MOTT MACDONALD

North West Corridor

WelTAG Stage 1 Report

8 February 2021

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Transport for Wales

North West Corridor

WelTAG Stage 1 Report

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Scope and Purpose

Mott MacDonald was commissioned by Transport for Wales (TfW), the Welsh Government, Cardiff City Council and Rhondda Cynon Taf County Borough Council to undertake a WelTAG Stage 1 assessment of Cardiff's North West Corridor.

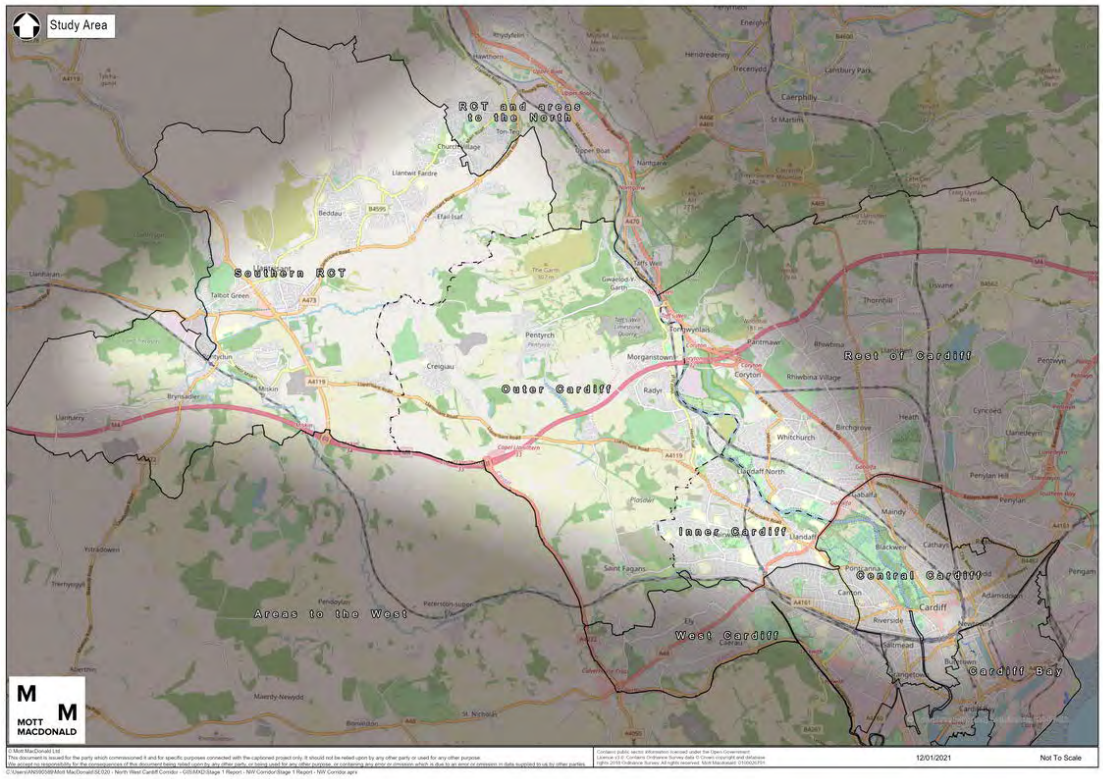
The study area defined to guide the assessment is shown in Figure 0.1. Broadly, the term North West Corridor is used to describe the segment of Cardiff bordered by the A4232 link road in the West and the A470 and Merthyr rail line in the east. The Corridor extends into the southern part of Rhondda Cynon Taf and incorporates the settlements of Pontyclun, Llantrisant, Beddau and Llantwit Fardre.

The North West Corridor incorporates a number of Strategic Sites in Cardiff and Rhondda Cynon Taf, including the new Plasdwr district of Cardiff which is in the process of being delivered. Within current planning horizons, there are five Strategic Sites within the North West Corridor with the potential for over 10,000 new homes. Plans for developments of this scale, without corresponding firm proposals for a mass transit solution, have led to public concerns of increased traffic congestion affecting north-west Cardiff and parts of Rhondda Cynon Taf.

WelTAG is the 'Welsh transport appraisal guidance' produced by Welsh Government. The overarching purpose of the WelTAG Stage 1 study is to identify a short-list of potential public transport solutions for the corridor, in response to a set of objectives that have been derived from a specific set of existing and future transport-related issues. The focus of this assessment is on mass transit solutions for the North West Corridor. Therefore, improvements to the highway network and active travel schemes are not a primary focus of the study.

At WelTAG Stage 1, a range of strategic options are identified in order to generate a short list of options to consider taking forward for more detailed assessment. It should be noted that as this is a high level strategic assessment, no formal decision or commitment has been taken to progress with any specific mode, route, or alignment at this time.

Figure 0.1: North West Corridor Study Area[1]



Source: Mott Macdonald

The Case for Change

There is a compelling strategic case to enhance public transport provision in the North West Corridor both to address existing transport problems and to cater for the expected rapid growth in population and housing.

The Corridor incorporates three Strategic Sites allocated in Cardiff's Local Development Plan (LDP): North West Cardiff or 'Plasdwr' (Site C), North of Junction 33 (Site D), and South of Creigiau (Site E). Rhondda Cynon Taf's LDP is due to be updated. The 2011 plan included two Strategic Sites which lie within the study area: Cwm Colliery and Coking Works located between Beddau and Llantwit Fardre, and the Mwyndy / Talbot Green area. The A4119 Corridor: The Regional Rhondda Gateway has been designated as a Strategic Opportunity Area (SOA) by Rhondda Cynon Taf County Borough Council, reflecting the significant opportunities for job creation and housing to support economic growth.

The North West Corridor is flanked by the City Line, Merthyr Line and South Wales Main Line but much of the corridor, including the Strategic Sites themselves, are not directly served by the rail network. As a result, whilst the dominance of car transport is a feature of the city-region, a

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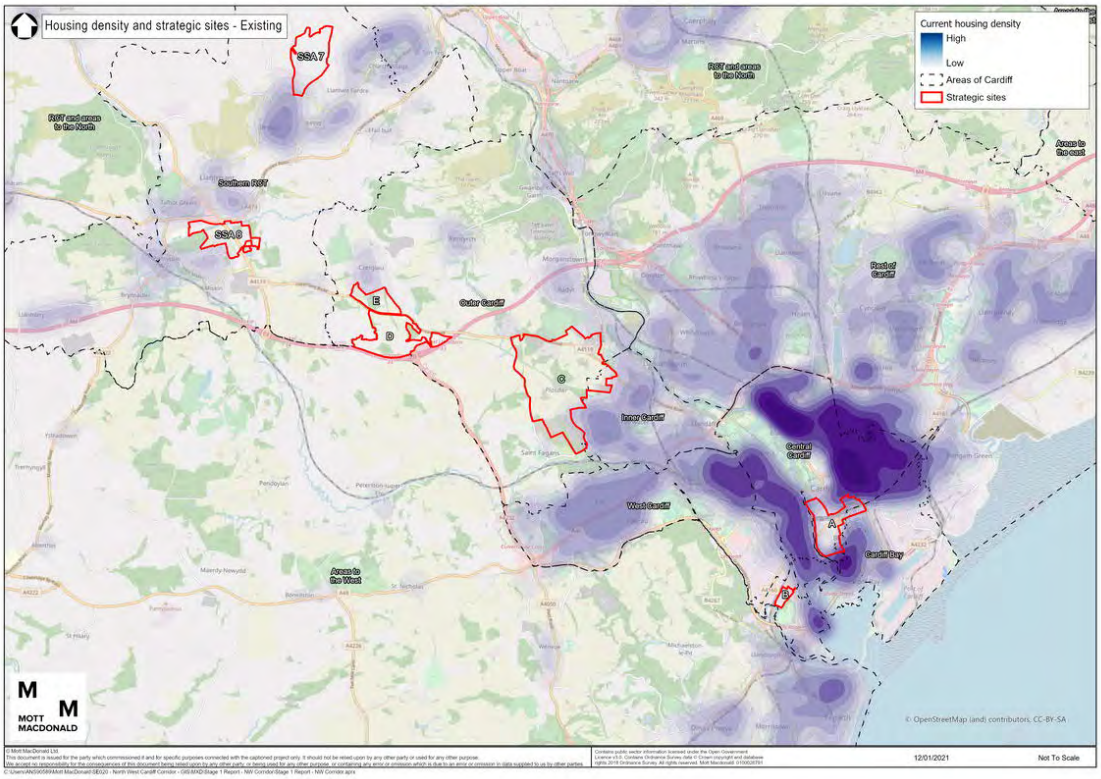
higher proportion of the North West Corridor workforce travels by car than the average for either Cardiff or the Cardiff Capital Region as a whole.

The highway network service in the North West Corridor includes a number of regionally significant congestion issues, most notably on the M4 motorway between Junctions 33 and 34, on the A4232 Peripheral Distributor Road in Cardiff, and on the A4119 between central Cardiff and Llantrisant. Therefore, development in the Corridor will place further pressure on an already constrained highway network. The planned growth can be delivered in a sustainable way through the provision of new transport infrastructure in a phased manner to support the developments.

A range of incremental improvements to the existing transport network are already being delivered to support the development in the Corridor. However, it is recognised that the potential exists to develop a dedicated public transport corridor connecting Cardiff city centre to the Strategic Sites in North West Cardiff and strategic development areas beyond Cardiff's boundary in Rhondda Cynon Taf. To this end, some sections of the corridor have been protected from development that runs alongside the disused Llantrisant Branch Line.

Figure 0.2: Strategic Sites and Current Housing Density[2]



Source: Mott Macdonald

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Objectives

A set of WelTAG objectives have been identified which are intended to respond to the problems and opportunities of the Corridor. The performance of options has been assessed according to their ability to meet these objectives and the objectives will continue to guide the project as it progresses through the WelTAG stages towards delivery. They are as follows:

Transport

- **Reduce public transport journey times** between central Cardiff, Cardiff's North West Corridor and the southern end of Rhondda Cynon Taf;
- Provide **frequent, reliable and high-quality** mass transit services in line with the Welsh Government's principles for connectivity in Wales; and
- Ensure the Corridor is **integrated** with the wider South Wales Metro and existing assets.

Economic and Social

- **Facilitate the delivery of employment and housing** in Cardiff's North West Corridor and southern Rhondda Cynon Taf;
- Improve the **personal affordability** of passenger transport in the Cardiff Capital Region; and
- Deliver a system that is accessible for all.

Environment

- **Stimulate mode shift** in line with the LDPs and help move towards a 50% sustainable transport mode share; and
- **Improve air quality** within the Corridor with the aim of delivering a system with zero emissions at point of use.

Funding and Delivery

- Deliver a system which **maximises the commercial viability** of public transport in the North West Corridor.

Options Development and Assessment: Key Findings

A two-stage options assessment and sifting process has been undertaken during WelTAG Stage 1. The key findings of the assessment at Stage 1 can be summarised as follows:

- A package of public transport measures is required to address the transport issues in the North West Corridor and meet future capacity requirements. This will require investment in existing and new transport infrastructure across all public transport modes;
- Both rail and bus-based solutions are required, and each mode plays a complementary role. Rail-based solutions provide a high quality of service and can minimise journey times between key population centres, whereas bus-based measures are more flexible and provide better penetration into residential areas of the Corridor;
- There are opportunities to improve the existing rail network through additional services and new stations. Shortlisted options include increased service frequencies on the South Wales Main Line and City Lines, and new stations at Junction 34 of the M4 (on the South Wales Main Line) and Ely Mill (on the City Line);
- Notwithstanding the benefits of these improvements, much of the North West Corridor is not served by the existing rail network and therefore such interventions will fail to fully address the problems identified. A new mass transit solution will be required to serve the Strategic Site at Plasdwr and to achieve the step change in public transport provision within the Corridor more generally;

- The Safeguarded Corridor should be earmarked for a rail-based solution, rather than a bus rapid transit (BRT) solution. A rail-based solution provides the greatest scope to minimise public transport journey times and would offer the quality of service expected of a major new rapid transit route;
- Use of the Core Valley Lines (CVL) tram-train technology (potentially in a modified form) on the North West Corridor is preferred to the introduction of a wholly new light rail system which would introduce significant extra costs and complexity for relatively modest benefits;
- Delivering a new North West Corridor tram-train route, combined with enhanced services on the City Line, will necessitate infrastructure changes to overcome capacity constraints through Cardiff West Junction and at Cardiff Central. Three broad approaches to the connection at Cardiff Central have been shortlisted, each of which involves complex trade-offs which need to be considered in the context of wider aspirations for the rail network in the Cardiff Capital Region;
- Extensions of the tram-train route into southern Rhondda Cynon Taf have been shortlisted. Subject to further business case assessment, routes to both Pontyclun and Beddau have potential merit and the ultimate preferred outcome may be a Y-shaped network serving both locations;
- BRT options and improved interchange facilities with active travel, can play an important role in improving public transport alongside a new tram-train route. BRT is a general term applied to a modern, fast, reliable bus system and the success of any new BRT routes will depend on the degree of segregation achieved. Implementing the BRT measures could deliver some benefits in a shorter timeframe compared to the tram-train solution. Therefore, a phased approach for the works could see the tram-train routes being implemented at a later stage, resulting in the full benefits of a complementary tram-train and BRT package;
- In Cardiff, possible BRT corridors have been identified via the A4232, connecting with a strategic park and ride facility at Junction 33, and an urban route serving Plasdwr and Fairwater areas with a potential interchange with the City Line at Waun-gron Park. In Rhondda Cynon Taf, BRT corridors via the A4119 could both improve end-to-end services to/from Cardiff and provide connections to stations at Junction 33 and 34;
- There will be opportunities, which should be explored at the next stage, to enhance active travel in the corridor by delivering new active travel corridors alongside rail and bus route, as well as enhancing opportunities to interchange between public transport and active travel modes.

Shortlisted Options

A shortlist of options has been identified which merit further development and assessment at WelTAG Stage 2.

The enhancements to the existing rail network listed below have been shortlisted for further assessment at WelTAG Stage 2:

- Increased service frequency to at least 4 trains per hour on the City Line between Cardiff Central and Radyr;
- A new station on the City Line at Ely Mill;
- Increased service frequency on the South Wales Main Line and therefore enhanced services from Pontyclun;
- Enhanced quality of interchange between active travel, bus, rail and car; and
- A new ‘Parkway’ station on the South Wales Main Line at Junction 34 of the M4.

Bus related measures are as follows:

- A strategic bus park and ride at Junction 33 of the M4;
- A new BRT route between central Cardiff and Junction 33 via Leckwith Road and the A4232;
- A bus gate and spur providing access from the A4232 (northbound and southbound) to Plasdwr;
- A bus:rail and active travel interchange at Waun-gron Park station on the City Line;
- A new BRT route from Central Cardiff to Plasdwr via Cowbridge Road East, Waun-gron Park and Fairwater;
- Improved bus:rail and active travel interchange at Radyr station on the City Line; and
- A new BRT route from Junction 33 to Talbot Green via the A4119 with onward connections to settlements in southern Rhondda Cynon Taf.

The shortlisted new tram-train routes are as follows:

- A new tram-train route via the City Line and potentially utilising the route of the Safeguarded Corridor between central Cardiff, Junction 33 and Creigiau;
- An extension of the tram-train route from Creigiau to Pontyclun via Cross Inn; and
- An extension of the tram-train route from Creigiau to Beddau via Cross Inn.

A key constraint to achieving the new tram-train options, as well as increasing frequencies on the existing City Line, is the capacity of Cardiff West Junction and Cardiff Central to accommodate additional rail services. Three variants of the tram-train solution have been shortlisted. These are:

- Changes in the track layout at Cardiff West Junction to increase the capacity for North West Corridor and/or City Line services operating into existing platforms at Cardiff Central;
- Provision of a new junction between the City Line and Barry/Penarth Line services at Penarth Curve to enable North West Corridor and/or City Line services to operate into new platforms located to the south of Cardiff Central Station. This option provides the potential for services to operate to Porth Teigr should this route also be progressed; and
- An on-street solution that would divert North West Corridor and/or City Line services away from Cardiff West Junction via an on-street route to the south of the City Line into new platforms at Cardiff Central and/or Callaghan Square. As above, this provides the potential for a direct link to Porth Teigr.

Phasing

Consideration has been given to the possible phasing of interventions in the North West Corridor. The phasing takes into account both demand side factors (in particular the timescales for the delivery of Strategic Sites) and supply side factors (the realistic timescales for design development, statutory processes and construction, as well as dependencies with other projects e.g. CVL transformation).

Phase 1 covers the period in advance of the delivery of a new route, potentially on the disused rail corridor. The interventions during this phase are centred on increasing services on the existing rail network, improvements to bus services and enhancing the quality of interchange between car, bus, rail and active travel modes. All of the shortlisted bus related measures (including the proposed new BRT routes) are included in Phase 1. Subject to the availability of funding, each of these shortlisted options could be delivered between 2020 and 2025.

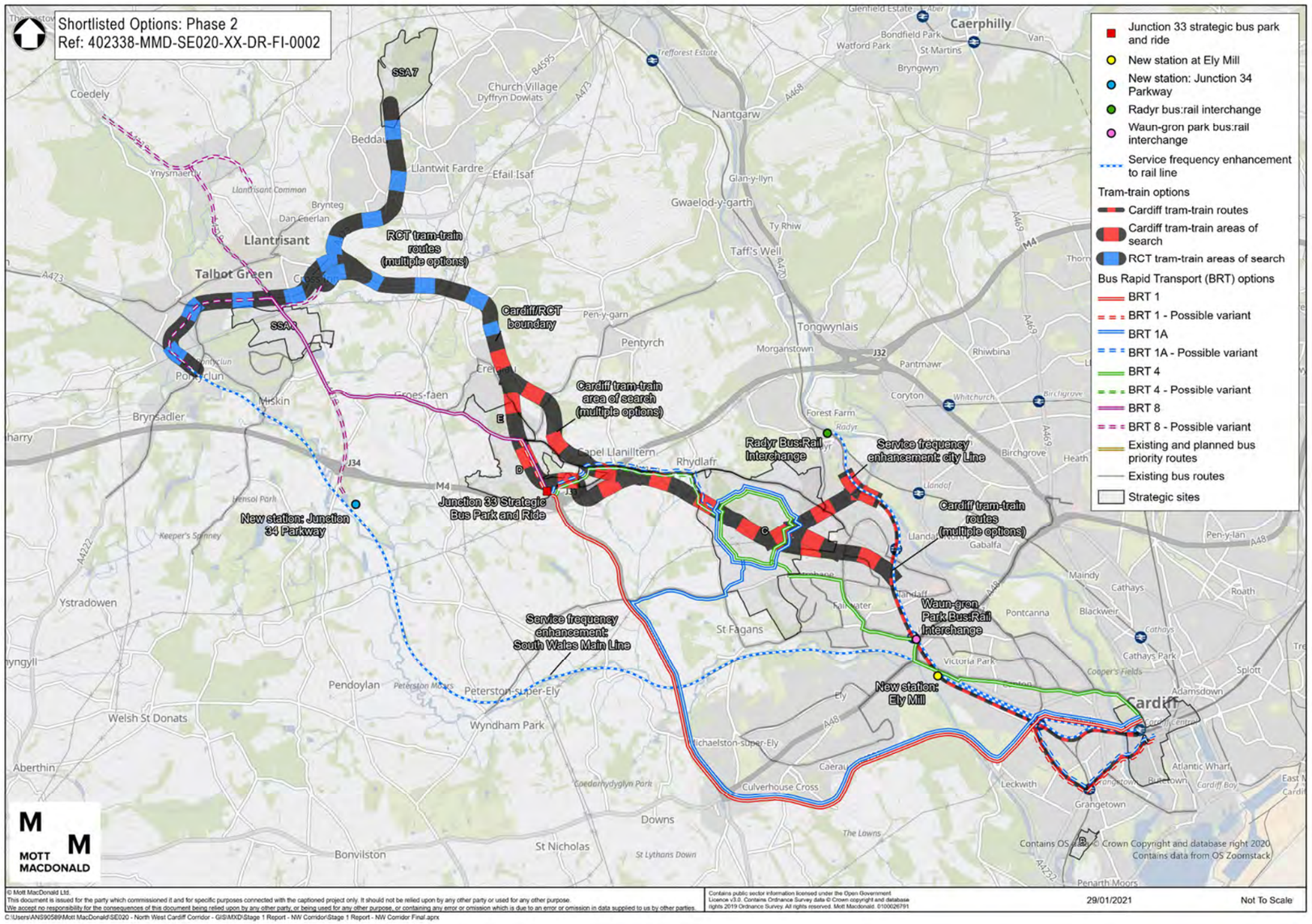
Phase 2 would be focussed on the development of the new tram-train route for the North West Corridor via the City Line and the Safeguarded Corridor. This is a high cost project which would represent a major investment in the Cardiff Capital Region. The business case for the new line will need to be underpinned by passenger demand from Plasdwr and the Strategic Sites north of Junction 33 and south of Plasdwr in combination. If funding is available, this option could be open to passengers towards the end of this decade to coincide with the completion of phases 2 and 3 of the Plasdwr development which are adjacent to the Safeguarded Corridor.

To improve the affordability of the project, consideration could be given to a phased approach whereby the line is constructed between the City Line and Junction 33 or Creigiau initially, followed later by extensions into Rhondda Cynon Taf. Whether the North West Corridor tram-train route is delivered as a single project or delivered in phases is largely a policy decision that would need to be determined by funders.

Next Steps

It is recommended that the shortlisted options are taken forward for more detailed design development and assessment at WelTAG Stage 2.

Figure 0.3: Shortlisted Options at WelTAG Stage 1[3]



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1 Introduction

1.1 Purpose of the Study

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1.2 Scope

The study area defined to guide the assessment is shown in Figure 1.1. Broadly, the term North West Corridor is used to describe the segment of Cardiff bordered by the A4232 link road in the West and the A470 and Merthyr rail line in the east. The Corridor extends into the southern part of Rhondda Cynon Taf and incorporates the settlements of Pontyclun, Llantrisant, Beddau and Llantwit Fardre.

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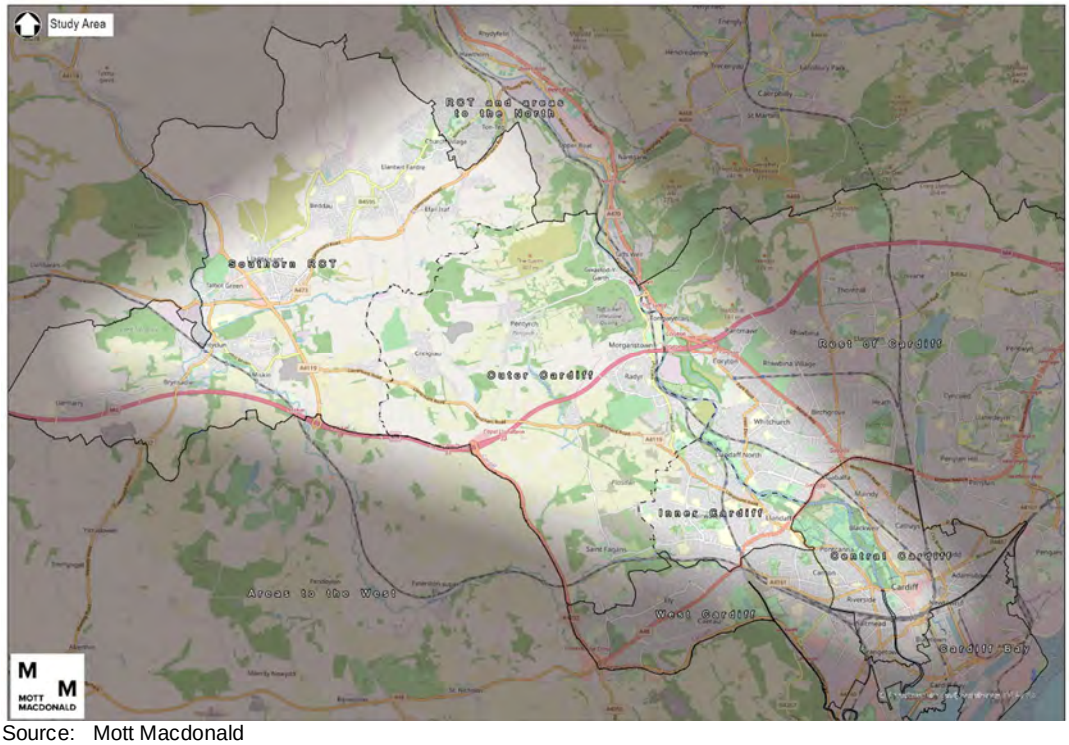

Source: Mott Macdonald

1.3 WelTAG Process

WelTAG is the 'Welsh transport appraisal guidance' produced by Welsh Government. It provides a process and framework for identifying, appraising and evaluating solutions to address transport related issues. The WelTAG process comprises five stages which are intended to cover the lifecycle of a proposed transport intervention, from conception to post-implementation evaluation. Welsh Government intends the WelTAG process to be evidence-based, proportionate to the impacts being investigated, collaborative (involving stakeholder consultation), and to provide decision-makers with information required to make decisions.

WelTAG 2017 is aligned with the HM Treasury five case model for transport business cases. WelTAG Stage 1 is aligned to the first of three business case stages, the Strategic Outline Case (SOC).

The purpose of WelTAG Stage 1 is to 'understand the issue of concern, explore its context and to present a wide list of possible solutions and to select a short list of options for more detailed consideration'[5]. Short listed solutions should be those that are most likely to solve the issues of concern and align with the stated objectives for solutions, leading to the most favourable impacts.

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[5] WelTAG 2017 Welsh Transport Appraisal Guidance, page 10

The WelTAG guidance summarises the steps to be taken when developing the SOC at Stage 1:

- Identify issues that need addressing;
- Establish objectives;
- Develop a long list of possible solutions; and
- Assess the long list of options against objectives.

At the end of Stage 1, the Strategic Case (one of the cases in the five-case model) should be fully developed, setting out the need for change. The Transport Case (the second of the five cases) then provides an initial assessment of the expected impacts of a long list of solutions. The remaining cases (Delivery, Financial, Commercial) will be preliminary, identifying key issues that will affect the options being taken forward to WelTAG Stage 2.

Figure 1.2: WelTAG Process

Source: Mott Macdonald

1.4 Stakeholder Engagement

WelTAG is a collaborative process and engagement with stakeholders is an important part of WelTAG Stage 1. Two stakeholder workshops have been held in order to:

- Review and rank the identified issues, to ensure that objectives and solutions that would deal with the most critical problems are proposed (Workshop 1 – Problems, Opportunities and Objectives);
- Review, refine, and prioritise the objectives (Workshop 1 – Problems, Opportunities and Objectives);
- Generate a long list of potential solutions (Workshop 1 – Problems, Opportunities and Objectives); and
- Inform and comment on the initial multi-criteria assessment of potential solutions (Workshop 2 – Options Assessment).

Stakeholders invited to participate in this process include:

- Welsh Government;
- TfW;
- Cardiff City Council;

- Rhondda Cynon Taf County Borough Council (CBC);
- Vale of Glamorgan County Council;
- Natural Resources Wales;
- Cardiff Capital Region Transport Authority;
- South East Wales Trunk Road Agency;
- Network Rail;
- Bus operators: Cardiff Bus, NAT, Stagecoach;
- Rail operators: TfW Rail Services, Great Western Railway; and
- Strategic Site developers.

1.5 WelTAG Review Group

The purpose of the WelTAG Review Group is to consider the contents of the WelTAG Stage Reports, assess the study objectives, assess each of the options presented, and decide on the actions to be taken at the end of that WelTAG stage.

The WelTAG Review Group for the North West Corridor comprises:

- Welsh Government;
- TfW / TfW Rail Services;
- Cardiff City Council;
- Rhondda Cynon Taf CBC;
- Vale of Glamorgan County Council;
- Cardiff Capital Region Transport Authority; and
- Network Rail.

1.6 Report Structure

This report presents evidence gathered during the WelTAG Stage 1 Appraisal for the North West Corridor. It sets out each of the five cases under the Government's 'five case model' for business cases.

- Section 2 of this report is the Strategic Case; it sets out the case for change for the North West Corridor, including the legislative and policy context, and information on existing conditions in the Corridor;
- Section 3 describes the options in more detail, including their key issues such as capacity constraints, and the use of the Safeguarded Corridor;
- Section 4 is the Transport Case; this considers the impacts of the different options and scores these against the WelTAG assessment criteria;
- Section 5 covers the Financial Case, considering the affordability of the schemes, taking into account financial costs and benefits;
- Section 6 concerns the Commercial Case, exploring potential procurement and commercial arrangements;
- Section 7 is the Management Case, which demonstrates how the preferred option can be delivered;
- Section 8 provides an overview and conclusions of the document; and
- Section 9 provides appendices to the report including maps.

2 Strategic Case

There is a compelling strategic case to enhance public transport provision in the North West Corridor both to address existing transport problems and to cater for the expected rapid growth in population and housing.

2.1 Introduction

This section provides an overview of the Strategic Case for the North West Corridor. The Strategic Case sets out the legislative and policy context to the study. It describes the existing transport network and plans for housing and employment development in the Corridor. Objectives have been defined which, drawing on engagement with stakeholders, respond to the identified problems and opportunities in the Corridor. The Strategic Case also describes the approach to options identification and sifting and details the 'long list' of interventions.

2.2 Legislative Context

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

The Well-being of Future Generations Act focuses on sustainability, encouraging Wales to think about the long-term economic, environmental, social and cultural impact of its decisions. Its main framework consists of 7 objectives to encourage this sustainable way of thinking:

- **A Prosperous Wales** – Creating an innovative, productive, low-carbon society using resources efficiently to generate wealth and employment opportunities;
- **A Resilient Wales** – Maintaining and enhancing a biodiverse natural environment;
- **A Healthier Wales** – Maximising physical and mental well-being;
- **A More Equal Wales** – Enabling people to reach their full potential no matter what their background;
- **A Wales of Cohesive Communities** – Safe and attractive well-connected communities;
- **A Wales of Vibrant Culture and Thriving Welsh Language** - Promoting Welsh culture, heritage, and language; and
- **A Globally Responsible Wales** – Making a positive contribution to global well-being.

This Act means public bodies must act according to the **sustainable development principle** which means public bodies must "act in a manner which seeks to ensure that the needs of the present are met without compromising the ability of future generations to meet their own needs"[6]. Public bodies must develop their own well-being statement and wellbeing objectives.

This WelTAG study has been developed in accordance with these principles and potential interventions have been assessed in respect of their contribution to the well-being goals listed above.

2.2.2 Other Relevant Legislation

The study has been informed by a range of other legislation including:

- Environment (Wales) Act 2016;
- Climate Change Act (2008);

[6] Well-being of Future Generations (Wales) Act, section 5, paragraph 1

- The Active Travel (Wales) Act 2013; and
- Welsh Government Environment Act 1995 (Feasibility Study for Nitrogen Dioxide Compliance) Air Quality Direction 2018.

2.3 Policy Context

Proposals for the North West Corridor need to respond to the wider policy context. This section briefly identifies and describes key policies at a national, regional and local level.

2.3.1 National (Wales) Policy Context

2.3.1.1 Taking Wales Forward (2016-2021)

Taking Wales Forward sets out a 5-year programme to improve the Welsh economy, creating a Wales which is:

- Prosperous and Secure;
- Healthy and Active;
- Ambitious and Learning; and
- United and Connected.

It sets out plans to develop a not-for-profit rail franchise and more effective bus networks. Seamless ticketing, the South Wales Metro, and Active Travel are also highlighted for future importance.

2.3.1.2 Prosperity for All: The National Strategy (2017) and Economic Action Plan (2017)

This National Strategy takes the commitments made in 'Taking Wales Forward' and sets out the work of the wider Welsh public service to lay the foundations for achieving prosperity for all. The National Strategy situates transport issues within a long-term context and highlights the importance of future investment into Active Travel and the South Wales Metro. This aims to ensure that land use planning is undertaken to ensure new developments are sufficiently served by transport connections.

The Economic Action plan aims to ensure sustainable economic growth in the future and puts emphasis on the need for environmentally friendly transport and addressing congestion pinch points/ bottlenecks. It also identifies the South Wales Metro as an important project in creating growth.

2.3.1.3 National Development Framework (2020-2040)

The National Development Framework (NDF) establishes the direction of development in Wales until 2040. It replaces the current Wales Spatial Plan (2008) meaning it "sets a direction of where infrastructure should be invested"[7] at a national scale. A draft is available on the Welsh Government website, however, this is not yet adopted.

This document sets high-level recommendations which then guide Strategic Development Plans and Local Development Plans. It sets out policies covering housing, environment and transport. Transport policies aim to build sustainable places by reducing car usage and encouraging more sustainable transport.

It aims to create a Wales where people live…

[7] National Development Framework (2020-2040), p.6

- …and work in connected inclusive and healthy places;
- in vibrant rural places with access to homes, jobs and services;
- in distinctive regions that tackle health and socio-economic inequality through sustainable growth;
- in places with thriving Welsh language;
- and work in towns and cities which are a focus and springboard for sustainable growth;
- in places where prosperity, innovation and culture are promoted;
- in places where travel is sustainable;
- in places with world-class digital infrastructure;
- in places that sustainably manage their natural resources and reduce pollution;
- in places with biodiverse, resilient and connected ecosystems; and
- in places which are de-carbonised.

The framework sets out the ambition for cities that are compact and organised around public transport hubs and urban centres, where there are different amenities within close proximity to residential housing, allowing journeys to be made through more sustainable means. Cardiff is recognised as the focal point of South Wales, and the new Metro development as providing opportunity for development in settlements further outside of the city.

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

This report establishes over-arching goals for Welsh Transport and provides a long-term framework for all modes. Its objectives are:

- Reducing greenhouse gas emissions and other environmental impacts;
- Integrating local transport;
- Improving access between key settlements and sites;
- Enhancing international connectivity; and
- Increasing safety and security.

The Welsh Government is currently developing a new Wales Transport Strategy which will supersede the 2008 strategy.

2.3.1.5 White Paper: Improving Public Transport (2018)

The paper sets out proposals for an integrated transport network across Wales. It gives proposals for improvements in the legislation for bus services in Wales, and reform of licensing regimes for taxis and private hire vehicles. It proposes options to empower local authorities to provide efficient bus services through:

- Establishing Joint Transport Authorities;
- Increasing the age of eligibility for concessionary bus passes;
- Promoting Enhanced Quality Partnership Schemes (EQPSs);
- Allowing authorities to establish municipal operations;
- Changing the franchising process;
- Making new requirements for operators, local authorities and the Traffic Commissioner to provide more information about services including routes, timetables, etc.; and
- Changing taxi and private hire vehicle licensing.

2.3.1.6 Written Statement: Principles for Public Transport Connectivity (2018)

This statement considers the long-term vision of transport across Wales. It is highly relevant to this study as it sets the principles that should be considered when infrastructure schemes are being planned and services procured. Selected relevant recommendations this statement makes include:

- Services should be provided by zero emissions vehicles;
- Stations will be fully accessible with step-free access, and level boarding to vehicles;
- Pricing strategies will be developed that incentivise use by disadvantaged communities;
- No one will have to stand for more than 20 minutes because of a lack of a seat;
- High capacity park and ride/park and share facilities will be provided at key network nodes, particularly where the network intersects with strategic or arterial roads;
- All Metro stations to benefit from at least 4 services per hour in each direction Monday-Saturday; and
- In South-east Wales, journey times to a principal interchange shall be no more than 60 minutes.

2.3.1.7 Other National Policy Documents

Other national policy documents considered include:

- Environment Strategy for Wales (2006);
- One Wales: One Planet – the Sustainable Development Scheme of the Welsh Assembly Government (2009);
- Climate Change Strategy for Wales (2010);
- Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2011);
- Local Air Quality Management in Wales – Policy Guidance (2017);
- The Wales Spatial Plan (2008);
- Planning Policy Wales (2016);
- Planning Policy Wales Technical Advice Note (TAN) 12: Design (2016);
- Planning Policy Wales Technical Advice Note (TAN) 18: Transport (2007); and
- An Active Travel Action Plan for Wales (2016).

2.4 Local and Regional Policy Context

This section briefly describes selected key policies at a local and regional level.

2.4.1.1 Cardiff City Deal Strategic Business Plan: Wider Investment Fund (2018)

The Cardiff Capital Region (CCR) City Deal is a £1.2bn programme agreed in 2016 between the UK Government, the Welsh Government and the ten local authorities in South East Wales to bring about significant economic growth in the region through investment, upskilling, and improved physical and digital connectivity.

One of the CCR's objectives is to connect communities, business, jobs, facilities and services in the area. The CCR Transport Authority, working closely with the Welsh Government, TfW and others, has been established as a sub-committee by the CCR Cabinet to facilitate the City Deal by coordinating transport planning and investment across the region.

One of the main priorities is the delivery of the South Wales Metro. Of the £1.2bn, £738million of the City Deal fund has been pre-allocated for the project, which will be split between the Core Valley Lines (CVL) Electrification programme and the wider South Wales Metro scheme.

The Strategic Business Plan sets out the requirements to make Cardiff a prosperous capital City region. Actions include the need for a Strategic Sites Programme to identify land which should be developed to catalyse new development, create city-to-city links, connect neighbourhoods, and focus development on the M4 and Great Western Mainline.

2.4.1.2 Cardiff Local Development Plan (adopted 2016)

The vision for Cardiff established in the Local Development Plan (LDP) is that, "by 2020, Cardiff will be a world class European capital city with an exceptional quality of life and at the heart of a thriving city-region"[8]. The LDP identifies the need for 41,415 new dwellings and 40,000 new jobs in Cardiff over the LDP plan period (2006- 2026). It also identifies the need to prioritise the provision of infrastructure in a planned and focussed way.

The LDP has four objectives:

1. To respond to evidenced economic needs and provide the necessary infrastructure to deliver development;
2. To respond to evidenced social needs;
3. To deliver economic and social needs in a co-ordinated way that respects and enhances Cardiff's environment; and
4. To create sustainable neighbourhoods that form part of a sustainable city.

The Plan identifies the need for Cardiff to establish itself as a regional and national transport hub which is accessible from all areas within the city and from other UK cities. It also addresses the need to establish Cardiff as a sustainable city, through reducing the need to travel, decreasing private car usage and improving the central bus and train stations. The Plan suggests land use is important for minimising car use by designing and building new developments which are not car-based.

This document defines a total of eight Strategic Sites, three of which are in the North West Corridor. These three sites are expected to bring forward a minimum of 7,650 new houses within the development planning period (until 2026). More information on these sites can be found in Section 2.6.

The LDP identifies strategic transport corridors with priority measures, with the Western Bus Corridor (Cowbridge Road, A48, A4055 Cardiff Road, A4119 Llantrisant Road from the County Boundary to Cowbridge Road and A4232 Trunk Road from Culverhouse Cross to J33 on the M4) running through the North West Corridor. Improvements to the city cycle network are also important, in order to introduce new orbital routes and new interchanges.

2.4.1.3 Cardiff Transport White Paper: Transport Vision to 2030

Cardiff Council's Transport White Paper establishes a 10-year plan for the City; the main aims are to tackle climate change, reduce congestion, improve air quality, and provide ring-fenced funding to invest into public transport. It sets ambitious targets for the city, such as for 76% of all journeys to be made by sustainable travel modes by 2030 and doubling the numbers travelling by bus by 2030 (from 2018).

[8] Cardiff Local Development Plan (2016), p.24

Proposals in the White Paper relevant to the North West Corridor are as follows:

- A new 'Cardiff Crossrail' tram-train service running from Cardiff Bay (Porth Teigr) through to Radyr to serve new housing developments planned between J33 and J34, and the new Plasdwr site. There is potential to extend this onto Splott and Tremorfa;
- Improved frequency of services on the Coryton and City Lines;
- Establishing a new cross-city bus network, linked to the new Metro network;
- Take major traffic off Cardiff roads by establishing new Park & Ride facilities at strategic areas including at Junction 33; and
- Building a segregated cycle network across the city, including a cycle loop in the city centre to link all six Cycleways together.

The paper also identifies ambitions to better connect Llantrisant, Talbot Green and Cardiff through BRT and tram-train measures. Further potential future projects within this area include:

- An interchange at J34, including between active travel modes; and
- A new road link to support new bus measures.

2.4.1.4 Rhondda Cynon Taf Local Development Plan (adopted 2011)

The Rhondda Cynon Taf LDP covers the period 2006 to 2021. A full review of the Plan will be undertaken for the period 2020 to 2030. Therefore, future land use planning and related policies in Rhondda Cynon Taf are subject to change.

The aim of the Rhondda Cynon Taf LDP is for Rhondda Cynon Taf to become a "County Borough of Opportunity. That means working together to enable individuals and communities to achieve their full potential, in terms of both their work and social life[9].

The current LDP identifies a total of eight Strategic Sites. Two of these strategic sites are situated within the North West Corridor, which together will provide 1300 new houses. Some of the future transport proposals that the LDP identifies include:

- Management of the A4119/ A473 corridor; and
- Safeguarding rail network improvements between Pontyclun and Beddau, with potential for new stations in Talbot Green, Llantrisant, Gwaun Miskin and Tyn-y-Nant.

2.4.1.5 Other local policy documents

The following local policy documents have also been taken into consideration during this study:

- Cardiff LDP Monitoring Reports (2017, 2018, 2019);
- Cardiff Draft Economic Strategy: Building more and Better Jobs, Consultation Green Paper (2019);
- Cardiff Local Transport Plan (2015-2020);
- Cardiff Transport and Clean Air Green Paper;
- Cardiff LDP Infrastructure Plan, Background Technical Paper no.6 (2013);
- Rhondda Cynon Taf LDP Annual Monitoring Report (2016, 2017, 2017-2018);
- South East Wales Valleys Local Transport Plan (2015);
- Vale of Glamorgan Local Development Plan (2011-2026);

[9] Rhondda Cynon Taf Local Development Plan (adopted 2011), p.21

- Vale of Glamorgan Local Transport Plan (2015-2030);
- Cardiff Well-being Plan (2018-2023);
- Cwm Taf Well-being Plan (2018-2023); and
- Natural Resources Wales' Well-being Statement (2017).

2.5 The North West Corridor

This section of the report provides an overview of the socio-economic context in the Corridor. Section 2.6 sets out the planned development in the Corridor. Sections 2.7 and 2.8 describe the existing transport network and Sections 2.9 to 2.11 list the problems, opportunities and constraints that have been defined for the North West Corridor.

2.5.1 Population and Settlements

For the purposes of the baseline analysis, a study area for the North West Corridor has been defined using boundaries that accord with the Office for National Statistics (ONS) statistical boundaries (namely, Lower Super Output Areas). To provide additional granularity, the North West Corridor has been divided into three parts: Inner Cardiff, Outer Cardiff and Southern Rhondda Cynon Taf. The delineation of these areas is shown in Figure 2.1. It should be noted that the identification and assessment of transport options encompasses measures which extend into Cardiff's city centre and takes account of opportunities for onward travel to other destinations. However, the baseline analysis of socio-economic conditions is focussed on the North West Corridor itself and therefore excludes the city centre.

According to the 2011 Census, the total population of the Corridor is around 72,000, although based on mid-2017 estimates, this number is now just under 74,000. Of this around half are resident in Southern Rhondda Cynon Taf. The population of the Corridor grew rapidly between 2001 and 2011 from approximately 65,000 to over 72,000. Given that the Corridor has been experiencing significant new housing development, the expectation is that the 2021 census will show a further significant increase in population.

The population of the North West Corridor will continue to increase given the future housing developments documented in this report. Future increases in population will continue to be focussed primarily on Outer Cardiff and Southern Rhondda Cynon Taf and most of the allocated new housing in the Corridor relates to the Strategic Sites located in Outer Cardiff.

The three areas defined differ in their character. Inner Cardiff (which includes the Fairwater area of Cardiff) is typical of an inner suburban area with high population density (40 residents per hectare as compared with 7 and 8 for Outer Cardiff and Southern Rhondda Cynon Taf respectively).

Much of Outer Cardiff is undeveloped farmland and woodland. It includes the suburbs of Radyr and Morganstown and the villages of Creigiau and Pentyrch on the outskirts of the City, Strategic Sites C (North West Cardiff or 'Plasdwr'), D (North of junction 33) and E (South of Creigiau). Notwithstanding these developments, the population of this area grew by approximately 20% between 2001 and 2011.

As defined for this study, Southern Rhondda Cynon Taf incorporates the towns of Pontyclun, Llantrisant and Talbot Green, Beddau and Llantwit Fardre. These towns function as linked urban settlements in their own right and incorporate significant areas of employment and retail development. Nevertheless, there are strong economic linkages between these areas and Cardiff with nearly a third of residents of Southern Rhondda Cynon Taf commuting to Cardiff. There are two Strategic Sites identified in Rhondda Cynon Taf's LDP which lie within the

Corridor: Cwm Colliery and Coking Works to the east of Beddau, and Mwynddy/Talbot Green Area which is located south of the A473 and to the west of the A4119. As noted, Rhondda Cynon Taf's LDP is due to be updated. The population of Southern Rhondda Cynon Taf increased by 17% between 2001 and 2011.

2.5.2 Economic Context

In overall terms, relative to Wales as a whole, the North West Corridor is an area of high employment and low unemployment. Employment rates are higher in Outer Cardiff (67.8%) and Southern Rhondda Cynon Taf (65.6%) than in Inner Cardiff (61.8%).

In total, there are 29,000 jobs in the study area. The majority of these are in Southern Rhondda Cynon Taf. Each part of the Corridor has overall net outward commuting (i.e. the number of people commuting out of the area exceeds the number commuting to jobs located within the area). Outward commuting exceeds inward commuting by a ratio of two to one in Inner Cardiff and by over three to one in Outer Cardiff. Commuting flows are more closely balanced in Southern Rhondda Cynon Taf. Commuting patterns are described in more detail in section 2.7.

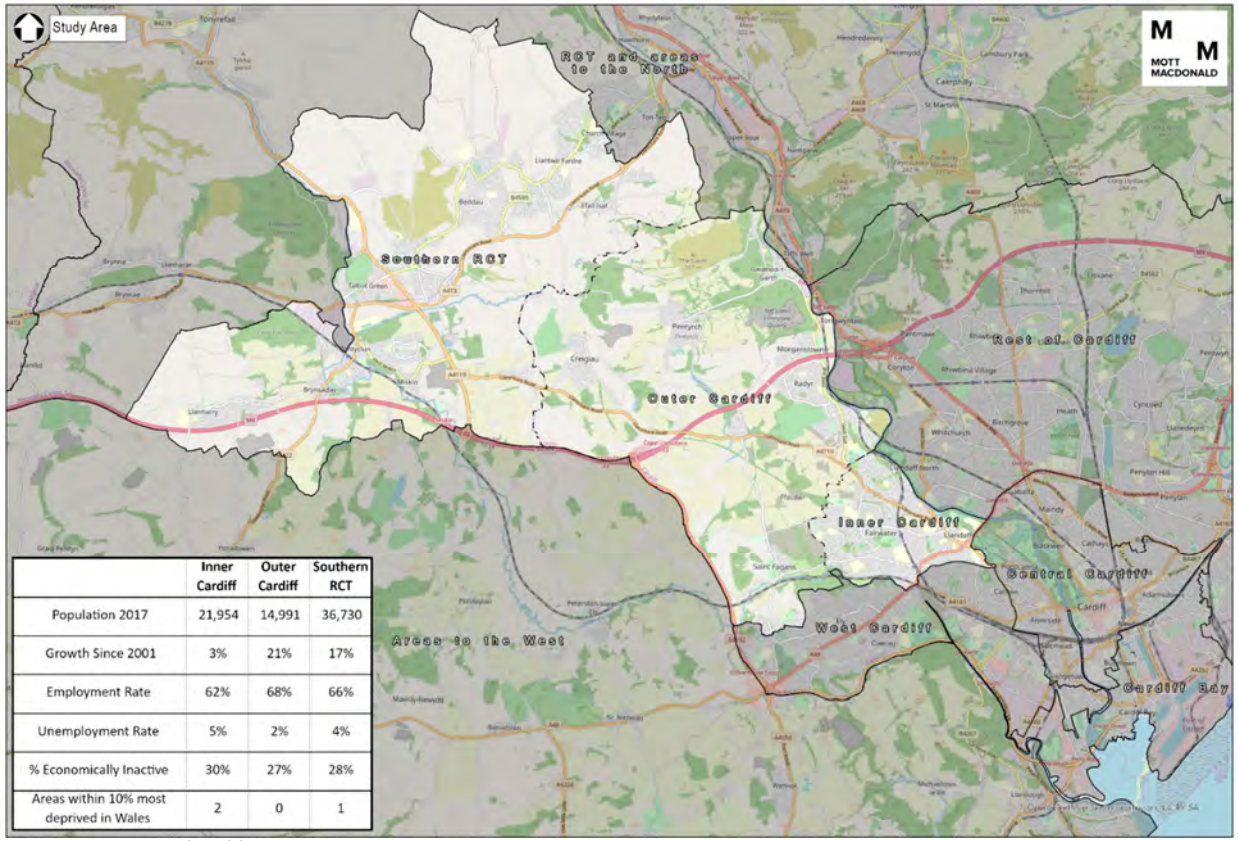
There are only very limited pockets of deprivation in the study area, as measured by the Wales Index of Multiple Deprivation. Of the 46 Lower Super Output Areas within the study area, just three are ranked in the top 10% most deprived in Wales. These are:

- 'Fairwater 7' (located to the north of St. Fagans Road);
- 'Fairwater 4' (located adjacent to Fairwater 7) in Inner Cardiff; and
- 'Tyn-y-Nant 3' in southern RCT in Inner Cardiff.

Most of the neighbourhoods within the Corridor are ranked amongst the 50% 'least deprived' local areas in Wales. However, it is notable that the outer areas of the Corridor (particularly in Rhondda Cynon Taf) perform less well in the 'Access to Services' domain (which reflects a household's ability to access a range of services, using travel time in minutes, using both private and public transport, to access the nearest community services, such as pharmacies, food shops, GPs, post offices, schools, petrol stations and leisure centres) than for the index as a whole.

Although not lying within the study area directly, it is relevant to note that communities to the north of Talbot Green, such as Tonyrefail, Williamstown and within the Rhondda Fawr exhibit higher levels of deprivation, and the North West Corridor is an important artery which they use to access employment and other services in central Cardiff.

Figure 2.1: Definition of the North West Corridor for Baseline Analysis[10]



	Inner Cardiff	Outer Cardiff	Southern RCT
Population 2017	21,954	14,991	36,730
Growth Since 2001	3%	21%	17%
Employment Rate	62%	68%	66%
Unemployment Rate	5%	2%	4%
% Economically Inactive	30%	27%	28%
Areas within 10% most deprived in Wales	2	0	1

Source: Mott Macdonald

[10] Contains OS data © Crown copyright and database right 2019. Contains data from OS Zoomstack. Contains public sector information licensed under the Open Government Licence v3.0. © Crown copyright [and database rights] 2020 OS 100060670

2.6 Planned Development

Development centred around the Strategic Sites will significantly alter patterns of population density in the Corridor and as such the demand for new transport corridors from these new sites. This section explores the planned developments in more detail, providing information on their current progress and any completions to date.

2.6.1 Strategic Sites in Cardiff

Five of Cardiff's Strategic Sites are described in this section, three of which (sites C, D and E) are located within the North West Corridor itself.

2.6.1.1 Cardiff Site A: Cardiff Central Enterprise Zone

Cardiff Central Enterprise Zone comprises three developments: Capital Quarter, Central Square and Central Quay.

Development at both Central Square and the Capital Quarter is well progressed. At Central Square, the new transport interchange at Marland Street was granted planning permission in autumn 2018 and the HMRC's new premises at Wood Street is currently under construction.

Central Quay is a planned development located to the south of Cardiff Central Station. Planning permission was granted in autumn 2018 for Phase 1 of the development, which will comprise a mixed-use office building, a multi-storey car park and new public realm. A 'masterplan' for the wider area has been created to help shape development over the coming years.

2.6.1.2 Cardiff Site B: Former Gas Works

The former Gas Works, Ferry Road, is in the Grangetown area of Cardiff to the west of the city centre. The site lies outside the North West Corridor to the south. The site has been allocated for a housing-based scheme of 500 homes and other associated community uses although no formal planning permissions have been submitted to date.

2.6.1.3 Cardiff Site C: Plasdwr

Plasdwr is the largest Strategic Site allocated in Cardiff's LDP. The LDP originally made provision for a minimum of 5,000 homes expected to be delivered within the LDP plan period (until 2026) with a further 1,500 homes expected to be delivered post-2026. Based on latest available information, the site has the potential for over 7,000 new homes. The site will have a mix of homes, a secondary school, three primary schools, district and local centres with shops, offices and commercial use.

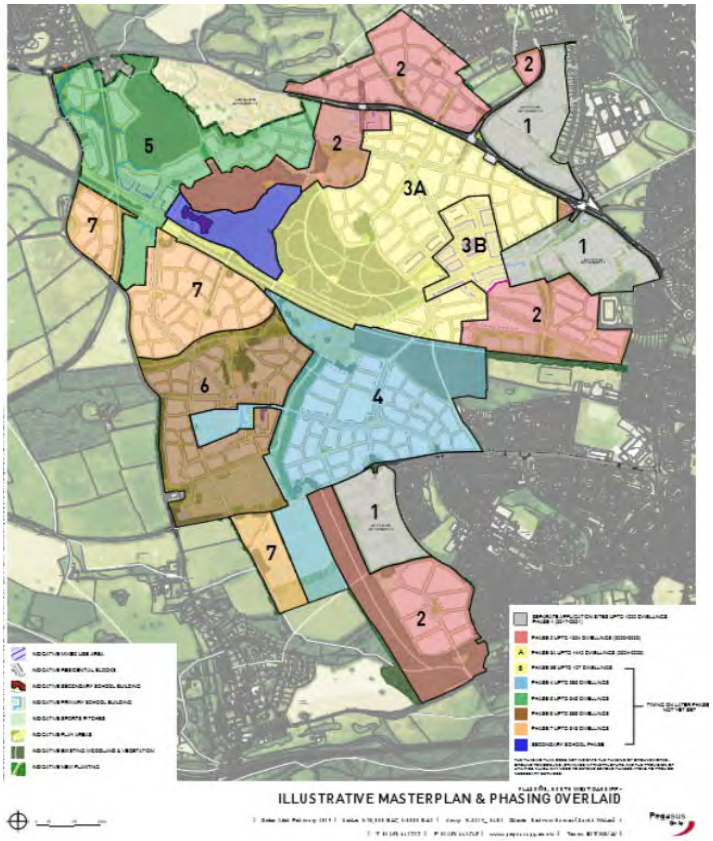
The site is split into four areas. Up to date information on the progress and timescales for the development across these four areas is provided here:

- C1: North West Cardiff – This forms the main part of Strategic Site C. Outline planning permission for 5,970 homes was granted in 2017.
- C2: Goitre Fach Farm – This site is 24 acres and is proposed to contain 263 homes. Outline planning permission was granted in spring 2017 for up to 300 homes. Reserved matters were consented in 2018 for a total of 263 homes. Construction work started in 2018, and by spring 2019, 87 properties had been completed.
- C3: North and South of Llantrisant Road - This area will contain up to 630 homes, including affordable homes, a primary school, and open spaces. Construction has started for site C3.1(1) in early 2017, and 104 homes have been completed as of Autumn 2019.

- C4: South of Pentrebane Road - This area is 22.5 acres and will contain up to 290 homes. The reserved matters application for the north of the site was granted and construction began in late 2017/ early 2018. This part of the site will have 120 homes – as of autumn 2019, 61 homes have been completed. The south of the site has a live reserved matters application for 118 homes.

Taking the four areas together, there are nine planned phases to the Plasdwr development. The eastern side of the site is set to be delivered first, with the western side of the site to follow. Phases 1, 2 and 3B are all scheduled to be complete by 2029. This comprises around 4,000 new homes and covers most of the area lying between the Safeguarded Corridor (see Section 2.6.2.1) and Radyr. Phases 3B onwards have no defined time frame as yet.

Figure 2.2: Plasdwr Phasing[11]



Source: www.plasdwr.co.uk

The nine phases include:

- Phase 1: approved planning application of up to 1,220 dwellings (2017 – 2021);
- Phase 2: up to 1,324 dwellings (2020 – 2025) ;
- Phase 3A: up to 1,442 dwellings (2024 – 2029);
- Phase 3B: up to 127 dwellings;
- Phase 4: up to 965 dwellings;

[11] Note site C2 is not in this phasing map as it is a separate application (located above phase 5 area). Construction of this site is underway

- Phase 5: up to 545 dwellings;
- Phase 6: up to 668 dwellings;
- Phase 7: up to 818 dwellings; and
- The secondary school phases.

2.6.1.4 Cardiff Site D: Land North of J33

Land north of J33 has been established for a mixed-use development of 2,000 homes. Outline planning permission has been granted for 1,500 homes, alongside 405 homes on the northern part of the site with reserved matters. As of April 1st 2019, there had been no completions on site although construction is underway.

2.6.1.5 Cardiff Site E: Land South of Creigiau

Land South of Creigiau, will contain approximately 650 homes; there is currently a live application for this although there have been no completions as of April 1st 2019. The proposal includes provision of open space and areas for recreation, improvement to existing highways and pedestrian/ cycle access.

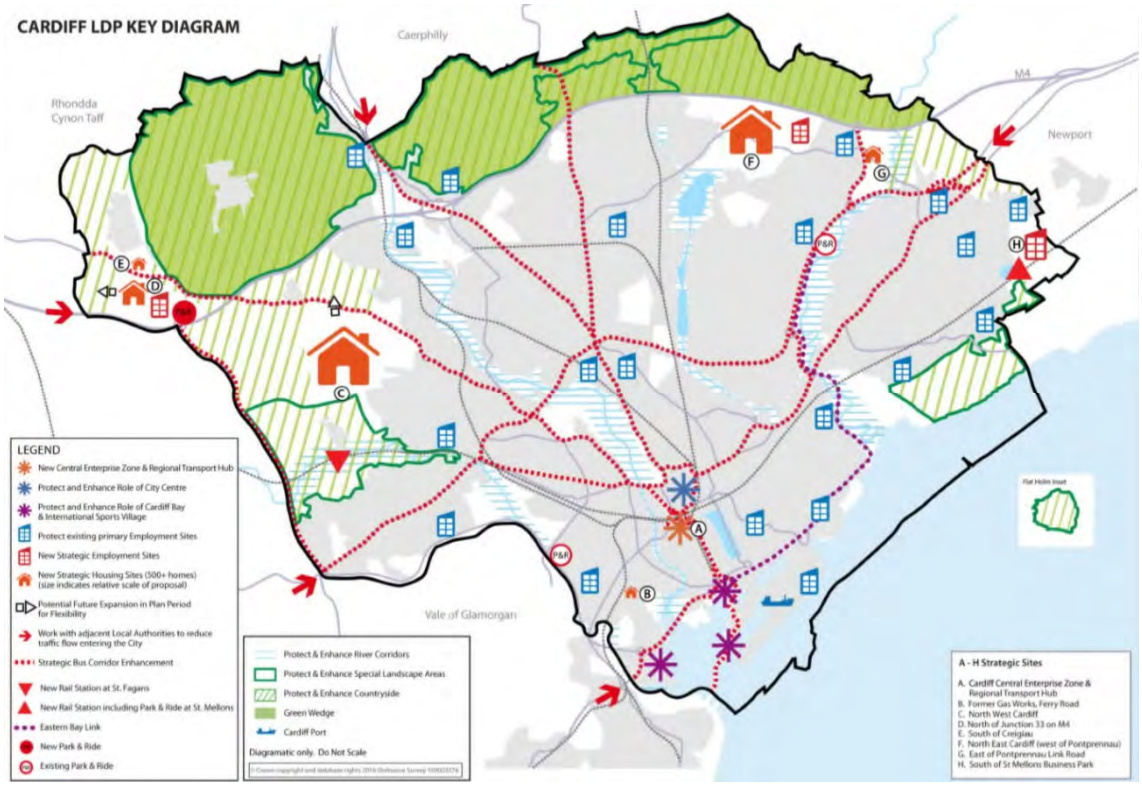
2.6.2 Development Related Transport Proposals

Cardiff's LDP outlines the transport infrastructure improvements to be delivered as part of these developments and the contributions to these schemes required of developers. For Strategic Sites C, D and E this includes:

- Highway and junction improvements along A4119 (Llantrisant Road) and at Junction 33;
- Bus priority measures focussed on the A4119;
- Park and Ride car park for 1,000 spaces (750 spaces accessible from J33 and 250 spaces accessible from A4119);
- Cycle and pedestrian enhancements; and
- Contributions to the cost of operating bus services.

A 'Strategic Bus Corridor' (shown in red in Figure 2.3) has been identified which follows the route of the A4119 from the boundary with Rhondda Cynon Taf, through Radyr/Plasdwr and Llandaff, connecting to the city centre via Cathedral Road and Cowbridge Road East.

Figure 2.3: Cardiff LDP Key Diagram



Source: Cardiff LDP

2.6.2.1 Safeguarded Corridor

The Safeguarded Corridor passes through the centre of the Plasdwr site. The former rail line extended from Waterhall Junction (on what today is the City Line) to Creigiau Quarry. Near Cross Inn, the line connected into the 'Llantrisant and Taff Vale Junction Railway' which linked the Taff Vale Line (between Pontypridd and Cardiff via Llandaff) in the east and the Ely Valley Railway and South Wales Main Line in the west.

Cardiff's LDP takes account of the potential for a new 'metro' route through North West Cardiff following a route, potentially using part or all of the disused rail line. In order not to preclude the delivery of a new route, a corridor running alongside and including the disused line has been protected from development. The protected route was informed by feasibility studies undertaken to inform the LDP[12,13]. However, it should be noted that the use of the Safeguarded Corridor is only a possible option for the metro extension route and will be subject to further study.

The LDP also requires that land uses, densities and layouts respond positively to any potential future metro routes. This is subsequently reflected in the masterplans for the developments at Plasdwr and Junction 33.

[12] North West Cardiff Corridor Study, 2013 (Cardiff Council / Plymouth Estates / Westgate Park Cardiff Limited / Castell-Y-Mynach Estate).

[13] Rapid Transit for Cardiff: LDP 2006 – 2026 Strategic Transport Infrastructure (Cardiff Council, April 2013)

2.6.3 Strategic Sites in Rhondda Cynon Taf: Cwm Colliery and Mwyndy/ Talbot Green sites

There are two Strategic Sites allocated in Rhondda Cynon Taf's LDP which lie within the North West Corridor. Strategic Site 6 in Rhondda Cynon Taf (Cwm Colliery and Coking Works) is located between Beddau and Llantwit Fardre. The site was allocated for up to 950 homes and 1.9 hectares of employment land. Strategic Site 7 (Mwyndy / Talbot Green Area) made provision for 500 dwellings, 15 hectares of employment land and additional retail and leisure development.

There have been no housing completions at either Strategic Site. Currently the site at the former Cwm Colliery has an outline approval for the development of 851 residential units and a primary school/ open space and other amenities.

The Mwyndy/ Talbot Green site has outline consent for the town centre, and there is full approval for a superstore within the new town centre development. The construction of the infrastructure for the wider town centre is advanced. In 2017-2018, the outline application was approved for 460 dwellings at Cefn yr Hendy, but this is subject to a village green inquiry.

2.6.4 A4119 Corridor: Regional Rhondda Gateway

The A4119 corridor extends from Junction 34 of the M4 through Llantrisant and Talbot Green towards the Royal Glamorgan Hospital and the employment area at Llantrisant Business Park. The business park is an important regional employment area and includes the Royal Mint and a variety of mainly manufacturing and industrial uses. Further north, the A4119 extends through Coed Ely to Tonyrefail.

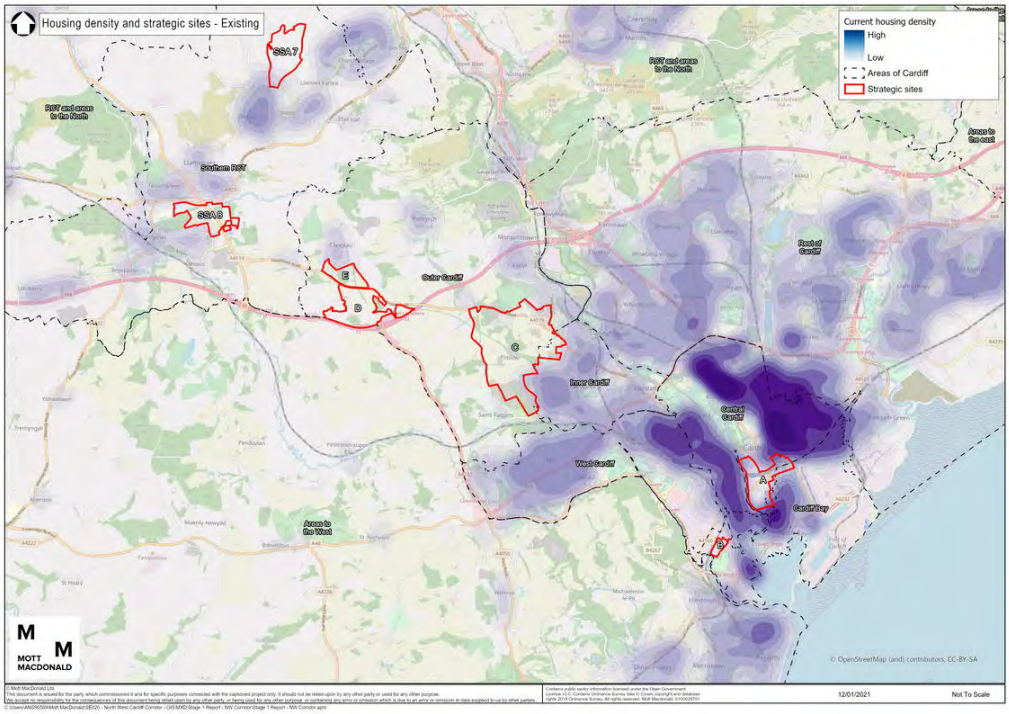
The A4119 Corridor: The Regional Rhondda Gateway has been designated as a Strategic Opportunity Area (SOA) by Rhondda Cynon Taf CBC, reflecting the significant opportunities for job creation and housing to support economic growth. In 2019, Rhondda Cynon Taf CBC secured £2.58m of European funding towards the creation of a quality modern business unit on the former Coed Ely colliery site. This site provides over 15 hectares of reclaimed employment land owned by Welsh Government for new quality industrial and office units for delivery through partnership between public and private sectors.

Rhondda Cynon Taf CBC is progressing plans to dual the A4119 between Ynysmaerdy (Llantrisant Business Park) and Coed Ely. The dualling will act as a catalyst for the Strategic Opportunity Area and in particular the Coed Ely development site, whilst also dealing with existing traffic issues along this corridor.

2.6.5 Impacts of Planned Developments

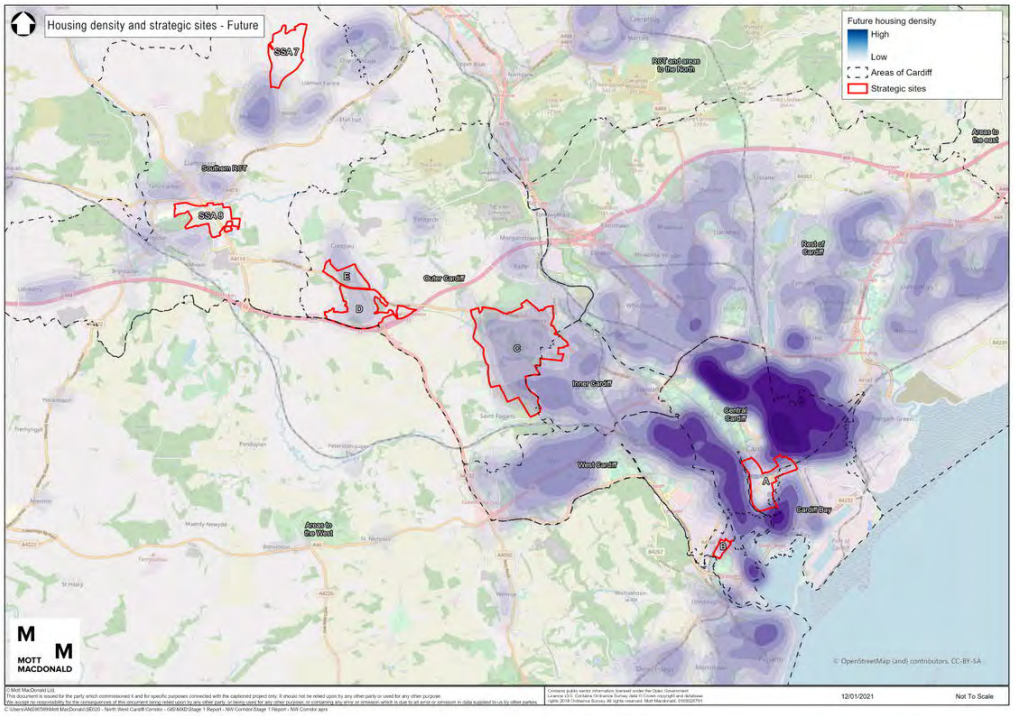
In total, the Strategic Sites within the North West Corridor comprise over 9,000 new houses which are planned across three Strategic Sites in Cardiff within the current LDP period, with a further 1,300 homes at two Strategic Sites in southern Rhondda Cynon Taf.

Figure 2.4: Strategic Sites and Current Housing Density[14]



Source: Mott Macdonald

Figure 2.5: Strategic Sites and Future Housing Density (sites C, D and E only)



Source: Mott Macdonald

2.7 Travel Patterns

2.7.1 Commuting

Although the dominant commuting flows are towards Cardiff city centre, commuting flows are complex and the jobs filled by residents of the Corridor are dispersed over a wide area. As of 2011, 32% of commuters resident in Inner Cardiff worked in either Central Cardiff or Cardiff Bay, as compared with 27% of commuters living in Outer Cardiff and 13% of commuters living in southern Rhondda Cynon Taf. A smaller proportion of commuters from the North West Corridor travel to areas of Cardiff Bay (6%) than to central Cardiff (17%).

It is notable that fewer residents of the Corridor commute to jobs in the city centre and Cardiff Bay than those who commute to other parts of the City ('rest of Cardiff'). This reflects the fact that employment in Cardiff is dispersed across different areas of the City. Nevertheless, it should equally be considered that, in contrast to the city centre, employment in the 'rest of Cardiff' will be spread across a wide area. This makes it more challenging to provide direct public transport connections to serve these trips.

As referred to above, a significant proportion of people in Southern Rhondda Cynon Taf work within the Borough. For Southern Rhondda Cynon Taf, 31% of commuters work in some part of Cardiff. This compares with 82% of Inner Cardiff's commuters and 70% of commuters from Outer Cardiff.

In overview, whilst the commuting patterns re-enforce the need to provide connectivity within the North West Corridor and to/from central Cardiff, it also highlights the need to provide for east-west travel and onward connections to other parts of the city region. This requirement was also noted by stakeholders during the Problems, Opportunities and Objectives workshop.

Table 2-1: Commuting outflows by number of people (% of outflows)

Place of work	Place of residence			Total
	Inner Cardiff	Outer Cardiff	Southern RCT	
Inner Cardiff	1,046 (11%)	300 (4%)	225 (1%)	**1,571 (6%)**
Outer Cardiff	135 (1%)	421 (6%)	241 (2%)	**797 (3%)**
Southern RCT	99 (1%)	213 (3%)	3,720 (25%)	**4,032 (13%)**
Central Cardiff	2,486 (25%)	1,392 (20%)	1,391 (9%)	**5,269 (17%)**
Cardiff Bay	719 (7%)	469 (7%)	589 (4%)	**1,777 (6%)**
Rest of Cardiff	3,677 (37%)	2,222 (32%)	2,197 (15%)	**8,096 (25%)**
Areas to the West	668 (7%)	609 (9%)	2,091 (14%)	**3,368 (11%)**
RCT areas to the North	512 (5%)	813 (12%)	4,020 (27%)	**5,345 (17%)**
Areas to the East	472 (5%)	414 (6%)	672 (4%)	**1,558 (5%)**
Total Commuting by North West Corridor Residents	**9,814 (100%)**	**6,853 (100%)**	**15,146 (100%)**	**1,571 (100%)**

Source: NOMIS

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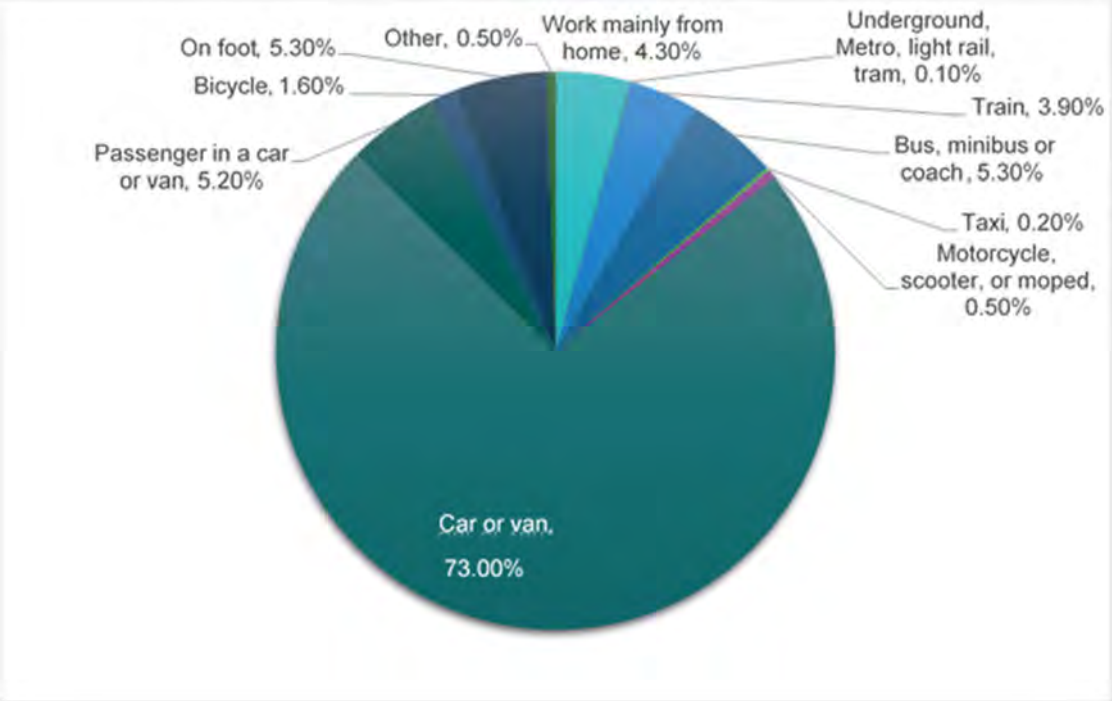
2.7.1.1 Commuting Mode Shares

Based on the 2011 Census, commuting journeys from the North West Corridor are predominantly made by car. For the Corridor as a whole, over three quarters of residents (73%) commute by car with a further 5% travelling as a passenger in a car of van. Only 9% use public transport and 6% walk or cycle to work. Notably, whilst the dominance of car transport is a feature of the city-region, a higher proportion of the North West Corridor workforce travels by car than the average for either Cardiff or the Cardiff Capital Region as a whole.

Mode shares differ significantly for different parts of the Corridor. Commuters from Inner Cardiff are more likely to travel by bus (13% compared to 6% for the Corridor as a whole). The highest share of journeys using the rail network is found in Outer Cardiff, a high proportion of which are likely to be those using Radyr station. Residents of Southern Rhondda Cynon Taf have a much higher reliance on car transport with only 8% of residents commuting by bus or rail. These differences are likely to reflect the coverage and quality of bus and rail services which is explored further in section 2.8.

Figure 2.6: Commuting Mode Shares: North West Corridor[15]



Source: 2011 Census

2.7.2 All Travel (South East Wales Transport Model)

Data has been extracted from the South East Wales Transport Model (SEWTM) to provide further evidence of current and expected travel patterns and transport conditions in the North West Corridor. For the purposes of this analysis, model sectors (areas) have been defined which align with the study area definition illustrated in Figure 2.1. Travel demand and mode share data extracted from SEWTM relates to all trip purposes and provides a representation of travel within a typical hour during the AM or PM peaks or during the 'Inter-Peak' period for the

[15] There are no 'Underground, Metro, Light Rail, Tram' services in south Wales and therefore the inclusion of this category in census responses is likely to be due to respondents whose main place of work is elsewhere in the UK.

year in question. It should not be expected, therefore, that travel patterns and mode shares will match Census data which relates to the reported behaviour of commuters at a point in time in 2011.

The SEWTM analysis provided in this report is based on currently available model runs and no new modelling has been undertaken for the purposes of WelTAG Stage 1. Data from two SEWTM model years (2015 and 2036) has been used to inform this study. Forecasts for 2036 make allowance for expected development at each of the Strategic Sites in Cardiff and Rhondda Cynon Taf. However, it should be noted that the degree of detail applied to the representation of these sites and their local transport networks is limited. Therefore, the analysis should be interpreted as providing an initial indication of the impact of the development sites. During WelTAG Stage 2 – during which demand modelling of potential interventions will take place – more detailed modelling will be required and the assumptions in respect of development sites will need to be updated. Moreover, when interpreting future year SEWTM forecasts, it should be noted that patterns of travel demand and mode shares will be influenced by the provision of transport. Therefore, the analysis provided here represents a situation in which no improvements to the transport network are delivered and shows the resultant trips which may not necessarily reflect the level of demand if constraints on capacity and journey times or costs were lessened.

Across a 24-hour period, on a typical weekday, the total number of trips originating in the North West Corridor is forecast to increase from approximately 100,000 to 157,000 by 2036[16]. In 2015, these trips are split 51%:20%:29% between Southern Rhondda Cynon Taf, Outer Cardiff and Inner Cardiff respectively. These proportions change to 38%:38%:24% by 2036, reflecting the very large increase in housing in Outer Cardiff.

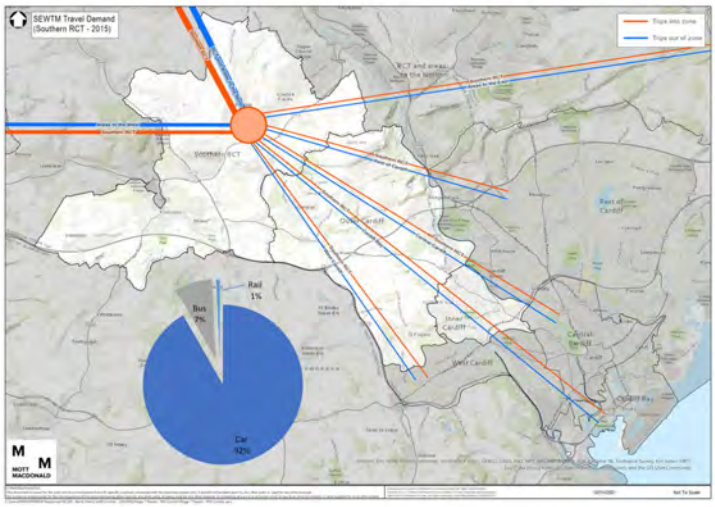
Figure 2.7 shows the travel patterns and mode shares of trips originating in the North West Corridor during the peak hours as forecast for 2036. For the North West Corridor as a whole, 29% of trips originating in the Corridor in the AM peak are destined for other areas of the Corridor, 12% are destined for the city centre and just 3% to Cardiff Bay.

This picture varies significantly across the study area. For Southern Rhondda Cynon Taf, 30% of trips have a destination in other parts of the Borough or the area further north and just 5% of trips are made to the city centre or Cardiff Bay. In contrast, 18% of trips from Outer Cardiff and 24% of trips from Inner Cardiff are bound for the city centre or Cardiff Bay.

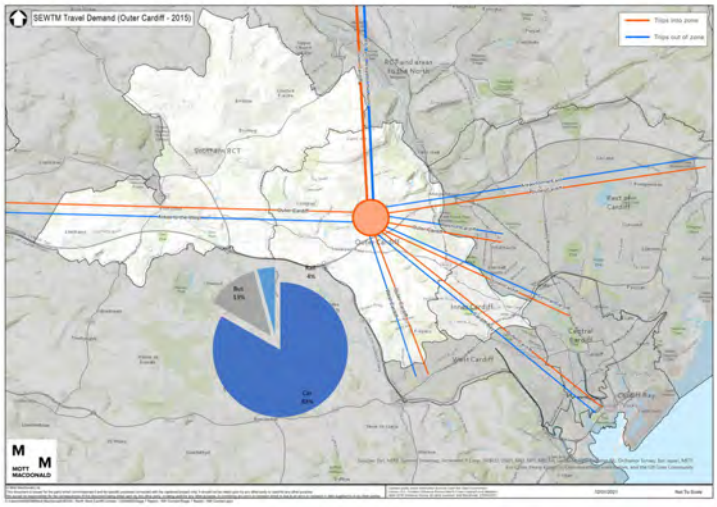
Mirroring the 2011 Census travel to work statistics, the public transport mode shares for peak time travel from the North West Corridor shows a higher proportion of public transport trips from Inner or Outer Cardiff as compared with Southern Rhondda Cynon Taf.

[16] Excludes goods vehicles.

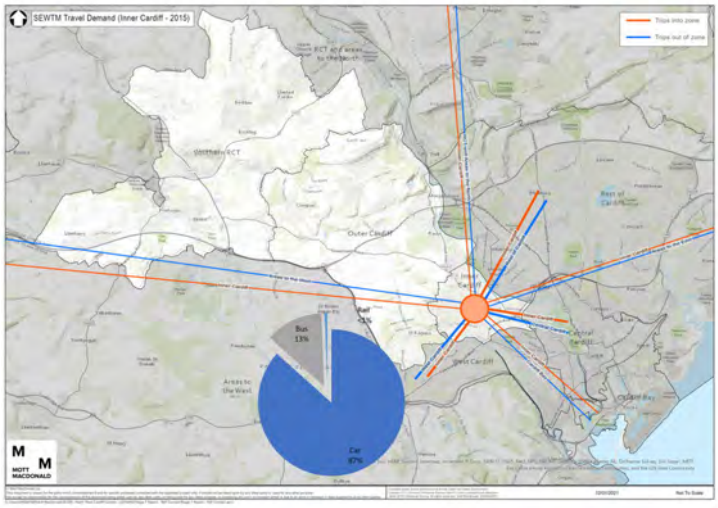
Figure 2.7: SEWTM 2036: Travel Patterns and Mode Shares (excludes goods vehicles)[17]



Destination	Origin: Southern RCT			
	AM Peak Hour		PM Peak Hour	
North West Corridor	1,514	30%	1,674	32%
Central Cardiff	160	3%	48	1%
Cardiff Bay	94	2%	70	1%
Rest of Cardiff / West Cardiff	381	8%	317	6%
RCT and areas to the north	1,484	30%	1,702	33%
Rest of Wales/UK	1,374	27%	1,375	27%



Destination	Origin: Outer Cardiff			
	AM Peak Hour		PM Peak Hour	
North West Corridor	2,563	31%	1,700	42%
Central Cardiff	1,141	14%	295	7%
Cardiff Bay	300	4%	38	1%
Rest of Cardiff / West Cardiff	1,566	19%	597	15%
RCT and areas to the north	1,283	15%	699	17%
Rest of Wales/UK	1,545	18%	685	17%



Destination	Origin: Inner Cardiff			
	AM Peak Hour		PM Peak Hour	
North West Corridor	678	22%	703	28%
Central Cardiff	630	20%	404	16%
Cardiff Bay	120	4%	43	2%
Rest of Cardiff / West Cardiff	922	30%	785	32%
RCT and areas to the north	261	8%	183	7%
Rest of Wales/UK	512	16%	360	15%

Source: South East Wales Transport Model

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2.8 Existing Transport Network and Services

2.8.1 Highway Network

The highway network in the vicinity of the North West Corridor is shown in Figure 2.8. As noted, the North West Corridor has been defined as the area lying broadly between the A4232 (sometimes referred to as the Peripheral Distributor Road, or PDR) to the west and Merthyr Line to the east which runs parallel to the A470 to the north of the M4. The key routes from outer areas of the Corridor towards central Cardiff are the A4232 which is a dual carriageway between Junction 33 of the M4 and Cardiff Bay, and the A473, primarily a single carriageway road which extends from central Cardiff via Llandaff towards Creigiau and onward to Llantrisant/Talbot Green. The A4119 passes to the south of Radyr and passes through the northern part of the Plasdwr Strategic Site. Within Rhondda Cynon Taf, the A4119 provides a radial route towards Cardiff but also extends south to Junction 33 of the M4. The A473 provides the main east-west route connecting the settlements in Southern Rhondda Cynon Taf.

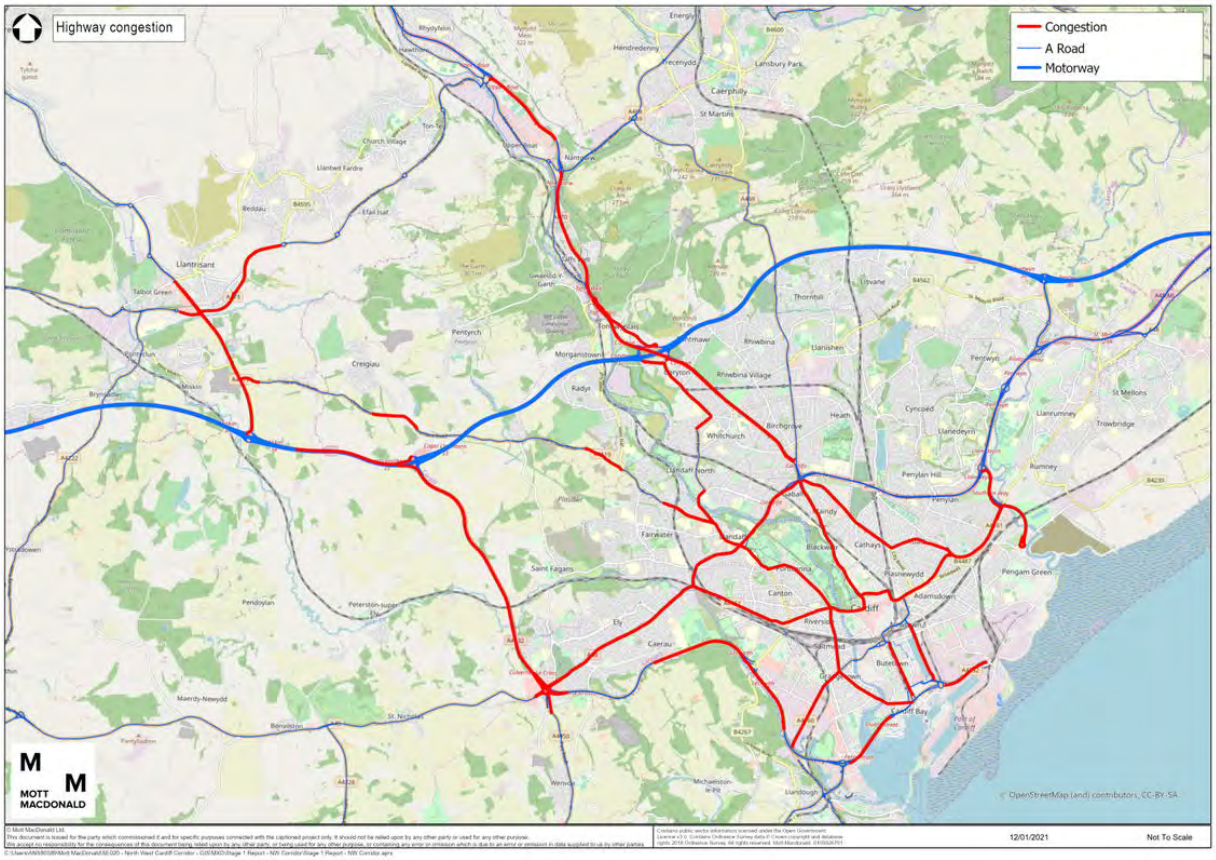
There are multiple pinch points on this network. These are illustrated in Figure 2.8, which highlights parts of the road network which typically suffer peak time congestion issues. Key congestion issues include the following:

- **M4 Junction 33** – on the eastbound carriageway of the M4 and the eastbound off-slip to Junction 33 (AM only), the northbound approach from the A4232 and the entry to the roundabout (AM and PM);
- **M4 Junction 34** – on the A4119 between the A473 roundabout and M4 Junction 34 (southbound in the AM and northbound in the PM), the Junction 34 circulatory and the eastbound on-slip to the M4 (AM only) and the westbound on-slip (PM only);
- **A4232 Link Road** – on the northbound approach to M4 Junction 33, the approaches to Culverhouse Cross, and at the Leckwith Junction;
- **A4119 Llantrisant Road/ Cardiff Road** – various sections of this route experience congestion at peak times although the most severe delays are apparent on the section between Talbot Green and M4 Junction 34 and between Radyr (Clos Park Roundabout) and Penhill Road, including the interchange with the A48;
- **Various routes into the city centre** – including St Fagans Road/Penhill Road/Cathedral Road and Cowbridge Road/Ely Bridge/Lansdowne Road; and
- **On east-west routes in southern Rhondda Cynon Taf** – most notably on the A473 Church Village Bypass between Church Village (Station Road) and Treforest/Upper Boat.

The M4 between Junctions 33 and 34 is subject of a separate WelTAG study[18]. The Stage 2 report shortlists a range of capacity improvements for these junctions and for the mainline motorway itself in this location.

[18] A470/M4 Corridor Congestion Study (WelTAG Stage 2) Outline Business Case Report. July 2019

Figure 2.8: Highway Network and Current Peak Time Congestion Issues[19]



Source: Mott Macdonald

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2.8.1.1 Impacts of Planned Development

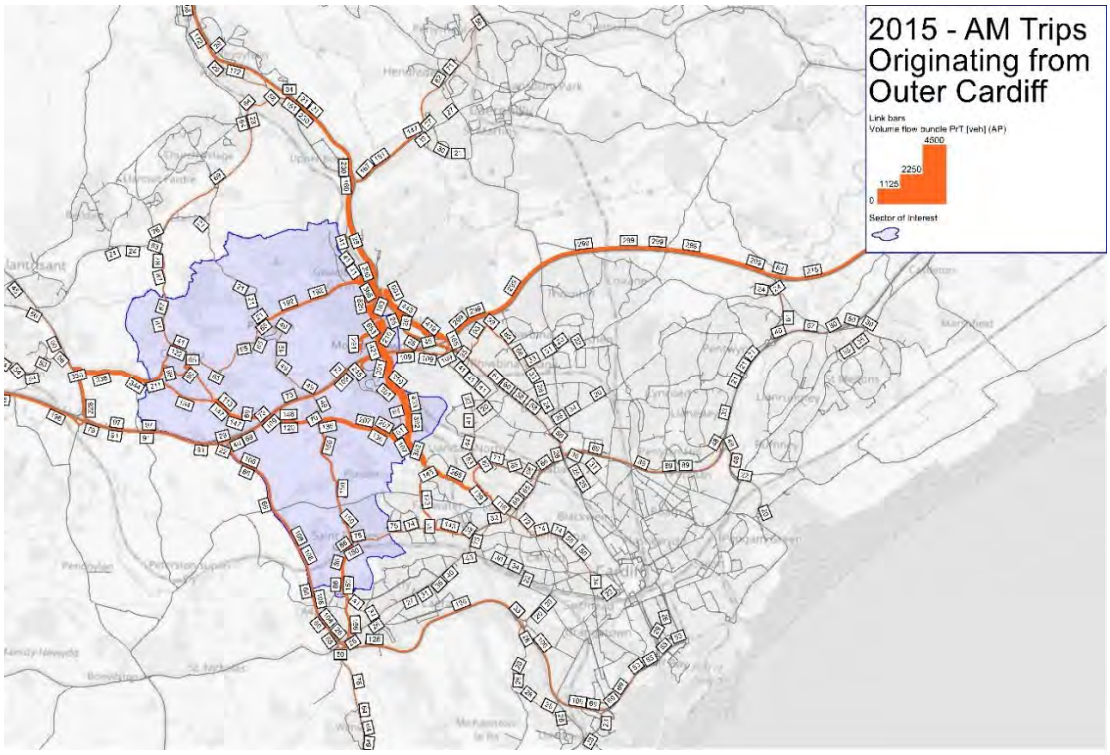
Traffic data from the SEWTM model has been analysed to better understand the potential impact of future demand growth and planned development in the Corridor, particularly in Outer Cardiff and Southern Rhondda Cynon Taf. As noted in section 2.7.2, the future year SEWTM analysis is based on a simplified representation of the future local transport network (both highway and public transport) connecting to the new development and therefore the analysis is intended to provide only an illustration of the patterns of impact rather than an accurate representation of impact. In practice, planned public transport improvements will mitigate these impacts to some degree.

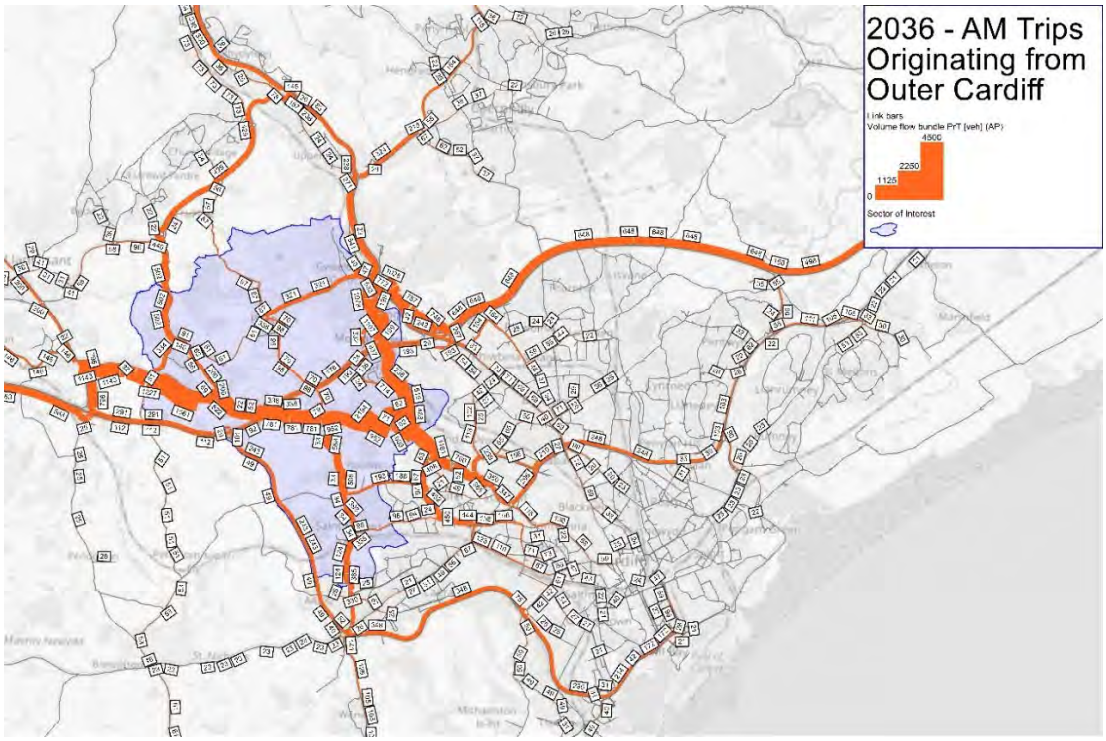
Figure 2.9 and Figure 2.10 show highway trip volumes on the network in the North West Corridor and beyond. The traffic volumes shown relate only to those trips originating from the study area in question: in this case Outer Cardiff and Southern Rhondda Cynon Taf. The first maps show the traffic volumes in 2015. The second maps show the predicted traffic volumes in 2036.

Planned development in Outer Cardiff has a visible impact on highway traffic volumes from this area. Very large increases in traffic are predicted on the A4119 from Plasdwr and the Strategic Sites to the north of the M4. Increases are also evident on the A4232 and on the M4. From Southern Rhondda Cynon Taf, increases in traffic are expected on the A4119 from Llantrisant/Talbot Green to Junction 34 of the M4, and on the A4232. It is notable that the volume of traffic using the A4119 reduces between 2015 and 2036 which is the result of increased congestion on this corridor (due largely to the Strategic Sites in Cardiff) ‘choking off’ demand from further north on this corridor.

In overview, in the absence of intervention, future demand growth and development is expected to significantly worsen the congestion issues listed in this report.

Figure 2.9: Impact of Demand Growth on Highway Traffic Volumes (Outer Cardiff)[20]





Source: South East Wales Transport Model

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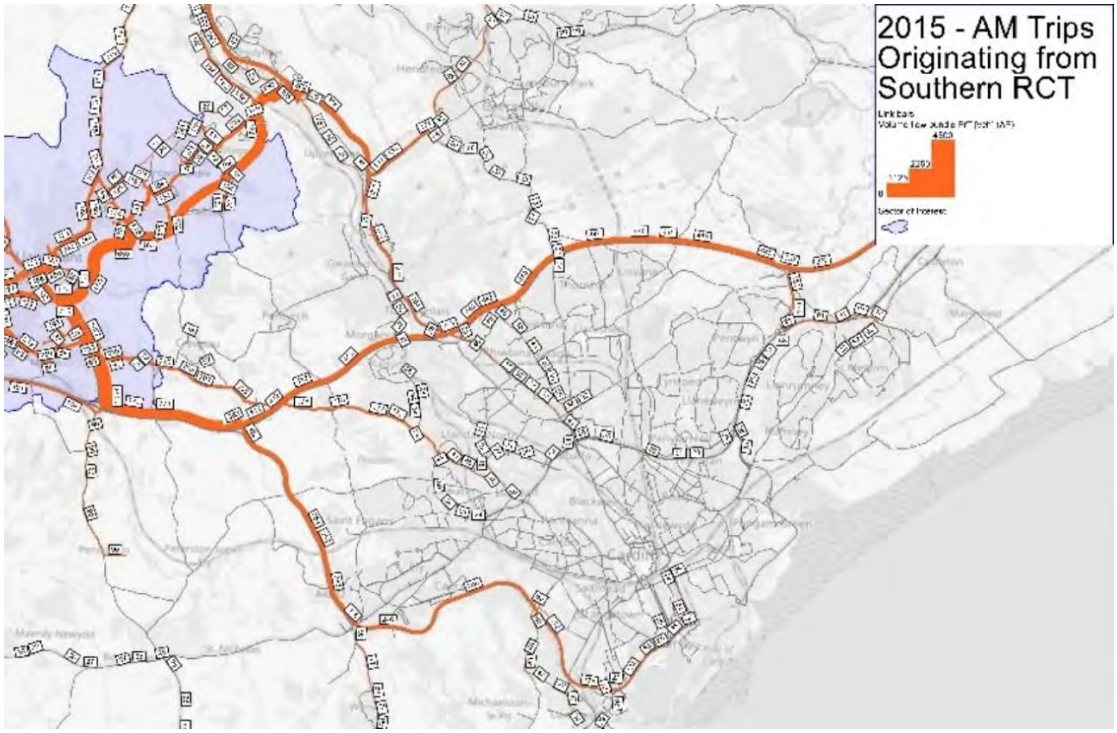
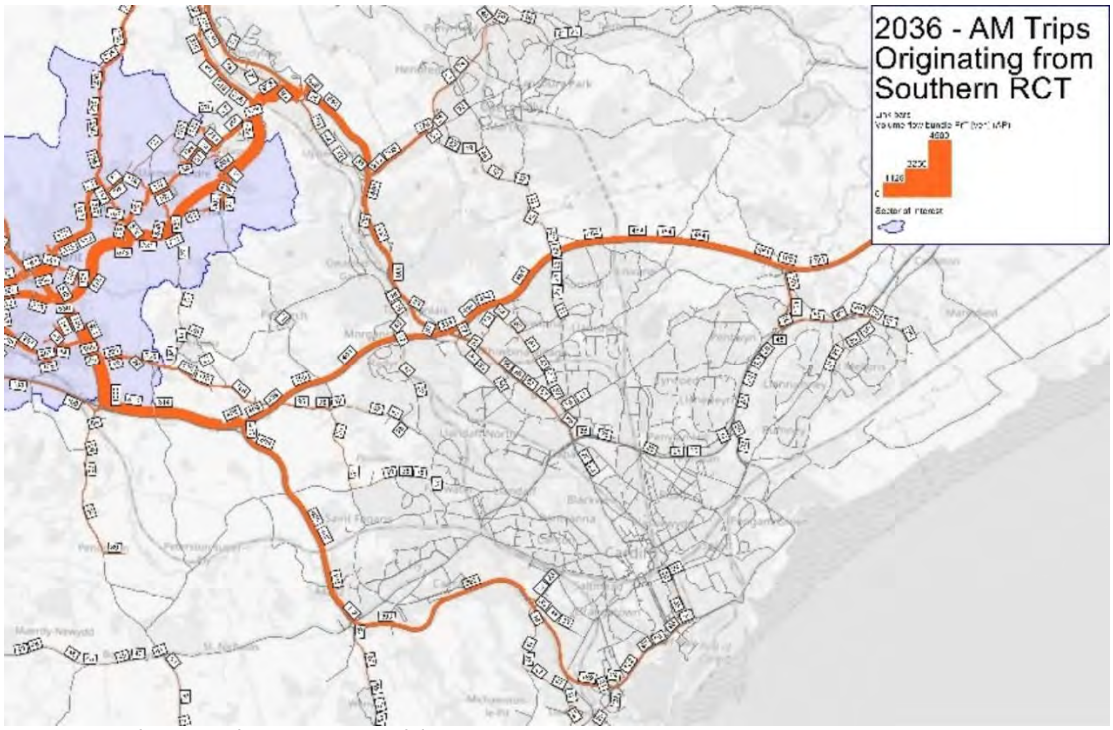
Figure 2.10: Impact of Demand Growth on Highway Traffic Volumes (Rhondda Cynon Taf)[21]





Source: South East Wales Transport Model

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2.8.2 Rail Network and Services

Rail lines that serve the North West Corridor are the City Line and the South Wales Main Line.

The City Line has stations at Ninian Park, Waun-Gron Park, Fairwater, Danescourt and Radyr. There are currently two trains per hour on this line into Cardiff Central Station which ultimately terminate at Coryton. It serves inner areas of the Corridor and Radyr itself. Radyr is served by services via both the City Line (two services per hour) and the Merthyr Line (six services per hour). Given the level of service and the availability of parking at Radyr, this station is likely to attract users from a relatively wide area to the north and west.

Pontyclun station is located on the South Wales Main Line and is served by local stopping services. The station is served by an hourly service during most of the day although additional services stop at the station during the peak so that the service pattern is broadly two trains per hour between 7.00am and 9.00am. However, the spacing of these services reduces the attractiveness of this station.

Each of the stations within the Corridor have experienced rapid growth in demand over the past decade. The largest increases in growth are evident at the stations on the City Line south of Radyr which grew by an average of over 200%. This compares with average growth for stations across Wales of 48%.

Table 2-2: North West Corridor Station Passengers (Entries and Exits)

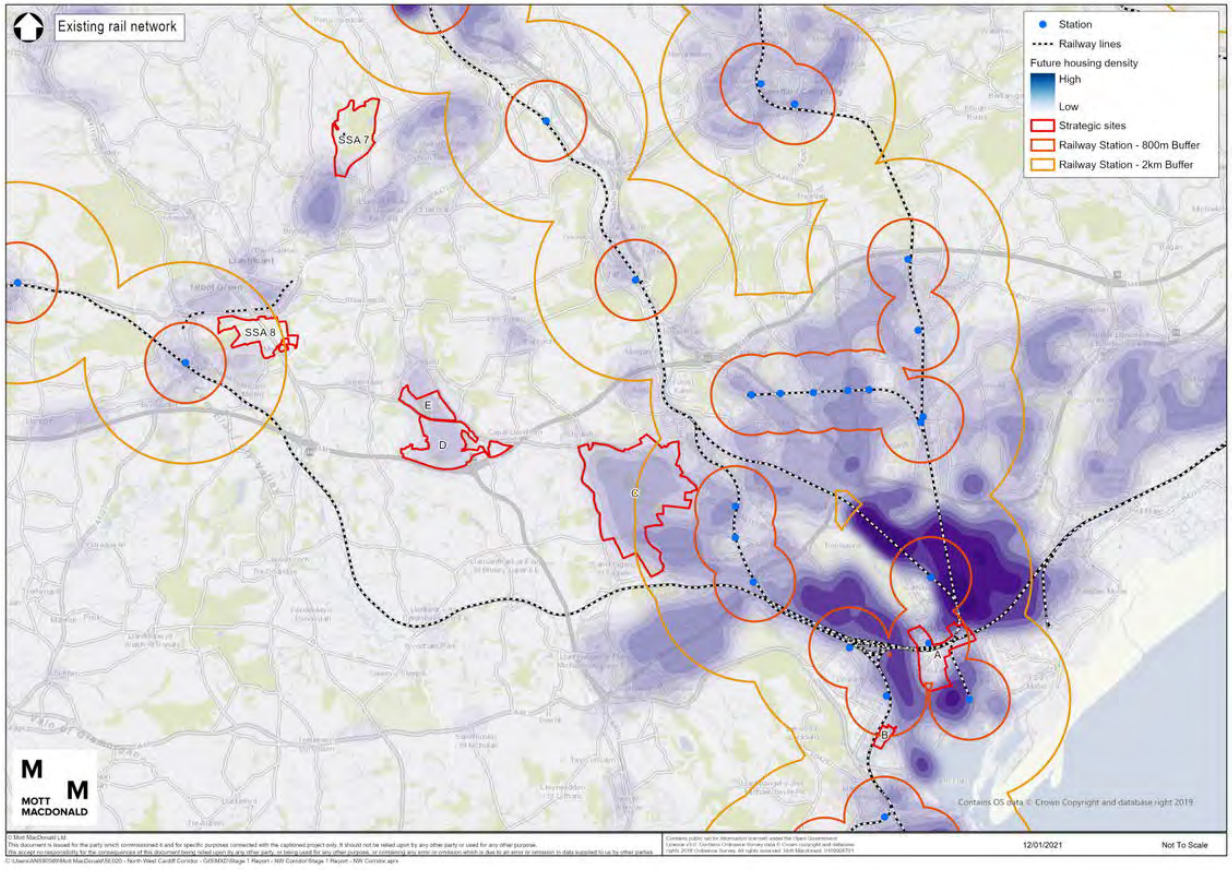
Line	North West Corridor Station	2008/9	2018/19	% Change
City Line	Ninian Park	50,346	135,292	169%
	Waun-gron Park	31,996	126,844	296%
	Fairwater	27,652	102,376	270%
	Danescourt	68,884	132,758	93%
	Radyr	449,530	735,734	64%
South Wales Main Line	Pontyclun	223,148	365,524	64%

Source: Office of Rail and Road

2.8.2.1 Rail Network Coverage

Figure 2.11 shows the rail network in the context of the distribution of housing in the North West Corridor (taking account of the impact of Cardiff's Strategic Sites). Illustrative station catchment areas are also drawn at an 800m (broadly speaking equivalent to a walk-up catchment area) and 2km radius from the station. This highlights the fact that the existing rail network fails to serve large areas of the Corridor including at least part of the Plasdwr development, Strategic Sites D and E, the villages of Creigiau and Pentyrch, and much of Southern Rhondda Cynon Taf between Talbot Green and Church Village.

Figure 2.11: Rail Network and Station Catchment Areas[22]



Source: Mott Macdonald

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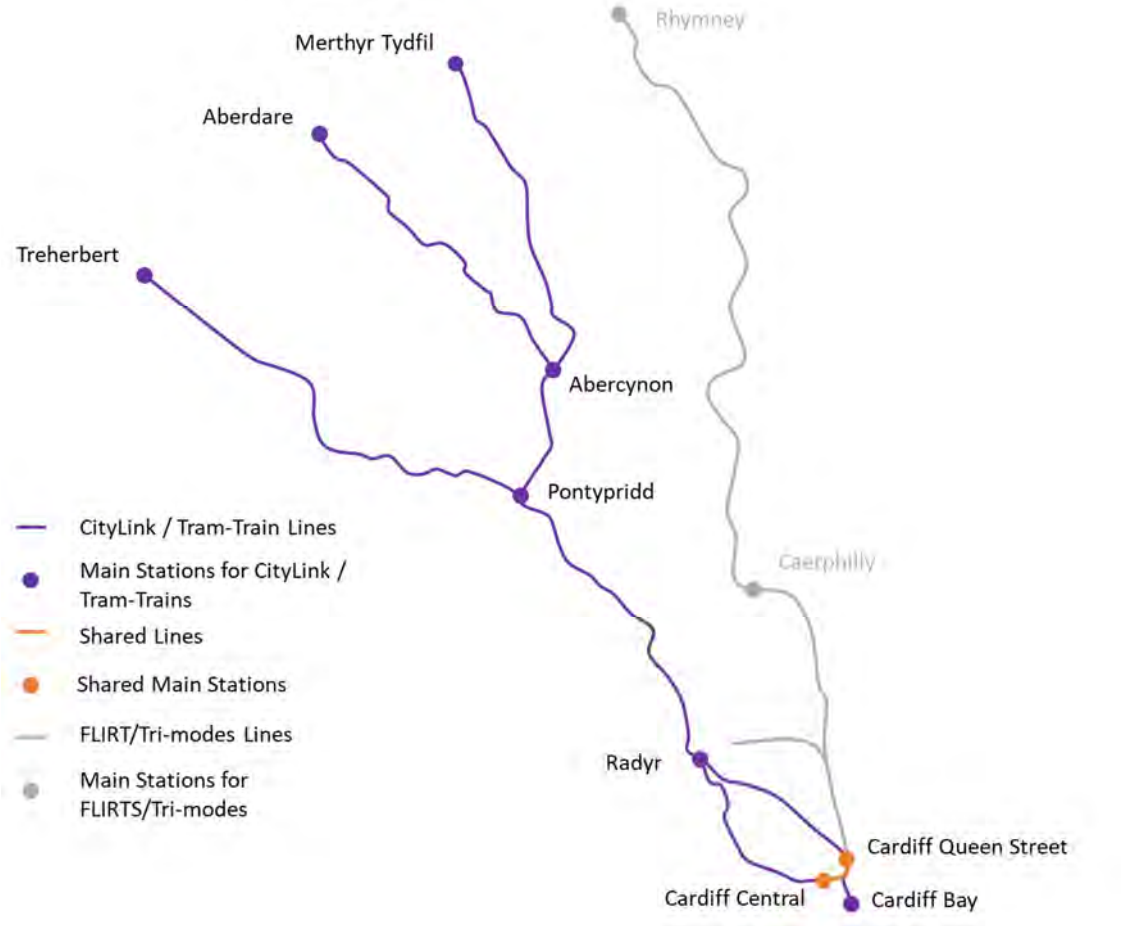
2.8.2.2 South Wales Metro

Very significant changes to the rail network are planned as a result of the new TfW rail franchise and the South Wales Metro. Most pertinently, the City Line will be converted from existing heavy rail trains to tram-train operation as part of the CVL transformation. The network being transferred to tram-train operation is shown in Figure 2.12.

As part of these plans, ownership of the CVL (together with maintenance responsibilities) will transfer from Network Rail to TfW. The devolved portion of the network includes the City Line in addition to the three lines via Pontypridd: Merthyr, Treherbert and Aberdare. The Rhymney line will remain under heavy rail operation using the new Tri-mode FLIRT vehicles.

Figure 2.12: CVL Lines by type of Rolling Stock

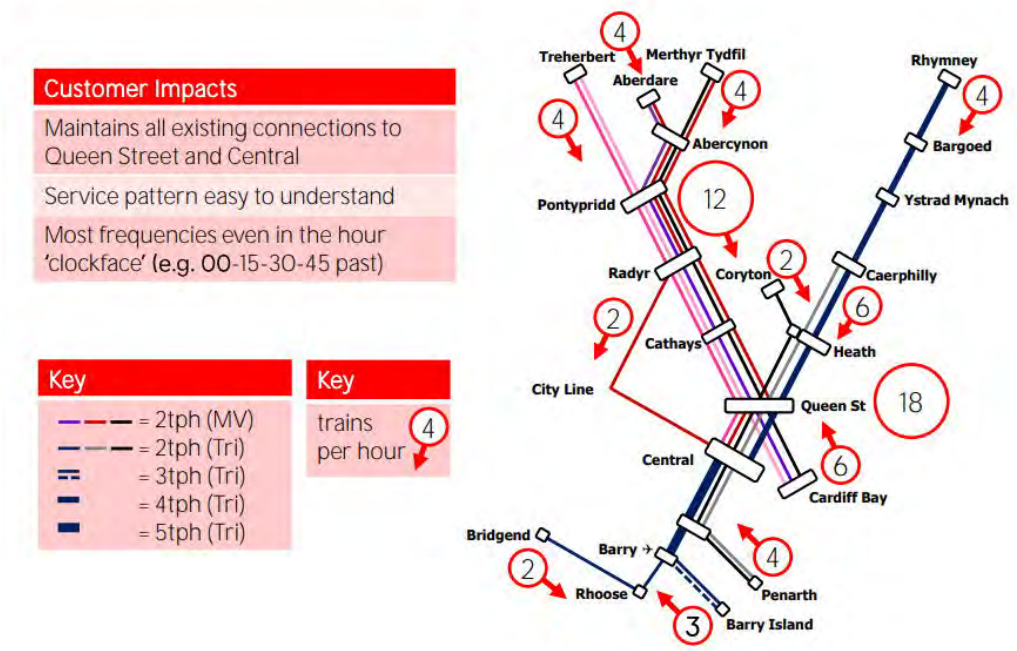


Source: Mott Macdonald

By December 2023 services on the City Line will be operated using Stadler Citylink Metro Tram-train Vehicles. Platforms on the City Line will be extended such that they can accommodate a formation of two 40 metre tram-train vehicles (80 metres in total).

CVL transformation will mean an improvement in the quality and capacity of services on the City Line although the frequency of trains will remain at two trains per hour. Increased frequency on the Merthyr Line from Aberdare, Merthyr and Treherbert to four trains per hour will result in the service pattern from Radyr increasing from 8 to 14 trains per hour.

Figure 2.13: CVL Frequency of services for December 2023



Source: Transport for Wales

2.8.3 Bus Network and Services

There are several bus services which operate through the North West Corridor. Services are provided by three primary operators: Cardiff Bus, New Adventure Travel, and Stagecoach. Existing bus routes connecting the North West Corridor and Cardiff are shown in Figure 2.14. The figure also illustrates the peak time frequency of services.

Peak time bus frequencies on inner areas of the Corridor are reasonably high with at least 4 buses per hour. There is also a regular service between Talbot Green and Cardiff. Outlying areas of the Corridor receive a much less frequent service. For example, there is a single bus per hour from Creigiau. Bus services from Beddau and Llantwit Fardre are more attractive via the A470 (with approximately 2 buses per hour and a journey time of around 1 hour) than via the North West Corridor (which requires passengers to change at Talbot Green with a journey time of around 1 hour 20 minutes).

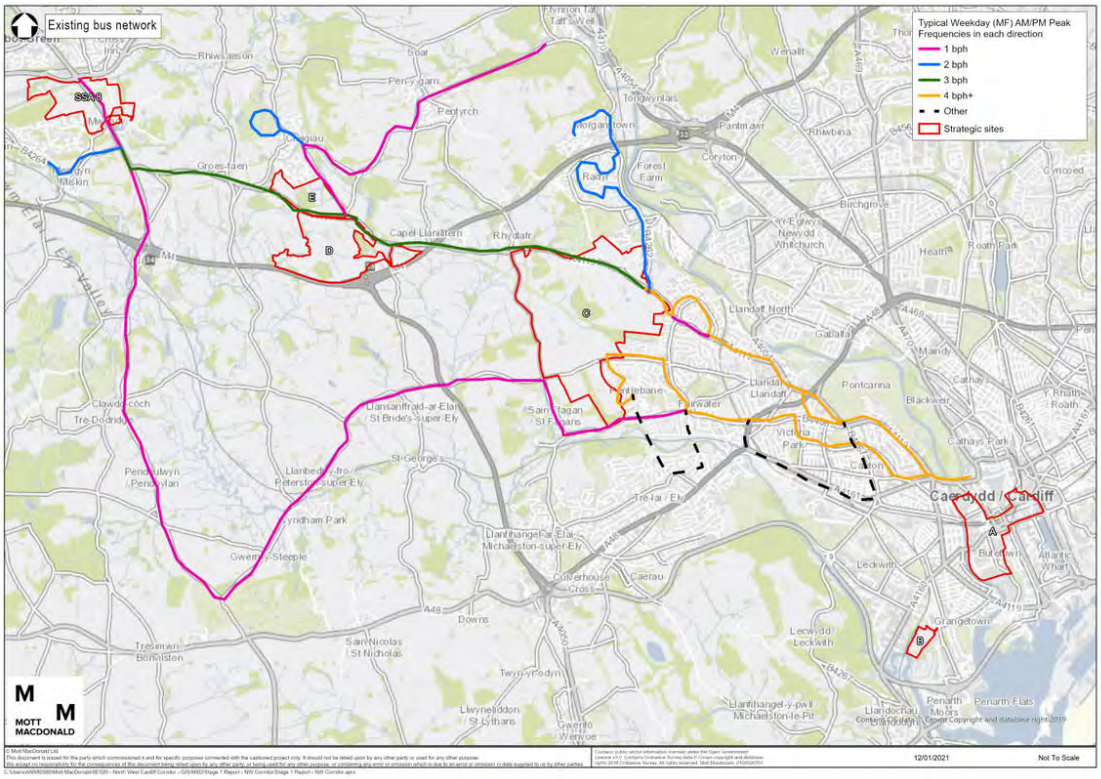
Within the North West Corridor, there is some, albeit limited, competition between existing bus operators. Although certain roads and areas are served by different operators, in practice, these routes are focused on different markets. For example:

- On the A4119 Llantrisant Road corridor, bus services are provided by Cardiff Bus and Stagecoach. The Cardiff Bus routes serve the urban areas of Cardiff such as Danescourt and Radyr with a new service to Rhydlafar. Stagecoach routes are longer distance inter-urban and linking Central Cardiff with places such as Talbot Green and further north. As a

result there are differences in frequencies (Cardiff Bus operating higher frequency services) and pricing (with modest differences in ticket prices); and

- Towards St Fagans and the southern part of the North West Corridor, Cardiff Bus frequent services are supplemented by a local authority supported service that provides a social link to the communities of North East Vale of Glamorgan to Talbot Green.

Figure 2.14: Existing North West Corridor Bus Service Frequency[23]



Source: Mott Macdonald

2.8.4 Journey Times

One of the factors which influence the mode shares in the Corridor (set out in 2.7.1.1) are the relative journey times of alternative modes. An illustrative comparison of journey times for car, bus and rail travel is provided in Table 2-3 for selected locations. During peak times, bus journey times are un-competitive with car journeys, particularly from the more northerly areas of the Corridor. For areas of Rhondda Cynon Taf, bus journey times are some 42% higher during the AM and PM peak periods than outside the peaks. Relatively long bus journey times are a product of the nature of bus routes, but also bus journey times are constrained because of the impact of traffic congestion and the lack of segregated bus lanes.

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Table 2-3: Journey times, typical traffic flows peak evening (approx. 17:30) (mins)

Location	Car	Bus	Train
City centre - Pontyclun	24-40	-	12
City centre – Creigiau	22-45	38	-
City centre – Talbot Green	22-45	58	-
City centre – Beddau	26- 45	>1hr	-

Source: Google Maps journey times estimates

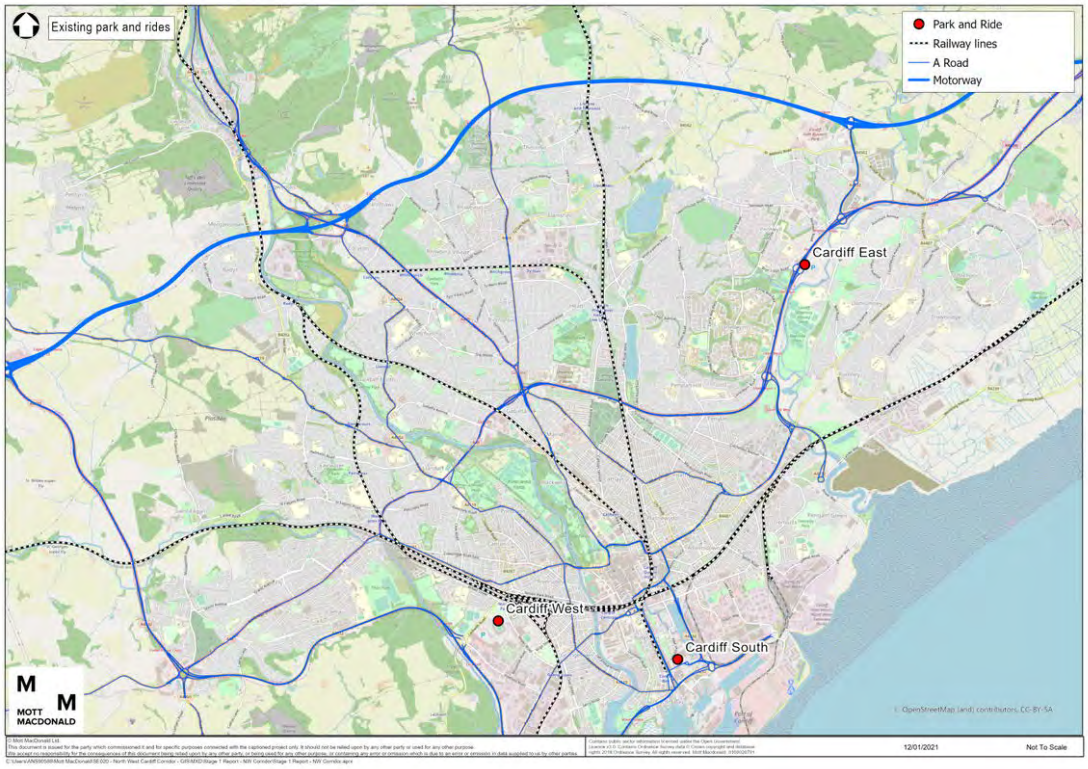
2.8.5 Strategic Park and Ride

There are three large park and ride sites in Cardiff, which can be seen in Figure 2.15. There are also a number of smaller park and ride facilities in the North West Corridor which include:

- Cardiff West Park and Ride – A bus-based park and ride accessible from the A4232 at Leckwith;
- Radyr Station – A recently expanded car park providing 291 parking spaces across the station car park and adjacent park and ride car park; and
- Pontyclun Station – Also recently expanded, the station car park has 50 spaces.

Park and ride provision in the Corridor has a number of drawbacks. The strategic bus park and ride (Cardiff West) requires users from outer areas of the Corridor and beyond to travel a significant distance on the already congested A4232. Radyr station car park provides a useful local function but is not ideally located on the highway network for a ‘strategic’ park and ride given that accesses to the station are via residential streets. Finally, Pontyclun station car park also provides a useful local function, although capacity is limited and there are constraints likely to prevent further expansion of the car park.

Figure 2.15: Bus Park and Ride Sites in Cardiff[24]



Source: Mott Macdonald

2.9 Identified Problems

Drawing on the baseline analysis (set out here) and the stakeholder workshop, a range of economic, social, transport and environmental problems have been identified. These have been discussed and agreed with the WelTAG Review Group. Detailing the problems that the project is seeking to address is an important part of the WelTAG process as the problems shape the agreed objectives which in turn influence the shortlisted options.

The key transport, economic, social and environmental problems are listed in the following sections of this report.

2.9.1 Economic and social problems

- **The need to accommodate rapid growth in population and employment in the Corridor** – Cardiff's population is predicted to increase from approximately 348,000 in 2014, to 430,000 by 2036[25]. Within the North West Corridor, a minimum of 7,650 new houses are planned across three Strategic Sites in Cardiff within the current LDP period with a further 1,300 homes at two Strategic Sites in southern Rhondda Cynon Taf. Increased employment in the Corridor is also expected, including at the strategic sites and the 'Regional Rhondda Gateway'. Sufficient infrastructure will need to be provided to serve the increase in

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[25] Cardiff Local Transport Plan, p.5

population but also to provide connectivity to employment and services, particularly within the Cardiff Enterprise Zone;

- **Dispersed settlement pattern within the Corridor** – One of the key challenges facing the South East Wales economy is the lack of a major urban conurbation and the fact that population is (relative to other large city-regions such as Greater Manchester) dispersed over a wide area. The lack of a major 'agglomeration' contributes to the productivity gap between South Wales and other UK city-regions. This is also reflected in the settlement pattern of the North West Corridor which incorporates inner-city and suburban areas of Cardiff, outlying villages (such as Creigiau) and several towns and villages in Southern Rhondda Cynon Taf; and
- **Some areas with higher levels of deprivation** – For the most part the North West Corridor is characterised by high levels of employment and most areas[12] rank amongst the 50% 'least deprived' areas of Wales according to the Wales Index of Multiple Deprivation. However, according to the Index, the study area also contains some localised areas which exhibit higher levels of deprivation and, relevant to this study, perform less well in terms of residents' access to services. The North West Corridor is also an important artery for a number of more deprived communities to the north of Talbot Green.

2.9.2 Transport problems

- **Development is being planned and delivered in the absence of firm plans for public transport provision** – Strategic Site C (Plasdwr) is in the process of being delivered. Phase 1 (1,220 dwellings) will be completed by 2021. Phase 2 (1,324 dwellings) will be completed by 2025, and Phase 3 (888 dwellings) by 2029. The timescales for other phases are yet to be determined. Strategic Sites D and E comprise 2,000 and 650 homes respectively. Measures are in place or planned to improve bus infrastructure and services (alongside investments in cycling and pedestrian infrastructure) although this falls short of providing a major step-change in the quality and capacity of public transport provision;
- **Further development may be supported by new transport infrastructure** – In some parts of the Corridor, planned development has not been realised as quickly as expected. This may be, at least in part, a reflection of relatively poor transport links. Future land use plans need to be developed alongside in response to long term plans for transport provision. This need is particularly acute in Rhondda Cynon Taf which is about to embark on the development of a new LDP;
- **Timing of transport provision could be important** – Should housing development be delivered in the absence of high quality public transport, this could lock-in a degree of car dependency which may make it more difficult to change transport behaviours in the future; and
- **The North West Corridor and the region as a whole is overly reliant on the private car** – As highlighted in Cardiff City Council's Transport White Paper, 80% of the 100,000 people who commute into Cardiff from outside the city do so by car (as compared with 85.8% for those commuting from southern Rhondda Cynon Taf into Cardiff). In the North West Corridor, 73% of residents commute by car compared with 67% for south east Wales as a whole[26].

2.9.3 Highway

- **Some of the most severe traffic issues in the Cardiff Capital Region are those on the North West Corridor highway network.** Key pinch points are as follows:

[26] 2011 Census

  - M4 Junction 33;
  - M4 Junction 34;
  - A4232 Link Road;
  - A4119 Llantrisant Road/ Cardiff Road;
  - Various routes into the city centre; and
  - On east-west routes in southern Rhondda Cynon Taf.
- **Accident clusters** (which in turn are associated with traffic disruption and unreliable journey times) include:
  - A4119/M4 Junction 34 – on the A4119 on the approach to the M4 Junction 34;
  - M4 Junction 33 – on the eastbound approach to Junction 33 and the eastbound off-slip; and
  - A4232 Link Road – on the approach to Junction 33 and the approach to Culverhouse Cross.

2.9.4 Bus

- **Cardiff, as a whole, has a lower level of bus use than many comparable cities –** Bus statistics from the 2014 Cardiff Bus Network Study[27] show that Nottingham and Tyne and Wear, for example, have 156 and 126 bus journeys per head of population compared to approximately 90 for Cardiff;
- **The frequency of bus services in outer areas of the North West Corridor are low** – Given services are largely provided on a commercial basis, bus routes have evolved around a core network with higher frequencies and a second-tier network with fewer services with sometimes meandering routes;
- **Bus journey times compare poorly with car transport** – Given the limited level of bus segregation on routes, bus journeys are impacted by congestion with an impact on overall journey times;
- **Increased congestion resulting in low bus speeds during peak times** – Bus vehicle tracking data collected for the 2014 Cardiff Bus Network Study has revealed low bus speeds in peak periods. This has shown, for example, that speeds drop to 10kph inbound through Llandaff in the AM peak;
- **Limited bus segregation/ priority in the west of the City** – There are limited stretches of bus lane along Cowbridge Road East (near Victoria Park), Cathedral Road (near Sophia Gardens) and Llantrisant Road (near the BBC and west of the junction with Heol Isaf); and
- **Lack of integrated ticketing between bus operators and between bus and rail –** The Corridor is served principally by three operators (Cardiff Bus, Stagecoach, NAT) but integrated ticketing between operators and between bus and rail modes is limited.

2.9.5 Rail

- **Limited coverage of the rail network in the North West Corridor** – Much of the Corridor is not served by rail with no station within walking distance. The City Line serves inner areas of the Corridor and Radyr but will not provide a local transport option for the new development at Plasdwr. Local services on the South Wales Main Line stop at Pontyclun;

[27] Arup 2014 Cardiff Bus Network Study for Cardiff Council

- **Service frequencies fail to meet the Welsh Government's benchmark of four services per hour**[28].
  - There is an hourly service from Pontyclun to Cardiff Central. Extra services up to 2 trains per hour are provided during the peaks although these trains are poorly spaced.
  - Under TfW's plans for the new franchise, frequencies from Radyr will increase from six to 12 trains per hour by 2024. However, service frequencies on the City Line will remain at two trains per hour; and
- **Poor but improving train quality** – The current quality of rolling stock is poor although a programme of rolling stock upgrades by TfW Rail Services is underway. This includes the delivery of new electric tram-trains to operate on the CVL including the City Line.

2.9.6 Park and Ride

- **The North West of Cardiff lacks a strategic park and ride site to discourage car trips into central areas of Cardiff** – current park and ride capacity includes;
  - Bus-based park and ride at Leckwith which requires drivers to travel a significant distance (via A4232) towards the city centre before boarding a bus;
  - Very limited park and ride capacity at Pontyclun Station; and
  - A recently expanded car park at Radyr albeit this station is not ideally located for a strategic park and ride site given the nature of the local road network.

2.9.7 Environmental Problems

- **Air quality is an issue across south east Wales and is a feature of this Corridor.** Air quality issues include;
  - Generally high regional NOx emissions; and
  - The presence of Air Quality Management Areas at Ely Bridge, Llandaff, city centre (Cardiff) and at Mwyndy and Church Village (Rhondda Cynon Taf).
- **Lack of electrified public transport** – All bus and rail services in the Corridor are currently operated by diesel vehicles which contributes to poor air quality and particulate emissions (although rail services on the CVL will be converted to electric operation from December 2023); and
- **Carbon emissions** – the level of carbon emissions in the transport sector is generally high and, as noted, trips in this Corridor are heavily skewed towards car transport.

2.10 Identified Opportunities

Notwithstanding the challenges set out in section 2.9, a range of opportunities have also been identified which could support the improvement of public transport in the Corridor:

- The population of Cardiff and southern Rhondda Cynon Taf is growing rapidly. Housing and employment development will deliver an increase in demand for transport required to support and justify a new mass rapid transit corridor;
- There is strong political support for a comprehensive public transport solution for the Corridor but also for investment in transport in the Cardiff Capital Region more widely;
- A Safeguarded Corridor for a possible future mass rapid transit has been designated and the potential role of the Corridor is reflected in the masterplans for Cardiff's Strategic Sites;

[28] In 2019, the Minister for Economy and Transport set out a set of principles for connectivity that should be considered when transport schemes are being planned. This includes at least four services per hour in each direction Monday to Saturday at all Metro Stations. https://gov.wales/written-statement-principles-public-transport-connectivity

- Improvements to public transport in this Corridor are already in the pipeline. The A4119 has been designated as a Strategic Bus Corridor and works are currently being delivered to increase highway capacity and introduce new segregation of bus services from car traffic. It is expected that a new park and ride facility at Junction 33 will be delivered by the developers of Strategic Site D and forms part of the planning consent for the site;
- Cardiff's cycle superhighway network includes a route to Llandaff with potential to be extended through the North West Corridor;
- The conversion of the CVL (including the City Line) to tram-train provides greater flexibility to consider new services and extensions of the network. The tram-trains (if modified) can be operated on a line-of-sight basis which offers the potential to operate services more flexibly and integrate with road traffic where required;
- Devolution of the CVL provides more local control over the future operation and investment in the network;
- Emerging plans for the redevelopment of Cardiff Central Station, the South side of the station and Callaghan Square offers the opportunity to consider innovative approaches to this interchange, including enhancing active travel; and
- Proposed forthcoming bus legislation may provide an opportunity to plan and implement new bus services in a more co-ordinated manner.

2.11 Identified Constraints

This section details the constraints that have been identified to delivering transport improvements in the Corridor.

2.11.1 Bus Network / Governance Constraints

- There are multiple constraints to achieving an enhanced level of bus segregation on the existing network, particularly in more built-up areas (e.g. Fairwater / Llandaff / Canton / Riverside). Many routes are already heavily congested (which in turn limits options for transferring road space from cars to buses). Limited road space and frontage constraints (e.g. A4119 through Llandaff) reduce the opportunities for bus segregation measures;
- Capacity issues and concerns at several junctions (e.g. A4119 Cardiff Road/A48 Western Avenue and St Fagans Road/A48 Western Avenue) also limit opportunities for bus priority measures;
- Immediate land constraints around most of the existing railway stations (e.g. Pontyclun, Radyr, Danescourt – Waun-gron Park being a possible exception) limit opportunities for improved integrated public transport hubs;
- Largely market-led provision of bus services may require a mixture of pump-priming and/or de-minimis agreements to provide comprehensive bus provision (although new Welsh legislation could provide alternative approaches[29]); and
- Existing planning agreements to improve bus services are largely based on development completion trigger points.

2.11.2 Rail Network and Operational Constraints

- Capacity constraints at Cardiff Central Station and Cardiff West Junction (specifically the conflicts between City Line and Barry/Penarth Line services) limit the potential for increased services without infrastructure enhancement;

[29] White Paper: Improving Public Transport (Welsh Government)

- If required, there are likely to be significant engineering challenges associated with the provision of additional tracks at the approach to Cardiff Central and the Taff River Viaduct and/or the construction of any new platforms at Cardiff Central; and
- The tram-trains on the CVL will be operated using traditional heavy rail signalling and timetabled in the normal way. A modified version of the tram-trains would be required if on-street operation is considered and complexities associated with integrating timetabled and 'service pattern' based services would need to be carefully considered.

2.11.3 Environmental and Social Constraints

Environmental constraints can be better understood for specific options and routes, although potential environmental issues for proposals in this Corridor have been set out here.

- Natura 2000 European Designated Site (Cardiff Beech Woods SAC & Severn Estuary SAC and SPA) within close proximity to the area of assessment;
- Ty Du Moor, Caeau Blaen-Bielly, and Ely Valley Sites of Special Scientific Interest (SSSI) designated for their biological status;
- Numerous Sites of Interest for Nature Conservation (SINCs) and Local Nature Reserves are situated throughout the study area. They are designated for both their habitats and priority species;
- As no formal records have been requested as part of the initial assessment, the types of protected species are currently unknown within the study area. However, from local knowledge, a number of protected species records are present in the Fairwater area including Great Crested Newts (GCN), and Dormice. It is likely that other protected species will be present within the area, which may include bats, otters, badgers, reptiles and schedule 1 birds;
- The impact on species, habitat loss and severance must be established and designed into the scheme, avoiding retro-fitting schemes;
- There are multiple listed buildings and structures and a number of Scheduled Ancient Monuments within the study area;
- Sections of the assessment area are within flood risk areas;
- There are several historic landfills / potentially contaminated land sites within the study area;
- New transport routes could impact habitat severance; and
- A new transport route may introduce severance between communities.

2.11.4 Financial Constraints

- In overall terms, rail services in South Wales require ongoing subsidy. Falling bus patronage is also placing increasing pressure on commercial bus services. Introducing new, high frequency services risks increasing the overall level of public transport subsidy;
- New rapid transit corridors can attract high capital costs and there have been several high-profile projects which have suffered significant cost overruns; and
- Funding for transport improvements may need to be linked to the value of development in the Corridor which creates a dependency between development and transport provision.

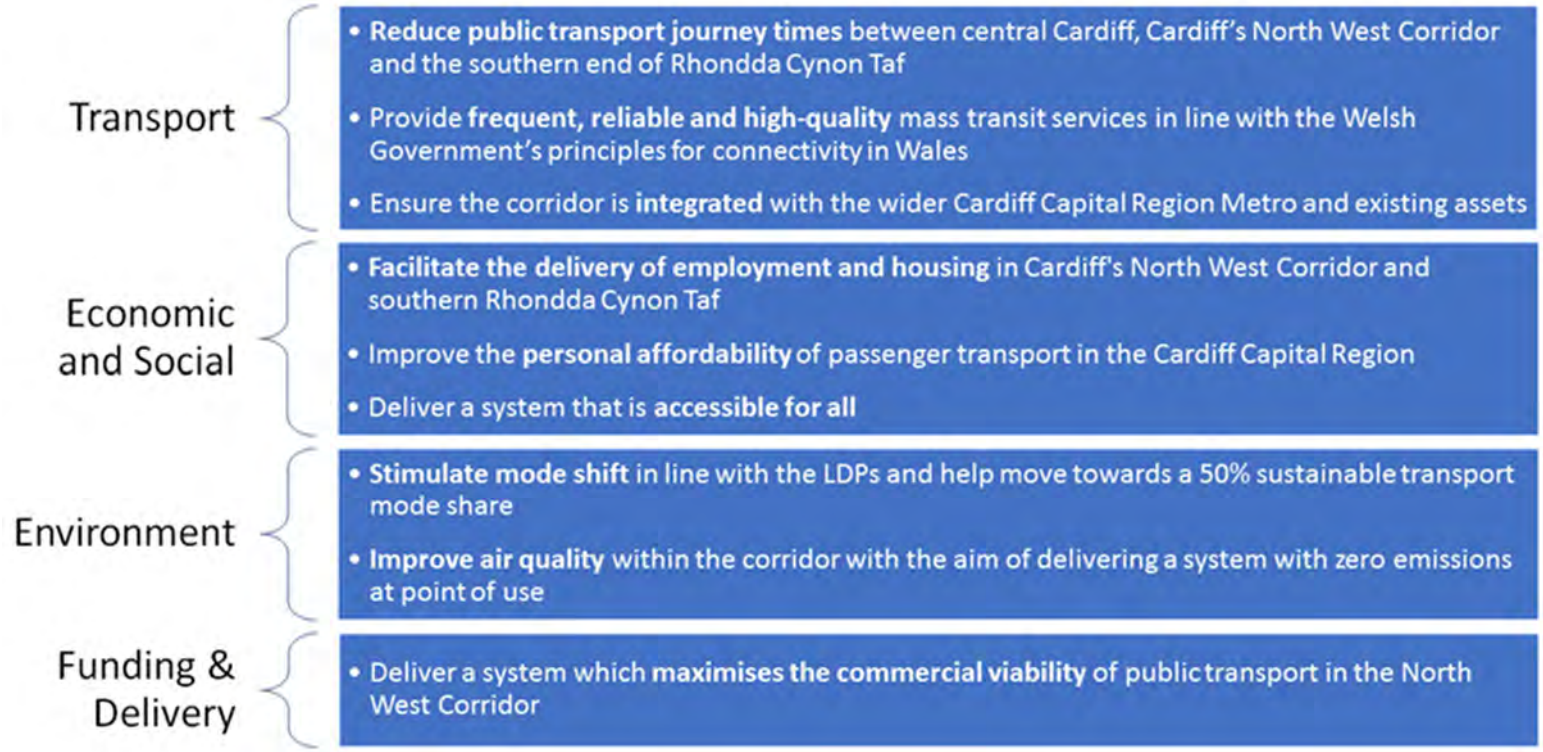
2.12 WelTAG Objectives

A set of WelTAG objectives have been identified which are intended to respond to the problems and opportunities of the Corridor. Draft objectives were presented to stakeholders for discussion and the final objectives were agreed by the WelTAG Review Group. The performance of options

has been assessed according to their ability to meet these objectives and the objectives will continue to guide the project as it progresses through the WelTAG stages towards delivery.

The agreed objectives are shown in Figure 2.16.

Figure 2.16: Agreed WelTAG Objectives



2.12.1 Alignment with Well-Being Goals

As noted, the Well-being of Future Generations (Wales) Act (2015) focuses on sustainability and encourages Wales to take into consideration the long-term economic, environmental, social and cultural impact of its decisions.

The Well-being Impact Evaluation Tool (WELLIE) is a toolkit developed by Mott Macdonald to assess the well-being impact of our projects and has been used to assess how the scheme will impact on well-being. One of the requirements of WELLIE is that the scheme objectives are mapped against the well-being goals to ensure that well-being is integrated throughout this process.

Table 2-4 maps the Scheme objectives against the Well-being Goals, showing that all Well-being Goals are addressed through the scheme objectives, and that all objectives directly contribute to at least one development goal. It also shows how the achievement of objectives can be measured and tracked.

Table 2-4: Scheme objective mapping against the Well-being Objectives

Scheme objectives	Measurement	A Prosperous Wales	A Resilient Wales	A Healthier Wales	A more Equal Wales	A Wales of cohesive communities	A Wales of vibrant/ thriving Welsh Language	A Globally Responsible Wales
1) Reduce public transport journey times between central Cardiff, Cardiff's North West Corridor and the southern end of Rhondda Cynon Taf	Change in passenger journey times between key destinations within the Corridor	✓	✓	✓	✓	✓		✓
2) Provide frequent, reliable and high quality mass transit services in line with the Welsh Government's principles for connectivity in Wales	Increasing the number of public transport services per hour from key destinations	✓	✓	✓	✓	✓		✓
3) Ensure the Corridor is integrated with the wider South Wales Metro and existing assets	Provision of additional interchange facilities between car, bus, rail and active travel transport modes	✓	✓	✓	✓	✓		✓
4) Facilitate the delivery of employment and housing in Cardiff's North West Corridor and southern Rhondda Cynon Taf	New housing delivered in the Corridor	✓			✓	✓		
5) Improve the personal affordability of passenger transport in the Cardiff Capital Region	Generalised cost of transport by public transport modes between key destinations	✓			✓	✓		
6) Deliver a system that is accessible for all	PTAL/ passenger numbers for those with accessibility impairments	✓		✓	✓	✓		
7) Stimulate mode shift in line with the LDPs and help move towards a 50% sustainable transport mode share	Commuter and peak time public transport mode shares trips from the North West Corridor	✓	✓	✓	✓	✓		✓
8) Improve air quality within the Corridor with the aim of delivering a system with zero emissions at point of use	Reduction in NOx emissions Monitoring air quality at AQMAs	✓	✓	✓	✓	✓		✓
9) Deliver a system which maximises the commercial viability of public transport in the North West Corridor	Impact of transport improvements on the public sector subsidy requirement	✓	✓					

2.13 Options Identification and Sifting Process

2.13.1 Process

An options identification and sifting process has been undertaken. Options have been sifted in two stages as illustrated in Figure 2.17.

Figure 2.17: Options Sifting Process

Source: Mott Macdonald

2.13.1.1 Options Identification

The initial list of options was identified following a review of previous proposals for transport improvements in the Corridor. The various studies and historical options, were supplemented by additional options and variants identified during this WelTAG Stage 1 study.

As noted, the focus of this WelTAG assessment is on mass transit solutions for the corridor and therefore options relate to public transport only. Highway improvement schemes for the purposes of increasing capacity for car travel have not been included. Specific interventions to improve active travel measures (walking and cycling) have not been included although it should be noted that new public transport corridors and interchanges provide opportunities to enhance active travel routes and facilities. Such opportunities would need to be considered during more detailed design stages for shortlisted options.

2.13.1.2 Sift 1

All options have undergone a high-level assessment as part of the initial sift ('Sift 1'). At this stage, options were assessed in respect of their technical and operational feasibility, as well as the degree to which they contribute to the objectives.

The technical and operational feasibility assessment has taken account of the following:

- Infrastructure feasibility;
- Operational feasibility;
- Land/highway take;
- Complexity and interdependencies; and
- Extendibility.

Options which were deemed in-feasible or which failed to meet the objectives were discarded at this stage.

2.13.1.3 Sift 2

The 'long list' of options which were progressed into 'Sift 2' were assessed to a higher level of detail and an assessment of their impact against a set of appraisal criteria has been undertaken. The contribution of the options to the well-being goals under the Well-being of Future Generations Act has also been considered.

2.13.2 Modes Assessed

Options for mass transit solutions have been grouped into the following categories:

- Options which relate to the improvement of the **existing rail network**;
- New **tram-train or light rail** route;
- New **BRT** route; and
- **Other** options (e.g. new transport interchanges between car, bus, rail and active travel modes).

The term Bus Rapid Transit' refers to a bus system that provides greater capacity, speed and reliability than a conventional bus route. It incorporates 'guided buses'[30] as well as conventional buses on segregated routes.

Heavy rail rolling stock was ruled out as an option for a new rail-based route. The reasons for this decision were as follows:

- Heavy rail requires fully segregated running, as well as grade-separated crossings (i.e. subways or bridges) which could be a significant disadvantage for a new route passing through residential areas. This is because the Office of Rail and Road (ORR) do not allow any new level crossings on the UK rail network. Heavy rail route would create a severance between communities;
- Heavy rail would limit the potential for extending the route at its northern extent, as well as to the south of Cardiff Central;
- Track alignment requirements in terms of radii through curves and gradients are more restrictive for heavy rail than for a tram-train or light rail systems;
- Heavy rail would require some sort of Multi Aspect Signalling (MAS) system with a more expensive infrastructure requirement; and
- Most pertinently, the Treherbert, Aberdare and Merthyr services on the CVL will be converted to tram-trains from December 2023 and therefore a heavy rail solution would use different rolling stock to that used on the City Line.

2.14 Sift 1 – Identification of the Long List Options

The Strategic Case summarises the outcomes of Sift 1 and identifies the resultant 'long list' of options. Sift 2 is summarised in the Transport Case.

[30] A guided busway is usually a dedicated, buses-only route with buses running on a purpose-built track. The bus is guided along the route so that steering is automatically controlled and, like a tram, the vehicle follows a set path. The bus driver controls the speed of the vehicle.

2.14.1 Existing Rail Network Options

Long list options to enhance the existing rail network are set out in Table 2-5. Rejected options are listed below the table together with a brief summary of the rationale for their exclusion.

Table 2-5: Long List Options: Existing Rail Network

Ref.	Option	Description
Rail 1	Service frequency enhancement: City Line	This line will be converted to tram-train operation as part of the CVL transformation although there are no plans to increase service frequencies beyond the current two trains per hour. This option would double service frequency to the Welsh Government's benchmark for metro services of four trains per hour.
Rail 2	New Station: St Fagans	A new station on the South Wales Main Line in the St Fagans area of Cardiff with options to provide a shuttle bus service to the National Museum of History. There are synergies with 'Rail 7' – increased service frequencies on the South Wales Main Line.
Rail 4	New Station: Ely Mill	A new station at 'The Mill' development site on the City Line between Ninian Park and Waun-gron Park. There are synergies with 'Rail 1' – more frequent services on the City Line.
Rail 7	Service frequency enhancement: South Wales Main Line	Increased service frequencies for local stations on the South Wales Main Line including Pontyclun. This will require an increase in the volume of rail services between Cardiff and Bridgend to provide the opportunity to achieve a better mix of fast and stopping services. Whilst it is feasible to increase frequencies, achieving the Welsh Government's benchmark of four trains per hour will be challenging, but a regular two train per hour timetable is achievable.
Rail 8	New Station: Junction 34 Parkway (Miskin)	A new parkway style station at Junction 34 providing park and ride and bus:rail interchange, together with active travel. This is likely to require highway capacity improvements at Junction 34. There are synergies with Rail 7 – more frequent services on the South Wales Main Line.

2.14.1.1 Rejected Options

The following options were rejected following the initial sift:

- **Rail 3: New Station: Morganstown** – The case for an additional station on the Merthyr Line (with its attendant timetable impacts) is unlikely to be strong given the relatively small local catchment area and the proximity of stations to the north (Taffs Well) and south (Radyr).

2.14.2 New Tram-train and Light Rail Routes[31]

Long list options for new tram-train or light rail route are set out in Table 2-6.

All of the tram-train/light rail options included in the long list involve the construction of a new route on or adjacent to at least part of the route of the Safeguarded Corridor with a connection to the City Line.

A key constraint to achieving the new tram-train options is the capacity of Cardiff West Junction and Cardiff Central to accommodate additional rail services. The options set out in Table 2-6 are differentiated only in respect of the solutions proposed in the vicinity of Cardiff West Junction and Cardiff Central. Further details of these capacity issues and detailed consideration of potential solutions is provided in Section 3.4.

There are a number of variants relating to the location of the connection to the City Line and the route to Creigiau which are common to all of the options in Table 2-6 and these are described in further detail in Section 3.3. Conclusions drawn in respect of the choice between tram-train and light rail modes are also provided in Section 3.3.2.

Table 2-6: Long List Options: Tram-train / Light Rail Routes

Ref.	Option title	Description
Tram-train / Light Rail 1	City Line and Safeguarded Corridor connecting into existing platforms at Cardiff Central with no track modifications	A low-cost capacity solution would not involve any infrastructure modifications at Cardiff West Junction / Cardiff Central. Services would continue to operate into existing platforms.
Tram-train / Light Rail 2	City Line and Safeguarded Corridor connecting into existing platforms at Cardiff Central with track layout modifications at Cardiff West Junction	This solution would involve track modifications at Cardiff West Junction to reduce conflicts between City Line/North West Corridor and Barry/Penarth services at Cardiff West Junction. Services would use existing platforms at Cardiff Central albeit with changes to platforming arrangements
Tram-train / Light Rail 3	City Line and Safeguarded Corridor connecting into new platforms to the south of Cardiff Central	Under this approach, services would operate into new platforms located to the south of Cardiff Central thereby providing the potential for services to operate to Porth Teigr should this route also be progressed. Diverting City Line/North West Corridor services to the south of Cardiff Central may be achievable within the existing footprint of the approach to Cardiff Central or, alternatively, could be achieved by constructing a new section of track to the south of existing tracks and building a new Taff Crossing.

[31] An exercise has been undertaken to simplify the numbering system for these options and therefore the numbering may differ from that presented during stakeholder workshops.

Tram-train / Light Rail 6	City Line and Safeguarded Corridor via a new Taff Crossing and on-street section, potentially along Pendyris Street into new platforms to the south of Cardiff Central	The City Line/North West Corridor would divert from existing tracks at the Penarth Curve and follow a new on-street section of track, potentially via Pendyris Street. A new bridge would be constructed to the south of the existing Taff crossing. Services would operate into new platforms located to the south of Cardiff Central thereby providing the potential for services to operate to Porth Teigr should this route also be progressed.
Tram-train / Light Rail 9	City Line and Safeguarded Corridor via a new on-street route, potentially via Penarth Road and Sloper Road before connecting to City Line near Ninian Park	The City Line/North West Corridor would divert from existing tracks at Ninian Park Road and follow a new on-street section of track, potentially via Sloper Road and Penarth Road. Services would operate into new platforms located to the south of Cardiff Central thereby providing the potential for services to operate to Porth Teigr should this route also be progressed.
Tram-train / Light Rail 12	Creigiau to Pontyclun Station via Cross Inn	Extension from Creigiau to Cross Inn before crossing the A473 and heading west parallel with the A473. The route would potentially follow a disused rail line towards Pontyclun, terminating in a parallel platform at Pontyclun Station.
Tram-train / Light Rail 13	Creigiau to Beddau Strategic Site via Cross Inn	Extension from Creigiau to Cross Inn before crossing the A473 and heading north-east parallel with the A473. The route would potentially follow a disused rail line which extends north, bisecting Beddau and Llantwit Fardre, providing a direct connection to the Strategic Site at Beddau
Tram-train / Light Rail 14	Creigiau to Cross Inn Only	Extension from Creigiau, potentially via the disused railway to a new Terminus in Cross Inn.

2.14.2.1 Rejected Options

The following options were rejected following the initial sift:

- **Tram-train / Light Rail 4: Safeguarded Corridor via the Merthyr Line** – Capacity constraints for additional services operating through Cardiff Queen Street and Cardiff Central are likely to be prohibitive. Moreover, a connection to the Safeguarded Corridor Line via the City Line is likely to be significantly less problematic than a connection via the Cardiff and Merthyr Line;
- **Tram-train / Light Rail 5: City Line and Safeguarded Corridor via South Wales Main Line** – Using the South Wales Main Line would reduce capacity on an already constrained section of railway and would limit the ability to extend tram-train vehicles beyond Cardiff Central;
- **Tram-train / Light Rail 7: City Line and Safeguarded Corridor via new Taff Crossing and on-street section via Tudor Street (with options to connect to City Line at Ninian**

Park or Waun-gron Park) – There are multiple constraints to the achievement of an on-street section of track in a dense urban environment. This would require significant new infrastructure running parallel to the existing railway. Operating services into a new terminus at Wood Street likely to be problematic on event days;

- **Tram-train / Light Rail 8**: **City Line and Safeguarded Corridor via new on-street route, potentially via Penarth Road, connecting to Barry/Penarth Lines near Grangetown before connecting to City Line (with alternative options for connection at Grangetown)** – This involves an on-street section of track in a dense urban environment, requiring significant new infrastructure running parallel to the existing railway and highly complex connections to Barry/Penarth Lines;
- **Tram-train / Light Rail 10: Entirely on-street route connecting directly to the Safeguarded Corridor potentially at Waterhall (various routes)** – Provision of an on-street route of this length would be highly challenging to achieve and would likely render this option unaffordable. Options using the City Line are therefore preferred;
- **Tram-train / Light Rail 11: Options connecting to the city centre via Castle Street** – As for option 10, provision of an on-street route of this length would be highly challenging to achieve and would likely render this option unaffordable; and
- **Tram-train / Light Rail 15: Creigiau to Efail Isaf** – Although feasible, this route fails to connect with large population centres and has limited options for extensions further north and therefore fails to sufficiently meet the objectives.

2.14.3 Bus Rapid Transit (BRT) Routes

Long list options for new BRT routes are set out in Table 2-7.

Table 2-7: Long List Options: Bus Rapid Transit Routes

Ref.	Option	Description
BRT1	New BRT Route: Central Cardiff to Junction 33 via Leckwith Road and A4232	This option uses the A4232 to connect a new strategic park and ride site at Junction 33 with Cardiff city centre. This route is via Wood Street, Ninian Park Road and Leckwith Road before joining the A4232 at the Leckwith Interchange.
BRT1A	New BRT Route: A4232 (northbound and southbound) Bus Gate and Spur to Plasdwr	This option is a permutation of the BRT1. This option would utilise the same route as BRT1 between Cardiff city centre and the A4232. A bus gate and slip road from the A4232 would provide a segregated bus connection into the Plasdwr development from the west. New bus-only slip roads would need to be provided from both the northbound and southbound carriageways of the A4232 connecting onto a new bus-way extending towards Pentrebane and Plasdwr.
BRT4	New BRT Route: Central Cardiff to Plasdwr via Cowbridge Road East, Waun-gron Park, Fairwater	This option provides a new BRT route between Plasdwr and Cardiff city centre. option provides a new BRT route between Plasdwr and Cardiff city centre. It follows a route via Westgate Street, the A4161 (Cowbridge Road East), the A48, St Fagans Road and Plasmawr Road before connecting into Plasdwr's internal road network.

		A minor variant to this route would be to use Lansdowne Road instead of Cowbridge Road East. Two variants of this option have been identified: • An option using Waterhall Road, before potentially joining the disused rail route towards Junction 33 of the M4 and Creigiau; and • An option that penetrates the Plasdwr development further south at Pentrebane Road.
BRT8	New BRT Route: Junction 33 to Talbot Green via A4119	Extension of BRT north of Junction 33, through new development, along existing A4119 corridor towards Talbot Green Centre.

2.14.3.1 Rejected Options

The following options were rejected following the initial sift:

- **BRT2: A4232 via A48 Cowbridge Road West** – This would involve extensive highway reconfiguration including Cowbridge Road West and may not achieve good journey time reliability (e.g. congestion at Culverhouse Cross);
- **BRT3 Central Cardiff to Junction 33 via Cardiff Bay and A4232** – This route has relatively poor journey times as a result of the route through Cardiff Bay;
- **BRT5 Central Cardiff to Plasdwr via Llandaff Fields, Llantrisant Road** – This option would achieve a good journey time but the route through Llandaff Fields, Pontcanna and to the immediate east of Llandaff meadows would meet significant public resistance. In addition, there are environmental designations and land covenants that restrict potential use;
- **BRT6 City Line and Safeguarded Corridor** – This option would achieve a good journey time but would involve the loss of the existing railway route along the City Line and would preclude potential expansion of rail-based services;
- **BRT7 Central Cardiff to Plasdwr via Llandaff village** – Whilst providing a direct route which has had some recent bus priority improvements, this option would offer poor journey time reliability particularly around the congestion pinch point of Llandaff where segregated measures would be difficult to achieve;
- **BRT14 Radyr Station to Plasdwr** – This option would require a change of services at Radyr Station (which will involve a journey time delay) and achieving segregation along Heol Isaf and Kings Road in Radyr would be difficult to achieve;
- **BRT8A: Junction 33 to Talbot Green via M4** – This option would not serve the strategic site north of Junction 33 and may not improve journey time reliability due to congestion at Junction 33 and Junction 34 of the M4 unless a significant level of segregation is in place;
- **BRT9: Plasdwr to Talbot Green via A4119** – Whilst providing a direct link between Plasdwr and the Strategic Sites north of Junction 33 and south of Llantrisant, this option is likely to have longer journey times as compared with a route via the A4232;
- **BRT10 to BRT 13: Junction 33 or Plasdwr to Talbot Green or Beddau via A4119 or Creigiau** – These options were rejected on the basis that overall end to end journey times to/from Talbot Green or Beddau are unlikely to be competitive compared to other routes or modes. For example, a bus-based option from Beddau may be faster if routed through the A470 as opposed to along the North West Corridor; and

- **BRT 14 Radyr Station to Plasdwr** – This route would operate between the station and Plasdwr via Kings Road and Heol Isaf. It would complement the development of a bus:rail and active travel interchange at Radyr Station (Rail 6). However, the proximity of residential properties means that significant segregation could not be achieved and therefore the provision of a BRT route has been rejected.

2.14.4 Other Options

A range of other options included in the long list are set out in Table 2-8.

Table 2-8: Long List Options: Other

Ref.	Option	Description
P&R 1	Junction 33 Strategic Bus Park and Ride	A new strategic bus-based park and ride located at Strategic Site D with direct access to Junction 33.
Rail 5	Waun-gron Park Bus:Rail and Active Travel Interchange	Facilities for a bus:rail and active travel interchange on the former refuse site at Waun-gron park station providing potential interchange between City Line and bus services from the north west and east-west services via the A48 and Cowbridge Road.
Rail 6	Radyr Station Bus:Rail and Active Travel Interchange	A bus:rail and active travel interchange facility at Radyr Station and provision of bus services to connect residential areas of Radyr and Plasdwr to the City Line.

2.14.4.1 Rejected Options

The following two options were considered but discarded:

- **P&R 2: Pontyclun station park and ride expansion** – The car park has already undergone expansion and space for further expansion is limited. The location of this station is unsuited to a strategic park and ride; and
- **P&R 3: Junction 34 bus park and ride** – For the purposes of the North West Corridor, a bus-based park and ride at Junction 33 (P&R 1) is likely to be more effective and providing a connection into the junction at Junction 33 is much less challenging than at Junction 34. A rail-based park and ride (Rail 8) at Junction 34 is preferred.

2.14.5 Complementary Measures – East-West Connections

Although not included in the 'long list' of options, two further options have been identified which improve east-west connectivity to/from the Corridor. These options do not align closely with the objectives of the North West Corridor which are focussed on improving journey times within the Corridor itself and between the North West Corridor and central Cardiff. As such, these options are outside the scope of this study and have not been developed in any detail. Nevertheless, it is recognised that these options need to be considered as potential elements of the transport network and may merit further consideration outside of this study. These are:

- **Cardiff Circle Line** – This scheme would provide a connection between the Coryton and Merthyr Lines north of Radyr. The objective of a circle line would be to provide new ways of connecting between suburban areas of Cardiff. New stations on this route at Velindre and

Junction 32 (park and ride) have been proposed[32]. Under this option, services could operate a circular route via the Coryton Lines and City Lines.

In later stages of the WelTAG process, the operational solution for the City Line and North West Corridor would need to take account of plans or aspirations for the Circle Line and any implications it has for service frequencies through Cardiff West Junction.

It may also be feasible to connect the Circle Line with a new North West Corridor route via the Safeguarded Corridor. As described in Section 3.4.4 of this report, one option for a new tram-train or light rail route would be to connect to the City Line to the north of Danescourt. If this route is preferred, consideration could be given to the provision of a delta junction connection onto the City Line which would allow trains using the North West Corridor to travel north on the City Line to Radyr and onward via the Circle Line.

It should be noted that this variant of the Circle Line is very much exploratory at this stage and there are substantial engineering and environmental constraints that would need to be investigated. No detailed consideration has been given to these options as part of this study, although the option to connect into the City Line north of Danescourt has been retained and therefore further consideration could be given to the 'delta junction' during WelTAG Stage 2.

Whilst the Circle Line concept merits further consideration, it performs a different transport function to the options identified for the North West Corridor and therefore a separate WelTAG study would be required to establish its feasibility, costs and benefits; and

- **East-West Cardiff Bus Priority Corridor** – The bus options considered in this assessment are focussed primarily on providing connections within the North West Corridor itself, as well as providing for journeys to and from central Cardiff. Nevertheless, the importance of east-west connectivity was highlighted during the stakeholder workshops. Of particular importance is providing onward connections to east-west services. In this respect, improvements to bus services on east-west routes via the A48 – aligned to a possible interchange at Waun-gron Park – could be an important complementary measure. Detailed consideration of this option is outside the scope of the North West Corridor study.

2.15 Long List Options

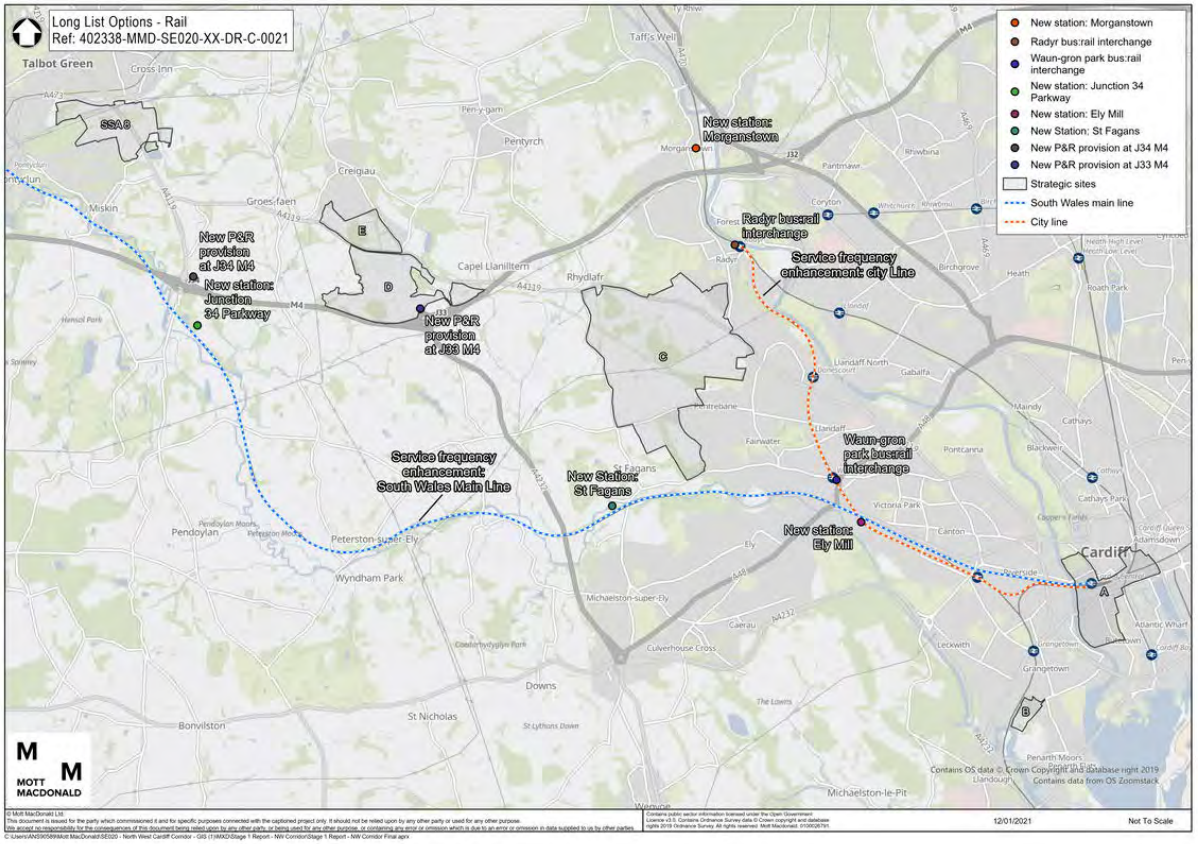
To summarise, the long list options are listed below and shown in Figure 2.18, Figure 2.19 and Figure 2.20. Full route maps are also provided in appendix B.

- Existing Rail Network Enhancements:
  - Rail 1: Service frequency enhancement: City Line;
  - Rail 2: New Station: St Fagans;
  - Rail 4: New Station: Ely Mill;
  - Rail 7: Service frequency enhancement: South Wales Main Line; and
  - Rail 8: New Station: Junction 34 Parkway (Miskin).
- New tram-train / light rail Routes:
  - Tram-train / Light Rail 1: City Line and Safeguarded Corridor connecting into existing platforms at Cardiff Central with no infrastructure modifications;
  - Tram-train / Light Rail 2: City Line and Safeguarded Corridor connecting into existing platforms at Cardiff Central with track layout modifications at Cardiff West Junction;

[32] Cardiff' Transport White Paper: Transport Vision to 2030.

  - Tram-train / Light Rail 3: City Line and Safeguarded Corridor connecting into new platforms to the south of Cardiff Central;
  - Tram-train / Light Rail 6: City Line and Safeguarded Corridor via a new Taff Crossing and on-street section, potentially along Pendyris Street into new platforms to the south of Cardiff Central;
  - Tram-train / Light Rail 9: City Line and Safeguarded Corridor via new on-street route, potentially via Penarth Road and Sloper Road before connecting to City Line near Ninian Park;
  - Tram-train / Light Rail 12: Extension from Creigiau to Pontyclun Station via Cross Inn;
  - Tram-train / Light Rail 13: Extension from Creigiau to Beddau via Cross Inn; and
  - Tram-train / Light Rail 14: Extension from Creigiau to Cross Inn Only.
- New BRT Routes:
  - BRT1: Central Cardiff to Junction 33 via Leckwith Road and A4232;
  - BRT1A: A4232 (Northbound and Southbound) Bus Gate and Spur to Plasdwr;
  - BRT4: Central Cardiff to Plasdwr via Cowbridge Road East, Waun-gron Park, Fairwater; and
  - BRT8: Junction 33 to Talbot Green via A4119.
- Other Options:
  - P&R 1: Junction 33 Strategic Bus Park and Ride;
  - Rail 5: Waun-gron Park Bus:Rail and Active Travel Interchange; and
  - Rail 6: Radyr Station Bus:Rail and Active Travel Interchange.

Figure 2.18: Long List Options - Existing Rail Network[33]



Source: Mott Macdonald

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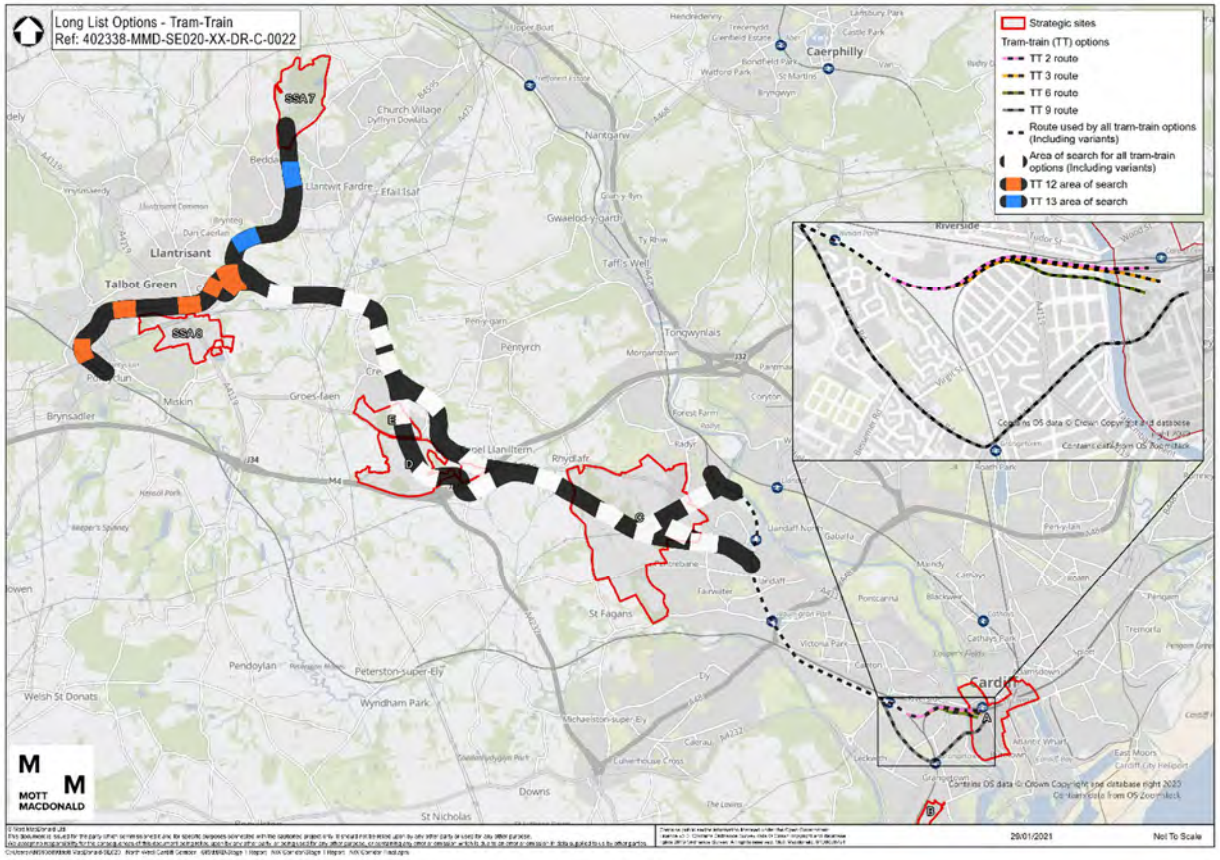
Figure 2.19: Long List Options - Tram-train / Light Rail Routes[34]



Source: Mott Macdonald

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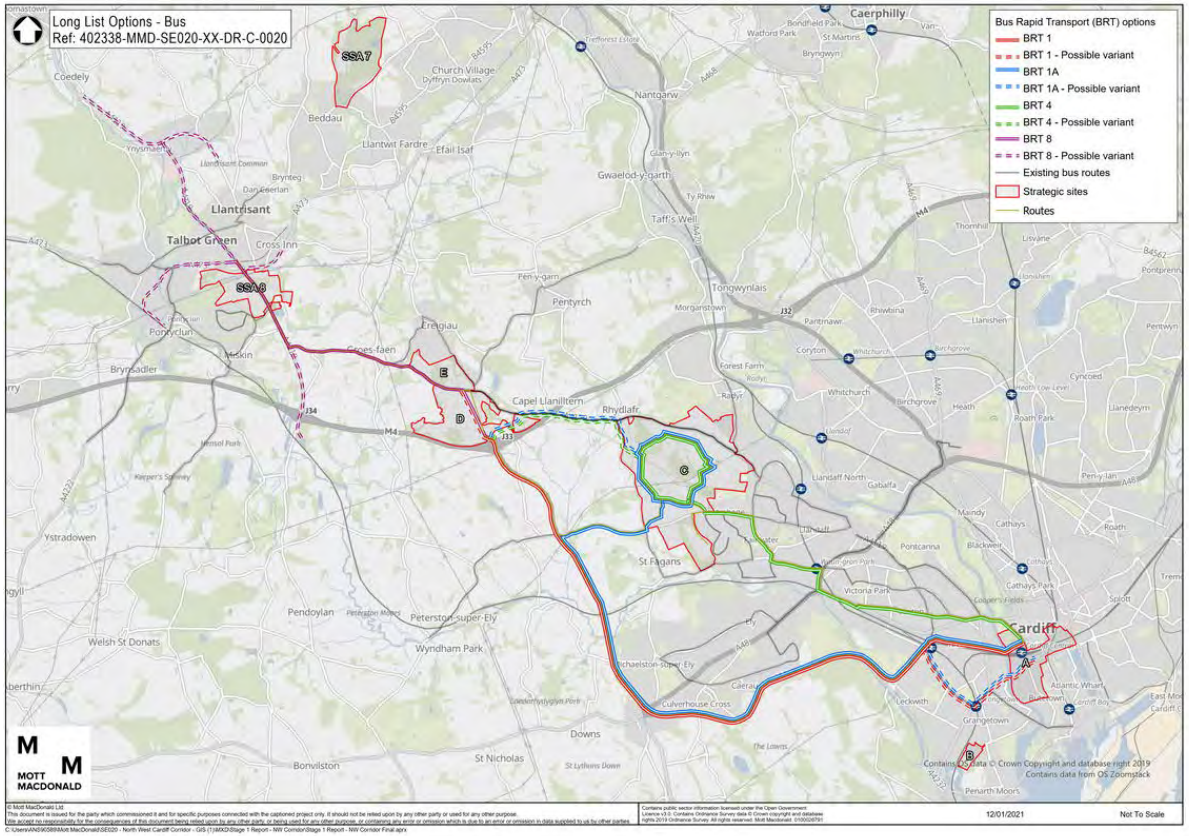
Figure 2.20: Long List Options - Bus Rapid Transit Routes[35]



Source: Mott Macdonald

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3 Further Option Development

As part of WelTAG Stage 1, further technical development of the public transport options has been undertaken. This has focussed on key operational considerations with respect to tram-train or light rail solutions, the feasibility of improving bus segregation and the role of the Safeguarded Corridor.

3.1 Introduction

This section provides further details of the technical development of the 'long list' of options during WelTAG Stage 1. Much of the effort at this stage has been focussed on issues related to a new tram-train or light rail route. This reflects the additional operational complexity of these options and the need for early consideration of operational and engineering constraints which are material to the feasibility and impact of these options.

3.2 Integration of Transport Modes

3.2.1 Integration of Bus and Rail Modes

A package of measures is required to address the transport issues in the North West Corridor and meet future capacity requirements. This will require investment in existing and new transport infrastructure across all public transport modes.

Both rail and bus-based solutions are required, and each mode plays a complementary role. Rail-based solutions provide a high quality of service and can minimise journey times between key population centres, whereas bus-based measures are more flexible and provide better penetration into residential areas of the Corridor.

There are opportunities to improve the existing rail network through additional services and new stations. However, much of the North West Corridor is not served by the rail network and therefore such interventions will fail to fully address the problems identified.

The development and assessment of options is organised across the different modes. However, the shortlisted options need to be viewed as an overall package of measures to address transport issues in the Corridor and, in practice, the assessment has taken account of how the various modes combine to provide a comprehensive public transport network for the Corridor.

A phased approach to the implementation of the package of works will see the bus and BRT measures realised first due to the short to medium term benefits, with the construction of the tram-train corridor being completed at a later stage to deliver the full benefits.

3.2.2 Active Travel

As noted, this study does not directly address walking and cycling options. However, delivering new rail or bus route will open up opportunities to provide parallel cycle and pedestrian routes whilst new stations and bus stops can provide better opportunities for people to use a combination of cycling/walking and public transport to make journeys rather than drive.

It is recommended that, at the next stage of development, any new bus or rail corridors are developed on the assumption that, provided space allows, parallel pedestrian/cycleways would also be provided.

Consideration should also be given to how these new routes connect with existing infrastructure. For instance, for the light rail/ tram-train options which route through the Plasdwr development, there is a clear opportunity to investigate how a pedestrian/cycleway could connect with and enhance Cardiff City Council's proposed 'Cycleway 4' (which routes from the City Centre to Llandaff, Danescourt and North West Strategic Development Site via Llandaf fields).

As well as providing opportunities for enhancing active travel, it also needs to be acknowledged that new transport routes can create new barriers to walking and cycling between different areas. The requirements for active travel crossings will need to be assessed as part of the next stage of design although (as illustrated in Figure 3.1) the technological solution for the corridor will affect the type and frequency of crossing that can be provided.

3.3 New Tram-train or Light Rail Routes

3.3.1 Option Development

Options for a new rail route to serve the North West Corridor have been explored in the past, including as part of the development of Cardiff's LDP, and these earlier reports relating to the Corridor have been reviewed in detail. Importantly, all previous assessments of options for a new rail-based solution pre-date the award of the new TfW rail franchise and confirmation of the technological solution for the South Wales Metro and, more specifically, the CVL transformation and the deployment of tram-train style vehicles.

In this context, consideration has been given to:

- The appropriate technological and operational solution for the North West Corridor including consideration of alternative operational solutions using the CVL tram-train technology, and renewed assessment of the relative merits of the CVL tram-trains against light and heavy rail solutions;
- Rail capacity constraints and potential engineering and operational solutions with a focus on the pinch points at Cardiff West Junction and Cardiff Central; and
- Engineering challenges associated with possible routes given the known capabilities of the CVL tram-train vehicles.

Engineering assessment has focused on the major capacity constraints and engineering challenges on the North West Corridor. These include the capacity of Cardiff Central Station and Cardiff West Junction; use of the City Line shared with CVL services; the location for the connection between the City Line and the Safeguarded Corridor; and the potential use of the disused rail lines.

3.3.2 Alternative rail modes

As well as the different routes, consideration has been given to the technical solution for a rail-based solution for the North West Corridor. Given the rejection of a heavy rail solution (as described in 2.13.2), the following three alternative rail modes have been considered:

- Unmodified CVL tram-train vehicles (high-floor) using Multi Aspect Signalling;
- Modified CVL tram-train vehicles (high-floor) using a combination of Multi Aspect Signalling and Line of Sight Operation; or
- Light Rail (low-floor) using Line of Sight Operation.

3.3.2.1 Signalling Options

Before considering the advantages and disadvantages of the alternative modes, it is necessary to set out some key principles of the main approaches to signalling and timetabling which are important differentiators between the modes.

Multi-Aspect Signalling (MAS)

On the City Line, South Wales Main Line and at the approach to Cardiff Central, the existing multi-aspect signalling system ensures a safe braking distance between trains as well as ensuring that points and crossings are set and locked in the correct position.

Conventional signalling systems divide the track into sections (often referred to as blocks) utilising either track circuits or axle counters to detect when trains are occupying blocks. It then informs drivers via colour-coded (multi-aspect) lineside signals if they can proceed into an unoccupied block. This is required for heavy rail operations, where the vehicles' lower acceleration and deceleration capabilities mean they require long distances to stop.

For these systems, the services are operated under a centrally held timetable in order to maximise the number of services, and to ensure they are able to run without disruption in normal circumstances.

Line of Sight Signalling

The majority of tram systems utilise line of sight signalling which is comparable to that used by road users. Like MAS, the driver relies on signals to follow permitted routes. However, unlike MAS, the signals are used purely to control junctions or areas of limited visibility and are operated directly by the vehicles (generally on a 'first come, first served' basis). In other words, there are only simple local interlockings, train detection and protection at junctions.

Elsewhere all responsibility is placed on the driver to ensure that the vehicle does not make an unsafe move. This means that line of sight railways run at significantly lower speeds than signalled ones, although within urban areas with frequent station stops and/or junctions, the differences in overall journey times between MAS and line of sight operations can be minimal. Line of sight systems operate under the supervision of a central control room and use a vehicle location system to drive passenger information and control room display systems. The trains do not generally operate under the control of a centrally held timetable.

3.3.2.2 Timetable vs Service Pattern Operations

As noted, heavy rail systems across the country tend to work to a set timetable, designed to ensure that the service can run without disruption. This is particularly the case where the line has services coming from different destinations, with different rolling stock types, different speeds and different station calls.

On the other hand, a line working to a service pattern will operate on the assumption that the services will call at a station at a specified interval from the previous one. Light Rail or Tram services tend to be operated in this way, as is the case for Manchester MetroLink. This benefits on-street running sections as the services can be controlled to keep the relevant gap between services, instead of having to be fixed to a specific minute in the hour which can become difficult to maintain where there are interactions with pedestrians, cyclists and cars.

Of relevance to the North West Corridor is a case where trains operate between line of sight and MAS sections of track. In this case, when services are delayed in the service pattern/line of sight section, it can have a negative impact once the service re-joins the timetabled section of

the track. In this case, the service will potentially join late (after it's allocated slot on the timetable) or it will be delayed at the junction giving priority to the on-time timetabled service (as is the case for the Sheffield network).

As noted, the CVL rolling stock vehicles that are being procured will operate on the Treherbert, Aberdare, Merthyr and City lines to Cardiff Queen Street, Cardiff Central and Cardiff Bay, will consist of Stadler CityLink tram-train vehicles. At the time of writing, the rolling stock being procured is being specified with heavy rail wheel profiles, and no on-street running communication equipment. However, the vehicle is specified for gradients of up to 6%, a minimum turning radius of approximately 25m, and has the performance characteristics (acceleration, deceleration etc.) to operate on a line of sight basis.

3.3.3 Assessment of Alternative Rail Modes

The advantages and disadvantages of the remaining mode options – unmodified CVL, modified CVL and light rail – are discussed in this section.

3.3.3.1 Unmodified CVL Tram-train vehicles and operation

The latest plans for the CVL operation and tram-train vehicles demonstrates the network will be operated more like a heavy rail network, operating under MAS on a set timetable on the Aberdare, Treherbert, Merthyr and City Lines (Figure 2.12). The exception to this is the Cardiff Bay line, where line of sight operation will be used.

Under this option, a new North West Corridor route would be operated by the CVL tram-train vehicles operating under MAS. Whilst additional vehicles would need to be procured to serve the new line, no modifications to in-cab equipment or wheel profile would be required and there would be no need for a 'sub-fleet' of vehicles for the North West Corridor.

Vehicles will be high-floor to serve the existing high-floor platforms at the almost 60 stations across the CVL with changes being proposed to ensure all platforms are at least 80m in length. These vehicles would still benefit from the performance of tram-train vehicles in terms of enhanced acceleration and deceleration, ability to turn through tight curves of 25m or 30m radius and navigate gradients of 6%. However, they are unable to operate on roads where they share the space with cars due to the lack of relevant equipment and wheel profile. Crossings on the new line potentially could be made as tramway crossings, with the appropriate line speeds and risk assessments. However, these could be considered as heavy rail level crossings by the Office of Rail and Road (ORR) which they no longer allow the introduction of on the UK rail network. Risk assessments would have to demonstrate the safety of these new crossings. In this scenario, there is a possibility that no new level crossings would be allowed resulting in all crossings being in the form of bridges or underpasses.

Key advantages:

- This is the lowest cost option;
- Uses the same vehicles as the rolling stock proposed for the Merthyr, Aberdare and Treherbert lines providing operational flexibility;
- Offers maintenance efficiencies as the additional vehicles could be maintained from the existing Taffs Well depot[36];
- No additional requirements for driver training other than route familiarity;

[36] We understand that sufficient capacity is built into the design for Taffs Well depot that means that additional vehicles required for the North West Corridor could be accommodated. It is likely, however, that a location for overnight stabling on the North West Corridor would be required.

- No requirement to order a newly specified vehicle from the manufacturer (Stadler);
- Existing rail infrastructure does not need to be modified to accommodate the new vehicles.
- Avoids the issues associated with a mixed operation – vehicles operating between timetabled and line of sight route sections; and
- Indications are that track gradients and curvature associated with the Safeguarded Corridor would be within the capability of the CVL tram-trains.

Key disadvantages:

- The route would need to be segregated from street traffic as the vehicle would not have the appropriate communication equipment for running on-street. Additionally, the wheel profile of the current vehicle specification is not compatible with on-street running;
- The need for segregation severely limits options for pedestrian and road crossings, creating severance similar to that of a heavy rail line; and
- The requirements for segregation limits the potential flexibility to deliver extensions at both the north and south ends of the line.

3.3.3.2 Modified CVL tram-train vehicles and operation

With modifications to the CVL tram-train vehicles they could be made capable of on-street running and operate in a similar manner to a traditional tram. The changes would relate to signalling equipment on board to allow for the vehicles to get priority at junctions with other road users and to be able to set the points on the track as required in on-street running sections.

This option would use the bi-mode tram-train (25kv and on- board batteries) in ‘Non-Mainline Light Rail mode’. The section of line shared with the CVL services would be operated under the existing MAS system, and the new sections of line could be operated under line of sight, allowing for lower infrastructure costs. The tram-train could switch from Mainline to Non-Mainline operation as it leaves the City Line in a similar manner to how the tram-train will operate along the Cardiff Bay line.

As noted, the CVL tram-train vehicles have been specified with a standard railway wheel (P8 profile) appropriate for use on Network Rail infrastructure but this profile is not appropriate for on-street running sections and a modified wheel profile would be required similar to the Sheffield tram-train Pilot project. The reason for not addressing this during Phase 2 of the South Wales Metro was to reduce risk associated with the ERDF funding and infrastructure changes that would have been required at all switches and crossings to fit what are known as ‘raised’ checkrails. If any future extension requires tram-train operation on-street and on Network Rail track, it will require alterations to both the tram-train and the infrastructure (CVL and Network Rail) to implement a “modified” wheel profile as is common in similar systems including Manchester Metrolink and Sheffield Supertram.

Items that may need to be updated on the current tram-train fleet include:

- Modified wheel profile;
- Addition of controls for on-street operation;
- Retro-fitting of 750V DC overhead “spot charging” for recharging on-street; and
- Provision for additional on-board battery packs to extend catenary free range.

The differences in character between ‘heavy rail’ and ‘light rail’ styles of operation are illustrated in Figure 3.1. The images on the right-hand side show a road and pedestrian crossing for a system operating under line of sight. Also shown is the requirement for fencing to segregate a

line operating under heavy rail rules as opposed to the softer landscaping that can be achieved by a light rail or tram-train line operating under line of sight.

In practice, it is likely that even with modified tram-train vehicles and operation, large parts of a new rail route would be segregated, without vehicle or pedestrian crossing points, in order to achieve a minimum level of safety, speed and reliability. New sections operating under MAS will continue to require segregated crossings. Nevertheless, this option would permit tramway crossings with normal road signals and safety infrastructure in place for pedestrians and cyclists. Therefore, bridges or underpasses would not be required at crossings on the line of sight sections.

Any on-street running sections would be powered from the batteries, as 25kV is not suitable for use in urban environments. Further analysis will be required to establish the range of the CVL vehicles under battery operation to establish the extent of on-street operation and/or un-electrified track sections that could be incorporated into the design of the new route.

Key advantages:

- The basic vehicle type would be the same as the rest of the CVL fleet and could be maintained from Taffs Well depot;
- Modified vehicles would allow for line of sight operation and on-street running, providing greater flexibility to penetrate into urban areas and to extend the line further north or south;
- At-grade tramway style crossings for pedestrians and cyclists reduce the severance issues created by the new line; and
- Reduced infrastructure costs associated with signalling required.

Key disadvantages:

- The additional costs of procuring modified vehicles including in-cab junction controls for on-street running and potentially larger batteries;
- Requires investment in training for both maintenance staff and drivers;
- Inefficiencies relating to running two separate fleets (spare units cannot be used interchangeable so spares would be required for each fleet);
- Will require modifications to parts of the track shared with the un-modified CityLink vehicles (City Lines, Cardiff Central and tracks up to the Taffs Well Depot); and
- Battery capacity and range may limit the extent of on-street running and/or non-electrified sections.

Figure 3.1: Heavy Rail Lines (on the left) and Tram-train Lines (on the right)

Source: Images from Mott MacDonald

3.3.3.3 Light Rail

This option involves a light rail system using an entirely separate fleet of vehicles to that planned for the CVL network. The light rail vehicles could operate on the same tracks as the CVL tram-trains on the existing City Line with the inclusion of raised checkrails. However, these vehicles would not normally be allowed to run on the mainline, and as such could require segregating services where they operate on parallel routes. This would likely include the City Line between the Leckwith Loop (where freight can access the City Line and head south) and Cardiff Central. Additionally, the vehicles would have to be maintained in a new maintenance facility as well as requiring additional stabling.

New Light Rail rolling stock would be able to match or better a tram-train turning radius, gradients and similar acceleration and deceleration curves, whilst providing the opportunity to be designed to run on-street. This would provide greater flexibility to consider routes that penetrate urban areas. It would also provide greater flexibility in respect of extensions to the line.

The long list options for the North West Corridor all involve use of the City Line which therefore means that North West Corridor services will share track with CVL services via the City Line. Therefore, whilst this option has been specified as operating under ‘line of sight’ signalling, in practice it will be necessary for the services to operate to a timetable under MAS on the shared section of the City Line.

A new light rail solution could utilise low floor vehicles which would be better suited for urban environments, eliminating the requirements for ramps to be constructed to allow access to high platforms and ensure step-free access to vehicles. However, in this case, the requirement to share part of the City Line with CVL services is a significant barrier to the implementation of low-floor vehicles given that the City Line stations would continue to require high-floor platforms. A possible solution could be the use of a vehicle which combines both low-floor and high-floor exits or incorporating both low and high platforms at each of the stations on the shared section.

Key advantages:

- Enhanced capability in respect of track gradients and curvature which could provide flexibility in considering alternative routes (e.g. through Plasdwr); and
- The new line could be developed to use low-floor vehicles better suited to new stations in urban environments.

Key disadvantages:

- Light rail vehicles would need to be fully segregated from heavy rail tracks on the City Line between the Leckwith Loop and Cardiff Central, determining that a high cost infrastructure solution will be required to achieve this;
- In practice, the ability to fully achieve the benefits of a light rail style of operation (service pattern operation with line of sight signalling and low-floor vehicles) is constrained by the need to share the City Line with CVL tram-trains operating to a timetable;
- A light rail solution would be a wholly new system and would increase costs and may be a relatively small fleet of vehicles. In addition, these will require a new maintenance depot, stabling and a dedicated driver workforce; and

- This option introduces additional operational and commercial complexity to the rail network in south east Wales.

3.3.4 Overall Conclusion

Given the capabilities of the tram-train vehicles planned for operation on the CVL, the case for a bespoke light rail solution would appear to be weak. The indications are that the CVL tram-train vehicles can navigate the gradients and track curvature required to deliver a new North West Corridor rail route. Furthermore, modifications to the CVL tram-train technology could facilitate a tram style operation with improved opportunities for road and pedestrian crossings. The primary advantage of a light rail system over a modified CVL tram-train solution would be the ability to tailor the vehicle specification to the specific requirements of the North West Corridor. Although it should be noted that this flexibility is constrained by the need to operate alongside CVL tram-trains on the shared section of the City Line. This advantage is unlikely to justify the additional costs and complexities associated with procuring a wholly new system.

Whilst the conclusion of this assessment is that a new rail route should be integrated with the CVL operation, there are important differences between a ‘modified’ and ‘un-modified’ version of the CVL tram-train vehicle, as outlined above, and these should be considered further in WelTAG Stage 2.

3.4 Rail Capacity Considerations and Potential Measures

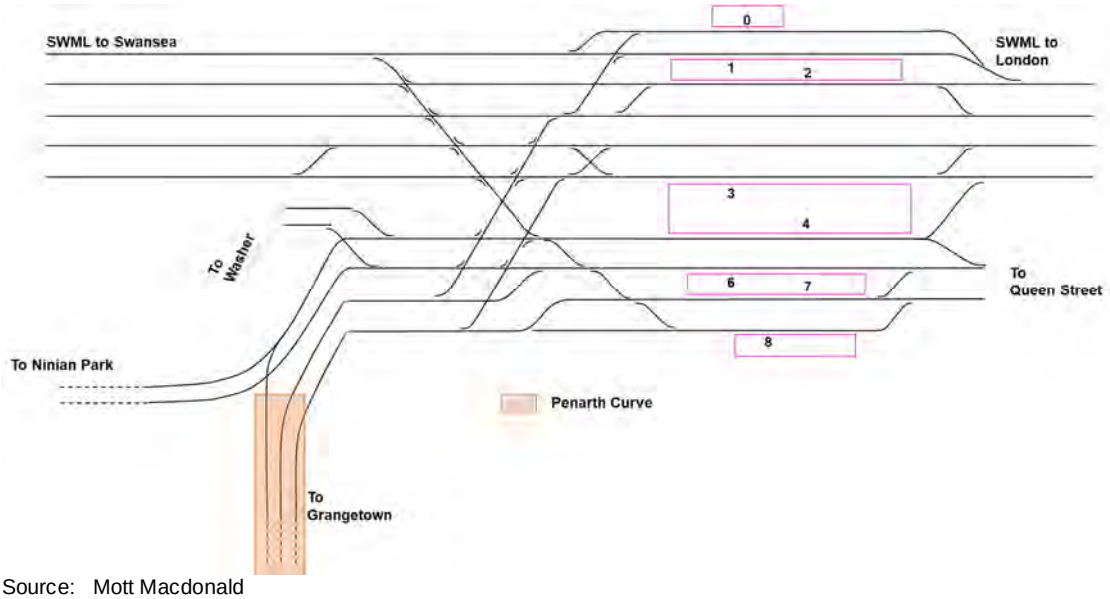
This section describes the capacity issues resulting from an increased service frequency on the City Line / North West Corridor. It goes on to propose a number of possible solutions which have then informed the development of the tram-train options. A separate, targeted study of rail capacity solutions is being undertaken by Mott MacDonald and will be available to inform the development of rail options at WelTAG Stage 2.

3.4.1 Existing Layout and Services

The layout of Cardiff Central and lines to the west is illustrated in Figure 3.2. At present City Line trains, and services using the Barry and Penarth lines, use the four most southerly tracks approaching Cardiff Central from the West. Of these four lines, the City Line services use the two tracks to the north and Barry/Penarth services use the two tracks to the south. Services from both the City and Barry/Penarth lines operate in and out of platforms 6, 7 and 8 at Cardiff Central.

At the Penarth curve, there is an additional section of single track (up Barry Relief line) which allows services to connect from the northern platforms at Cardiff Central (platforms 0, 1, and 2) to the Barry/Penarth lines. This is used by GWR services which use the Vale of Glamorgan line during periods of engineering works on the South Wales Main Line.

Figure 3.2: Cardiff West Junction Layout



Source: Mott Macdonald

Currently, at peak times, there are two services per hour in each direction on the City Line and a total of eight services per hour to Barry and Penarth from the Coryton and Rhymney Lines. Additionally, the timetable allows for one freight movement per hour through Cardiff Central. This gives a total of 10 passenger services and one freight train per hour.

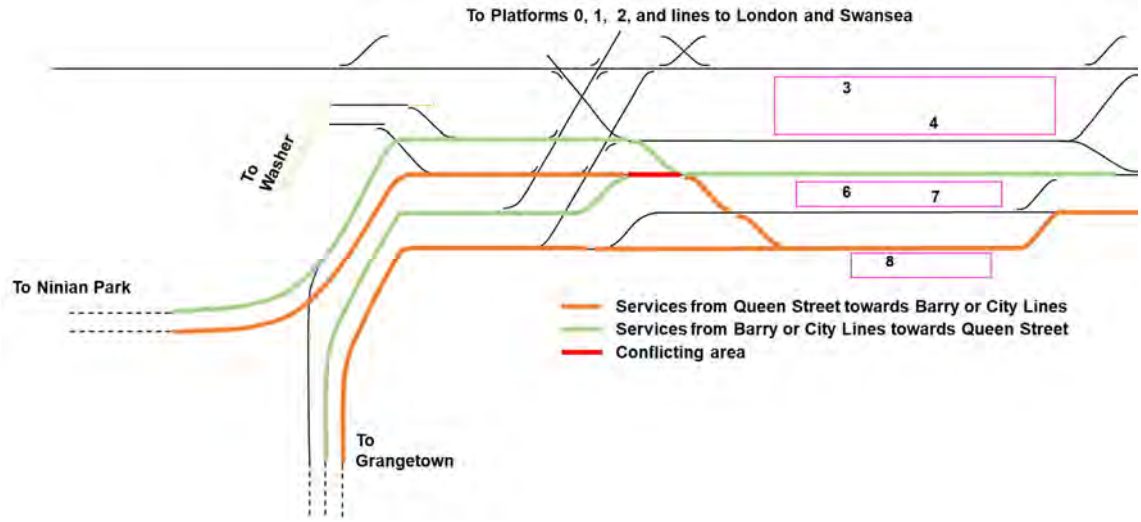
3.4.2 Capacity Constraints

Currently City Line and Barry/Penarth services use platforms 6, 7 and 8, this means that services need to cross over at least one other line to either leave or enter Cardiff Central. Analysis of the junction also indicates that (other than a service departing platform 8, whilst a

second service arrives into platform 6) most other moves conflict or require occupation of a short section of critical single line track. This pinch point is indicated in red in Figure 3.3. Conflicting moves at this section forms the primary constraint on capacity for Barry/Penarth and City Line services, although this needs to be considered alongside constraints on platform capacity at Cardiff Central.

Based on current routing of trains and junction margins, initial analysis suggests that there is capacity for only 10 trains per hour in each direction through the junction (20 movements in total). Based on current service levels, this leaves no paths available through the junction according to the timetable planning rules, and in some hours the junction is currently running at over 100% capacity. However, in practice, the signalling system has lower headway values and a greater level of capacity, enabling more services to operate than the planning rules would suggest is possible. It should be noted that running more services than suggested by the timetable planning rules places a serious risk to network performance and may constrain recovery during times of disruption. Therefore, this is generally avoided.

Figure 3.3: Current Pathing of Services



Source: Mott Macdonald

By December 2023, following transformation of the CVL to tram-train operation, services on the City Line will be operated using Stadler Citylink Metro Vehicles. Services using the Barry Lines to Barry, Penarth and Bridgend will be operated using new Stadler Flirt Tri-mode multiple units. Under the operator's plans, Barry and Penarth services will connect to the Rhymney and Coryton Line services. From December 2023, TfW Rail Services plans indicate that two trains per hour from Pontypridd will divert via the City Line from Radyr to Cardiff Central where the services would turnback (as per the TfW Rail Services Timetable).

The overall volume of CVL services (10 passenger services) will be unchanged. However, TfW has stated its intention to increase service frequencies on the Vale of Glamorgan Line between Bridgend and Cardiff from one to two trains per hour which would therefore result in a requirement to accommodate 11 passenger services.

On the City Line itself (between Ninian Park Junction and Radyr Junction), based on current timetable planning rules (with a 7 minute planning headway), there is capacity for six trains per hour (75% utilisation), potentially increasing to seven trains per hour (88% utilisation) if services are operated at a high level of utilisation. This provides sufficient capacity to operate four trains

per hour on the North West Corridor in addition to two or four services on the City Line. With current signalling, operating in excess of 6 trains per hour may represent a significant performance risk, especially when considering the potential conflicts at Cardiff West Junction. However, this constraint could be overcome with modification of signalling infrastructure on this line should there be a case for increasing frequencies further.

Because of this, the focus of the capacity analysis is on Cardiff West Junction and Cardiff Central. However, capacity constraints on the City Line, including identifying the number of services which would terminate at Radyr and those which would go on to the North West Corridor, would also need consideration.

3.4.3 Potential Solutions

3.4.3.1 Approach

Initial consideration has been given to possible approaches to reducing the capacity constraint at Cardiff West Junction. These are based on high level analysis and a detailed assessment would need to be undertaken before the feasibility, cost and impact of each can be fully assessed and verified. The options would need to be considered in the context of other plans and aspirations for service enhancements on all lines in the medium and longer term and not limited to options for the City Line and the North West Corridor.

In line with the Welsh Government's Principles for Connectivity, the assessment of potential solutions has been undertaken on the basis that a four train per hour service may ultimately be required on the North West Corridor. Should a new tram-train route tie into the existing City Line between Fairwater and Danescourt, achieving at least four trains per hour for all stations would require a total of eight trains per hour via the City Line / North West Corridor. If the new line were to tie into the City Line north of Danescourt (as per the variant described later in this section of the report) then the four train per hour ambition could be achieved with a total of six trains per hour via the City Line/North West Corridor (assuming the requirement to route services from Merthyr/Aberdare/Treherbert via the City Line remains). These services would need to be accommodated alongside eight or nine passenger services on the Barry and Penarth Lines, and a single freight path per hour.

There is precedence for new lines being delivered with lower frequencies of service (for example the Ebbw Vale Line and Vale of Glamorgan Lines were opened with one train per hour). It is acknowledged that a lower frequency of service of two trains per hour may provide sufficient capacity, particularly if services are operated by 2x40metre vehicles as would be possible following the CVL transformation.

A lower frequency of service may be made possible if the line is delivered in a phased manner given that the short-term capacity requirement would be reduced until such time that the line is extended.

The following solutions have been prepared with reference to both short and long-term capacity requirements at Cardiff West Junction and Cardiff Central.

Furthermore, the solutions identified also take account of the proposals set out in Cardiff City Council's Transport White Paper (see section 2.4.1.3) for a 'Crossrail' line that would connect the North West Corridor via a proposed new route between Cardiff Central and Cardiff Bay, and potentially on to East Cardiff.

3.4.3.2 Solutions

In relation to this study four possible ways of resolving the capacity constraint at Cardiff West Junction have been considered and are reflected in the tram-train options included in the long list set out in section 2.14 and shown in Figure 3.5 and appendix B.

1. **No Infrastructure Modifications (Tram-train 1)**

The theoretical capacity of the junction is determined by the junction margins. At present, a 3-minute gap is required between passenger services. Freight train occupation of the junction is likely to be 3.5 minutes. A low-cost solution involves changing the timetable planning rules to give a revised junction margin of 2.5 minutes. This would be aided by the fact that services will be operated by newer and better performing trains and tram-trains. The revised junction margin may be justifiable on the grounds that a transit speed of 30mph could be assumed for passenger services in the future. Additionally, this would require a review of the Cardiff West infrastructure and connecting lines to ascertain its suitability for upgrade to 30mph. This would give a theoretical junction capacity of 24 trains per hour at 100% utilisation and would enable (subject to running at high levels of utilisation) the ability to run an extra two services per hour per direction.

An initial assessment suggests that platform capacity at Cardiff Central would be available to operate two additional services. In any case, the option may exist for services to/from Treherbert/Aberdare/Merthyr, that would otherwise terminate in the platforms at Cardiff Central, to be extended along the City Line and on to the North West Corridor. Thus, an increase in service frequency on the City Line could be achieved without an increase in platform occupation.

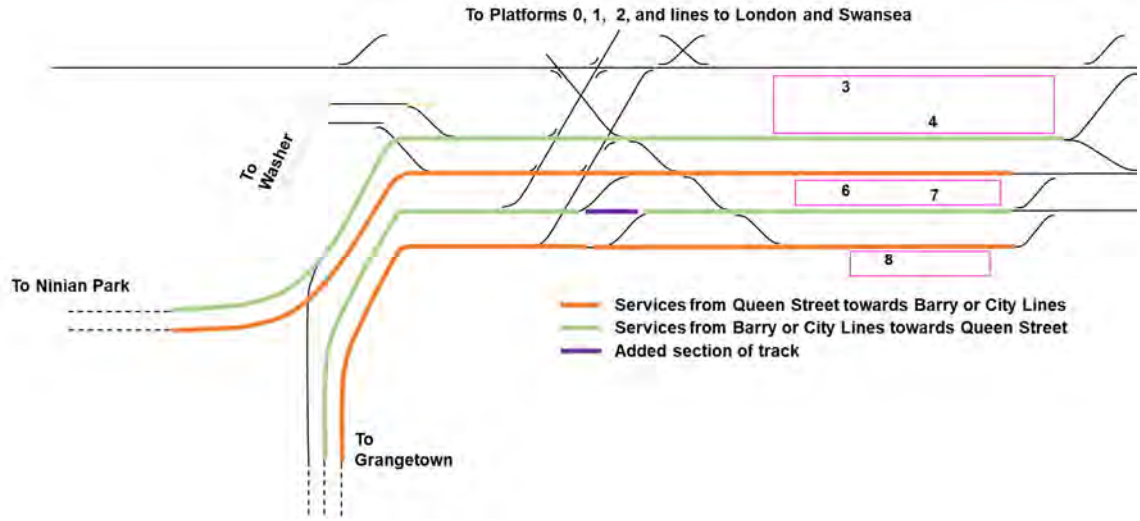
It should be noted that this solution (changing timetable planning rules) does not involve any physical changes to the junction. The actual practical capacity of the junction would be unchanged and therefore an adverse impact on the reliability of services would be expected. TfW would need to be satisfied that the benefits of increased frequency outweigh any negative impacts on reliability and the operator may need to be protected in this respect. This change would require the agreement of Network Rail who would need to evaluate the proposals.

In conclusion, notwithstanding the issues discussed, this option merits further analysis as a means of increasing service frequencies on the City Line in the short term in the absence or in advance of a new North West Corridor. It offers the potential to operate two additional services without incurring capital costs. However, this option is unlikely to be attractive for the purposes of the North West Corridor given that it would restrict service frequencies to two trains per hour on this route (assuming no increase in frequency on the City Line) and because the reliability of services may be less than that expected of a new service. These disadvantages are reflected in the scoring of this option set out in the Transport Case.

2. **Connecting into existing platforms at Cardiff Central with track layout modifications at Cardiff West Junction (Tram-train 2)**

A more invasive option involves altering the track layout at Cardiff West Junction. As noted, the primary capacity constraint at Cardiff West is created by the section of track shared by Barry/Penarth and City Line services (see Figure 3.3). By adding the ‘missing’ track connection between the inbound and outbound Barry lines (as show in Figure 3.4), service flows can be properly segregated, and deliver a significant increase in capacity without requiring a change in timetable planning rules. This option would also enable better use of platforms at Cardiff Central with Barry/Penarth services using platforms 7 and 8, and City Line services using platforms 4 and 6. The route of this option is illustrated in Figure 3.5 and appendix B.

Figure 3.4: Service Pathing with Additional Track Section



Source: Mott Macdonald

The infrastructure works required would include slewing of a short existing section of track and installation of a short section of track. Signal interlocking changes at either side of the new connection would be required. High level desk-based assessment suggests large-scale track realignment would not be required. Whilst this remains a significant intervention, the costs are likely to be modest in the context of a new North West Corridor.

The track modifications would improve junction capacity at Cardiff West and permit a significant increase in services through the ability to segregate by line and direction, as well as resulting in a more optimal use of platform capacity at Cardiff Central.

Subject to detailed timetable modelling, it is considered that this option would facilitate an increase of at least four trains per hour. In the context of the North West Corridor, the increase in capacity could facilitate a service pattern of two trains per hour on the City Line to Radyr (as today) and four trains per hour on the North West Corridor. Further work is required to establish the feasibility of increasing service frequencies beyond this.

As for option 1, platform capacity issues could be eased by linking more City Line / North West Corridor services with CVL services via the Merthyr Line that would otherwise terminate in Cardiff Central. It should be noted that any additional services running to Cardiff Queen Street will require a further operational assessment to understand the available capacity east of Cardiff Central.

Depending on the cost, even at lower frequencies (i.e. four trains per hour on the City Line), this option may be preferred to option 1 (no infrastructure modifications) given that it would enable an increase in service frequency without adversely affecting reliability.

Crucially, this option would result in the Barry / Penarth services using the two most southerly tracks into platforms 7 and 8 and City Line / North West Corridor services using the two tracks to the north into platforms 4 and 6. As a result, this option would rule out any direct connection between the City Line / North West Corridor and a new line to Porth Teigr (i.e. the Crossrail

concept) given that this would require a new connection between the two lines to the south of existing platforms at Cardiff Central[37].

3. Connecting into new platforms to the south of Cardiff Central (Tram-train 3)

This option would provide the opportunity to operate services into new platforms located to the south of Cardiff Central and, ultimately, onward to Cardiff Bay via a new line to Porth Teigr as envisaged by the 'Crossrail' concept.

This option requires a new junction at or near the Penarth Curve to enable services from the City Line and/or North West Corridor to cross to the south of the Barry Lines before ramping down into new platforms located to the south of the existing station. The issues associated with this option are complex and, as noted, a separate more detailed technical study is underway to establish the feasibility and cost of this approach.

The form of the junction will depend on the frequency of services that need to be accommodated. In the short term, at lower frequencies, an at-grade solution may be feasible and could provide a more affordable option. This would require services to be timed to maximise parallel moves through this junction. However, given aspirations for future service frequencies on these lines, it is likely that a grade-separated junction would ultimately be required. A phased approach could be considered whereby an at-grade solution is used in the short term to facilitate a connection between the City Line and the south of Cardiff Central, to be replaced by a grade-separated junction in the longer term once the North West Corridor services are in operation.

A grade-separated junction (tunnel or flyover) would offer much greater capacity and would allow the City Line/North West Corridor to be fully or partially segregated from the Barry/Penarth Lines and services. While further assessment is required, a tunnel under the Barry Lines at the Penarth Curve is the most likely form of grade-separated junction given the potential height of a flyover and the visual intrusion created by the new structure.

Two variants of this option are outlined below:

Variant 1

Under this variant, a new tunnel or flyover would shift the North West Corridor services onto the existing alignment of the two most southerly tracks (i.e. the current alignment of the Barry Lines). The Barry/Penarth services would be diverted to the north to connect into what is currently the City Lines. This variant involves a realignment of existing tracks and re-routing of services rather than any overall increase in the footprint of the approach to Cardiff Central.

As well as the cost implications, the barriers to this option are potentially significant. Realigning the Barry lines further north may affect the 'third line' at Penarth curve which allows trains to connect from Barry / Penarth into the northern platforms at Cardiff Central. Because it involves substantial track works on both the City Lines and Barry lines, the disruption caused by this option could be a major issue. Furthermore, the signalling upgrades required could be substantial.

This option would provide the same additional capacity as option 2 for both the City and Barry lines coming into Cardiff Central, on the assumption that the track modification which is outlined for option 2 is also implemented.

[37] Although it is not the purpose of this work, in theory, a connection between the Barry Line services and Porth Teigr could be provided (in a similar manner to that proposed in tram-train Option 3) However, this would require Barry and Penarth services to be operated using the same tram-train or light rail technology as on the Porth Teigr link rather than the heavy rail tri-mode trains that will be used from 2023.

Variant 2

Under this variant, the North West Corridor services coming from the City Line would be diverted onto a new section of track within the triangular piece of land south of Canton Depot. A tunnel / flyover would connect to a new tram-train route located to the south of the existing Barry Lines. The alignment would run parallel to the existing track. A new bridge would be required to carry the new track across Clare Road followed by a new bridge over the river Taff and into a new station south of Cardiff Central. As such, this option would involve widening the footprint of the approach to Cardiff Central.

The new section of track may need to be a single line section due to the restricted space available. A high-level assessment suggests the length of the single line section would be sufficiently short to allow a high frequency of service notwithstanding the need for trains to wait for the single line section to clear.

Since the North West Corridor vehicles would not use Cardiff West Junction or existing platforms at Cardiff Central, no additional track modifications or signalling upgrades would be required to accommodate planned services on other lines. As the new route would avoid Cardiff West Junction and connect into new platforms to the south of Cardiff Central, this would mean that operations on platforms 6 to 8 would remain as they currently are.

The option would then exist to modify the layout of Cardiff West Junction in a similar way to that described for the medium-cost option in order to increase service frequencies from Barry and Penarth.

The alignment of this variant is illustrated in Figure 3.5 and appendix B.

4. On-Street Solutions

The alternative solution to capacity constraints at Cardiff West Junction and Cardiff Central is to divert the North West Corridor away from this area via an alternative ‘on-street’ route as illustrated in Figure 3.5 and appendix B. Multiple on-street routes were considered during Sift 1, with two options ultimately being included on the long list. These are:

- Tram-train 9: City Line and Safeguarded Corridor via a new on-street route, potentially via Penarth Road and Sloper Road before connecting to the City Line near Ninian Park; and
- Tram-train 6: City Line and Safeguarded Corridor via a new Taff Crossing and potentially on-street section along Pendyris Street.

Both options negate the issues at Cardiff West by diverting North West Corridor tram-trains further west of the Canton depot area via an on-street route, thereby freeing up junction and platform capacity for services via the Barry/Penarth lines. As with option 3, the on-street solutions also provide the opportunity to connect with a new line to Porth Teigr via Cardiff Central and/or Callaghan Square.

3.4.4 Tram-train Route Variants and Engineering Constraints

This section considers the route variants and associated engineering and environmental constraints for the possible tram-train routes. The routes are considered in sections as listed below:

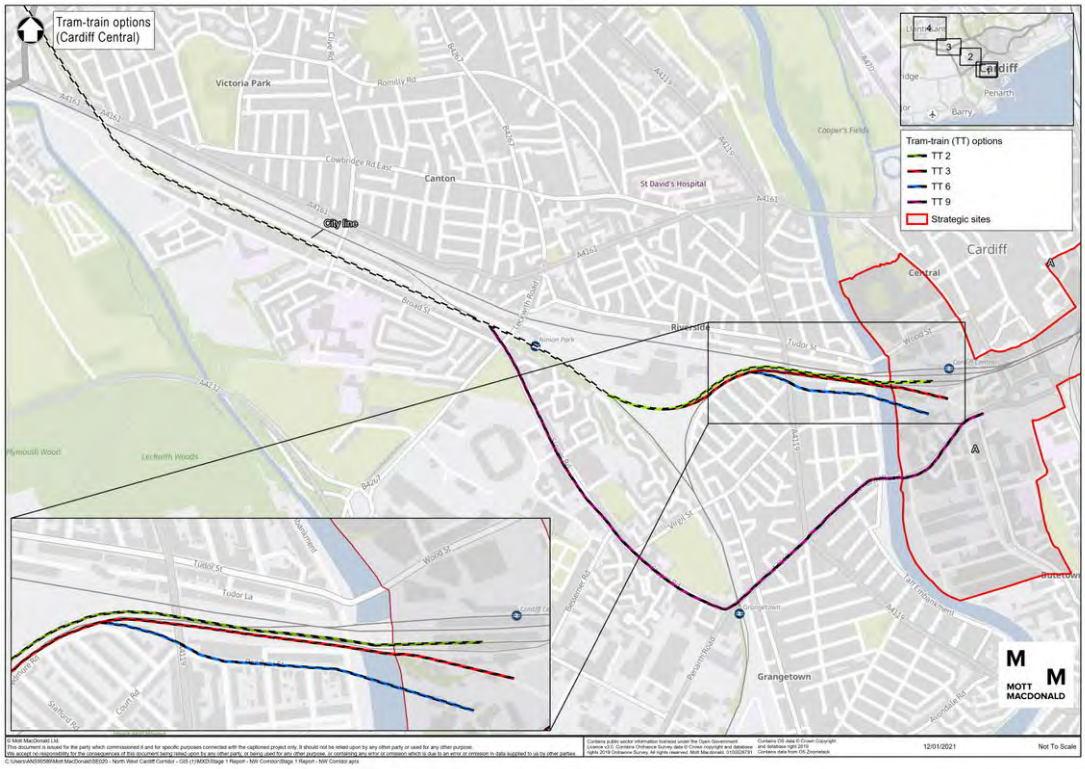
1. Central Cardiff;
2. The City Line connection and Plasdwr;
3. Use of the Safeguarded Corridor;
4. M4 crossing options and connecting into Creigiau; and

5. Routes through Rhondda Cynon Taf.

3.4.4.1 Central Cardiff

The possible route variants and associated engineering and environmental constraints within central Cardiff have been discussed throughout section 3.4. The long list options considered are shown in Figure 3.5 and appendix B.

Figure 3.5: Tram-train Routes – Cardiff Central[38]



Source: Mott Macdonald

3.4.4.2 City Line Connection and Plasdwr

The most direct route or area of search used for all tram-train options between the City Line and Plasdwr depart from the City Line to the north of Fairwater Station and follow (broadly) the route of the Safeguarded Corridor through Plasdwr. However, a number of variants on this option exist which will require more detailed consideration at WelTAG Stage 2. The options are outlined below and shown in Figure 3.6.

1. **Direct route: Connect City Line to the Safeguarded Corridor**

As noted, this is the most direct route for all tram-train options between the City Line and Plasdwr. It is the shortest and most direct route with the least engineering constraints.

2. **Longer route: Divert from City Line to the north of Danescourt Station**

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Another possible connection from the City Line to the Safeguarded Corridor would be to divert from the City Line to the north of Danescourt Station as shown in Figure 3.6. The new route would go up the steep gradient before following an on-street route through Plasdwr and connect with the Safeguarded Corridor near the centre of the development.

A benefit of this variant is that North West Corridor services could stop at Danescourt station. Given that Radyr receives a high frequency of services due to services from Pontypridd via Cardiff Queen Street, this would mean that all intermediate stops on the City Line could be provided for by North West Corridor services. This would have a network capacity benefit by eliminating the need to increase frequencies on the City Line in addition to introducing services on the North West Corridor.

Furthermore, this route provides the option for a 'delta junction' connection to the City Line which would also allow trains to turn north from the North West Corridor towards Radyr. This could be attractive particularly if a connection between the City Line and Coryton Line is considered in the future (as described in 2.14.5).

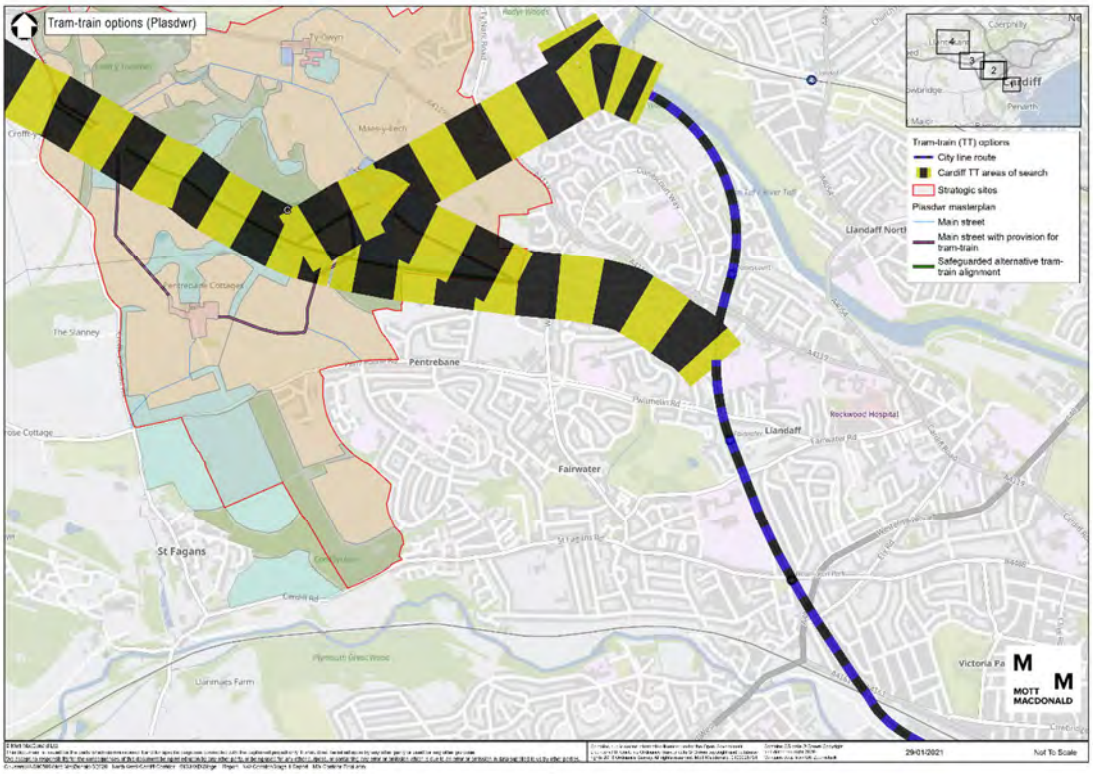
Notwithstanding these advantages, at this stage, this option has a number of feasibility issues and other potential drawbacks. These are as follows:

- This is a less direct route. Diverting from the City Line further north would result in a journey time penalty in the region of 4 minutes as compared to the direct route variant 1; and
- An initial assessment suggests that the gradient from the City Line towards Plasdwr is steeper than the maximum gradient of 6% that a CVL tram-train vehicle can navigate. The route design must aim to overcome this by scaling the gradient diagonally at a suitable gradient of less than 6%. If this is not possible and the gradient is too steep, it may be necessary to consider cut and cover. Cut and cover may be required either way if the adverse impact of locating the route in this area is too significant. Should this option be progressed, further assessment of its feasibility would need to be undertaken given the steep gradient from the City Line, as well as any potential impacts on existing land and developments.

3.4.4.3 Alternative routes through Plasdwr

Alternative routes through Plasdwr have been considered which depart from the Safeguarded Corridor but provide better penetration into the site. These options could provide better access within the development but will likely mean additional costs and longer journey times for passengers not alighting at Plasdwr. These options would likely require on-street running and as such the appropriate modifications to the Metro vehicle discussed in section 3.3.3 would be required.

Figure 3.6: Tram-train Routes – City Line and Plasdwr[39]



Source: Mott Macdonald

Whichever route is ultimately preferred, there would be an opportunity to provide an active travel corridor alongside the rail line that could form part of the active travel network within Plasdwr but also link with Cardiff's proposed Cycleway 4 towards the City Centre.

3.4.4.4 Use of the Safeguarded Corridor

Although formerly a rail line, constructing a new rail line on or alongside the disused rail corridor is expected to have adverse environmental impacts. The disused line is bounded by greenfield land towards the M4 which has a SSSI directly to the south of the disused railway line in Plasdwr. There are also a number of Ancient Woodlands and SINCs in close proximity or directly adjacent to the disused rail line.

Furthermore, vegetation has grown within the disused rail line and has become a habitat for many species of wildlife. This study has found that a new tram-train route should be offset from the centre of the disused rail line as much as possible to minimise the environmental impact.

3.4.4.5 M4 crossing options and connecting into Creigiau

A number of options have been considered for crossing the M4 and connecting into Creigiau. The two most plausible options are outlined below and illustrated in Figure 3.7.

1. **Cross under the M4, potentially via the existing underpass.**

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This route follows the Safeguarded Corridor to the south of the M4 and pass under the M4, potentially via the existing underpass. It then serves the Junction 33 park and ride site before passing through Strategic Sites D and E and on to Creigiau.

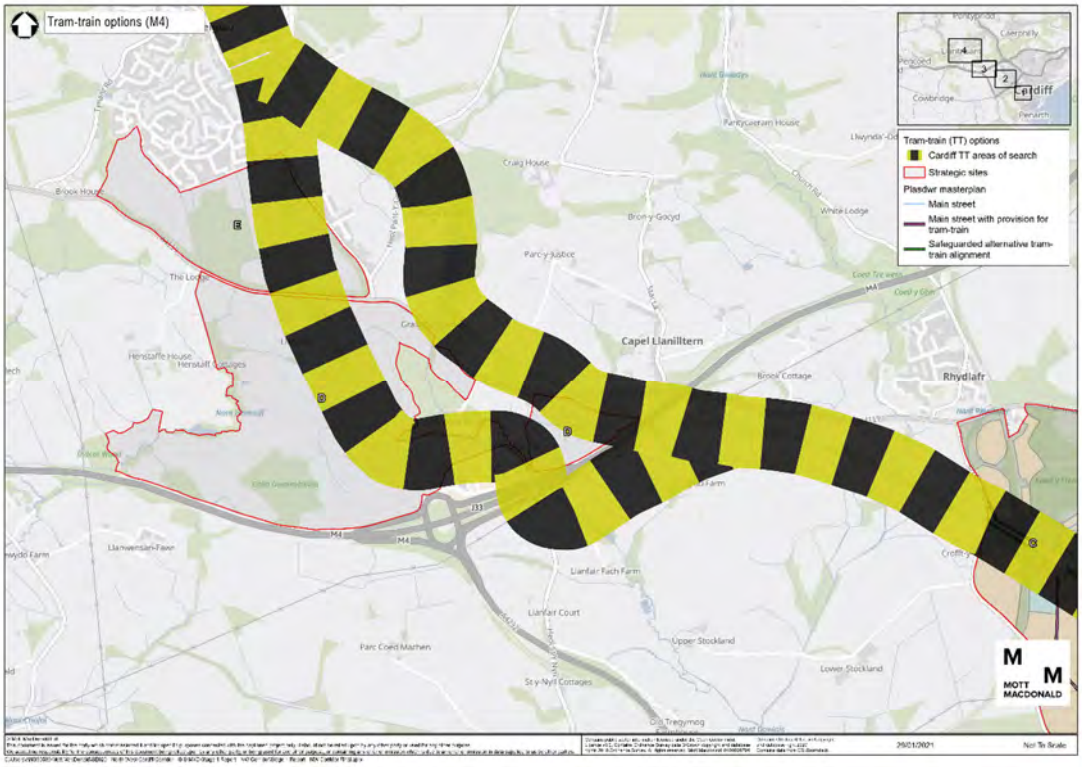
The underpass has sufficient height and width for tram-train vehicles to pass through. The width is approximately 9m and would allow either single or double track and shared running with road vehicles. However, if there is opportunity to remove road traffic and this interface, service reliability could be improved. The headroom ranges from 5.2m to 7.3m and is sufficient for tram-trains.

2. Cross over the M4 with a new bridge.

This option for crossing the M4 would involve constructing a new rail over road bridge over the motorway. This would require a large structure to achieve the required clearances over the M4 whilst also maintaining the maximum 6% gradient that the tram-trains can navigate. Extensive earthworks would also be required either side. The visual and environmental impact would be significant and might negate this option being considered over option 1 outlined above.

Furthermore, this option could potentially miss out on calling at the Junction 33 park and ride and strategic sites D and E. The route could also impact on the SINC and existing developments as shown in Figure 3.7.

Figure 3.7: Tram-train route – M4 Crossing and Creigiau [40]



Source: Mott Macdonald

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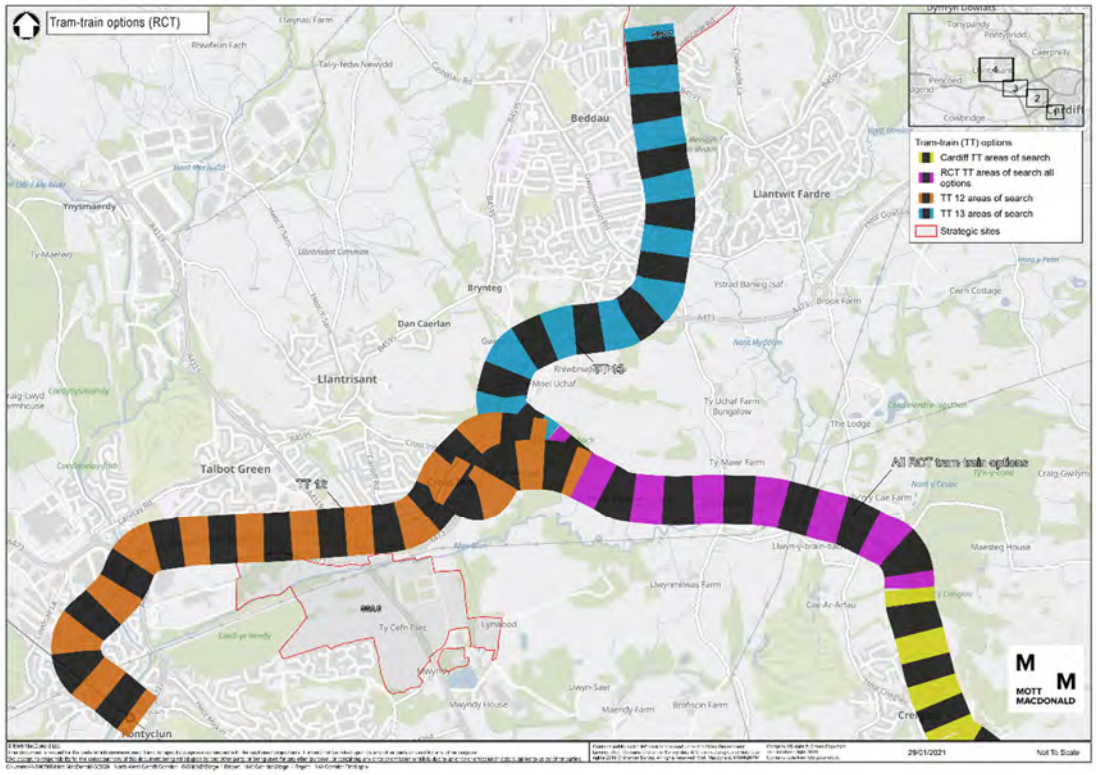
3.4.4.6 Rhondda Cynon Taf

The route beyond Creigiau would potentially require the utilisation of the disused rail lines and involve upgrades to bridges, new road crossings and potential on-street running. However, none of the options present major engineering challenges. The end destination presents three opportunities as below and illustrated in Figure 3.8:

- Extension of the North West Corridor tram-train route beyond Creigiau, potentially via the disused rail route to Cross Inn and onwards towards Beddau;
- Extension of the tram-train route beyond Creigiau, potentially via the disused rail route to Cross Inn before turning westwards and continuing parallel to the A473, terminating alongside existing heavy rail platforms at Pontyclun station; and
- Extension of the tram-train route beyond Creigiau, potentially via the disused route to Cross Inn where a delta junction could provide a Y-shaped route with two spurs; one turning westwards and continuing parallel to the A473, terminating alongside existing heavy rail platforms at Pontyclun station; the other heading north towards Beddau.

Much of the disused rail corridor in this area, along either branch, has been converted to a cycleway. As for the sections in Cardiff, it is expected that a cycleway could be retained alongside the rail line and therefore the current provision would be retained although further work will be required to assess the feasibility of this approach.

Figure 3.8: Tram-train Routes – Rhondda Cynon Taf[41]



Source: Mott Macdonald

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3.5 Bus Rapid Transit Routes

As compared with tram-train route, they key advantages of bus-based solutions is that they are more flexible in terms of route options, can be implemented more quickly and expanded in line with the phasing of development, and can be a more effective means of penetrating into residential areas in order to widen the coverage of the public transport network. Notwithstanding the flexibility of bus services (relative to a new rail route) the success of bus corridors can depend to a significant extent on the degree of segregation from traffic congestion and therefore high quality bus based corridors can be costly and complex to implement.

There is no firm definition of 'Bus Rapid Transit'. As noted, it generally refers to a bus system that provides greater capacity, speed and reliability than a conventional bus route. Key features that have been considered in the development of options for the North West Corridor include:

- Fully segregated bus lanes including the potential for a guided busway where higher bus speeds could be achieved;
- Use of bus gates including bus only on-off slip;
- Enhanced bus stops with pre-boarding ticketing facilities; and
- Use of high quality, electric buses.

The images below are from the MetroBus BRT Scheme in the Greater Bristol area and provide examples of each of these features.

Figure 3.9: Examples of BRT related measures

Source: Images from Google

Notwithstanding the enhancements associated with a BRT system, bus-based options have three main challenges that need to be tackled:

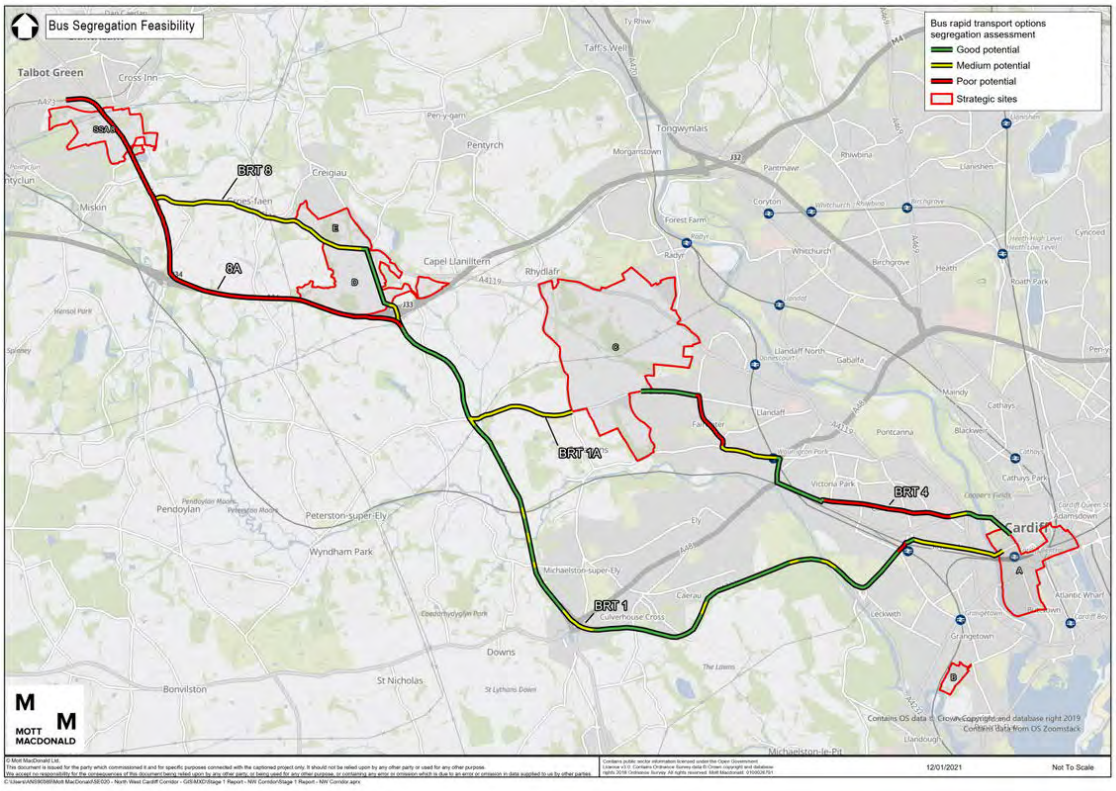
- Faster bus journey times require higher levels of infrastructure segregation and priority from existing road traffic. The level of potential segregation is limited by the range of constraints on each route. These constraints are typically most severe within more dense urban environments where traffic congestion is also likely to be severe.
- Perceptions of buses as an attractive mode of transport is generally poor. Whilst there are many methods to improve the quality of the bus offer (for example, high specification interiors), there is a risk that bus-based options may not achieve the level of desired modal transfer or may not achieve the step-change towards unlocking economic aspirations.
- Whilst the legislative and regulatory bus framework is changing in Wales, bus services are largely provided on a commercial basis. Although there are existing mechanisms around partnerships and additional public subsidy that can be used, guaranteeing and future proofing a consistent service requires planning and agreement. Providing high quality BRT services will require public subsidy as well as capital investment. This will be particularly the case in the immediate years following the introduction of a service when ridership is yet to be fully established.

3.5.1 Bus Segregation Issues

As described in the Strategic Case, one of the key problems with current public transport provision is a combination of low bus speeds and the fact that bus speeds are significantly reduced during peak times. The route options identified use parts of the road network which are also those highlighted in the Strategic Case as suffering from congestion and poor reliability due to accidents. This highlights the fact that the success of any BRT option within the corridor may depend to a significant extent on the degree to which buses can be segregated from traffic.

In developing options for the North West Corridor, a high-level assessment has been made of the potential for bus segregation for the BRT options included in the long list. Bus segregation maps for Cardiff (BRT options 1, 1A and 4) and Rhondda Cynon Taf (BRT option 8) are shown in Figure 3.10. This shows that there are challenges around achieving segregation particularly where there is a lack of off-street parking available, relatively narrow highway width, constrained junction layouts and major structures such as bridges.

Figure 3.10: Bus Segregation Assessment[42]



Source: Mott Macdonald

3.5.2 BRT Routes – Variants and Constraints

The BRT options have considerable scope for route permutations and extension. These are summarised below.

3.5.2.1 BRT1 Central Cardiff to Junction 33 via Leckwith Road and A4232

This option provides the most direct connection possible between a strategic Park and Ride site at Junction 33 and Cardiff's city centre. As noted, the park and ride site forms part of the planning consent for the Junction 33 Strategic Site. There would be potential to extend the BRT route extension from the planned park and ride at Junction 33 through Strategic Site E and towards Creigiau.

The route follows the A4232 dual carriageway and direct access would be provided from the park and ride site to the junction. If a sufficient level of segregation or bus priority measures can be achieved along Tudor Street, Ninian Park Road and Leckwith Road, this option would effectively provide a limited stop 'express' service between the city centre and Junction 33.

There are two main challenges related to this option:

- Achieving sufficient segregation and priority particularly along Ninian Park Road where any potential loss of on-street parking may face opposition; and

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- Additional measures on the A4232 particularly around the on/off slips which may experience congestion.

Along the dual carriageway, there are opportunities to provide segregated provision for buses although this will require widening of the highway to maintain two lanes for other traffic and would therefore attract a high capital cost. Significant improvements in journey time reliability could be achieved through the provision of bus lanes on the northbound approach to Junction 33. Crucially, some of the more congested sections of the A4232 – at Junction 33 itself, at Culverhouse Cross and at Leckwith - would be more challenging to provide segregation due to the constraints of existing structures and raised sections of the highway.

The main route from the A4232 is via Leckwith Junction, Leckwith Road and Ninian Park Road. Departing the A4232 at Leckwith avoids the need for buses to navigate congested sections through Leckwith Junction and on the viaduct over Cardiff Bay which would be highly challenging to implement bus priority measures.

Based on an initial assessment, this route appears to offer the greatest scope for segregation. An alternative route, potentially via Sloper Road and Penarth Road is slightly less direct but would provide the opportunity for an interchange with the rail network, together with active travel, at Grangetown. This variant merits further assessment at WelTAG Stage 2.

3.5.2.2 BRT1A – A4232 Bus Gate and Spur to Plasdwr:

This option is a permutation on the BRT route via the A4232. This would provide direct access from the eastern edge of the Plasdwr development to the A4232 via a bus gate near St Brides Road. Bus only slip roads would need to be provided from the northbound and southbound carriageways and a new bus-way which would likely be via St Brides Road which crosses underneath the carriageway of the A4232. Because of the infrastructure requirements of this option, this is likely to be a relatively high cost option. Given the timescales for the development of the eastern portion of Plasdwr, this is a potential second phase to BRT1. The two challenges identified above in BRT1 also apply to this option. In addition, there are two further challenges:

- Engineering and environmental considerations around an on/off slip from the A4232 onto St Brides Road; and
- Phasing of the construction of the internal Plasdwr road network and whether a link from St Brides Road/Crofft-y Genau Road can be progressed earlier than planned.

This option is shown using a route following St Brides Road into the internal road layout within Plasdwr. A variant on this option would be to extend the route along Pentrebane Road in order to serve the Cae St Fagans development of Plasdwr (west of Pentrebane).

3.5.2.3 BRT4 – Central Cardiff to Plasdwr via Cowbridge Road East, Waun-gron Park, Fairwater:

As set out in the Strategic Case, a variety or urban BRT routes through the North West Corridor in Cardiff have been considered. These are chiefly intended to provide a direct route from Plasdwr to the city centre. The main route included in the long list of options is via Westgate Street, the A4161 (Cowbridge Road East), the A48, St Fagans Road and Plasmawr Road before connecting into Plasdwr's internal road network.

There would be the potential for this option to connect into and follow the Safeguarded Corridor through Plasdwr. However, as described in section 3.6, a conclusion of WelTAG Stage 1 is that a rail-based solution is likely to be preferred for this corridor. Therefore, the variant of BRT4 which has been shown connects into Plasdwr's internal road network via Pentrebane Road.

From the perspective of bus-based options, a route via the A4232 (BRT1) is likely to provide more competitive journey times between Junction 33 and areas to the north and Cardiff's city centre. Therefore, BRT4 is shown as connecting into Plasdwr's internal road network and penetrating into residential areas. Nevertheless, a possible variant of this option would be to extend the route along the A4119 towards the planned park and ride at Junction 33 and onward towards Creigiau and/or Llantrisant.

Minor variations on the route between Plasdwr and the city centre may be considered during Stage 2, although this route appears to provide the most promise in terms of maximising the portion of the route that is segregated from traffic.

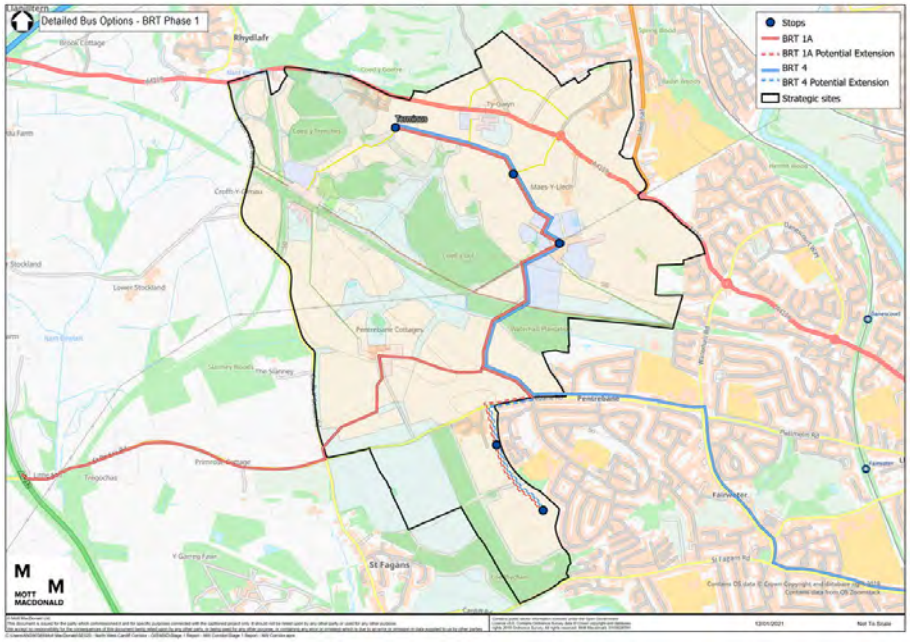
One of the strengths of this option is that there is scope for existing services such as Ely, Fairwater and Pentrebane to utilise some of the improvements as well as providing connections at Waun-gron Park station. Links into the Plasdwr area are dependent on the phasing of the construction of the internal road network. The greatest challenge around this option is achieving segregation and improved priority. This includes:

- Along Cowbridge Road East;
- Ely Bridge junction; and
- St Fagans Road.

3.5.2.4 Route through Plasdwr

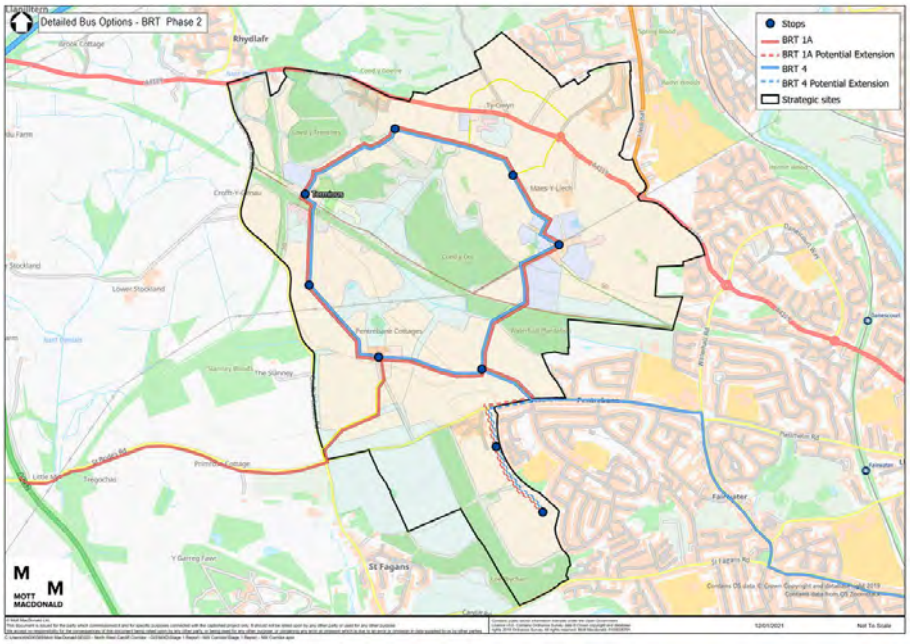
BRT options 1A and 4 serve Plasdwr. Consideration has been given to the potential route through the development itself. This has been designed to provide BRT coverage for the development as a whole and would provide BRT stops at 400 metre intervals. A phased approach could be taken to the implementation of this corridor reflecting the phasing of housing delivery, with the potential route for phase 1 shown in Figure 3.11, and the potential route for phase 2 shown in Figure 3.12.

Figure 3.11: BRT Route through Plasdwr – Phase 1[43]



Source: Mott Macdonald

Figure 3.12: BRT Route through Plasdwr – Phase 2[44]



Source: Mott Macdonald

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3.5.2.5 BRT8 – Junction 33 to Talbot Green via A4119

BRT8 Links Junction 33 with the centre of Talbot Green. It serves the strategic sites north of Junction 33 and south of Talbot Green. It provides the most direct bus route between Rhondda Cynon Taf and central Cardiff.

Following the A4119 between Llantrisant and Junction 33 is preferred to a route via Junction 34 and the M4 (i.e. BRT 8A). This is because of the level of congestion on the approaches to Junction 34 and at the junction itself, as well as the difficulties and cost of providing bus segregation on the M4. However, should a new parkway style rail station be developed at Junction 34 ('Rail 8'), then consideration would need to be given to the potential for bus priority measures at Junction 34 and on the A4119 if this is to function as a public transport interchange, including with active travel modes, rather than simply a car based park and ride.

At Llantrisant/Talbot Green it is envisaged that BRT 8 would connect into multiple routes in Rhondda Cynon Taf. The potential has been identified for an interchange or 'bus hub' at Talbot Green where bus services from the north, east and west would converge. There would be scope to extend services, and bus priority measures, further north on the A4119 towards the Royal Glamorgan Hospital, Llantrisant Business Park, the Coed Ely development and, ultimately, Tonyrefail. An extension from Talbot Green towards Pontyclun railway station could also be considered. This could use the A473 or, as shown in Figure 3.10, potentially follow part of the disused rail route.

Further east, from Beddau and Llantwit Fardre, bus routes via the A470 corridor may continue to provide the main bus corridor.

3.6 Use of the Safeguarded Corridor: Rail vs BRT Solutions

A key conclusion of WelTAG Stage 1 is that based on currently available evidence, a new tram-train route is likely to have a greater impact on the achievement of the WelTAG objectives than a new BRT route. A tram-train solution provides the greatest scope to minimise public transport journey times, encourage modal shift, and catalyse housing and employment development. Therefore, it is recommended that a tram-train solution is prioritised for the Safeguarded Corridor.

It should be noted however, that implementing the BRT measures could deliver some benefits in a shorter timeframe compared to the tram-train solution. Therefore, a phased approach for the works could see the tram-train routes being implemented at a later stage, resulting in the full benefits of a complementary tram-train and BRT package.

Table 3-1 provides a high-level assessment of the approximate journey times that could be achieved for the two primary modes: tram-train and BRT. The analysis is based on the typical speeds that can be achieved for each mode taking into account stopping times. For the BRT options, the analysis assumes peak time travel conditions, but it also assumes that bus priority measures are implemented on sections of the route where this is likely to be feasible.

A tram-train service, potentially using the disused rail route and running into Cardiff Central via existing tracks, could have a journey time of as little as 10 minutes from the eastern end of Plasdwr. In contrast, the journey time for a BRT option (following a similar route to BRT 4, assuming improvements in bus segregation and limited bus stops) is estimated to be a minimum of 23 minutes. A key reason for this is that the main constraints to improving bus journey times in the Corridor relate to the road network in central areas of the City between central Cardiff and Plasdwr. Whilst substantial bus segregation could be provided, a fully

segregated, ‘free-flow’ BRT solution is unlikely to be achievable for the full extent of a BRT route from Plasdwr to central Cardiff.

These differences continue to be felt further along the Corridor with a tram-train journey time advantage over BRT of at least 9 minutes. It is notable that, whilst it would fail to serve Plasdwr and inner areas of the North West Corridor, a BRT route via the A4232 would offer lower journey times from Junction 33 of the M4 and beyond than a route via the Safeguarded Corridor. Therefore, a new rail corridor via the Safeguarded Corridor could be extended into southern Rhondda Cynon Taf whereas the longer journey times for a bus-based solution using the same corridor are likely to be unattractive to passengers.

Table 3-1: Bus and Rail Journey Time Analysis

Approx. journey time to Cardiff Central	**Tram-train via Fairwater**	**BRT via Safeguarded Corridor (via Pentrebane Rd)**	**BRT via Safeguarded Corridor (via Waterhall)**	**BRT via A4232**
Plasdwr	10	27	23	NA
Junction 33 P&R	17	32	28	24
Creigiau	23	36	32	27

3.6.1.1 Consideration of a Phased BRT and Tram-train Approach

Given the potential timescales involved in the delivery of a new rail route, consideration has been given to the potential for a phased approach whereby the disused rail corridor is initially used as a bus corridor (with potential access routes to the new Corridor from the A4119 to the north and Pentrebane Road from the south) before being replaced by the tram-train route. The rationale for this approach is that a busway could be delivered more quickly and at lower cost and therefore could provide an interim solution.

However, a number of potential disadvantages of this approach have been identified. Whilst the busway could be designed to account for the eventual transformation to a rail corridor, the abortive costs could be significant and may be difficult to justify as an interim measure. The phased approach could be a disruptive solution given that it would involve two phases of construction. Maintaining bus services whilst constructing the rail solution would be challenging and may increase construction timescales. Moreover, for a BRT solution, the benefit of using the disused route may be relatively modest compared with existing routes (e.g. the A4119) given that the primary constraints to achieving competitive journey times are on inner city routes.

Notwithstanding these issues, a phased approach is feasible, and should funders wish to consider this approach further, an exercise could be undertaken during Stage 2 to establish the likely implications for construction costs of a two-stage approach.

4 Transport Case

The transport case considers the impacts and merits of the long list of options and identifies the proposed shortlist of measures that will be progressed for further development and assessment at WelTAG Stage 2. Together, these measures comprise an outline public transport strategy for the North West Corridor.

4.1 Introduction

The Transport Case explores the impact of each of the options in terms of their social, environmental and economic effects. It considers which options are likely to have beneficial impacts and achieve good value for money.

4.2 Approach

4.2.1 Appraisal Criteria

As noted, the options sifting process at WelTAG Stage 1 has been undertaken in two stages. The outcomes of the initial sift were detailed in the Strategic Case. The Transport Case details the outcomes of Sift 2. This stage 2 involves an assessment of the performance of the long list options against a set of WelTAG appraisal criteria. Based on this assessment, better performing options have been included in the shortlist options that will go forward for more detailed assessment at WelTAG Stage 2.

Long list options were assessed according to the following WelTAG appraisal criteria.

Table 4-1: WelTAG Stage 1 Appraisal Criteria

Transport and economic impacts	Social and cultural impacts	Environmental impacts
Journey times	Physical activity	Noise
Journey time reliability	Journey quality	Air quality
Productivity	Accidents	Greenhouse gases
Induced investment and land use change	Access to employment	Landscape
	Access to services	Townscape
	Affordability	Historic environment
	Severance	Biodiversity
	Option value	Water environment

As well as the above ‘Transport Case’ impacts, the financial cost and feasibility of the options also informs the selection of the shortlist. Therefore, options have also been assessed in respect of the following aspects which relate to the Financial, Commercial and Management Cases.

Table 4-2: WelTAG Stage 1 Financial and Commercial Considerations

Financial case	Commercial and Management (Delivery) case
Capital cost	Engineering complexity and risk
Operating cost or subsidy requirement	Operational complexity and risk
	Consenting risk
	Stakeholder and public acceptability
	Commercial viability

4.2.2 Scoring

In accordance with WelTAG, the significance and scale of the impacts of each option is assessed using a seven-point scale as follows:

Table 4-3: Scoring applied to the WelTAG Stage 1 assessment

	Score
Large beneficial	+3
Medium beneficial	+2
Minor beneficial	+1
Neutral/negligible	0
Minor adverse	-1
Medium adverse	-2
Large adverse	-3

Source: Mott MacDonald

It should be noted that the scoring of options provides a guide for the selection of the shortlist. No attempt has been made to derive an overall average score across all criteria with which to rank the options. This approach acknowledges the fact that many of the options for the North West Corridor are complementary rather than competing with each other. In identifying the final shortlist, consideration is given to how the options will work together as part of an integrated public transport network.

4.3 Options Assessment

4.3.1 WelTAG Stage 1 Scoring

The WelTAG scoring for all of the long list options can be seen in Table 4-4: WelTAG ScoringTable 4-4

Table 4-4: WelTAG Scoring

			Existing rail options					Tram train options/ Light rail options								Bus rapid transit options				Other options	
			Rail1	Rail 2	Rail 4	Rail 7	Rail8	TT1	TT2	TT3	TT6	TT9	TT12	TT13	TT14	BRT1	BRT1A	BRT4	BRT8	Rail 5	Rail 6
Transport case	Transport and economic impacts	Journey times	+	+	+	+	++	++	+++	+++	++	++	++	+++	+	+	+	++	++	+	+
		Journey time reliability	-	+	+	-	+	--	++	++	+	+	+	+	+	+	+	+	+	+	+
		Productivity	+	+	+	+	0	++	++	++	++	++	++	++	+	+	+	+	+	0	0
		Induced investment and land use change	0	0	+	0	+	++	+++	+++	+++	+++	+++	+++	+	+	+	+	+	0	0
	Social and cultural	Physical Activity	+	+	+	+	+	+	++	++	+	+	++	++	+	0	+	+	+	+	+
		Journey quality	+	+	+	+	+	+	++	++	++	++	++	++	++	+	+	+	+	++	++
		Accidents	0	0	0	0	0	+	+	+	+	+	+	+	+	0	0	0	0	0	0
		Access to employment	+	+	+	+	+	+	++	++	+	+	++	++	+	+	+	+	+	0	0
		Access to services	0	+	+	0	0	+	+	+	+	+	+	+	+	0	0	+	0	+	+
		Affordability	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Severance	0	0	0	0	0	--	--	--	--	--	--	--	-	0	0	0	0	0	0
		Option Value	0	+	+	0	+	++	++	++	++	++	++	++	+	0	0	0	0	+	+
	Environment	Noise	-	-	-	-	-	-	-	-	-	-	--	--	-	0	-	-	-	-	-
		Air quality	+	-	+	-	0	++	++	++	++	++	++	++	++	++	++	++	++	0	0
		Greenhouse gases	+	-	+	-	0	++	++	++	++	++	++	++	++	++	++	++	++	0	0
		Landscape	0	-	0	0	--	--	--	--	--	--	--	--	--	0	-	-	-	0	0
		Townscape	0	0	0	0	0	--	--	--	--	--	-	-	-	0	0	0	0	0	0
		Historic Environment	0	+	0	0	0	0	0	0	0	0	-	-	-	0	-	0	0	0	0
		Biodiversity	0	-	-	0	--	--	--	--	--	--	--	--	--	0	-	--	-	0	--
		Water Environment	0	0	0	0	--	--	--	--	--	--	--	--	--	0	-	--	-	0	--
Financial case		Capital cost	N/A	£0 to £10m	£0 to £10m	N/A	£10 to £25m	£100 to £250m	£100 to £250m	£250 to £500m	£250 to £500m	£250 to £500m	£100 to £250m	£100 to £250m	£50 to £100m	£50 to £100m	£25 to £50m	£25 to £50m	£25 to £50m	£0 to £10m	£0 to £10m
		Operating cost or subsidy requirement	£1m - £3m pa	<£100k pa	<£100k pa	£5m - £10m pa	<£100k pa	£5m - £10m pa	£5m - £10m pa	£5m - £10m pa	£5m - £10m pa	£5m - £10m pa	£3m - £5m pa	£3m - £5m pa	£100k - £500k	£100k - £500k subsidy	£100k - £500k subsidy	£100k - £500k subsidy	£100k - £500k subsidy	<£100k pa	<£100k pa
Commercial and delivery case		Engineering Complexity and Risk	Very Low Risk	High Risk	Low Risk	Very Low Risk	Med Risk	High Risk	High Risk	Very High Risk	Very High Risk	Very High Risk	High Risk	High Risk	High Risk	Med Risk	Med Risk	Med Risk	Med Risk	Very Low Risk	Med Risk
		Operational Complexity and Risk	High Risk	Med Risk	Low Risk	Med Risk	Low Risk	Very High Risk	Med Risk	Med Risk	High Risk	High Risk	Med Risk	Med Risk	Med Risk	Low Risk	Low Risk	Low Risk	Low Risk	Very Low Risk	Low Risk
		Consenting Risk	No risk	High Risk	Very Low Risk	No risk	No risk	High Risk	High Risk	High Risk	Very High Risk	Very High Risk	High Risk	High Risk	High Risk	Low Risk	Low Risk	Low Risk	Low Risk	No risk	No risk
		Stakeholder and Public Acceptability	No risk	High Risk	Very Low Risk	No risk	No risk	High Risk	High Risk	High Risk	Very High Risk	Very High Risk	High Risk	High Risk	High Risk	Med Risk	Med Risk	Med Risk	Med Risk	Low Risk	Med Risk
		Commercial Viability	Med Risk	High Risk	Very Low Risk	Med Risk	Med Risk	High Risk	High Risk	Very High Risk	Very High Risk	Very High Risk	Med Risk	Med Risk	Med Risk	Low Risk	Low Risk	Med Risk	Low Risk	Med Risk	Med Risk

The following sections identify the shortlist options and the rationale for their inclusion. They also explain the rationale for rejecting options at this stage.

4.3.2 Existing Rail Network Options

4.3.2.1 Shortlisted Options

Rail 1: Service frequency enhancement: City Line

The existing frequency of two trains per hour is below other Valleys Lines and fails to meet the Welsh Government's benchmark of four trains per hour for 'metro' stations. Increasing service frequency on the City Line would improve effective journey times and help to encourage greater use of public transport. Whether this option delivers value for money would need to be tested quantitatively during WelTAG Stage 2.

The operational considerations are relatively complex. Theoretically, this option could be achieved in the short term with no additional infrastructure, but this is subject to more detailed examination of train performance impacts and engagement with both Network Rail and Operators on the feasibility of relaxing current train planning rules in relation to Cardiff West Junction.

Should this approach not be achievable then infrastructure changes will be required. A range of broad approaches to increasing capacity at Cardiff West Junction and Cardiff Central were set out in relation to the proposed new tram-train route in Section 3.4. Options include changes to the track layout at Cardiff West Junction, or provision of a new junction between the City Line and Barry/Penarth Line services at Penarth Curve to enable North West Corridor and/or City Line services to operate into new platforms located to the south of the Cardiff Central Station. The latter option is likely to attract higher costs but offers the potential to provide a direct connection between the North West Corridor and City Line and a proposed line to Porth Teigr. In theory, either of the above approaches could be employed to facilitate enhanced services on the City Line in advance of the delivery of a new tram-train route.

The operational solution pursued for the City Line and the business case for investing in enhanced capacity will need to take account of future aspirations of the City Line, North West Corridor and Barry/Penarth Lines in combination.

Rail 4: New Station: Ely Mill

This station is located within a densely populated area. Initial demand forecasts suggest this station could attract in the region of 100,000 trips per annum. This option can be achieved with limited operational impact on existing City Line services albeit with a potential negative impact on journey times. Subject to more detailed analysis it is adjudged that this option would have overall positive economic, social and environmental impacts.

This option has been shortlisted as part of the Welsh Government's 'New Rail Stations Prioritisation' exercise and is included in its' vision for the railway in Wales. Following the delivery of a rail based North West Corridor route there may be potential to operate limited stop services at Ely Mill (in addition to Fairwater, Waun-gron Park and Ninian Park) to reduce journey times whilst maintaining at least four trains per hour to Cardiff Central from each station.

Rail 7: Service frequency enhancement: South Wales Main Line

Service frequencies from Pontyclun are currently inadequate and therefore this option would have a beneficial albeit localised impact. Higher frequencies provide the opportunity to achieve a better mix of fast and stopping services which would, in turn, facilitate timetable improvements

for Pontyclun Station, whilst also strengthening the case for a new station at Junction 34 (Rail 8).

Whilst it is feasible to increase frequencies, achieving the Welsh Government's benchmark of 4 trains per hour will be challenging. Achieving this option would require an increase in the volume of rail services operating between Cardiff and Bridgend. Platform capacity at Cardiff Central is limited for additional terminating services although there is potential to extend up to two existing terminating services to provide additional services per hour west of Cardiff.

The case for increased frequency on the South Wales Main Line is broader than the issues relating to the North West Corridor and the Welsh Government has set out the strategic case for improving services on this line.

Rail 8: New Station: Junction 34 Parkway (Miskin)

A new station at Junction 34 has the potential to improve rail links from Southern Rhondda Cynon Taf and reduce traffic flows on some of the most congested parts of the North West Corridor. This option has been shortlisted in two separate WelTAG Stage 2 assessments: the M4 (Junction 34) to A48 Transport Improvements study, and; the A470/M4 Corridor Congestion Study.

The majority view of stakeholders is that Junction 34 Parkway would be complementary to, rather than competing with, a Junction 33 park and ride (P&R 1). This option would require the delivery of capacity measures at Junction 34 and/or a new link road from the M4 to the A48. The case for the new station may also depend upon increased service frequencies on the South Wales Main Line.

4.3.2.2 Rejected Options

The following existing rail network option was rejected:

- **Rail 2: New Station: St. Fagans** – This station has a limited local catchment area and would fail to address the transport issues in the North West Corridor. Transport connections to the station are potentially problematic and the presence of a new station could have a negative impact on the local road network. A recent Welsh Government station prioritisation exercise considered but did not shortlist this station.

4.3.3 New Tram-train Routes

4.3.3.1 Shortlisted Options

Tram-train 2: City Line and Safeguarded Corridor connecting into existing platforms at Cardiff Central with track layout modifications at Cardiff West Junction

A tram-train route via the Safeguarded Corridor, connecting with the City Line, provides the best opportunity to provide a mass transit solution offering competitive journey times and a high quality of service. Tram-train route via the Safeguarded Corridor achieve the highest scores in respect of transport, economic and social impacts. From an environmental perspective, improvements in air quality and greenhouse gases would need to be weighed against other impacts such as impacts on landscape, biodiversity and the water environment.

The development of a new tram-train corridor could be used to enhance the active travel network in Cardiff although this will require careful design both to incorporate pedestrian and cycleways and to provide sufficient and appropriately located crossings.

Tram-train 2 could provide a relatively low-cost solution to the capacity constraint at Cardiff West Junction / Cardiff Central. Initial indications are that this option would provide the capacity required for the North West Corridor without any degradation in capacity on existing routes. However, this option would preclude the option of connecting the City Lines / North West Corridor to a new route to Porth Teigr.

Detailed assessment of the installation of the track connection at Cardiff West Junction and signalling requirements is required at WelTAG Stage 2. Operational modelling of the proposal will need to be undertaken in consultation with TfW Rail Services and Network Rail.

Tram-train 3: City Line and Safeguarded Corridor connecting into new platforms to the south of Cardiff Central

This option achieves similar scores to tram-train 2 in respect of its economic, social and environmental outcomes. The engineering constraints to delivering this option, whether at-grade or grade-separated, are potentially significant and this option would attract higher capital costs than tram-train 2 (connecting into existing platforms). Nevertheless, if fully segregated, this option would do most to release capacity on other lines and offers the potential to provide a direct connection to Porth Teigr, if those proposals are also progressed. It would also reduce pressure on Cardiff Central in respect of passenger congestion within the station, on platforms, walkways and at gate-lines. At WelTAG Stage 2, an assessment is required to establish whether these benefits outweigh the additional costs.

Tram-train 9: City Line and Safeguarded Corridor via a new on-street route, potentially via Penarth Road and Sloper Road before connecting to City Line near Ninian Park

This option negates the issues at Cardiff West by diverting North West Corridor tram-trains further west of the Canton depot area via an on-street route. It also provides the opportunity to connect with a new line to Porth Teigr at Cardiff Central and/or Callaghan Square.

A disadvantage is that the more indirect, on-street route would increase journey times for all passengers except those using the stops on this section. It also introduces potential operational issues arising from delays from on-street running that could affect the CVL network.

An on-street route provides the opportunity to penetrate new areas of the city and serve trip generators such as the Cardiff City Stadium. However, there is potential for operational issues during event days at Cardiff City Stadium given the volume of pedestrian traffic generated. Existing accesses would need to be maintained and sufficient road space provided for cars and buses on what are heavily trafficked city centre roads. Furthermore, existing public transport provision in this area is reasonable and will be enhanced by the increased services on the City Line as a result of the North West Corridor implementation.

Whilst this option is technically feasible, it is likely to be challenging to deliver given the constrained space available for a tramway and the potential for disruption during construction of the on-street infrastructure. This is considered a high cost option and may only be considered if the options connecting into Cardiff Central via the City Line prove not to be feasible.

Tram-train 12: Creigiau to Pontyclun Station via Cross Inn

The extension to Pontyclun has potential to follow the disused rail route. There is likely to be space to operate tram-trains into new platforms parallel to the heavy rail platforms at Pontyclun Station providing an effective interchange with services operating on the South Wales Main Line. The design of this option will need to consider how the existing cycleway can be retained and segregation of areas either side of the rail line minimised.

It should be considered that journey times from Pontyclun to Cardiff Central via the South Wales Main line would significantly outperform the tram-train route via the North West Corridor. Should services on the South Wales Main Line be improved, demand for end-to-end trips via the North West Corridor may be limited and therefore this option would need to be justified on the basis of trips between intermediate stations and trips interchanging at Pontyclun to travel west on the South Wales Main Line. Engineering feasibility and environmental impact of the new route requires further assessment at WelTAG Stage 2.

Tram-train 13: Creigiau to Beddau strategic site via Cross Inn

A North West Corridor tram-train route could be extended to Beddau, potentially via the disused rail route. The line would serve a large existing rail catchment area whilst also connecting to the Strategic Site near Beddau. As such, this option could have a substantially positive impact on demand for new housing and employment development in this part of Rhondda Cynon Taf. The primary challenges to achieving this option are likely to be the need for the line to cross the A473 at two locations. As for the other route, this option brings both opportunities and challenges in respect of the provision of active travel.

4.3.3.2 Rejected Options

The following tram-train options were rejected:

- **Tram-train 1: City Line and Safeguarded Corridor connecting into existing platforms at Cardiff Central with low cost capacity solution** – The low-cost approach would provide insufficient capacity for a new North West Corridor. Changing the train planning rules could provide capacity for two additional services through Cardiff West Junction and may be a possibility for the purposes of an incremental improvement in frequency on the City line. However, it is insufficiently robust for the purposes of a new branch line and, in any case, fails to provide the desired frequency of four trains per hour;
- **Tram-train 6: City Line and Safeguarded Corridor via a new Taff Crossing and on-street section, potentially along Pendyris Street, into new platforms to the south of Cardiff Central** – This option has been rejected due to feasibility and cost issues. There are a number of complexities associated with this option including: the requirement for a new Taff Crossing; potential conflicts with plans for the Central Quay development to the south of Cardiff Central Station; complexities associated with the on-street section potentially along Pendyris Street and limitations on road space; the requirement for a road crossing across the heavily trafficked Clare Road; complexities associated with the connection to the existing tracks at Clare Road; and
- **Tram-train 14: Creigiau to Cross-Inn Only** – Extending the line to Cross Inn avoids the costs and complexities of the options which extend further to Pontyclun or Beddau but would deliver only modest benefits given that it would fail to penetrate the major population centres in southern Rhondda Cynon Taf.

4.3.4 New Bus Rapid Transit Routes

4.3.4.1 Shortlisted Options

BRT1 – Central Cardiff to Junction 33 via Leckwith Road and A4232

This option would improve bus journey times and the reliability of bus services between the Strategic Sites to the north of Junction 33 and Cardiff's city centre. In combination with BRT8 it would also significantly improve bus journey times from Rhondda Cynon Taf to the city centre. The extent of the improvement will depend on the level of bus segregation which is possible. If

bus services are subject to the traffic congestion and unreliability that is currently present on this corridor then the services may be unattractive to passengers. The engineering challenges associated with achieving sufficient segregation are likely to be significant given that the provision of bus segregation is likely to require widening of sections of the A4232. These issues are made more challenging because part of the route – including the more congested sections- are raised sections. Because of the uncertainties relating to the scope of bus segregation measures, the costs of this option are highly uncertain at this stage.

This route would maximise the benefits of a strategic park and ride at Junction 33 (P&R1), helping to achieve a small reduction in traffic on the A4232 and on other routes in Cardiff. Assuming electrically powered vehicles, this would contribute to improvements in air quality and reduced greenhouse gas emissions. No negative environmental impacts have been identified at this stage although this assumes no widening of highway boundaries for the purposes of bus priority measures.

BRT1A A4232 Bus Gate and Spur to Plasdwr

This option would also improve bus journey times and journey time reliability for parts of St Fagans and Plasdwr. This option merits further investigation at WelTAG Stage 2. However, further work is required to establish the cost, feasibility and impact of this option. Potentially negative environmental impacts have been identified in respect of the construction of the new bus gate, slip roads and construction of a bus-way along St Brides Road.

BRT4 Central Cardiff to Plasdwr via Cowbridge Road East, Waun-gron Park, Fairwater

This option would improve bus journey times and journey time reliability for inner areas of the North West Corridor and Plasdwr. Should a tram-train option be progressed, it is considered that this BRT route would be complementary as it would serve intermediate locations and would provide better penetration into residential areas, particularly within Plasdwr itself. As for the other BRT options the impact and cost are dependent on the level of bus segregation delivered and a broad spectrum of options exist in this respect.

BRT8 Junction 33 to Talbot Green via A4119

This option works in combination with BRT1 although bus services could also continue along the A4119 towards Radyr and Plasdwr. It would provide enhanced bus journey times and reliability for areas of Rhondda Cynon Taf. It would contribute to lower overall levels of car travel and it therefore scores positively in respect of air quality and greenhouse gas emissions. The environmental impacts of new bus infrastructure would need to be considered during WelTAG Stage 2 as the design of this option is progressed.

4.3.5 Other Options

4.3.5.1 Shortlisted Options

P&R 1: Junction 33 Strategic Bus Park and Ride

This park and ride site effectively forms part of the BRT route via the A4232 (BRT 1). Plans are already in place to deliver this site as part of the development of Strategic Site D. The attractiveness of the park and ride service will depend on the quality of bus services and the level of segregation achieved under BRT 1. This option would contribute to reducing car travel and would therefore deliver improvements in air quality and greenhouse gases.

Rail 5: Waun-gron Park Bus:Rail and Active Travel Interchange

A bus:rail and active travel interchange at this location aligns with the shortlisted BRT option serving Plasdwr (BRT 4). The interchange could provide connections with east-west bus routes via the A48 as well as the City Line rail services. Increased service frequencies on the City Line would increase the attractiveness of this interchange. Providing this interchange could be an important measure during the period in advance of the delivery of a new mass transit solution for the Safeguarded Corridor.

Rail 6: Radyr Station Bus:Rail and Active Travel Interchange

From December 2023, a frequent service of 12 trains per hour will operate from Radyr. At present, bus services do not connect directly with the station. Strengthening this interchange could be an important measure during the period in advance of the delivery of a new mass transit solution for the Safeguarded Corridor. Further engagement with bus operators is required to establish the appetite to operate services from the Radyr and Plasdwr area to Radyr station should interchange facilities be provided.

4.4 Final Shortlist

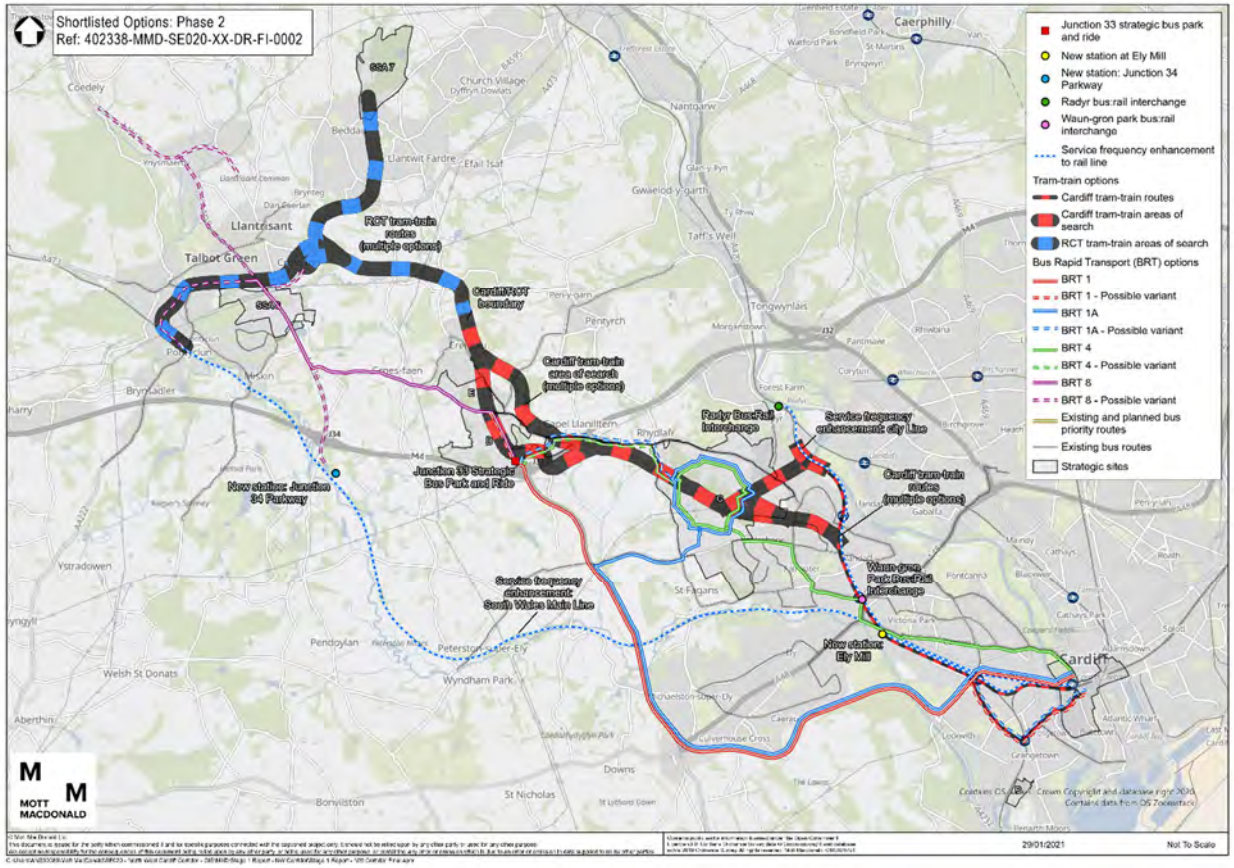
As noted, for the most part, the shortlisted options are complementary. Therefore, the shortlisted options should be seen as comprising an overall strategy for improving transport in the North West Corridor. The final shortlist is listed below and illustrated in Figure 4.1. The shortlist map is also provided in appendix C. Consideration of the phasing of implementation of shortlist options is provided in the Management Case.

Shortlisted options:

- **Existing rail network:**
  - Service frequency enhancement: City Line;
  - New Station: Ely Mill;
  - Service frequency enhancement: South Wales Main Line; and
  - New Station: Junction 34 Parkway (Miskin).
- **New tram-train route:**
  - City Line and Safeguarded Corridor:
    - Connecting into existing platforms at Cardiff Central with track layout modifications at Cardiff West Junction;
    - Connecting into new platforms to the south of Cardiff Central;
    - Via a new on-street route, potentially via Penarth Road and Sloper Road before connecting to City Line near Ninian Park;
  - Creigiau to Pontyclun Station via Cross Inn; and
  - Creigiau to Beddau via Cross Inn.
- **New Bus Rapid Transit route:**
  - Central Cardiff to Junction 33 via Leckwith Road and A4232;
  - A4232 Bus Gate and Spur to Plasdwr;
  - Central Cardiff to Plasdwr via Cowbridge Road East, Waun-gron Park, Fairwater; and
  - Junction 33 to Talbot Green via A4119.
- **Other Options:**
  - Junction 33 Strategic Bus Park and Ride;

- Waun-gron Park Bus:Rail and Active Travel Interchange; and
- Radyr Station Bus:Rail and Active Travel Interchange.

Figure 4.1: Shortlisted Options at WelTAG Stage 1[45]



Source: Mott Macdonald

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4.5 Well-being Assessment

This section identifies a number of impact areas and potential metrics for measuring the well-being of the Scheme at a later stage in the study. This shows that the Scheme is anticipated to positively contribute towards each of the Well-being Goals as established in the Well-being of Future Generations (Wales) Act 2015.

Table 4-5: Well-being Impact Areas

Source: Mott Macdonald

Wellbeing Goal	Relevant Scheme Objectives	Impact Areas	Potential Metrics
A Prosperous Wales	1) Reduce public transport journey times between central Cardiff, Cardiff's North West Corridor and the southern end of Rhondda Cynon Taf	Journey times	Reduction in passenger journey time
	2) Provide frequent, reliable and high quality mass transit services in line with the Welsh Government's principles for connectivity in Wales	Frequent and reliable services	Improved passenger service levels
	3) Ensure the corridor is integrated with the wider Cardiff Capital Region Metro and existing assets	Integration with the Metro	Number of interchanges at Metro nodes
	4) Facilitate the delivery of employment and housing in Cardiff's North West Corridor and southern Rhondda Cynon Taf	Employment and housing land	Increased levels of employment land, housing completions within close proximity of interventions
	5) Improve the personal affordability of passenger transport in the Cardiff Capital Region	Affordability	Stakeholder engagement, number of people reporting price as a barrier to public transport use
	6) Deliver a system that is accessible for all	Accessibility	Stakeholder engagement/ survey
	9) Deliver a system which maximises the commercial viability of public transport in the North West Corridor	Commercial viability	Profit impact
A Resilient Wales	1) Reduce public transport journey times between central Cardiff, Cardiff's North West Corridor and the southern end of Rhondda Cynon Taf	In-vehicle journey times will reduce, causing a decrease in emissions	AQMA monitoring or equivalent air pollution monitoring
	7) Stimulate mode shift in line with the LDPs and help move towards a 50% sustainable transport mode share	Modal shift	Decreased numbers using the private car, increased public transport usage
	8) Improve air quality within the corridor with the aim of delivering a system with zero emissions at point of use	Air quality	AQMA monitoring or equivalent air pollution monitoring
A healthier Wales	7) Stimulate mode shift in line with the LDPs and help move towards a 50% sustainable transport mode share	Modal shift will cause increased take up of active travel for first and last miles	Passenger numbers, number using active travel for first and last mile
	8) Improve air quality within the corridor with the aim of delivering a system with zero emissions at point of use	Air quality	AQMA monitoring or equivalent air pollution monitoring
A More Equal Wales	1) Reduce public transport journey times between central Cardiff, Cardiff's North West Corridor and the southern end of Rhondda Cynon Taf	Journey times	Reduction in passenger journey time
	2) Provide frequent, reliable and high quality mass transit services in line with the Welsh Government's principles for connectivity in Wales	Frequent and reliable services	Improved passenger service levels
	3) Ensure the corridor is integrated with the wider Cardiff Capital Region Metro and existing assets	Integration with the Metro	Number of interchanges at Metro nodes
	5) Improve the personal affordability of passenger transport in the Cardiff Capital Region	Affordability	Stakeholder engagement, number of people reporting price as a barrier to public transport use
	6) Deliver a system that is accessible for all	Accessibility	Stakeholder engagement/ survey
A Wales of cohesive communities	1) Reduce public transport journey times between central Cardiff, Cardiff's North West Corridor and the southern end of Rhondda Cynon Taf	Journey times	Reduction in passenger journey time
	2) Provide frequent, reliable and high quality mass transit services in line with the Welsh Government's principles for connectivity in Wales	Frequent and reliable services	Improved passenger service levels
	3) Ensure the corridor is integrated with the wider Cardiff Capital Region Metro and existing assets	Integration with the Metro	Number of interchanges at Metro nodes
	4) Facilitate the delivery of employment and housing in Cardiff's North West Corridor and southern Rhondda Cynon Taf	Employment and housing land	Increased levels of employment land, housing completions within close proximity of interventions
	5) Improve the personal affordability of passenger transport in the Cardiff Capital Region	Affordability	Stakeholder engagement, number of people reporting price as a barrier to public transport use
	6) Deliver a system that is accessible for all	Accessibility	Stakeholder engagement/ survey
	7) Stimulate mode shift in line with the LDPs and help move towards a 50% sustainable transport mode share	Modal shift	Decreased numbers using the private car, increased public transport usage
A Wales of vibrant and thriving Welsh language	3) Ensure the corridor is integrated with the wider Cardiff Capital Region Metro and existing assets	Integration with the Metro, improved access to Welsh cultural assets	Welsh cultural trip attractors visitor numbers
A Globally Responsible Wales	2) Provide frequent, reliable and high quality mass transit services in line with the Welsh Government's principles for connectivity in Wales	Frequent and reliable services will encourage modal shift	Improved passenger service levels, passenger numbers
	7) Stimulate mode shift in line with the LDPs and help move towards a 50% sustainable transport mode share	Modal shift	Decreased numbers using the private car, increased public transport usage
	8) Improve air quality within the corridor with the aim of delivering a system with zero emissions at point of use	Air quality	AQMA monitoring or equivalent air pollution monitoring

5 Financial Case

The financial case considers the affordability of the proposals in respect of capital and revenue costs. At WelTAG Stage 1 this is based on order of magnitude cost estimates with more detailed cost and affordability assessments undertaken at Stage 2.

5.1 Introduction

The financial case demonstrates the affordability of the options, and the potential source of funding in order to identify any potential funding issues throughout the lifespan of the scheme.

5.2 Option Costs and Risk Assessment

This study considers a broad range of options across multiple transport modes. In the absence of detailed cost estimates, the financial assessment employs cost bands rather than point estimates. A similar approach has been taken to the assessment of operating costs and subsidy requirements. The assessment of cost and cost risk for all of the shortlisted options is summarised in Table 5-1.

Table 5-1: Cost estimates and commentary

Option	Description	Capital cost	Operating cost and subsidy requirement	Commentary
Rail1	Service frequency enhancement: City Line	N/A	£1m- £3m pa	The capital cost of this option will depend on whether changes to the track layout at Cardiff West Junction are required. If the performance impacts of operating additional services within current infrastructure are deemed to be acceptable then it may be possible to deliver this option with no capital investment. The operating cost estimate given here does not take account of the off-setting revenue impact of improved service frequency. Nevertheless, an overall increase in subsidy requirement is expected.
Rail 4	New station: Ely Mill	£0 to £10m	<£100k pa	A new two platform station could be expected to cost less than £10m. By comparison, Pye Corner station in Newport was delivered at a cost of £3.7m in 2014. The revenue impact of Ely Mill station is difficult to assess without more detailed work. Demand forecasting for the New Stations Prioritisations Exercise suggested Ely Mill could attract 100,000 passengers with only 12,000 abstracted from neighbouring stations. This might suggest the station will have an overall positive financial impact although this would need to be weighed against the revenue impact of longer journey times for through passengers.
Rail 7	Increased service frequency on SWML	N/A	£5m- £10m pa	As for the City Line frequency enhancement, no capital costs have been assumed at this stage although the cumulative effect of increased services to/from Cardiff Central could trigger the requirement for capital investment, for example, the delivery of a new Platform 0 at Cardiff Central. The operating cost analysis assumes two additional trains between Cardiff and Bridgend and does not take account of any offsetting increase in fare revenue. In practice there are a variety of options for new services on the South Wales Main Line and the case for these services is much broader than any costs and benefits relating to the North West Corridor.

Rail 8	New park and ride station at J34	£10m - £25m	<£100k pa	This station is likely to attract a high capital cost given the requirement for associated road access improvements, parking areas and interchange facilities. By comparison the recently opened Worcester Parkway station cost £22m, although it should be noted that this station has platforms on two intersecting rail lines. A key area of uncertainty for this option is the cost of highway works at Junction 34. Improvements to Junction 34 are likely to have broader benefits and therefore may not be borne by the station. As for all new station projects, in respect of ongoing revenue impacts, the increase in rail demand needs to be weighed against changes in the timetable to accommodate the extra stop and it is premature to draw any conclusions in that respect at this stage.
Tram-train 2	City Line and Safeguarded Corridor connecting into existing platforms at Cardiff Central	£100m - £250m	£5m - £10m pa	A new tram-train route is a high cost option and would represent a major investment in Wales' public transport network. A high degree of caution should be applied when considering the potential cost of this option until further design work has been undertaken. This approach – connecting into existing platforms – is likely to offer the best potential to minimise the costs of capacity measures at Cardiff West Junction / Cardiff Central. The operation cost estimate is based on a high-level assessment of the resource requirements of a four train per hour timetable and excludes off-setting revenue impact. Revenue impacts of the new line are difficult to predict but an overall increase in subsidy requirement of the CVL network is expected. Operating costs are likely to be on the lower end of this range.
Tram-train 3	City Line and Safeguarded Corridor connecting into new platforms to the south of Cardiff Central	£250m-£500m	£5m - £10m pa	As for 'Tram-train 2' this is a high cost option and would represent a major investment in Wales' public transport network. This approach – whereby a new connection would be provided into platforms to the south of Cardiff Central – could have a significant impact on the cost of the project, although further work is required to quantify this with any degree of accuracy. Operating costs are likely to be on the lower end of this range.
Tram-train 9	City Line and Safeguarded Corridor via new on-street route, potentially via Penarth Road and Sloper	£250m-£500m	£5m- £10m pa	Whilst this option eliminates the requirement for capacity enhancements at Cardiff West Junction / Cardiff Central. The inclusion of a significant section of on-street route will introduce significant additional complexity and cost. Operating costs are likely to be on the lower end of this range.

	Road before connecting to City Line near Ninian Park			
Tram-train 12	Creigiau to Pontyclun Station via Cross Inn	£100m - £250m	£3m - £5m pa	As for the route in Cardiff, a new tram-train is a high cost option and would represent a major investment in Wales' public transport network. A high degree of caution should be applied when considering the potential cost of this option until further design work has been undertaken. Extending the line to either Pontyclun or Beddau, or delivering a Y-shaped network, is expected to result in an overall increase in the CVL subsidy requirement.
Tram-train13	Creigiau to Beddau via Cross Inn	£100m - £250m	£3m - £5m pa	
BRT1	New BRT Route: Central Cardiff to Junction 33 via Leckwith Road and A4232	£50 to £100m	£100- £500k subsidy	The capital cost of the BRT options is very challenging to predict with any accuracy at this stage and may increase substantially. All things being equal, new BRT routes are likely to be significantly less costly than tram-train route. However, costs will vary depending on the level of bus segregation implemented and therefore further design work will be required before useful cost estimates can be provided. An iterative process is likely to be taken to identifying the optimum level of bus segregation based on the benefits that investment is likely to deliver. Ultimately, the cost will depend on the level of quality of service funders wish to deliver given budget constraints. At this stage, a higher capital cost has been put against those options which involve the provision of new busways (for example, the A4232 Bus Gate and spur) or which involve the provision of bus priority measures in more built-up areas. On some corridors, bus services may be operated on a commercial basis and therefore will require no additional direct subsidy, although it should be noted that even in these cases there may be an indirect effect on Government funding through, for example, concessionary fares payments. Where there are no existing commercial services, subsidy will be required to operate or at least pump-prime services. As for capital cost, the ongoing costs of bus measures will depend on the level and quality of service that is delivered. It is envisaged that a 'BRT' style service would involve frequent service operated using high quality, more environmentally friendly vehicles and operators would need to be incentivised to provide this. As described in the commercial
BRT1A	New BRT Route: A4232 Bus Gate and Spur to Plasdwr	£25m - £50m	£100- £500k subsidy	
BRT4	New BRT Route: Central Cardiff to Plasdwr via Cowbridge Road East, Waun-gron Park, Fairwater	£25m - £50m	£100- £500k subsidy	
BRT8	New BRT Route: Junction 33 to Talbot Green via A4119	£25m - £50m	£100- £500k subsidy	

				case, delivering such services could involve use of directly tendered services or enhanced bus quality partnerships which will require on-going public funding.
Rail 5	Waun-gron Park Bus:Rail and Active Travel Interchange	£0 to £10m	<£100k pa	Investment in new interchange facilities will require one-off capital investment. The costs of these measures may not be substantial in the context of the overall investment required for the Corridor. Ongoing costs of maintenance are likely to be relatively modest. This infrastructure could be maintained by the local authority as is the case with bus stops, or alternatively, in the case of bus:rail and active travel interchange, the requirement to maintain interchanges could be placed on the station owner.
Rail 6	Radyr Station Bus:Rail and Active Travel Interchange	£0 to £10m	<£100k pa	

5.3 Funding and Affordability

As described in the Strategic Case, the North West Corridor has significant potential for future housing and employment development. Facilitating development and contributing to economic growth forms part of the objectives for the Corridor. Much of the development planned for the Corridor, particularly in Cardiff, has already been allocated and funding contributions secured for transport investments, many of which form the baseline for this strategy. However, in the longer term, the second generation of sites in the Corridor provide a further unity to harness the value of development. It is recommended that a more detailed assessment of development potential and the most appropriate mechanisms for capturing the value of land use change is undertaken in WelTAG Stage 2.

Whilst there are opportunities to capture the value of future development, investments of the scale proposed for the North West Corridor will ultimately require public sector grant funding from the Welsh and UK Governments. Moreover, the likelihood is that the public transport measures will require an increase in overall ongoing public transport subsidy. Nevertheless, there are a variety of funding sources and approaches that could form part of the overall approach to funding transport improvements in the Corridor.

The approach to funding and the affordability of the proposals will need to be assessed during WelTAG Stage 2 at the point where preferred options have been identified, costed and programmed. The following broad mechanisms should be considered:

- **Welsh Government Capital Funding** - Direct capital funding from the Welsh Government is likely to be the primary mechanism for the delivery of new large-scale infrastructure;
- **Local Authority Transport Grant Funding** – This is not an alternative funding source per se as the funding ultimately derives from Welsh Government capital budgets. However, for smaller scale projects and project development phases, Welsh Government funding can be allocated to local authorities via the Local Transport Grant process;
- **Welsh Government Non-Profit Distributing Model (NPD)** – A form of public-private partnership funding but the NPD involves a fixed rate return for private investors with surplus profits retained by the public sector;
- **Prudential borrowing** - Public bodies are able to raise capital through the Public Works Loan Board (PWLB) and pay off the loan through revenue spending;
- **City Deal Funding** – The Cardiff Capital Region City Deal comprises at £1.2bn programme of investment. One of the main priorities is the delivery of the South Wales Metro and £738m of the City Deal fund has been pre-allocated for the project. This will be split between the Valley Lines Electrification programme and the wider South Wales Metro scheme. This means that additional City Deal funding for major new transport infrastructure may be limited. A further £495m will be deployed through the Wider Investment Fund. Funds will be invested across three priorities of infrastructure, innovation and challenge (competitiveness interventions). Given the investment in the Metro, funding for transport projects via the Wider Investment Fund may be limited and priority will be given to those projects which create jobs and leverage private sector investment;
- **Central Government** – With the exception of the CVL network, rail infrastructure in Wales continues to be the responsibility of UK Government. The Government has established the Rail Network Enhancement Pipeline (RNEP) approach to funding rail enhancements. This replaces the previous five-year funding cycles. Successful projects progress through five stages – discover, develop, design, deliver and deploy – with decisions being taken to advance projects based on a business case. In particular, the RNEP process is likely to be appropriate for enhancements to the South Wales Main Line and ‘Cardiff Central Station’

(passenger and train capacity) and 'South Wales journey time improvement (Swansea to Cardiff)' have already been included in the cohort of schemes at the 'develop' stage;

- **New Stations Fund (NSF)** – NSF 3 is a £20m fund for investment in new station projects in England and Wales. The amount of funding is severely restricted given that it covers the whole of England and Wales. Nevertheless, the current or future rounds of NSF funding could be a possible avenue to secure UK Government funding or funding contributions for the new station projects identified in this report: Ely Mill (City Line) and Junction 34 (South Wales Main Line);
- **Restoring Your Railway Fund** – The UK Government has been seeking proposals for the restoration of lost rail connections which could apply to the re-use of the Safeguarded Corridor and other disused lines further north. Whilst the deadline for the submission of proposals in 2020 has passed, this policy suggests that the UK Government may be willing to invest in the re-opening of rail lines. It should be considered, however, that there are likely to be many competing proposals for this funding; and
- **Developer Contributions and Land Value Capture** – In respect of the existing Strategic Sites in Cardiff (Sites C, D and E), developer contributions to transport infrastructure improvements have already been negotiated and allocated to projects. In respect of the shortlisted schemes, this includes a requirement to deliver a strategic bus park and ride site at Junction 33. In the longer term, it will be vital to ensure that transport and development within the Corridor are aligned such that transport investment is delivered in a way that facilitated development and, in turn, the value of future development is harnessed to contribute to funding transport. In the context of the south east Wales economy, where the private sector case for investment may be marginal, a balanced approach needs to be taken that avoids stymying development.

  A strategic approach is taken to securing developer contributions within the Corridor. There are a range of mechanisms through which developer contributions can be secured or through which changes in land value can be captured, such as:

  - **Planning obligations** (i.e. Section 106 Agreements) are agreements made between a developer and the Local Planning Authority (LPA) designed to meet the concerns an LPA may have about meeting the cost of providing new infrastructure made necessary by the development;
  - The **Community Infrastructure Levy (CIL)** is a locally determined, fixed-rate development charge designed to help finance the infrastructure needed to deliver infrastructure to support the development of the affected area. Responsibility for legislation related to the CIL has been devolved to the Welsh Government. Rhondda Cynon Taf is one of only three local authorities in Wales to introduce CIL. CIL is not currently in operation in Cardiff. Funds raised from CIL could be ring fenced for transport projects in the Corridor; and
  - **Business Rates Retention / Tax Increment Financing (TIF)** permits local authorities to borrow money for infrastructure projects against the anticipated increase in tax receipts resulting from the infrastructure. In the UK, TIFs take the form of increasing the proportion of business rates that are retained by local authorities, which in turn expands the authorities' borrowing capacity. TIF is likely to be suitable only where it is possible to clearly identify the area that is expected to benefit from the transport scheme, and this could be applicable to some projects in the North West Corridor.

6 Commercial Case

Initial consideration has been given to the possible commercial delivery routes for key interventions proposed for the North West Corridor.

6.1 Introduction

The Commercial Case provides information on the procurement strategy for the project, risk allocation and any contractual arrangements. At WelTAG Stage 1, this information is provided in outline at a high level.

6.2 Possible Approaches

The commercial viability of all the shortlisted options for rail and tram-train have been considered and given a banding during the WelTAG scoring and can be seen in Table 4-4. The shortlisted options are wide ranging in terms of their scale and the modes of transport they cover. At this stage it is not practical to provide specific recommendations as to the route to delivery of all the options and therefore initial consideration has been given to the primary delivery options for key interventions.

6.2.1 Rail and Tram-train Options

6.2.1.1 New Stations on Existing Lines

For new stations on the existing rail network, the two main options for procurement are for Network Rail to lead on the design and construction of the station, or for TfW / Welsh Government to deliver the project directly. The most typical approach in the UK is for Network Rail's Infrastructure Projects (IP) division to design and deliver projects using existing supply chains. However, there are many examples of new stations that have been delivered by third parties and handed back to Network Rail as owner and operator of the rail network. This includes Pye Corner station, the most recent new station project delivered in Wales.

Whilst this applies to the proposed station at Junction 34, Ely Mill Station is located on the CVL network which will be transferred to TfW. This means that direct delivery by TfW is the most obvious route for Ely Mill. TfW's delivery mechanisms are discussed in relation to the tram-train options.

Whichever body is responsible for the delivery of the project, the broad contractual options are the same:

- Traditional – separates between design and construction processes;
- Design and Build – in which a single contract is tendered for both the design and construction of the infrastructure asset; and
- Early Contractor Involvement – this approach is used mainly for larger projects. The contractor is involved as an integrated member of the team in the early stages of a project, contribute to the design process, advising on the buildability and sequencing of the project with potential for greater innovation.

Within each of the above approaches there are a spectrum of options for the degree to which risk is transferred to the contractor and this would be a key consideration in later stages of the WelTAG process.

6.2.1.2 New Tram-train Route – Infrastructure

The current Phase 2 South Wales Metro project is being developed in accordance with the requirements of Schedule 3B of the Operator & Development Partner (ODP) Grant Agreement between TfW and Keolis Amey, dated 4 June 2018. The associated design development work has been undertaken by the ODP using a self-assuring process and the works are being delivered by the ODP and a range of Infrastructure Development Partners (IDPs) from TfW's STRIDE framework. The South Wales Central Metro will be fully transformed by December 2023, with the Treherbert, Aberdare and Merthyr branches complete by December 2022.

To facilitate the transformation the CVL, assets will transfer from Network Rail to Welsh Government on the 28 March 2020. In order for this to happen, the necessary regulatory bodies such as the Office of Rail and Road (ORR) and Department for Transport (DfT) have been satisfied by TfW and the ODP that Asset Transfer can take place and that the requirements of the Infrastructure Manager Services can be successfully undertaken by the ODP.

Schedule 3B to the Grant Agreement covers the contractual requirements in regard to CVL and South Wales Metro extendibility options. It is split into two type of services that the ODP can offer:

- Principal Infrastructure Services (CVL Phase 2); and
- Additional Infrastructure Services (Future phases of CVL or improvements elsewhere in Wales).

The Principal Infrastructure Services is the contracted scope of infrastructure work for the CVL Transformation (tram-train services on the Treherbert, Aberdare and Merthyr lines to Cardiff Bay and Cardiff Central, and Tri-mode services from Rhymney and Coryton to Barry and Penarth). There are 4 mechanisms that could realistically be used for procuring services to design and construct extensions to the CVL network:

- ODP self-delivery;
- ODP managing agent with IDP delivery;
- IDP only delivery (using STRIDE; detailed design could be done using the ECS framework); and
- Separate Major Scheme Procurement.

Under the general agreement, TfW can instruct the first two procurement routes using a mechanism called the Additional Infrastructure Services. Any Additional Infrastructure Services carried out by the ODP will be performed in accordance with the provisions of Schedule 3B, the Conditions of Contract for Infrastructure Services and the relevant Package Order. The ODP do not have to accept the Additional Infrastructure Services offered by TfW and in such circumstance could be offered to IDP contractors or TfW may decide to undertake a brand-new procurement.

There would also be an opportunity to use Early Contractor Involvement (ECI) in the development of the design and construction solutions as has been done on Phase 2 where an Infrastructure Delivery Alliance was created. The Alliance Agreement which is known as the 'Craidd Alliance' ('Core Alliance') includes gain / risk share between the alliance partners and a similar mechanism could be used for the proposed extensions.

6.2.1.3 Rolling Stock

There are two ways in which vehicles can be procured:

- Leasing (as per Heavy Rail and CVL Phase 2); and
- Client Purchase (As per UK Light Rail & Metro systems).

For CVL Phase 2 the tram-train vehicles will be leased although TfW has underwritten to retain the vehicles beyond the life of the GA. As part of the current rolling stock contract a further 10 tram-train vehicles are available. This may be insufficient for the purposes of the North West Corridor in combination with the demands of other projects and therefore a new procurement exercise is likely to be required. If a modified fleet of tram-trains is required this would, in any case, trigger the requirement for a new procurement exercise. As for the main fleet, it is likely that the vehicles would be leased by the ODP and underwritten by TfW.

Whilst the requirement for a new procurement exercise complicates the delivery of the North West Corridor and introduces additional risks relating to the cost of rolling stock, it is considered unlikely that any issues relating to the availability of tram-trains of the same type as the wider CVL fleet (albeit potentially modified).

6.2.1.4 Rail Services

New tram-train services on the City Line or a new North West Corridor would be operated by the ODP. The franchise period extends to 2033 and therefore it is envisaged that the service enhancements would be delivered, at least in part, during the current franchise period. These services have not been included as options under the current franchise. Nevertheless, there are mechanisms within the contract that deal with the negotiation of terms for enhanced services.

The shortlisted options also include enhanced frequency on the South Wales Main Line. These services could, in theory, be provided through any combination of the Wales and Borders, Great Western and Cross-Country franchises which currently operate services on the South Wales Main Line into Cardiff Central. The Great Western and Cross-Country franchises are the responsibility of the DfT. Franchise renewal offers an opportunity to look at service enhancements. The franchise renewal process is currently on hold pending the completion of the ongoing Rail Review (the 'Williams Review'). Whilst this process is ongoing, the Great Western Franchise has been extended to March 2023 and the Cross-Country Franchise extended to October 2020.

6.2.2 New Bus Rapid Transit Routes

6.2.2.1 Infrastructure

Bus infrastructure improvements are typically smaller scale projects which are delivered directly by local authorities through existing tender processes and frameworks. However, depending on the approach to packaging, the BRT options set out in this report could be relatively large-scale projects which could either be delivered by a local authority or TfW via the procurement routes set out in 6.2.1.1.

6.2.2.2 Bus Services

The provision of local bus services is largely governed by the Transport Act 1985. This means bus services are largely run on a commercial basis with local transport authorities having a statutory function around monitoring bus networks. The Act gave more powers to the Traffic Commissioners particularly around regulatory market entry requirements, specification of routes and timetables, as well as statutory 56-day notice periods.

There are other ways to improve and specify bus services:

- **Quality bus partnerships –** a voluntary agreement between the local transport authority and bus operators. Usually around matching infrastructure improvement with enhancement to bus services and quality;
- **Open tender –** local authorities can directly tender services which are not currently provided by commercial operators but which are seen as socially necessary;
- **De minimis agreements –** either extensions or additional services to existing commercially operated services; and
- **Planning agreements –** Usually part of the S106 agreements, a new service is provided as part of a development usually for a set period from a development phasing trigger point.

As of March 2020, the legislative framework for bus services is set to change in Wales. The Bus Services (Wales) Bill, which is going through the current term of the Welsh Assembly, will introduce a wider range of measures to improve local bus services. These include:

- Welsh Partnership Schemes;
- Franchising;
- Local authority-run bus services; and
- Improved information.

Table 6-1 summarises the main features of these:

Table 6-1: Proposed main features of the Bus Services (Wales) Bill

Heading	Description
Welsh Partnership Schemes	• Bill will allow local authorities to establish Welsh Partnership Schemes. • Provides a more comprehensive partnership scheme than the existing Quality Partnership Schemes and voluntary partnerships. • Delivers shared objective to improve bus service provision • Intention to introduce a workable partnership scheme which is a genuine collaboration between local authorities and bus operators
Franchising	• Changes to the procedure for developing and making a franchising scheme • Removal of the current limit on the duration for which a scheme can remain in place • Guidance to be provided • Provides a means of addressing challenges with bus service delivery in a local authority area and meeting the needs of the community
Local authority run bus services	• Allows local authorities to provide local bus services directly. • Allows local authorities to establish own company if they so choose. • Would be subject to the same competitive restraints as any other commercial operator • Same process – licensing and registration regime.
Improved information	• More consistent and reliable information data on bus services • Bus companies provide information about service they intend to vary or cancel • Allows local authorities to share prescribed information (in restricted circumstances). • Informs decision making and provision of alternative services where necessary

Source: Mott MacDonald

7 Management Case

Consideration has been given to the phasing of projects in the North West Corridor.

7.1 Introduction

The Management Case demonstrates the plans for delivery, monitoring and evaluation of the scheme. At this stage in the WelTAG process, this is very high level. This section also includes information on the proposed phasing of the North West Corridor scheme.

7.2 Phasing

7.2.1 Phasing Considerations

The options have been packaged across two phases. The phasing takes into account both demand side considerations (in particular the timescales for the delivery of strategic sites) and supply side factors (the realistic timescales for design development, statutory processes and construction, as well as dependencies with other projects e.g. CVL transformation).

This section is intended to provide a broad indication of the possible approach to phasing and the timescales involved and there may be considerable scope to bring forward the delivery of options if funding is available.

The schemes set out in the following sections are limited to public transport measures only.

7.2.2 Related Constructed Schemes

The following schemes have been constructed or are being constructed as of January 2020:

- A4119 Llantrisant Road bus priority measures, including an inbound bus lane, between Waterhall Road and the Goitre Fach development of Plasdwr;
- Inbound bus lane on the A4119 Llantrisant Road in Llandaff;
- Inbound bus lane on the Cathedral Road near Sophia Gardens; and
- Inbound and outbound bus lane and priority measure on Cowbridge Road East between Ely Bridge and Victoria Park.

The following improvements will be delivered as part of TfW's plans for the rail network:

- Conversion of the City Line to Bi-mode (electric via overhead cables and on-board batteries) tram-train operation as part of the broader CVL transformation;
- Operation of new Stadler City Link Metro tram-train vehicles from December 2023;
- Rolling stock improvements on the South Wales Main Line serving Pontyclun; and
- Extension of platforms lengths on the City Line stations to 80m.

7.2.3 Phase 1

Phase 1 covers the period in advance of the delivery of a new route, potentially on the disused rail corridor. Depending on the availability of funding, each of these shortlisted options could be delivered between 2020 and 2025. The interventions during this phase are centred on increasing services on the existing rail network, improvements to bus services and enhancing

the quality of interchange between car, bus, rail and active travel modes. Figure 7.1 and appendix C show the phase 1 shortlisted options.

An increase in service frequency on the City Line could be delivered in advance of the CVL transformation in December 2023. However, the CVL transformation provides a logical point at which to deliver the enhancement. Subject to further business case assessment, this enhancement could be included in the plan and allowance made for the additional rolling stock requirement.

A key determinant of the timescale and business case for this option will depend on the operational solution at Cardiff West Junction. As noted, in theory, increased frequency could be achieved without infrastructure changes at Cardiff West although this would come with increased performance risk. Further detailed operational analysis is required to establish whether the performance impacts are acceptable. This is covered in a separate study currently being delivered by Mott MacDonald. Alternatively, given the longer-term aspirations for the City Line, North West Corridor and the Barry and Penarth Lines, a more comprehensive capacity solution could be considered including the possibility of operating the City Line into new platforms to the south of Cardiff Central.

Enhancing the frequency of services on the South Wales Main Line may be out of the control of the Welsh Government because an attractive option of achieving this option would be to extend Great Western Rail services through Cardiff Central although other options exist. Increasing service frequency provides the flexibility to achieve a better mix of fast and stopping services which could benefit local stations including Pontyclun. The business case for enhancing services on the South Wales Main Line would be broader than considerations of the North West Corridor and the Welsh Government has set out the strategic case for enhancing the South Wales Main Line[46].

The interventions proposed for Phase 1 are shown in Figure 7.1 and appendix C and are listed below.

Shortlisted bus-based measures:

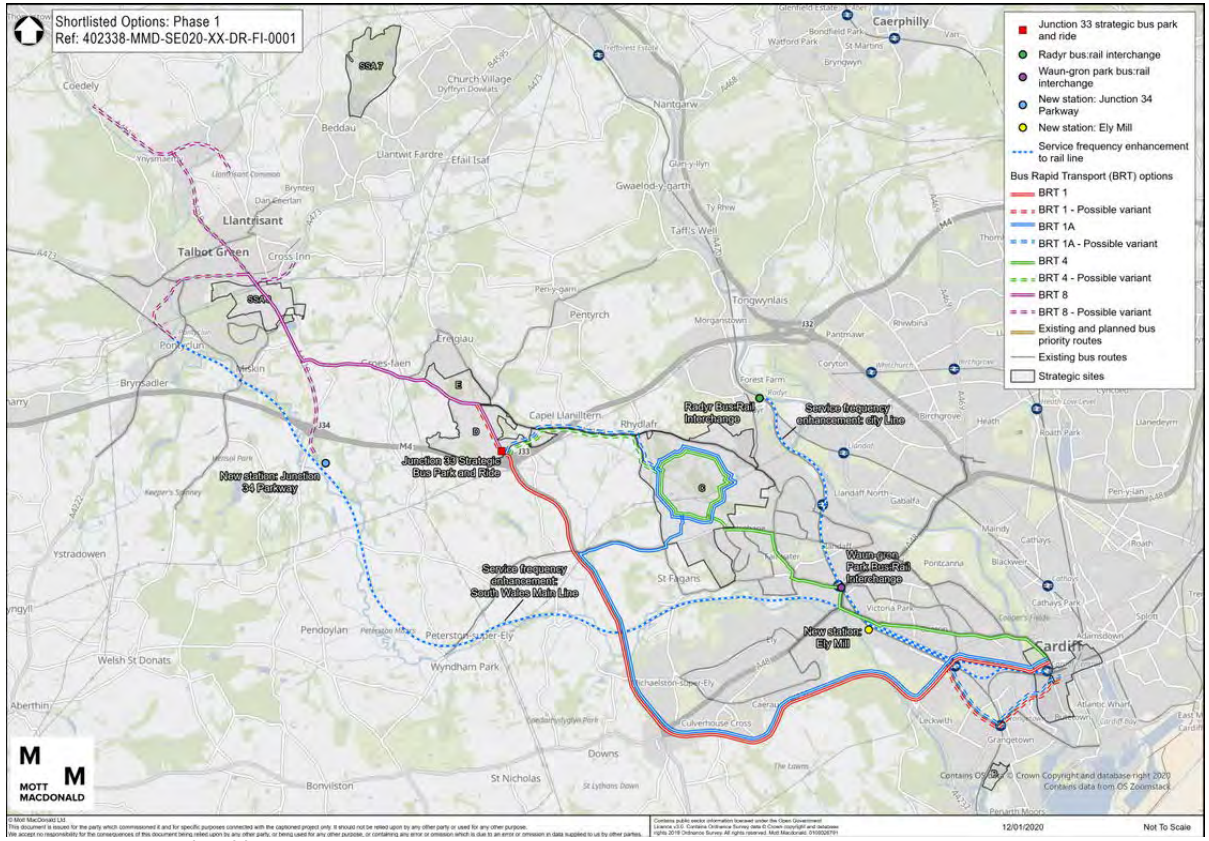
- P&R 1: Junction 33 Strategic Bus Park and Ride;
- Rail 5: Waun-gron Park Bus:Rail and Active Travel Interchange;
- Rail 6: Radyr Station Bus:Rail and Active Travel Interchange;
- BRT1: New BRT route from Central Cardiff to Junction 33 via Leckwith Road and A4232;
- BRT 1A: Bus gate and spur from A4232 (northbound and southbound) to Plasdwr (timescales dependent upon the main internal road network in Plasdwr in place);
- BRT4: New BRT route from Central Cardiff to Plasdwr via Cowbridge Road East, Waun-gron Park, Fairwater; and
- BRT8: New BRT route from Junction 33 to Talbot Green via A4119.

Shortlisted rail-based measures:

- Rail 1: Service frequency enhancement: City Line;
- Rail 4: New Station: Ely Mill;
- Rail 7: Service frequency enhancement: South Wales Main Line and therefore enhanced services from Pontyclun; and
- Rail 8: New Station: Junction 34 Parkway (Miskin).

[46] The Rail Network in Wales: The Case for Investment (Professor Mark Barry, September 2018)

Figure 7.1: Phase 1 Shortlisted Options[47]



Source: Mott Macdonald

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7.2.4 Phase 2

Phase 2 would be focussed on the development of the new tram-train route for the North West Corridor via the City Line and the Safeguarded Corridor. This is a high cost project which would represent a major investment in the South Wales Metro. The business case for the new line will need to be underpinned by passenger demand from Plasdwr and the Strategic Sites north of Junction 33 and south of Plasdwr in combination. If funding is available, this option could be open to passengers towards the end of this decade to coincide with the completion of phases 2 and 3 of the Plasdwr development which are adjacent to the Safeguarded Corridor.

As described in Section 3.6.1.1, consideration could be given to using the disused rail corridor for bus services (linked to BRT 4) in advance of the delivery of a new tram-train solution, although the costs of this approach and the potential for disruption may be prohibitive.

There are no practical barriers to delivering the full Y-shaped network from Cardiff Central to Rhondda Cynon Taf as a single project. However, to improve the affordability of the tram-train project, consideration could be given to a phased approach whereby the line is constructed between the City Line and Junction 33 or Creigiau initially, followed later by extensions into Rhondda Cynon Taf. Whether the North West Corridor tram-train route is delivered as a single project or delivered in phases is largely a policy decision that would need to be determined by funders.

Shortlisted Measures – Phase 2a

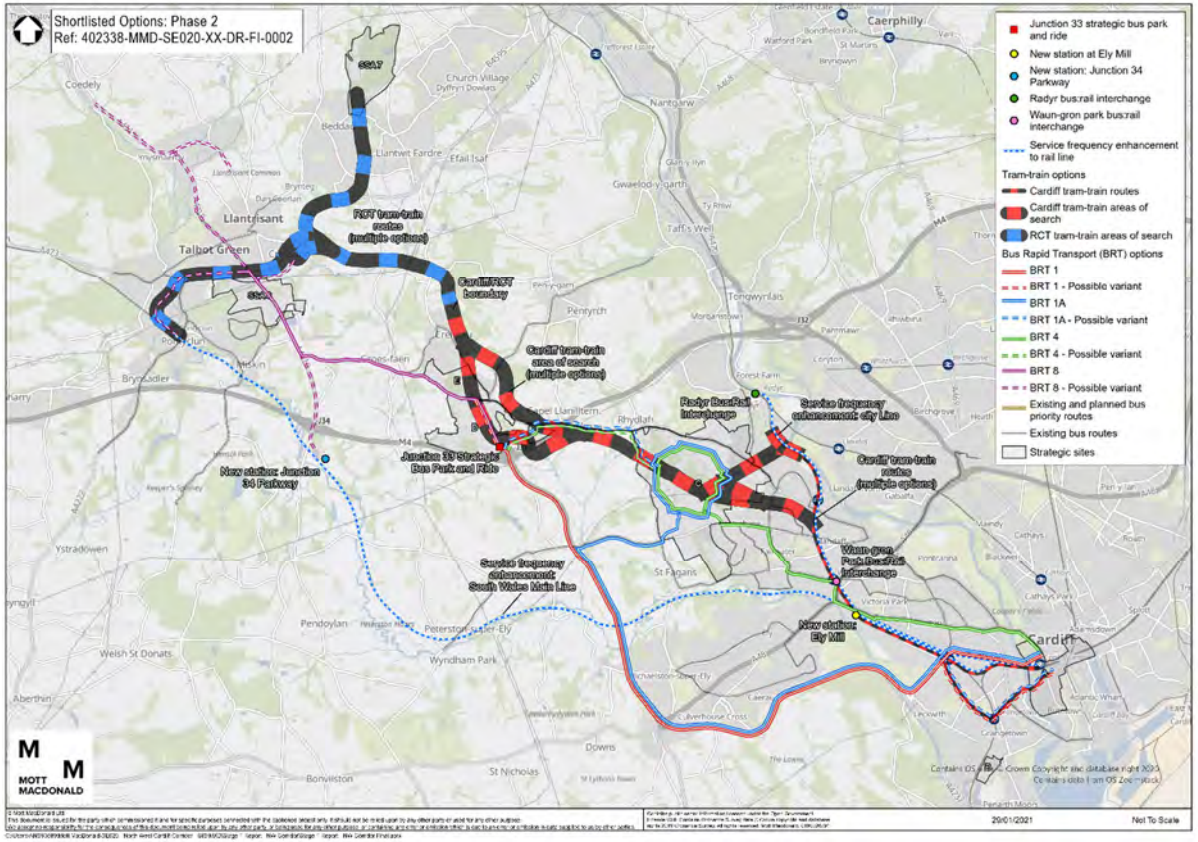
- Tram-train 2: City Line and Safeguarded Corridor connecting into existing platforms at Cardiff Central with a medium cost capacity solution;
- Tram-train 3: City Line and Safeguarded Corridor connecting into new platforms at Cardiff Central with a high cost capacity solution; and
- Tram-train 9: City Line and Safeguarded Corridor via a new on-street route, potentially via Penarth Road and Sloper Road before connecting to City Line near Ninian Park.

Shortlisted Measures – Phase 2b

- Tram-Train 12: Creigiau to Pontyclun Station via Cross Inn; and
- Tram-Train 13: Creigiau to Beddau via Cross Inn.

Figure 7.2 and appendix C show the interventions across Phases 1 and 2 combined.

Figure 7.2: Phase 2 Shortlisted Options[48]



Source: Mott Macdonald

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7.3 Project Management and Governance

The approach to management and governance would be determined on a scheme by scheme basis and therefore no specific consideration has been given to these arrangements at this stage. However, given the breadth of options identified, the following organisations may be involved in delivering transport improvements in the North West Corridor:

- Welsh Government;
- TfW
- TfW Rail Services;
- Cardiff City Council and Rhondda Cynon Taf CBC ;
- Cardiff Capital Region Transport Authority ;
- DfT;
- Network Rail;
- Other Rail Operators; and
- Bus Operators.

7.4 Planning and Consenting

Planning and consenting routes will differ across the package of measures identified for the Corridor and a planning strategy will be required for major projects as part of WelTAG Stage 2.

Network Rail, as a Statutory Undertaker, has certain permitted development rights across England, Wales and Scotland (although under separate legislation) to undertake certain works without further planning permission. However, the construction of new stations is not usually possible under permitted development rights. In such cases, a Transport and Works Act Order (TWAO) is most likely. Measures delivered on the highway network (such as BRT infrastructure) are likely to follow the TWAO route. The benefit of a TWAO is that it wraps up a host of planning conditions and allows scheme promotors to have flexibility to amend designs within the limits of deviations to account for any issues that arise as the scheme progresses.

A new tram-train route is likely to qualify as a Development of National Significance (DNS) as a rail project with a continuous length of more than two kilometres of track. The implications of the DNS process for the tram-train options is explored in greater detail below.

7.4.1 DNS Process

DNS is a consenting process for large infrastructure projects of national importance. The statutory basis for the DNS process is provided by the Planning (Wales) Act 2015, which amends the Town and Country Planning Act 1990, and the Developments of National Significance (Wales) Regulations 2016 (as amended) and subsequent Regulations.

An application for a DNS is dealt with by the Planning Inspectorate on behalf of Welsh Government by an appointed Inspector. The appointed Inspector will then consider evidence from the applicant, the Local Planning Authority and other statutory consultees and interested parties. Through this examination process, the Inspector will write a report to Welsh Ministers with a recommendation as to whether or not the application should be granted planning permission.

7.4.1.1 DNS Projects

The thresholds and criteria for whether a project could qualify as a DNS is set out within the Development of National Significance (Specified Criteria and Prescribed Secondary Consents) (Wales) Regulations 2016 (as amended).

The construction of a railway represents a DNS only if the railway (when constructed):

- Is wholly or partly in Wales;
- Is part of a network operated by an approved operator; and
- Includes a stretch of track that is a continuous length of more than two kilometres.

Additional clarification and details relating to this is set out within the 2016 Regulations and there is a separate criteria for rail freight interchanges, and nothing explicit relating to light rail projects.

It is recommended that the overall consenting approach is reviewed as the project evolves including consideration of the Town and Country Planning Act, Development Consent Order and TWAO processes.

7.4.1.2 Stages of DNS Application

There are four broad stages to the DNS Application process, and these are summarised below:

1. **Stage 1: Pre-application engagement and consultation**

This stage comprises of inception meetings and pre-application advice, whilst publicising draft proposals, and engaging with a range of stakeholders. It includes the submission of a notification of intention to submit a DNS, and a period of statutory pre-application consultation undertaken by the promoter.

2. **Stage 2: Application**

This stage relates to the submission of the application along with a Consultation Report. The Planning Inspectorate will then validate and consult on the application, whilst the Local Planning Authority prepares a Local Impact Report. Depending on the nature of the consultation period, there is then a time period for the Applicant to determine whether to amend the planning application.

3. **Stage 3: Examination**

The appointed Inspector commences examination of the application and determines the procedure to undertake this, which may be written representations, hearing or inquiry, or a combination of all three.

4. **Stage 4: Decision**

Following receipt of a report with a recommendation from the Inspector, the application is determined by the Welsh Ministers and a decision is issued.

The timescales for a DNS application depend on the nature of the project and the extent of consultation. This will require further assessment during WelTAG Stage 2.

7.5 Regulatory Processes (Tram-train Routes)

Specific and early consideration needs to be given to the regulatory processes involved in the development of a new tram-train route. This section sets out the potential regulatory requirements of the tram-train options.

7.5.1 Regulatory Classification of CVL Phase 2

The majority of the CVL will remain as a mainline railway in accordance with the Railways and Other Guided Transport Systems (Safety) Regulations 2006 (ROGS) and therefore will be subject to the Railways (Interoperability) Regulations 2011 (RIR) and the Technical Specifications for Interoperability (TSIs). The currently identified exceptions to this are as follows:

- The tram-train will be made exempt by the ORR (current tram-train listing only covers Network Rail Infrastructure);
- The Cardiff Bay branch from Queen Street South Junction to Cardiff Bay will require re-classification from the ORR as non-mainline as defined in ROGS. This branch will be operated using line of sight rules and classified as an “off-street tramway” in accordance with Light Rail Safety Standards Board (LRSSB) Tramway Principles & Guidance 2019. These works will require Safety Verification in accordance with ROGS and an Independent Competent Person (ICP) with experience of UK line of light tramway operations; and
- In accordance with ORR guidance, the new tram-train maintenance depot at Taffs Well, along with the existing train maintenance depot at Canton, should be considered outside of the operational railway and therefore not subject to ROGS or the RIRs.

7.5.2 Extensions to the CVL Network

For the proposed extensions, the rail corridor will fall into one of two categories:

a. Mainline Heavy Rail – compliant with RIR and vehicles compliant with TSIs; or
b. Non-mainline Light Rail – Exempt from RIR, vehicles compliant with highway legalisation and Rail Vehicle Accessibility Regulations (RVAR).

Mainline Considerations

It may be possible for the North West Corridor tram-train route considered to be an extension of the CVL asset. New connection agreements are unlikely to be required unless the Corridor includes a new connection from the Network Rail network to facilitate the on-street link between Cardiff Central and the Bay Line via new platforms to the south of Cardiff Central. This section considers some of the key interfaces if the extensions are operated as mainline operations with the extension having to be built in accordance with Railway Group Standards.

Services Agreement

A new Basic Services Agreement with Network Rail will not be required but it may need updating. The Network Rail supplier contracts that will need to be reviewed are:

i. the CVL Services Agreement (including FTN/GSM-R Services Agreement for cab communication and FTN network for telecoms); and
ii. the Network Rail Route Services Agreement (including use of Network Rail standards).

Asset Protection Agreements

If the extensions require works to Network Rail infrastructure, such as at Cardiff West Junction, then Network Rail would require asset protection agreements with TfW.

License Holder

From the 28th March 2020 the ODP via Amey Keolis Infrastructure Ltd will be the license holder for the CVL assets and Network rail for their current network.

ORR Regulatory Readiness

Under ROGS, no one is able to operate vehicles or manage infrastructure on the UK railway unless they have obtained the appropriate safety certificate or authorisation. Those operating vehicles require a certificate, and those who operate infrastructure require a safety authorisation. If a train operator also manages infrastructure (or vice versa), they will need both a certificate and an authorisation[49].

The ODP have obtained the following licences and approvals to undertake their role as Infrastructure Manager for Phase 2. These would also be appropriate for a mainline extension too:

- Safety Authorisation;
- CVL Network Licence;
- Regulated Agreements;
  - Station access agreements; and
  - Track access agreements.
- CVL Station Access Conditions;
- CVL Track Access Contract (compensation and performance regimes);
- Claims Allocation and Handling Agreement;
- The CVL Network Code;[50]
- CVL Access Dispute Resolution Rules;[51]
- CVL Network Statement; and[52]
- Connection Agreements between CVL and NR assets.

Non-Mainline Considerations

If the extensions are developed as non-mainline routes, much of the regulatory processes associated with Mainline Railways can be avoided and leaves TfW as the masters of the destiny of the extension and its network.

The ORR website sets out what rail systems are excluded from the mainline railway requirements of the ROGS[53]. ROGS allows transport systems to be excluded from the mainline railway requirements where they fall within one or more of the following categories:

1. Metros and other light rail systems;
2. Networks that are functionally separate from the rest of the mainline railway and intended only for the operation of local, urban or suburban passenger services, as well as transport undertakings operating solely on these networks;
3. Heritage, museum or tourist railways that operate on their own networks; and
4. Heritage vehicles that operate on both the mainline and non-mainline railway and comply with national safety rules.

For non-mainline systems, the ORR do not approve the system and schemes have to comply with ROGs though the application of the Safety Verification process using an Independent

[49] More information in this is available on the ORR website https://orr.gov.uk/rail/health-and-safety/health-and-safety-laws/rogs/safety-certificates-and-safety-authorisations

[50] https://tfwrail.wales/about-us/core-valley-lines-infrastructure-manager

[51] https://tfwrail.wales/about-us/consultation-centre

[52] https://tfwrail.wales/about-us/consultation-centre

[53] https://orr.gov.uk/rail/health-and-safety/health-and-safety-laws/rogs/exclusions-from-mainline-railway-requirements.

Competent Person (ICP). When transport operators (transport undertakings or infrastructure managers) introduce new or altered rolling stock or infrastructure, they need to ensure that health and safety considerations are incorporated into their design processes. ROGS contain provisions for the safety management system (SMS) of non-mainline transport operators to include arrangements on how safety verification will be managed. Safety verification is a flexible process to make sure that projects which could significantly increase risk are safe. The arrangements in the SMS must describe the process to control risks arising from the introduction of new or altered vehicles and infrastructure. If these risks are new or significantly increased, a safety verification process must be followed.

Regulatory Elements for non-mainline

- ROGS 2006;
- Rail Vehicle Accessibility Regulations;
- Tramcars and trolley Vehicles (Modification of Enactments) Regulations 1996;
- Roads Traffic Regulations Act 1984 and 1988;
- Road Traffic Signs Regulations and General Directions 2016 (TSRGD); and
- Construction (Design and Management) Regulation 2015 (CDM).

There are no standards for non-mainline systems but the Light Rail Safety and Standards Board has issued the latest version of the Tramway Principles & Guidance document that is followed by many as the minimum requirements for non-mainline schemes.

Needs of the operator

Regardless of whether the system is mainline or non-mainline, there is a need for the Operator of the systems to:

- Produce a Safety Management System (SMS);
- Obtain vehicle authorisations;
- Start and maintain a Design log (rolling stock);
- Start and maintain a Hazid Log;
- Start and maintain an Electro-Magnetic Compatibility Hazard log;
- Start and maintain Change control / Safety Committee Meetings; and
- Comply with the requirements of any Rail Accident Investigation Branch (RAIB) investigations.

CVL Asset Lease

The CVL Asset Lease will need to be updated, where appropriate, to reflect assets that the ODP take responsibility for on the extensions regardless of whether it is Mainline or non-mainline and include items such as:

- The Railway Assets;
- Station Lease and Station Letting Conditions;
- Telecoms Site Agreement and Wayleave Agreement;
- Bridge Agreements;
- Leases for new stabling sites; and
- Review Insurances and public liability cover.

Other items

The following is a list of some of the items that will need to be considered when implementing new extensions:

- Technical Standards (Railway Group Standards. Tramway Principles & Guidance etc.);
- RM3 risk model;
- Sale of Access Rights to follow the requirements of the Railways (Access, Management and Licensing of Railway Undertakings) Regulations 2016;
- Performance Regime management;
- A Business Continuity Management Plan;
- Operator of Last Resort in case the incumbent company becomes insolvent;
- Confirm whether Phase 2 supplies at Upper Boat (Western Power) and Canton Depot (Network Rail) are sufficient to support the proposed extensions;
- Capacity of the CVL Infrastructure Control Centre (ICC) to cover the extensions (both server room and workstations);
- GSM-R telephony coverage to allow communication with drivers and other staff on the network;
- Extensions may require alterations to the infrastructure design, including the location and length of passing loops, to ensure that the timetable is deliverable and the ODP can meet its obligations;
- Use of FTN/FTNX telecoms network supported by Network Rail Telecoms (NRT) or whether to invest in a bespoke TfW system; and
- Impact of additional services on the Operational Performance of CVL.

7.6 Business Case Process

As set out in Section 1.3, WelTAG follows a five-stage process.

The transport solutions identified for the North West Corridor are wide ranging and cover all public transport models. As a result, this Strategic Outline Case is more similar to a 'programme business case' than a scheme business case. Therefore, for some options, the level of technical design development undertaken at this point is less than would normally be expected at WelTAG Stage 1.

The options identified in this report comprise an overall strategy for transport in the Corridor and it will be important to ensure that a strategic approach to transport improvements in the Corridor is maintained. Nevertheless, to ensure sufficient focus on design development and delivery, it is recommended that, at WelTAG Stage 2, the project is split into several linked scheme level business cases. This could comprise WelTAG Stage 2 business cases for the following:

- North West Corridor tram-train route;
- North West Corridor BRT solutions;
- Ely Mill Station;
- Junction 34 Park and Ride Station; and
- City Line Service Frequency Enhancements.

7.6.1 Appraisal Methods at Stage 2

At Stage 1 of the WelTAG process, much of the focus of the assessment is on the Strategic Case and identifying feasible options. At Stage 2, the emphasis will be on the Transport Case although significant development of the Financial Case, Commercial Cases and, to a lesser extent, the Management Case.

As a corridor business case, Stage 1 has involved the assessment of a large number of options which has limited the level of detail applied in the assessment of options. In respect of each of the business cases identified above, better evidence will be required in respect of capital costs, operating costs, expected transport demand and revenues, and quantifiable benefits.

For each of the shortlist measures, a range of technical studies will need to be undertaken to develop initial designs upon which realistic cost estimates can be made. Development of the operational solution will also be required for bus and rail options from which operating cost assessments can be undertaken.

For the proposed new public transport corridors, it is recommended that the SEWTM model is used as the primary basis for forecasting demand. A multi-modal model will be required for these options given that they involve a step change in transport provision in the corridor, rather than an incremental improvement to existing services. This will also provide an indication of the impact of public transport measures on the highway network. A key driver of demand will be the housing development at the Strategic Sites identified in this report and therefore significant attention will need to be given to the 'coding' of these developments and the transport network that would serve these developments under a 'do minimum' scenario.

For the interventions on the existing rail network, alternative approaches to demand forecasting may be more appropriate either instead of, or in combination with, the SEWTM model. For new stations, demand forecasting approaches based on an assessment of the catchment area for the station and the application of 'trip rates' drawn from comparable stations can be an effective approach. For an incremental increase in service frequency – as is the case for the City Line frequency enhancements – the uplifts in demand set out in the rail industry's Passenger Demand Forecasting Handbook (which can be applied through use of the MOIRA model) is likely to be sufficient.

In respect of the assessment of the shortlisted options, it is likely that the appraisal criteria will be similar to the criteria used at Stage 1 although the level of detail employed in the analysis will be greater and informed by quantitative analysis in many cases.

8 Conclusions

8.1 Key Conclusions

The key findings of this assessment at WelTAG Stage 1 can be summarised as follows:

- A package of measures is required to address the transport issues in the North West Corridor and meet future capacity requirements. This will require investment in existing and new transport infrastructure across all public transport modes;
- Both rail and bus-based solutions are required, and each mode plays a complementary role. Rail-based solutions provide a high quality of service and can minimise journey times between key population centres, whereas bus-based measures are more flexible and provide better penetration into residential areas;
- There are opportunities to improve the existing rail network through additional services and new stations. Shortlisted options include increased service frequencies on the South Wales Main Line and City Lines, and new stations at Junction 34 of the M4 (on the South Wales Main Line) and Ely Mill (on the City Line);
- In areas of the Corridor not served by rail, traditional bus services alone are likely to fail to substantially alter mode shares in the Corridor and reduce the current reliance on the private car. Therefore, there is a good strategic case for a new mass transit corridor;
- Use of the CVL tram-train technology (potentially in a modified form) on the North West Corridor is preferred to the introduction of a wholly new light rail system which would introduce significant extra costs and complexity for relatively modest benefits;
- Notwithstanding the benefits of these improvements, much of the North West Corridor is not served by the existing rail network and therefore such interventions will fail to fully address the problems identified. A new mass transit solution will be required to serve the Strategic Site at Plasdwr and to achieve the step change in public transport provision within the Corridor more generally;
- The Safeguarded Corridor should be earmarked for a rail-based solution, rather than a BRT solution. A rail-based solution provides the greatest scope to minimise public transport journey times and would offer the quality of service expected of a major new rapid transit route;
- Delivering a new North West Corridor tram-train route, combined with enhanced services on the City Line, will necessitate infrastructure changes to overcome capacity constraints through Cardiff West Junction and at Cardiff Central. Three broad approaches to the connection at Cardiff Central have been shortlisted, each of which involves complex trade-offs which need to be considered in the context of wider aspirations for the rail network in the Cardiff Capital Region;
- Extensions of the tram-train route into southern Rhondda Cynon Taf have been shortlisted. Subject to further business case assessment, routes to both Pontyclun and Beddau have potential merit and the ultimate preferred outcome could be a Y-shaped network serving both locations;
- BRT options and improved interchange facilities, including active travel facilities, can play an important role in improving public transport alongside a new tram-train route. BRT is a general term applied to a modern, fast, reliable bus system and the success of any new BRT routes will depend on the degree of segregation achieved. Implementing the BRT measures could deliver some benefits in a shorter timeframe compared to the tram-train solution,

ensuring growth in travel demand from new development is via a low carbon transport network. Therefore, a phased approach for the works could see the tram-train routes being implemented at a later stage, resulting in the full benefits of a complementary tram-train and BRT package;

- In Cardiff, possible BRT routes have been identified via the A4232, connecting with a strategic park and ride facility at Junction 33, and an urban route serving Plasdwr and Fairwater areas with a potential interchange with the City Line at Waun-gron Park. In Rhondda Cynon Taf, BRT corridors via the A4119 could both improve end-to-end services to/from Cardiff and provide connections to park and ride sites at Junction 33 and 34; and
- There will be opportunities, which should be explored at the next stage, to enhance active travel in the corridor by delivering new active travel corridors alongside rail and bus route, as well as enhancing interchange opportunities.

8.2 Shortlisted Options

A shortlist of options has been identified which merit further development and assessment at WelTAG Stage 2.

The enhancements to the existing rail network listed below have been shortlisted for further assessment at WelTAG Stage 2:

- Increased service frequency to at least 4 trains per hour on the City Line between Cardiff Central and Radyr;
- A new station on the City Line at Ely Mill;
- Increased service frequency on the South Wales Main Line and therefore enhanced services from Pontyclun;
- Enhanced quality of interchange between active travel, bus, rail and car; and
- A new 'Parkway' station on the South Wales Main Line at Junction 34 of the M4.

Bus related measures are as follows:

- A strategic bus park and ride at Junction 33 of the M4;
- A new BRT route between central Cardiff and Junction 33 via Leckwith Road and the A4232;
- A bus gate and spur from the A4232 (northbound and southbound) to Plasdwr;
- A bus and active travel interchange at Waun-gron Park station on the City Line;
- A new BRT route from Central Cardiff to Plasdwr via Cowbridge Road East, Waun-gron Park and Fairwater;
- Improved bus:rail and active travel interchange at Radyr station on the City Line; and
- A new BRT route from Junction 33 to Talbot Green via the A4119 with onward connections to settlements in southern Rhondda Cynon Taf.

The shortlisted new tram-train routes are as follows:

- A new tram-train route via the City Line and the Safeguarded Corridor between central Cardiff, Junction 33 and Creigiau;
- An extension of the tram-train route from Creigiau to Pontyclun via Cross Inn; and
- An extension of the tram-train route from Creigiau to Beddau via Cross Inn.

A key constraint to achieving the new tram-train options, as well as increasing frequencies on the existing City Line, is the capacity of Cardiff West Junction and Cardiff Central to

accommodate additional rail services. Three variants of the tram-train solution have been shortlisted. These are:

- Changes in the track layout at Cardiff West Junction to increase the capacity for North West Corridor and/or City Line services operating into existing platforms at Cardiff Central;
- Provision of a new junction between the City Line and the Barry/Penarth Line services at Penarth Curve to enable North West Corridor and/or City Line services to operate into new platforms located to the south of Cardiff Central Station. This option provides the potential for services to operate to Porth Teigr should this route also be progressed; and
- An on-street solution that would divert North West Corridor and/or City Line services away from Cardiff West Junction via an on-street route, potentially via Sloper Road and Penarth Road into new platforms at Cardiff Central and/or Callaghan Square. As above, this provides the potential for a direct link to Porth Teigr.

8.3 Phasing

Consideration has been given to the possible phasing of interventions in the North West Corridor. The phasing takes into account both demand side factors (in particular the timescales for the delivery of Strategic Sites) and supply side factors (the realistic timescales for design development, statutory processes and construction, as well as dependencies with other projects e.g. CVL transformation).

Phase 1 covers the period in advance of the delivery of a new route, potentially on the disused rail corridor. The interventions during this phase are centred on increasing services on the existing rail network, improvements to bus services and enhancing the quality of interchange between active travel, car, bus and rail modes. All of the shortlisted bus related measures (including the proposed new BRT routes) are included in Phase 1. Subject to the availability of funding, each of these shortlisted options could be delivered between 2020 and 2025.

Phase 2 would be focussed on the development of the new tram-train route for the North West Corridor via the City Line and the Safeguarded Corridor. This is a high cost project which would represent a major investment in the Cardiff Capital Region. The business case for the new line will need to be underpinned by passenger demand from Plasdwr and the Strategic Sites north of Junction 33 and south of Plasdwr in combination. If funding is available, this option could be open to passengers towards the end of this decade to coincide with the completion of phases 2 and 3 of the Plasdwr development which are adjacent to the Safeguarded Corridor.

To improve the affordability of the project, consideration could be given to a phased approach whereby the line is constructed between the City Line and Junction 33 or Creigiau initially, followed later by extensions into Rhondda Cynon Taf. Whether the North West Corridor tram-train route is delivered as a single project or delivered in phases is largely a policy decision that would need to be determined by funders.

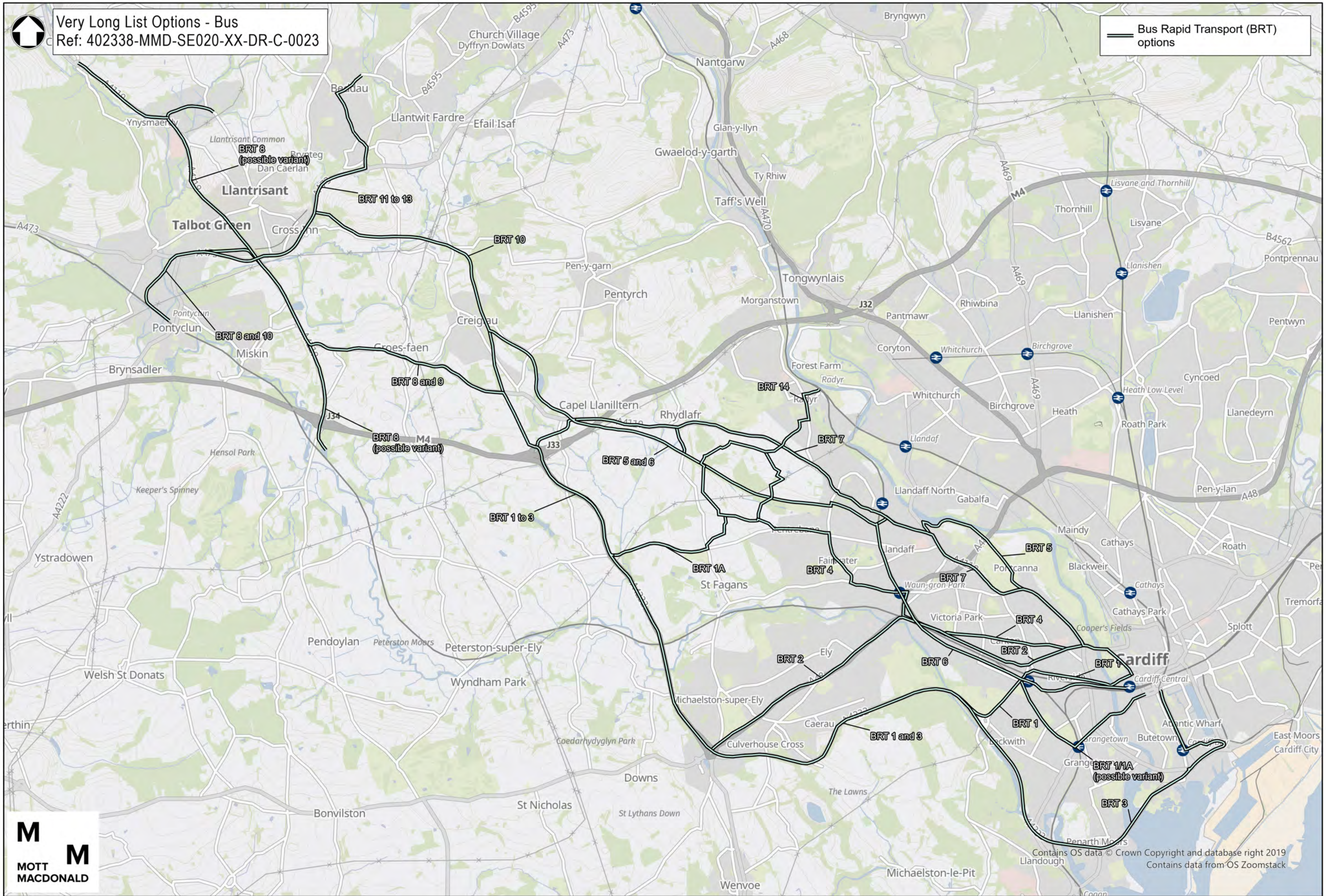
8.4 Next Steps

It is recommended that the shortlisted options are taken forward for more detailed design development and assessment at WelTAG Stage 2.

9 Appendices

- Appendix A includes maps of the options which were initially identified
- Appendix B includes maps of the options which were taken forward to the long list appraisal
- Appendix C includes maps of the shortlisted options

Appendix A: Initially Identified Options Maps



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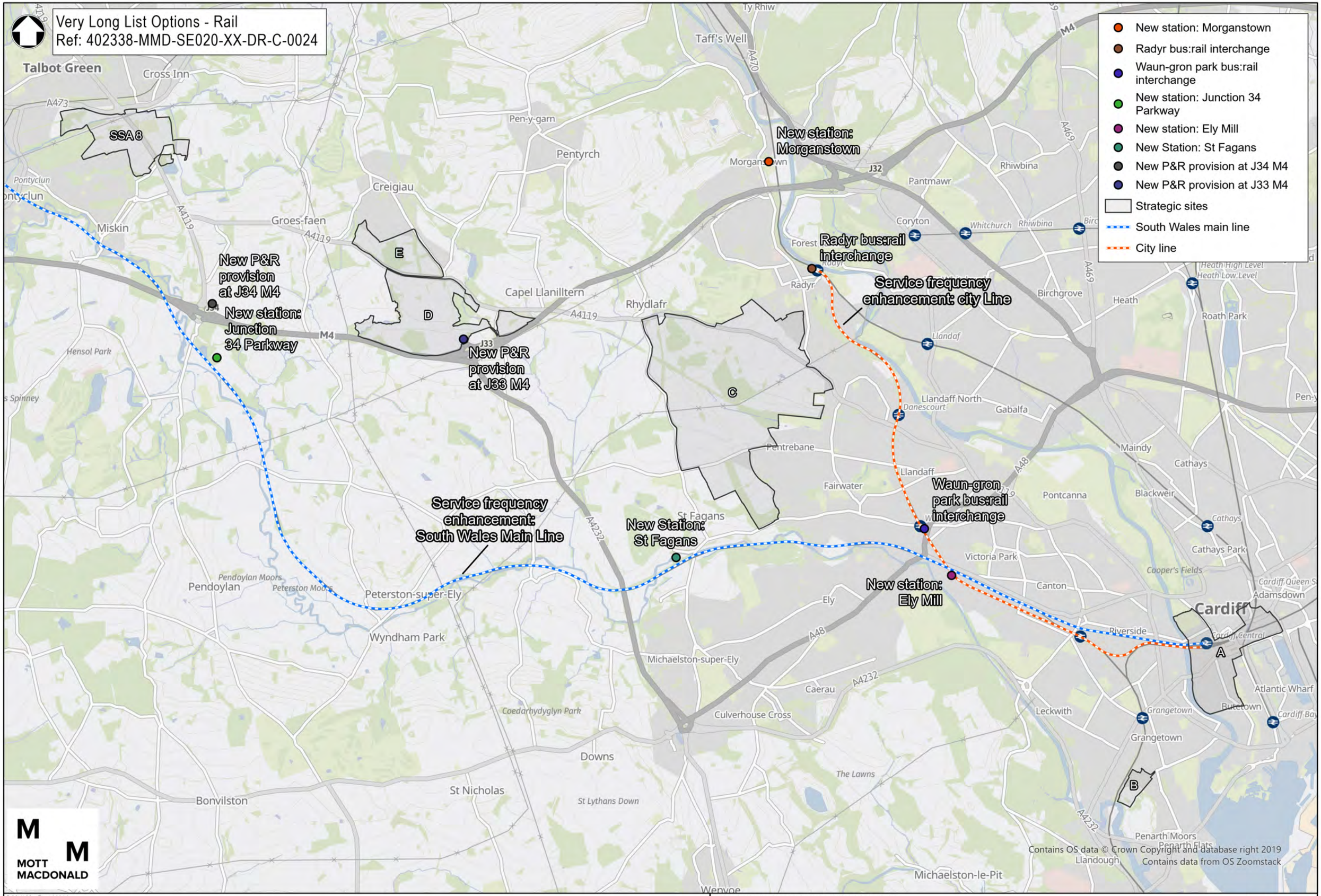
Very Long List Options - Rail
Ref: 402338-MMD-SE020-XX-DR-C-0024



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Very Long List Options - Tram-Train
Ref: 402338-MMD-SE020-XX-DR-C-0025

Tram-train routes
Tram-train areas of search
Strategic sites

SSA 7
SSA 8
TT 13
TT 15
TT 12
TT 5
TT 7
TT 7, 10
TT 11
TT 10
TT 8
TT 8, 9
TT 6
TT 9
TT 2
TT 1
TT 3
TT 4
E
D
C
B
A
Circle Line to NW Corridor
Circle Line to Merthyr Line and Taffs Well Depot
All options use Protected Corridor
Existing City Line used by most routes except as shown

Coedely
Ynysmaerdy
Llantrisant Common
Brynteg
Dan Caerlan
Llantrisant
Beddau
Llantwit Fardre
Church Village
Dyffryn Dowlais
Upper Boat
Trefforest Estate
Nantgarw
Glan-y-llyn
Gwaelod-y-garth
Ty Rhiw
Taff's Well
Trecenydd
Glenfield Estate
Aber
Castle Park
Caerphilly
Bondfield Park
Watford Park
St Martins
Van
Bryngwyn
Thornhill
Lisvane and Thornhill
Lisvane
Llanishen
Pontyclun
Miskin
Brynsadler
Groes-faen
Creigiau
Pen-y-garn
Pentyrch
Tongwynlais
Morganstown
J32
Pantmawr
Rhiwbina
Forest Farm
Radyr
Whitchurch
Birchgrove
Heath
Heath Low Level
Roath Park
Cyncoed
Llanedeyrn
Capel Llanilltern
Rhydlafr
J34
M4
J33
Hensol Park
Keeper's Spinney
Llandaf
Llandaff North
Gabalfa
Pen-y-lan
Pentrebane
Maindy
Cathays
Roath
Blackweir
Waun-gron Park
St Fagans
Ystradowen
Victoria Park
Cathays Park
Cooper's Fields
Canton
Cardiff
Riverside
Cardiff Central
Adamsdown
Splott
Ely
Michaelston-super-Ely
Caerau
Culverhouse Cross
Leckwith
Atlantic Wharf
Butetown
Cardiff Bay
Grangetown
Aberthin
Bonvilston
St Nicholas
St Lythans Down
Downs
The Lawns

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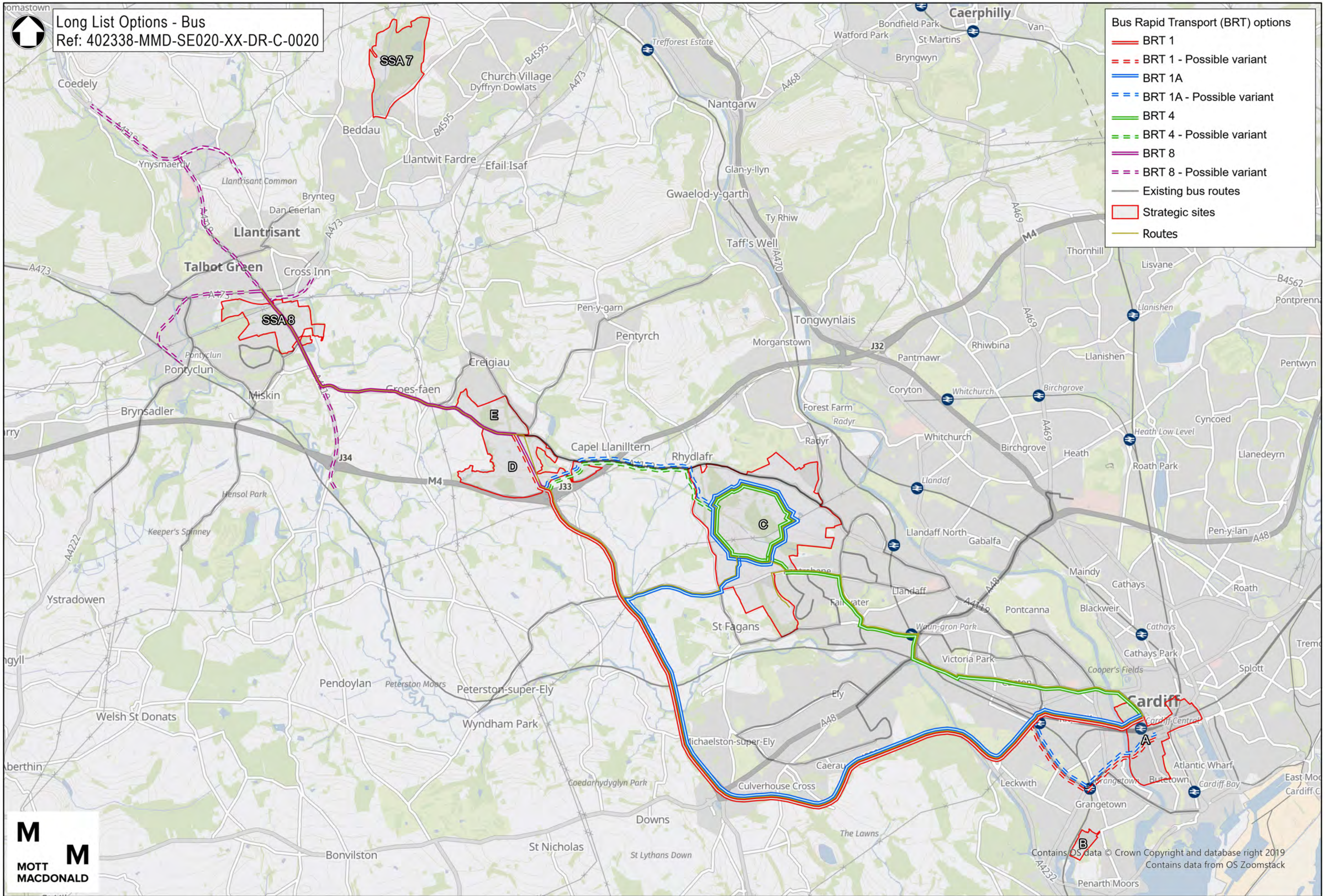
Appendix B: Long List Options Maps


Long List Options - Bus
Ref: 402338-MMD-SE020-XX-DR-C-0020
Bus Rapid Transport (BRT) options
BRT 1
BRT 1 - Possible variant
BRT 1A
BRT 1A - Possible variant
BRT 4
BRT 4 - Possible variant
BRT 8
BRT 8 - Possible variant
Existing bus routes
Strategic sites
Routes
SSA 7
SSA 8
E
D
C
A
B
J33
J34
J32
M4
A473
A4119
A470
A469
A48
A4232
A4222
A468
B4595
B4562
Caerphilly
Coedely
Beddau
Church Village
Dyffryn Dowlais
Nantgarw
Trefforest Estate
Bondfield Park
Watford Park
St Martins
Bryngwyn
Van
Llantwit Fardre
Efail Isaf
Glan-y-llyn
Gwaelod-y-garth
Ynysmaerdy
Llantrisant Common
Brynteg
Dan Caerlan
Llantrisant
Talbot Green
Cross Inn
Ty Rhiw
Taff's Well
Thornhill
Lisvane
Llanishen
Pontprennau
Pen-y-garn
Pentyrch
Tongwynlais
Morganstown
Rhiwbina
Pentwyn
Pontyclun
Creigiau
Miskin
Brynsadler
Croes-faen
Pantmawr
Coryton
Whitchurch
Birchgrove
Forest Farm
Radyr
Cyncoed
Heath Low Level
Heath
Roath Park
Llanedeyrn
Capel Llanilltern
Rhydlafr
Llandaf
Hensol Park
Keeper's Spinney
Llandaff North
Gabalfa
Pen-y-lan
Maindy
Cathays
Roath
Llandaff
Fairwater
Pontcanna
Blackweir
Ystradowen
St Fagans
Waun-gron Park
Cathays Park
Victoria Park
Tremorfa
Splott
Cooper's Fields
Pendoylan
Peterston Moors
Peterston-super-Ely
Ely
Cardiff
Cardiff Central
Welsh St Donats
Wyndham Park
Michaelston-super-Ely
Caerau
Atlantic Wharf
Aberthin
Coedarhydyglyn Park
Culverhouse Cross
Leckwith
Grangetown
Butetown
Cardiff Bay
East Moors
Downs
The Lawns
St Nicholas
St Lythans Down
Bonvilston
Penarth Moors
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Long List Options - Rail

Ref: 402338-MMD-SE020-XX-DR-C-0021

- New station: Morganstown
- Radyr bus:rail interchange
- Waun-gron park bus:rail interchange
- New station: Junction 34 Parkway
- New station: Ely Mill
- New Station: St Fagans
- New P&R provision at J34 M4
- New P&R provision at J33 M4
- Strategic sites
- South Wales main line
- City line

SSA 8

New station: Morganstown

Radyr bus:rail interchange

Service frequency enhancement: city Line

New P&R provision at J34 M4

New station: Junction 34 Parkway

New P&R provision at J33 M4

Service frequency enhancement: South Wales Main Line

New Station: St Fagans

Waun-gron park bus:rail interchange

New station: Ely Mill

A

B

C

D

E

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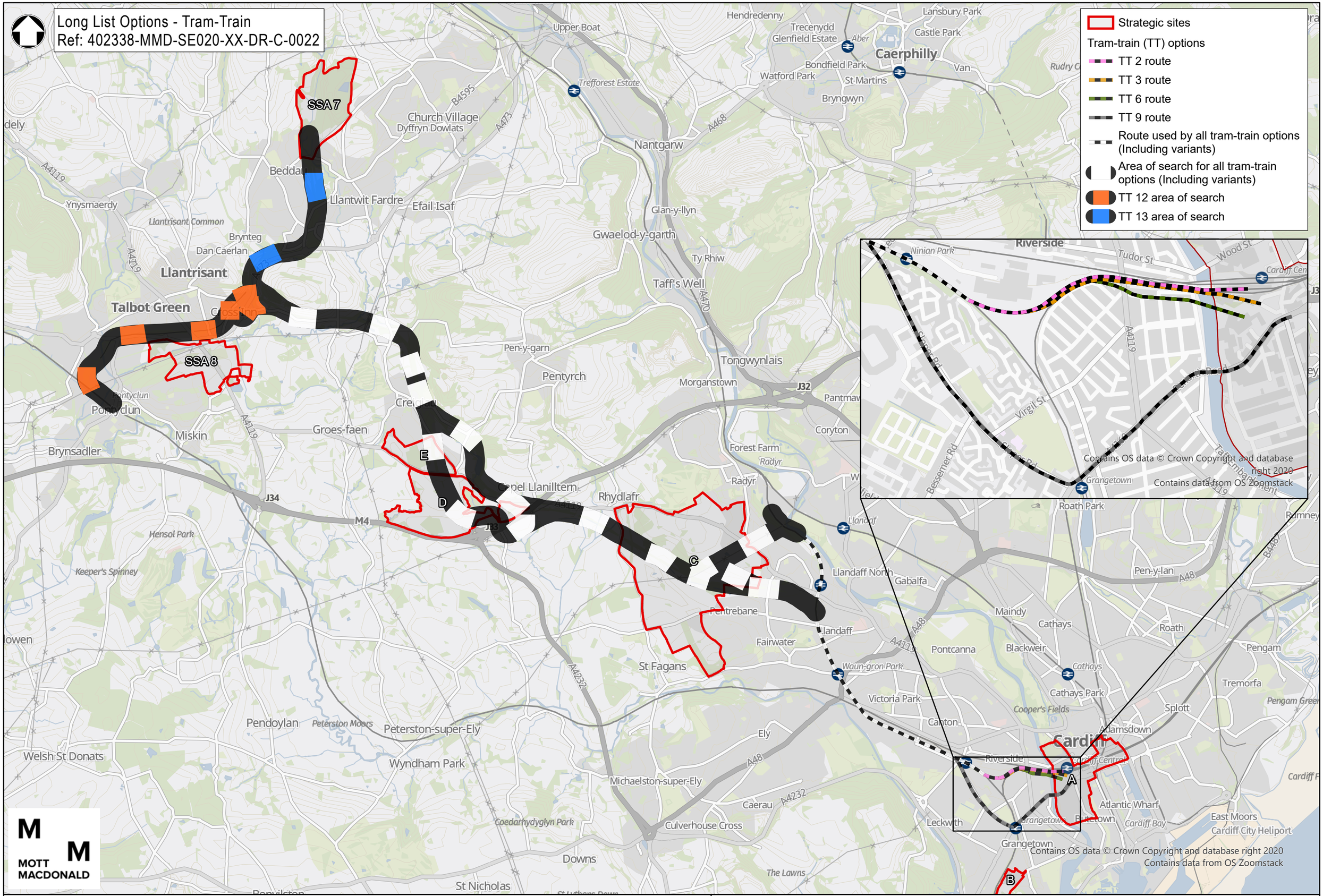
Long List Options - Tram-Train
Ref: 402338-MMD-SE020-XX-DR-C-0022



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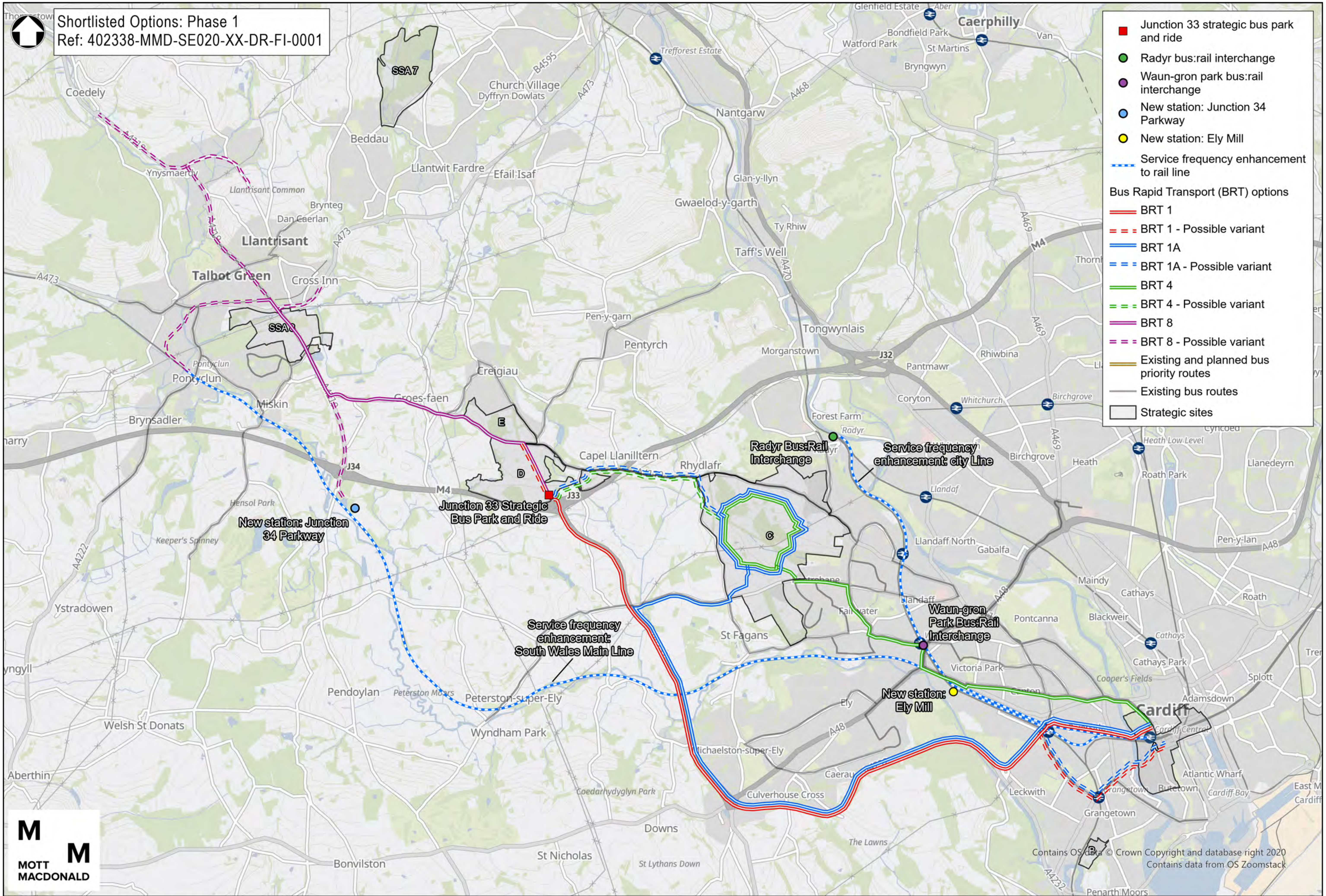
Appendix C: Shortlisted Options Maps


Shortlisted Options: Phase 1
Ref: 402338-MMD-SE020-XX-DR-FI-0001
Junction 33 strategic bus park and ride
Radyr bus:rail interchange
Waun-gron park bus:rail interchange
New station: Junction 34 Parkway
New station: Ely Mill
Service frequency enhancement to rail line
Bus Rapid Transport (BRT) options
BRT 1
BRT 1 - Possible variant
BRT 1A
BRT 1A - Possible variant
BRT 4
BRT 4 - Possible variant
BRT 8
BRT 8 - Possible variant
Existing and planned bus priority routes
Existing bus routes
Strategic sites
Radyr Bus:Rail Interchange
Service frequency enhancement: city Line
Junction 33 Strategic Bus Park and Ride
New station: Junction 34 Parkway
Service frequency enhancement: South Wales Main Line
Waun-gron Park Bus:Rail Interchange
New station: Ely Mill
SSA 7
SSA 8
E
D
C
J33
J34
J32
M4
Caerphilly
Nantgarw
Church Village
Llantrisant
Talbot Green
Pontyclun
Creigiau
Pentyrch
Tongwynlais
Radyr
Whitchurch
St Fagans
Ely
Cardiff
Grangetown
Pendoylan
Peterston-super-Ely
Wyndham Park
Culverhouse Cross
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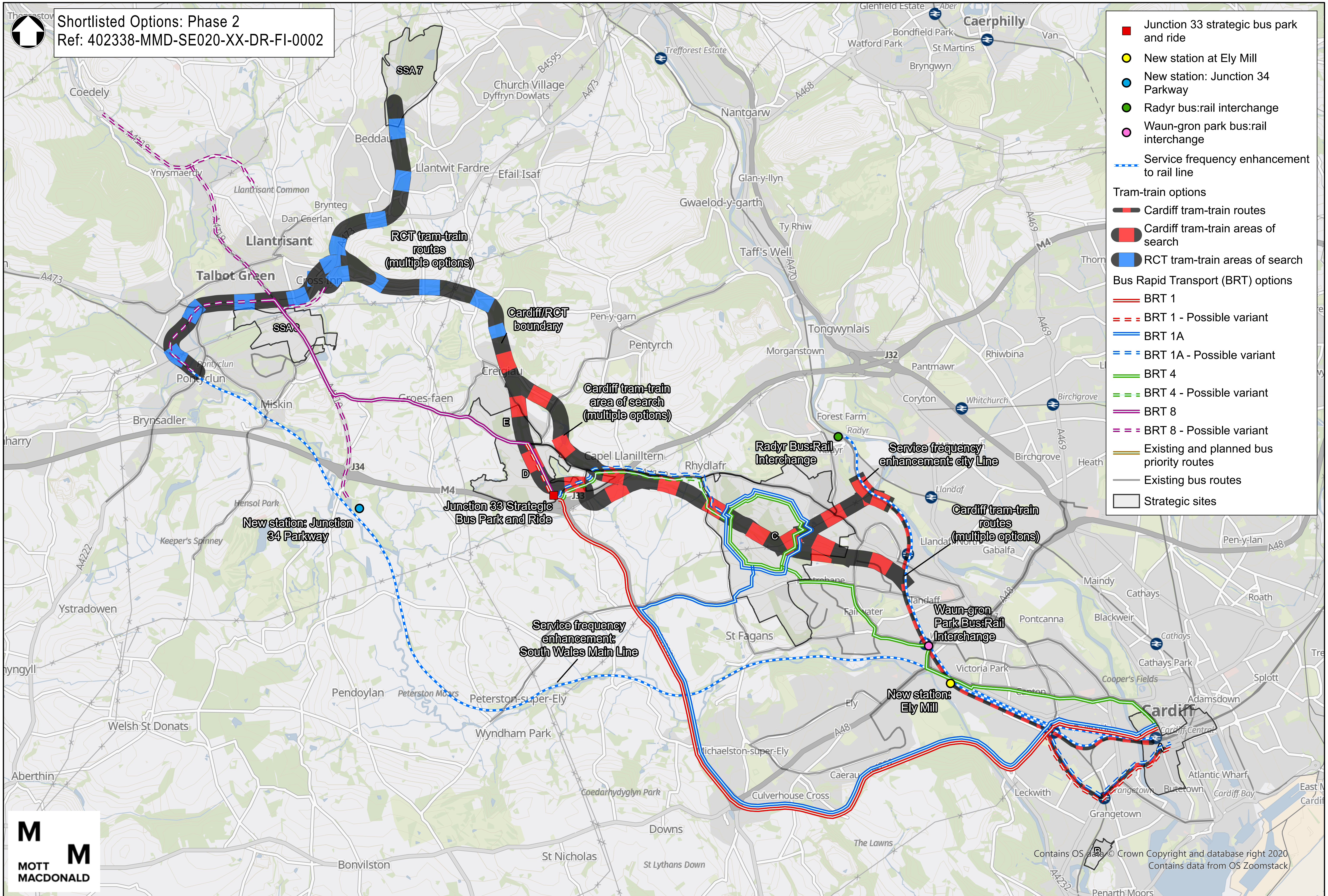

Shortlisted Options: Phase 2
Ref: 402338-MMD-SE020-XX-DR-FI-0002
Junction 33 strategic bus park and ride
New station at Ely Mill
New station: Junction 34 Parkway
Radyr bus:rail interchange
Waun-gron park bus:rail interchange
Service frequency enhancement to rail line
Tram-train options
Cardiff tram-train routes
Cardiff tram-train areas of search
RCT tram-train areas of search
Bus Rapid Transport (BRT) options
BRT 1
BRT 1 - Possible variant
BRT 1A
BRT 1A - Possible variant
BRT 4
BRT 4 - Possible variant
BRT 8
BRT 8 - Possible variant
Existing and planned bus priority routes
Existing bus routes
Strategic sites
RCT tram-train routes (multiple options)
Cardiff/RCT boundary
Cardiff tram-train area of search (multiple options)
Junction 33 Strategic Bus Park and Ride
New station: Junction 34 Parkway
Radyr Bus:Rail Interchange
Service frequency enhancement: city Line
Cardiff tram-train routes (multiple options)
Waun-gron Park Bus:Rail Interchange
New station: Ely Mill
Service frequency enhancement: South Wales Main Line
SSA 7
SSA 8
J32
J33
J34
M4
Caerphilly
Llantrisant
Talbot Green
Pontyclun
Cardiff
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