Railway Procurement Agency

Metro West

Outline Business Case

Additional Information

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6 Draft	16/12/08	RPA	Draft to DoT	POD

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TABLE OF CONTENTS

Executive Summary

RPA has produced this paper in response to a request for additional information to support the Outline Business Case, from the Department of Transport. The analysis presented in this report are based on current information from available sources.

RPA has studied the relative benefit of the Light Rail Transit (LRT) and Bus Rapid Transit (BRT) on a global and corridor basis considering factors such as: capacity, reliability, cost, development potential, attractiveness, environmental and economic feasibility.

RPA do not believe that a BRT system would achieve the vision for Metro West which is to provide a high quality orbital Light Rail service by 2015, delivered as an affordable / bankable PPP, connecting Tallaght, Clondalkin, Liffey Valley and Blanchardstown and linking the radial network to provide connection to the Airport , Swords and the City Centre.

The role of high quality light rail as trip attractor has been demonstrated using real case examples and reference to studies elsewhere. The analysis has confirmed a revealed preference for LRT above other transit modes of similar service character. Additionally, evidence would suggest that a comparable BRT system in place of Metro West would not be as attractive and would not achieve the high levels of forecast demand.

The 2006 Census of population considered peoples journey to work. The census suggested that the are currently large volumes of both orbital and radial trips being made to and from the Metro West corridor. According to the 2006 census, almost 40,000 journey-to-work trips originated from within a 1km catchment of Metro West. The census also revealed that the Metro West corridor received over 50,000 trips to work comprising approximately 10,000 trips originating in the corridor and the remaining 40,000 trips from outside. The census reveals a large volume of existing work related trips into and out of the Metro West catchment, with many made entirely within the catchment of Metro West. Other non work based trips such as to leisure, school and retail are not included in the census data but are expected to be high given the number of large trip attractors such as shopping and town centres on the route.

A high level assessment of the strategic impacts of the Metro West project on the M50 was undertaken by RPA consultants using the 2016 strategic DTO model. The conclusion of that analysis that Metro West was forecast to primarily remove local based trips from the M50. Reductions in M50 traffic is forecast, particularly in the section between the N3 and the M1 intersections in addition to reduction on radial routes to the M50 from the N4, N3 and N2 routes and on the M1 between the Airport and the City Centre. The results also showed that a global reduction in traffic volumes along the M50 did not however emerge. This suggests that the reduction in local trips entering the M50 was offset by an increase in longer distance trips forecast to use the newly available capacity. This suggests that the introduction of Metro West facilitates the removal of unwanted local based trips from the motorway, allowing it to operate as originally intended, as a by pass of the city

The continuation of the economic recession will have an impact on the forecast demand for Metro West. In the first instance the number of new developments in the corridor may not now materialise, at least not in the time horizon envisaged. The RPA have however undertaken CBA sensitivity analysis of the project under various land use development scenarios. The worst case for Metro West would be a scenario where no new developments were to occur and population and employment and demand for travel were to remain at current (2006) levels. This analysis suggested that the case for Metro West remains strong with between 23 and 30 million new Metro patrons and BCRs of between 1.43:1 and 1.89:1 forecast, depending on service patterns and network assumptions. This is in keeping with the high rates of trip making identified in the corridor in the 2006 census.

Whilst there is no doubt of a nervousness in the financial markets at present, the Metro West project does not expect to be requesting bids from consortia until well into 2010 at best. It is also the case that many lending institutes, contractors and investment companies will in future most likely be looking for more secure investments and innovative approaches to funding. A PPP such as Metro West which has limited demand risk, is backed by the Government and has certainty of availability payments over a considerable time period, would be seen as a favourable investment.

CHAPTER 1

LIGHT RAIL TRANSPORT VERSUS BUS RAPID TRANSPORT ANALYSIS

Introduction

Bus Rapid Transit (BRT) is a broad term given to a variety of transportation systems that, through improvements to infrastructure, vehicles and scheduling attempt to provide a service that is of a higher quality than an ordinary bus line. It is sometimes defined as 'A flexible, rubber-tired rapid transit mode that combines stations, vehicles, running ways, and intelligent transportation systems into an integrated system with a strong positive identity that evokes a unique image.

There are various forms of BRT systems in operation worldwide. They are generally more than a QBC (Quality Bus Corridor) with a new bus, but require additional investment in infrastructure. While some BRT systems are much less segregated, others remove the buses fully from other traffic, for example, running parallel to an often congested motorway.

The main features of a quality enhanced BRT are as follows:

- Bus Only, grade-separated (or at-grade exclusive) right of way: The main feature of a BRT system is having dedicated bus lanes which operate separate from all other traffic modes. This allows buses to operate at a very high level of reliability.
- Comprehensive coverage: In addition to using dedicated busways, BRT's can also take advantage of existing roadways and cities that already have a comprehensive road network. Service can be made more time efficient and reliable than a standard bus system by taking advantage of bus priority methods
- Bus Priority/Bus lanes: Preferential treatment of buses at intersections can also involve the extension of green time or actuation of the green light at signalised intersections upon detection of an approaching bus.
- Vehicles with tram like characteristics: Recent technological developments such as bi-directional buses or guided buses have benefited the set-up of BRT systems. The main developments include:
    - Improved riding quality
    - Increased capacity
    - Reduced operating costs compared to unregulated buses

- A specific image with a brand name: stations with state of the art features, for example, automatic vending machines
- Off-Bus fare collection: which allow passengers to board through all doors to quicken the boarding times.
- Level Boarding: Many BRT systems also use low floor buses to speed up passenger boardings and enhance accessibility.
- Stations: High Quality BRT systems often feature significant investment in enclosed stations.

Difference between LRT and BRT

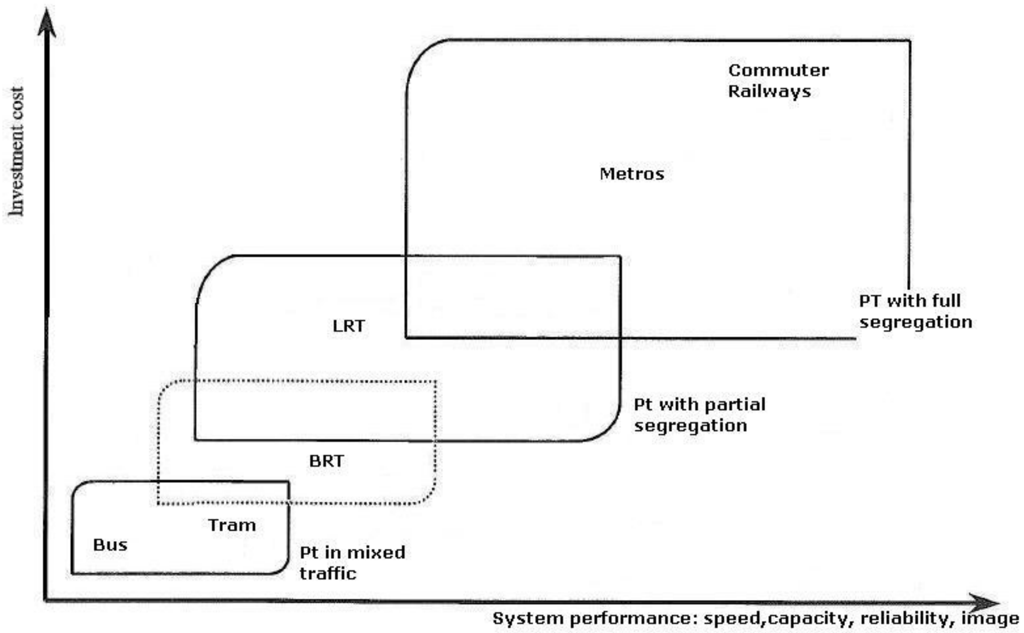
BRT represents a significant upgrading over regular buses which require moderate investment and short implementation period, while LRT would be another further step with higher investment and much better performance, passenger attraction and productivity. The BRT concept offers benefits in improving present bus services. Its implementation can lead to upgrading a complex network of low-image bus lines into a distinct network of frequent, reliable lines.

For applications on heavily used trunk lines, LRT represents a higher investment/higher performance transit system than BRT. In addition to comfortable, quiet and reliable service, LRT provides better vehicle performance and the possibility to use tunnels and serve pedestrian areas without the noise and pollution that diesel vehicles produce. LRT system generally requires less street space due to guidance, reduced clearances and often narrower vehicles. This often makes it easier to implement into existing street networks.

LRT tracks symbolize permanence and represent a strong stimulus for economic development and human oriented environment. With low-floor vehicles LRT stations fit aesthetically well in the centres of urban activities.

BRT and LRT should be considered as complementary modes. BRT tends to be more appropriate for small to medium size densities which do not justify introduction of a different higher capacity technology. For heavy passenger volumes, use of tunnels in high density urban centres and direct service in pedestrian zones, LRT is usually distinctly superior to BRT. The advantages it brings in such applications may easily justify the higher initial investment cost LRT involves. Moreover, with its stimulus for urban physical upgrading and economic development, LRT exerts unique long term positive impacts on livability of city.

The graph below illustrates the differences between the different types of systems. This graph was produced Professor Vukan R. Vuchic of the University of Pennsylvania and from his work 'Urban Transit - Operations, Planning and Economics'.



When considering which system or mode is best to suit particular needs a comparison under the following headings should be considered.

- Capacity
- Reliability
- Cost
- Development potential
- Attractiveness
- Environmental
- Accessibility
- Economic

Metro West

The vision for Metro West is to provide a high quality orbital Light Rail service by 2015, delivered as an affordable / bankable PPP, connecting Tallaght, Clondalkin, Liffey Valley and Blanchardstown and linking, linking with Metro North to provide a connection to the Airport, Swords and the City Centre and connecting with existing and proposed radial transport corridors.

These areas are generally unconnected and isolated from each other whilst there is a substantial demand for travel between them. This demand is presently only served by limited infrastructure with strong reliance on the M50 which, as a result, suffers from severe traffic congestion.

This transport deficit between these town centres must be redressed to reduce the pressure on the existing infrastructure and to allow the future consolidation of new development in a sustainable manner.

Preferred Route

The chosen route for Metro West is approximately 25.5km long and serves Tallaght, Clondalkin, Liffey Valley and Blanchardstown and connects to Metro North in the Dardistown area. The line runs through FCC (Fingal County Council) and SDCC (South Dublin County Council) administrative areas.

There are a total of 22 stops being considered along the route including the Dardistown stop which is shared with Metro North. Of the 22 stops, 18 are likely to be provided initially with passive provision being made for the remaining 4, to be delivered at some future stage subject to surrounding development taking place.

Metro West system is being designed for an initial capacity of 5,000 passengers per direction per hour (ppdph), using 47m vehicles at 4 minute headways. The system will be capable of being incrementally upgraded to at least twice that capacity as and if demand increases.

The infrastructure is being designed to allow operation of up to 94m long vehicles so that the initial capacity can be easily increased to 10,000 ppdph as demand increases, whilst maintaining the peak headway of 4 minutes.

Ultimately the capacity of Metro West may be increased to 20,000 ppdph by reducing the headway to 2 minutes. However this capacity requirement is unlikely to emerge in the medium term.

The Metro West concept allows interoperability with Metro North, allowing passengers to travel from Tallaght for example to destinations on Metro North without the need for interchange. The ability of the service to allow movement between Metro West and Metro North without the penalty of interchanging is a key driver of some of the expected demand for Metro West. In addition this interoperable service means that, for a large portion of the route, north of the Liffey, Metro West operates like a radial service with competitive journey times to the City Centre.

The Metro West concept is based on an efficient, reliable journey time to ensure the service is more attractive than taking two radial trips, that is, one radial trip into town to come back out and another radial trip.

Capacity

As mentioned above Metro West is being designed for an initial capacity of 5,000 ppdph using vehicles at a 4 minute headway that can be incrementally upgraded to ultimately 20,000 ppdph in the long term. This is based on vehicle capacity in the order of 330 passengers.

Passenger forecasts of Metro West suggest that the project will attract in the order of 30 - 35 million new Metro passengers in 2016. This equates into a maximum peak hour lineflow of 4,543.

BRT systems depending on the level of segregation typically have capacity ranging between 2,000 and 6,000 ppdph. A typical modern BRT vehicle would have a capacity for 120 passengers. If a BRT system was designed to accommodate the initial demand forecast for Metro West headways of approximately 1.5 minutes would be required. This is 40 vehicles per direction per hour as compared to 15 vehicles per direction per hour with LRT. This three fold increase in vehicles required for the BRT system would have significant adverse effects on the reliability of the system and also the operating (number of drivers) and maintenance costs. This would mean many crossings of road junctions with considerable disruption and likely result in less or no priority – unless complete segregation.

With a BRT system there would be very limited system reserve capacity available to accommodate future demand. Capacity increase is significantly easier with a LRT system due to multiple unit operation and the modular design of the vehicles.

Reliability and Integration

To match the initial forecast demand for Metro West with a typical BRT system with a vehicle capacity of 120 it would be required to operate in the order of 40 buses per hour per direction. This would result in reduced reliability and performance particularly at road junctions because in affect there would be a bus crossing each junction on average every 45 seconds which is substantially less than the average signal cycle time in Dublin (typically 120 seconds). Operating BRT with priority, particularly where busy radial routes are to be crossed is likely to prove infeasible and thus such a system could only operate with less or no priority. At these frequencies removal of priority would lead to bunching of services and a complete deterioration of reliability and quality. Service quality worsens as service speeds and reliability decline because of the increased frequency required. This may only be achieved through segregation which would also increase costs.

The Metro West concept allows interoperability with Metro North, allowing passengers to travel from Tallaght for example to destinations on Metro North without the need for interchange. Passengers could travel for example form Tallaght to the airport and from Blanchardstown to the city centre without the need for interchange. If a BRT system was implemented it will not offer this interoperability and no matter how good an interchange facility is it will reduce the demand on the system. The service patterns examined for the Outline Business Case showed that the interoperable services were significantly more attractive than those without. A large penalty is incurred for interchange – this is especially true between different modes. The modeling suggest that a service pattern that involves direct running to the city centre and the airport and Swords will attract in the order of 3.5 million trips per year over one that involves an interchange at Dardistown. It would be expected that an interchange involving different modes would result in an even less attractive service.

In addition to the interoperability with Metro North the Metro West preferred route offers interchange with the Kildare and Maynooth heavy railway line and also the recently identified Luas Line F preferred corridor. It would be doubtful whether a BRT system offering these interchanges would be as successful in attracting passengers interchanging. This is because interchange between different modes is generally perceived as more onerous than interchange within the same mode.

Cost

BRT is generally cheaper to build than LRT, although the cost savings are less in systems that involve construction of a segregated busway. If eventual LRT conversion is part of the long term plan, this would also reduce BRT's ultimate capital cost savings. Also, with added high end technological enhancements and the like, the total BRT bill rises rapidly.

BRT's lower investment cost, especially in its simplified form, explains its growing importance in cities in the developing world, some of which must build infrastructure on extremely limited budgets.

However for a BRT system to match the vision outlined above for Metro West any potential cost savings would be minimal due to the nature of any realistically comparable BRT system. The BRT system would have to be a high end quality system, including state of the art vehicles, off board fare collection, station facilities and be totally segregated from other road users to maintain its headway. To maintain an end to end journey time that is competitive with private modes of transport and to attract people form this mode a significant number of road junctions would have to be grade separated which increases the capital cost.

Along the preferred Metro West route currently there is a distinct lack of possible BRT or even bus infrastructure present at Clondalkin, across the Liffey Valley and between Blanchardstown and Airport. For a comparable BRT system to work a significant investment would be required in new dedicated BRT infrastructure (roads bridges etc). In particular the ability to build a new Liffey Valley bridge that successfully links up with the road networks on the north and south sides is likely to be extremely difficult if not impossible.

BRT systems often require more physical space than a LRT system increasing the cost due to alignment clearances and overtaking facilities at stops when the system is being run at such high frequencies.

The costs involved to implement such a system may be too much especially when it does not offer any prospects of meeting any potential future demand due to the lack of reserve capacity.

Some cities use BRT systems as a way to build ridership in advance of LRT construction. This view is sometimes taken because it can be useful in terms of getting something built sooner rather than later and building ridership for the future. However, building a BRT with the anticipating of a future LRT conversion carries its share of risks. Once you have made a big investment in bus infrastructure, it may not make sense to convert it. The conversion itself can also be logistically difficult, particularly for the BRT system in a dedicated corridor, as the LRT construction could disrupt services for years.

Development Potential

International evidence suggests that if one of the goals of a system is to stimulate development at stations along a corridor that has or is poised to see sufficient growth and density, then LRT would be a better choice. BRT tends to be more successful where the lower capital investment makes more sense given a lower level of projected ridership, and where uncoordinated growth has led to low density housing coupled with significant traffic congestion. Again international evidence suggests LRT is a better catalyst for growth, while BRT may be a better response to sprawl.
LRT tracks symbolize permanence and represent a strong stimulus for economic development and can help trigger investment and job creation. It also builds confidence in the long term for developers and landowners.

There is also the whole issue about land value. Research suggests BRT systems have never shown to have any really significant uplift effect on property value, whereas rail based systems have been shown in international research to have a significant effect. It has shown that commercial and residential land values can increase between +5% and +35% next to LRT.

Along the preferred route identified for Metro West there is significant development potential particularly in Fingal County. Indeed in many areas of the corridor the development of lands is tied to the delivery of Metro West, primarily due to the capacity that it will provide in terms of sustainable transport and its capacity to be upgraded as and if required. This development potential may not be realised if a BRT system is implemented instead of Metro West. It should be noted that forecast demand for Metro West is based on the future demographic data that may not be realised with the introduction of a BRT system.

LRT is also perceived to be more conducive to landscaping efforts and substantial upgrading of urban realm. There is also a better coexistence of LRT with soft modes such as pedestrians and cyclists.

Attractiveness

Central to the effort to promote "BRT" systems is the contention that there is no basic difference in attractiveness to passengers between BRT buses and rail transit. BRT is often touted to offer the speed and comfort of rail – on a bus budget. The reality is that this might not be so as the ride quality with rubber on road normally is not as good as steel on steel.

There is no evident preference for rail travel over bus when quantifiable service characteristics such as travel time, reliability and cost are equal, but a bias does arise when rail travel offers a higher quality service. Indeed experience on the current Luas system suggests that travelers will choose the more reliable rail based mode over the bus alternative even where that alternative offers cost and time savings. In order to increase ridership to public transit, the service should be designed to have favourable levels of passenger convenience. Whether it is a rail system or bus system should not be of great importance. However from actual transit operations the evidence overwhelmingly suggests that rail, such as LRT significantly outperforms BRT in attracting ridership.

Light rail has been regarded from surveys as an acceptable and convenient alternative to the car and generally considered to be frequent, quick, clean and safe. In contrast buses were perceived as falling substantially short of meeting people's needs and were seen as undesirable and low status. There are a number of case studies of both rail and BRT operations which tend to suggest that, with similar service levels in the same or similar corridors, the BRT services have not attracted the same level of ridership as rail operations.

The mode specific constant (MSC) is the user perceived attractiveness of one transit mode compared to another, excluding the influence of factors such as fare, walk time, wait time, in vehicle time, and the need to transfer. The MSC is usually measured as a constant and expressed in minutes of equivalent in-vehicle travel time. Many studies have found that, other things being equal, most public transport users prefer rail to bus because of the greater comfort.

From international evidence it suggests that a comparable BRT system replacing Metro West would not be as attractive and not achieve the forecast demand.

The image of LRT is significantly better than BRT. Since its establishment Luas has been extremely successful and has become one of the landmarks of Dublin and has played a key role in the regeneration of particular parts of the city. Building on this huge success two line extensions are under construction and five more Luas Lines and two Metro Lines are being planned. It is has the ability to attract development, inward investment, be it form residential, to commercial developments and retail outlets, as it has played a key role in justification of these investments business plans.

Accessibility

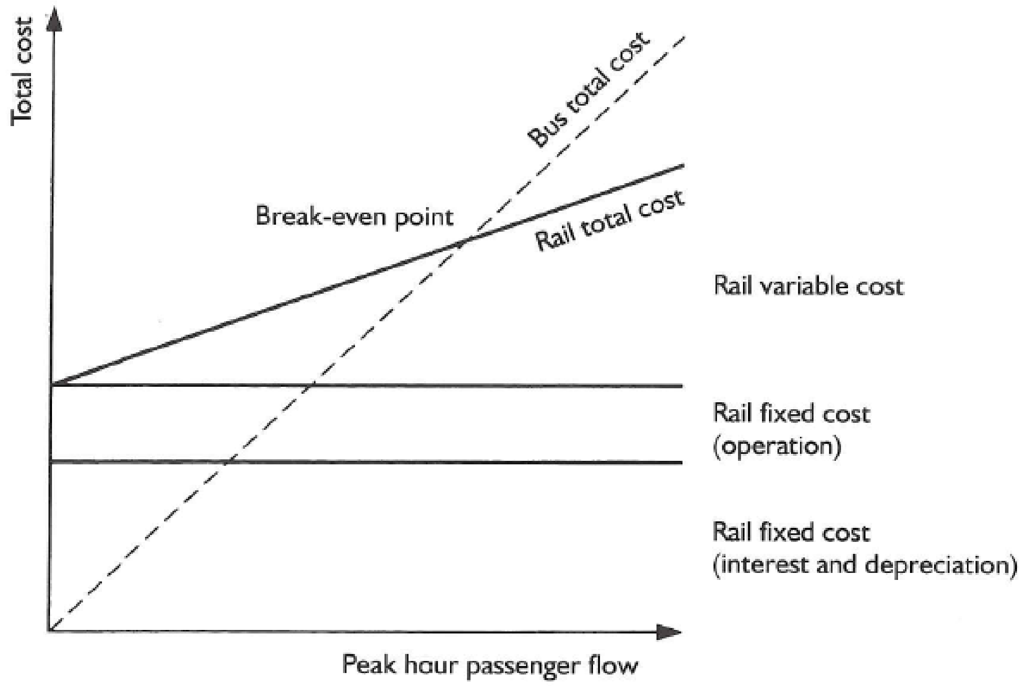
Rail guidance is essential where long vehicles are required to carry the same number of passengers as several standard buses and yet penetrate existing street networks. It would be extremely difficult for a BRT system driver to maintain a constant clearance in the absence of a guided system.

LRT stations involve platforms about twice the height of a normal kerb that offer ‘step free, gap free’ boarding which allow for level boarding of trams by persons in wheelchairs and other persons whose mobility is impaired. Platforms are typically ramped at each end to allow easy access to the platform for boarding. It is difficult to achieve the same level of accessibility with a BRT without some form of mechanical devises which will increase dwell times at stops. BRT vehicles cannot consistently follow the same horizontal and vertical line at a platform especially ones that are located in streets.

Economic

For a system to capture new users it must be of high quality and evidence suggests that rail systems attract much higher numbers than BRT. With a BRT system that offers a very high frequency of buses the operating costs rise significantly over that of an LRT due to the reduced numbers of vehicles required to meet demand. Maintenance cost per unit would be higher for a LRT vehicle but total maintenance costs would be higher on a BRT system due to the larger number of vehicles in the fleet.

The choice between modes is sometimes conceived as the balance between CAPEX and OPEX over the life of a project. Depending on the cost base of the economy (i.e. the wage levels) then above a certain capacity the huge cost of operations and maintenance outweighs the cost of capital investment in infrastructure for high capacity LRT systems. In every country the crossover point will be different between modes because of the relative cost of labour versus cost of capital and its availability, but in London for example the crossover between BRT and LRT would be at about 3,750 ppdph for high cost LRT. Buses can carry high passenger volumes but operating costs increase severely as passengers grow. The graph below illustrates this point. The graph below is taken from 'Public Transport: Its Planning, Management and Operation' 4th edition by Professor Peter White.



Actual and forecast demand is a main driver in an economic evaluation of this nature because the higher the demand the greater the advantages for an LRT system. As mentioned earlier, BRT is often pursued in developing countries where limited budgets exist for transport investment. BRT in these circumstances have often proven successful and cost effective for a number of key reasons but primarily because labour costs are lower and because the choice of transport is mode is limited, quiet simply the choice is often limited to walk or take the bus. Neither of these determining factors applies in a developed economy such as Ireland.

Environmental

An assessment of the environmental effects when considering which mode or system should be implemented is required. LRT systems are normally considered more environmentally friendly. Some of the reasons include the amount of emissions particularly in sensitive areas as they do not have an exhaust. There is much less dependence on fossil fuels with a LRT system and noise levels are normally reduced with an LRT system.

With a BRT system the amount of air pollution is normally considered the worst type of system particularly where the number of vehicles required to meet the forecast demand is high.

The preferred route identified for Metro West goes though one particular environmentally sensitive area. The sensitive nature of the Liffey Valley environment would also prove extremely challenging for the delivery of an appropriate and suitable bus system, particularly where very high frequencies are required and where diesel propulsion is concerned. It is also the case that mechanisms would have to be put in place to prevent other vehicles using the route as the provision of another Liffey road crossing in the area has long been opposed.

The Metro West preferred route also runs in close proximity to a number of houses along its route. A BRT system which would have increased air pollution and increased noise levels may not be suitable for a public transport system of this nature.

Conclusion

When considering which system or mode is best to suit particular needs a comparison under the following headings should be considered.

- Capacity
- Reliability
- Cost
- Development potential
- Attractiveness
- Environmental
- Economic

There are situations where a BRT system should be considered as being the most appropriate form of transport system particularly where there is potentially a lower actual and future demand which may not justify the higher cost of an LRT system but would benefit in the quick implementation of a BRT system to replace an unregulated bus network.

With regards to the possibility of implementing a BRT system as opposed to current Metro West LRT system RPA do not believe that a BRT system would achieve the vision for Metro West which is to provide a high quality orbital Light Rail service by 2015, delivered as an affordable / bankable PPP, connecting Tallaght, Clondalkin, Liffey Valley and Blanchardstown and linking the radial network to provide connection to the Airport and the City Centre.

As highlighted above under the different headings, for this type of public transport system a BRT system would fall short. A BRT system may be able to meet the initial capacity required by running a very high number of vehicles but it would unlikely do so reliably. A BRT system would have very little capacity reserve to meet future growth in demand compared to a LRT system and indeed would be unlikely to attract the same demand as Metro West in the first instance.

By running such a high frequency of vehicles to meet the forecast demand it can result in reduced reliability and performance particularly at road junctions because in affect there would be bus crossing each junction every minute.

The Metro West concept allows interoperability with Metro North, allowing passengers to travel from Tallaght to destinations on Metro North without the need for interchange. Passengers can travel to the airport and the city centre for example without the need for interchange. If a BRT system was implemented it will not offer this interoperability and no matter how good an interchange facility is it will reduce the demand on the system.

In addition to the interoperability with Metro North the Metro West preferred route offers interchange with the Kildare and Maynooth heavy railway line and also the recently identified Luas Line F preferred corridor. It would be doubtful whether a BRT system offering these interchanges would be as successful in attracting passengers interchanging.

For a BRT system to match the vision outlined above for Metro West any potential cost savings would be minimal due to the nature of any realistically comparable BRT system. The BRT system would have to be a high end quality system, including state of the art vehicles, off board fare collection, station facilities and be totally segregated from other road users to maintain its headway.

The costs involved to implement such a system may be too much especially when it does not offer any prospects of meeting any potential future demand due to the lack of reserve capacity.

International evidence suggests that if one of the goals of a system is to stimulate development at stations along a corridor that has or is poised to see sufficient growth and density, then LRT would be a better choice. This development potential along the Metro West corridor may not be realised if a BRT system is implemented instead of Metro West.

With regards to the attractiveness of the system in capturing new users international evidence would suggest that a comparable BRT system replacing Metro West would not be as attractive and not achieve the forecast demand.

As noted above the actual and forecast demand is a main driver in an economic evaluation of this nature because the higher the demand the greater the advantages for an LRT system. With the high demand forecast for Metro West it would suggest that a BRT would not be a suitable system because of its attractiveness in capturing new users and high operating and total maintenance cots.

Environmentally a BRT system running along the Metro West corridor with the number of vehicles required to meet demand the increased air pollution and increased noise levels may not be suitable for a public transport system of this nature.

CHAPTER 2

ROLE OF HIGH QUALITY LIGHT RAIL ON DEMAND AS TRIP ATTRACTOR

Role of Quality in LRT Demand

It is well established that high quality public transport modes, such as Luas, offer attractiveness to travellers over and above the 'classic' determinants of demand for public transport, such as journey time, fare, frequency etc. In forecasting the demand for public transport, a transport model can easily capture certain 'tangible' characteristics of a journey, such as the travel time and fare paid; what such models cannot easily capture is an appreciation of modal preferences.

For example, models cannot capture the fact that someone would rather travel on a nice clean light rail vehicle that glides along with smooth acceleration, feeling segregated from the rest of the traffic, than on an unsteady, difficult-to-board bus that is slow and goes over roads with variable quality. Additionally, bus service is typically heavily reliant on the human factor and lacks integrated systems management and coordination to ensure reliability and integrity of service. As a further example, the provision of real-time information provides certainty for travellers and helps to reduce the disutility associated with waiting, compared with the situation of waiting for a bus not knowing when and if it will turn up.

In modelling terms, a parameter is used to reflect this general perception of differing modes that is not captured by the journey time, walk and wait time or fare elements of the generalised cost. This is called a Mode Specific Constant (MSC). It is used within the modelling process to reflect soft factors in determining modal choice between tram and bus, such as ambience, ride quality, reliability, cleanliness, image and information.

The application of mode specific preference can be made by either a fixed value, say 5 minutes in-vehicle time (IVT) of tram over bus, or as an IVT factor, such as 1.1 for bus and 0.8 for tram (these were the values used in forecasting for the Edinburgh Tram project), which relates the value to journey length. The choice in approach is influenced by the model structure and application and the results of any surveys undertaken in this regard.

A selection of mode constant values derived from surveys which have been used in the planning of various UK tram schemes are presented in Table 1 below. Most of the values are constants, the exception being Case 1 which adopts the IVT factor approach.

Table 2.1: Mode Preference Values

Case	Mode	Comparison	Period	MC (min)	Comments
1	Tram	Tram Vs Bus	-	0.76*IVT	**Factor used to weight the IVT for tram**
2	Metro	Metro Vs Bus	peak	4.5	
			off peak	5.8	
		Car Vs Bus (Short)	peak	14.5	**Short = Inside City**
			off peak	15.8	
3	Tram	Tram Vs bus paying segments	peak	8.2	**The mode constant employed applies 75% of the value identified through SP, to take account of future improvements to buses**
			off peak	8.2	
		Tram Vs bus non paying segments	peak	6.2	
			off peak	6.2	
		Car Vs Tram	peak	19.6	
			off peak	19.6	
4	Tram	Tram Vs Bus	peak	16.1	
			off peak	16.0	
5		Tram Vs Bus (non car-available)	peak	4.0	
			off peak	4.0	
		Tram Vs Bus (car-available)	peak	8.5	
			off peak	8.5	
		Car Vs Bus	peak	20.0	
			off peak	20.0	
6	Tram	Tram Vs Bus (non car-available)	peak	6.0	**For NCA, value used was half of SP derived value, which was, considered too high. Car vs bus value calibrated.**
			off peak	6.0	
		Tram Vs Bus (car available)	peak	15.0	
			off peak	14.0	
		Car Vs Bus	peak	43.0	
			off peak	**43.0**	

Source: Edinburgh Tram (Line One) Bill Committee, Written Evidence on the Updated Preliminary Financial Case, December 2004

The particular value is usually derived from stated preference surveys – there is very little revealed preference work done (this is presumably because there is little demand for this ex-post analysis once a scheme has been built). A typical mode constant used in demand forecasting for UK LRT schemes would be 8 -10 minutes travel time preference for tram over bus. In general terms this means a bus would have to be between 8 and 10 minutes quicker than LRT in order for passengers to choose it, if all other elements of the journey being equal.

The MSC used in the RPA model is 11.7 minutes. The mode constants were derived from revealed preference analysis between DART and car which was considered to appropriate for use as the basis of a Metro /Luas versus car choice.

These are generally in line with expectations and international norms. The MSC used in the RPA model were initially derived from stated preference work undertaken in advance of the introduction of Luas. No revealed preference study has yet been undertaken since the introduction of Luas.

Modal Preference on Luas

In the case of Luas, there is some evidence of passengers' preference for the innate quality features of the system compared to bus. The challenge in identifying the degree to which quality features generate demand lies in isolating the impact of so-called hard characteristics of mode, such as journey time, frequency, and fare.

Some insight in this regard can be gained by examining the mode choice made by passengers disembarking rail services at Heuston Station who are making onward journeys by public transport. All passengers boarding/disembarking either tram or bus on a set date each year are counted. The results of the count are used to determine factors for the division of add-on revenue collected by Iarnród Éireann from customers who prepay for city centre connectivity.

Currently there are rail add-on tickets that allow arriving rail passengers to travel by Luas or bus from Heuston Station to the city centre. Passengers travelling to the city centre have the choice of either the Luas Red Line to Abbey Street/Connolly, or buses no. 90, 91 or 92. The bus services offer different journey opportunities:

- Service 90 goes from Heuston via Bachelor's Walk to the IFSC,
- Service 92 goes from Heuston via Bachelor's Walk to Leeson Street; and
- Service 91 operates to/from Heuston and the City Centre in conjunction with train arrivals and departures at Heuston Station.

For passengers with Iarnród Éireann add-on tickets, the fare to the city centre is the same whether they take the bus or Luas. For passengers buying single tickets, the tram is slightly more expensive, €1.50 compared to a bus fare of €1.30.

The journey time from Heuston to Connolly on Luas is approximately 14 minutes, and approximately 12 minutes to Abbey Street, depending on the time of day. The timetabled journey time for bus is 15 minutes from Heuston to Bachelor's Walk, and 30 minutes from Heuston to Connolly. It has been observed however that the bus is often quicker than scheduled and sometimes quicker than Luas, particularly since the introduction of additional bus priority measures on the North Quays. This is most prevalent in the off peak hours.

For passengers travelling to the south side of the city centre, bus is likely to be the preferred mode, as the 92 service serves the south city centre, terminating at Leeson Street; in contrast Luas does not serve the south city centre, and an approximate 15 minute walk is required between Abbey Street stop to St. Stephen's Green. During the morning peak, passengers have minimal waiting time for both services.

It is clear from the above that, although the two modes offer similar services, there are differences that may confer a clear advantage for some passengers making particular journeys.

The most recent survey count data (2007) show an overall mode share of 72% Luas, 28% bus. During the am peak hour, the split is more evenly matched 54% to 46% bus. In the off peak and pm peak, Luas is the dominant mode, with a mode share ranging between 70%-95%.

It is worth noting that the bus share of boardings is 33%, whereas its share of alightings is 22%, (averaging 28%), meaning passengers who use bus to go to the city centre use Luas for the return journey. It is likely that the advantage of some of the Luas quality features, such as reliability, waiting environment, real time information on next service, etc. is mitigated to an extent at Heuston as there is generally a bus waiting for passengers as they exit the station, although there is still uncertainty for passengers about how long they will have to wait on the bus before it departs.

In addition, outside the am peak, reliability is likely to be more important on trips to Heuston rather than on trips from Heuston, because passengers require connection with a particular train departure at Heuston.

To date there have been three passenger counts undertaken at Heuston, in 2004, 2005 and 2007 (Table 2). The surveys show that Luas mode share has been rising steadily, staring at 38% in 2004, and rising to 72% in 2007.

It should however be noted that Luas Red Line services only commenced in October 2004 and the survey was undertaken in November of that year. In addition the service provision on the line was incrementally increased over following months and into 2005.

Table 2.2: Summary of Boardings and Alightings at Heuston Station, Previous Surveys

	2004 Survey		2005 survey		2007 Survey	
	Pax.	%	Pax.	%	Pax.	**%**
Bus	6,131	**62%**	4,314	**36%**	3,727	**28%**
Luas	3,822	**38%**	7,586	**64%**	9,761	**72%**
Total	**9,953**	**100%**	**11,900**	**100%**	**13,488**	**100%**

Conclusions

High quality public transport modes, such as Luas, generate demand over and above that which can be explained by hard journey factors such as journey time, frequency, fare etc. This demand reflects an innate mode preference, usually driven by features such as comfort of ride, reliability, ambience, and information, which confer an advantage on modes such as Luas.

In modelling terms, the Mode Specific Constant is used to reflect such modal preferences, and the particular value is usually derived from stated preference surveys – there is very little revealed preference work done (this is presumably because there is little demand for this ex-post analysis once a scheme has been built). A typical mode constant used in demand forecasting for UK LRT schemes would be 8-10 minutes travel time preference for tram over bus.

There has been no revealed preference analysis yet for Luas, although this is an area of work which the RPA is considering. However, the results of passenger counts on the Heuston Station/City Centre route, where bus and Luas offer similar services, illustrate passengers' revealed preference for Luas over bus. RPA believe this Luas mode share cannot be explained entirely by differences in journey time, but rather reflect a preference by passengers for Luas features such as reliability, real-time information, ease of access, etc. The quality features of Luas which differentiate it from bus are one of the key reasons for the success of the scheme.

When Luas was first introduced, the situation was reversed, suggesting the public needed time to gain the "trust" of Luas and to appreciate its reliability and comfort features.

The Luas was first introduced in late 2004 and did not operate at high frequencies on start-up. The first full year of operations was 2005 and it was at this stage that we had the increased patronage. This popularity was one of the drivers for extending the vehicles from 30m to 40m.

The role of the Luas-type system has demonstrated preference as a trip attractor, and further more as stated in previous chapter, as a catalyst for business and residential development.

CHAPTER 3

POTENTIAL MARKET FOR METRO WEST BASED ON CURRENT TRIP PATTERNS

The CSO's 2006 census journey-to-work (POWCAR) data was analysed to determine how many trips originated from electoral divisions (EDs) within the Metro West corridor and how many of these trips could potentially use Metro West.

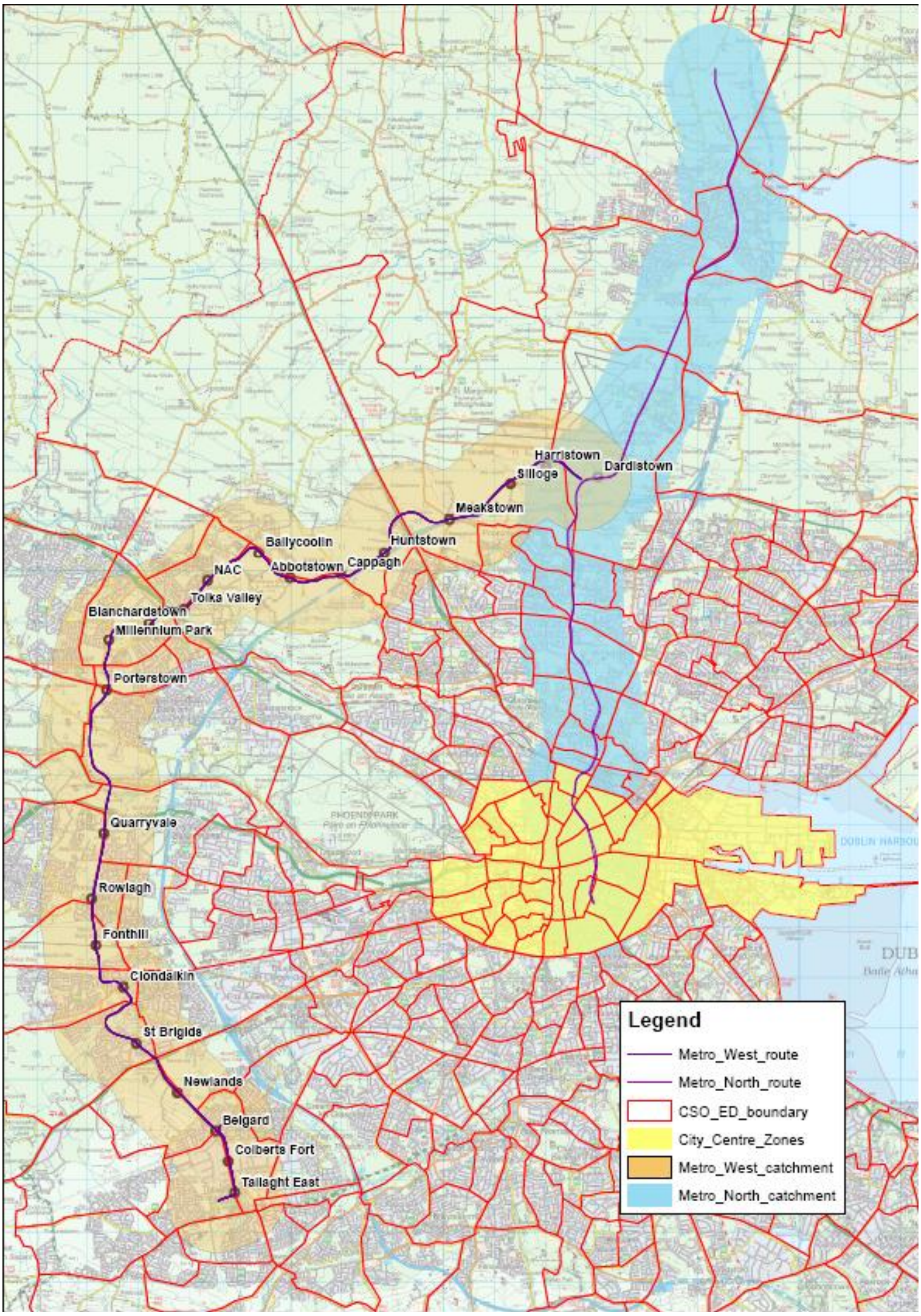
In order to conduct this analysis the study area was first defined. This study area includes EDs that are within approximately 1km distance of the Metro West route and EDs in Dublin city centre and along the route of Metro North. The reason these EDs are included is because the introduction of Metro West offers the potential for radial trips to the city centre using Metro North infrastructure in addition to orbital routes along the Metro West alignment.

Indeed Metro West will operate as both a provider of radial and orbital trips, through the interoperable service with Metro North and via the many interchanges it facilitates with the existing and proposed radial network. In particular the service will be most attractive as a radial service in the section north of Porterstown. It is expected that an interoperable service will run from Blanchardstown Town Centre to O'Connell Street in circa thirty (30) minutes. This is substantially quicker than existing radial services in the area and thus makes this service potentially very attractive. The interoperable services effectively increase the catchment of the Metro West scheme.

A total of 35 EDs were identified as being partly or wholly contained within this 1km buffer (Figure 3.1). To take into account that not all of these EDs lay fully within the defined 1km Metro West corridor the proportional area of the ED that lay inside the corridor was used to factor the POWCAR results. For robustness a base map showing the current developed areas was overlaid to show current development. From this it is possible to determine if the proportional area factor is appropriate or not to use. For example if all of the current development is concentrated in one part of a large ED the proportional area factor would not be appropriate.

For avoidance of doubt, the "Metro West corridor" referred in this chapter is the 1km catchment area along the route.

Figure 3.1: Study Area



According to the 2006 census, a total of 39,500 journey-to-work trips originated from this corridor. Of these, 16,800 trips had a destination either within the Metro West corridor itself or within Dublin city centre (as defined in Figure 3.1), and could therefore potentially use the Metro West service.

However, the estimated potential demand for city centre (i.e. radial) trips on Metro West was reduced to reflect the fact that alternative modes would likely be used for this journey from some of the catchment, for example those in the South Dublin County Council area. Having made this adjustment, an estimated 3,500 work trips with destinations in the city centre would potentially use Metro West.

The remaining estimate of 9,400 (24% of the total) work trips originating within the Metro corridor also had their destination within the corridor. This indicates that there is a potential demand for purely orbital movements on the Metro West service.

In addition, an estimated 7,200 work trips originating in this corridor had their destination in the catchment of Metro North. Depending on the service pattern this journey could potentially be made using Metro West alone or a combination of Metro West and Metro North services.

The census also revealed that the Metro West corridor received approximately 43,000 trips from EDs outside of its boundary. Therefore approximately 52,400 (43,000 + 9,400) journey-to-work trips were made to the catchment of Metro West.

Table 3.1: "Journey to Work" (JTW) Results Summary (2006 CSO Census)

Description	No. of Trips
Trips From Metro West Corridor To:	**39,500**
City Centre	**3,500**
Metro North Catchment	**7,200**
Metro West Corridor	**9,400**
Other areas (external to 1km catchment)	**19,400**
Trips To Metro West Corridor From:	**52,400**
Metro West Corridor	**9,400**
Outside Metro West Corridor	**43,000**

Conclusion

An initial analysis of the CSO's POWCAR data shows that a significant number of work-based trips are made to and from the immediate catchment of the Metro West route. In particular this data details that almost 40,000 trips are made from the Metro West corridor to a work destination.

Of this total, there are nearly 10,000 work-based trips that both begin and finish within the corridor. Thus, there is potential demand for purely orbital movements within this corridor, which would be catered for within the Metro West service alone.

The remaining 30,000 trips which begin in the corridor but are destined for a work location outside the immediate area could also use Metro West for all or a portion of their journey (possible via interchange or by using interoperable service on Metro North).

In addition to trips originating within the Metro West corridor, almost 43,000 work-based trips, which originate outside the Metro West corridor, also have their destination within this area and thus could use Metro West for all or a portion of their journey (possibly via interchange or by using the interoperable services on Metro North).

It should be noted that a single journey to work would result in two trips on the network as those who go to work must return. Thus the approximately 80,000 journeys to work being made either to or from the corridor would translate to 160,000 work based trips (to and from work).

It should also be noted that this analysis only deals with journey-to-work trips and does not cover the additional potential demand for Metro West from education and leisure journey purposes (this would include shopping trips, non work-based journeys to Dublin Airport and journeys to educational institutions in the Metro West corridor).

Metro West will serve many of the largest existing retail and leisure centres in Dublin – Tallaght, Liffey Valley, Blanchardstown, Charlestown and City Centre, Airport and Swords Pavilions via interoperation with Metro North.

For example, The Square, Liffey Valley and Blanchardstown have a combined annual footfall of approximately 70 million. Currently, there over 5,000 students attending IT Tallaght and IT Blanchardstown. Capturing a small proportion of these leisure journeys could be a substantial addition to Metro West demand. Capturing an even small proportion of such leisure based trips would add considerable annual patronage to Metro West.

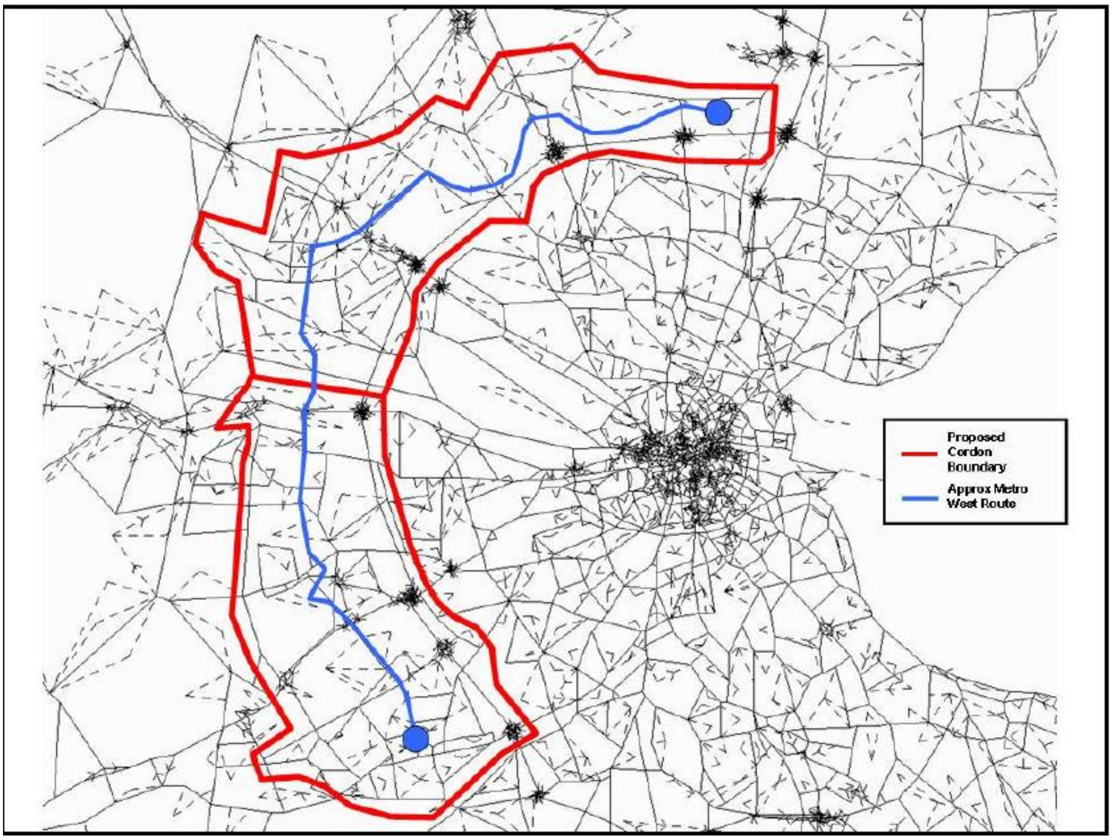
CHAPTER 4

METRO WEST IMPACT ON THE M50: A REVIEW OF FABER MAUNSELL TECHNICAL NOTE

Study Findings

In October 2008, consultants acting on behalf of RPA undertook a high level assessment of the potential strategic impact of Metro West on the Dublin traffic network using the DTO 2016 strategic model. The study area defined for this analysis is depicted in Figure 4.1.

Figure 4.1 Metro West Route and Cordon



In order to conduct the analysis, the 2016 DTO strategic model was run in two scenarios (with and without Metro West) to determine the impact the introduction of Metro West. The results forecast on specific routes show a decrease in traffic volumes, (Figure 4.2) whilst on other routes (Figure 4.3) traffic volumes increase on the highway network due to the introduction of Metro West.

Figure 4.2 Decrease in traffic due to introduction of Metro West

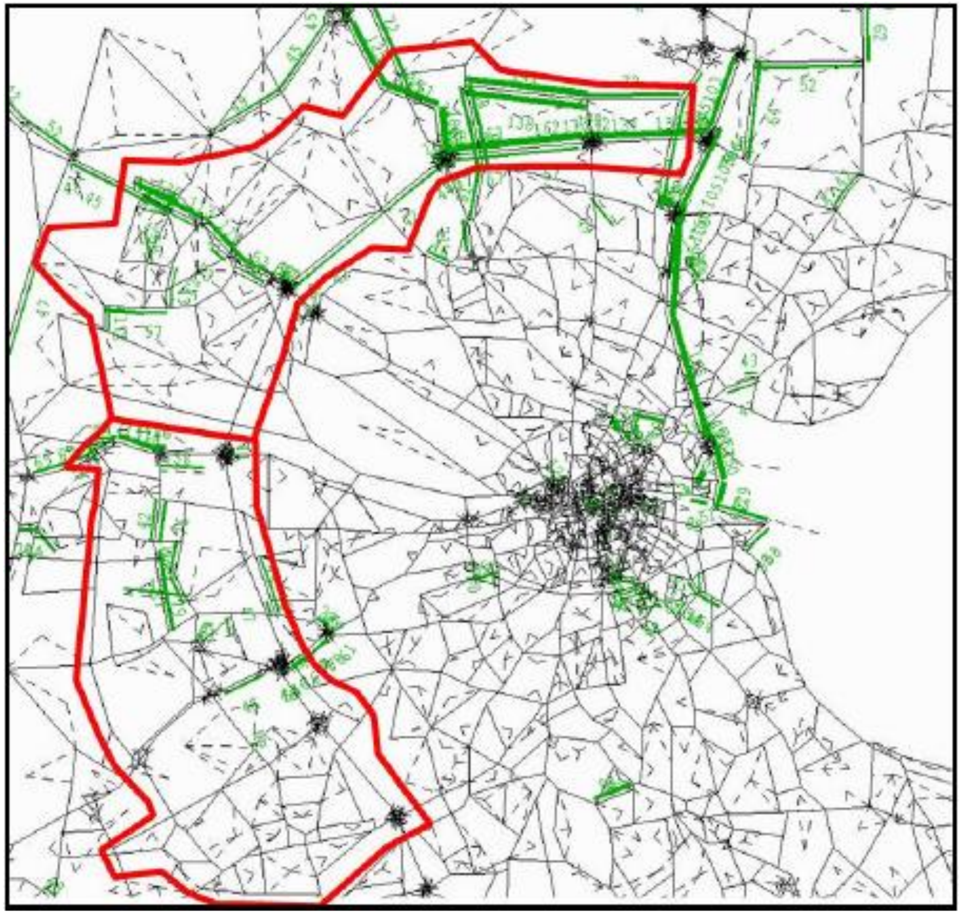
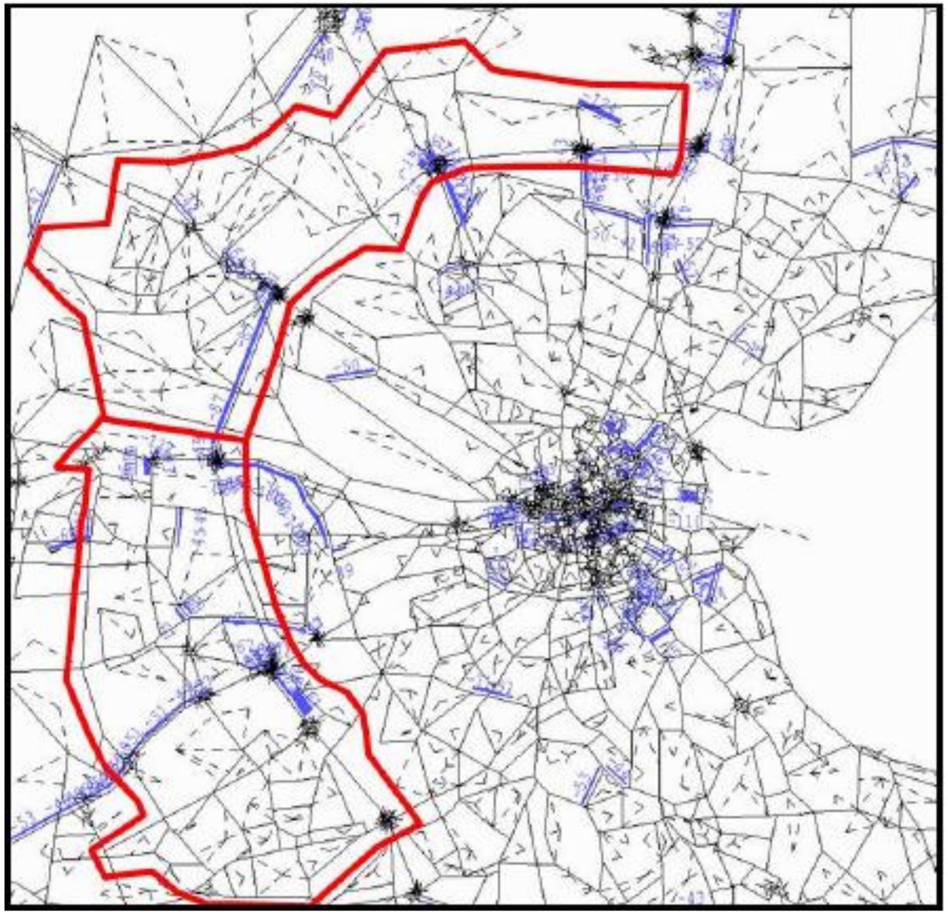


Figure 4.3 Increase in traffic due to introduction of Metro West



Figures 4.2 and 4.3 are graphical representations of the strategic road network as coded in the DTO model. The figures indicate the change in traffic volumes on that network as a result of the introduction of Metro West. The routes with reduced traffic volumes are shown in green whilst increases are shown in blue. The greater the change in traffic level, the wider (thicker) the coloured lines.

Interpretation of Results

The results suggest the following:

- Traffic volumes on the M50 are forecast to reduce considerably in the section between the N3 and M1 interchanges;
- Traffic volumes on the M50 are forecast to increase between the N3 and N4 interchanges;
- Traffic volumes over the whole of the M50 are forecast not to change substantially;
- Traffic volumes on the N3, N4 and M1 are forecast to considerably reduce;
- Traffic volumes on the N7 are forecast to increase marginally;
- Traffic volumes at and around the Airport are forecast to substantially reduce;
- Most traffic changes are local in relation to Metro West.

It is difficult to draw strong conclusions from the analysis but one interpretation might be that:

- Local traffic on the M50 is being attracted onto Metro West, this is indicated by the reduction in M1, N2, N3 and N4 volumes;
- The resulting capacity made available is being used by non local trips; this is indicated by the increase in traffic on the N7 and on the M50 between the N4 and N3 interchanges.

Local traffic in this instance is traffic that is destined for somewhere in the corridor of Metro West or for the city centre. For example, traffic coming in the N3 to access the city centre but uses the M50 and M1 to do so.

Capacity of M50 and Metro West

It should be noted that the upgraded M50 will have capacity throughout for 3 lanes of traffic plus an auxiliary (turning) lane in each direction throughout. The capacity of a single motorway lane is generally between 1,400 and 1,800 passenger carrying units (pcus) per hour. A single pcu is a private car and a truck, for example, is 3 pcus. The M50 thus has thus capacity for a maximum of 7,200 pcus/h, Average car occupancy in Dublin is approximately 1.2 persons. Thus the capacity of the M50 is for approximately 8,640 persons per direction per hour.

Metro West is being designed to carry initially 5,000 passengers per direction per hour (ppdph) and 10,000 ppdph with long (94m) vehicles and ultimately up to 20,000 ppdph by reduced headways. The design capacity (94m vehicles) of Metro West is equivalent, in person carrying terms, to a 5 lane motorway with the capability to be upgraded to the equivalent of a 10 lane motorway,

Conclusion

Based on the interpretation of the DTO strategic model results, Metro West is forecast to primarily remove local based trips from the M50. Reductions in M50 traffic, particularly in the section between the N3 and the M1 intersections, is forecasted. There is also a reduction forecast on some of the radial routes to the M50, i.e., the N4, N3 and N2 routes and on the M1 between the Airport and the City Centre. The results showed that the anticipated global reduction in traffic volumes along the M50 did not emerge. This suggests that the reduction in local trips entering the M50 was offset by an increase in longer distance trips forecast to use the newly available capacity on the M50. This suggests that the introduction of Metro West facilitates the removal of unwanted local based trips from the motorway, allowing it to operate as originally intended, as a by-pass of the city.

The provision of Metro West is equivalent in capacity terms to the provision of a 10 lane motorway capable of being upgraded to a 20 lane system.

CHAPTER 5

IMPACT OF RECESSION

Global View

The current economic recession may impact the Metro West project in the following tow key areas:

1. It may reduce the ability of the public and private sectors to raise capital to fund the delivery of the scheme;
2. It may lead to a reduction in population and employment growth in the corridor, leading to reduced demand and thus reduced revenues.

Private Sector Funding

Overall, the PPP model has been a successful form of delivering a range of projects on time and on budget. Failure to deliver key infrastructure projects such as Metro West would only widen the current infrastructure gap and will fail to address the imminent public transport need. This would inhibit the ability to grow, would decrease productivity and capacity. Lack of public transport creates less attractive environment for residents, businesses, people who work locally and visitors and attraction of foreign direct investments.

It is evident that the slowdown in the economy has occurred most prominently as a result of the global crisis on the financial markets. At the same time, the overreliance on the housing industry and the bursting of the property bubble had created larger pessimism in the economy.

There is an evident track record that demonstrates that international contractors find the Irish PPP market an attractive investment. Metro West is seen as very attractive project and the spare capacity created in the construction industry could provide an opportunity for the Government to achieve a better value for money in procuring these services.

The deliverability of Metro West is also safe guarded by the requirements of the lenders, which are very much aligned with those of the public sector, as lenders would look to ensure that Metro West would be delivered as per the specifications consistent with the RPA requirements.

In June of this year, RPA undertook an optional market sounding by asking responses from the banking sector. Its main objective was to establish the bank interest to deliver the project, determine bankability of project, and assess appetite for risk transfer. NDFA has commented and advised on the bankability questionnaire. Information regarding the optional market sounding was posted on the RPA website under the “Metro West” section.

Respondents had demonstrated extensive experience in project finance of similar nature and size, as average size of financing deals stated were within a range of €2-2.5 billion. The largest financing transaction stated was £8.8bn.

The respondents have expressed large interest in providing finance to the private sector partner for the Metro West project.

Whilst there is no doubt of a nervousness in the financial markets at present, the Metro West project does not expect to be requesting bids from consortia until well into 2010 at best. It is also the case that many lending institutes, contractors and investment companies will in future most likely be looking for more secure investments and innovative approach to funding. A PPP such as Metro West which has limited demand risk, is backed by the Government and has certainty of availability payments over a considerable time period, would be seen as a favourable investment.

The research indicated that the recent market developments are likely to result in an increased tendency for Banks to “club” project financing i.e. a larger number of banks involved in arranging the deal in the first place. In turn, there will be fewer underwritten loans, where smaller groups of lenders take on the full debt quantum at financial close and subsequently syndicate the deal to a larger group of participant banks.

Land Use and Demand Sensitivity Testing

RPA have undertaken various land use and demand sensitivity tests in order to assess the impact of land use changes on the projected forecast demand, and reflect possible impact of recession.

Demand forecasts were determined based on alternative land use projections. The sensitivity tests have been developed to test the robustness of the Metro West project to reductions in land use projections. To ensure a robust comparison three different land use projections were taken into account as follows:

- 2006 Land Use (No further/new Development)
- 50% of Forecast New Development
- 80% of Forecast New Development

Test one is the worst case scenario, as it uses the current land use figures for the area, i.e. no new development will take place up to 2016.

The land use projections have been changed in the immediate vicinity of the Metro West alignment (approximately 1km buffer). The changes were applied to population and employment projections in the Electoral Divisions (EDs) in the immediate vicinity of the alignment. The changes were mainly applied in Blanchardstown to Dardistown section of the alignment as these are areas are undeveloped, whilst change in Tallaght to Blanchardstown section was predominantly around the Clonburris area as the remainder of alignment runs through developed and well established areas.

For comparison purposes the model scenarios used in the Outline Business Case from May 2008 were run to show the impact of changed land use data on Metro West. These were as follows:

- Base Case
- T21 Network
- Phasing Option Porterstown
- Phasing Option Blanchardstown

Base Case Scenario

The first scenario (base case) in the table below shows assumed projects in place. Projects such as the Interconnector, Luas Line F, Luas Line BXD and other Luas extensions were not included but are currently proposed by the Department of Transport in Transport 21.

Table 4.1 – Transport Assumptions Base Case

Table 1: Base Case Project Assumptions		
Assumption	**Do minimum**	**Do Something**
Luas Tallaght to Connolly (Red Line)	Yes	**Yes**
Luas St Stephen's Green to Sandyford (Green Line)	Yes	**Yes**
Luas Connolly to The Point (Line C1)	Yes	**Yes**
Luas Sandyford to Bride's Glen (Line B1)	Yes	**Yes**
Luas Belgard to Saggart (Line A1)	Yes	**Yes**
Metro North	Yes	**Yes**
Metro West	**No**	**Yes**
Luas City-centre to Lucan (Line F)	No	**No**
Luas Stephen's Green to Broombridge (Line BX/D)	No	**No**
Luas Bride's Glen to Bray/Fassaroe (Line B2)	No	**No**
Irish Rail Interconnector	No	**No**
Dublin Port Tunnel	Yes	**Yes**
Dublin Outer Orbital Road	Yes	**Yes**
Luas P&R	Yes	**Yes**
DTO Quality Bus Network	Yes	**Yes**
Integrated Ticketing	Yes	**Yes**
Demand management	**No**	**No**

Within the base case there was two service patterns compared against each other. Service pattern 1 has three different services to and from Tallaght. One third of the services go between Tallaght and Belinstown, another third go between Tallaght and the city centre and the final third goes between Tallaght and Dardistown. Service pattern 2 has all services running between Tallaght and Dardistown only. To travel onwards to the airport or city centre for example requires interchange. Table 2 highlights the different service patterns used in the Base Case.

Table 4.2 – Service Pattern Base Case

Table 2: Base Case Service Patterns	Headway (minutes)	
Metro West - Service Pattern 1:	Peak	**Off Peak**
Tallaght - Belinstown	12	**24**
Tallaght - Dardistown	12	**24**
Tallaght - City Centre	12	**24**
Metro West - Service Pattern 2:		
Tallaght - Dardistown	**4**	**8**

Transport 21 Scenario

Assumed that the public transport element for the Greater Dublin Area of the Transport 21 programme was in place in the do-minimum, and then Metro West services were added for the do-something, as per Table 3 below. The same service patterns used in the base case apply here also.

Table 4.3 – Transport Assumptions Transport 21 Network

Assumption	Do minimum	Do Something
Luas Tallaght to Connolly (Red Line)	Yes	**Yes**
Luas St Stephen's Green to Sandyford (Green Line)	Yes	**Yes**
Luas Connolly to The Point (Line C1)	Yes	**Yes**
Luas Sandyford to Bride's Glen (Line B1)	Yes	**Yes**
Luas Belgard to Saggart (Line A1)	Yes	**Yes**
Metro North	Yes	**Yes**
Metro West	**No**	**Yes**
Luas City-centre to Lucan (Line F)	No	**No**
Luas Stephen's Green to Broombridge (Line BX/D)	Yes	**No**
Luas Bride's Glen to Bray/Fassaroe (Line B2)	Yes	**No**
Irish Rail Interconnector	Yes	**No**
Dublin Port Tunnel	Yes	**Yes**
Dublin Outer Orbital Road	Yes	**Yes**
Luas P&R	Yes	**Yes**
DTO Quality Bus Network	Yes	**Yes**
Integrated Ticketing	Yes	**Yes**
Demand management	**No**	**No**

Phasing Option 1 – Porterstown to Metro North

In this phasing scenario Metro West services run from Porterstown to Dardistown. Project Assumptions are the same as for Base Case scenario, presented in Table 1.

The service pattern has changed as Porterstown is now the new Metro West terminus (Table 4):

Table 4.4 – Service Pattern for Phasing Option Porterstown

Phasing Option Porterstown **Service Pattern**	**Headway (minutes)**	
	Peak	**Off peak**
Metro West - Service Pattern:		
Porterstown – Belinstown	12	**24**
Porterstown – Dardistown	12	**24**
Porterstown - City Centre	12	**24**
Metro West - Service Pattern 2:		
Porterstown - Dardistown	**4**	**8**

Phasing Option 2 – Tallaght to Blanchardstown

The second phasing option tests the scenario whereby Metro West services run from Tallaght to Blanchardstown/Abbottstown. Table 5 shows the Project Assumptions for this scenario:

Table 4.5 – Project Assumptions Phasing Option Blanchardstow

Assumption	**Do minimum**	**Do Something**
Luas Tallaght to Connolly (Red Line)	Yes	**Yes**
Luas St Stephen's Green to Sandyford (Green Line)	Yes	**Yes**
Luas Connolly to The Point (Line C1)	Yes	**Yes**
Luas Sandyford to Bride's Glen (Line B1)	Yes	**Yes**
Luas Belgard to Saggart (Line A1)	Yes	**Yes**
Metro North	No	**No**
Metro West	**No**	**Yes**
Luas City-centre to Lucan (Line F)	No	**No**
Luas Stephen's Green to Broombridge (Line BX/D)	No	**No**
Luas Bride's Glen to Bray/Fassaroe (Line B2)	No	**No**
Irish Rail Interconnector	No	**No**
Dublin Port Tunnel	Yes	**Yes**
Dublin OuterOrbital Road	Yes	**Yes**
Luas P&R	Yes	**Yes**
DTO Quality Bus Network	Yes	**Yes**
Integrated Ticketing	Yes	**Yes**
Demand management	**No**	**No**

In this phasing option there is one service pattern between Tallaght and Blanchardstown as shown in Table 6:

Table 4.6 – Service Pattern Phasing Option Blanchardstown

Service Pattern Phasing Option Blanchardstown	**Headway (minutes)**	
	Peak	**Off peak**
Metro West - Service Pattern:		
Tallaght – Blanchardstown	**4**	**8**

Sensitivity Tests Results on Metro West Demand

The land use sensitivity tests are presented below together with, for comparison purpose, the results from the Metro West OBC which were based on full 2016 land use development taking place.

Table 4.7: Sensitivity Test Results – Metro Patronage

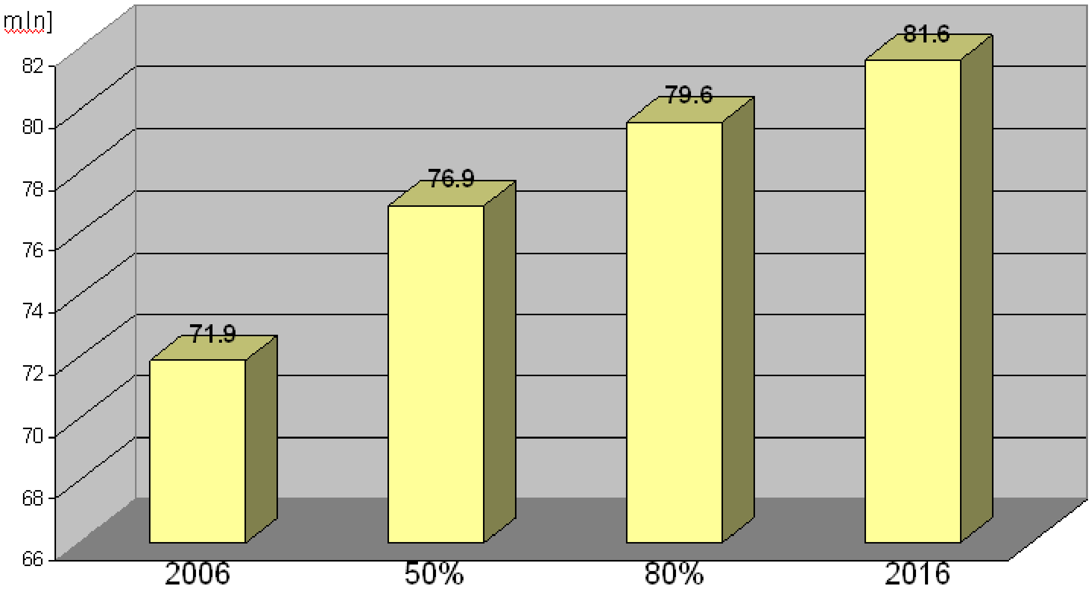
Base Case	**0% (2006)**	**50%**	**80%**	**100% (OBC)**
Service Patten 1				
Additional Metro patronage	30.5m	33.7m	34.7m	36.1m
Total Metro patronage	71.9m	76.9m	79.6m	81.6m
Service Pattern 2				
Additional Metro patronage	27.4m	30.1m	31.1m	32.5m
Total Metro patronage	68.7m	73.4m	76.0m	78.1m

Transport 21 Network	**0% (2006)**	**50%**	**80%**	**100% (OBC)**
Service Patten 1				
Additional Metro patronage	25.2m	27.8m	28.6m	29.9m
Total Metro patronage	65.0m	69.9m	72.7m	74.7m
Service Pattern 2				
Additional Metro patronage	23.2m	27.3m	28.2m	29.5m
Total Metro patronage	64.5m	69.4m	72.3m	74.3m

Phasing Option Porterstown	**0% (2006)**	**50%**	**80%**	**100% (OBC)**
Service Patten 1				
Additional Metro patronage	13.1m	14.0m	14.5m	15.0m
Total Metro patronage	54.5m	57.2m	59.4m	60.6m
Service Pattern 2				
Additional Metro patronage	10.2m	10.9m	11.6m	12.1m
Total Metro patronage	51.5m	54.1m	56.5m	57.6m

Phasing Option Blanchardstown (No Metro North)	**0% (2006)**	**50%**	**80%**	**100% (OBC)**
Additional Metro patronage	15.3m	16.9m	17.1m	17.7m
Total Metro patronage	15.3m	16.9m	17.1m	17.7m

The graph below illustrates the forecast demand for the base case scenario with different land use projections.



*Annual Figures in millions

Taking the base case scenario, in the situation whereby no future development takes place and the land use projections remain at the current levels the forecast demand for additional trips added to the Metro Network is 30.5 million compared to 36.1 million using the 2016 land use projections.

The worst case scenario, where no new development takes place, passengers are forced to interchange with Metro North and the complete Transport 21 network is in place suggests Metro West would add 23.2 million trips to the network. This is a significant increase in trips made on the Metro Network with the introduction of Metro West.

The analysis demonstrates that there is strong demand for Metro West even if no future development takes place.

The phasing options also seem viable with the lowest forecasts of between 10.2 million and 15.3 million new Metro passengers depending on the phasing option.

Sensitivity Tests Results on Metro West Cost Benefit

The outputs from the RPA transport model results have been applied to estimate the benefits resulting from Metro West with the different land use projections. The Cost Benefit Analysis of Metro West demonstrates a strong economic case for the project with a benefit to cost ratio of 2.21 and 1.81 in the base case for both service patterns and full land use development having taken place.

The parameters and methodology used in the CBA are consistent with the guidance issued by the Department of Transport for appraisal of transport projects. All costs and benefits have been discounted to 2002 for analysis purposes, in accordance with the same guidelines.

A conservative approach was taken when extrapolating the results from the forecast year. It is assumed the benefits are constant in each year, that is, they do not grow from year to year.

As tables 4.8 and 4.9 below demonstrate, there is a good strong and robust economic case for the project even in the scenario based on current land use projections. In this scenario the benefit to cost ratio is still a strong 1.89:1 and 1.52:1 depending on service pattern as outlined below. The benefit to cost ratio increase as the development grows.

Table 4.8 – CBA base case scenario (service pattern 1)

Discounted to 2002 (€m)	Existing land use	50% 2016	80% 2016	2016
User Time Savings	[text deleted]	[text deleted]	[text deleted]	[text deleted]
Non user Time Savings	[text deleted]	[text deleted]	[text deleted]	[text deleted]
Vehicle Operating Cost Savings	[text deleted]	[text deleted]	[text deleted]	[text deleted]
Accident Savings	[text deleted]	[text deleted]	[text deleted]	[text deleted]
Air Emissions Savings	[text deleted]	[text deleted]	[text deleted]	[text deleted]
Total Benefits	[text deleted]	[text deleted]	[text deleted]	[text deleted]
Operating Costs	[text deleted]	[text deleted]	[text deleted]	[text deleted]
Renewals Costs	[text deleted]	[text deleted]	[text deleted]	[text deleted]
Capital Costs	[text deleted]	[text deleted]	[text deleted]	[text deleted]
Total Costs	[text deleted]	[text deleted]	[text deleted]	[text deleted]

Economic Net Present Value (NPV)	[text deleted]	[text deleted]	[text deleted]	[text deleted]
Benefit to Cost Ratio (BCR)	**1.89:1**	**2.05:1**	**2.14:1**	**2.21:1**
Internal Rate of Return (IRR)	**12.1%**	**13.1%**	**13.7%**	**14.1%**

Table 4.9 – CBA base case scenario (service pattern 2)

Discounted to 2002 (€m)	Existing land use	50% 2016	80% 2016	2016
User Time Savings	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Non user Time Savings	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Vehicle Operating Cost Savings	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Accident Savings	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Air Emissions Savings	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Total Benefits	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Operating Costs	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Renewals Costs	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Capital Costs	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Total Costs	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Economic Net Present Value (NPV)	**[text deleted]**	**[text deleted]**	**[text deleted]**	**[text deleted]**
Benefit to Cost Ratio (BCR)	**1.52:1**	**1.68:1**	**1.75:1**	**1.81:1**
Internal Rate of Return (IRR)	**8.8%**	**10.0%**	**10.5%**	**10.9%**

CBA for Transport 21 Scenario

The outputs from the RPA transport model results have been applied to estimate the benefits resulting from Metro West with the different land use projections. The Cost Benefit Analysis of Metro West demonstrates a strong economic case for the project with a benefit to cost ratio of 1.89 and 1.43 in the Transport 21 scenario for both service patterns and full land use development having taken place.

Table 4.10 – CBA for Transport 21 scenario (service pattern 1)

Discounted to 2002 (€m)	Existing land use	50% 2016	80% 2016	2016
User Time Savings	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Non user Time Savings	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Vehicle Operating Cost Savings	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Accident Savings	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Air Emissions Savings	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Total Benefits	**[text deleted]**	**[text deleted]**	**[text deleted]**	**[text deleted]**
Operating Costs	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Renewals Costs	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Capital Costs	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Total Costs	[text deleted]	[text deleted]	[text deleted]	**[text deleted]**
Economic Net Present Value (NPV)	**[text deleted]**	**[text deleted]**	**[text deleted]**	**[text deleted]**
Benefit to Cost Ratio (BCR)	**1.64:1**	**1.77:1**	**1.84:1**	**1.89:1**
Internal Rate of Return (IRR)	**10.2%**	**11.2%**	**11.7%**	**12.1%**

Table 4.10 – CBA for Transport 21 scenario (service pattern 2)

Discounted to 2002 (€m)	Existing land use	50% 2016	80% 2016	2016
User Time Savings	[text deleted]	[text deleted]	[text deleted]	[text deleted]
Non user Time Savings	[text deleted]	[text deleted]	[text deleted]	[text deleted]
Vehicle Operating Cost Savings	[text deleted]	[text deleted]	[text deleted]	[text deleted]
Accident Savings	[text deleted]	[text deleted]	[text deleted]	[text deleted]
Air Emissions Savings	[text deleted]	[text deleted]	[text deleted]	[text deleted]
Total Benefits	**[text deleted]**	**[text deleted]**	**[text deleted]**	**[text deleted]**
Operating Costs	[text deleted]	[text deleted]	[text deleted]	[text deleted]
Renewals Costs	[text deleted]	[text deleted]	[text deleted]	[text deleted]
Capital Costs	[text deleted]	[text deleted]	[text deleted]	[text deleted]
Total Costs	**[text deleted]**	**[text deleted]**	**[text deleted]**	**[text deleted]**
Economic Net Present Value (NPV)	**[text deleted]**	**[text deleted]**	**[text deleted]**	**[text deleted]**
Benefit to Cost Ratio (BCR)	**1.43:1**	**1.57:1**	**1.63:1**	**1.67:1**
Internal Rate of Return (IRR)	**8.2%**	**9.2%**	**9.6%**	**10.0%**

Conclusions

The business case for Metro West remains robust.

Taking the base case scenario, in the situation whereby no future development takes place and the land use projections remain at the current levels the forecast demand for additional trips added to the Metro Network is 30.5 million compared to 36.1 million using the 2016 land use projections. The very worst case shows forecast additional Metro demand of 23.2 million passengers.

This is a significant increase in trips made on the Metro Network with the introduction of Metro West even when no future development takes place.

This demonstrates that there is a very strong demand for Metro West.

The phasing options also seem viable with the lowest forecasts of between 10.2 million and 15.3 million new Metro passengers depending on the phasing option.

The Cost Benefit Analysis illustrates there is a good, strong and robust economic case for the Metro West project even in the base case scenario based on current land use projections. In this scenario the benefit to cost ratio is still a strong 1.89:1. This is also the case with all the Transport 21 Assumptions in place, where benefit to cost ratio is still a strong 1.43: 1. The benefit to cost ratio is expected to increase as the development in the immediate vicinity of the alignment grows.