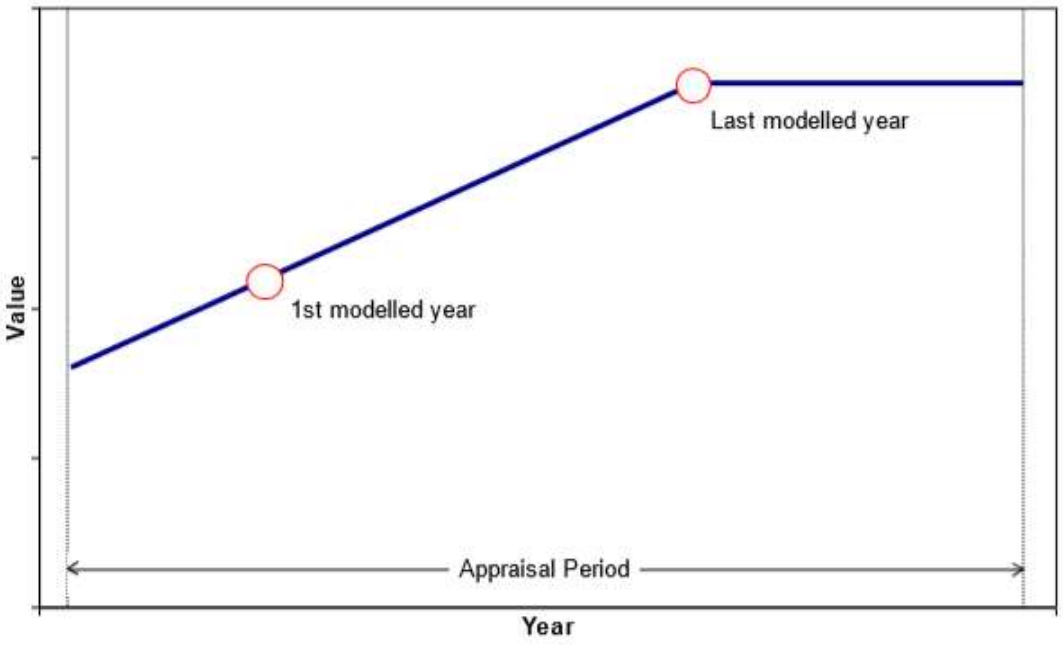
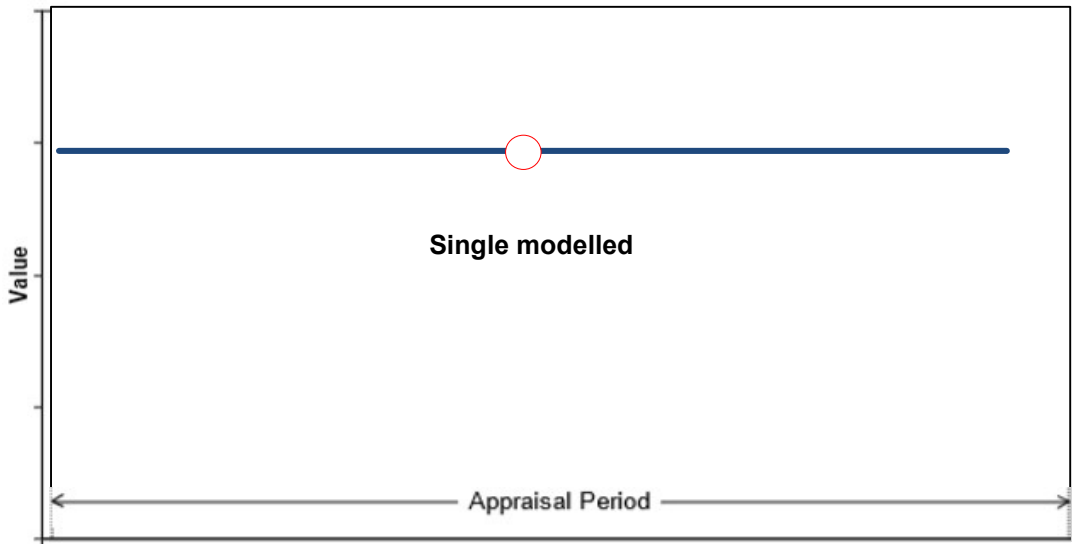


Figure 2-2 - Interpolation and extrapolation method undertaken for scheme



Sensitivity test – factored 2023 trip matrix

2.2.7 A sensitivity test has been undertaken to provide further information regarding the potential overestimation of benefits using a straight-line interpolation/extrapolation technique.

2.2.8 The National Trip End Model (NTEM) forecasts the growth in trip origin/destinations up to 2051. These forecasts are subject to uncertainty, especially when disaggregated to local zones, but could be used to estimate the expected level of reduction in trips in the scheme assessment area for the scheme opening year of 2023.

2.2.9 This can provide an alternative view of the potential level of benefits in 2023 and allow for the WebTAG standard interpolation and extrapolation methodology to be undertaken as in Figure 2-1.

2.2.10 A trip matrix reduction factor of 0.05 has been applied based NTEM trip end forecasts. This has been compared with close by local authorities to ensure it is of a comparable magnitude. Table 2-1 provides an overview of the NTEM forecasts.

Table 2-1 NTEM Trip end growth (Origin + Destination for all time periods)

Origin and Destination Trip-ends (all time periods	Bridgend	Rhonda Cynon Taff	Vale of Glamorgan
2023	424,835	623,340	352,075
2036	448,477	651,814	370,351
% change 2036-2023	-5.27%	-4.37%	-4.98%

2.2.11 This factor has been applied to the 2036 trip matrices to approximate the expected level of trips in 2023 for TUBA. It is important to note that all distance and time skims have been kept at the 2036 level as it has not been possible to run the factored trip matrix through the transport model.

2.2.12 This sensitivity should be regarded as an alternative view of the potential magnitude of benefits using more conservative assumptions and not as a substitute for actual transport model outputs.

2.3 Estimation of costs

2.3.1 For the Stage 2 of the WelTAG Study, 2 alignments have been considered and cost estimates produced:

- East Alignment - This alignment passes the village of Pendoylan to the east although utilises a section of existing road towards the north of the project
- West Alignment - This alignment passes the village of Pendoylan to the west although utilises a section of existing road towards the north of the project

2.3.2 Cost estimates have been produced following WebTAG guidelines for both alignments. A detailed explanation is provided in a technical note produced by the costing team.[2]

2.3.3 The cost estimates, in undiscounted 2017 market prices, are as follows (£000's):

- East Alignment - £71,854
- West Alignment - £61,923

2.3.4 For appraisal purposes, these costs need to be converted into 2010 prices and discounted to 2010. The following process was undertaken to achieve this:

- The costs were factored back to rebase them to 2010 calendar year values using the GDP deflators from the December 2017 WebTAG Data book.
- The cost estimates were discounted from 2017 to 2010 using the discount rate of 3.5%. This is a conservative estimate put in place in the absence of a construction profile.

2.3.5 The final cost estimates in 2010 prices and discounted to 2010 are as follows:

[2] Cost estimates provided in 10013270-ARC-XX-XX-RP-HE-0001 – M4 J34 – A48 WelTAG Study Stage 2

- East Alignment - £50,376
- West Alignment - £43,413

2.4 Accident Cost Savings

2.4.1 DfT's program COBALT (COst and Benefit to Accidents-Light Touch) has been used to undertake the analysis of the impacts on accidents as part of the economic appraisal of the road scheme. The accident impact assessment has been performed using the method set out in the COBALT Manual[3]. It is used to forecast changes in the number of accidents and casualties and estimate the monetary value of these impacts.

2.4.2 The latest COBALT scheme parameter file used for the assessment is 2017.1 in conjunction with the COBALT software version 2013.2.

2.4.3 The COBALT model estimates the number of accidents by summing the product of accident rates and forecast annual flows for each link using the relationships built into the COBALT software. Standard valuations for fatal, serious and slight accidents are applied within the program to calculate the cost of accidents in both 'without' and 'with' scheme scenarios and the difference between them. These savings (or costs) are then annualised and interpolated and extrapolated over the 60- year appraisal period and discounted to produce a 2010 present value of accident benefits in 2010 prices.

Interpolation and extrapolation assumptions for COBALT

2.4.4 Traffic flow data was provided for the Base year (2015), and for Do-Minimum and Do-Something for 2036. COBALT requires traffic flow data for a minimum of two forecast years to be able to do the linear interpolation between the two modelled forecast years, and extrapolate to the Horizon year, to estimate benefits over the 60-year appraisal period.

2.4.5 As mentioned above, the traffic modelled data has been provided for only one forecast year (2036), therefore to estimate flows for the opening year (2023) for Do-Min and Do-Some, a few assumptions have been made to be able to estimate the accident benefits of the scheme. The assumptions made to calculate the flows are as follows:

- Flows for Do-Min for opening year 2023 - Traffic flows data has been linearly interpolated between the Base year and the DM 2036, to get the flows for DM 2023;
- Flows for Do-Some for opening year 2023 - The percentage change in flows between DM 2036 and DS 2036 has been calculated for each link and applied to the DM 2023 flows calculated above to find out the flows for DS 2023.

2.4.6 This methodology is likely to **underestimate** the benefits as the interpolation is used from the Base year which is 2015, but these assumptions are considered to be the best way to estimate flows for a second forecast year.

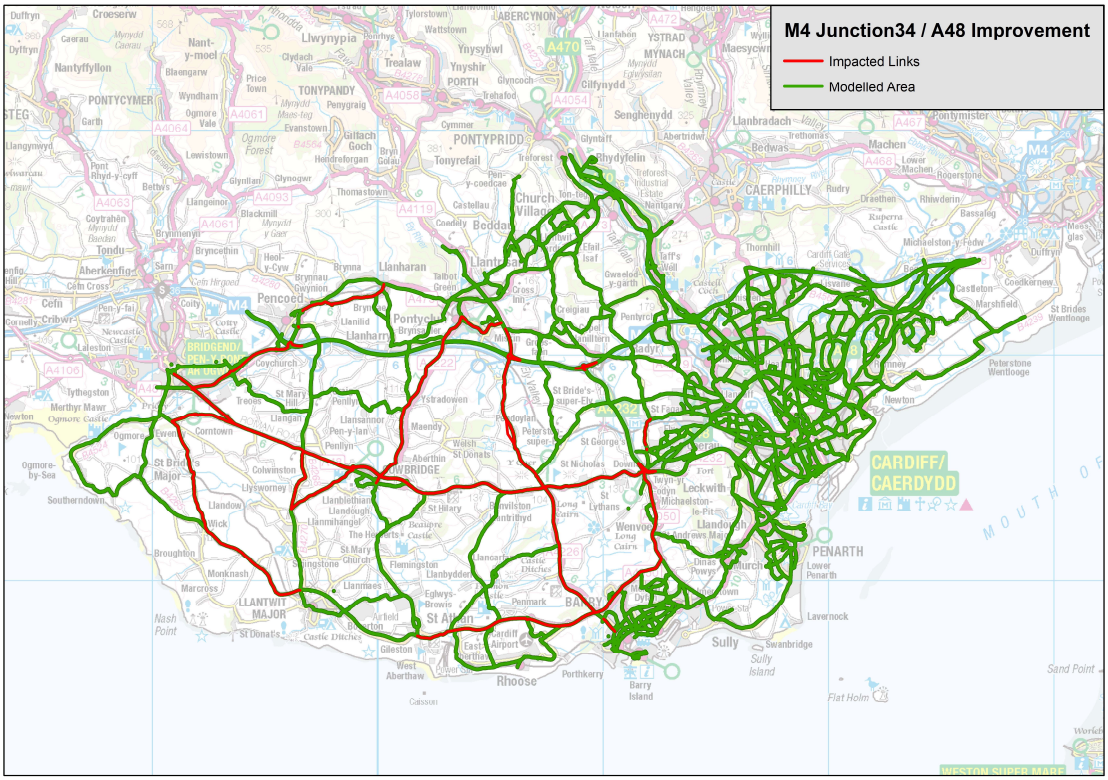
Impacted links (Study Area)

2.4.7 The impacted links were identified by finding the change in AADT (Annual Average Daily Flows) as a result of the scheme and using the standard criteria of finding the links where the change in flows is 5% or more with a flow change of +/- 500 AADT for 2036.

2.4.8 COBALT uses traffic flows and accident rates attributed for each link type, and within the link types, the accident rates are split by speed limit. As COBALT results are only affected by a change in flows or change in link type, it was decided to undertake the accident benefit assessment for the impacted links only instead of a cordon area. Figure 2-3 shows the impacted links in the modelled area.

[3] https://www.gov.uk/government/publications/cobalt-software-and-user-manuals

Figure 2-3: Impacted links for the accident assessment



Other Assumptions for COBALT

2.4.9 The combined link and junction analysis has been used, as this scheme does not require analysing links and junctions separately to estimate the accident benefits.

2.4.10 The accident rates used for this assessment are the default accident rates (national average) provided in the Tag Databook[4], which has a base year 2009.

3 Economic appraisal results

3.1 User and provider benefits

3.1.1 The Transport User Benefits Appraisal (TUBA) tool which calculates transport user benefits and indirect taxation has been used to estimate direct economic benefits for the scheme. As only one year of modelled data has been provided, 2036 modelled data has been extrapolated for every other year in the appraisal. For this reason, 2036 model data has also been set at 2035 providing a horizonal appraisal profile as demonstrated in Figure 2-2.

3.1.2 The user and provider benefits for the scheme are reported in the TEE tables. Table 3-1 presents these benefits and distinguishes between benefits to business users and consumers.

[4] https://www.gov.uk/government/publications/webtag-tag-data-book-december-2017

Table 3-1 : User and provider benefits (£000's PVB 2010 prices discounted to 2010)

£m PVB 2010 prices		Scheme Benefits
Commuting	**Travel Time**	34,807
	VOC	1,223
Other consumers	**Travel Time**	48,319
	VOC	1,529
Business	**Travel Time**	49,099
	VOC	3,184
Total		138,161
Business benefits as % of total		38%

VOC = vehicle operating cost

3.1.3 The current scheme user and provider benefits have been estimated at £138 million. It should be noted that this is likely to be an overestimation of benefits due to the extrapolation technique required for a single modelled year.

3.2 Public accounts

3.2.1 Table 3-2 shows the effects of the options on public finances, taking into account the impact on the broad transport budget after allowing for changes in revenues. It also includes changes in the broader indirect tax revenues which accrue to the government.

Table 3-2 : Public accounts (PVC £000's 2010 prices discounted to 2010)

Scheme costs	East Alignment	West Alignment
Investment Costs	50,376	43,413
Operator Costs	-	-
Revenue	-	-
Indirect Tax Revenue	-2,460	-2,460

3.2.2 The net impact on the transport budget is estimated at £48 million for the East route alignment and £41 million for the West route alignment.

3.2.3 The indirect tax revenue values shown are increase in revenue to the wider public finances and, in accordance with WebTAG guidance, are included in the calculation of the Present Value of Benefits (PVB). The sign of the value in the PA table is therefore reversed in the AMCB table because the PA table presents costs to the public accounts as positive values.

3.2.4 The AMCB tables combine the results from the TEE tables and the PA tables supplemented by information on accidents and environmental effects. The results from the appraisal of the impact on accidents. The results from the appraisal of accidents is set out below.

3.3 Accident cost savings

3.3.1 Table 3-3 outlines the accident cost savings for the impacted links, which are based on the COBALT run outputs, using default accident rates (national averages). These are for the 60-year assessment period (2023-2082). The savings are discounted to 2010 prices.

Table 3-3: Accident Benefits summary (Cost in £000's discounted to 2010)

		Without Scheme	With Scheme	Total Savings (diff. of with and without scheme)
Accident cost	Total (£000)	226,573	209,981	16,591
Accident Summary	Total	4,963	4,517	446
Casualty Summary	Total	6,749	6,184	566
	Fatal	51	51	1
	Serious	649	602	47
	Slight	6,049	5,530	518

3.3.2 The results show positive scheme benefits with a reduction in accident cost of 16.6m, over the 60-year period in 2010 prices. The table also shows that the scheme will reduce 446 accidents, which is a significant reduction considering that the improvement is to a small part of the network.

3.4 AMCB tables

3.4.1 The AMCB tables combine results from the TEE tables and the PA tables supplemented by information on accidents. A summary of the results for the scheme appraisal is set out in Table 3-4.

Table 3-4 - AMCB summary table (prices in £000, discounted to 2010)

	Scheme costs	East Alignment	West Alignment
A	**Accidents**	16,591	16,591
B	**Economic efficiency: Commuting**	36,030	36,030
C	**Economic efficiency: Other**	49,848	49,848
D	**Economic efficiency: Business**	52,306	52,306
E	**Wider Public Finances (ITR)**	-2,460	-2,460
F	**PVB** (A+B+C+D+E)	152,315	152,315
G	**PVC**	50,376	43,413
H	**NPV** (F-G)	101,939	108,902
I	**BCR** (F/G)	3.02	3.51

3.5 Sensitivity test – factored 2023 trip matrix

3.5.1 A sensitivity test was undertaken to provide further information regarding the impact of the straight-line interpolation/extrapolation methodology undertaken due to a lack of transport model data. This sensitivity used an NTEM derived trip reduction factor to estimate the impact a reduced level of traffic in 2023 would have on the scheme benefits. Table 3-5 demonstrates the impact of a reduced 2023 trip matrix on the PVBs and BCRs.

Table 3-5 - AMCB summary table for sensitivity test (prices in £000's, discounted to 2010)

	Scheme costs	East Alignment	West Alignment
A	**Accidents**	16,591	16,591
B	**Economic efficiency: Commuting**	35,745	35,745
C	**Economic efficiency: Other**	49,471	49,471
D	**Economic efficiency: Business**	52,020	52,020
E	**Wider Public Finances (ITR)**	-2,532	-2,532
F	**PVB** (A+B+C+D+E)	151,295	151,295
G	**PVC**	50,376	43,413
H	**NPV** (F-G)	100,919	107,882
I	**BCR** (F/G)	3.00	3.49

3.5.2 Introduction of the factored 2023 trip matrix has led to a decrease in benefits of around 0.5%. There has been a minimal impact on the PVBs and BCRs of the scheme, this is likely due to the following reasons:

- Only 15-years of the 60-year appraisal have been impacted by the change in trips (2023-2036)
- For this 15-year period, the interpolation methodology further reduces the impact of the change in trips up to 2036.

3.5.3 This sensitivity test has helped to inform the core analysis and suggests that the current approach to calculating benefits is a robust methodology given the modelling outputs provided.

4 Summary and Conclusions

4.1 Summary of economic appraisal

4.1.1 Total benefits for the East and West Alignment have been assumed to be the same with the only difference being introduced with the costs.

4.1.2 The methodology used to undertake the transport user benefits using TUBA will likely lead to an overestimation of benefits, whereas in case of accident benefits using COBALT, there might be an underestimation of the benefits. However, given the context specific data provided, it has been deemed as the most robust approach.

4.1.3 The West Alignment route has a higher BCR of 3.5 and NPV of £107.9m than the East Alignment route which has a BCR of 3.0 and NPV of £100.9m. This is due to providing the lowest cost estimate of around £43 million for the West Alignment.

4.1.4 On the basis of greatest economic advantage, the West Alignment route is best performing option, although it is recognised that economic performance is only one of the elements which must be taken into account in decision making.

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