Welsh Assembly Government

Cardiff International Airport and Culverhouse Cross Access Improvements

WelTAG Appraisal Report Stage 2

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July 2009

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Job number 122153

ARUP

Document Verification [User Note2]

Job title	Cardiff International Airport and Culverhouse Cross Access Improvements		Job number 122153
Document title	WelTAG Appraisal Report Stage 2		File reference 4-50-26
Document ref	09/7546		

Revision	Date				
Draft 1	29/05/09	Description	First draft		
			Prepared by	Checked by	Approved by
		Name	Jessica Jones	Richard Sanders	Paul Witham
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Draft 2	02/07/09	Filename	0001 WelTAG Stage 2 Draft 2.doc		
		Description	Second draft		
			Prepared by	Checked by	Approved by
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		Signature			
Issue	16/07/09	Filename	0003WelTAG Stage 2 Report.doc		
		Description	Updated to include WAG comments		
			Prepared by	Checked by	Approved by
		Name	Jessica Jones	Richard Sanders	Paul Witham
		Signature	J. Jones	R J Sanders	
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			

Issue Document Verification with Document ✓

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Glossary of Terms

1 Introduction

Arup was commissioned by the Welsh Assembly Government to undertake the Cardiff International Airport and Culverhouse Cross Access Improvements study in late 2006 and the study formally commenced on 1 February 2007. During the course of the study, the Welsh Assembly Government recognised the need to extend its scope to include the emerging Welsh Transport Appraisal Guidance (WelTAG) in order to undertake a comprehensive transport appraisal.

1.1 Aim of the WelTAG Appraisal Guidance

WelTAG was formally published by the Welsh Assembly Government in June 2008. A draft version had been published in May 2007. Paragraph 1.1.1 of WelTAG states that the guidance:

"has been developed by the Welsh Assembly Government with the intention that it is applied to all transport strategies, plans and schemes being promoted or requiring funding from the Welsh Assembly Government".

WelTAG has two primary purposes:

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

Paragraph 2.2.3 of WelTAG sets out the structure of the WelTAG process, which comprises the following stages:

- A planning stage, which includes problem and opportunity identification, proposal rationale, objective setting, possible solution identification and sifting, option development and option testing;
- A two stage appraisal process, with Stage 1 largely comprising a qualitative assessment and Stage 2 comprising a more detailed quantitative assessment;
- A post appraisal stage which involves on-going monitoring or performance and an evaluation/value for money assessment; and
- Participation, including public consultation, which occurs at several stages in the planning process.

WelTAG aims to ensure that transport proposals contribute to the wider policy objectives for Wales. Three pillars of sustainability, known as Welsh Impact Areas, underlie policy in Wales. These are:

- Economy: this reflects the importance of a strong and developing economy for Wales;
- Environment: this reflects both the legal requirements and desire to protect and enhance the condition of the built and natural environment; and
- Society: this reflects the desire to address issues of social exclusion and to promote social justice and a high quality of life for Welsh people.

1.2 Summary of the Appraisal Stages

Stage 1

Paragraph 5.3.1 of the WelTAG guidance states that the Stage 1 appraisal is intended to screen and test options against the Transport Planning Objectives (TPOs) and the Welsh Impact Areas of Economy, Environment and Society, as well as more detailed tests for deliverability, risks and the degree of support from the public and other stakeholders.

WelTAG advises that the analysis in Stage 1 should be qualitative for some or most criteria, be sufficiently robust to be able to identify and differentiate the most suitable options and to provide sufficient information to complete the Appraisal Summary Tables (ASTs) of the options (Paragraph 5.3.4)

Stage 2

Guidance on the Stage 2 appraisal is set out in Section 5.5 of WelTAG. Stage 2 is a more detailed, quantitative and evidence-based appraisal, which is designed to be applied to only a limited number of options. As in Stage 1, the results of the Stage 2 appraisal are presented in ASTs for each transport option.

1.3 Significance of Impact

Following each impact appraisal for both Stages 1 and 2, WelTAG recommends that the significance of impact for each criterion is assessed using a seven point scale detailed in Paragraph 3.7.1 of the guidance. This scale includes the following assessment criteria:

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

The assessment of impact on each of the Welsh Impact Areas is provided in the ASTs at both Stages 1 and 2.

1.4 Distribution

WelTAG also requires in Paragraph 3.5.1 that the distribution of impacts is carefully considered. This part of the assessment refers to how impacts might be distributed geographically and how they might affect different groups in society.

1.5 Purpose of this Report

This report summarises the WelTAG appraisal to date including the Planning Stage and the Public Consultation Exercise. It provides a summary of the Stage 1 appraisal process and the detailed Stage 2 assessment of route corridors and public transport schemes. Stage 2 Appraisal Summary Tables (ASTs) are provided for both the route and public transport options.

2 Planning Stage

A WelTAG stakeholder workshop was held on 24 January 2008 and the *Planning Stage Report* was subsequently prepared and issued in June 2008 in accordance with the draft WelTAG guidance available at that time. The formal WelTAG guidance was subsequently published by the Welsh Assembly Government in June 2008.

The Planning Stage identified nine transport problems and nine Transport Planning Objectives (TPOs).

2.1 Transport Problems

During the planning stage, the transport problems were identified as follows:

- P1: Poor accessibility to/from Cardiff International Airport by public transport, walking and cycling and poor information.
- P2: Poor accessibility and peak time journey time reliability to Cardiff International Airport by car.
- P3: Community severance and environmental degradation caused by inappropriate traffic flows on local roads in the area.
- P4: Poor safety record on routes to the airport .
- P5: Congestion at Culverhouse Cross, with little alternative if the junction is experiencing problems.
- P6: Poor accessibility to/from Culverhouse Cross by public transport, walking and cycling.
- P7: A4232 problems of congestion, no hard shoulders, and few alternative routes when there are problems.
- P8: A high level of car dependence
- P9: Increases in journey trips due to on-going and proposed developments.

2.2 Transport Planning Objectives

These transport problems led to the identification of the following TPOs for the study:

- TPO 1: To improve transport safety in the study area.
- TPO 2: To discourage airport traffic flows on inappropriate routes.
- TPO 3: To improve public transport, walking and cycling accessibility to/from Cardiff International Airport.
- TPO 4: To improve accessibility and journey time reliability to/from Cardiff International Airport by private transport.
- TPO 5: To improve public transport, walking and cycling accessibility to Culverhouse Cross.
- TPO 6: To reduce congestion at Culverhouse Cross.
- TPO 7: To identify opportunities to improve accessibility to regional developments and complement local development plan strategies.
- TPO 8: To improve journey time reliability on the A4232(T).
- TPO 9: To reduce the level of car dependency.

3 Public Consultation

Following the completion of the Planning Stage, a number of transport options, in three route corridors (Corridors A, B and C), were identified for further consideration. A public exhibition of the proposals for the three route corridors and public transport options was held between 9-12 July 2008, with the period for public responses closing on 3 October 2008. A copy of the public consultation brochure, which illustrates the three route corridors, is provided in Appendix A.

The public consultation brochure described the three route corridors as follows:

- *"Corridor A utilises the existing signposted route to the airport with widening to three lanes on the A4232(T) from M4 Junction 33 to a western bypass improvement at Culverhouse Cross to reduce congestion. Corridor A included online and offline improvement choices on the A4050 at Wenvoe, which will enable journey time improvements.*
- *Corridor B investigates options for route options using the A4232(T) from M4 Junction 33 and the A48 with an improved Sycamore Cross junction and route improvement on Five Mile Lane (A4226). A key choice is the bypass option at St. Nicholas. Congestion at Culverhouse Cross is alleviated with provision of a western bypass to divert the north-south traffic away from the junction. However, traffic on this corridor to the airport would still pass through the Culverhouse Cross junction.*
- *Corridor C provides options for routes from the M4 Junction 34 to the airport with a bypass of Pendoylan, junction improvement at Sycamore Cross and online or offline improvements to Five Mile Lane (A4226). A single lane carriageway with climbing lane provision and alternating sections with two lanes in one direction will provide safe overtaking opportunities on this corridor. A single carriageway western bypass at Culverhouse Cross is also proposed with the Corridor C options to address the existing congestion issues."*

Full details of the consultation process and the results of the public consultation exercise are provided in the following reports:

- *Report on Public Consultation Exhibitions 2008*; and
- *Public Consultation Report*.

4 Summary of the Stage 1 Appraisal

4.1 Introduction

The three route corridors considered as part of the public consultation exercise included a large number of individual elements (15 in total). In order to provide a transparent process and methodology for the assessment, Stage 1 comprised a qualitative review of each of the individual route elements, with the aim of filtering out inappropriate route options and identifying preferred route options for more detailed quantitative assessment in the WelTAG Stage 2 appraisal. This was achieved by two sifts of the elements in a study team workshop:

- The first sift comprised an assessment of each element and a comparison of element options, where appropriate. This reduced the number of potential routes.
- The second sift involved an overview of the elements in terms of public and stakeholder acceptability, as well as technical and operational feasibility, which eliminated further unsuitable options.

Full details of the Stage 1 appraisal are provided in the *WelTAG Appraisal Report Stage 1*. Public transport options were also assessed as detailed in the *Public Transport Improvement Options Part 1 Appraisal*.

4.2 Stage 1 Appraisal – Road Schemes

The 15 route elements in Corridors A, B and C, which were considered in the Stage 1 appraisal are summarised in Table 4.1 and are illustrated on Figure B.01 in Appendix B.

Table 4.1: Stage 1 List of Elements

No.	Element	Corridor
1	A4232(T) from M4 Jn. 33 to Drope	A, B
2	Culverhouse Cross Western Bypass (including Culverhouse Cross Junction and St. Fagan's Access)	A, B, C
3	Wenvoe A4050 Online Improvement	A
4	Offline Wenvoe Improvement	A
5	North Barry Offline Improvement	A
6	St. Nicholas Southern Bypass	B
7	St Nicholas Northern Bypass	B
8	M4 Jn. 34 to Sycamore Cross – Pendoylan Bypass Outer West	C
9	M4 Jn. 34 to Sycamore Cross – Pendoylan Bypass Inner West	C
10	M4 Jn. 34 to Sycamore Cross – Pendoylan Bypass East	C
11	Five Mile Lane Sycamore Cross to Moulton A4226 Online Improvement	B, C
12	Five Mile Lane Sycamore Cross to Moulton A4226 Offline Improvement	B, C
13	Five Mile Lane Moulton to Waycock Cross A4226 Online Improvement	B, C
14	Five Mile Lane Moulton to Airport Roundabout Offline Improvement	B, C
15	A4226 Online Improvement Waycock Cross to CIA Roundabout	B, C

The primary aim of the Stage 1 appraisal was to filter and reduce the number of options in order to allow a more detailed assessment of routes in Stage 2. Where a choice of options was put forward for consideration at the Public Consultation Exercise, a comparison of the element choices was undertaken and summarised in a comparison AST. Each comparison AST provided a summary and recommendation on the route option to be considered as part of the Stage 2 assessment of routes. In cases where there was no choice in the elements put forward for consideration as part of the Public Consultation, elements were considered on an individual basis. These elements were integral to the three route corridors and were taken forward for further assessment as part of the Stage 2 review of routes.

TPOs were not assessed as part of the Stage 1 appraisal. The Stage 1 appraisal considered the individual elements of route corridors rather than specific routes. As TPOs refer to scheme objectives for whole routes, they could not practicably be applied to separate elements.

4.3 Stage 1 Results – Road Schemes

The Stage 1 WelTAG appraisal resulted in the following elements being discarded for the reasons set out in the Stage 1 report:

Table 4.3: Stage 1 Discarded Elements

No.	Route Element	Corridor
3	Wenvoe A4050 Online Improvement	A
9	M4 Jn. 34 to Sycamore Cross – Pendoylan Bypass Inner West	C
6	St. Nicholas Southern Bypass	B
7	St Nicholas Northern Bypass	B
10	M4 Jn. 34 to Sycamore Cross – Pendoylan Bypass East	C
11	Five Mile Lane Sycamore Cross to Moulton A4226 Online Improvement	B, C

As a result, of the elimination of these elements, Corridor B was discarded since a continuous route option in Corridor B would not be available. In addition, the initial COBA results indicated that Corridor B would be the least well performing corridor.

4.4 Elements for Stage 2 Appraisal

The following elements in Corridors A and C were taken forward for the Stage 2 WelTAG appraisal and combined into routes for more detailed assessment:

Table 4.4: Elements for Stage 2 Appraisal

No.	Route Element	Corridor
1	A4232(T) from M4 Jn. 33 to Drope	A,
2	Culverhouse Cross Western Bypass (including Culverhouse Cross Junction and St. Fagan's Access)	A, C
4	Offline Wenvoe Improvement	A
5	North Barry Offline Improvement	A
8	M4 Jn. 34 to Sycamore Cross – Pendoylan Bypass Outer West	C
12	Five Mile Lane Sycamore Cross to Moulton A4226 Offline Improvement	C
13	Five Mile Lane Moulton to Waycock Cross A4226 Online Improvement	C
14	Five Mile Lane Moulton to Airport Roundabout Offline Improvement	C
15	A4226 Online Improvement Waycock Cross to CIA Roundabout	C

These elements, when combined, create three routes in Corridors A and C. The three routes are:

- Route A: Elements 1, 2, 4 and 5;
- Route C1: Elements 2, 8, 12, 13 and 15;
- Route C2: Elements 2, 8, 12 and 14.

The Culverhouse Cross bypass and improvement to the National History Museum at St Fagans (Element 2) are common to all three routes. The routes are illustrated on Figure C.01 in Appendix C.

Composite ASTs were prepared for the three routes at the conclusion of the Stage 1 assessment. These tables represent a long version of an AST, but bring together the individual appraisals of route elements for the three route options. The composite ASTs also incorporate an initial review of each route against the TPOs for the scheme. It should be noted, however, that this review was undertaken on the basis of the qualitative information that was available at Stage 1. The Stage 2 appraisal incorporates a detailed and more refined analysis of the routes against the TPOs, in accordance with the WelTAG guidance, and as such the appraisal results may have changed as part of the Stage 2 assessment. The composite ASTs are provided in Appendix E.

4.5 Stage 1 Appraisal – Public Transport Options

The aim of the public transport assessment was to identify the problems regarding existing public transport provision to Cardiff International Airport and to improve the service by

assessing the merits and drawbacks of various improvement options. Access to the airport could be achieved by improving factors such as journey time, reliability, frequency, accessibility, standard of interchange/waiting facilities and reducing the need for interchange.

An AST of each public transport option was prepared and these are provided in the WelTAG Appraisal Report Stage 1. Full details of the public transport options that have been considered are provided in the Public Transport Options Part 1 Report and are summarised as follows:

Table 4.5: Public Transport Options

Ref.	Public Transport Options
Rail Options	
R1	Valley line tram train to airport terminal
R2	Heavy rail service to airport terminal
R2	Shuttle bus from Barry Station including interchange improvements with bus lanes/bus priority in Barry
R4	Shuttle bus from proposed Miskin Parkway Station (near M4 J34) (This option is dependant on a new road and new station)
R5	Re-routing of 1 train per hour from Barry Island to Rhoose/Aberthaw
R6	Re-routing of 1 train per hour from Barry Island to Bridgend
R7	Re-routing of 3 trains per hour from Barry Island to Rhoose and independent operation of Barry Island branch line
R8	Re-routing of 3 trains per hour from Barry Island to Rhoose/Bridgend and independent operation of Barry Island branch line
R9	Re-routing of 3 trains per hour from Barry Island to Bridgend and independent operation of Barry Island branch line
R10	Additional hourly Cardiff Central to Rhoose
R11	Extension of the FGW Taunton Service to Rhoose station
R12	Extension of the FGW Taunton Service to Swansea
R13	Extension of the FGW Portsmouth Harbour service to Rhoose station
R14	Extension of the FGW Portsmouth Harbour service to Swansea
R15	Two hourly Swansea to Cardiff “all stations” service increased to 1 per hour and re-routed via Rhoose
R16	Railway station on existing Vale of Glamorgan line closer to the airport terminal
R17	Cardiff Central Station interchange facility improved
R18	Bridgend Station interchange facility improvements (lifts)
Bus Options	
B1	Additional hourly X91 “limited stop” service terminating at airport
B2	Branded airbus express service
B3	Create Penarth to airport bus link by extending one of the existing Cardiff-Penarth-Barry bus services
B4	Airport-Cardiff-Newport bus/coach return service
B5	Swansea-Bridgend-Airport-Cardiff-Newport bus/coach return service
B6	More unsocial hours service to airport
B7	Bus priority measures at Culverhouse Cross, Cowbridge Road East and West
Public Transport options	
PT1	Improved information and waiting facilities at the airport and key interchanges (real-time bus and rail information
PT2	Integrated ticketing (bus and rail)
PT3	Provision for heavy luggage on bus, shuttle bus and rail services

4.6 Stage 1 Results – Public Transport Options

The first stage analysis of public transport options concluded that five public transport options should be considered in more detail as part of the Public Transport Improvement Options Part 2 Appraisal Report. These include:

Table 4.6: Public Transport Options for Stage 2 Appraisal

Ref	Public Transport Option
R1	Tram-train to airport terminal
R2	Heavy rail to airport terminal
R3	Shuttle bus from Barry station
R6	Re-routing of 1 train per hour from Barry Island to Bridgend
B2	Branded airbus express service (with possible Cardiff city centre loop for pick-up / drop-off)

4.7 Summary

In summary, the Stage 1 WelTAG appraisal assessed 15 route elements and a wide range of public transport measures to improve access to Cardiff International Airport and to reduce congestion at Culverhouse Cross. The Stage 1 appraisal concluded that three routes, Routes A, C1 and C2, plus five public transport options should be considered further as part of the more detailed and quantitative Stage 2 WelTAG assessment.

5 Stage 2 Appraisal

5.1 Introduction

The primary aim of the WelTAG Stage 2 appraisal is to undertake a detailed and, where possible quantitative assessment, of the transport options that have been taken forward from the Stage 1 assessment. The focus of the Stage 2 appraisal has been against the Welsh Impact Areas of the Economy, Environment and Society as well as assessing the performance of the transport options against the TPOs for the scheme.

5.2 Route Options

The following route options were derived from the Stage 1 appraisal and have been subject to detailed analysis during the Stage 2 appraisal:

- Route A
- Route C1
- Route C2.

The Culverhouse Cross bypass and the access modifications to the National History Museum at St Fagans are common to all three routes, which are illustrated on Figure C.01 in Appendix C. A summary of each route description is provided as follows:

- **Route A**: The route utilises the existing signposted route to the airport with widening to three lanes on the A4232(T) from M4 Junction 33 to a western bypass improvement at Culverhouse Cross, an eastern bypass of Wenvoe with traffic calming measures on the existing A4050 at Wenvoe to reduce through traffic and an offline improvement to the A4050 to the north of Barry. A new access to the National History Museum at St Fagans is also proposed, as well as safety improvements to Five Mile Lane (A4226).
- **Route C1**: The route provides a link from the M4 Junction 34 to the airport with an outer western bypass of Pendoylan, junction improvement at Sycamore Cross and improvements to Five Mile Lane (A4226). A single lane carriageway with climbing lane provision, or an additional lane in one direction would provide safe overtaking opportunities on this route. A single carriageway western bypass at Culverhouse Cross and a new access to the National History Museum at St Fagans is also proposed.
- **Route C2**: The route provides a link from the M4 Junction 34 to the airport with an outer western bypass of Pendoylan, junction improvement at Sycamore Cross and improvements to Five Mile Lane (A4226) to the north of Moulton and a new road over the Waycock Valley to connect to the existing eastern roundabout (the main access to the airport). A single lane carriageway with climbing lane provision or an additional lane in one direction would provide safe overtaking opportunities on this route. A single carriageway western bypass at Culverhouse Cross is also proposed and a new access to the National History Museum at St Fagans.

5.3 Public Transport Options

Five public transport options have been considered as part of the Stage 2 appraisal. These are summarised as follows and are illustrated on Figure D.01 in Appendix D:

- **R1: Tram train to airport terminal**. The principle of tram train operation allows for shared running of heavy rail services and light rail services on the same track. This option would require major infrastructure work to provide a direct light rail link from the Vale of Glamorgan line to the airport terminal, as well as tram infrastructure work between Cardiff Central and Cardiff Bay. There would also be a need for signalling upgrades along the Vale of Glamorgan line to allow for shared running. The proposed tram train route would provide a direct link between Cardiff Bay and Cardiff International Airport. This route may form part of a wider tram train network within Cardiff. A service

frequency that would be likely to meet the forecast demand is half-hourly. Independent operation of Barry Island to Barry services may be required due to capacity constraints at Cogan junction, which limits the number of trains that can operate between Barry and Cardiff. A likely journey time of around 30 minutes between the airport and Cardiff would provide a competitive alternative to the express bus service.

- **R2: Heavy rail link to airport terminal**. This option would require major infrastructure work to provide a direct heavy rail link from the Vale of Glamorgan line to the airport terminal. The proposed heavy rail route would provide a direct link between Pontypridd and Cardiff International Airport via Cardiff Central. A service frequency that would be likely to meet the demand is half-hourly. Independent operation of Barry Island to Barry services may be required due to capacity constraints at Cogan junction, which limits the number of trains that can operate between Barry and Cardiff. A likely journey time of around 30 minutes between the airport and Cardiff would provide a competitive alternative to the express bus service.
- **R3: Shuttle bus from Barry rail station**. In order to operate a shuttle bus from the airport and Barry station infrastructure upgrades would be required at Barry station to create a shuttle bus stop on the station forecourt. Lifts would need to be installed to provide step free access to the westbound platform at Barry station. A half-hourly service would be likely to meet demand. During peak hours, if required, the option exists to upgrade the frequency to quarter-hourly without altering rail service operation. Likely journey time savings would depend on wait time at Barry station and the implementation of bus priority measures along the shuttle bus route. These are likely to be in the region of 5 minutes compared to existing rail journeys between Cardiff and the airport via Rhoose.
- **R6: Re-routeing of one train per hour from Barry Island to Bridgend**. No major infrastructure upgrades would be required to operate two services per hour along the VoG between Barry and Bridgend. The loss of one train per hour from the Barry Island branch could be compensated by providing shuttle services between Barry and Barry Island. This would depend on the construction of a third platform within the Cardiff Area Signalling Renewal. The main benefit of this option is that by upgrading shuttle bus frequency between the airport and Rhoose station a half-hourly connection would be provided between the airport, Cardiff and Bridgend. There would also be wider benefits to commuters from Llantwit Major and Rhoose. However, this option would have no impact on journey times between the airport, Cardiff and Bridgend.
- **B2: Branded Airbus express service**. The branded express bus service is proposed to operate along the route of the existing X91 service between the airport and Cardiff bus station. Opportunities to implement bus priority measures at Culverhouse Cross may arise as a result of the proposed highway improvements. These, in conjunction with possible further bus priority measures along the route, would increase reliability of services and reduce journey times between the airport and Cardiff. Journey time savings could be reduced from around 30 minutes to around 25 minutes. A frequency enhancement from hourly to half-hourly is also proposed. The express bus services could be extended to operate into Cardiff city centre and the Cardiff Bay area, thereby providing a direct connection to the airport from a larger catchment within Cardiff.

5.4 Economic Impacts

The appraisal of the economic impact area is set out in Section 6.0 of WelTAG and has two components, which cover all the economic impacts resulting from a proposal:

- Transport Economic Efficiency (TEE), covers the impacts ordinarily captured by standard cost-benefit analysis – the impacts of a proposal within the transport sector; and
- Economic Activity and Location Impacts (EALIs), allows the impact of proposals to be expressed in terms of their effects on the local, regional and/or Welsh economy – that is, the consequences beyond the transport sector.

5.4.1 Transport Economic Efficiency

Paragraph 6.2.1 of WelTAG states that this part of the appraisal is designed to measure the impact of the proposal on the economic efficiency of the transport system. Relevant impacts include the costs and benefits incurred by users and operators of the transport system and those providing funding.

The economic impacts of the scheme were not assessed during Stage 1 as the analysis related to elements rather than complete routes. However, the methodology for the Stage 2 appraisal follows the guidance on undertaking economic assessments for transport schemes is given in WelTAG, DMRB Volume 13 and the WebTAG 3.5 series.

The economic impacts of a scheme are derived by comparing the future year situation with the scheme (Do-Something scenario) against that without the scheme (Do-Minimum). The economic assessment appraises the costs and benefits of a transport scheme that are accrued over a 60 year period in monetary terms. In order to ensure consistency, all monetary values are discounted to a common price base to give 'present values'. The current price base year for economic assessments stipulated by the guidance is 2002. The benefits are broadly made up of the following:

- Journey time savings;
- Vehicle operating cost savings;
- User charges, such as tolls; and
- Additional costs to travellers due to disruption during construction and maintenance works;

These benefits relate to the 'Economic Efficiency' of the transport system and are presented in the form of a Transport Economic Efficiency (TEE) table.

The 'public accounts' relate to the costs faced by government (either local or central) to implement the scheme. They include the following:

- Revenue (for example through the introduction of tolls);
- Operating costs;
- Investment costs;
- Developer and other contributions;
- Grant/subsidy payments; and
- Indirect tax revenues, where a positive value indicates a reduction in income (cost) to government though fuel duty etc. as a result of the scheme. A negative value indicates an increase in income to government due to the scheme.

The above costs are presented in a Public Accounts Table, as part of the Transport Economic Efficiency (TEE) tables in the "*Economic Assessment Report*".

The Analysis of Monetised Costs and Benefits Table presents a summary of the costs and benefits listed above. It also includes benefits due to savings in accidents and carbon emissions, which would be negative should either of these increase. The total benefits given in the TEE Table are combined with the accident and carbon benefits to give a Present Value of Benefits (PVB). The Present Value of Costs (PVC) is the total costs taken from the Public Accounts Table.

The Analysis of Monetised Costs and Benefits Table also presents the Net Present Value (NPV) and Benefit to Cost Ratio (BCR) for the scheme. The NPV is calculated by subtracting the present value of costs (PVC) from the total present value of benefits (PVB). The BCR is calculated by dividing the PVB by the PVC.

A positive NPV and a BCR greater than unity indicate that the benefits due to the scheme outweigh its costs and so it is positive in economic terms. The higher the NPV and BCR, the better the value for money of the scheme.

Full details of the TEE appraisal methodology and results are provided in the "*Economic Assessment Report*".

5.4.2 Economic Activity and Location Impacts

The EALI is the primary mechanism through which the potential local and national economic impacts of a scheme are understood. It is an attempt to measure economic consequences of an improvement for the real economy, outside the transport sector. The EALI is focussed on understanding how transport improvements affect the economic choices made by businesses and individuals and the consequences for economic activity and economic outcomes. For example, transport improvements can influence decisions about where to work, where to invest and where to live.

The EALI is concerned with impacts on income and employment at a local and national level. Only in the case of more significant or strategic transport improvements will there be significant net impacts at a national (Wales) level. However, smaller scale transport improvements can have gross impacts at a local level which need to be considered. The EALI is also concerned with the impacts across different social groups. The purpose is to identify winners and losers from transport improvements, identifying where improvements have particular consequences for social groups or regeneration areas.

The Stage 1 EALI appraisal comprises an initial analysis, which involves:

- Segmentation of the economic context by economic sectors or drivers of economic development – further segmentation may be required to differentiate particular economic actors/decision makers.
- Analysis of potential local and national level impacts in each sector.

At Stage 2 it is necessary to identify and quantify the impacts and address uncertainties identified in Stage 1. In most cases it will be appropriate to develop a case based on some or all of the following, depending on the chains or links identified at Stage 1:

- Primary research with relevant types/sectors of economic activity which are likely to be affected;
- Economic analysis:
  - Micro/industrial analysis;
  - Labour market analysis;
  - Property market analysis.
- Evidence of impacts from other studies.

Details of the EALI appraisal are provided in the Economic Activity and Location Impacts Stage 2 Report.

5.5 Environmental Impacts

Appraisal under the environment impact area is a requirement for both Stages 1 and 2 and the WelTAG appraisal criteria are consistent with European and national legislative requirements. A summary of the methodologies employed for the appraisal of the environment impact area are provided in the following sections. Full details of the methodologies and the detailed results of the appraisal are provided in the *DMRB Stage 2 Environmental Assessment Report* and the *Route Options - Geotechnical Overview*.

5.5.1 Noise

Noise from transport sources is measured in dB(A). Paragraph 7.4.1 of WelTAG defines noise as follows:

"Noise annoyance is defined by the World Health Organisation as 'a feeling of displeasure evoked by noise'. Noise nuisance from transport sources can adversely affect the quality of living of local communities. Vibration is a similar effect, but instead of being transmitted by air, it is transmitted by the earth. Noise is normally considered as an approximate indicator for both noise and vibration, since its effects are normally felt more strongly."

WelTAG notes that the introduction of transport proposals may generate additional noise, both during construction and system operation. However, the guidance focuses on operational noise impacts as any construction impacts will be temporary.

For Stage 1, WelTAG advises that a qualitative assessment of noise may be sufficient, but that at Stage 2 a quantitative assessment in accordance with established predictive methodologies for the estimation of road noise is appropriate. The noise assessment for the study has, therefore, been undertaken in accordance with the guidance in DMRB Vol 11 Part 7.

Traffic model predictions were not available during the consideration of individual route elements at Stage 1. As a result, the appraisal was undertaken using qualitative assessments based on the number of receptors for each element. For Stage 2, the noise assessment has been carried out under the DMRB methodology. The DMRB approach to assessing noise impact is to compare the noise levels for the Do Something scenario (with proposed scheme) against noise levels for the Do Minimum scenario (without scheme). The method requires that comparisons are made between the baseline noise situation (before the change produced by the scheme) and the noise level in both the scheme opening year and the worst-case year in the first fifteen years after opening (generally the 15th year after opening). For the purposes of this assessment the baseline and future years have been assumed to be 2013 (ie the proposed year of opening) and 2028 respectively.

The calculations are carried out according to the CRTN methodology using proprietary software. Traffic noise levels are calculated across a grid of receiver positions over the study area, and contours of noise level exposure are established. The study area extends to 600m either side of all scheme roads and those existing roads within 2km of the proposed scheme subject to large traffic flow changes (ie +25% or -20%).

Noise levels are calculated in terms of the LA10,18h index as specified in CRTN. This represents the A-weighted noise level exceeded for 10% of the time between the hours of 06:00 and 00:00 on an average weekday. The traffic flow predictions on which the noise calculations are made are taken from the traffic impact assessment data for the different scenarios.

In addition to traffic flow information, the traffic noise calculations are determined from digital mapping data including topographical and landscaping details, including man-made features such as existing noise mitigation barriers and bunding; positions of noise sensitive receivers, e.g houses, schools and hospitals; type of ground cover and type of road surface used. Noise maps have been produced for each of the three route corridors.

5.5.2 Local Air Quality

Paragraphs 7.5.1 and 7.5.2 of WelTAG define local air quality as follows:

"Exhaust emissions from transport sources disperse in the air, affecting its quality. A deterioration in local air quality can cause damage to human health and to the urban environment (e.g. through the soiling of materials, buildings and other structures), while certain pollutants can affect the world's climate (contributing to global warming though greenhouse gas emissions)…The key local pollutants that affect local air quality are PM_{10} and NO_2."

Traffic model predictions were not available during the consideration of individual route elements at Stage 1. As a result, the appraisal was undertaken using qualitative assessments based on the number of receptors for each element. For Stage 2, the methodology used for the air quality assessment is based on the WelTAG guidance, which refers extensively to Volume 11, section 3, Part 1 of the Design Manual for Roads and Bridges (DMRB). The air quality assessment of the development proposal consists of the following components:

- A review of the existing air quality situation;
- Collation of road traffic data and scoping out of local road links with changes in traffic flows or speeds too small to influence local air quality under each proposed scheme;
- An assessment of the changes in air quality at representative receptors arising from the operation of the proposed scheme as a result of the changing the road access strategy for Cardiff International Airport and adjoining road network for each proposed option;
- A comparison of changes in local exposure to road traffic related air pollution for each proposed option; and
- The proposal of mitigation measures, where appropriate, to ensure any adverse effects on air quality are minimised.

Air quality has been assessed with reference to four potential impacts:

- Exhaust NOx, PM10, PM2.5 and CO2 emissions at the source (i.e. not considering the effects of dispersion). This is based on the total emissions from all affected links within the traffic model domain.
- NO2, PM10 and PM2.5 concentration levels at representative human receptors for comparing predictions to air quality standards, hence enabling an indirect correspondence to be made between the impact and human health.
- Local exposure to NO2, PM10 and PM2.5 concentrations for each route option. There are no assessment criteria for this metric but it does provide a useful means of comparing each route option.
- NOx concentrations and nitrogen deposition rates within designated nature conservation sites (SSSIs, SACs, SPAs and Ramsar sites) for comparing predictions to air quality standards and environmental capacity.

5.5.3 Greenhouse Gases

The methodology for the calculation of greenhouse gases is provided in the DMRB Volume 11 Section 3 on Air Quality. The results of the assessment are provided in Table 5.5.3. Table 5.5.3 refers to the following user classes:

- UC1: Cars commuting;
- UC2: Cars shopping;
- UC3: Cars employers business;
- UC4: Cars – other;
- UC5: CIA staff – commuting;
- UC6: CIA passengers;
- UC7: Light goods vehicles;
- UC8: Heavy goods vehicles (OGV 1);
- UC9: Heavy goods vehicles (OGV 2).

Table 5.5.3: Airport Access - Carbon Emissions (Results from TUBA, based on variable demand model) for Routes A, C1 and C2

Route A	**Emissions (tonnes)**			**Cost (£000, medium)**		
	Do Minimum	Do Something	Change	Do Minimum	Do Something	Change
UC1	3793344	3810663	17319	121263	121846	583
UC2	2113807	2115878	2071	67574	67653	79
UC3	1455515	1464346	8831	46805	47100	295
UC4	3614248	3631299	17051	115686	116252	566
UC5	34813	35284	471	1118	1133	15
UC6	131605	143332	11727	4156	4526	370
UC7	2628026	2646667	18641	82821	83414	593
UC8	3366889	3377909	11020	108618	108970	352
UC9	4402427	4414650	12223	139835	140220	385
TOTAL	**21540674**	**21640028**	**99354**	**687876**	**691114**	**3238**
Route C1	**Emissions (tonnes)**			**Cost (£000, medium)**		
	Do Minimum	Do Something	Change	Do Minimum	Do Something	Change
UC1	3793344	3799454	6110	121263	121472	209
UC2	2113807	2114140	333	67574	67587	13
UC3	1455515	1464112	8597	46805	47078	273
UC4	3614248	3627894	13646	115686	116121	435
UC5	34813	35357	544	1118	1135	17
UC6	131605	145392	13787	4156	4586	430
UC7	2628026	2640703	12677	82821	83223	402
UC8	3366889	3370894	4005	108618	108739	121
UC9	4402427	4407025	4598	139835	139973	138
TOTAL	**21540674**	**21604971**	**64297**	**687876**	**689914**	**2038**
Route C2	**Emissions (tonnes)**			**Cost (£000, medium)**		
	Do Minimum	Do Something	Change	Do Minimum	Do Something	Change
UC1	3793344	3800157	6813	121263	121498	235
UC2	2113807	2112850	-957	67574	67550	-24
UC3	1455515	1462312	6797	46805	47023	218
UC4	3614248	3627577	13329	115686	116116	430
UC5	34813	35548	735	1118	1142	24
UC6	131605	146102	14497	4156	4606	450
UC7	2628026	2639186	11160	82821	83179	358
UC8	3366889	3373981	7092	108618	108833	215
UC9	4402427	4410237	7810	139835	140070	235
TOTAL	**21540674**	**21607950**	**67276**	**687876**	**690017**	**2141**

5.5.4 Landscape and Townscape

WelTAG states in Paragraph 7.7.1 that the *"..landscape character of a place is derived from the underlying geology, natural processes and human activity on the land over the years. Townscape relates to the physical and social features of the urban environment, hence is applied to built-up areas. Both aspects are concerned with any visual impact caused by the implementation of the scheme under consideration." (sic)*

WelTAG does not include a specific category on visual effects, but for completeness an appraisal of visual affects has been undertaken as part of the appraisal. The landscape and visual effect assessment has been carried out in accordance with the DMRB Volume 11 Section 3, Part 5 and has taken account of the approach used in WelTAG. The assessment has also followed the "Guidelines for Landscape and Visual Impact Assessment" 2nd Edition by The Landscape Institute and Institute for Environmental Management and Assessment. This methodology has been followed for both the Stage 1 and Stage 2 assessments.

The baseline assessment was been carried out in the summer of 2008 and the Vale of Glamorgan and Cardiff LANDMAP, landscape character and Special Landscape Area (SLA) information dates from this time. Whilst LANDMAP is cited as an important resource in WelTAG there is no definitive guidance on precisely how to use this information to inform effects on landscape. This assessment uses LANDMAP in terms of the value of aspects areas affected by route options and as the basis for deriving landscape character areas and the sensitivity of those character areas.

The landscape assessment has been undertaken by conducting a desktop study of Ordnance Survey maps and photographs, followed by an overview on-site survey, undertaken by a Chartered Member of The Landscape Institute. Areas of similar landscape character have been identified and landscape sensitivity to change considered. The magnitude of the effect and the significance of predicted effects on the landscape are also assessed.

In terms of visual effects, the extent to which the various routes and route elements affect visual receptors has been ascertained by a combination of desk study of Ordnance Survey maps and aerial photographs with on-site observation from various viewpoints on or near the routes. The level of study is proportionate to the stage of the assessment and should not be taken as a detailed and comprehensive assessment from individual properties and receptors, which is appropriate at a later stage. However it provides an indication of the broad level of effect and gives a picture of the relative effects of each element and route option.

5.5.5 Biodiversity

Biodiversity, as defined in Paragraph 7.8.1 of WelTAG, relates to the loss, damage or disturbance of fauna and flora, ecosystems and habitats. It also relates to any enhancement of biodiversity.

The assessment methodology as applied to Stage 1 and 2 is published in DMRB Vol.11 Section 3 Part 4. Further guidance with regard to ecological impact assessment has been published by the Institute for Ecology and Environmental Management (IEEM 2006). The biodiversity assessment of the scheme proposal consists of the following components:

- Desk top assessment;
- Consultation with the relevant statutory consultees and non-statutory organisations to obtain ecological data for a study area focused on the options; and
- An ecological walkover survey.

A desk-top assessment has been carried out based on all relevant and available information that could be sourced from website-based searches and information to gain a more thorough understanding of the physical conditions experienced across the study area. Data

collected and reviewed as part of this desk-top analysis is presented using Geographical Information Systems (GIS). GIS software features spatial analysis tools which can be utilised to organise a range of data sets for presentation within a specified study to show the spatial extent of any environmentally sensitive areas. The information was incorporated into the GIS database and an associated map of the study area, to allow visual assessment of the potential environmental effects of each of the Transport Corridors.

Datasets included designated sites such as Special Areas of Conservation (SAC), Special Protection Areas (SPAs), Ramsar Sites, Sites of Special Scientific Interest (SSSIs) and National Nature Reserves (NNRs); non-statutory sites of local importance for nature conservation, to include: ecosites, Sites of Importance for Nature Conservation (SINCs), Woodland Trust Sites, Local Nature Reserves; and other valuable habitats to include hedgerow networks, LBAP priority habitats and species.

The ecological walkover survey was undertaken during April 2008 broadly following the 'Extended Phase 1' methodology as set out in Guidelines for Baseline Ecological Assessment (Institute of Environmental Assessment 1995). The area surveyed covered all of the proposed Transport Corridors with a 500m buffer where practicable. Access was restricted to public roads and footpaths which were walked along, and where possible vantage points were used to scan the area with binoculars, thereby providing visual coverage of a wider area.

Any gaps were filled in using CCW's existing Phase 1 habitat data and aerial photographs. The extended phase 1 habitat survey provides information on the habitats in the survey area and assesses the potential for notable fauna to occur in or adjacent to the site. Target notes are used to describe habitat and species composition and highlight features of ecological interest. Plant names follow New Flora of the British Isles (2nd edition, Stace 1997).

5.5.6 Soils

Paragraphs 7.9.1 and 7.9.2 of WelTAG refer to soils. It states that,

"Transport schemes can have an impact on the soil of an area, which in turn can strongly influence the vegetation and general habitats the area can support. They may also have an effect on the local agricultural and horticultural practices. The converse an also occur, whereby poor soil conditions can constrain the proposed development (e.g. contaminated land."

WelTAG recommends that the assessment should include the consideration of geological interest, soils and contaminated land. Accordingly, a geotechnical overview of the route options had been prepared on the basis of available desktop information. The review summarises the engineering geological characteristics and comments on any associated geotechnical risks. It also summarises the route options on a chainage by chainage basis and provides preliminary geotechnical comments.

With regard to soils, the assessment comprised a desktop review of the 1:250 000 Series Agricultural Land Classification (ALC) map in order to identify the quality of agricultural land in the study area. The routes were mapped using a Geographical Information System (GIS) and their lengths measured. These were multiplied by the widths of the different road types applicable on the sections of the routes to give an area of agricultural land lost in each ALC grade. Where the route option involves widening of an existing road, it is assumed that agricultural land take would be negligible. This method also does not take account of land take associated with earthworks for the route options.

5.5.7 Heritage

Paragraph 7.10.1 of WelTAG defines heritage as:

- Buildings (singly or in groups) of architectural or historical importance;
- Areas, such as parks, gardens, other designed landscapes or public spaces, remnant historic landscapes, archaeological complexes and heritage coasts;

- Sites (e.g. ancient monuments, places with cultural or historical associations such as battlefields, preserved evidence of human effects on the landscape, etc);
- Individual artefacts that form part of the overall archaeological resource; and
- The sense of identity and place which the combination of these features provides.

The assessment methodology as applied to Stage 1 and 2 is published in DMRB Volume 11 Section 3 Part 2. Further guidance with regard to archaeological impact assessment has been published by the Institute of Field Archaeologists Standard and Guidance for Archaeological Desk Based Assessment (Revised September 2001). The cultural heritage assessment of the scheme proposal consists of the following components:

- Desk top assessment of documentary, cartographic, aerial photographic and archaeological sources;
- Consultation with the relevant statutory consultees and non-statutory organisations to obtain cultural heritage data for a study area focused on these options;
- An archaeological walkover survey from publicly accessible land.

The Historic Environment Record (HER) data was collected for the study. This includes a comprehensive list of scheduled ancient monuments, the sites and monuments records, as well as the National Monuments Records for Wales and unpublished archaeological reports for the study area. Historical maps were examined at the National Library of Wales, in Aberystwyth, along with additional documentary sources held by the National Library of Wales. Online resources such as the Vale of Glamorgan County Treasures series were consulted.

An aerial photographic report was undertaken by Waterman CPM: Environmental Planning and Design. The object of the interpretation was to provide information on the location and nature of archaeological features or areas of archaeological potential visible on existing aerial photographs within the study area. Consultation was undertaken with the Curatorial Planning Officer at the Glamorgan Gwent Archaeological Trust on the 18th April 2008. An archaeological walkover survey from publicly accessible land was conducted on the 17th April 2008.

5.5.8 Water Environment

Paragraph 7.11.1 of WelTAG refers to water quality. It states that effects on water quality include any changes likely to occur to the existing water course (including rivers, ponds, lakes, wetlands and underground resources).

Baseline studies were undertaken to gain an understanding of the water environment in the study area to inform the Stage 1 and Stage 2 appraisal. Baseline data gathered comprised:

- Mapping and aerial photography
- Water quality (using the EA's GQA data)
- Mapping of flood zones (also available on the EA's website)
- Data on Source Protection Zones (SPZs)
- The Local Environment Agency Plan (LEAP) for the Ely and Vale of Glamorgan Area.

In line with DMRB, the importance of the water environment attributes present in the study area was estimated. This ranges from low to very high. Following establishing the baseline for the water environment, the magnitude of impact on the water environment attributes was estimated. The magnitude of impact was arrived at differently for the different elements of the water environment, but in all cases, a Geographic Information System (GIS) was used to map the route options onto the baseline data sets. The following activities were undertaken in order to estimate the magnitude of impact:

- Rivers and streams – in line with DMRB, this focuses on the risk of contamination of the watercourses from accidental spillages or routine runoff. At this stage of the project it is not possible to quantify the risk and as such a qualitative judgement of the risk was made. Potential impact on fisheries and nature conservation sites was also considered.
- Lakes, ponds and reservoirs – as for rivers and streams above.
- Groundwater – For rivers and streams, a quantitative approach at estimating the risk of contamination was not possible at this stage and a qualitative judgement of this risk was made. Loss of aquifers was also considered.
- Flood plain – the quantitative assessment of change in peak flood level recommended in DMRB was not possible at this stage of assessment. A qualitative judgement of the effects on flood plains was instead made.

5.6 Social Impacts

Paragraph 2.4.17 of WelTAG states that transport proposals, as well as having impacts on economic performance and the environment, can affect the more general quality of people's lives. The aim of the Society impact area in WelTAG is to *'capture, describe and where possible quantify these impacts. As with environment, there is no single or simple valuation measure and consequently a number of criteria need to be used in the appraisal'*.

The consideration of the social impacts of transport proposals are set out in detail in Section 8 of WelTAG. This states that social objectives, such as improving the quality of life, health and welfare are central to policy in Wales. *"Wales: A Better Country"* states that:

"We will continue to promote social inclusion by focusing all of our policies – economic, health, education, transport, housing, the Welsh language and culture and the environment – on building stronger and more sustainable communities across Wales."

WelTAG sets out guidance methodology on how social impacts should be assessed, the assessment for Stage 1 being less detailed than for Stage 2. Full details of the methodology and the results of the appraisal are provided in the following documents:

- WelTAG Social Impacts Report – Stages 1 and 2;
- Walking and Cycling Accessibility Report;
- Non-Motorised User Context Report.

5.6.1 Transport Safety

WelTAG confirms that the promotion of a safer transport system is a key priority in Wales. It defines transport safety in Paragraph 8.2.1 as *"freedom from risk of transport accident" and under this criterion are generally found estimates of the number of personal injury accidents avoided, changes in the severity of accidents and damage to property that would result from a transport proposal."*

WelTAG acknowledges that at Stage 1 it is unlikely that a detailed analysis of transport safety will be available and as such, the Stage 1 appraisal was based on a qualitative assessment. The Stage 2 appraisal methodology for transport safety is set out in Paragraphs 8.2.5 – 8.2.11 of WelTAG.

In accordance with WelTAG, accident analysis for the scheme has been undertaken in line with the current Department for Transport guidance in DMRB (Volume 13, Section 1, Part 2). For the purpose of this assessment, the calculation of accident benefits has been restricted to that part of the network most affected by the Do- Something scenarios.

5.6.2 Personal Security

WelTAG defines personal security in Paragraph 8.3.1 and states that it is intended to mean *"freedom from risk or fear of attack or robbery and extends to the transport user's personal possessions, including bicycles''*. WelTAG states that the degree of security which

individuals feel when using the transport network is of great importance. It can influence their choice of mode, destination and time of travel (Paragraph 8.3.3). An individual's sense and perception of security may change and increase with features, such as better lighting, CCTV and informal surveillance (Paragraph 8.3.4).

Paragraph 8.3.9 of WelTAG confirms that a qualitative analysis of personal security impacts will be satisfactory for both Stage 1 and 2 and recommends that the assessment should follow the appraisal principles set out in WebTAG Unit 3.4.2 on the Security Sub-Objective. The general principles for assessing personal security for road schemes set out in WebTAG have observed in preparing the assessment. In particular, the following personal security issues have been considered:

- Improvements to highway safety, which may reduce road users' vulnerability to crime by reducing incidents and delays;
- Reduced congestion and delays at traffic lights, which may reduce road users' vulnerability to crime;
- Design of laybys to existing highway standards so that they would be clearly visible from a distance and with clear sight lines to all areas;
- Potential for improvements to footbridges and crossing points to improve safety.

5.6.3 Permeability

Permeability is defined in Paragraph 8.4.1 of WelTAG and relates to any change in the ease with which people in the affected area can travel by non-motorised modes. It is intended to capture the impact of a proposal on the movement of people in its vicinity on foot, by bicycle and on horseback.

WelTAG requires the assessment of permeability to take account of freedom of movement and the capacity to reach key services, while the WebTAG Severance Sub-Objective tends to focus on the estimation of numbers of pedestrians, cyclists or equestrians that would be affected. As the information on pedestrian or cyclist flows in the study area is either general or related to existing road links, the estimation of the number of people whose permeability might be affected is problematic. As a result, a qualitative assessment for both Stages 1 and 2 has been undertaken based on the appraisal of non-motorised user (NMU) activity as set out in the Design Manual for Roads and Bridges. A separate Non-Motorised User Context Report has been prepared and the main findings of that report have informed the appraisal of permeability.

5.6.4 Physical Fitness

The physical fitness criterion is considered in Paragraph 8.5.1 of WelTAG and includes opportunities for travelling on foot, bicycle or on horseback. WelTAG considers that the link between health and transport includes increased fitness through physical activity, safety and environmental benefits, reduced congestion, accidents and carbon emissions and time savings.

WelTAG acknowledges, in Section 8.5, that data to measure changes in trips by active modes may be limited. As a result, a qualitative assessment has been undertaken for both the Stage 1 and Stage 2 assessment, based on a reasoned view on whether travel by active modes would be likely to increase or decrease as a result of the scheme. The assessment is supported by the results of the *Walking and Cycling Accessibility Report* and the *Non-Motorised User Context Report*.

5.6.5 Social Inclusion

WelTAG considers that social inclusion and accessibility are effectively synonymous. Paragraph 8.6 states,

"…accessibility is the measurement of the relative ease with which people can get to destinations and obtain the services that are important to them."

"Social inclusion…is the degree with which members of society are able to lead a full life. Its converse, social exclusion, is the situation faced by many people whose choices are limited by a range of barriers, a key one of which is lack of suitable transport."

Although WelTAG acknowledges that social inclusion has a wider reach than accessibility, such as poverty or low educational attainment, within the transport context of WelTAG social exclusion is *"the degree to which a lack of accessibility hampers individuals' quality of life."*

Paragraph 8.61 of WelTAG notes that particular interest is focused on those people whose options in life are limited by not having the transport they would wish to have. For instance, people without a car are more likely to find it hard to make important journeys as the distance may be too great to walk or cycle and public transport may not offer the services they need.

WelTAG also includes a requirement for the preparation of a Social Inclusion Report if certain tests are met. It was concluded that the scheme was of sufficient scale to trigger the preparation of a Social Inclusion Report and this has been incorporated into the Social Impacts Report. The appraisal methodology requires the consideration of accessibility to key services by public transport. These are:

- Access to an NHS District General Hospital in terms of the number of households within 60 and 90 minute public transport travel time between 10:00 and 12:00 on a Tuesday;
- Access to Post-16 Learning Providers in terms of the number of people aged 16-74 within 60 and 90 minute public transport travel time between 07:00 and 09:00 on a Tuesday;
- Access to a Key Centre in terms of the number of households within 60 and 90 minute public transport travel time between 10:00 and 12:00 on a Saturday.
- Access to a Key Centre in terms of the number of households within 60 and 90 minute public transport travel time between 20:00 and 22:00 on a Saturday.

An assessment of accessibility by public transport to these key facilities before and after the scheme has been undertaken using Accession modelling.

5.6.6 Equality, Diversity and Human Rights

Paragraph 8.7.2 of WelTAG confirms that the Wales Transport Strategy promotes the Welsh Assembly Government's commitment to mainstreaming equality and human rights, which is defined as *"respecting and integrating diversity and equality of opportunity into everything that it does"*. The Welsh Assembly Government has a statutory duty to promote equality through its strategic policies. These focus on all equality impact groups including age, sexual orientation, religion or belief and human rights.

Paragraph 8.7.8 of WelTAG states that if a scheme has no discriminatory effect, the Stage 1 assessment should be recorded as neutral and that no further assessment is required. This is confirmed in Paragraph 8.7.12 in respect of the Stage 2 assessment. As the Stage 1 assessment of the scheme recorded the equality, diversity and human rights impact as neutral, this issue has not been considered at Stage 2 in accordance with the advice set out in WelTAG.

5.7 Health Impact Assessment

The completion of a Health Impact Assessment (HIA) is a mandatory requirement of WelTAG. However, WelTAG does not provide any guidance for conducting such an assessment. Nevertheless, paragraph 9.2.4 of WelTAG does state that,

"HIA should be developed to suit the circumstances, making the best use of resources and time available. To this regard, the impact of a transport proposal on health and wellbeing can be demonstrated by extracting relevant components of the WelTAG output and re-defining them in accordance with the conditions of HIA."

An HIA of the scheme has been undertaken and, in accordance with the guidance in WelTAG, the HIA is based on the relevant appraisal criteria for the scheme. The HIA is provided in a separate Health Impact Assessment report for the study.

5.8 Public Transport Interface with Routes

This criterion was included in the Stage 2 appraisal summary tables in order to provide a link between the routes and the public transport options.

5.9 Nearby Public Facilities

An additional criterion on nearby public facilities was included in the assessment to provide further detail in the appraisal. This category lists key public facilities, such as schools, in proximity to the three routes.

5.10 Public and Stakeholder Acceptability

This category provides a summary of the public consultation responses and the responses received from stakeholders. With regard to stakeholder responses, only those stakeholders that expressed a preference on the routes were included in the appraisal summary tables. Full details of the public consultation response and stakeholder comments are provided in the Public Consultation Report.

5.11 Construction Issues

The section on construction issues considers likely disruption during construction to traffic and receptors along the routes, road closures and the need for night working, plus impacts on and disruption to property. Details are provided in the Technical Appraisal Report, Section 6.5.

5.12 Technical and Operational Feasibility

This category considers the technical and operational feasibility of the three routes. Issues considered include network resilience, the availability of alternative routes in the event of a major incident and the relief of congestion along the route and other transport corridors. Details are provided in the Technical Appraisal Report.

5.13 Financial Affordability and Deliverability

Issues considered include the estimated scheme costs for each route and opportunities for phased construction. Details are provided in the Technical Appraisal Report.

5.14 Risks

A review of risks associated with each route has been undertaken. Full details of potential risks are provided in the Risk Register Report for the project.

5.15 Appraisal Summary Tables (ASTs)

Appraisal Summary Tables have been prepared for each of the route options, together with a summary appraisal of the three routes. Copies of the ASTs and the Summary Appraisal of Routes are provided in Appendix F.

The public transport measures have been compared against the TPOs for the scheme. However, full ASTs on the public transport options have not been prepared as the measures are considered in detail in the Public Transport Improvement Options Report Part 2. That report included a “traffic light” appraisal of the selected options against a range of criteria including timescale, capital cost, operating cost, implementability, feasibility, increased public transport mode share and accessibility. Finally a comparative analysis of public transport options has been undertaken incorporating the traffic light appraisal and the analysis of TPOs. A copy of the Traffic Light Appraisal Summary Table, Public Transport

Assessments and the Summary Appraisal of Public Transport Options are provided in Appendix G.

As far as practicable, the ASTs have been written in non-technical language so that they can be readily understood by members of the public. However, due to the nature of some of the technical appraisals, it has been necessary to include a number of technical terms and reference documents within the ASTs. As a result, a comprehensive Glossary of Terms has been prepared to explain any technical references and is provided in Appendix H.

5.16 Conclusions

The Stage 2 appraisal has assessed three routes and five public transport options to improve access to Cardiff International Airport and to reduce congestion at Culverhouse Cross in accordance with the WelTAG appraisal guidance.

Although route A performs the best economically, it does not fulfil the Transport Planning Objectives as strongly as routes C1 or C2. Of the three road improvements taken forward to WelTAG Stage 2 Appraisal, Route C1 is the best overall and recommended to be taken forward.

The proposed route C1 has a positive benefit:cost ratio of 3.27 with Central Growth forecasts and would be expected to best deliver beneficial impacts for the Welsh economy in widening the airport's catchment area, improving international connectivity and accessibility to Barry and St Athan. The WelTAG appraisal summary indicates it best meets the Welsh Impact Areas although further mitigation measures to address the adverse environmental issues will need to be considered at key stage 3 as part of the Environmental Statement.

None of the road improvements by themselves meet the Transport Planning Objectives agreed for the study regarding improvements to public transport and a reduction in the level of car dependency. These objectives are considered to be most effectively addressed by the inclusion of associated public transport measures as part of a scheme package. These measures have been identified as short, medium and long term measures.

The short term measures are the introduction of a branded express bus service from Cardiff city centre, with improved real time public transport information and luggage facilities. Another short term option is the rerouting of one Barry Island train per hour to Bridgend to increase the frequency of the rail service on the Vale of Glamorgan Line to half-hourly.

The medium term measure would be the introduction of a shuttle bus from Barry Station. Long term measures that require further investigation are the tram train or heavy rail service to the airport terminal but their economic viability are dependent upon the level of growth at the airport.

Out of the five public transport improvement options assessed in the WelTAG Stage 2 Appraisal, both of the long term options focus on creating a direct rail connection to CIA either for heavy rail or tram train vehicles. In comparison to all other options a proposal for a direct heavy rail or tram train link to the airport best addresses the planning objectives of reducing car dependency and improving public transport links to CIA. Both the tram train and heavy rail would also provide significantly more capacity than other options, because they are based purely on rail rather than a combination of bus and rail or wholly on bus. Consequently, to cater for potentially high future demand forecasts and encourage mode shift towards public transport the long term ambition should be to create a direct rail connection to CIA in addition to any short term measures that may be necessary on a temporary or permanent basis.

Both the tram train and heavy rail proposals perform similarly in terms of improving accessibility and increasing public transport mode share, but there are some differences which help to identify the better performing option out of the two. The key performance indicators that highlight differences between heavy rail and tram train are operating cost and

feasibility. Analysis has shown that tram train operation might reduce operating costs by up to 30%. A tram train rail alignment between CIA and Porthkerry is also judged to be technically more feasible because design guidelines allow for much steeper gradients and tighter curve radii. The differences in design between heavy rail and tram train would also impact on construction costs, with heavy rail being the more expensive of the two.

Appendix A

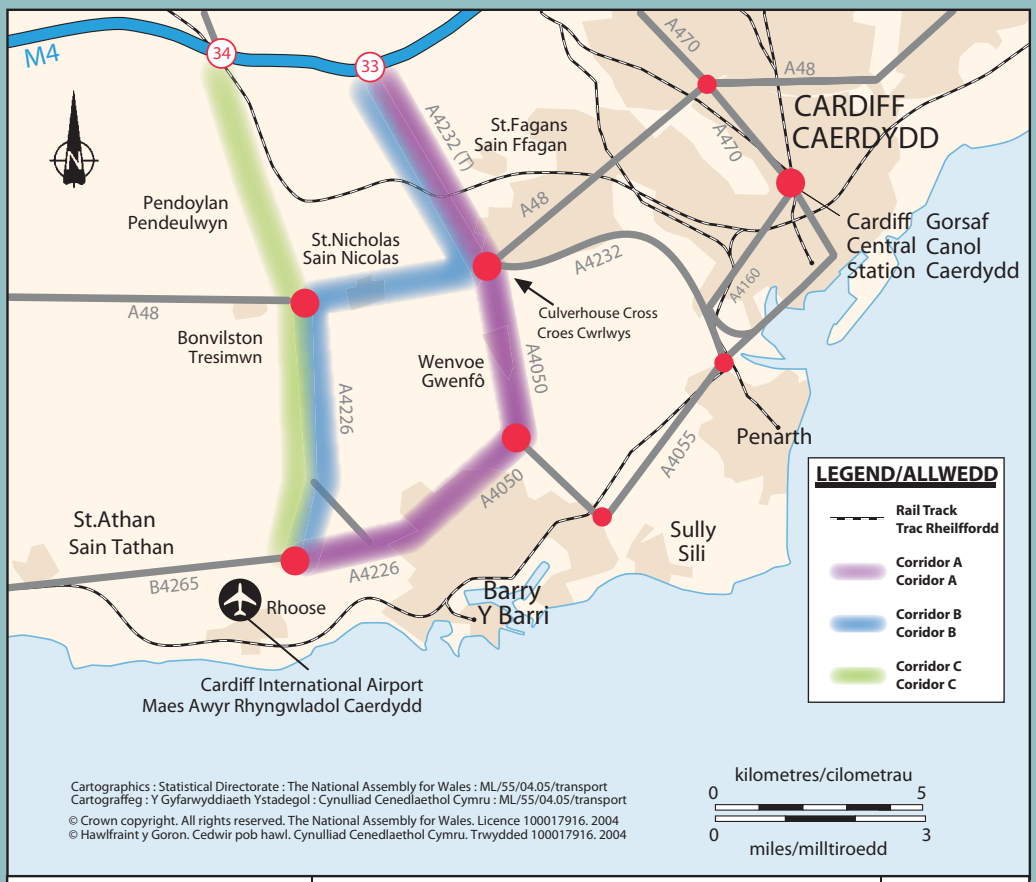
Public Consultation Brochure

Welsh Assembly Government
Transport Wales

Llywodraeth Cynulliad Cymru
Trafnidiaeth Cymru

Improving Access to Cardiff International Airport

Public Consultation - July 2008



Cartographics : Statistical Directorate : The National Assembly for Wales : ML/55/04.05/transport
Cartograffeg : Y Gyfarwyddiaeth Ystadegol : Cynulliad Cenedlaethol Cymru : ML/55/04.05/transport

Date/ Dyddiad	Exhibitions/ Arddangosfeydd	Time/ Amser
Wednesday 9 July 2008 Mercher 9 Gorffennaf 2008	Wenvoe Community Centre, Wenvoe Y Ganolfen Gymunedol, Gwenfo	10am - 7pm
Thursday 10 July 2008 Iau 10 Gorffennaf 2008	Pendoylan Memorial Hall, Pendoylan Neuadd Goffa Pendeulwyn, Pendeulwyn	10am - 7pm
Friday 11 July 2008 Gwener 11 Gorffennaf 2008	Bonvilston Reading Room, Bonvilston Ystafell Ddarllen Tresimwn, Tresimwn	10am - 8pm
Saturday 12 July 2008 Sadwrn 12 Gorffennaf 2008	Highlight Park Community Centre, Stirling Road, Barry Canolfan Gymunedol Highlight Park, Stirling Road, Y Barri	10am - 5pm

Gwella Mynedaid i Faes Awyr Rhyngwladol Caerdydd

Pamffled ymgynghoriad cyhoeddus - Gorffennaf 2008

Introduction

This brochure is part of the Welsh Assembly Government's study to improve access to Cardiff International Airport and ease congestion around Culverhouse Cross. It provides:

- Information about public transport
- Plans of three road corridors being considered and the options in each one
- Details of forthcoming public exhibitions (9-12 July 2008)
- Information about how you can make comments on the options
- Information on what happens next.

Purpose of the Study

Cardiff International Airport has experienced considerable growth. This puts increasing demand for access to the airport on an already busy road network, particularly in the Culverhouse Cross area of Cardiff. It is forecast that the traffic situation will worsen unless improvements are made. The Welsh Assembly Government commissioned consultants, Arup, to investigate transport options to improve access to the airport and alleviate traffic and safety problems at Culverhouse Cross. At previous public exhibitions, public transport and road improvements were identified to help solve specific problems. The key objectives are:

- To improve public transport accessibility to/from the airport
- To improve private transport accessibility to/from the airport
- To reduce congestion at Culverhouse Cross
- To improve transport safety in the study area.

Arup are investigating various options to address these issues whilst taking into account social, environmental and economic considerations. The options explored are summarised here, but you can find out more at the exhibitions.

Cyflwyniad

Mae'r pamffled hwn yn rhan o astudiaeth Llywodraeth Cynulliad Cymru i wella mynediad i Faes Awyr Rhyngwladol Caerdydd ac i liniaru tagfeydd o amgylch Croes Cwrlwys. Mae'n cynnwys:

- gwybodaeth am drafnidiaeth gyhoeddus
- cynlluniau tri choridor ffordd sy'n cael eu hystyried a'r opsiynau ar gyfer pob un ohonynt
- manylion am yr arddangosfeydd cyhoeddus sydd ar ddod (9-12 Gorffennaf 2008)
- gwybodaeth am sut y gellir rhoi sylwadau am yr opsiynau
- gwybodaeth am yr hyn sy'n digwydd nesaf.

Diben yr astudiaeth

Mae Maes Awyr Rhyngwladol Caerdydd wedi profi twf sylweddol. Mae hyn yn galw am fynediad cynyddol i'r maes awyr gan ddefnyddio rhwydwaith sydd eisoes yn brysur, yn enwedig yng nghyffiniau Croes Cwrlwys, Caerdydd. Mae'n rhagweld bydd y sefyllfa traffig yn gwaethygu oni bai fod gwelliannau yn cael ei wneud. Mae Llywodraeth Cynulliad Cymru wedi comisiynu'r ymgynghorwyr Arup i archwilio pa opsiynau trafnidiaeth sydd ar gael er mwyn gwella mynediad i'r maes awyr ac i liniaru problemau traffig a diogelwch yng Nghroes Cwrlwys. Mewn arddangosfeydd cyhoeddus blaenorol, cafodd gwelliannau i drafnidiaeth gyhoeddus ac i'r ffyrdd eu hadnabod er mwyn helpu i ddatrys problemau penodol. Dyma'r amcanion allweddol:

- Gwella hygyrchedd trafnidiaeth gyhoeddus yn ôl ac ymlaen o'r maes awyr
- Gwella hygyrchedd trafnidiaeth breifat yn ôl ac ymlaen o'r maes awyr
- Lleihau tagfeydd yng Nghroes Cwrlwys
- Gwella diogelwch trafnidiaeth yn ardal yr astodiaeth

Mae Arup yn archwilio amryw o opsiynau er mwyn cyfeirio at y materion hyn gan ystyried materion cymdeithasol, amgylcheddol ac economaidd. Mae'r opsiynau'n cael eu harchwilio yma, ond gallwch ddod o hyd i fwy o wybodaeth yn yr arddangosfeydd.

What happens if we do nothing?

The main signposted access to the airport is from M4 Junction 33 along the A4232(T) through Culverhouse Cross junction and the A4050 through Wenvoe and Barry. This route is heavily trafficked and suffers from congestion at peak times. Culverhouse Cross has been a recent focal point for 'out of town' land use developments, adding to congestion in the area. If nothing is done we can expect:

- A reduction in journey time reliability to the airport
- Increased community severance and environmental degradation through increased traffic flows on local roads
- A continuing poor safety record on some routes to the airport
- Worsening congestion at Culverhouse Cross and on the A4232(T) with little alternative when incidents occur
- Limited accessibility to and from the airport by public transport.

Beth fydd yn digwydd os na wneir dim?

Gellir dod oddi ar Gyffordd 33 yr M4 ar hyd yr A4232(T) drwy gyffordd Croes Cwrlwys a'r A4050 drwy Wenfô a'r Barri er mwyn dod o hyd i brif fynediad y maes awyr, sydd ag arwyddbyst. Mae traffig trwm ar y ffyrdd hyn ac fe geir tagfeydd yn ystod oriau brig. Mae Croes Cwrlwys wedi bod yn ganolbwynt ar gyfer datblygu defnydd tir 'y tu allan i'r dref', gan ychwanegu at dagfeydd yr ardal. Os na wneir dim, disgwylir:

- lleihad yn nibynadwyedd hyd y siwrnai i'r maes awyr
- mwy o dor-cysylltiad cymunedol a dirywiad amgylcheddol drwy fwy o lif traffig ar ffyrdd lleol
- Cofnod diogelwch gwael parhaol ar rai o'r ffyrdd i'r maes awyr
- Tagfeydd sy'n gwaethygu yng Nghroes Cwrlwys ac ar yr A4232(T) heb fawr o ffyrdd eraill i'w dewis pan fo damweiniau'n digwydd
- Hygyrchedd cyfyngedig yn ôl ac ymlaen o'r maes awyr gan ddefnyddio trafnidiaeth gyhoeddus.

Public Transport

A key action of The Wales Transport Strategy (2008) is to improve public transport links to Cardiff International Airport.

Current access to the airport is mainly by private car. However, in order to provide more sustainable travel options, public transport to the airport must be further improved.

The Welsh Assembly Government is undertaking a study to test the impact of a series of measures to improve local and regional public transport access to the airport in the short, medium and long term.

Possible short-term measures include:

- Re-routing one train per hour from Barry Island to Bridgend and increasing shuttle bus frequency to give half-hourly rail access to the airport via Rhoose station.
- Increase of the X91 'limited-stop' bus service frequency to half-hourly or less between Cardiff city centre and the airport.
- More frequent bus services to cater for shift patterns of airport workforce and early or late flights.
- A direct express bus service from Cardiff city centre to the airport.
- Real-time bus & rail information at the airport terminal.
- Better heavy luggage facilities on bus & rail.

Possible medium-term measures include:

- Bus lanes and bus priority measures at the most congested areas in Cardiff and the Vale of Glamorgan to decrease bus journey times and increase reliability.
- Long distance rail services to call at Rhoose station to provide direct access to the airport for more people.
- Shuttle bus operation at minimum half-hourly frequency from Barry instead of Rhoose station.
- Provision of a railway station closer to the airport terminal.

Potential long-term measures under investigation include a direct tram train link between the airport terminal and Cardiff city centre (running on a combination of existing heavy and new light rail track), see illustration below.

Trafnidiaeth gyhoeddus

Mae gwella rhwydwaith trafnidiaeth gyhoeddus i Faes Awyr Rhyngwladol Caerdydd yn weithred allweddol yn Strategaeth Drafnidiaeth Cymru (2008).

Gellir cael mynediad ar hyn o bryd i Arena Rhyngwladol Caerdydd yn bennaf drwy deithio mewn car preifat. Fodd bynnag, er mwyn darparu opsiynau teithio mwy cynaliadwy, rhaid gwella trafnidiaeth gyhoeddus i'r maes awyr.

Mae Llywodraeth Cynulliad Cymru yn cynnal astudiaeth i brofi effaith cyfres o fesurau i wella mynediad trafnidiaeth gyhoeddus leol a rhanbarthol i'r maes awyr, yn y tymor byr, tymor canolig ac yn yr hirdymor.

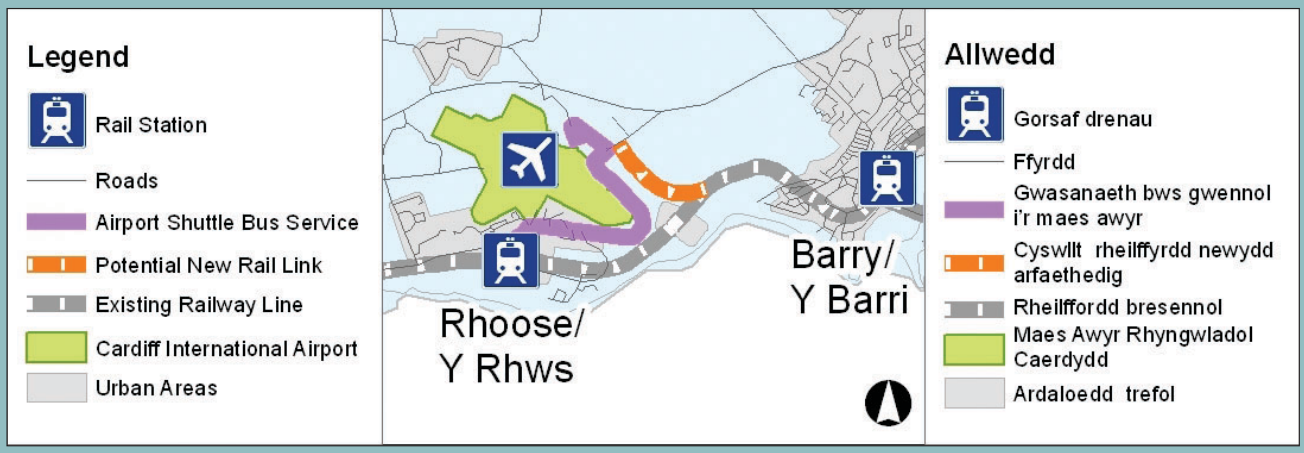
Mae mesurau tymor byr posibl yn cynnwys:

- Creu ail lwybr i un trên bob awr o Ynys y Barri i Ben-y-bont ar Ogwr a chynyddu amledd bysiau gwennol i drenau deithio bob hanner awr i gael mynediad i'r maes awyr drwy orsaf Rhws.
- Cynyddu amledd gwasanaeth aros mewn nifer cyfyngedig o safleoedd bws X91 i bob hanner awr neu lai rhwng canol dinas Caerdydd a'r maes awyr.
- Mwy o wasanaethau bws rheolaidd er mwyn darparu ar gyfer patrwm shifftiau gweithlu'r maes awyr a hedfaniadau yn gynnar yn y bore neu'n hwyr yn y nos.
- Gwasanaeth bws cyflym o ganol dinas Caerdydd i'r maes awyr.
- Gwybodaeth gwir amser am fysiau a threnau yn nherfynfa'r maes awyr.
- Gwell cyfleusterau i fagiau trwm ar y bws a'r trên.

Mae mesurau tymor canolig yn cynnwys:

- Lonydd a mesurau sy'n rhoi blaenoriaeth i fysiau yn yr ardaloedd hynny yng Nghaerdydd a Bro Morgannwg sydd â'r tagfeydd mwyaf er mwyn lleihau hyd siwrneiau bws a chynyddu dibynadwyedd.
- Y gwasanaethau trên pellter hir i alw yng ngorsaf Rhws er mwyn darparu mynediad uniongyrchol i'r maes awyr ar gyfer mwy o bobl.
- Gweithredu bws gwennol ar isafswm amledd o bob hanner awr o orsaf y Barri, yn hytrach na'r Rhws.
- Darparu gorsaf drenau yn agosach at derfynfa'r maes awyr.

Mae'r mesurau hirdymor posibl sydd o dan archwiliadau yn cynnwys rhwydwaith trenau tram uniongyrchol rhwng terfynfa'r maes awyr a chanol dinas Caerdydd (yn teithio ar gyfuniad o draciau trwm presennol y rheilffordd a'r rhai ysgafn, newydd).



Comparison of Corridors and Options

Corridor	Benefits	Disadvantages
Corridor A	Provides for forecast traffic growth on the A4232(T). Eases congestion at Culverhouse Cross and on the A4050 at Barry. Provides improved access to Cardiff city centre.	Increased reliance on Junction 33. Traffic disruption during widening. Barry Woodlands Site of Special Scientific Interest (SSSI) and ancient woodlands at Wenvoe Castle affected. Severe impact on Brynhill golf course. Overhead power cables affected.
Corridor B	Provides for forecast traffic growth on the A4232(T). Eases congestion at Culverhouse Cross. Provides improved access from the west on the A48 and to Cardiff city centre.	Increased reliance on Junction 33. Traffic disruption during widening. Traffic for airport still passes through Culverhouse Cross junction.
Corridor C	Increased resilience on the road network in the event of an incident. Provides improved access from both east and west from the M4 motorway and the A48.	Greater impact on agricultural land. Less beneficial for access from Cardiff city centre.
Corridor A Options		
Online widening of A4050 at Wenvoe to dual carriageway.	Reduced impact on biodiversity and ecology.	Increased community severance. Noise and air quality concerns at Wenvoe.
An eastern bypass of Wenvoe with traffic calming measures on the existing A4050 to reduce through traffic.	Reduced community severance and increased road safety measures at Wenvoe. Improved journey times.	Increased greenfield landtake. Greater impact on biodiversity and ecology.
Corridor B Options		
A southern bypass of St Nicholas with access to Dyffryn Gardens.	Reduced community severance and increased road safety in St Nicholas.	Greater length than northern bypass with increased greenfield landtake.
A northern bypass of St Nicholas.	Reduced community severance and increased road safety in St Nicholas.	No access to Dyffryn Gardens without passing through St Nicholas.
Corridor C Options		
An 'outer' western bypass of Pendoylan.	Increased visual screening from Pendoylan.	Close to properties south of Pendoylan. Potential disruption to bat habitat.
An 'inner' western bypass of Pendoylan.	Better north and south access provision to Pendoylan. Visual impact west of Pendoylan minimised by road in cutting.	More visual impact on slopes south of Pendoylan. Potential increase noise impact on Pendoylan.
An eastern bypass of Pendoylan.	Minimal severance of existing lane.	Visual intrusion of embankments. Close proximity to River Ely floodplain. Potential noise impacts to east Pendoylan. Extensive link roads to maintain access.
Options for Corridors B and C at Moulton		
Maximise use of the existing A4226 with online improvements whilst improving safety.	Minimal new landtake. Reduced farm land severance issues.	More junctions required for field access. Close to Scheduled Ancient Monument site.
Provide a new length of road on the A4226 to maximise overtaking opportunities.	Improved journey times. Less disruption on the A4226 during construction	Increased land take and severance of land plots.
Options for Corridors B and C at approach to the airport		
Improve the existing Five Mile Lane down to Waycock Cross.	Minimal land severance issues. More direct access to west Barry.	Impact on Barry Woodlands SSSI on west edge of existing Five Mile Lane north of Waycock Cross.
A new road over the Waycock valley to connect to the existing eastern roundabout, the main access to the airport.	Offers better journey times with a more direct route.	Significant viaduct required to cross the Waycock valley – significant visual impact. Overhead power cables affected. Embankment impact at Blackton Farm. Barry Woodlands SSSI affected.

Cymharu'r Coridorau a'r Opsiynau

Coridor	Manteision	Anfanteision
Coridor A	Yn darparu mwy o allu i ragweld yn y traffig ar yr A4232(T). Yn lliniaru tagfeydd yng Nghroes Cwrlwys ac ar yr A4050 yn y Barri. Yn darparu gwell mynediad at ganol dinas Caerdydd.	Yn fwy dibynnol ar Gyffordd 33. Amharu ar y traffig yn ystod lledu ffyrdd. Effaith ar goetiroedd Safle o Ddiddordeb Gwyddonol Arbennig (SoDdGA) y Barri a Choetiroedd hynafol yng Nghastell Gwenfô yn cael. Effaith ddifrifol ar gwrs golff Brynhill. Y ceblau trydan uwchben yn cael eu heffeithio.
Coridor B	Yn darparu mwy o allu i ragweld yn y traffig ar yr A4232(T). Yn lliniaru tagfeydd yng Nghroes Cwrlwys. Yn darparu gwell mynediad o'r gorllewin ar yr A48 ac i ganol dinas Caerdydd.	Yn fwy dibynnol ar Gyffordd 33. Amharu ar y traffig yn ystod lledu ffyrdd. Traffig i'r maes awyr o hyd yn pasio drwy gyffordd Croes Cwrlwys.
Coridor C	Y rhwydwaith ffyrdd yn fwy cadarn pe bai damwain yn digwydd. Yn darparu gwell mynediad o'r dwyrain a'r gorllewin, ill dau, o draffordd yr M4 a'r A48.	Mwy o effaith ar dir amaethyddol. Llai manteisiol ar gyfer mynediad i ganol dinas Caerdydd.
Opsiynau Coridor A		
Lledu'r A4050 ar-lein i ffordd ddeuol yng Ngwenfô.	Llai o effaith ar fioamrywiaeth ac ecoleg.	Mwy o dor-cysylltiad cymunedol. Pryderon am sŵn ac ansawdd yr aer yng Ngwenfô.
Ffordd osgoi i'r dwyrain o Wenfô gyda mesurau gostegu traffig ar yr A4050 presennol i lehau traffig trwodd.	Llai o dor-cysylltiad cymunedol a mwy i fesurau diogelwch ar y ffyrdd yng Ngwenfô. Lleihau hyd y siwrnai.	Cymryd mwy o dir maes glas. Mwy o effaith ar fioamrywiaeth ac ecoleg.
Opsiynau Coridor B		
Ffordd osgoi i'r de o St Nicholas gyda mynediad i Erddi Dyffryn.	Llai o dor-cysylltiad cymunedol a mwy o ddiogelwch ar y ffyrdd yn St Nicholas.	Yn hirach na'r ffordd osgoi sydd i'r gogledd, gyda mwy o gymryd tir maes glas.
Ffordd osgoi i'r gogledd o St Nicholas.	Llai o dor-cysylltiad cymunedol a mwy o ddiogelwch ar y ffyrdd yn St Nicholas.	Dim mynediad i Dyffryn heb deithio drwy St Nicholas.
Opsiynau Coridor C		
Ffordd osgoi 'allanol' i'r gorllewin o Bendeulwyn.	Mwy o sgrinio gweledol o Bendeulwyn.	Yn agos i adeiladau sydd i'r de o Bendeulwyn. Amhariad posibl ar rywogaeth ystlumod.
Ffordd osgoi 'mewnol' i'r gorllewin o Bendeulwyn.	Gwell darpariaeth mynediad o'r gogledd a'r de i Bendeulwyn. Effaith weledol i'r gorllewin o Bendeulwyn yn cael ei lleihau drwy gynnwys yr heol.	Mwy o effaith weledol ar lechweddau i'r de o Bendeulwyn. Effaith cynnydd posibl mewn sŵn ar Bendeulwyn.
Ffordd osgoi i'r dwyrain o Bendeulwyn.	Gwahanu lleiaf i'r lôn bresennol.	Ymyrraeth weledol gan argloddiau. Wrth ymyl gorlifdir Trelái. Effaith sŵn posibl i'r dwyrain o Bendeulwyn. Rhwydwaith ffyrdd helaeth ar gyfer mynediad.
Opsiynau ar gyfer Coridor B a C ym Moulton		
Uchafu defnydd o'r A4226 presennol gyda gwelliannau ar-lein wrth wella diogelwch.	Cymryd y darn lleiaf o dir newydd. Lleihau materion yn ymwneud â gwahanu tir ffermydd.	Angen mwy o gyffyrdd er mwyn cael mynediad i'r cae. Yn agos i safle'r Heneb Gofrestredig
Darparu hyd newydd i ffordd A4226 er mwyn uchafu cyfleoedd i oddiweddyd.	Gwell hyd i'r siwrneiau. Llai o amharu ar yr A4226 yn ystod adeiladu.	Cymryd mwy o dir a gwahanu lleiniau tir.
Opsiynau ar gyfer Coridor B a C wrth agosáu at y maes awyr		
Gwella o'r Five Mile Lane bresennol hyd at Waycock Cross.	Materion lleiaf yn ymwneud â gwahanu tir. Mynediad mwy uniongyrchol i orllewin y Barri.	Effaith ar goetiroedd SoDdGA y Barri ar ochr y Five Mile Lane presennol i'r gogledd o Waycock Cross.
Ffordd newydd dros ddyffryn Waycock i gysylltu â'r gylchfan ddwyreiniol bresennol, y prif fynediad i'r maes awyr.	Yn cynnig gwell hyd siwrnai gyda llwybr mwy uniongyrchol iddi.	Angen traphont sylweddol i groesi dyffryn Waycock - effaith weledol sylweddol. Y ceblau trydan uwchben yn cael eu heffeithio. Effaith y llechweddau ar fferm Blackton Farm. Effaith ar goetiroedd SoDdGA y Barri.

How can you help?

You can give your views on the options by returning the enclosed questionnaire by **3 October 2008**. Before that, we suggest that you visit one of the exhibitions (see cover). Representatives from the Welsh Assembly Government and its consultant Arup will be available to answer your questions and to explain the options in more detail.

A report on previous exhibitions, a planning stage report, and a preliminary scheme assessment report can also be inspected during normal business hours from 3 July 2008 until 3 October 2008 at:

- Orders Branch, (TPA3), Transport Wales, Welsh Assembly Government, Cathays Park, **Cardiff**
- Vale of Glamorgan Council, Civic Offices, Holton Road, **Barry**
- Vale of Glamorgan Council, The Alps, Quarry Road, **Wenvoe**
- Cardiff Council, Regulatory Control, City Hall, **Cardiff**
- Cardiff Council, Brindley Road, Leckwith, **Cardiff.**

What happens next?

Responses from you and from local authorities and other interested bodies will be considered carefully by the Welsh Assembly Government and its consultant prior to further scheme development.

Contact details

Copies of the exhibition material will be available on the Assembly's website: http://new.wales.gov.uk/topics/transport/roads/NewRoads3/ *then click on* **Cardiff International Airport Access.**

You can complete the enclosed comment form, or pick one up at the exhibitions. Use the freepost envelope provided. If you have any further queries regarding Improving Access to Cardiff International Airport, please:

- write to Improving Access to Cardiff International Airport, Transport Wales, Welsh Assembly Government, Cathays Park, Cardiff CF10 3NQ.
- e-mail **ia2cwl@wales.gsi.gov.uk**

Access to information

The Welsh Assembly Government will use these questionnaires to provide evidence for developing ways to improve traffic access to Cardiff International Airport and to improve traffic flow around the Culverhouse Cross interchange. They will also be used to provide evidence for measures to improve public transport in these areas and to improve public transport into Cardiff as well. A summary of the responses to this questionnaire will be published.

All personal identifying information on your questionnaire is confidential to the Welsh Assembly Government and its agents. No identifiable information about you will be provided to local authorities, other bodies, members of the public or the press. The questionnaire form will be disposed of securely after it has served these purposes.

Sut gallwch chi helpu?

Gallwch roi eich barn am yr opsiynau drwy ddychwelyd yr holiadur sydd wedi ei amgáu erbyn **3 Hydref 2008**. Cyn hynny, awgrymwn eich bod yn ymweld ag un o'r arddangosfeydd (gweler y clawr). Bydd cynrychiolwyr o Lywodraeth Cynulliad Cymru a'r ymgynghorydd Arup ar gael i ateb eich cwestiynau ac i esbonio'r opsiynau yn fwy manwl.

Gellir hefyd archwilio adroddiad ar arddangosfeydd blaenorol, adroddiad ar gam cynllunio, ac adroddiad asesu cynllun rhagarweiniol yn ystod oriau busnes arferol o 3 Gorffennaf tan 3 Hydref 2008 yn:

- Y Gangen Gorchmynion, (TPA3), Trafnidiaeth Cymru, Llywodraeth Cynulliad Cymru, Parc Cathays, **Caerdydd**
- Cyngor Bro Morgannwg, Swyddfeydd Dinesig, Heol Holton, **y Barri**
- Cyngor Bro Morgannwg, Yr Alpau, Heol y Chwarel, **Gwenfô**
- Cyngor Caerdydd, Rheolaeth Rheoleiddio, Neuadd y Ddinas, **Caerdydd**
- Cyngor Caerdydd, Heol Brindley, Lecwydd, **Caerdydd**.

Beth sy'n digwydd nesaf?

Bydd eich ymatebion chi a rhai'r awdurdodau lleol a chyrff eraill sydd â diddordeb yn cael eu hystyried yn ofalus gan Lywodraeth Cynulliad Cymru a'i hymgynghorydd cyn datblygu'r cynllun ymhellach.

Manylion ar gyfer Cysylltu

Bydd copïau o'r deunydd arddangos ar gael ar wefan y Cynulliad: http://new.wales.gov.uk/topics/transport/roads/NewRoads3/ *yna cliciwch ar* **Mynediad i Faes Awyr Rhyngwladol Caerdydd.**

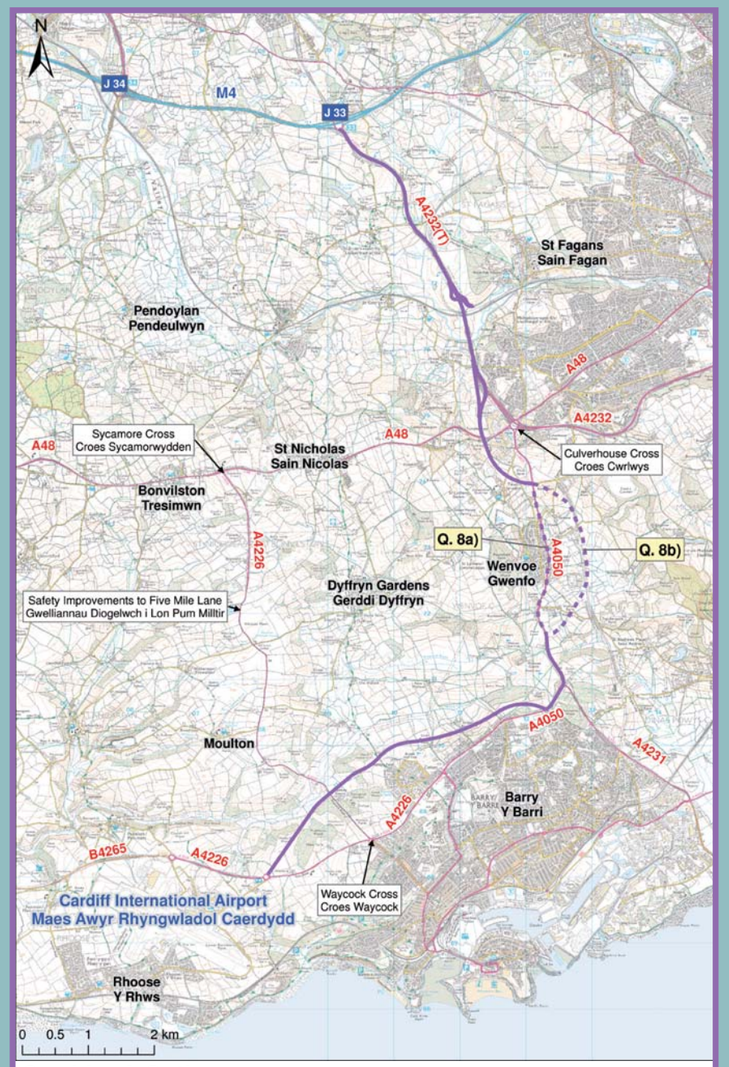
Gellir llenwi'r ffurflen sylwadau amgaeedig, neu casglwch un yn yr arddangosfeydd. Defnyddiwch yr amlen rhadbost sy'n cael ei darparu. Os oes gennych unrhyw ymholiadau ynglŷn â Gwella Mynediad i Faes Awyr Rhyngwladol Caerdydd:

- ysgrifennwch at Gwella Mynediad i Faes Awyr Rhyngwladol Caerdydd, Trafnidiaeth Cymru, Llywodraeth Cynulliad Cymru, Parc Cathays, Caerdydd CF10 3NQ.
- e-bost **ia2cwl@wales.gsi.gov.uk**

Mynediad at wybodaeth

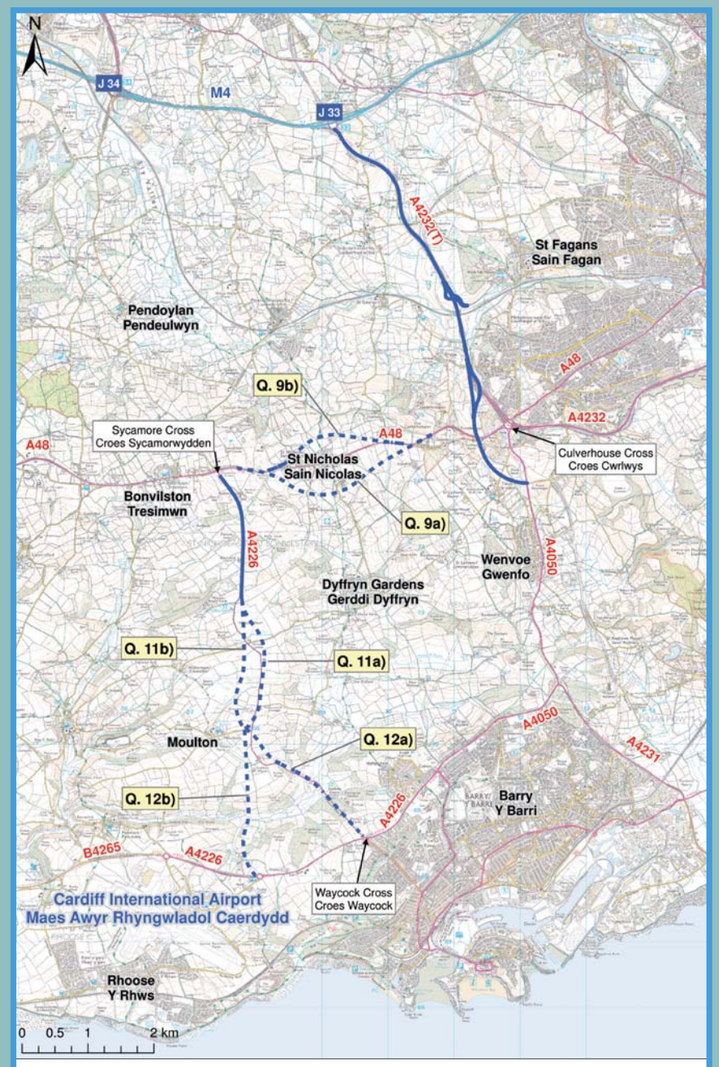
Bydd Llywodraeth Cynulliad Cymru yn defnyddio'r holiaduron hyn i ddarparu tystiolaeth ar gyfer datblygu ffyrdd i wella mynediad traffig i Faes Awyr Rhyngwladol Caerdydd ac i wella llif traffig o amgylch cyfnewidfa Croes Cwrlwys. Byddant hefyd yn cael eu defnyddio er mwyn darparu tystiolaeth ar gyfer mesurau i wella trafnidiaeth gyhoeddus i mewn i Gaerdydd hefyd. Bydd crynodeb o'r ymatebion i'r holiadur hwn yn cael ei gyhoeddi.

Gwybodaeth gyfrinachol yw'r holl wybodaeth adnabod bersonol sydd ar eich holiadur i Lywodraeth Cynulliad Cymru a'i hasiantaethau. Ni fydd gwybodaeth bersonol y gellir eich adnabod drwyddi yn cael ei rhoi i awdurdodau lleol, cyrff eraill, y cyhoedd na'r wasg. Bydd yr holiaduron yn cael eu gwaredu'n ddiogel ar ôl iddynt ateb eu dibenion.



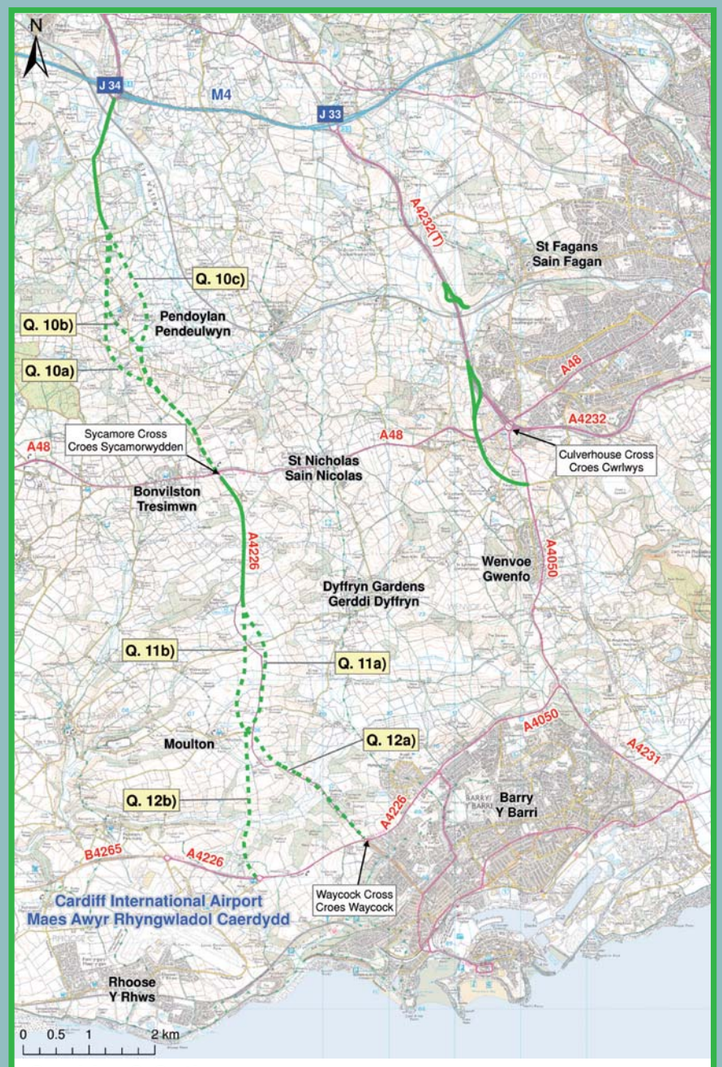
Corridor A Options
Opsiynau Coridor A

Q. 11b) Refers to the option question number in the comment form / Yn cyfeirio at rif y dewisiad ar y ffurflen sylwadau



Corridor B Options
Opsiynau Coridor B

Q. 11b) Refers to the option question number in the comment form / Yn cyfeirio at rif y dewisiad ar y ffurflen sylwadau



Corridor C Options
Opsiynau Coridor C

Q. 11b) Refers to the option question number in the comment form / Yn cyfeirio at rif y dewisiad ar y ffurflen sylwadau

Route options within each of the three corridors are described in the comparison table

Corridor A utilises the existing signposted route to the airport with widening to three lanes on the A4232(T) from M4 Junction 33 to a western bypass improvement at Culverhouse Cross to reduce congestion. There are online and offline improvement choices on the A4050 at Wenvoe which will enable journey time improvements.

Corridor B investigates options for route improvements using the A4232(T) from M4 Junction 33 and the A48 with an improved Sycamore Cross junction and route improvement on Five Mile Lane (A4226). A key choice is the bypass options at St Nicholas. Congestion at Culverhouse Cross is alleviated with provision of a western bypass to divert the north-south traffic away from the junction. However traffic on this corridor to the airport would still pass through Culverhouse Cross junction.

Corridor C provides options for routes from the M4 Junction 34 to the airport with a bypass of Pendoylan, junction improvement at Sycamore Cross and online or offline improvements to Five Mile Lane (A4226). A single lane carriageway with climbing lane provision and alternating sections with two lanes in one direction will provide safe overtaking opportunities on this corridor. A single carriageway western bypass at Culverhouse Cross is also proposed with the corridor C options to address the existing congestion issues.

Disgrifir yr opsiynau ffyrdd oddi mewn i bob un o'r tri choridor yn y tabl cymhariaeth.

Mae coridor A yn defnyddio'r ffordd bresennol ag arwyddbyst i'r maes awyr sy'n lledu i dair lôn ar yr A4232(T) o Gyffordd 33 ar yr M4 at y ffordd osgoi i'r gorllewin yng Nghroes Cwrlwys sy'n cael ei gwella er mwyn lleihau tagfeydd. Mae opsiynau i'r gwelliannau ar-lein ac all-lein ar yr A4050 yng Ngwenfô a fydd yn galluogi gwella hyd y siwrnai.

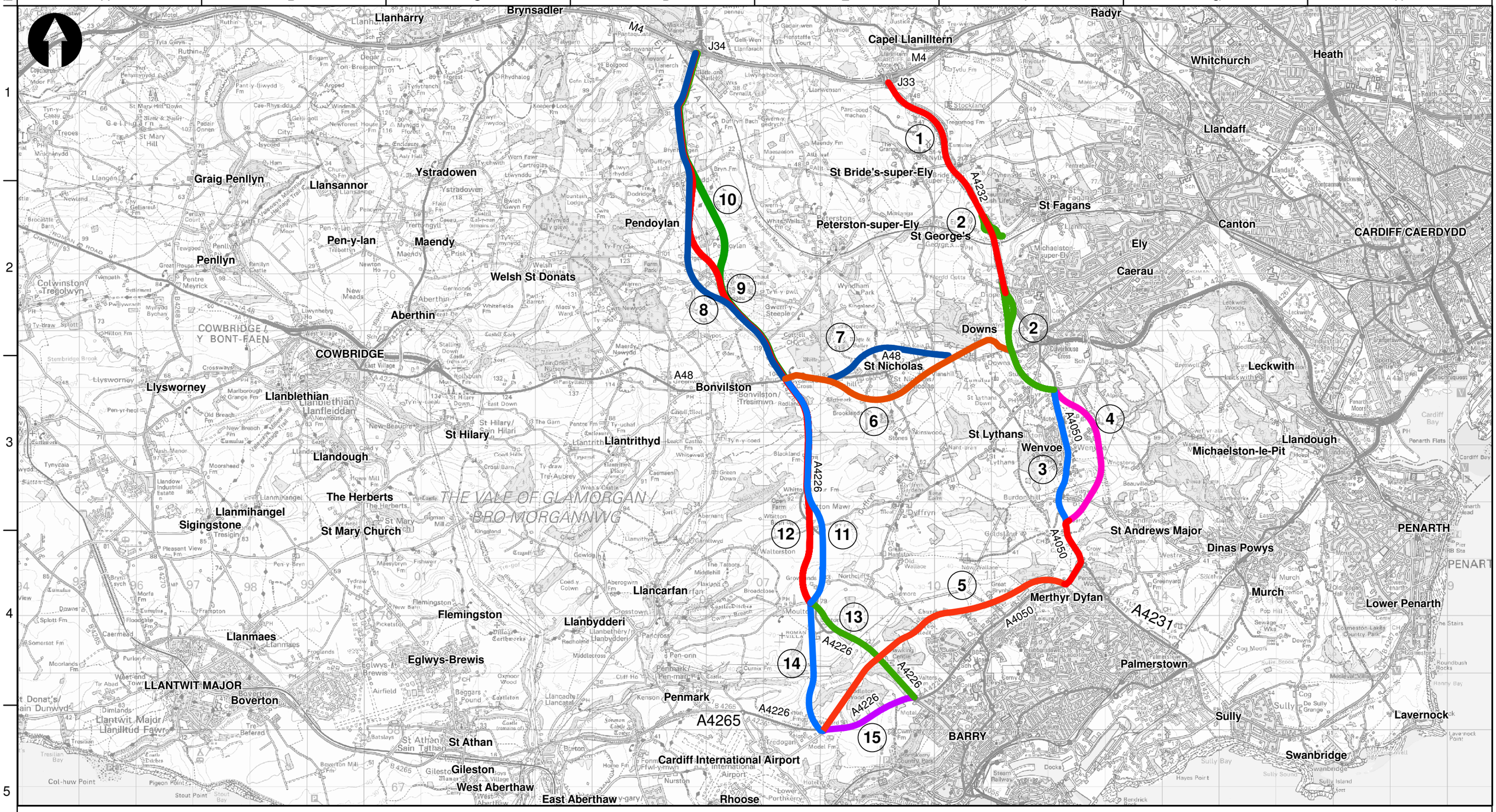
Mae coridor B yn archwilio'r opsiynau ar gyfer gwelliannau i'r ffyrdd gan ddefnyddio'r A4232(T) o Gyffordd 33, yr M4, a'r A48 gyda gwell cyffordd yn Sycamore Cross a gwelliant i ffordd Five Mile Lane (A4226). Mae'r opsiynau sy'n perthyn i ffordd osgoi yn St Nicholas yn ddewis allweddol. Mae'r tagfeydd yng Nghroes Cwrlwys yn cael eu lliniaru drwy ddarparu ffordd osgoi orllewinol er mwyn dargyfeirio traffig y de-gogledd i ffwrdd o'r gyffordd. Fodd bynnag, byddai traffig y coridor hwn sy'n teithio i'r maes awyr o hyd yn teithio drwy gyffordd Croes Cwrlwys.

Mae coridor C yn rhoi opsiynau ar gyfer teithio o Gyffordd 34 yr M4 i'r maes awyr, gan ddefnyddio ffordd osgoi Pendeulwyn, gwella cyffordd yn Sycamore Cross a gwelliannau ar-lein ac all-lein i Five Mile Lane (A4226). Bydd ffordd gerbydau lôn sengl gyda darpariaeth lôn sy'n dringo a rhannau, sydd â dwy lon bob yn ail i'r un cyfeiriad, yn darparu cyfleoedd diogel i oddiweddyd ar y coridor hwn. Mae ffordd osgoi ffordd gerbydau'r gorllewin hefyd ar y gweill gydag opsiynau coridor C yn mynd i'r afael â'r materion sy'n ymwneud â'r tagfeydd sy'n bodoli ar hyn o bryd.

Appendix B

Route Elements

A2



Legend

1 Route Elements

Issue	Date	By	Chkd	Appd

Client

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

Trafnidiaeth Cymru
Parc Cathays
Caerdydd
CF10 3NQ

Transport Wales
Cathays Park
Cardiff
CF10 3NQ

Job Title

Cardiff International Airport and Culverhouse Cross Access Improvements

Drawing Title

Stage 1 Elements

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4 Pierhead St., Capital Waterside
Cardiff, CF10 4QP
Tel. +44 (0)29 2047 3727
Fax. +44 (0)29 2047 2277
www.arup.com

Scale at A2 1:63,675

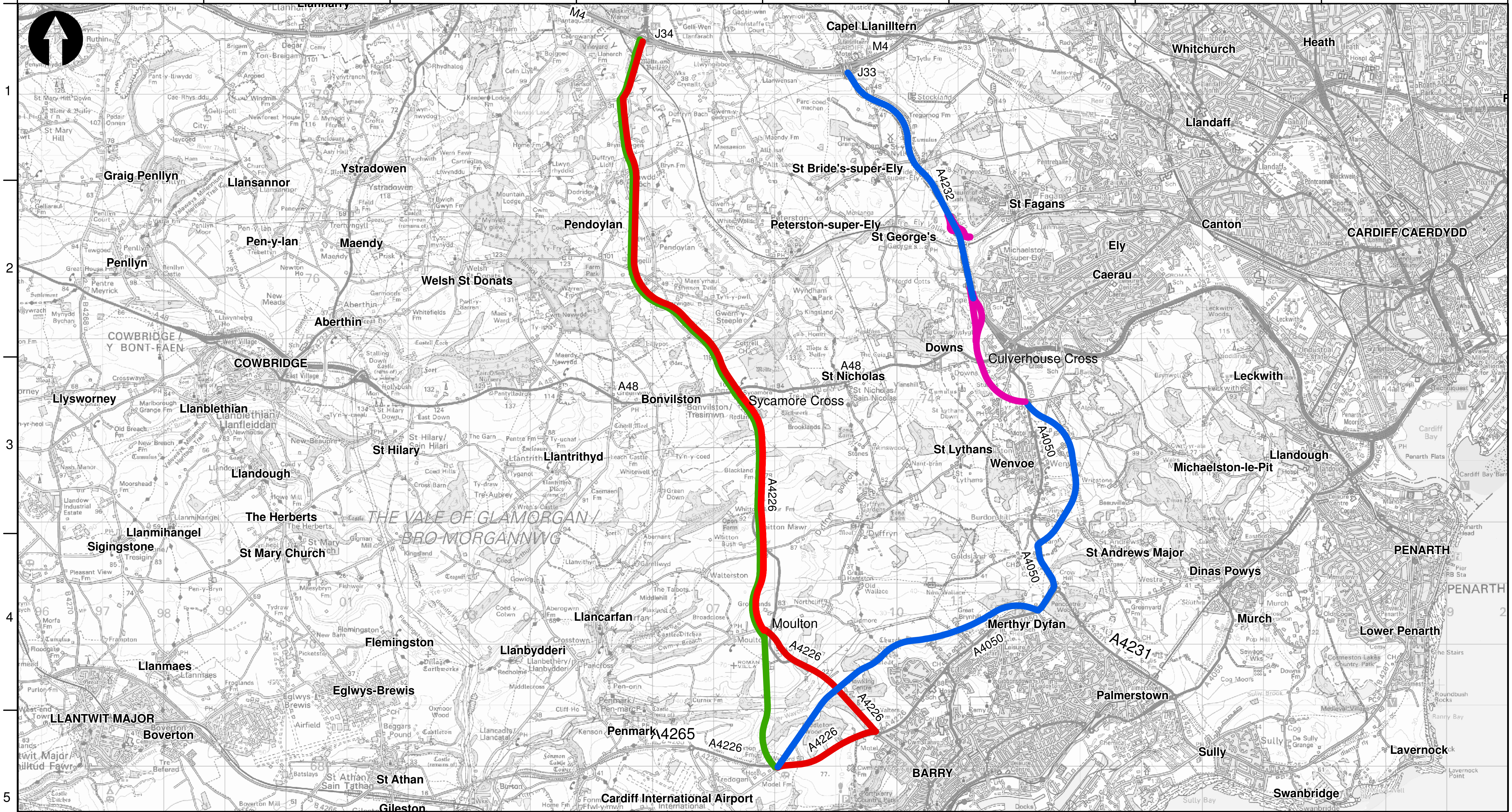
Plot ID

Drawing Status **Final**

Job No	Drawing No	Issue
122153	B.01	01

Appendix C

Stage 2 Routes


A3
A
B
C
D
E
F
G
H
1
2
3
4
5
M4
J34
Capel Llanilltern
M4
J33
Whitchurch
Heath
Llandaff
Graig Penllyn
Llansannor
Ystradowen
St Bride's-super-Ely
A4232
St Fagans
Pendoylan
Peterston-super-Ely
St George's
Canton
CARDIFF/CAERDYDD
Pen-y-lan
Maendy
Penllyn
Ely
Welsh St Donats
Caerau
Aberthin
COWBRIDGE
Y BONT-FAEN
COWBRIDGE
Downs
Culverhouse Cross
A48
St Nicholas
A48
Leckwith
Llysworney
Llanblethian
Bonvilston
Sycamore Cross
A4050
St Hilary
Llantrithyd
St Lythans
Wenvoe
Llandough
Llandough
Michaelston-le-Pit
A4226
The Herberts
THE VALE OF GLAMORGAN / BRO MORGANNWG
Llanmihangel
Sigingstone
St Mary Church
St Andrews Major
A4050
PENARTH
Dinas Powys
Llancarfan
Moulton
Merthyr Dyfan
Murch
Flemingston
A4226
A4050
A4231
Lower Penarth
Llanbydderi
Llanmaes
Eglwys-Brewis
Palmerstown
A4226
LLANTWIT MAJOR
Boverton
Penmark
A4265
A4226
A4226
Sully
Lavernock
St Athan
BARRY
Gileston
Cardiff International Airport
Swanbridge

Legend

[Note: Culverhouse Cross Bypass and St Fagans Access Road are common to all route options]

- Route A
- Route C.1
- Route C.2
- Culverhouse Cross Bypass and St Fagans Access Road

Issue	Date	By	Chkd	Appd
P1	Mar 09	KM	PW	PW

Client

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

Trafnidiaeth Cymru
Parc Cathays
Caerdydd
CF10 3NQ

Transport Wales
Cathays Park
Cardiff
CF10 3NQ

Kilometers
0 0.35 0.7 1.4

Job Title
Cardiff International Airport and Culverhouse Cross Access Improvements

Drawing Title
Route Corridors

ARUP
4 Pierhead St., Capital Waterside
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Scale at A3: 1:60,000

Plot ID

Drawing Status: Final

Job No: 122153

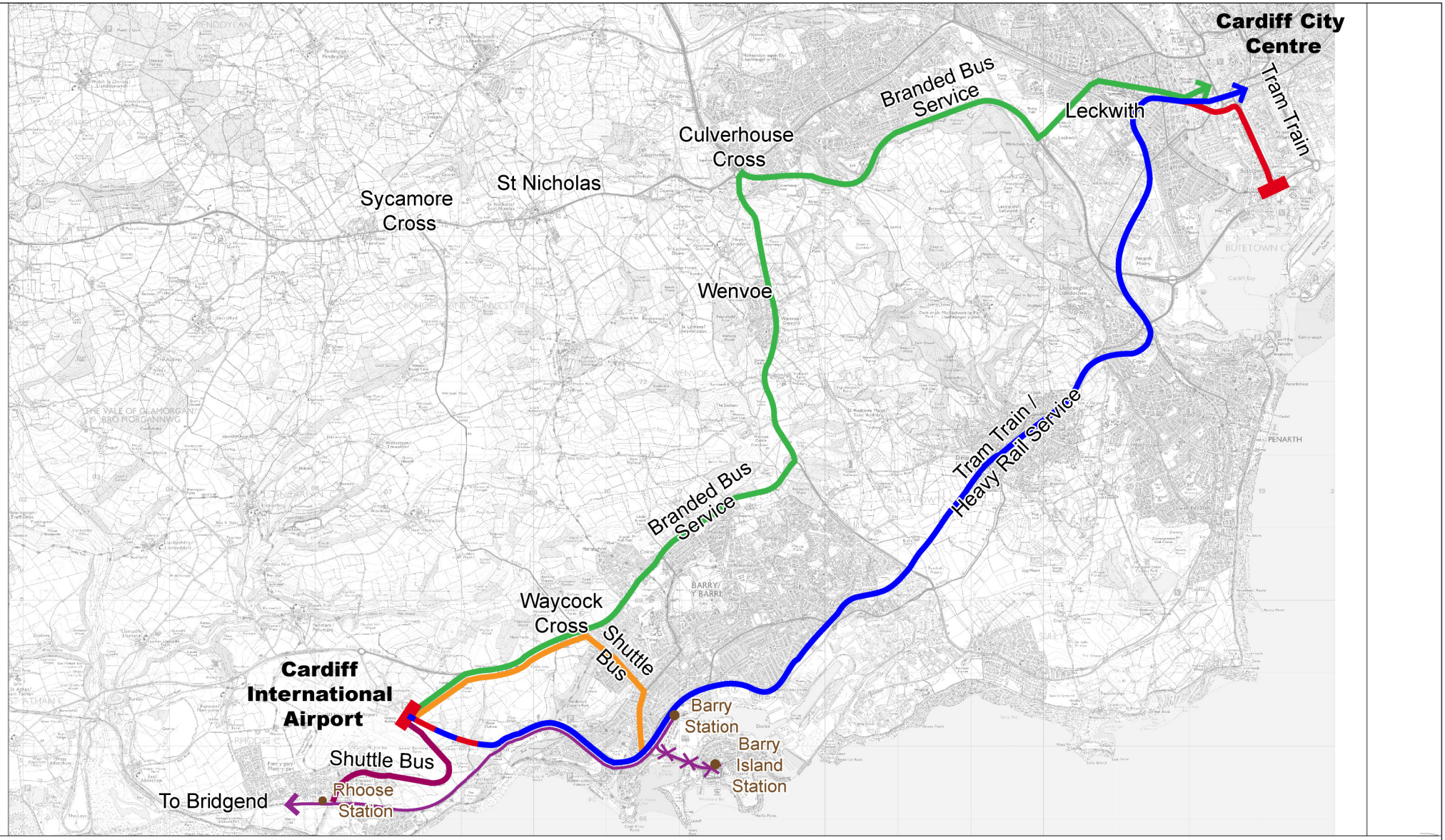
Drawing No: C.01

Issue: 01

Appendix D

Public Transport Options

A4



ARUP

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Client

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

Yr Is-adran Rheilffyrdd a Ffyrdd Newydd
Trafnidiaeth Cymru
Parc Cathays
Caerdydd
CF10 3NQ

Rail and New Roads Division
Transport Wales
Cathays Park
Cardiff
CF10 3NQ

Job Title

Cardiff International Airport and Culverhouse Cross Access Improvements

Drawing Title

Public Transport Options

Scale at A4 NTS

Plot ID

Drawing Status

Job No	Drawing No	Issue
122153	Figure D.01	

Appendix E

Composite Appraisal Summary Tables (ASTs)

Stage 1 Route assessments: Route A

Route: A (Incorporating Element Nos. 1, 2, 4 and 5)
Relevant Public Consultation Refs: Q8b
Description: Route utilises the existing signposted route to the airport with widening to three lanes on the A4232(T) from M4 Junction 33 to a western bypass improvement at Culverhouse Cross, an eastern bypass of Wenvoe with traffic calming measures on the existing A4050 at Wenvoe to reduce through traffic and an offline improvement to the A4050 to the north of Barry. A new access to the St Fagans National History Museum is also proposed, as well as safety improvements to Five Mile Lane (A4226). (Corridor A: Element Nos. 1, 2, 4 and 5).

Criteria	Assessment		Distribution	Significance
Welsh Impact Area: *Economy*				
TEE	Not assessed as part of Stage 1.		Not applicable	Not applicable
EALI	Not assessed as part of Stage 1.		Not applicable	Not applicable
Welsh Impact Area: *Environment*				
Noise Source: DMRB Stage 2 Env Report – Sections 8.1, 9.1, 10.1, 11.1	E1	More traffic on improved element would lead to slight increases in noise on the A4232, but resurfacing would mitigate noise increases. No schools immediately adjoin element. There are 391 properties within 300m of Elements 1 & 2.	No significant changes in noise distribution.	Neutral
	E2	Traffic relieved at Culverhouse Cross and noise levels reduced. Junction would remain open and experience some traffic noise. No schools immediately adjoin element. There are 391 properties within 300m of Elements 1 & 2.	Noise redistributed to bypass.	Slight beneficial
	E4	Less traffic on A4050 would provide large noise reduction, but A4050 would remain open and continue to experience some traffic noise. Bypass would redistribute noise away from residential properties along A4050, Wenvoe library and junior school. Element has 47 properties within 300m.	Noise redistributed to bypass.	Large beneficial
	E5	Less traffic on A4226/A4050 would reduce traffic noise. However, existing road would remain open and still experience some traffic noise. Bypass would redistribute noise away from existing route, which includes 3 schools and a community centre within 150m of the A4226/A4050, plus 1245 properties within 200m. Bypass has 298 properties within 300m.	Noise redistributed to bypass.	Neutral
Local air quality Source: DMRB Stage 2 Report – Sections 8.2, 9.2, 10.2, 11.2	E1	More traffic on improved element would create more emissions, but improved journey times would reduce emissions and reduce this impact. No schools immediately adjoin element. There are 391 properties within 300m of Elements 1 & 2. To be amplified as part of full route assessment.	No significant changes in distribution of emissions.	Neutral
	E2	Traffic relieved at Culverhouse Cross and emissions reduced. Emissions redistributed along new bypass, but improved journey times would reduce this impact. No schools immediately adjoin element. There are 391 properties within 300m of Elements 1 & 2. To be amplified as part of full route assessment.	Emissions redistributed to bypass.	Slight beneficial
	E4	Less traffic on A4050 would reduce traffic emissions, but A4050 would remain open and continue to experience some emissions. Bypass would redistribute emissions away from residential properties along A4050 Wenvoe, Wenvoe library and junior school. Element has 47 properties within 300m. Improved journey times would also help to reduce impact. To be amplified as part of full route assessment.	Emissions redistributed to bypass.	Moderate beneficial
	E5	Less traffic on A4226/A4050 would reduce emissions. Existing road would remain open and still experience some traffic emissions. Bypass would redistribute emissions away from existing route, which includes 3 schools and a community centre within 150m of the A4226/A4050, plus 1245 properties within 200m. Bypass has 298 properties within 300m. Improved journey times would also reduce impact. To be amplified as part of full route assessment.	Emissions redistributed to bypass.	Slight beneficial
Greenhouse gas emissions Source: DMRB Stage 2 Report – Sections 8.2, 9.2, 10.2, 11.2	E1	More traffic on improved element would create more emissions, but improved journey times would reduce emissions and reduce this impact. No schools immediately adjoin element. There are 391 properties within 300m of Elements 1 & 2. To be amplified as part of full route assessment.	No significant changes in distribution of emissions.	Neutral
	E2	Traffic relieved at Culverhouse Cross and emissions reduced. Emissions redistributed along new bypass, but improved journey times would reduce this impact. No schools immediately adjoin element. There are 391 properties within 300m of Elements 1 & 2. To be amplified as part of full route assessment.	Emissions redistributed to bypass.	Neutral
	E4	Less traffic on A4050 would reduce traffic emissions, but A4050 would remain open and continue to experience some emissions. Bypass would redistribute emissions away from residential properties along A4050 Wenvoe, Wenvoe library and junior school. Element has 47 properties within 300m. Improved journey times would also help to reduce impact. To be amplified as part of full route assessment.	Emissions redistributed to bypass.	Neutral
	E5	Less traffic on A4226/A4050 would reduce emissions. Existing road would remain open and still experience some traffic emissions. Bypass would redistribute emissions away from existing route, which includes 3 schools and a community centre within 150m of the A4226/A4050, plus 1245 properties within 200m. Bypass has 298 properties within 300m. Improved journey times would also reduce impact. To be amplified as part of full route assessment.	Emissions redistributed to bypass.	Neutral
Landscape and townscape Source: DMRB Stage 2 Report – Sections 8.3, 9.3, 10.3, 11.3	E1	Removal of vegetation would expose road to view, until new landscape planting has had time to establish. Areas most significantly affected are Ely Valley character areas, including St. Fagan's lowlands, where embankments are highest (See Plan D.01). Planting on the embankments and cuttings would reduce the effect when established. Element partly adjoins Special Landscape Area.	No significant distributional impacts.	Moderate adverse

Route: A (Incorporating Element Nos. 1, 2, 4 and 5)
Relevant Public Consultation Refs: Q8b
Description: Route utilises the existing signposted route to the airport with widening to three lanes on the A4232(T) from M4 Junction 33 to a western bypass improvement at Culverhouse Cross, an eastern bypass of Wenvoe with traffic calming measures on the existing A4050 at Wenvoe to reduce through traffic and an offline improvement to the A4050 to the north of Barry. A new access to the St Fagans National History Museum is also proposed, as well as safety improvements to Five Mile Lane (A4226). (Corridor A: Element Nos. 1, 2, 4 and 5).

Criteria	Assessment		Distribution	Significance
	E2	Impact of element on character of Culverhouse Cross built up area and Wenvoe environs is minor, but bypass runs along lower ridge slopes to the south and west of Culverhouse Cross. The road runs through a Green Wedge designation and Special Landscape Area between Wenvoe and Culverhouse Cross. (See Plan D.01).	Extends up the lower ridge slopes	Moderate adverse
	E4	Element would be noticeable route in landscape east of Wenvoe. Element also runs through Green Wedge designation and would reduce tranquility of the countryside east of the settlement. (See Plan D.02).	Element would introduce noticeable element east of Wenvoe.	Moderate adverse
	E5	Bypass through Wenvoe Castle grounds affects key view and ancient woodland. Element to north of Barry along ridge slopes visible to the Dyffryn Basin and also crosses the lower Waycock Valley. These are sensitive areas, but already affected by some development such as housing and power lines. Element runs through Special Landscape Area. (See Plan D.05).	Element runs through Dyffryn Basin and lower Waycock valley and would reduce tranquility of landscape north of Barry.	Large adverse
Visual Effects Source: DMRB Stage 2 Report – Sections 8.3, 9.3, 10.3, 11.3	E1	The receptors affected by this stretch of road are mainly rural dwellers and those using the access to St Fagans, public footpaths and bridleways.	Rural areas close to A4232 including Ely Valley environs and Stockland lowlands to the east.	Moderate adverse
	E2	The receptors affected by the Culverhouse bypass are mainly urban edge dwellers and those using the access to St Fagans, public footpaths and bridleways. Screening by woodland, development and the road in cutting for part of its length reduce effects.	Urban area and ridge slopes to the south and Ely valley to the north.	Moderate adverse
	E4	The receptors affected by the option are mainly settlement edge dwellers and those using public footpaths and bridleways in the Wenvoe valley area. The numbers affected are less than the online option.	Eastern edge of Wenvoe and countryside to the east up the valley sides.	Moderate Adverse
	E5	The receptors affected by this stretch of road are a combination of urban edge dwellers in Barry who have views to the north over the Dyffryn Basin, rural dwellers in the Basin itself and those using public footpaths. Users of the two golf courses are also affected.	Edge of Barry to the south and Dyffryn Basin and ridges to the north and north west.	Large Adverse
Bio-diversity Source: DMRB Stage 2 Report – Sections 8.4, 9.4, 10.4, 11.4	E1	Potential impact on River Ely SSSI (See Plan E.01) through widening of existing culvert and bridge crossing. Records of protected species in the vicinity, which may require mitigation.	No significant distributional impacts.	Moderate adverse
	E2	There are records of dormice in areas of woodland in the Wenvoe area. These animals may be present in hedgerows that would be affected by this element.	Potential habitat fragmentation for protected species.	Slight adverse
	E4	Bypass crosses a tributary of Cadoxton River. Dormice known to occur in the vicinity of Wenvoe along with other protected species. As this element crosses more green field land the risk of impacts on protected species and the need for mitigation may be higher.	No significant distributional impacts.	Slight adverse
	E5	This element would result in the severance of section of the Barry Woodlands SSSI, important for its ancient semi-natural woodland. This could be in conflict with WAG obligations under Section 28G of the Wildlife and Countryside Act 1981 (as amended). There are also records of great crested newts in Wenvoe Castle Gardens and other protected species in the vicinity, which may require mitigation.	New line of severance in SSSI	Large adverse
Heritage Source: DMRB Stage 2 Report – Sections 8.5, 9.5, 10.5, 11.5	E1	Element runs through a landscape shaped by medieval and post medieval features. Element would impact on the Battlefield Site of St Fagans and the settings of a Scheduled Ancient Monument (See Plan F.01)	Distribution assessment not required (Para. 7.10.7 of WelTAG June 2008)	Moderate adverse
	E2	Element generally traverses an area that has experienced extensive modern development. However, the bypass crosses fields with potential for prehistoric or Roman archaeology. The proposed St Fagan's access road would impinge on a known battlefield site and would have a large adverse impact. The remainder of the element would have a slight adverse impact. St. Fagans National History Museum would benefit from improved access. (See Plan F.01).	Distribution assessment not required (Para. 7.10.7 of WelTAG June 2008)	Large adverse
	E4	Element travels through a rich archaeological landscape to the east of Wenvoe. Scheduled ancient monument lies to the west and road may affect its setting. Bypass would offer improvement to Wenvoe Conservation Area and its setting. (See Plan F.02)	Distribution assessment not required (Para. 7.10.7 of WelTAG June 2008)	Slight adverse
	E5	Element runs in close proximity between two Scheduled Ancient Monuments. Element also crosses into the south western portion of the Wenvoe Castle landscape (Grade II registered park and garden. Evidence of a strong Roman presence in the area. (See Plan F.03)	Distribution assessment not required (Para. 7.10.7 of WelTAG June 2008)	Large adverse
Water environment Source: DMRB Stage 2 Report – Sections 8.6, 9.6, 10.6, 11.6	E1	Element runs through flood zones B and C2 at existing river crossings. Element would be designed to have no adverse impact on flood risk and would include attenuation. Element would have potential impact on water quality during construction, but would offer an improvement in water quality in the long term.	No significant distributional impacts.	Slight beneficial
	E2	No direct interface with any rivers or streams. Majority of bypass does not lie in an area at risk from flooding. Element passes through small areas of zone B, but element would have negligible impact and would include attenuation. Element would have potential impact on water quality during construction, but would be a neutral impact in long term.	No significant distributional impacts.	Neutral

Route: A (Incorporating Element Nos. 1, 2, 4 and 5)
Relevant Public Consultation Refs: Q8b
Description: Route utilises the existing signposted route to the airport with widening to three lanes on the A4232(T) from M4 Junction 33 to a western bypass improvement at Culverhouse Cross, an eastern bypass of Wenvoe with traffic calming measures on the existing A4050 at Wenvoe to reduce through traffic and an offline improvement to the A4050 to the north of Barry. A new access to the St Fagans National History Museum is also proposed, as well as safety improvements to Five Mile Lane (A4226). (Corridor A: Element Nos. 1, 2, 4 and 5).

Criteria	Assessment		Distribution	Significance
	E4	Bypass crosses a tributary of Cadoxton River, which is of high importance for water quality. Section of bypass runs through flood risk zone B, but element would have negligible impact on flood risk and would include attenuation. Element, would have impact on water quality during construction, but would be neutral impact in long term.	No significant distributional impacts.	Neutral
	E5	Element crosses two tributaries of the River Waycock. Section near western end of bypass runs through flood Zone B, but would be designed to have negligible impact. Element would include attenuation. Potential impact on water quality during construction, but would be neutral impact in long term.	No significant distributional effects	Neutral
Soils Source: DMRB Stage 2 Report – 8.7 & Geotechnical Overview	E1	Some land is available within highway boundary, but additional land required off site. Element runs online through Grade 2 and 3 agricultural land. Construction works required for widening existing cuttings and embankments.	No significant distributional impacts.	Slight adverse
	E2	Some highway land available, but majority of element is offline, running through Grade 2 and 3 agricultural land. Construction works required for cuttings and embankments.	No significant distributional impacts.	Moderate adverse
	E4	Element runs through Grade 2 and Grade 3 agricultural land. Construction works required for cuttings and embankments.	No significant distributional impacts.	Moderate adverse
	E5	Bypass runs through Grade 3 agricultural land. Construction works required for cuttings and embankments.	No significant distributional effects	Moderate adverse
Welsh Impact Area: *Social*				
Transport safety Source: WelTAG Social Impacts Report	E1	Online widening, with improved traffic flow, would reduce driver frustration, stress and also improve safety for travellers.	All road users	Slight beneficial
	E2	Bypass would improve north-south traffic flow, reducing driver frustration and stress. However, average traffic speeds would increase. Less traffic using Culverhouse Cross would result in a general improvement for all road users.	All road users.	Slight beneficial
	E4	Bypass would improve traffic flow, reducing driver frustration and stress. However, average traffic speeds would increase. Significantly less traffic on existing A4050 would result in an improvement in safety for all road users.	All road users.	Moderate beneficial
	E5	Bypass would improve traffic flow, reducing driver frustration and stress. However, average traffic speeds would increase. Less traffic on existing A4050/A4226 would result in an improvement in safety for all road users. Consultation responses refer to morning fog and mist in this area, which could be mitigated by lighting and advanced variable message signing.	All road users.	Slight beneficial
Personal security Source: WelTAG Social Impacts Report	E1	No significant personal security impacts.	No significant distributional effects	Neutral
	E2	No significant personal security impacts.	No significant distributional effects	Neutral
	E4	No significant personal security impacts.	No significant distributional effects	Neutral
	E5	No significant personal security impacts.	No significant distributional effects	Neutral
Permeability Source: WelTAG Social Impacts Report	E1	Scheme would involve online widening of existing road and it is unlikely that there would be any changes to non-motorised movement in the area.	No significant distributional effects	Neutral
	E2	Bypass would affect accessibility to the south of Culverhouse Cross. However, less traffic at the interchange would improve conditions for non motorised modes.	No significant distributional effects	Neutral
	E4	Element would affect existing footpaths without appropriate mitigation. However, significantly less traffic on existing A4050 would improve conditions for pedestrians, cyclists and equestrians.	Pedestrians and cyclists in the Wenvoe area	Moderate beneficial
	E5	Element would affect existing footpaths without appropriate mitigation. Less traffic on existing A4050/A4226 would improve conditions for pedestrians and cyclists.	Pedestrians and cyclists in the north Barry area	Slight beneficial
Physical fitness Source: WelTAG Social Impacts Report	E1	Scheme would involve online widening of existing road and it is unlikely that there would be any changes to non-motorised movement or physical fitness in the area.	No significant distributional effects	Neutral
	E2	Bypass would reduce traffic at Culverhouse Cross and may encourage more pedestrian and cyclist trips.	Pedestrians & cyclists travelling to Culverhouse Cross	Slight beneficial
	E4	Improved safety for pedestrians, cyclists and equestrians may encourage more trips, but existing footpaths could be affected without appropriate mitigation.	Pedestrians and cyclists in the Wenvoe area	Slight beneficial
	E5	Improved safety for pedestrians and cyclists may encourage more trips, but footpaths could be affected without appropriate mitigation.	Pedestrians and cyclists in the north Barry area	Slight beneficial
Social inclusion Source: WelTAG Social Impacts Report	E1	Improving the element from J33 of the M4 would reduce congestion and improve accessibility.	Distribution assessment not required (Para. 8.6.31 of WelTAG June 2008)	Slight beneficial
	E2	Reduced congestion at Culverhouse Cross would improve the reliability and journey times of bus services.	Distribution assessment not required (Para. 8.6.31 of WelTAG June 2008)	Slight beneficial

Route: A (Incorporating Element Nos. 1, 2, 4 and 5)
Relevant Public Consultation Refs: Q8b
Description: Route utilises the existing signposted route to the airport with widening to three lanes on the A4232(T) from M4 Junction 33 to a western bypass improvement at Culverhouse Cross, an eastern bypass of Wenvoe with traffic calming measures on the existing A4050 at Wenvoe to reduce through traffic and an offline improvement to the A4050 to the north of Barry. A new access to the St Fagans National History Museum is also proposed, as well as safety improvements to Five Mile Lane (A4226). (Corridor A: Element Nos. 1, 2, 4 and 5).

Criteria	Assessment		Distribution	Significance
	E4	Relieving congestion would improve the reliability and journey time of bus services. A reduction in traffic on the A4050 would also improve accessibility generally in the area.	Distribution assessment not required (Para. 8.6.31 of WelTAG June 2008)	Slight beneficial
	E5	Relieving congestion would improve the reliability and journey time of bus services. A reduction in traffic on the A4050/A4226 would also improve accessibility generally in the area.	Distribution assessment not required (Para. 8.6.31 of WelTAG June 2008)	Slight beneficial
Equality diversity & human rights Source: WelTAG Social Impacts Report	E1	No positive or negative discriminatory impact on any individual equality impact group.	No discriminatory impact	Neutral
	E2	No positive or negative discriminatory impact on any individual equality impact group.	No discriminatory impact	Neutral
	E4	No positive or negative discriminatory impact on any individual equality impact group.	No discriminatory impact	Neutral
	E5	No positive or negative discriminatory impact on any individual equality impact group.	No discriminatory impact	Neutral
Transport Planning Objectives				
TPO1: To improve transport safety in the study area.		Traffic flow along the route would be improved, reducing driver frustration and stress, improving safety for travellers. However, average traffic speeds would increase on bypass sections of the route. There would be less traffic at Culverhouse Cross, on the A4050 at Wenvoe and on the A4050/A4226 at Barry, providing a safety improvement for all road users.	All road users	Slight beneficial
TPO2: To discourage airport traffic flows on inappropriate routes.		Improved journey times and accessibility along the route would encourage some travellers from the west to use this route to the airport. However, it is likely that vehicles from the west would still continue to use inappropriate and unsigned routes.	No significant distributional impacts	Neutral
TPO3: To improve public transport, walking and cycling accessibility to/from Cardiff International Airport.		Less traffic using the A4050/A4226 at Wenvoe and Barry would improve conditions for pedestrians and cyclists in this area. Reduced traffic flow and improved journey times along the route would improve the reliability and journey times for bus services, improving public transport accessibility to the airport.	Pedestrians and cyclists in Wenvoe and the north Barry area and public transport users.	Slight beneficial
TPO4:To improve accessibility and journey time reliability to/from Cardiff International Airport by private transport.		Journey times and accessibility to CIA would be improved for vehicles travelling from Cardiff and the east. Improved journey times and accessibility along the route would encourage some travellers from the west to use this route to the airport providing slight benefits to those travellers.	No significant distributional impacts	Moderate beneficial
TPO5:To improve public transport, walking and cycling accessibility to Culverhouse Cross.		Less traffic at Culverhouse Cross would improve conditions for non-motorised modes and would encourage more pedestrian and cyclist trips.	Pedestrians and cyclists travelling to Culverhouse Cross	Slight beneficial
TPO6:To reduce congestion at Culverhouse Cross.		The route, which incorporates a bypass at Culverhouse Cross, would reduce congestion at this junction.	All road users.	Moderate beneficial
TPO7:To identify opportunities to improve accessibility to regional developments and complement local development plan strategies.		Route A would provide a more direct route to the airport, plus the strategic opportunity area at St. Athan and the key settlement at Barry, which are identified in the Wales Spatial Plan.	No significant distributional impacts	Slight beneficial
TPO8:To improve journey time reliability on the A4232(T).		Online widening of the A4232 (T) would reduce journey times on this road. Culverhouse Cross bypass would contribute to improved journey times by reducing congestion and tailbacks from Culverhouse Cross on to the southbound carriageway of the A4232(T).	No significant distributional impacts	Moderate beneficial
TPO9:To reduce the level of car dependency		Less traffic on existing routes at Culverhouse Cross, Wenvoe and Barry would improve conditions for pedestrians, cyclists and equestrians and encourage more non-motorised trips. Public transport reliability and journey times would also be improved.	All road users.	Neutral

Key local issues: St Fagan's Natural History Museum, Wenvoe library and junior school, Barry Woodlands SSSI, Wenvoe Castle grounds, Brynhill Golf Clubs, Welsh Hawking Centre, 3 schools and 1 community centre along A4226 in Barry.

Public acceptability: PCE results: Corridor A was identified as least preferred - 1028 responses, Corridor B – 544 responses, Corridor C – 541 responses. Wenvoe Action Group established.

Acceptability to other stakeholders: St Fagans National History Museum: preferred corridor; Michaelston Community Council objection; National Grid: least impact; Wenvoe Community Council: least preferred; CCW: least preferred, significant concerns with impact on Barry Woodlands SSSI; Wenvoe action Group: Objection.

Technical and operational feasibility: Significant construction disruption plus noise impact for adjoining properties along A4232, minor tie-ins at Culverhouse Cross junction and Wenvoe bypass, significant construction disruption online from Wenvoe and Docks Link roundabout.

Financial affordability and deliverability: To be completed in Stage 2

Risks: To be completed in Stage 2

Stage 1 Route assessments: Route C1

Route: C1 (Incorporating Element Nos. 8, 12, 13 and 15) **Relevant Public Consultation Refs: Q10a, Q11a, Q12a** **Description:** Route provides a link from the M4 Junction 34 to the airport with an outer western bypass of Pendoylan, junction improvement at Sycamore Cross and improvements to Five Mile Lane (A4226). A single lane carriageway with climbing lane provision, or an additional lane in one direction would provide safe overtaking opportunities on this route. A single carriageway western bypass at Culverhouse Cross and a new access to the St Fagans National History Museum is also proposed. (Corridor C: Element Nos. 2, 8, 12, 13 and 15)				
Criteria	**Assessment**		**Distribution**	**Significance**
Welsh Impact Area: *Economy*				
TEE	Not assessed as part of Stage 1.		Not applicable	Not applicable
EALI	Not assessed as part of Stage 1.		Not applicable	Not applicable
Welsh Impact Area: *Environment*				
Noise Source: DMRB Stage 2 Report – Sections 13.1, 14.1, 15.1	E8	Less traffic on the existing route would reduce noise for properties close to the main road. Existing road would remain open and still experience some traffic noise Pendoylan junior school and nursery situated within 165m of bypass, plus 58 properties within 300m.	Noise redistributed to bypass.	Slight adverse
	E12	Less traffic on existing Five Mile Lane would reduce traffic noise, but road would remain open and still experience some traffic noise. Element has 13 properties within 300m.	Noise redistributed to bypass.	Slight adverse
	E13	More traffic along improved element would lead to more traffic noise. Element has 144 properties within 300m.	Minor changes to the distribution of noise due to new road alignment.	Slight adverse
	E15	Comparable traffic to “do minimum” case. Negligible impact on noise along element.	No significant changes in noise distribution.	Neutral
Local air quality Source: DMRB Stage 2 Report – Sections 13.2, 14.2, 15.2	E8	Less traffic on local roads would reduce emissions through Pendoylan. Existing road would remain open and still experience some emissions. Pendoylan junior school and nursery situated within 90m of bypass, plus 58 properties within 300m. Improved journey times would also reduce impact. To be amplified as part of full route assessment.	Emissions redistributed to bypass.	Slight adverse
	E12	Less traffic on existing Five Mile Lane would reduce traffic emissions, but road would remain open and still experience some traffic emissions. More traffic along improved element, but improved journey times would reduce this impact. Element has 13 properties within 300m. To be amplified as part of full route assessment.	Emissions redistributed to bypass.	Slight adverse
	E13	More traffic along improved element would lead to more traffic emissions, but improved journey times would reduce traffic emissions and reduce this impact. Element has 144 properties within 300m. To be amplified as part of full route assessment.	Minor changes to the distribution of emissions due to new road alignment.	Slight adverse
	E15	Comparable traffic to “do minimum” case. Negligible impact on local air quality along element. To be amplified as part of full route assessment.	No significant changes in distribution of emissions.	Neutral
Greenhouse gas emissions Source: DMRB Stage 2 Report – Sections 13.2, 14.2, 15.2	E8	Less traffic on local roads would reduce emissions through Pendoylan. Existing road would remain open and still experience some emissions. Pendoylan junior school and nursery situated within 165m of bypass, plus 58 properties within 300m. Improved journey times would also reduce impact. To be amplified as part of full route assessment.	Emissions redistributed to bypass.	Neutral
	E12	Less traffic on existing Five Mile Lane would reduce traffic emissions, but road would remain open and still experience some traffic emissions. More traffic along improved element, but improved journey times would reduce this impact. Element has 13 properties within 300m. To be amplified as part of full route assessment.	Emissions redistributed to bypass.	Neutral
	E13	Increased traffic along improved element would lead to increased traffic emissions, but improved journey times would reduce and reduce this impact. Element has 144 properties within 300m. To be amplified as part of full route assessment.	Minor changes to the distribution of emissions due to new road alignment.	Neutral
	E15	Comparable traffic to “do minimum” case. Negligible impact on emissions along element. To be amplified as part of full route assessment.	No significant changes in distribution of emissions.	Neutral
Landscape and townscape Source: DMRB Stage 2 Report – Sections 13.3, 14.3, 15.3	E8	Element runs on Ely Valley sides, partly in cutting, and maintains significant separation from the village of Pendoylan, which is a Conservation Area. Element cuts across small tributary valleys to the south west. Adverse impact on St. Nicholas and Bonvilston Ridge Slopes. Majority of element runs through Special Landscape Area. (See Plan D.08).	Element would introduce road development into the relatively tranquil area to the west of Pendoylan.	Large adverse
	E12	Element runs along alignment of existing road but then diverges onto a parallel corridor on the open gently undulating ridge crest to the west, but avoids more sensitive landscape character areas. Element runs through Special Landscape Area. (See Plan D.06).	Element avoids more sensitive landscape character areas.	Slight adverse
	E13	The element runs for a short stretch offline on the side of the broad ridge, but runs online through the more sensitive Dyffryn Basin. There would be some loss of woodland, but this would be generally screened. Element runs through Special Landscape Area. (See Plan D.06).	No significant distributional effects	Slight adverse
	E15	The element remains online on road with semi-rural character with minor loss of vegetation on one side opening up views on one side until mitigation becomes effective. Element adjoins Special Landscape Area and Green Wedge designation. (See Plan D.06).	No significant distributional effects.	Slight adverse
Visual Effects Source: DMRB Stage 2 Report – Sections 13.3,	E8	The receptors affected by this stretch of road are mainly houses on the western edge of Pendoylan, scattered rural dwellings south and west of the village, the eastern edge of Clawdd Coch and those using public footpaths and bridleways. This option affects the least number of dwellings.	Ely valley sides and the western edge of Pendoylan	Large adverse

Route: C1 (Incorporating Element Nos. 8, 12, 13 and 15)
Relevant Public Consultation Refs: Q10a, Q11a, Q12a
Description: Route provides a link from the M4 Junction 34 to the airport with an outer western bypass of Pendoylan, junction improvement at Sycamore Cross and improvements to Five Mile Lane (A4226). A single lane carriageway with climbing lane provision, or an additional lane in one direction would provide safe overtaking opportunities on this route. A single carriageway western bypass at Culverhouse Cross and a new access to the St Fagans National History Museum is also proposed. (Corridor C: Element Nos. 2, 8, 12, 13 and 15)

14.3, 15.3	E12	The receptors affected by this stretch of road are a few, very scattered rural dwellers, and those using public footpaths and bridleways. The effects are slightly more adverse than for the online option.	Affects plateau top to the west of the existing road.	Slight adverse
	E13	The receptors affected by this stretch of road are mainly roadside dwellings and properties which are already affected by the existing road with resulting limited effects.	No significant distributional effects	Slight adverse
	E15	The receptors affected by this stretch of road are mainly roadside dwellings and public footpaths which are already affected by the existing road with resulting limited effects.	No significant distributional effects	Slight adverse
Bio-diversity Source: DMRB Stage 2 Report – Sections 13.4, 14.4, 15.4	E8	Crossing of River Ely SSSI, but no works envisaged. Bypass intersects number of tributaries of the Ely River. Online section and bypass lie close to areas of ancient semi-natural woodland. Records of protected species in the vicinity, which may require mitigation.	No significant distributional impacts.	Moderate adverse
	E12	Element crosses tributary of the Nant Llancarfan. Records of protected species in the vicinity, which may require mitigation. This element would intersect a number of hedgerows leading to habitat fragmentation.	No significant distributional impacts.	Slight adverse
	E13	Although element passes through Barry Woodlands SSSI, the loss of area from the SSSI could potentially be suitably mitigated. Records of protected species in the vicinity, which may require mitigation.	Increase existing severance in SSSI	Moderate adverse
	E15	Records of protected bird species, which may require mitigation.	Element would impact on Barry Woodlands	Neutral
Heritage Source: DMRB Stage 2 Report – Sections 13.5, 14.5, 15.5	E8	Bypass would have an adverse effect on the setting of two Scheduled Ancient Monuments, situated on either side of the element. Grade 1 listed building and Registered Park and Garden at Hensol Castle situated to the west of online section. Listed buildings and Conservation Area at Pendoylan. Element passes close to a Grade II listed building. (See Plan F.05)	Distribution assessment not required (Para. 7.10.7 of WelTAG June 2008)	Large adverse
	E12	Element is in close proximity with a number of known archaeological sites from the prehistoric, Roman and Medieval periods, including the Whitton Lodge Roman Villa site. Llancarfan Landscape of Outstanding Historic Interest lies to the west. Scheduled Ancient Monument lies adjacent to online element on existing A4226. Bonvilston Conservation Area extends eastwards from the village to the west of the Sycamore Cross junction. (See Plan F.06)	Distribution assessment not required (Para. 7.10.7 of WelTAG June 2008)	Large adverse
	E13	Element is not in close proximity of any known archaeological or built heritage resource, but the Moulton Roman complex scheduled ancient monument and Llancarfan Landscape of Outstanding Historic Interest lie to the west. Element may have slight adverse impact on the setting of scheduled ancient monument. (See Plan F.06)	Distribution assessment not required (Para. 7.10.7 of WelTAG June 2008)	Slight adverse
	E15	Element does not come into proximity of any known archaeological or built heritage resource. (See Plan F.06)	Distribution assessment not required (Para. 7.10.7 of WelTAG June 2008)	Neutral
Water environment Source: DMRB Stage 2 Report – Sections 13.6, 14.6, 15.6	E8	Crossing of River Ely SSSI, but no works envisaged. Bypass also intersects tributaries of the Ely River. Online link from Jn. 34 passes through flooding zones B and C2, but negligible impact due to use of existing structure. Bypass does not run through a flood risk area. Element would include attenuation. Potential impact on water quality during construction, but neutral impact in long term.	No significant distributional impacts	Neutral
	E12	Bypass intersects a tributary of Nant Llancarfan. Element is not situated in an area at risk from flooding, but would include attenuation. Potential impact on water quality during construction, but would be a neutral impact in long term.	No significant distributional impacts.	Neutral
	E13	Central section of online element runs through flood Zones B and C2. Crossing of the River Waycock via existing structure would not adversely affect flood risk and would include attenuation. Element would have potential impact on water quality during construction, but would offer an improvement in water quality in the long term.	No significant distributional effects	Slight beneficial
	E15	No direct interface with any rivers or streams. Element is not in an area at risk of flooding. Scheme would include attenuation. Potential impact on water quality during construction, but would offer an improvement in water quality in the long term.	No significant distributional effects	Slight beneficial
Soils Source: DMRB Stage 2 Report – 8.7 & Geotechnical Overview	E8	Element runs through Grades 2, 3 and 4 agricultural land. Construction works required for cuttings and embankments	No significant distributional impacts	Moderate adverse
	E12	Element runs through Grades 2, 3 and 4 agricultural land. Generally no geotechnical constraints anticipated. Construction works required for cuttings and embankments.	No significant distributional impacts.	Moderate adverse
	E13	Some land is available within highway boundary, but some land required off site. Route runs online through Grade 3 agricultural land. No geotechnical constraints to online section, but some excavations required.	No significant distributional effects	Slight adverse
	E15	Some land is available within highway boundary, but some land required off site. Element runs on line through Grade 3 agricultural land. No	No significant distributional effects	Slight adverse

Route: C1 (Incorporating Element Nos. 8, 12, 13 and 15)
Relevant Public Consultation Refs: Q10a, Q11a, Q12a
Description: Route provides a link from the M4 Junction 34 to the airport with an outer western bypass of Pendoylan, junction improvement at Sycamore Cross and improvements to Five Mile Lane (A4226). A single lane carriageway with climbing lane provision, or an additional lane in one direction would provide safe overtaking opportunities on this route. A single carriageway western bypass at Culverhouse Cross and a new access to the St Fagans National History Museum is also proposed. (Corridor C: Element Nos. 2, 8, 12, 13 and 15)

		geotechnical constraints to online element.		
Welsh Impact Area: *Social*				
Transport safety Source: WelTAG Social Impacts Report	E8	Element would reduce traffic through Pendoylan improving safety for travellers & pedestrians. Scheme would provide safe overtaking opportunities and an improved access to Pendoylan from the A48.	All road users.	Moderate beneficial
	E12	Existing A4226 has record of 2 fatal accidents and 3 slight severity accidents between 2005 and 2007. Element would provide safety improvement for travellers and pedestrians. Improved traffic flow would reduce driver frustration and stress and also improve safety.	All road users	Moderate beneficial
	E13	Online improvements would improve safety for travellers. Improved traffic flow would reduce driver frustration and stress and also improve safety.	All road users	Slight beneficial
	E15	Existing A4226 has record of 5 slight severity accidents and 1 serious accident between 2005 and 2007. Element would provide safety improvements for travellers and pedestrians. Improved traffic flow would reduce driver frustration and stress and also improve safety.	All road users	Slight beneficial
Personal security Source: WelTAG Social Impacts Report	E8	No significant personal security impacts.	No significant distributional effects	Neutral
	E12	No significant personal security impacts.	No significant distributional effects	Neutral
	E13	No significant personal security impacts.	No significant distributional effects	Neutral
	E15	No significant personal security impacts.	No significant distributional effects	Neutral
Permeability Source: WelTAG Social Impacts Report	E8	Element would affect existing footpaths without appropriate mitigation. However, reduced levels of through traffic in Pendoylan would improve conditions for pedestrians and cyclists.	Pedestrians and cyclists in the Pendoylan area.	Slight beneficial
	E12	Element would affect one footpath without appropriate mitigation. However, reduced traffic on existing A4226 would improve conditions for pedestrians and cyclists.	Pedestrians and cyclists	Slight beneficial
	E13	There are no footpaths affected by this element, but scheme would include provision of new footpath.	No significant distributional effects	Slight beneficial
	E15	Element adjoins 3 existing footpaths. Element could offer improved connection between footpaths and improve conditions for pedestrians and cyclists.	Pedestrians and cyclists	Slight beneficial
Physical fitness Source: WelTAG Social Impacts Report	E8	Improved safety for pedestrians and cyclists in Pendoylan may encourage more trips, but footpaths could be affected without appropriate mitigation	Pedestrians and cyclists in the Pendoylan area.	Slight beneficial
	E12	Improved safety for pedestrians and cyclists along existing A4226 may encourage more trips, but footpath could be affected without appropriate mitigation	Pedestrians and cyclists.	Slight beneficial
	E13	There are no footpaths affected by this element. Provision of a new footpath as part of this element may encourage more trips by pedestrians.	No significant distributional effects	Slight beneficial
	E15	Improved safety for pedestrians and cyclists along existing A4226 may encourage more trips. Improved connections and access to the airport for pedestrians and cyclists.	Pedestrians and cyclists.	Slight beneficial
Social inclusion Source: WelTAG Social Impacts Report	E8	Element would improve bus journey times and could provide opportunities for service enhancements. A reduction in traffic on Pendoylan Lane would also improve accessibility generally in the area.	Distribution assessment not required (Para. 8.6.31 of WelTAG June 2008)	Slight beneficial
	E12	Element would improve reliability and journey times of bus services.	Distribution assessment not required (Para. 8.6.31 of WelTAG June 2008)	Slight beneficial
	E13	Element may improve reliability and journey times of bus services.	Distribution assessment not required (Para. 8.6.31 of WelTAG June 2008)	Slight beneficial
	E15	Element is unlikely to affect public transport accessibility.	No significant distributional effects	Neutral
Equality diversity & human rights Source: WelTAG Social Impacts Report	E8	No positive or negative discriminatory impact on any individual equality impact group.	No discriminatory impact	Neutral
	E12	No positive or negative discriminatory impact on any individual equality impact group.	No discriminatory impact	Neutral
	E13	No positive or negative discriminatory impact on any individual equality impact group.		
	E15	No positive or negative discriminatory impact on any individual equality impact group.		
Transport Planning Objectives				
TPO1: To improve transport safety in the study area.		Existing A4226 has record of accidents. New section and improved online element would provide safety improvement for travellers and pedestrians. Improved traffic flow would reduce driver frustration and stress. Access to Pendoylan would be improved and traffic reduced through Pendoylan, also improving safety.	All road users	Moderate beneficial

Route: C1 (Incorporating Element Nos. 8, 12, 13 and 15)
Relevant Public Consultation Refs: Q10a, Q11a, Q12a
Description: Route provides a link from the M4 Junction 34 to the airport with an outer western bypass of Pendoylan, junction improvement at Sycamore Cross and improvements to Five Mile Lane (A4226). A single lane carriageway with climbing lane provision, or an additional lane in one direction would provide safe overtaking opportunities on this route. A single carriageway western bypass at Culverhouse Cross and a new access to the St Fagans National History Museum is also proposed. (Corridor C: Element Nos. 2, 8, 12, 13 and 15)

TPO2: To discourage airport traffic flows on inappropriate routes.	Route C1 would provide a more direct route to the airport and improved journey times. A new north south route would discourage airport traffic flow away from inappropriate routes.	All road users	Moderate beneficial
TPO3: To improve public transport, walking and cycling accessibility to/from Cardiff International Airport.	Route would improve bus journey times and could provide opportunities for service enhancements, improving public transport accessibility to the airport. Improved safety and connections for pedestrians and cyclists on existing A4226 would also enhance accessibility.	Pedestrians and cyclists in the north Barry area and public transport users.	Slight beneficial
TPO4:To improve accessibility and journey time reliability to/from Cardiff International Airport by private transport.	Journey times and accessibility to CIA would be improved for vehicles travelling from the north and west. Journey times and accessibility for vehicles travelling from the east would also benefit with some trips using the new route as a direct link, providing relief of traffic from the A4232/A4050/A4226 corridor.	No significant distributional impacts	Moderate beneficial
TPO5:To improve public transport, walking and cycling accessibility to Culverhouse Cross.	Route C1 includes the bypass of Culverhouse Cross. Less traffic at Culverhouse Cross would improve conditions for pedestrian and cyclist trips.	Pedestrians and cyclists travelling to Culverhouse Cross	Slight beneficial
TPO6:To reduce congestion at Culverhouse Cross.	Route C1 includes the bypass of Culverhouse Cross, which would reduce congestion at this junction.	All road users	Moderate beneficial
TPO7:To identify opportunities to improve accessibility to regional developments and complement local development plan strategies.	Route C1 would provide a more direct route to the airport, plus the strategic opportunity area at St. Athan and the key settlements of Barry and Llantrisant, which are identified in the Wales Spatial Plan.	No significant distributional impacts	Moderate beneficial
TPO8:To improve journey time reliability on the A4232(T).	Route C1 includes the bypass of Culverhouse Cross. The bypass would contribute to improved journey times by reducing congestion and tailbacks from Culverhouse Cross on to the southbound carriageway of the A4232(T).	No significant distributional impacts	Moderate beneficial
TPO9:To reduce the level of car dependency	Less traffic on existing routes and the provision of a footway on Five Mile Lane would improve conditions for pedestrians and cyclists. Public transport reliability and journey times would also be improved and there may be opportunities for service enhancements.	All road users	Neutral

Key local issues: Primary school and nursery at Pendoylan, Cottrell Park Golf Course, Amelia Trust Farm, Welsh Hawking Centre

Public acceptability: PCE results: Corridor C was identified as most preferred in 1342 responses, Corridor A – 742 responses, Corridor B – 165 responses. 1427 responded “Yes” and 1220 responded “No” to the existing A4226 improvement from Moulton to Waycock Cross. NEVAR Action Group established.

Acceptability to other stakeholders: Defence Estates: support; Cardiff Council: support; Radyr & Morganstown Community Council: support; Wenvoe Community Council: preferred; Cardiff International Airport: preferred; CCW: preferred; SW Wales Economic Forum: support; St Nicholas Action Group: support; National Trust: objection

Technical and operational feasibility: Construction disruption to traffic on A4226. No construction issues anticipated on rest of route.

Financial affordability and deliverability: To be completed in Stage 2

Risks: To be completed in Stage 2

Stage 1 Route assessments: Route C2

Route: C2 (Incorporating Element Nos. 8, 12 and 14) **Relevant Public Consultation Ref: Q10a, Q11b, Q12b** **Description:** Route provides a link from the M4 Junction 34 to the airport with an outer western bypass of Pendoylan, junction improvement at Sycamore Cross and improvements to Five Mile Lane (A4226) to the north of Moulton and a new road over the Waycock Valley to connect to the existing eastern roundabout (the main access to the airport). A single lane carriageway with climbing lane provision or an additional lane in one direction would provide safe overtaking opportunities on this route. A single carriageway western bypass at Culverhouse Cross is also proposed and a new access to the St Fagans National History Museum is also proposed. (Corridor C: Element Nos. 2, 8, 12, and 14)				
Criteria	**Assessment**		**Distribution**	**Significance**
Welsh Impact Area: *Economy*				
TEE	Not assessed as part of Stage 1.		Not applicable	Not applicable
EALI	Not assessed as part of Stage 1.		Not applicable	Not applicable
Welsh Impact Area: *Environment*				
Noise Source: DMRB Stage 2 Report – Sections 13.1, 14.1, 15.1	E8	Less traffic on the existing route would reduce noise for properties close to the main road. Existing road would remain open and still experience some traffic noise Pendoylan junior school and nursery situated within 165m of bypass, plus 58 properties within 300m.	Noise redistributed to bypass.	Slight adverse
	E12	Less traffic on existing Five Mile Lane would reduce traffic noise, but road would remain open and still experience some traffic noise. Element has 13 properties within 300m.	Noise redistributed to bypass.	Slight adverse
	E14	Comparable traffic along Five Mile Lane. More traffic along new element would redistribute noise to bypass. Bypass would be on embankment across Waycock Valley. Element has 12 properties within 300m.	Noise redistributed to bypass.	Slight adverse
Local air quality Source: DMRB Stage 2 Report – Sections 13.2, 14.2, 15.2	E8	Less traffic on local roads would reduce emissions through Pendoylan. Existing road would remain open and still experience some emissions. Pendoylan junior school and nursery situated within 90m of bypass, plus 58 properties within 300m. Improved journey times would also reduce impact. To be amplified as part of full route assessment.	Emissions redistributed to bypass.	Slight adverse
	E12	Less traffic on existing Five Mile Lane would reduce traffic emissions, but road would remain open and still experience some traffic emissions. More traffic along improved element, but improved journey times would reduce this impact. Element has 13 properties within 300m. To be amplified as part of full route assessment.	Emissions redistributed to bypass.	Slight adverse
	E14	Comparable traffic along Five Mile Lane. More traffic along new element would redistribute emissions to new element, but new route is relatively remote from receptors. Element has 12 properties within 300m. To be amplified as part of full route assessment.	Emissions redistributed to bypass.	Slight adverse
Greenhouse gas emissions Source: DMRB Stage 2 Report – Sections 13.2, 14.2, 15.2	E8	Less traffic on local roads would reduce emissions through Pendoylan. Existing road would remain open and still experience some emissions. Pendoylan junior school and nursery situated within 165m of bypass, plus 58 properties within 300m. Improved journey times would also reduce impact. To be amplified as part of full route assessment.	Emissions redistributed to bypass.	Neutral
	E12	Less traffic on existing Five Mile Lane would reduce traffic emissions, but road would remain open and still experience some traffic emissions. More traffic along improved element, but improved journey times would reduce this impact. Element has 13 properties within 300m. To be amplified as part of full route assessment.	Emissions redistributed to bypass.	Neutral
	E14	Less traffic on Five Mile Lane would provide reduction in emissions, but Five Mile Lane would remain open and would still experience some emissions. More traffic along new element would redistribute emissions to new element, but improved journey times would reduce this impact. Element has 12 properties within 300m. To be amplified as part of full route assessment.	Emissions redistributed to bypass.	Neutral
Landscape and townscape Source: DMRB Stage 2 Report – Sections 13.3, 14.3, 15.3	E8	Element runs on Ely Valley sides, partly in cutting, and maintains significant separation from the village of Pendoylan, which is a Conservation Area. Element cuts across small tributary valleys to the south west. Adverse impact on St. Nicholas and Bonvilston Ridge Slopes. Majority of element runs through Special Landscape Area. (See Plan D.05).	Element would introduce road development into the relatively tranquil area to the west of Pendoylan.	Large adverse
	E12	Element runs along alignment of existing road but then diverges onto a parallel corridor on the open gently undulating ridge crest to the west, but avoids more sensitive landscape character areas. Element runs through Special Landscape Area. (See Plan D.06).	Element avoids more sensitive landscape character areas.	Slight adverse
	E14	Route passes through the sensitive steep sided valley of the River Waycock, although this is already affected by power lines. A section would be significantly affected with views from the east. Element also impinges on woodland on the southern valley side. Element runs through Special Landscape Area. (See Plan D.06).	A new corridor across the lower Waycock valley and adjoining plateau to the north and south.	Large adverse
Visual Effects Source: DMRB Stage 2 Report – Sections 13.3, 14.3, 15.3	E8	The receptors affected by this stretch of road are mainly houses on the western edge of Pendoylan, scattered rural dwellings south and west of the village, the eastern edge of Clawdd Coch and those using public footpaths and bridleways. This option affects the least number of dwellings.	Ely valley sides and the western edge of Pendoylan	Large adverse
	E12	The receptors affected by this stretch of road are a few, very scattered rural dwellers, and those using public footpaths and bridleways. The effects are slightly more adverse than for the online option.	Affects plateau top to the west of the existing road.	Slight adverse
	E14	The receptors affected are a few very scattered rural dwellers and those using public footpaths and bridleways.	The lower Waycock valley and adjoining plateau to the north and south.	Slight adverse
Bio-diversity	E8	Crossing of River Ely SSSI, but no works envisaged. Bypass intersects	No significant	Moderate

Route: C2 (Incorporating Element Nos. 8, 12 and 14)
Relevant Public Consultation Ref: Q10a, Q11b, Q12b
Description: Route provides a link from the M4 Junction 34 to the airport with an outer western bypass of Pendoylan, junction improvement at Sycamore Cross and improvements to Five Mile Lane (A4226) to the north of Moulton and a new road over the Waycock Valley to connect to the existing eastern roundabout (the main access to the airport). A single lane carriageway with climbing lane provision or an additional lane in one direction would provide safe overtaking opportunities on this route. A single carriageway western bypass at Culverhouse Cross is also proposed and a new access to the St Fagans National History Museum is also proposed. (Corridor C: Element Nos. 2, 8, 12, and 14)

Source: DMRB Stage 2 Report – Sections 13.4, 14.4, 15.4		number of tributaries of the Ely River. Online section and bypass lie close to areas of ancient semi-natural woodland. Records of protected species in the vicinity, which may require mitigation.	distributional impacts.	adverse
	E12	Element crosses tributary of the Nant Llancarfan. Records of protected species in the vicinity, which may require mitigation. This element would intersect a number of hedgerows leading to habitat fragmentation.	No significant distributional impacts.	Slight adverse
	E14	Element would affect areas of ancient semi natural woodland within the Barry Woodlands SSSI passing between several sections of this site. This would result in a significant barrier to species movement between woodland blocks reducing ecological connectivity. Records of protected species, which may require mitigation.	New line of severance in SSSI	Large adverse
Heritage Source: DMRB Stage 2 Report – Sections 13.5, 14.5, 15.5	E8	Bypass would have an adverse effect on the setting of two Scheduled Ancient Monuments, situated on either side of the element. Grade 1 listed building and Registered Park and Garden at Hensol Castle situated to the west of online section. Listed buildings and Conservation Area at Pendoylan. Element passes close to a Grade II listed building. (See Plan F.08)	Distribution assessment not required (Para. 7.10.7 of WelTAG June 2008)	Large adverse
	E12	Element is in close proximity with a number of known archaeological sites from the prehistoric, Roman and Medieval periods, including the Whitton Lodge Roman Villa site. Llancarfan Landscape of Outstanding Historic Interest lies to the west. Scheduled Ancient Monument lies adjacent to online element on existing A4226. Bonvilston Conservation Area extends eastwards from the village to the west of the Sycamore Cross junction. (See Plan F.06)	Distribution assessment not required (Para. 7.10.7 of WelTAG June 2008)	Large adverse
	E14	Element is in close proximity to a number of known archaeological sites from the prehistoric, Roman and Medieval periods. The Moulton Roman complex scheduled ancient lies to the west. The Llancarfan historic landscape lies to the north and west. (See Plan F.06)	Distribution assessment not required (Para. 7.10.7 of WelTAG June 2008)	Large adverse
Water environment Source: DMRB Stage 2 Report – Sections 13.6, 14.6, 15.6	E8	Crossing of River Ely SSSI, but no works envisaged. Bypass also intersects tributaries of the Ely River. Online link from Jn. 34 passes through flooding zones B and C2, but negligible impact due to use of existing structure. Bypass does not run through a flood risk area. Element would include attenuation. Potential impact on water quality during construction, but neutral impact in long term.	No significant distributional impacts	Neutral
	E12	Bypass intersects a tributary of Nant Llancarfan. Element is not situated in an area at risk from flooding, but would include attenuation. Potential impact on water quality during construction, but would be a neutral impact in long term.	No significant distributional impacts.	Neutral
	E14	Crossing of the River Waycock would be required on structure above flood zone C2. Element also runs through small areas of flood Zones B, but would include attenuation. Potential impact on water quality during construction, but would be a neutral impact in long term.	No significant distributional impacts	Neutral
Soils Source: DMRB Stage 2 Report – 8.7 & Geotechnical Overview	E8	Element runs through Grades 2, 3 and 4 agricultural land. Construction works required for cuttings and embankments	No significant distributional impacts	Moderate adverse
	E12	Element runs through Grades 2, 3 and 4 agricultural land. Generally no geotechnical constraints anticipated. Construction works required for cuttings and embankments.	No significant distributional impacts.	Moderate adverse
	E14	Element runs through Grade 3 agricultural land. Construction works required for cuttings and embankments.	No significant distributional impacts	Moderate adverse
Welsh Impact Area: *Social*				
Transport safety Source: WelTAG Social Impacts Report	E8	Element would reduce traffic through Pendoylan improving safety for travellers & pedestrians. Scheme would provide safe overtaking opportunities and an improved access to Pendoylan from the A48.	All road users.	Moderate beneficial
	E12	Existing A4226 has record of 2 fatal accidents and 3 slight severity accidents between 2005 and 2007. Element would provide safety improvement for travellers and pedestrians. Improved traffic flow would reduce driver frustration and stress and also improve safety.	All road users	Moderate beneficial
	E14	Bypass would improve traffic flow, reducing driver frustration and stress. However, average traffic speeds may increase.	All road users.	Slight beneficial
Personal security Source: WelTAG Social Impacts Report	E8	No significant personal security impacts.	No significant distributional effects	Neutral
	E12	No significant personal security impacts.	No significant distributional effects	Neutral
	E14	No significant personal security impacts.	No significant distributional effects	Neutral
Permeability Source: WelTAG Social Impacts Report	E8	Element would affect existing footpaths without appropriate mitigation. However, reduced levels of through traffic in Pendoylan would improve conditions for pedestrians and cyclists.	Pedestrians and cyclists in the Pendoylan area.	Slight beneficial
	E12	Element would affect one footpath without appropriate mitigation. However, reduced traffic on existing A4226 would improve conditions for pedestrians	Pedestrians and cyclists	Slight beneficial

Route: C2 (Incorporating Element Nos. 8, 12 and 14)
Relevant Public Consultation Ref: Q10a, Q11b, Q12b
Description: Route provides a link from the M4 Junction 34 to the airport with an outer western bypass of Pendoylan, junction improvement at Sycamore Cross and improvements to Five Mile Lane (A4226) to the north of Moulton and a new road over the Waycock Valley to connect to the existing eastern roundabout (the main access to the airport). A single lane carriageway with climbing lane provision or an additional lane in one direction would provide safe overtaking opportunities on this route. A single carriageway western bypass at Culverhouse Cross is also proposed and a new access to the St Fagans National History Museum is also proposed. (Corridor C: Element Nos. 2, 8, 12, and 14)

		and cyclists.		
	E14	Element would affect existing footpaths without appropriate mitigation	Pedestrians and cyclists	Neutral
Physical fitness Source: WelTAG Social Impacts Report	E8	Improved safety for pedestrians and cyclists in Pendoylan may encourage more trips, but footpaths could be affected without appropriate mitigation	Pedestrians and cyclists in the Pendoylan area.	Slight beneficial
	E12	Improved safety for pedestrians and cyclists along existing A4226 may encourage more trips, but footpath could be affected without appropriate mitigation	Pedestrians and cyclists.	Slight beneficial
	E14	It is unlikely that there would be any changes to non-motorised movement or physical fitness in the area.	Pedestrians and cyclists.	Neutral
Social inclusion Source: WelTAG Social Impacts Report	E8	Element would improve bus journey times and could provide opportunities for service enhancements. A reduction in traffic on Pendoylan Lane would also improve accessibility generally in the area.	Distribution assessment not required (Para. 8.6.31 of WelTAG June 2008)	Slight beneficial
	E12	Element would improve reliability and journey times of bus services.	Distribution assessment not required (Para. 8.6.31 of WelTAG June 2008)	Slight beneficial
	E14	Element would improve reliability and journey times of bus services.	Distribution assessment not required (Para. 8.6.31 of WelTAG June 2008)	Slight beneficial
Equality diversity & human rights Source: WelTAG Social Impacts Report	E8	No positive or negative discriminatory impact on any individual equality impact group.	No significant distributional effects	Neutral
	E12	No positive or negative discriminatory impact on any individual equality impact group.	No significant distributional effects	Neutral
	E14	No positive or negative discriminatory impact on any individual equality impact group.	No significant distributional effects	Neutral

Transport Planning Objectives

TPO1: To improve transport safety in the study area.	Existing A4226 has record of accidents. New section would provide safety improvement for travellers and pedestrians. Improved traffic flow would reduce driver frustration and stress. Access to Pendoylan would be improved and traffic reduced through Pendoylan, also improving safety. However, average traffic speeds may increase on bypass sections.	All road users	Moderate beneficial
TPO2: To discourage airport traffic flows on inappropriate routes.	Route C2 would provide a more direct route to the airport and improved journey times. A new north south route would discourage airport traffic flow away from inappropriate routes.	All road users	Moderate beneficial
TPO3: To improve public transport, walking and cycling accessibility to/from Cardiff International Airport.	Route would improve bus journey times and could provide opportunities for service enhancements, improving public transport accessibility to the airport.	Pedestrians and cyclists in the north Barry area and public transport users.	Slight beneficial
TPO4:To improve accessibility and journey time reliability to/from Cardiff International Airport by private transport.	Journey times and accessibility to CIA would be improved for vehicles travelling from the north and west. Journey times and accessibility for vehicles travelling from the east would also benefit with some trips using the new route as a direct link, providing relief of traffic from the A4232/A4050/A4226 corridor.	No significant distributional impacts	Moderate beneficial
TPO5:To improve public transport, walking and cycling accessibility to Culverhouse Cross.	Route C2 includes the bypass of Culverhouse Cross. Less traffic at Culverhouse Cross would improve conditions for pedestrian and cyclist trips.	Pedestrians and cyclists travelling to Culverhouse Cross	Slight beneficial
TPO6:To reduce congestion at Culverhouse Cross.	Route C1 includes the bypass of Culverhouse Cross, which would reduce congestion at this junction.	All road users	Moderate beneficial
TPO7:To identify opportunities to improve accessibility to regional developments and complement local development plan strategies.	Route C2 would provide a more direct route to the airport, plus the strategic opportunity area at St. Athan and the key settlements Barry and Llantrisant, which are identified in the Wales Spatial Plan.	No significant distributional impacts	Moderate beneficial
TPO8:To improve journey time reliability on the A4232(T).	Route C2 includes the bypass of Culverhouse Cross. The bypass would contribute to improved journey times by reducing congestion and tailbacks from Culverhouse Cross on to the southbound carriageway of the A4232(T).	No significant distributional impacts	Moderate beneficial
TPO9:To reduce the level of car dependency	Less traffic on existing routes would improve conditions for pedestrians and cyclists. Public transport reliability and journey times would also be improved and there may be opportunities for service enhancements.	All road users	Neutral

Key local issues: Primary school and nursery at Pendoylan, Cottrell Park Golf Course, Amelia Trust Farm.

Public acceptability: PCE results: Corridor C was identified as most preferred in 1342 responses, Corridor A – 742 responses, Corridor B – 165 responses. 1842 responded "Yes" and 949 responded "No" to a new road from Moulton to the airport eastern roundabout. NEVAR Action Group established.

Acceptability to other stakeholders: Defence Estates: preferred; Cardiff Council: support; Radyr & Morganstown Community Council: support; Wenvoe County Council: preferred; Cardiff International Airport: preferred; SW Wales Economic Forum: support; St Nicholas Action Group: support; National Trust: objection

Technical and operational feasibility: Construction disruption to traffic on A4226 No construction issues anticipated on rest of route.

Financial affordability and deliverability: To be completed in Stage 2

Risks: To be completed in Stage 2

Appendix F

Route Appraisal Summary Tables (ASTs)

Stage 2 Route Assessments: Route A

Route A Description: Route utilises the existing signposted route to the airport with widening to three lanes on the A4232(T) from M4 Junction 33 to a western bypass improvement at Culverhouse Cross, an eastern bypass of Wenvoe with traffic calming measures on the existing A4050 at Wenvoe to reduce through traffic and an offline improvement to the A4050 to the north of Barry. A new access to the St Fagans National History Museum is also proposed, as well as safety improvements to Five Mile Lane (A4226). (Corridor A: Element Nos. 1, 2, 4 and 5). **Relevant Public Consultation Ref:** Q8b			
Criteria	**Assessment**	**Distribution**	**Significance**
Welsh Impact Area: *Economy*			
TEE Source: Economic Assessment Report	Estimated scheme cost: £167.7m. PVC = £84.0m to £89.2m. The current average journey, at peak time, from J33 M4 to CIA is up to 23 minutes (via the current signposted route). Route would reduce journey times between CIA and J33 M4 by up to 7 minutes (opening year). PVB = £346.5-£366.4m. Approximately, 9% of PVB would be accrued from trips to and from the airport. Vehicle operating cost savings PVB = -£38.6m to -£36.1m. NPV = £257.4 to £282.5m. BCR = 3.89 - 4.36. (Range: low and high traffic growth).	All road users (light & heavy vehicles) to benefit from reduced journey times and improved journey reliability	Not applicable
EALI Source: EALI Report Stage 2	The route improves access to CIA and delivers the greatest benefits in terms of general improvements in transport conditions for business and commuters. It would also improve access to the identified Strategic Opportunity Areas at St. Athan and the key settlement of Barry.	Supports economic role of CIA & improves general transport conditions for business & commuters in Cardiff and the Vale of Glamorgan.	Not applicable
Welsh Impact Area: *Environment*			
Noise Source: DMRB Stage 2 Report – Section 17.1 Figures 33, 39-40	More properties would see benefits than would see adverse impacts. 240 properties would be subject to potentially significant adverse effects, but 314 properties would be subject to potentially significant beneficial effects. (In noise nuisance assessment, much more emphasis is placed on adverse impacts than on beneficial impacts).	Beneficial impacts to properties along A4232(T) & A4050 through Wenvoe. Adverse impacts to the north of Barry & for some properties east of Wenvoe.	Moderate adverse
Local air quality Source: DMRB Stage 2 Report – Section 17.1	All human health based air quality criteria are currently met along road links in the air quality assessment. Exposure to NO_2, PM_{10} and $PM_{2.5}$ would be increased. Increases in NO_2 would be slight adverse, but increases in PM_{10} and $PM_{2.5}$ would be of neutral significance. Increased nitrogen deposition would have a slight adverse impact on woodland vegetation.	Changes in current exposure to concentrations of NO_2 along route.	Slight adverse
Greenhouse gas emissions Source: DMRB Stage 2 Report – Section 17.1	The improved efficiency of the route would reduce queuing and stationary vehicles. However, this would be offset by an overall increase in traffic volume.	No significant distributional impacts	Neutral
Landscape and townscape Source: DMRB Stage 2 Report – Section 8.3 Figures 4, 5, 6 & 13a	Removal of vegetation along the A4232(T) would expose the improved road to the Ely Valley, St Fagan's Lowlands and Stocklands Lowlands character areas until new landscape planting has had time to establish. Parts of the Culverhouse Cross bypass run along high sensitivity lower ridge slopes, through a Green Wedge and Special Landscape Area between Wenvoe and Culverhouse Cross. The tranquility of the countryside east of Wenvoe may suffer from the new bypass. North of Barry, the bypass would affect the Dyffryn Basin and the Lower Waycock Valley Special Landscape Areas.	Route would introduce a noticeable element east of Wenvoe and north west of Barry, reducing the tranquility in both these areas.	Large adverse
Visual Effects Source: DMRB Stage 2 Report – Section 8.3	The most significant impact would occur along the northern edge of Barry, where the route would affect residents on the outskirts of Barry, rural dwellers and footpath/recreation users in the Dyffryn Basin, including the Wenvoe Castle and Brynhill golf courses. Residents on the western fringes of Cardiff and associated rural areas would also be affected as well as visitors to the St Fagan's National History Museum. Users of local public footpaths and bridleways east of Wenvoe would be affected as well as residents on the outskirts of Wenvoe.	Route would introduce a new visual impact east of Wenvoe and the edge of North Barry, Dyffryn Basin and ridges to the north and north west of the Dyffryn Basin.	Large adverse
Biodiversity Source: DMRB Stage 2 Report – 8.4 Figures 14-18	There are records of protected species along the whole route, in particular dormice in the vicinity of Wenvoe and great crested newts in Wenvoe Castle grounds, which would require mitigation. The improvements along the A4232(T) may impact upon the River Ely SSSI through widening or the bridge crossing. Severance of the Barry Woodlands SSSI would also occur as the route would pass between two sections of ancient woodland.	Potential habitat fragmentation for protected species. New line of severance in SSSI.	Large adverse
Heritage Source: DMRB Stage 2 Report – Section 8.5 Figures 27-32	Online widening of the A4232(T) runs through a landscape shaped by medieval and post medieval features, in particular the Battlefield Site of St Fagans and the setting of a SAM. There would be an impact on the rich archaeological landscape to the east of Wenvoe and the route could affect the setting of a SAM that lies to the west. The Wenvoe conservation area would benefit from the new bypass around the village. The bypass north of Barry would run in close proximity between two SAMs and would run into the south western portion of the Wenvoe Castle landscape (Grade II registered park and garden).	Distribution assessment not required (Para. 7.10.7 of WelTAG June 2008)	Large adverse
Water environment Source: DMRB Stage 2 Report – 8.6 Figure 34	Route runs through Flood Zones B and C2 at existing River Ely crossing on the A4232(T), crosses the Cadoxton River and areas of Flood Zone B bypassing Wenvoe, and crosses two tributaries of the River Waycock and Flood Zone B and C2 along the stretch north of Barry. Improvements to existing drainage on A4232(T) would have slight beneficial impacts.	No significant distributional impacts.	Slight beneficial
Soils Source: DMRB Stage 2 Report – 8.7.4, Figure 36 & Geotechnical Overview	Some land is available within highway boundary, but additional land required off line and for widening existing cuttings and embankments. Route runs online through Grade 2 and 3 agricultural land.	No significant distributional impacts.	Moderate adverse
Welsh Impact Area: *Social*			
Transport safety Source: WelTAG Social Impacts Report; Economic Assessment Report	Number of injury accidents saved: 1549 to 1718 Accident PVB = £63.0m to £68.7m (Range: low and high traffic growth, 60 year period). Improved road standards along A4232(T) and A4050. Bypasses of Culverhouse Cross, Wenvoe and North Barry would reduce traffic on existing roads thereby improving safety for all road users. Route also includes safety improvements to Five Mile Lane.	All road users	Large beneficial

Route A Description: Route utilises the existing signposted route to the airport with widening to three lanes on the A4232(T) from M4 Junction 33 to a western bypass improvement at Culverhouse Cross, an eastern bypass of Wenvoe with traffic calming measures on the existing A4050 at Wenvoe to reduce through traffic and an offline improvement to the A4050 to the north of Barry. A new access to the St Fagans National History Museum is also proposed, as well as safety improvements to Five Mile Lane (A4226). (Corridor A: Element Nos. 1, 2, 4 and 5). **Relevant Public Consultation Ref:** Q8b

Criteria	Assessment	Distribution	Significance
Personal security Source: WelTAG Social Impacts Report	The number of points for delay at traffic lights and junctions along the route would be reduced on the A4232 (T), Culverhouse Cross and on the A4050 through Wenvoe and Barry, which may reduce road users' vulnerability to crime. Laybys would be designed to existing highway standards to be clearly visible from a distance and with clear sight lines to all areas.	No significant distributional effects	Neutral
Permeability Source: WelTAG Social Impacts Report; Non Motorised User Context Report	Online widening of the existing A4232(T) is unlikely to lead to changes to non-motorised movement. Accessibility south of Culverhouse Cross bypass would need to be maintained. There are 5 footpaths along or adjoining the Wenvoe bypass, plus 11 footpaths along or adjoining the north Barry offline route plus other desire line routes, to which continuity of access should be maintained. Less traffic on the existing A4050/A4226 would improve accessibility for pedestrians, cyclists and equestrians in Wenvoe and north Barry. In line with the NMU Context Report, pedestrian and cyclist facilities will be improved/maintained.	Accessibility south of Culverhouse Cross. Pedestrians, cyclists and equestrians at Wenvoe and north Barry.	Slight beneficial
Physical fitness Source: WelTAG Social Impacts Report	Route is unlikely to lead to any changes in travel by active modes. However, less traffic on the existing Port Road at Wenvoe and Barry would afford an opportunity to improve public transport, walking and cycling accessibility generally.	No significant distributional impact	Neutral
Social inclusion Source: WelTAG Social Impacts Report	Reduced congestion at Culverhouse Cross, Wenvoe and north Barry would lead to improvements in the reliability and journey times of bus services, offering an opportunity to improve accessibility to key centres and facilities.	Distribution assessment not required (Para. 8.6.31 of WelTAG June 2008)	Slight beneficial
Transport Planning Objectives:			
TPO 1: Improve transport safety in the study area	The route would be designed to current standards, providing a safety improvement for all road users. The number of injury accidents saved would be 1549 to 1718 (low and high traffic growth). Most benefits are accrued from journeys between the M4, Central Southern Cardiff and the wider Barry area. Route also includes safety improvements to Five Mile Lane.	All road users, especially for journeys between the M4, Central Southern Cardiff and the wider Barry area.	Large beneficial
TPO 2: Discourage airport traffic flows on inappropriate routes	Airport traffic originating in the north and east would be encouraged to use this route, but it would do little to change existing driver behaviour for trips to CIA originating west of the airport.	Improvements to trips from the east and north, but no significant distributional impact on trips originating from the west.	Slight beneficial
TPO 3: Improve public transport, walking & cycling accessibility to/ from CIA	Less traffic on the existing Port Road at Wenvoe and Barry would afford an opportunity to improve public transport, walking and cycling accessibility to/from CIA.	Pedestrians and cyclists in Wenvoe and north Barry and public transport users.	Neutral
TPO 4: Improve accessibility & journey time reliability to/from CIA by private transport	Widening of A4232(T) and bypasses of Culverhouse Cross, Wenvoe and north Barry would improve journey time reliability and accessibility for private transport travelling to/from CIA.	Benefit to travellers to/from CIA from the east and north of the airport	Moderate beneficial
TPO 5: Improve public transport, walking & cycling accessibility to Culverhouse Cross	Less traffic at Culverhouse Cross would afford an opportunity to improve public transport, walking and cycling accessibility to Culverhouse Cross.	Pedestrians, cyclists and public transport users at Culverhouse Cross	Neutral
TPO 6: Reduce congestion at Culverhouse Cross	Bypass would reduce congestion at Culverhouse Cross.	All road users at Culverhouse Cross	Moderate beneficial
TPO 7: Identify opportunities to improve accessibility to regional developments & complement local development plan strategies	Route would improve accessibility to the airport, the strategic opportunity area at St. Athan and the key settlement at Barry, which are identified in the WSP. A surface access strategy to the airport, which will take into account the need to improve access to St. Athan, plus improved links between key settlements is an objective of the WTS. Improved airport accessibility is supported in the Vale of Glamorgan adopted UDP and emerging LDP.	No significant distributional impacts	Slight beneficial
TPO 8: Improve journey time reliability on A4232 (T)	Online widening of the A4232 (T) and the Culverhouse Cross bypass would improve journey time reliability by reducing congestion and tailbacks from Culverhouse Cross onto the southbound carriageway of the A4232(T).	No significant distributional impacts	Moderate beneficial
TPO 9: Reduce level of car dependency	Route, in isolation, would not reduce car dependency.	No significant distributional impacts	Slight adverse

Public transport interface with routes: Refer to public transport ASTs.

Nearby public facilities: St. Fagans National History Museum, Wenvoe Library, Wenvoe Infants School, Barry and Bryn Hafren Comprehensive Schools, Wenvoe Castle Golf Club and Grounds, South Wales Golf Centre, Brynhill Golf Club, Welsh Hawking Centre, Amelia Trust Farm, former Barry College site.

Public acceptability: PCE results: 3371 comment forms and 241 letters were received. Of the comment form responses, 743 respondents preferred Corridor A (this included the Culverhouse Cross improvement), but 1028 respondents considered Corridor A as least preferred (Q7). WCAG opposed the dualling of Port Road, but supported the bypass, which formed part of the route reserved in the Vale of Glamorgan UDP. Full details of the PCE response are provided in the Public Consultation Report.

Acceptability to stakeholders expressing a preference: St Fagans National History Museum & Cardiff Bus: preferred corridor; Michaelston Community Council objection; National Grid: least impact; Wenvoe Community Council & CCW: least preferred. Full details of stakeholder comments are provided in the Public Consultation Report.

Construction issues: Significant construction disruption for traffic on the A4232(T) (lane closures at night only), online on the A4050 south of Wenvoe to the Docks Link roundabout and the A4050 through Barry. Road closures for bridge beam lifts over the A4232(T). Construction noise impact for properties at Culverhouse Cross, online on the A4050 and to properties north of the A4050 through Barry. Disruption to traffic on Five Mile Lane during the safety improvements. Severe disruption to Bryn Hill golf course and likely disturbance to the Welsh Hawking Centre.

Technical and operational feasibility: Route susceptible to traffic congestion in the event of an incident on the A4232(T) or A4050 at Wenvoe. No direct alternative route available for airport access if the A4232(T) is closed. Route alleviates forecast congestion at Wenvoe.

Financial affordability and deliverability: Estimated scheme cost: £167.7m. Possible to deliver in a phased manner (Culverhouse Cross bypass, A4050 online dualling, Wenvoe bypass, offline improvement to north Barry, A4232(T) widening).

Risks: Major disruption on A4232(T) during construction. Potential adverse impact on retail & commercial businesses at Culverhouse Cross & Cardiff Bay during construction. Compensation costs. Adverse impact on the Barry Woodlands SSSI. Capacity at Junction 33 for additional traffic.

Stage 2 Route Assessments: Route C1

Route C1 Description: Route provides a link from the M4 Junction 34 to the airport with an outer western bypass of Pendoylan, junction improvement at Sycamore Cross and improvements to Five Mile Lane (A4226). A single lane carriageway with climbing lane provision, or an additional lane in one direction would provide safe overtaking opportunities on this route. A single carriageway western bypass at Culverhouse Cross and a new access to the St Fagans National History Museum is also proposed. (Corridor C: Element Nos. 8, 12, 13 and 15)
Relevant Public Consultation Refs: Q10a, Q11b, Q12a

Criteria	Assessment	Distribution	Significance
Welsh Impact Area: *Economy*			
TEE Source: Economic Assessment Report	Estimated scheme cost: £104.9m. PVC = £53.5m to £55.2m. The current average journey, at peak time, from J33 M4 to CIA is up to 23 minutes (via the current signposted route). Route would reduce journey times between CIA and J34 M4, compared to the existing signposted route from J33, by up to 9 minutes (opening year). PVB = £177.5m to £187.8m. Approximately, 11% of PVB would be accrued for trips to and from the airport. Vehicle operating cost savings PVB = -£28.5m to -£25.3m. NPV = £122.3m to £134.3m. BCR = 3.21 - 3.51. (Range: low and high traffic growth).	All road users (light & heavy vehicles) to benefit from reduced journey times and improved journey reliability.	Not applicable
EALI Source: EALI Report Stage 2	The route improves access to CIA with a direct link from the M4, but delivers less benefit in terms of improving general transport conditions for business and commuters and slightly less benefit for airport users than Route C2. However, the scheme would improve access to the identified strategic opportunity area at St. Athan and the key settlement of Barry. The route would also improve connectivity between Barry and Llantrisant (a strategic opportunity area/key settlement).	Supports economic role of CIA and improves general transport conditions for business and commuters in the Vale of Glamorgan.	Not applicable
Welsh Impact Area: *Environment*			
Noise Source: DMRB Stage 2 Report – Section 17.2 Figures 33, 41-42	Overall, 60 properties would be subject to potentially significant adverse effects and 41 properties subject to potentially significant beneficial effects. (In noise nuisance assessment much more emphasis is placed on adverse impacts than on beneficial impacts).	Adverse effects around new alignment from M4 J34 to CIA. Beneficial effects limited to properties immediately along existing routes.	Slight adverse (marginally less than Route C2)
Local air quality Source: DMRB Stage 2 Report – Section 17.2	All human health based air quality criteria are currently met along road links in the air quality assessment. Exposure to NO_2, PM_{10} and $PM_{2.5}$ would be increased. Increases in NO_2 would be slight adverse, but increases in PM_{10} and $PM_{2.5}$ would be of neutral significance. Increased nitrogen deposition would have a slight adverse impact on woodland vegetation.	Changes in current exposure to concentrations of NO_2 along route.	Slight adverse
Greenhouse gas emissions Source: DMRB Stage 2 Report – Section 17.2	The improved efficiency of the route would reduce queuing and stationary vehicles. However, this would be offset by an overall increase in traffic volume.	No significant distributional impacts	Neutral
Landscape and townscape Source: DMRB Stage 2 Report – Section 8.3 Figures 8-9 & 13a	The bypass of Pendoylan (a conservation area) would substantially be in cutting west of the settlement, but would cut across small tributary valleys to the south west, as well as having an adverse impact on the St. Nicholas and Bonvilston Ridge Slopes character area, reducing tranquility. Further south, the route tends to avoid the most sensitive landscape areas before running back online to minimise effects on the sensitive Dyffryn Basin, although this could result in some loss of woodland. A large proportion of the route runs through Special Landscape Areas.	New road element west of Pendoylan with limited distributional effects to the south.	Large adverse (but less than Route C2)
Visual Effects Source: DMRB Stage 2 Report – Section 8.3	A large proportion of receptors affected by the route are mainly houses on the southern edge of Pendoylan, as well as scattered rural dwellings south and west of the settlement, the eastern edge of Clawdd Coch, and those using public footways and bridleways. Also affected are a few scattered properties close to the existing road to the south.	Route would introduce new visual impact along the Ely Valley sides and south and west of Pendoylan.	Large adverse
Biodiversity Source: DMRB Stage 2 Report – 8.4 Figures 23-26	The Pendoylan bypass would intersect a number of tributaries of the River Ely and lies close to areas of ancient semi-natural woodland. There are records of protected species along the whole of the route. South of Moulton, the route would involve on line widening through the Barry Woodlands SSSI resulting in a loss from the SSSI along an existing line of severance.	Route would increase existing severance of the Barry Woodlands SSSI.	Moderate adverse
Heritage Source: DMRB Stage 2 Report – Section 8.5 Figures 27-32	The Pendoylan Bypass would have an adverse effect on the setting of two SAMs. A Grade 1 listed building and Registered Park and Garden at Hensol Castle lie to the west and the route passes close to a Grade II listed building. South of Sycamore Cross, the route is in close proximity to a number of known archaeological sites from the prehistoric, Roman, and Medieval periods, including the Whitton Lodge Roman Villa site. A SAM lies adjacent to online section of A4226. South of Moulton, the route may have a slight adverse impact on the Moulton Roman complex SAM. The Llancarfan Landscape of Outstanding Historic Interest lies to the west.	Distribution assessment not required (Para. 7.10.7 of WelTAG June 2008)	Large adverse
Water environment Source: DMRB Stage 2 Report – 8.6 Figure 34	The online link from Junction 34 of the M4 runs through Flood Zones B and C2. South of Sycamore Cross, the route intersects a tributary of the Nant Llancarfan, and crosses the River Waycock south of Moulton (Zones B and C2). There may be long term benefits to water quality following construction from improvements to the current drainage regime on Five Mile Lane and between Waycock Cross and the airport.	No significant distributional effects	Slight beneficial
Soils Source: DMRB Stage 2 Report – 8.7.4, Figure 36 & Geotechnical Overview	The Pendoylan Bypass and offline section of Five Mile Lane would run through Grades 2, 3 and 4 agricultural land. The online improvements south of Moulton and on the A4226 run through Grade 3 agricultural land. Some land would be required beyond the highway boundary for cuttings and embankments.	No significant distributional effects	Moderate adverse
Welsh Impact Area: *Social*			
Transport safety Source: WelTAG Social Impacts Report; Economic Assessment Report	Number of accidents saved: 487 to 512. PVB = £12.1m to £12.5m (Range: low and high traffic growth, 60 year period). Improved route between M4 J34 and Waycock Cross. Bypasses around Culverhouse Cross and Pendoylan would reduce traffic on existing roads thereby improving safety for all road users. A widened single carriageway with designated overtaking opportunities would be provided on various sections of the route. Route also includes safety improvements to Five Mile Lane.	All road users	Moderate beneficial

Route C1 Description: Route provides a link from the M4 Junction 34 to the airport with an outer western bypass of Pendoylan, junction improvement at Sycamore Cross and improvements to Five Mile Lane (A4226). A single lane carriageway with climbing lane provision, or an additional lane in one direction would provide safe overtaking opportunities on this route. A single carriageway western bypass at Culverhouse Cross and a new access to the St Fagans National History Museum is also proposed. (Corridor C: Element Nos. 8, 12, 13 and 15) **Relevant Public Consultation Refs:** Q10a, Q11b, Q12a			
Personal security Source: WelTAG Social Impacts Report	Improvements in highway safety would reduce incidents and delays, which may reduce road users' vulnerability to crime. Reduced traffic and congestion on the A4232(T), at Culverhouse Cross and on the A4050 through Wenvoe and Barry would also reduce the number of points for delay at traffic lights and junctions, which may reduce road users' vulnerability to crime. Laybys would be designed to existing highway standards to be clearly visible from a distance and with clear sight lines to all areas.	No significant distributional effects	Neutral
Permeability Source: WelTAG Social Impacts Report; Non Motorised User Context Report	Reduced traffic and improved safety for pedestrians, cyclists and equestrians would improve accessibility in Pendoylan village. There are 11 footpaths along or adjoining the route at Pendoylan plus 4 footpaths along or adjoining the remainder of the route plus other desire line routes, to which continuity of access should be maintained. In line with the NMU Context Report, pedestrian and cyclist facilities will be improved/maintained.	Pedestrians, cyclists and equestrians	Slight beneficial
Physical fitness Source: WelTAG Social Impacts Report	Route is unlikely to lead to any changes in travel by active modes. However, route would afford opportunities for public transport improvements, improved conditions for cycling accessibility and for pedestrians on remaining existing roads.	No significant distributional impacts	Neutral
Social inclusion Source: WelTAG Social Impacts Report	Route would improve bus journey times and could provide opportunities for service enhancements. A reduction in traffic on Pendoylan Lane would also improve accessibility generally in the area.	Distribution assessment not required (Para. 8.6.31 of WelTAG June 2008)	Slight beneficial
Transport Planning Objectives:			
TPO 1: Improve transport safety in the study area	The route would be designed to current standards, providing a safety improvement for all road users. The number of injury accidents saved would be 487 to 512 (low and high traffic growth). Most benefits are accrued for journeys between the M4 and the wider Barry area. Route also includes safety improvements to Five Mile Lane.	All road users, especially for journeys between the M4 and the wider Barry area	Moderate beneficial
TPO 2: Discourage airport traffic flows on inappropriate routes	Route would provide a new north-south link and direct access to CIA from the M4, serving to discourage airport traffic flows on inappropriate routes.	Improved conditions on inappropriate routes in study area	Moderate beneficial
TPO 3: Improve public transport, walking & cycling accessibility to/ from CIA	Route would afford opportunities for public transport improvements to/from CIA. Improved conditions for cycling accessibility to/from CIA along route. Improved conditions for pedestrians on remaining existing roads.	Public transport users and cyclists along route	Neutral
TPO 4: Improve accessibility & journey time reliability to/from CIA by private transport	Route would provide a new north-south link and direct access to CIA from the M4. Journey time reliability and accessibility would be significantly improved for private vehicles travelling to/from CIA.	Benefit to travellers to/from CIA from the east, north and west of the airport	Large beneficial
TPO 5: Improve public transport, walking & cycling accessibility to Culverhouse Cross	Less traffic at Culverhouse Cross would afford an opportunity to improve public transport, walking and cycling accessibility to Culverhouse Cross.	Pedestrians, cyclists and public transport users travelling to Culverhouse Cross	Neutral
TPO 6: Reduce congestion at Culverhouse Cross	Bypass would reduce congestion at Culverhouse Cross.	All road users at Culverhouse Cross	Moderate beneficial
TPO 7: Identify opportunities to improve accessibility to regional developments & complement local development plan strategies	Route would improve accessibility with a direct link from the M4 to the airport, the strategic opportunity area at St. Athan, the key settlement of Barry and the key settlement/strategic opportunity area at Llantrisant, which are identified in the WSP. A surface access strategy to the airport, which will take into account the need to improve access to St. Athan, plus improved links between key settlements is an objective of the WTS. Improved airport accessibility is supported in the Vale of Glamorgan adopted UDP and emerging LDP.	No significant distributional impacts	Moderate beneficial
TPO 8: Improve journey time reliability on A4232 (T)	The bypass of Culverhouse Cross would contribute to improved journey time reliability by reducing congestion and tailbacks from Culverhouse Cross onto the southbound carriageway of the A4232(T).	No significant distributional impacts	Slight beneficial
TPO 9: Reduce level of car dependency	Route, in isolation, would not reduce car dependency.	No significant distributional impacts	Slight adverse
Public transport interface with routes: Refer to public transport ASTs.			
Nearby public facilities: Primary school and nursery at Pendoylan, Cottrell Park Golf Course, Amelia Trust Farm, Welsh Hawking Centre, St. Fagans National History Museum, former Barry College site.			
Public acceptability: PCE results: 3371 comment forms and 241 letters were received. Of the comment form responses, 1343 respondents preferred Corridor C (this included the Culverhouse Cross improvement), but 542 considered Corridor C as least preferred (Q7). The majority of the Pendoylan response did not support any road improvement to the airport. There was strong support for improvements to Five Mile Lane. NEVAR opposed the construction of any road through the Ely Valley. SNAG supported Corridor C, bypass of Culverhouse Cross and safety improvements of Five Mile Lane. Full details of the PCE response are provided in the Public Consultation Report.			
Acceptability to stakeholders expressing a preference: Support for Corridor C: Cardiff Council, Cardiff International Airport, Radyr & Morganstown Community Council, Defence Estates & SW Wales Economic Forum. CCW & Wenvoe Community Council supported Corridor C with a preference for online improvements to the A4226. National Trust: raised concerns regarding environmental impact of Corridor C.			
Construction issues: Traffic disruption on the A4226 (Five Mile Lane). Disruption to traffic on A48 at Sycamore Cross. Noise and dust impact for properties adjacent to route. Disruption to traffic immediately south of junction 34 during online improvement.			
Technical and operational feasibility: Route provides resilience to trunk road network in the event of incident on the route or on the A4232(T). Route does not alleviate forecast congestion at Wenvoe on A4050. Route will cause an increase in traffic flows on the A48 compared to Do-Minimum.			
Financial affordability and deliverability: Estimated scheme cost: £104.9m. Limited opportunity for phased construction (Five Mile Lane improvements, Sycamore Cross junction, Waycock Cross roundabout, J34 to Sycamore Cross).			
Risks: Capacity at Junction 34 for additional traffic. Adverse impact on the Barry Woodlands SSSI. Compensation costs for Cottrell Park Golf Club.			

Stage 2 Route Assessments: Route C2

Route C2 Description: Route provides a link from the M4 Junction 34 to the airport with an outer western bypass of Pendoylan, junction improvement at Sycamore Cross and improvements to Five Mile Lane (A4226) to the north of Moulton and a new road over the Waycock Valley to connect to the existing eastern roundabout (the main access to the airport). A single lane carriageway with climbing lane provision or an additional lane in one direction would provide safe overtaking opportunities on this route. A single carriageway western bypass at Culverhouse Cross is also proposed and a new access to the St Fagans National History Museum. (Corridor C: Element Nos. 8, 12, and 14)

Relevant Public Consultation Ref: Q10a, Q11b, Q12b

Criteria	Assessment	Distribution	Significance
Welsh Impact Area: *Economy*			
TEE Source: Economic Assessment Report	Estimated scheme cost: £138.0m. PVC = £74.7m to £76.2m. The current average journey, at peak time, from J33 M4 to CIA is up to 23 minutes (via the current signposted route). Route would reduce journey times between CIA and J34 M4, compared to the existing signposted route from J33, by up to 11 minutes (opening year). PVB = £222.3m - £242.0m. Vehicle operating cost increase PVB = -£28.4m to £25.9m. Approximately, 17% of PVB would be accrued from trips to and from the airport. NPV = £146.1m to £167.3m. BCR = 2.92 to 3.24. (Range: low and high traffic growth).	All road users (light & heavy vehicles) to benefit from reduced journey times & improved journey reliability.	Not applicable
EALI Source: EALI Report Stage 2	The route is the most direct to CIA and would be expected to contribute most to supporting the economic role of the airport. It also improves general transport conditions for business and commuters. The scheme would improve access to the identified strategic opportunity area at St. Athan, the strategic opportunity area/key settlement at Llantrisant and the key settlement of Barry.	Contributes most to supporting economic role of CIA and improves general transport conditions for business and commuters in the Vale of Glamorgan.	Not applicable
Welsh Impact Area: *Environment*			
Noise Source: DMRB Stage 2 Report – Section 17.3 Figures 33, 43-44	Overall, 65 properties would be subject to potentially significant adverse effects and 43 properties subject to potentially significant beneficial effects. (In noise nuisance assessment much more emphasis is placed on adverse impacts than on beneficial impacts).	Adverse effects around new alignment from M4 J34 to CIA. Beneficial effects limited to properties immediately along existing routes.	Slight adverse
Local air quality Source: DMRB Stage 2 Report – Section 17.3	All human health based air quality criteria are currently met along road links in the air quality assessment. Exposure to NO_2, PM_{10} and $PM_{2.5}$ would be increased. Increases in NO_2 would be slight adverse, but increases in PM_{10} and $PM_{2.5}$ would be of neutral significance. Increased nitrogen deposition would have a slight adverse impact on woodland vegetation.	Changes in current exposure to concentrations of NO_2 along route.	Slight adverse
Greenhouse gas emissions Source: DMRB Stage 2 Report – Section 17.3	The improved efficiency of the route would reduce queuing and stationary vehicles. However, this would be offset by an overall increase in traffic volume.	No significant distributional impacts	Neutral
Landscape and townscape Source: DMRB Stage 2 Report – Section 8.3 Figures 8-9 & 13a	The bypass of Pendoylan (a conservation area) would substantially be in cutting predominantly west of the settlement, but would cut across small tributary valleys to the south west, as well as having an adverse impact on the St. Nicholas and Bonvilston Ridge Slopes character area, reducing tranquility. Further south, the route initially avoids the more sensitive landscape areas before running across the steep sided River Waycock valley. A large proportion of the route runs through Special Landscape Areas.	Route would introduce a new road element west of Pendoylan and across the lower Waycock valley, and adjoining plateau to the north and south.	Large adverse
Visual Effects Source: DMRB Stage 2 Report – Section 8.3	A large proportion of receptors affected by the route are mainly houses on the southern edge of Pendoylan, as well as scattered rural dwellings south and west of the settlement, the eastern edge of Clawdd Coch, and those using public footways and bridleways. Also affected are a few scattered properties close to the existing road line to the south, especially close to the airport.	New visual impact along Ely Valley sides, west of Pendoylan, Lower Waycock Valley and adjoining plateau.	Large adverse
Biodiversity Source: DMRB Stage 2 Report – 8.4 Figures 23-26	The Pendoylan bypass would intersect a number of tributaries of the River Ely and lies close to areas of ancient semi-natural woodland. There are records of protected species along the whole of the route. South of Moulton, the route would affect areas of semi-natural ancient woodland within the Barry Woodlands SSSI passing between several sections of the SSSI. This would result in a significant barrier to species movement between woodland blocks reducing ecological connectivity.	New line of severance in Barry Woodlands SSSI.	Large adverse
Heritage Source: DMRB Stage 2 Report – Section 8.5 Figures 27-32	The Pendoylan Bypass would have an adverse effect on the setting of two SAMs. A Grade 1 listed building and Registered Park and Garden at Hensol Castle lie to the west and route passes close to a Grade II listed building. South of Sycamore Cross, the route would be in close proximity to a number of known archaeological sites from the prehistoric, Roman, and Medieval periods, including the Whitton Lodge Roman Villa site. South of Moulton, the route would be in close proximity to a number of known archaeological sites from the prehistoric, Roman and Medieval periods. The Moulton Roman Complex SAM lies just to the west. The Llancarfan historic landscape also lies to the north and west.	Distribution assessment not required (Para. 7.10.7 of WelTAG June 2008)	Large adverse
Water environment Source: DMRB Stage 2 Report – 8.6 Figure 34	The online link from Junction 34 of the M4 would run through Flood Zones B and C2. South of Sycamore Cross, the route intersects a tributary of the Nant Llancarfan before crossing the River Waycock above flood Zone C2 and small areas of Flood Zone B.	No significant distributional impacts	Neutral
Soils Source: DMRB Stage 2 Report – 8.7.4, Figure 36 & Geotechnical Overview	The Pendoylan Bypass would run through Grades 2, 3 and 4 agricultural land. The offline section of road directly south of Moulton and on the A4226 would run through Grade 3 agricultural land.	No significant distributional impacts	Moderate adverse
Welsh Impact Area: *Social*			
Transport safety Source: WelTAG Social Impacts Report; Economic Assessment Report	Number of accidents saved: 574 to 644. PVB = £9.0m to £10.3m. (Range: low and high traffic growth, 60 year period). Improved route between M4 J34 and the airport roundabout. Bypasses around Culverhouse Cross and Pendoylan would reduce traffic on existing roads thereby improving safety for all road users. A widened single carriageway with designated overtaking opportunities would be provided on various sections of the route. Route also includes safety improvements to Five Mile Lane (A4226) to the north of Moulton.	All road users	Moderate beneficial

Route C2 Description: Route provides a link from the M4 Junction 34 to the airport with an outer western bypass of Pendoylan, junction improvement at Sycamore Cross and improvements to Five Mile Lane (A4226) to the north of Moulton and a new road over the Waycock Valley to connect to the existing eastern roundabout (the main access to the airport). A single lane carriageway with climbing lane provision or an additional lane in one direction would provide safe overtaking opportunities on this route. A single carriageway western bypass at Culverhouse Cross is also proposed and a new access to the St Fagans National History Museum. (Corridor C: Element Nos. 8, 12, and 14)
Relevant Public Consultation Ref: Q10a, Q11b, Q12b

Personal security Source: WelTAG Social Impacts Report	Improvements in highway safety would reduce incidents and delays, which may reduce road users' vulnerability to crime. Reduced traffic and congestion on the A4232(T), at Culverhouse House Cross and on the A4050 through Wenvoe and Barry would also reduce the number of points for delay at traffic lights and junctions, which may reduce road users' vulnerability to crime. Laybys would be designed to existing highway standards to be clearly visible from a distance and with clear sight lines to all areas.	No significant distributional effects	Neutral
Permeability Source: WelTAG Social Impacts Report; Non Motorised User Context Report	Reduced traffic and improved safety for pedestrians, cyclists and equestrians would improve accessibility in Pendoylan village. There are 11 footpaths along or adjoining the route at Pendoylan and 3 footpaths along or adjoining the remainder of the route plus other desire line routes, to which continuity of access should be maintained. In line with the NMU Context Report, pedestrian and cyclist facilities will be improved/maintained.	Pedestrians, cyclists and equestrians in Pendoylan.	Slight beneficial
Physical fitness Source: WelTAG Social Impacts Report	Route is unlikely to lead to any changes in travel by active modes. However, route would afford opportunities for public transport improvements, improved conditions for cycling accessibility and for pedestrians on remaining existing roads.	No significant distributional impacts	Neutral
Social inclusion Source: WelTAG Social Impacts Report	Route would improve bus journey times and could provide opportunities for service enhancements. A reduction in traffic on Pendoylan Lane would also improve accessibility generally in the area.	Distribution assessment not required (Para. 8.6.31 of WelTAG June 2008)	Slight beneficial
Transport Planning Objectives:			
TPO 1: Improve transport safety in the study area	The route would be designed to current standards, providing a safety improvement for all road users. The number of injury accidents saved would be 574 to 644 (low and high traffic growth). Most benefits are accrued for journeys between the M4 and the wider Barry area.	All road users, especially for journeys between the M4 and the wider Barry area	Moderate beneficial
TPO 2: Discourage airport traffic flows on inappropriate routes	Route would provide a new north-south link and the most direct access to CIA from the M4, serving to discourage airport traffic flows on inappropriate routes.	Improved conditions on inappropriate routes in study area	Moderate beneficial
TPO 3: Improve public transport, walking & cycling accessibility to/ from CIA	Route would provide opportunities for public transport improvements to/from CIA. Improved conditions for cycling accessibility to/from CIA along route. Improved conditions for pedestrians on remaining existing roads.	Public transport uses and cyclists along route	Neutral
TPO 4: Improve accessibility & journey time reliability to/from CIA by private transport	Route would provide a new north-south link and direct access to CIA from the M4. Journey time reliability and accessibility would be significantly improved for private vehicles travelling to/from CIA.	Benefit to travellers to/from CIA from the east, north and west of the airport	Large beneficial
TPO 5: Improve public transport, walking & cycling accessibility to Culverhouse Cross	Less traffic at Culverhouse Cross would afford an opportunity to improve public transport, walking and cycling accessibility to Culverhouse Cross.	Pedestrians, cyclists and public transport users travelling to Culverhouse Cross	Neutral
TPO 6: Reduce congestion at Culverhouse Cross	Bypass would reduce congestion at Culverhouse Cross.	All road users at Culverhouse Cross	Moderate beneficial
TPO 7: Identify opportunities to improve accessibility to regional developments & complement local development plan strategies	Route would improve accessibility with a direct link from the M4 to the airport, the strategic opportunity area at St. Athan, the key settlement of Barry and the key settlement/strategic opportunity area at Llantrisant, which are identified in the WSP. A surface access strategy to the airport, which will take into account the need to improve access to St. Athan, plus improved links between key settlements is an objective of the WTS. Improved airport accessibility is supported in the Vale of Glamorgan adopted UDP and emerging LDP.	No significant distributional impacts	Moderate beneficial
TPO 8: Improve journey time reliability on A4232 (T)	The bypass of Culverhouse Cross would contribute to improved journey time reliability by reducing congestion and tailbacks from Culverhouse Cross onto the southbound carriageway of the A4232(T).	No significant distributional impacts	Slight beneficial
TPO 9: Reduce level of car dependency	Route, in isolation, would not reduce car dependency.	No significant distributional impacts	Slight adverse

Public transport interface with routes: Refer to public transport ASTs.

Nearby public facilities: Primary school and nursery at Pendoylan, Cottrell Park Golf Course, Amelia Trust Farm, Welsh Hawking Centre, St. Fagans National History Museum, former Barry College site.

Public acceptability: PCE results: 3371 comment forms and 241 letters were received. Of the comment form responses, 1343 respondents preferred Corridor C (this included the Culverhouse Cross improvement), but 542 considered Corridor C as least preferred (Q7). The majority of the Pendoylan response did not support any road improvement to the airport. There was strong support for improvements to Five Mile Lane. The majority of responses supported a new link to the airport roundabout across the Waycock Valley. NEVAR opposed the construction of any road through the Ely Valley. SNAG supported Corridor C, bypass of Culverhouse Cross and safety improvements of Five Mile Lane. Full details of the PCE response are provided in the Public Consultation Report.

Acceptability to stakeholders expressing a preference: Support for Corridor C: Cardiff Council, Cardiff International Airport, CCW, Radyr & Morganstown Community Council, Wenvoe Community Council. Defence Estates & SW Wales Economic Forum supported Corridor C with a preference for the Waycock Valley route to the airport roundabout. National Trust: raised concern regarding environmental impact of Corridor C.

Construction issues: Traffic disruption on the A4226 (Five Mile Lane). Disruption to traffic on A48 at Sycamore Cross. Noise and dust impact for properties adjacent to route. Disruption to traffic immediately south of J34 during online improvement. Overhead power line diversions.

Technical and operational feasibility: Route provides resilience to trunk road network in the event of incident on the route or on the A4232(T). Route does not alleviate forecast congestion at Wenvoe on A4050. Route will cause an increase in traffic flows on the A48 compared to Do-Minimum.

Financial affordability and deliverability: Estimated scheme cost: 138.0m. Limited opportunity for phased construction (Sycamore Cross to Moulton improvement, Waycock valley crossing, Sycamore Cross junction, J34 to Sycamore Cross).

Risks: Capacity at Junction 34 for additional traffic. Adverse impact on the Barry Woodlands SSSI. Compensation costs for Cottrell Park Golf Club. Delays to due to overhead power line diversion.

Summary Appraisal of Routes

Appraisal Criteria	Summary of Significance		
	Route A	**Route C1**	**Route C2**
Welsh Impact Areas: Economy			
TEE	N/A	N/A	N/A
EALI	N/A	N/A	N/A
Welsh Impact Areas: Environment			
Noise	(--)	(-)*	(-)
Local air quality	(-)	(-)	(-)
Greenhouse gas emissions	(0)	(0)	(0)
Landscape and townscape	(---)	(---)*	(---)
Visual effects	(---)	(---)	(---)
Biodiversity	(---)	(--)	(---)
Heritage	(---)	(---)	(---)
Water environment	(+)	(+)	(0)
Soils	(--)	(--)	(--)
Welsh Impact Areas: Social			
Transport safety	(+++)	(++)	(++)
Personal security	(0)	(0)	(0)
Permeability	(+)	(+)	(+)
Physical fitness	(0)	(0)	(0)
Social inclusion	(+)	(+)	(+)
Transport Planning Objectives			
TPO 1: Improve transport safety	(+++)	(++)	(++)
TPO 2: Discourage airport traffic flows on inappropriate routes	(+)	(++)	(++)
TPO 3: Improve public transport, walking & cycling accessibility to/ from CIA	(0)	(0)	(0)
TPO 4: Improve accessibility & journey time reliability to/from CIA by private transport	(++)	(+++)	(+++)
TPO 5: Improve public transport, walking & cycling accessibility to Culverhouse Cross	(0)	(0)	(0)
TPO 6: Reduce congestion at Culverhouse Cross	(++)	(++)	(++)
TPO 7: Identify opportunities to improve accessibility to regional developments & complement local development plan strategies	(+)	(++)	(++)
TPO 8: Improve journey time reliability on A4232 (T)	(++)	(+)	(+)
TPO 9: Reduce level of car dependency	(-)	(-)	(-)
Public transport interface with routes	Reduced traffic volumes through Culverhouse Cross junction would allow for bus priority measures, which would benefit an express bus service between CIA and Cardiff and other bus services. Public transport journey time reliability would be improved in Wenvoe and north Barry.	Opportunity for improved bus services from the M4 and a possible Park and Ride site near J34. Reduced traffic volumes through Culverhouse Cross junction would allow for bus priority measures, which would benefit an express bus service between CIA and Cardiff and other bus services.	Opportunity for improved bus services from the M4 and a possible Park and Ride site near J34. Reduced traffic volumes through Culverhouse Cross junction would allow for bus priority measures, which would benefit an express bus service between CIA and Cardiff and other bus services.
Nearby public facilities	St. Fagans National History Museum, Wenvoe Library, Wenvoe Infants School, Barry and Bryn Hafren Comprehensive Schools, Wenvoe Castle Golf Club and Grounds, South Wales Golf Centre, Brynhill Golf Club, Welsh Hawking Centre, Amelia Trust Farm, former Barry College site.	Primary school and nursery at Pendoylan, Cottrell Park Golf Course, Amelia Trust Farm, Welsh Hawking Centre, St. Fagans National History Museum, former Barry College site.	Primary school and nursery at Pendoylan, Cottrell Park Golf Course, Amelia Trust Farm, Welsh Hawking Centre, St. Fagans National History Museum, former Barry College site.
Public acceptability	Comment forms: 743 preferred Corridor A, but 1028 considered Corridor A as least preferred. WCAG opposed the dualling of Port Road, but supported the bypass, which formed part of the route reserved in the Vale of Glamorgan UDP.	Comment forms: 1343 preferred Corridor C, but 542 considered Corridor C as least preferred. Majority of Pendoylan response did not support any road improvement to the CIA. Strong support for improvements to Five Mile Lane. NEVAR opposed the construction of any road through the Ely Valley. SNAG supported Corridor C, bypass of Culverhouse Cross and safety improvements of Five Mile Lane.	Comment forms: 1343 preferred Corridor C, but 542 considered Corridor C as least preferred. Majority of Pendoylan response did not support any road improvement to the CIA. Strong support for improvements to Five Mile Lane. Majority of responses supported a new link to CIA roundabout across the Waycock Valley. NEVAR opposed the construction of any road through the Ely Valley. SNAG supported Corridor C, bypass of Culverhouse Cross and safety improvements of Five Mile Lane.
Acceptability to other stakeholders	St Fagans National History Museum & Cardiff Bus: preferred; Michaelston Community Council objection; National Grid: least impact; Wenvoe Community Council & CCW: least preferred.	Support for Corridor C: Cardiff Council, CIA, Radyr & Morganstown Community Council, Defence Estates & SW Wales Economic Forum. CCW & Wenvoe Community Council supported Corridor C with a preference for online improvements to the A4226. National Trust raised concerns regarding environmental impact of Corridor C.	Support for Corridor C: Cardiff Council, CIA, CCW, Radyr & Morganstown Community Council, Wenvoe Community Council. Defence Estates & SW Wales Economic Forum supported Corridor C with a preference for the Waycock Valley route to the airport roundabout. National Trust: raised concern regarding environmental impact of Corridor C.
Construction issues	Significant construction disruption for traffic on the A4232(T) (lane closures at night only), online on the A4050 south of Wenvoe to the Docks Link roundabout and the A4050 through Barry. Road closures for bridge beam lifts over the A4232(T). Construction noise impact for properties at Culverhouse Cross, online on the A4050 and to properties north of the A4050 through Barry. Disruption to traffic on Five Mile Lane during the safety improvements. Severe disruption to Bryn Hill golf course and likely disturbance to the Welsh Hawking Centre.	Traffic disruption on the A4226 (Five Mile Lane). Disruption to traffic on A48 at Sycamore Cross. Noise and dust impact for properties adjacent to route. Disruption to traffic immediately south of junction 34 during online improvement.	Traffic disruption on the A4226 (Five Mile Lane). Disruption to traffic on A48 at Sycamore Cross. Noise and dust impact for properties adjacent to route. Disruption to traffic immediately south of J34 during online improvement. Overhead power line diversions.
Technical & other operational feasibility	Route susceptible to traffic congestion in the event of an incident on the A4232(T) or A4050 at Wenvoe. No direct alternative route available for airport access if the A4232(T) is closed. Route alleviates forecast congestion at Wenvoe.	Route provides resilience to trunk road network in the event of incident on the route or on the A4232(T). Route does not alleviate forecast congestion at Wenvoe on A4050. Route will cause an increase in traffic flows on the A48 compared to Do-Minimum.	Route provides resilience to trunk road network in the event of incident on the route or on the A4232(T). Route does not alleviate forecast congestion at Wenvoe on A4050. Route will cause an increase in traffic flows on the A48 compared to Do-Minimum.
Financial affordability & deliverability	Estimated scheme cost: £167.7m. Possible to deliver in a phased manner (Culverhouse Cross bypass, A4050 online dualling, Wenvoe bypass, offline improvement to north Barry, A4232(T) widening).	Estimated scheme cost: £104.9m. Limited opportunity for phased construction (Five Mile Lane improvements, Sycamore Cross junction, Waycock Cross roundabout, J34 to Sycamore Cross).	Estimated scheme cost: 138.0m. Limited opportunity for phased construction (Sycamore Cross to Moulton improvement, Waycock valley crossing, Sycamore Cross junction, J34 to Sycamore Cross).
Risks	Major disruption on A4232(T) during construction. Potential adverse impact on retail & commercial businesses at Culverhouse Cross & Cardiff Bay during construction. Compensation costs. Adverse impact on the Barry Woodlands SSSI. Capacity at Junction 33 for additional traffic.	Capacity at Junction 34 for additional traffic. Adverse impact on the Barry Woodlands SSSI. Compensation costs for Cottrell Park Golf Club.	Capacity at Junction 34 for additional traffic. Adverse impact on the Barry Woodlands SSSI. Compensation costs for Cottrell Park Golf Club. Delays to due to overhead power line diversion.

* Marginally less impact than Route C2

Appendix G

Public Transport Assessments

Public Transport Assessment

The Public Transport Improvement Options Report considered a range of public transport options. The following table represents a 'traffic light' appraisal of the selected options. All performance indicators were classified on a scale of 1 (worst) to 3 (best). A criteria weighting of 2 was applied to 'increased public transport mode share' and 'accessibility' to reflect one of the main study objectives of reducing car dependency and increasing public transport usage for trips to CIA. The overall score reflects the performance of each improvement option proposal with respect to the chosen performance indicators, with the highest score representing the best performance and the lowest score representing the worst performance.

'Traffic Light' Appraisal Summary Table

Option No.	Description	Timescale	Capital Cost	Operating Cost	Implementability	Feasibility	Increased PT Mode Share	Accessibility	Overall Score	Comments
	Criteria Weighting	-	1	1	1	1	2	2	-	
Public Transport Improvement Options										
R1	Tram train to airport terminal	Long Term	2	2	2	2	3	3	20	Could form part of wider Cardiff tram train network including City Line, Coryton Line and Cardiff Bay Line.
R2	Heavy rail service to airport terminal	Long Term	1	1	2	1	3	3	17	Some engineering complications due to typical heavy rail design parameters and ground levels in the Porthkerry area.
R3	Shuttle bus from Barry station	Medium Term	2	3	2	3	2	1	16	Includes interchange improvements and possible bus priority measures in Barry. Interchange facility on Broad Street side of Barry station feasible in principal.
R6	Re-routing of one train per hour from Barry Island to Bridgend	Medium Term	3	2	2	3	2	1	16	Once a third platform at Barry station is created as part of CASR possibility of running independent service between Barry and Barry Island.
B2	Branded Airbus express service	Short Term	3	3	3	3	2	3	22	Direct express connection between CIA and Cardiff city centre and additional loop around city centre for local pick-up / drop-off.

Source: Public Transport Improvement Options - Part 2 Appraisal

Transport Planning Objectives

Each public transport option has been assessed in relation to the Transport Planning Objectives (TPOs) for the scheme. The results of that appraisal are provided in the following ASTs.

Public Transport Assessments: Option R1

Option R1 Description: The new tram train service utilises the existing Vale of Glamorgan rail line between Barry and Cardiff Central with new tram train infrastructure between the airport terminal and the Vale of Glamorgan line near Porthkerry Viaduct as well as between Cardiff Central station and Cardiff Bay. Source: Public Transport Improvement Options - Part 2 Appraisal			
Transport Planning Objectives:			
TPO 1: Improve transport safety in the study area	The new rail infrastructure would be designed to current standards, providing a safety improvement for all public transport users accessing the airport by tram train as a result of eliminating the need for interchange at Rhoose station. Rail passengers would therefore not have to cross the level crossing at Rhoose. Transport safety improvements would also arise from modal shift from car to tram train.	All tram train users on journeys between Cardiff and CIA.	Slight beneficial
TPO 2: Discourage airport traffic flows on inappropriate routes	Better public transport provision is likely to encourage modal shift from car to public transport. Effect on travel along inappropriate routes is likely to be marginal.	Improvements to trips from the east and north, but less distributional impact on trips originating from the west.	Neutral
TPO 3: Improve public transport, walking & cycling accessibility to/ from CIA	Better public transport provision through direct connection between CIA and Cardiff, eliminating the need for interchange at Rhoose station. Also better direct public transport access into wider Cardiff Bay area. Less traffic on road network would afford an opportunity to improve bus, walking and cycling accessibility to/from CIA.	Pedestrians, cyclists and public transport users.	Moderate beneficial
TPO 4: Improve accessibility & journey time reliability to/from CIA by private transport	Increased number of public transport trips and reduced number of car trips to CIA would improve journey time reliability and accessibility for private transport travelling to/from CIA.	Benefit to travellers to/from CIA.	Slight beneficial
TPO 5: Improve public transport, walking & cycling accessibility to Culverhouse Cross	Less traffic on road network would afford an opportunity to improve bus, walking and cycling accessibility to/from Culverhouse Cross. Changes in highway demand at Culverhouse Cross likely to be insignificant.	Pedestrians, cyclists and public transport users at Culverhouse Cross	Neutral
TPO 6: Reduce congestion at Culverhouse Cross	Increased number of public transport trips and reduced number of car trips to CIA would reduce congestion at Culverhouse Cross.	All road users at Culverhouse Cross	Neutral
TPO 7: Identify opportunities to improve accessibility to regional developments & complement local development plan strategies	Tram train would improve accessibility to the airport and the key settlement at Barry, which are identified in the WSP. A surface access strategy to the airport, which will take into account the need to improve links between key settlements, is an objective of the WTS. Improved airport accessibility is supported in the Vale of Glamorgan adopted UDP and emerging LDP.	No significant distributional impacts	Slight beneficial
TPO 8: Improve journey time reliability on A4232 (T)	Lower car demand as a result of modal shift to public transport would reduce congestion and tailbacks from Culverhouse Cross and the M4 J33 roundabout onto the A4232(T). Effects are likely to be marginal.	No significant distributional impacts	Neutral
TPO 9: Reduce level of car dependency	Faster and more frequent public transport provision would reduce car dependency for trips to or from CIA.	Improvements to trips from the east and north, but less distributional impact on trips originating from the west.	Large beneficial

Public Transport Assessments: Option R2

Option R2 Description: The improved heavy rail service utilises the existing Vale of Glamorgan rail line between Barry and Cardiff Central with new rail infrastructure between the airport terminal and the Vale of Glamorgan line near Porthkerry Viaduct. The heavy rail service would provide through trips for passengers from the Valleys north of Cardiff. Source: Public Transport Improvement Options - Part 2 Appraisal			
Transport Planning Objectives:			
TPO 1: Improve transport safety in the study area	The new rail infrastructure would be designed to current standards, providing a safety improvement for all public transport users accessing the airport by heavy rail as a result of eliminating the need for interchange at Rhoose station. Rail passengers would therefore not have to cross the level crossing at Rhoose. Transport safety improvements would also arise from modal shift from car to heavy rail.	All heavy rail users on journeys between Cardiff and CIA.	Slight beneficial
TPO 2: Discourage airport traffic flows on inappropriate routes	Better public transport provision likely to encourage modal shift from car to public transport. Effect on travel along inappropriate routes likely to be marginal.	Improvements to trips from the east and north, but less distributional impact on trips originating from the west.	Neutral
TPO 3: Improve public transport, walking & cycling accessibility to/ from CIA	Better public transport provision through direct connection between CIA and Cardiff, eliminating the need for interchange at Rhoose station. Also better direct public transport access to the Valleys north of Cardiff giving direct access to a large proportion of the CIA catchment. Less traffic on road network would afford an opportunity to improve bus, walking and cycling accessibility to/from CIA.	Pedestrians, cyclists and public transport users.	Moderate beneficial
TPO 4: Improve accessibility & journey time reliability to/from CIA by private transport	Increased number of public transport trips and reduced number of car trips to CIA would improve journey time reliability and accessibility for private transport travelling to/from CIA.	Benefit to travellers to/from CIA.	Slight beneficial
TPO 5: Improve public transport, walking & cycling accessibility to Culverhouse Cross	Less traffic on road network would afford an opportunity to improve bus, walking and cycling accessibility to/from Culverhouse Cross. Changes in highway demand at Culverhouse Cross likely to be insignificant.	Pedestrians, cyclists and public transport users at Culverhouse Cross	Neutral
TPO 6: Reduce congestion at Culverhouse Cross	Increased number of public transport trips and reduced number of car trips to CIA would reduce congestion at Culverhouse Cross. Changes in highway demand at Culverhouse Cross likely to be insignificant.	All road users at Culverhouse Cross	Neutral
TPO 7: Identify opportunities to improve accessibility to regional developments & complement local development plan strategies	Heavy rail would improve accessibility to the airport and the key settlement at Barry, which are identified in the WSP. A surface access strategy to the airport, which will take into account the need to improve links between key settlements is an objective of the WTS. Improved airport accessibility is supported in the Vale of Glamorgan adopted UDP and emerging LDP.	No significant distributional impacts	Slight beneficial
TPO 8: Improve journey time reliability on A4232 (T)	Lower car demand as a result of modal shift to public transport would reduce congestion and tailbacks from Culverhouse Cross and the M4 J33 roundabout onto the A4232(T). Effects are likely to be marginal.	No significant distributional impacts	Neutral
TPO 9: Reduce level of car dependency	Faster and more frequent public transport provision would reduce car dependency for trips to or from CIA.	Improvements to trips from the east and north, but less distributional impact on trips originating from the west.	Large beneficial

Public Transport Assessments: Option R3

Option R3 Description: This option utilises the existing Vale of Glamorgan rail line between Barry and Cardiff Central. A new shuttle bus interchange at Barry allows for a dedicated rail passenger bus connection between Barry and CIA, thereby allowing for up to quarter hourly service frequency from Cardiff to CIA. Source: Public Transport Improvement Options - Part 2 Appraisal			
Transport Planning Objectives:			
TPO 1: Improve transport safety in the study area	The new bus route would eliminate the need for interchange at Rhoose station. Rail passengers would therefore not have to cross the level crossing at Rhoose. Transport safety improvements would also arise from modal shift from car to heavy rail.	All heavy rail users on journeys between Cardiff and CIA.	Slight beneficial
TPO 2: Discourage airport traffic flows on inappropriate routes	Better public transport provision likely to encourage modal shift from car to public transport. Effect on travel along inappropriate routes likely to be marginal.	Improvements to trips from the east and north, but less distributional impact on trips originating from the west.	Neutral
TPO 3: Improve public transport, walking & cycling accessibility to/ from CIA	Better public transport provision through higher frequency service connection between CIA and Cardiff. Less traffic on road network would afford an opportunity to improve bus, walking and cycling accessibility to/from CIA.	Pedestrians, cyclists and public transport users.	Slight beneficial
TPO 4: Improve accessibility & journey time reliability to/from CIA by private transport	Increased number of public transport trips and reduced number of car trips to CIA would improve journey time reliability and accessibility for private transport travelling to/from CIA.	Benefit to travellers to/from CIA.	Slight beneficial
TPO 5: Improve public transport, walking & cycling accessibility to Culverhouse Cross	Less traffic on road network would afford an opportunity to improve bus, walking and cycling accessibility to/from Culverhouse Cross. Changes in highway demand at Culverhouse Cross likely to be insignificant.	Pedestrians, cyclists and public transport users at Culverhouse Cross	Neutral
TPO 6: Reduce congestion at Culverhouse Cross	Increased number of public transport trips and reduced number of car trips to CIA would reduce congestion at Culverhouse Cross. Changes in highway demand at Culverhouse Cross likely to be insignificant.	All road users at Culverhouse Cross	Neutral
TPO 7: Identify opportunities to improve accessibility to regional developments & complement local development plan strategies	A surface access strategy to the airport, which will take into account the need to improve links between key settlements is an objective of the WTS. Improved airport accessibility is supported in the Vale of Glamorgan adopted UDP and emerging LDP. A shuttle bus connection between CIA and Barry would improve accessibility to CIA by improving service frequency.	No significant distributional impacts	Slight beneficial
TPO 8: Improve journey time reliability on A4232 (T)	Lower car demand as a result of modal shift to public transport would reduce congestion and tailbacks from Culverhouse Cross and the M4 J33 roundabout onto the A4232(T). Effects are likely to be marginal.	No significant distributional impacts	Neutral
TPO 9: Reduce level of car dependency	More frequent public transport provision would reduce car dependency for trips to or from CIA.	Improvements to trips from the east and north, but less distributional impact on trips originating from the west.	Moderate beneficial

Public Transport Assessments: Option R6

Option R6 Description: This option utilises the existing Vale of Glamorgan rail line between Barry and Cardiff Central. Re-routing of one train per hour from Barry Island to Bridgend would increase service frequency between Barry and Bridgend and allow for a higher frequency connection to CIA. Source: Public Transport Improvement Options - Part 2 Appraisal			
Transport Planning Objectives:			
TPO 1: Improve transport safety in the study area	Marginal transport safety improvements would arise from modal shift from car to heavy rail.	All heavy rail users on journeys between Cardiff and CIA.	Neutral
TPO 2: Discourage airport traffic flows on inappropriate routes	Better public transport provision likely to encourage modal shift from car to public transport. Effect on travel along inappropriate routes likely to be marginal.	No significant distributional impacts	Neutral
TPO 3: Improve public transport, walking & cycling accessibility to/ from CIA	Better public transport provision through higher frequency service connection between CIA and Cardiff. Less traffic on road network would afford an opportunity to improve bus, walking and cycling accessibility to/from CIA.	Pedestrians, cyclists and public transport users.	Slight beneficial
TPO 4: Improve accessibility & journey time reliability to/from CIA by private transport	Increased number of public transport trips and reduced number of car trips to CIA would improve journey time reliability and accessibility for private transport travelling to/from CIA.	Benefit to travellers to/from CIA.	Slight beneficial
TPO 5: Improve public transport, walking & cycling accessibility to Culverhouse Cross	Less traffic on road network would afford an opportunity to improve bus, walking and cycling accessibility to/from Culverhouse Cross. Changes in highway demand at Culverhouse Cross likely to be insignificant.	Pedestrians, cyclists and public transport users at Culverhouse Cross	Neutral
TPO 6: Reduce congestion at Culverhouse Cross	Increased number of public transport trips and reduced number of car trips to CIA would reduce congestion at Culverhouse Cross. Changes in highway demand at Culverhouse Cross likely to be insignificant.	All road users at Culverhouse Cross	Neutral
TPO 7: Identify opportunities to improve accessibility to regional developments & complement local development plan strategies	Rail service alteration would improve accessibility to the airport, the strategic opportunity area at St. Athan and the key settlement at Barry, which are identified in the WSP. A surface access strategy to the airport, which will take into account the need to improve access to St. Athan, plus improved links between key settlements is an objective of the WTS. Improved airport accessibility is supported in the Vale of Glamorgan adopted UDP and emerging LDP.	No significant distributional impacts	Slight beneficial
TPO 8: Improve journey time reliability on A4232 (T)	Lower car demand as a result of modal shift to public transport would reduce congestion and tailbacks from Culverhouse Cross and the M4 J33 roundabout onto the A4232(T). Effects are likely to be marginal.	No significant distributional impacts	Neutral
TPO 9: Reduce level of car dependency	More frequent public transport provision would reduce car dependency for trips to or from CIA.	No significant distributional impacts	Moderate beneficial

Public Transport Assessments: Option B2

Option B2 Description: A branded express bus service would follow the route of the existing X91 'limited stop' service. The new service would serve stops around Cardiff city centre and the Cardiff Bay area whilst maintaining the express bus functionality between Cardiff Central station and CIA. It would also provide a higher frequency connection between CIA and Cardiff compared to the existing X91 service. Source: Public Transport Improvement Options - Part 2 Appraisal			
Transport Planning Objectives:			
TPO 1: Improve transport safety in the study area	Transport safety improvements would also arise from modal shift from car to express bus.	All express bus users on journeys between Cardiff and CIA.	Slight beneficial
TPO 2: Discourage airport traffic flows on inappropriate routes	Better public transport provision likely to encourage modal shift from car to public transport. Effect on travel along inappropriate routes likely to be marginal.	Improvements to trips from the east and north, but less distributional impact on trips originating from the west.	Neutral
TPO 3: Improve public transport, walking & cycling accessibility to/ from CIA	Better public transport provision through faster, more frequent and more reliable connection between CIA and Cardiff. Also better direct public transport access into wider Cardiff Bay area. Less traffic on road network would afford an opportunity to improve bus, walking and cycling accessibility to/from CIA.	Pedestrians, cyclists and public transport users.	Moderate beneficial
TPO 4: Improve accessibility & journey time reliability to/from CIA by private transport	Increased number of public transport trips and reduced number of car trips to CIA would improve journey time reliability and accessibility for private transport travelling to/from CIA.	Benefit to travellers to/from CIA.	Slight beneficial
TPO 5: Improve public transport, walking & cycling accessibility to Culverhouse Cross	Less traffic on road network would afford an opportunity to improve bus, walking and cycling accessibility to/from Culverhouse Cross. Changes in highway demand at Culverhouse Cross likely to be insignificant.	Pedestrians, cyclists and public transport users at Culverhouse Cross	Neutral
TPO 6: Reduce congestion at Culverhouse Cross	Increased number of public transport trips and reduced number of car trips to CIA would reduce congestion at Culverhouse Cross.	All road users at Culverhouse Cross	Neutral
TPO 7: Identify opportunities to improve accessibility to regional developments & complement local development plan strategies	A surface access strategy to the airport, which will take into account the need to improve links between key settlements is an objective of the WTS. Improved airport accessibility is supported in the Vale of Glamorgan adopted UDP and emerging LDP.	No significant distributional impacts	Slight beneficial
TPO 8: Improve journey time reliability on A4232 (T)	Lower car demand as a result of modal shift to public transport would reduce congestion and tailbacks from Culverhouse Cross and the M4 J33 roundabout onto the A4232(T). Effects are likely to be marginal.	No significant distributional impacts	Neutral
TPO 9: Reduce level of car dependency	Faster, more frequent and more reliable public transport provision would reduce car dependency for trips to or from CIA.	Improvements to trips from the east and north, but less distributional impact on trips originating from the west.	Large beneficial

Summary Appraisal of Public Transport Options

Traffic Light Appraisal Summary						
Source: Public Transport Improvement Options - Part 2 Appraisal		Option				
		R1	R2	R3	R6	B2
Criteria	**Criteria Weighting**	**Tram train to airport terminal**	**Heavy rail service to airport terminal**	**Shuttle bus from Barry Station**	**Re-routing of one train per hour from Barry Island to Bridgend**	**Branded Airbus express service**
Timescale	-	Long term	Long term	Medium term	Medium term	Short term
Capital Cost	1	2	1	2	3	3
Operating Cost	1	2	1	3	2	3
Implementability	1	2	2	2	2	3
Feasibility	1	2	1	3	3	3
Increased PT Mode Share	2	3	3	2	2	2
Accessibility	2	3	3	1	1	3
Overall Score	-	20	17	16	16	22
Transport Planning Objectives Appraisal of Significance						
Transport Planning Objectives						
TPO 1: Improve transport safety in the study area		(+)	(+)	(+)	(0)	(+)
TPO 2: Discourage airport traffic flows on inappropriate routes		(0)	(0)	(0)	(0)	(0)
TPO 3: Improve public transport, walking & cycling accessibility to/ from CIA		(++)	(++)	(+)	(+)	(++)
TPO 4: Improve accessibility & journey time reliability to/from CIA by private transport		(+)	(+)	(+)	(+)	(+)
TPO 5: Improve public transport, walking & cycling accessibility to Culverhouse Cross		(0)	(0)	(0)	(0)	(0)
TPO 6: Reduce congestion at Culverhouse Cross		(0)	(0)	(0)	(0)	(0)
TPO 7: Identify opportunities to improve accessibility to regional developments & complement local development plan strategies		(+)	(+)	(+)	(+)	(+)
TPO 8: Improve journey time reliability on A4232 (T)		(0)	(0)	(0)	(0)	(0)
TPO 9: Reduce level of car dependency		(+++)	(+++)	(++)	(++)	(+++)
Public acceptability: 3371 comment forms and 241 letters were received. Full details of the PCE response are provided in the Public Consultation Report.		Of the comment form responses, 2084 (62%) supported a direct rail link to the airport terminal.	Of the comment form responses, 2084 (62%) supported a direct rail link to the airport terminal.	The comment form did not include this option. However, there was support for improved links between Barry station and CIA in letters submitted during the consultation process.	Of the comment form responses, 1423 (42%) supported a half hourly train service from Cardiff and shuttle bus to CIA from Rhoose station	Of the comment form responses, 1312 (39%) supported a regular half hourly or less express bus service. However, 1318 (39%) opposed bus priority measures to improve the reliability of services.

Legend

Traffic Light Appraisal Summary	Symbol
Long term, Score 1	
Medium term, Score 2	
Short term, Score 3	

Summary of Significance of Appraisal Impacts for TPOs	Symbol
Large beneficial	(+++)
Moderate beneficial	(++)
Slight beneficial	(+)
Neutral	(0)
Slight adverse	(-)
Moderate adverse	(- -)
Large adverse	(- - -)

Appendix H

Glossary of Terms

Glossary of Terms

Term	Definition	Source
General		
WelTAG	Welsh Transport Planning and Appraisal	WelTAG, Welsh Assembly Government, June 2008
DMRB	Design Manual for Roads and Bridges	Design Manual for Roads and Bridges, Department for Transport
AST	Appraisal Summary Table	WelTAG, Welsh Assembly Government, June 2008
CIA	Cardiff International Airport	
Economy		
TEE	Transport Economic Efficiency	
PVC	The Present Value of Costs incurred over a future year period, discounted to a defined base year (currently 2002)	WebTAG Unit 3.5.4, Department for Transport, February 2006;
PVB	The Present Value of Benefits of a stream of benefits arising over a future year period, discounted to a defined base year (currently 2002)	
NPV	Net Present Value: the difference between the present value of benefits and the present value of costs (NPV = PVB – PVC)	
BCR	Benefit Cost Ratio: the net benefit obtained in return for each unit of cost to public accounts (BCR = PVB / PVC)	
EALI	Economic Activity and Location Impacts	WelTAG, June 2008
Opening Year	The opening year is 2013	
Design Year	The design year is 2028	
Environment		
Significant noise impact	Change in noise levels of plus or minus 3dBA	
NO_2	Nitrogen dioxide	
PM_{10}	Particulate matter of 10µm	
$PM_{2.5}$	Particulate matter of 2.5µm	
SSSI	Site of Special Scientific Interest	
SLA	Special Landscape Area	Designated in the adopted Vale of Glamorgan Unitary Development Plan
SAM	Scheduled Ancient Monument	
Green Wedge	Land designated in the Vale of Glamorgan Unitary Development Plan to prevent coalescence between and within settlements	Adopted Vale of Glamorgan Unitary Development Plan
UDP	Unitary Development Plan	Adopted Vale of Glamorgan Unitary Development Plan
LDP	Local Development Plan	Emerging Vale of Glamorgan Local Development Plan
WSP	Wales Spatial Plan 2008 Update	
WTS	Wales Transport Strategy, 2008	
ALC	Agricultural Land Classification	Agricultural Land Classification of England and Wales, MAFF, 1988. Grades 1, 2 and 3a are classed as *"best and most versatile land."*
ALC Grade 1	Excellent	
ALC Grade 2	Very Good	
ALC Grade 3a	Good	
ALC Grade 3b	Moderate	
ALC Grade 4	Poor	
ALC Grade 5	Very Poor	
Flood Zone A	Considered to be at little or no risk of fluvial or tidal/coastal flooding	Technical Advice Note (TAN) 15: Development and Flood Risk
Flood Zone B	Areas known to have been flooded in the past	
Flood Zone C1	Served by significant infrastructure, including flood defences	
Flood Zone C2	Without significant flood defence infrastructure	
Transport Safety		
Accident PVB	The monetised Present Value of Benefits resulting from savings in the number of accidents over a future year period, discounted to a defined base year (currently 2002)	WebTAG Unit 3.5.4, Department for Transport, February 2006; Design Manual for Roads and Bridges, Volume 13 Section 1 Part 1, Department for Transport, June 2006
Permeability		
NMU	Non Motorised User	Non Motorised User Context Report
Financial Affordability and Deliverability		
Estimated scheme cost	Includes construction, optimism bias, VAT, land, preparation and supervision costs at 2009 prices	Refer to Economic Assessment Report for cost details
Public Consultation		
PCE	Public Consultation Exercise	Public Consultation Report, April 2009
WCAG	Wenvoe Community Action Group	Local action group
NEVAR	No Ely Valley Airport Road	Local action group
SNAG	St. Nicholas Action Group	Local action group
CCW	Countryside Council for Wales	
Resilience	Resilience is the ability of a network to cope with sudden changes in demand or operation, e.g. traffic throughput could be maintained during periods of temporary disruption.	
Do minimum	The Do-Minimum network comprises the existing road network, modified to include committed or probable highway schemes within the study area.	Forecasting Report

Summary of Significance of Appraisal Impacts	Symbol
Large beneficial	(+++)
Moderate beneficial	(++)
Slight beneficial	(+)
Neutral	(0)
Slight adverse	(-)
Moderate adverse	(- -)
Large adverse	(- - -)

Equality, Diversity and Human Rights

Paragraph 8.7.8 of WelTAG states that if a scheme has no discriminatory effect, the Stage 1 assessment should be recorded as neutral and that no further assessment is required. This is confirmed in Paragraph 8.7.12 in respect of the Stage 2 assessment. As the Stage 1 assessment of the scheme recorded the equality, diversity and human rights impact as neutral, this issue has not been considered at Stage 2 in accordance with the advice set out in WelTAG.