The Perth Northern Suburbs Railway - Transport Reform in Action?

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Abstract:

The 1976 *Corridor Plan for Perth* contained the initial idea for a rapid transit system serving the Northern Suburbs.

In 1988 Travers Morgan undertook a study into rapid transit options which examined possible routes and technologies, and recommended a busway along the centre of the Mitchell Freeway because of the lower capital cost and the relative indifference of surveyed public opinion between a busway and a railway (although the study found that a railway was also viable). An expert panel reviewed the rapid transit study findings and recommended that the railway option be built as soon as possible. The WA Government decided to proceed with the railway.

The Master Planning process was then set up. Travers Morgan was again engaged to undertake passenger demand forecasts.

Construction started in 1991 and the railway was opened to the public in March 1993. The project cost $277 million, including the extra rail fleet needed to operate the new line. Patronage on the railway has been high, but not as high as demand forecasts suggested. It is suspected that the need for mode-to-mode transfers is a significant factor in suppressing demand levels.

The paper examines the reasons for building the Northern Suburbs Railway, and its effectiveness in economic, environmental and social terms. The degree to which the project has reformed the area's public transport is open to question.

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1. INTRODUCTION

Perth continues to experience rapid growth, and the City of Wanneroo in Perth's northern suburbs is one of the fastest-growing local authority areas in Australia. Plans for a transit system to connect the northern suburbs to the Perth CBD were first contained in the 1976 Corridor Plan for Perth, which showed a rapid transit link in the Mitchell Freeway corridor.

In 1988, a study was conducted into the most appropriate rapid transit system for the northern suburbs (Travers Morgan, 1988). The study recommended a dedicated busway in the median of the Mitchell Freeway. A railway option was also found to be economically viable, but was considered inferior to the busway because of its higher capital cost, lower user benefits, and the slight public preference for bus in opinion surveys.

A subsequent review by an expert panel (Howard et al., 1988) recommended that the railway option be built as soon as possible. The State Government accepted this recommendation, and decided to build a railway. A Master Planning process followed in 1989. Construction of the railway line started in 1991, and it was opened to scheduled passenger services in March 1993.

This paper examines the performance of the Northern Suburbs Transit System (hereinafter referred to as the NSTS), and discusses how effectively the system has reformed transport in Perth's northern suburbs.

In the following sections the system's performance is assessed from available information, including costs, patronage and passenger satisfaction survey results. Finally some conclusions are drawn about the system's overall effectiveness.

2. OBJECTIVES OF THE NSTS

The objectives of the NSTS could be seen as:

(a) reducing operating costs for the public transport operator;
(b) converting car drivers to public transport, thereby increasing public transport patronage and reducing road traffic levels;
(c) providing improved levels of service and satisfaction to public transport users; and
(d) encouraging higher density nodal development around railway stations in the northern suburbs, thereby reducing urban sprawl.

3. THE SCHEME

The NSTS is an integrated system of public transport, comprising a railway along the Mitchell Freeway with associated feeder bus services and park-and-ride facilities. The twin-track railway is 29km long (from Perth to Currambine, just north of Joondalup), with eight stations, five of which are major bus/train interchanges whilst six have car parks.

Peak hour train services provide an average 8-minute headway north of Whitfords (about 18km north of Perth), with a 4-minute headway south of there.

4. COSTS

Capital Cost

The actual capital cost of the NSTS was approximately $277 million in 1993 prices (for all infrastructure and the railcar fleet). This figure is 50% higher than the $145 million ($185 million in 1993 prices) estimated by Travers Morgan in 1988.

The capital cost increased as a result of a number of factors. The railway was extended 3 km north of its originally-envisaged terminus at Joondalup. Station designs were considerably embellished to provide close interchange between buses and trains. The railcar specification was upgraded to a 110 km/hr operating speed instead of the original 100 km/hr. Finally, of course, prices escalated somewhat between the time of the planning study estimates (1988) and construction (1991-3).

Operating Costs

Travers Morgan estimated that with an electric railway, Transperth would make a net saving of about $2 million a year because of the associated reduction in bus operations. The expert panel argued that the savings would be greater, at $5.8 million a year. In reality the savings have been negligible, largely because a higher-than-envisaged frequency has been used for bus feeder services to the railway from the surrounding suburbs.

Transperth's annual operating expenditure has increased significantly, primarily because the cost of servicing NSTS borrowings is part of Transperth's operating budget. Figure 1 shows that the operating budget has increased from $155 million in 1988 (1993 dollars) to $225 million in 1993, a real increase of 45% in 5 years. Not all of this can be attributed to the NSTS (electrification of the other rail lines, and construction of Perth's new Busport is also included); the rail debt servicing component of Transperth's operating budget has

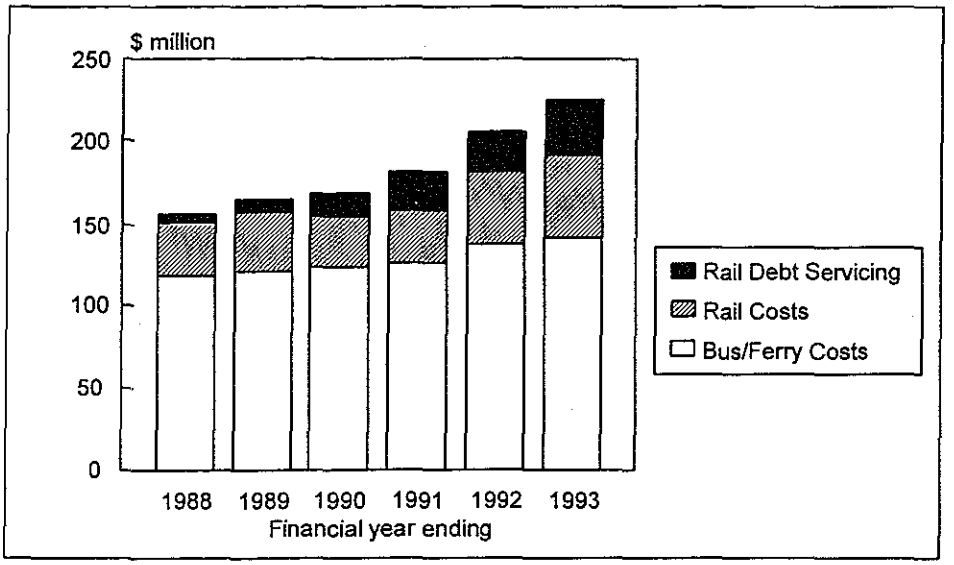

Figure 1 - Transperth's Operating Expenditure 1988-1993 (1993 dollars).
Source: Transperth Annual Reports 1988-1993.

increased from under $5 million in 1988 (1993 dollars) to $34 million in 1993

Figure 2 shows the fare revenue which has accompanied these increases in operating costs. Fare levels are set by the Government of Western Australia, and until recently, the policy was to keep fares increases below the rate of inflation. These real operating cost increases and revenue decreases have combined to adversely affect Transperth's cost recovery ratio.

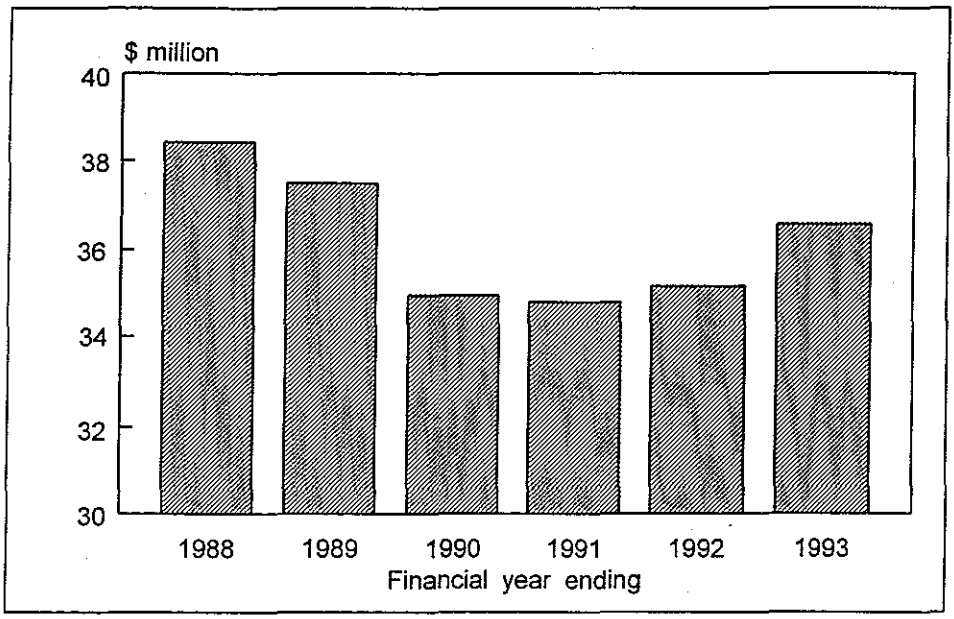

Figure 2 - Transperth's Fare Revenue 1988-1993 (1993 dollars).
Source: Transperth Annual Reports 1988-1993

The following observations can be made from the foregoing:

(a) it has cost much more to construct the NSTS than was anticipated in the original economic analysis of options ($277 million vs $185 million, in 1993 prices);
(b) the expected savings in bus operating costs (about $2.6 million a year in 1993 prices) have not materialised; and
(c) development of the NSTS (and electrifying the rest of the suburban rail system) has had a detrimental effect on Transperth's operating budget, due primarily to the increase in rail debt servicing costs

The last point should not be double-counted with the first. However there remains a large debt to be serviced by the State Government.

5. PATRONAGE

Perth is a car-dependent city. It has the highest per capita car ownership of any city in Australia, and one of the highest in the world. If a significant number of car drivers switched to using public transport instead of driving themselves, there would be less congestion on the roads, less pollution, fewer traffic accidents, less energy consumption, and less need for parking provision in the Perth CBD and other locations. The patronage

of a new public transport system, and in particular, the proportion of converted car drivers is a critical evaluation criterion when assessing the success of a new rapid-transit facility.

Current rail patronage is well below the 2001 forecasts made during the planning stage for the railway. However, patronage has been increasing since the electrification of the Fremantle, Midland and Armadale lines, and the completion of the NSTS. Table 1 shows the most recent patronage data available for the NSTS and the other three rail lines in Perth.

Table 1 Estimated Weekday Patronage on Perth Suburban Rail System

	Passengers entering/leaving Perth		
Line	**Peak Periods***	**Off-Peak**	**Total**
NSTS	15,850	15,150	31,000
Armadale	7,250	7,450	14,700
Midland	6,300	7,800	14,100
Fremantle	8,050	12,050	20,100
TOTAL	**37,450**	**42,450**	**79,900**

Source: Transperth Cordon Counts, March 1994.
* Morning (7am-9am) and evening (4pm-6pm) peaks combined

The original 2001 forecast for the NSTS (when the decision was made to construct the NSTS) was 11,730 passengers entering the central city cordon in the AM peak period (PUREP Team, 1989). The current equivalent figure is about 7,120. Therefore, in the morning peak the system is presently carrying about 61% of the originally-forecast 2001 patronage.

Travers Morgan has recently reviewed its earlier patronage forecasts for the NSTS, as shown in Table 2. The forecasts have been revised downwards for two reasons:

(a) the Master Plan estimate of 11,730 passengers was made by halving the modelled 6.7 minute transfer penalty used at NSTS stations in the original forecasting work (Travers Morgan, 1988). Latest reviews indicate that a transfer penalty of 6.7 minutes - the originally-selected value - allow a much closer replication of observed patronage with the forecasting model. The issue of transfer penalties is discussed again later in this paper.
(b) population projections for the outer northern suburbs have been revised downwards somewhat since the earlier forecasts were made.

Table 2 Revised Inbound Morning Peak Patronage Forecasts for the NSTS

Year	**Patronage Estimate**
1994 Existing	7,122
Original 2001 Estimate	11,734
Revised 2001 Estimate	8,117

Source: Travers Morgan, 1994

Table 2 shows that peak period patronage on the NSTS in 1994 is not as high as the Master Plan forecasts suggested it might be. It is noteworthy, however, that off-peak patronage has increased substantially on the other three lines since electrification, and is a high proportion of the daily total on the NSTS as well

Only about 16% of passengers gain access to the NSTS stations on foot; this is not surprising given the location of the railway in the freeway median, quite remote from residential areas for most of its length. Nearly 40% of patrons arrive at NSTS stations by bus, and 42% by car. Extensive park and ride facilities have been provided.

There have been no comprehensive surveys thus far which have attempted to estimate the number of converted car drivers using the NSTS. A sample survey undertaken by the University of Western Australia (Alexander and Houghton, 1993) suggests that about 24% of the current patronage on the NSTS are converted car drivers. The number of converted car passengers determined by the survey is much lower (1%) which casts some doubt on the validity of the results. However, even if the 24% figure is an overestimate, it is clear that some car drivers have shifted to public transport since the opening of the NSTS

Table 3 compares daily patronage into Perth before and after electrification and construction of the NSTS, whilst Table 4 gives the same comparison for the morning peak. As approximated by these figures (which exclude journeys not crossing the Perth CBD cordon line), total daily patronage on Perth's public transport has increased by 4% between 1987 and 1994, whilst morning peak patronage has increased 7%. Total rail patronage has more than tripled over the period, but this is offset by a large decrease in bus patronage.

Patronage from the northern suburbs has increased more than the average. Daily patronage has increased by 50%, and morning peak by 33%, since 1987. Over the same period, the population of the northern suburbs has increased by about 25%, suggesting an increase in usage of public transport per head in both the peak and the off-peak

Table 3 Passengers Entering Perth on Public Transport - Daily

		1987	1994	inc/(dec)	% change
Trains	NSTS	-	15,200	15,200	n/a
	Other lines	13,000	24,800	11,800	91%
	Total	**13,000**	**40,000**	**27,000**	**208%**
Buses	via Mitchell Fwy	6,000	-	(6,000)	-100%
	via Fitzgerald St	9,700	8,400	(1,300)	-13%
	via other routes	56,400	40,300	(16,100)	-29%
	Total	**72,100**	**48,700**	**(23,400)**	**-32%**
Total Buses and Trains		**85,100**	**88,700**	**3,600**	**4%**
Total from N Suburbs*		15,700	23,600	7,900	50%

Source: Transperth cordon counts.

* Direct comparison between 1987 and 1994 is approximate only because of bus route changes in the intervening period (different catchments served by buses using Fitzgerald Street).

Table 4 Passengers Entering Perth on Public Transport - Morning Peak (7-9am)

		1987	1994	inc/(dec)	% change
Trains	NSTS	-	7,100	7,100	n/a
	Other lines	5,300	7,300	2,000	38%
	Total	**5,300**	**14,400**	**9,100**	**172%**
Buses	via Mitchell Fwy	3,800	-	(3,800)	-100%
	via Fitzgerald St	4,100	3,400	(700)	-17%
	via other routes	18,700	16,300	(2,400)	-13%
	Total	**26,600**	**19,700**	**(6,900)**	**-26%**
Total Buses and Trains		**31,900**	**34,100**	**2,200**	**7%**
Total from N Suburbs*		7,900	10,500	2,600	33%

Source: Transperth cordon counts

* Direct comparison between 1987 and 1994 is approximate only because of bus route changes in the intervening period (different catchments served by buses using Fitzgerald Street)

It is noteworthy that, excluding the NSTS, patronage on the other three rail lines has also increased (by over 90% daily, and nearly 40% in the morning peak).

If the NSTS had not been built and bus patronage from the northern suburbs had grown in line with population growth from 1987 to 1994, there would have been 19,600 passengers a day entering Perth in 1994. The NSTS brings in 15,200 and the remaining buses 8,400, making 23,600. Therefore it is possible that the NSTS brings an extra 4,000 passengers a day (an increase of 20%). In the morning peak the same calculation suggests that the NSTS brings an extra 10,500 - (7,900 x 1.25) = 600 passengers (a 6% increase). Incidentally, if all of these were car users there would be about 500 fewer cars over two hours (assuming a car occupancy of 1.2), or about 350 cars less in the peak hour itself. This is about 10% of the inbound peak traffic flow on Mitchell Freeway.

The NSTS appears to have had some success in increased public transport patronage between the northern suburbs and Perth. But what effect has the total investment in public transport had on public transport usage in Perth? Despite large spending on public transport infrastructure (about $470 million) in the past five years, public transport patronage per capita continues to fall (Figure 3). In 1980-81, there were 56.4 public transport journeys per head of population in Perth. This statistic has more or less steadily declined every year since then; in 1992-93 it was 40.3 journeys per head. The 1993-94 figure (not available at the time of writing) is estimated to be 41.5, a slight increase which brings it almost back to the 1991 figure of 42.1. This may be indicative of a longer-term reversal of the trend, but it is only one year's observation.

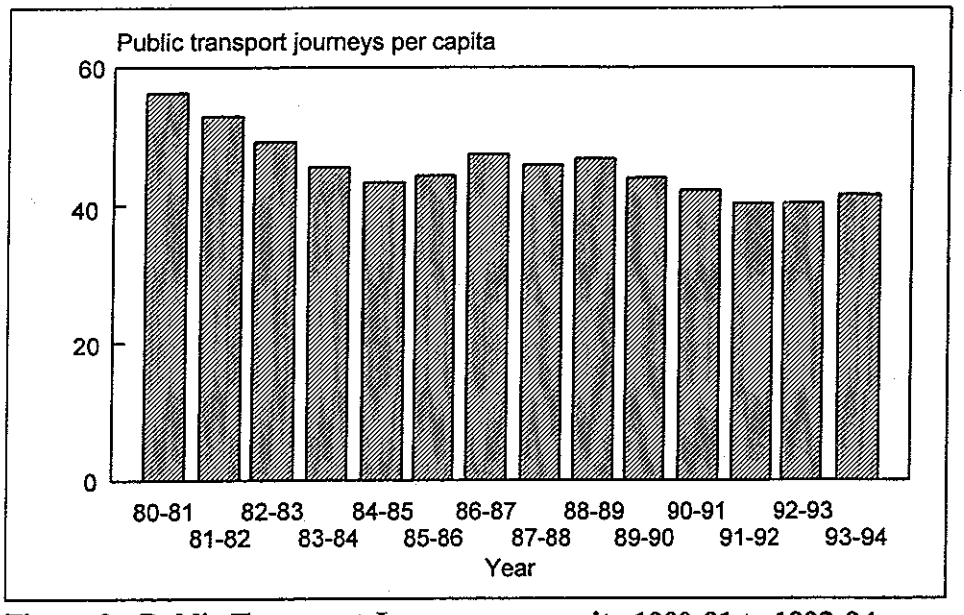

Figure 3 - Public Transport Journeys per capita 1980-81 to 1993-94
Source: Metropolitan Transport, Department of Transport (WA)

Has the investment in public transport infrastructure over the last 5 years resulted in a significant improvement in public transport mode share? This does not appear to be the case. It is recognised (Transperth, 1992) that building new public transport 'hardware' such as a railway line is politically attractive in the short term. However, in the longer term, the more difficult and sometimes unpopular transport and land use policy decisions which are required to improve the overall performance of public transport and reduce car dependency are avoided; there is little political mileage in them as yet.

Has private automobile use declined in the northern suburbs as a result of the NSTS? Surveys show that 42% of people using the NSTS use a car to access the rapid transit stations (Transperth 1993b). This figure is very high compared to other rapid transit systems around the world, but the system was designed to cater for a high park-and-ride component. Also, during construction of the NSTS, work was required on the Mitchell Freeway in order to accommodate the railway in the median strip on one section close to Perth. During this work, an extra lane was added to some sections of the Mitchell Freeway. The effect of this road widening on rail patronage and on freeway traffic volumes is unknown at this time. It can be said however, that widening a freeway concurrent with building a new rapid transit facility is not the most helpful thing that can be done to encourage public transport use.

Unfortunately there is no continuous record available of traffic levels on the Mitchell Freeway covering the period of opening the NSTS. Such data would have proved invaluable in assessing directly the effect of the system on car traffic. Available data in the form of intermittent counts, adjusted for seasonal variations, shows a continuous **increase** in traffic, but in our view the figures are too coarse to allow proper identification of the effects.

The following observations can be made about the patronage of the NSTS:

(a) public transport patronage in the northern suburbs has increased since the NSTS was opened, by around 6% in the morning peak and 20% over a typical weekday as a whole, over what it might have been if the NSTS had not been built.
(b) it is clear that some car drivers have converted to public transport as a result of the opening of the NSTS. The total number of converted car drivers is difficult to quantify without a comprehensive survey, and there is no direct evidence of a reduction in traffic on the Mitchell Freeway; and
(c) the construction of the NSTS has not yet had a major impact on the total number of public transport journeys per capita in Perth.

6. PASSENGER SATISFACTION

As part of the Northern Suburbs Rapid Transit Study (Travers Morgan, 1988), residents of the northern suburbs were consulted by means of an attitude survey to determine which of the short-listed options (bus expressway, guided busway, or electric railway) they preferred. The attitude survey found that faster journeys and a more frequent service were the two most important improvements people wanted to see to the public transport system. Other improvements, of lower importance but still significant, were services closer to origins and destinations, fewer transfers en route, less overcrowding, and lower fares. A subsequent opinion survey showed that of the short-listed options, about 41% preferred an electric railway, 34% chose a bus expressway, and 19% a guided busway (in other words, 53% in total preferred bus).

Before and after research was carried out by Transperth on passengers in the northern suburbs who were likely to use the NSTS (Transperth 1993a). The primary reason for this research was to quantify the perceived 'transfer penalty' that public transport users place on having to transfer from one vehicle to another. It is well documented in transport research (Horowitz and Zlosel, 1981, and Shortreed and Vaga, 1983) that transfers increase travel times (due to the indirect routing involved and the wait times at transfer stations), as well as the variance in travel times experienced (due to the uncertainty in 'making connections',etc.). As a result, there is a perceived time penalty (not including the waiting time) for transfers, which public transport planners use when modelling demand forecasts.

Passengers were asked (before and after opening the NSTS) about their travel times by public transport, the number of transfers they made on their journey, and their overall satisfaction with the system. The survey found that the average total journey time for passengers using the NSTS decreased by about 11 minutes from their previous bus-only journey, whilst the average number of transfers made on the system per journey increased from 0.55 to 1.04. It also found that overall passenger satisfaction with the system decreased slightly, which can be largely attributed to the fact that passengers were forced to transfer more often than before. It is postulated that the need for mode-to-mode transfers is a significant source of dissatisfaction, and could be a factor in suppressing demand levels on the NSTS. This is borne out by the forecasting model, in which transfer penalties had to be doubled from the low values assumed at the Master Planning stage in order for the model to replicate observed patronage more accurately.

Howard et al (1988) had the following to say about transfers:

> "The [Northern Suburbs Rapid Transit Study] report considers that transferring between modes is a major detriment to passenger attraction This was an opinion held by some transit planners in the late 1950's and 1960's which was later proved to be incorrect The best systems in the world such as Toronto, Paris, Hamburg, as well as those in low density cities such as Edmonton, Portland and Seattle greatly rely on transfers "
>
> " rail and bus lines in Atlanta are so well integrated that about two thirds of all transit trips use rail for at least a portion of their trips This indicates that transfers are fully accepted by passengers "

The most recent research done in Perth (Transperth, 1993a) has confirmed that passengers perceive a transfer penalty equivalent to between 6 and 9 minutes of in-vehicle time for each transfer made (in addition to the time taken for the transfer itself), depending on the modes of travel and the facilities at the transfer point These results reinforce the findings of Horowitz and Zlosel (1981) that:

> " transfers were found to be one of the most negative aspects of bus transit travel It has been shown here that much of the negative feelings towards trips with transfers is simply due to the requirement to change bus routes "

and also the findings of Shortreed and Vaga (1983):

> "Transfers have a significant impact on Transit Demand The reduction in demand is thought to vary between 10% and 40% depending on the quality of the transfer itself "

Transperth undertakes a regular 'Passenger Satisfaction Monitor' of all rail services including the NSTS The most recent results of this monitor show that users are highly satisfied with rail services, especially on the NSTS However bus users in the northern suburbs (i e on feeder services to the railway) are considerably less satisfied with the service provided there This may reflect dissatisfaction with transfers and connections to the railway, but more detailed research is necessary

The following observations can be made regarding passenger satisfaction of the NSTS:

(a) the original opinion survey of residents in the northern suburbs showed that 53% of respondents preferred a bus-based rapid transit system whilst 34% preferred a railway; and
(b) research undertaken before and after the implementation of the new system has revealed that travel times have decreased an average of 11 minutes and that the average passenger has to make 0 5 extra transfers per journey This research also found that overall satisfaction with the public transport system decreased slightly as a result of the new system It is suspected that the need for mode-to-mode transfers is a significant source of dissatisfaction and is a factor in suppressing

demand levels on the NSTS.

7. LAND USE CHANGES

Land use planning studies have been done for Glendalough and Leederville, the areas surrounding the innermost two stations on the line, which suggested new foci around the stations for commercial and retail development, with medium-density housing nearby. Elsewhere there has been little change to existing, low density land uses as yet, although there are a few examples of small medium-density townhouse redevelopments on former commercial land. Generally speaking there is little opportunity for major changes in population density; the northern suburbs are relatively young and many of the housing areas are only now becoming fully established.

Development of Joondalup city centre (22 kilometres north of Perth) is progressing. This will provide an important northern focus for trips on the system. However the regional centre will serve the surrounding low-density, high car-owning suburbs, and public transport is unlikely to achieve a high share of most journeys.

It is too early to say whether the NSTS will have a significant, lasting effect on land use patterns in the northern suburbs. Given the basic structure of the area and the railway's location in the freeway median (adding extra walking distance from adjacent suburbs), it is unlikely that redevelopment will significantly increase walk-on patronage on the system. This was of course recognised in the original studies; the system was designed accordingly.

8. CONCLUSIONS

Drawing together the conclusions from preceding sections, the following main observations can be made:

(a) the total capital cost of the NSTS was around 50% higher than originally envisaged
(b) there have been no significant net savings in public transport operating costs as a result of the new system.
(c) public transport patronage in the northern suburbs has increased since opening the NSTS, by about 6% in the morning peak and 20% on an average weekday.
(d) demand in the off-peak has exceeded expectations
(e) the NSTS has resulted in an average journey time saving of 11 minutes and an average increase of 0.5 transfers per journey. Despite this, overall satisfaction with the NSTS is slightly less than satisfaction with the old system
(f) it is suspected that the need for mode-to-mode transfers is a significant source of dissatisfaction and is a factor in suppressing demand levels on the NSTS.
(g) it is too early to comment on whether the NSTS is encouraging higher density land use developments in the northern suburbs, although there is little sign of this ocurring.

The decision to build the railway in Perth echoed similar decisions in many other cities at the time, especially in the United States. Light rail was also enjoying a renewed popularity

Since then, many writers have questioned the wisdom of these decisions in the light of cost overruns and disappointing patronage A recent review of California's transportation plans (Gordon and Richardson, 1994) concluded that:

> "Rail transit is the wrong kind of transportation for this region [Southern California] Other cities that have tried adding rail transit have failed to increase transit's mode share, despite the expenditure of billions of dollars (and frequent infliction of harm on the pre-existing bus system). The same pattern is beginning to be evident in greater Los Angeles Our first new rail line, the Blue Line, has a taxpayer cost of $21 per rider per day Since few of its riders are former drivers (as opposed to bus users), the system costs taxpayers $37,498 per year for every car it removes from the freeways."

Whilst Southern California has similar characteristics to Perth (low density, high car use), it is probably unfair to take the comparisons too far; Southern California is a much larger place with far more acute transportation problems than Perth is ever likely to see

It is left largely to the reader to judge the success of the NSTS as a transport reform measure In our view the system itself is excellent; it has been well-designed and it is well-operated Users generally appear highly satisfied with the railway itself, although this is true of all Perth's rail users, who have suffered over the years preceding electrification from the rapidly-decaying old diesel rollingstock.

It is possible to argue from the available data that the railway was not the best solution to the problem, given its high cost and lower-than-forecast patronage However a decision to build it was made, and it was made quickly If the choice had been considered at greater length there may not have been anything built at all, and the renaissance of Perth's suburban rail system, which has been spectacular, would not have been achieved

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