Integrated Transport & Land Use for Low Density

Presented by Peter Martinovich
Does Rail Have a Place in Low Density Settlement?
This presentation sets out to show how:

- With a proper understanding of the market
- A sound application of fundamentals
- Rail can be successfully applied to low density settlement
• 30-40% growth since 1997 in Perth, Brisbane and Melbourne
• Sydney has lagged with only 5% growth in the last decade

Source: G Glazebrook, University of Technology, Sydney
Perth – Mandurah Railway
Performance of Rail in Perth – A Comparison

![Graph showing the performance of rail in Perth compared to a comparable Australian City from 1990/91 to 2006/07. The graph includes line graphs for Perth and a comparable Australian City, with the total boardings (in millions) on the y-axis and years on the x-axis.](image-url)
Transport & Land Use Integration
The Transit Market of Metropolitan Perth

- Built on 40 km wide Swan Coastal plain
- 1.5m population & rising
- Settlement density amongst world’s lowest
- Car usage per capita in top four - worldwide
- Major environmental & underground water reserves
- Coastal living preference
- Coastal Corridor -130+ km long & growing
- Limited north-south river crossing points
<table>
<thead>
<tr>
<th>Year</th>
<th>Route Kms</th>
<th>Annual Trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>66kms</td>
<td>10 million</td>
</tr>
<tr>
<td>2001</td>
<td>95kms</td>
<td>29 million</td>
</tr>
<tr>
<td>2005</td>
<td>102kms</td>
<td>33 million</td>
</tr>
<tr>
<td>2008</td>
<td>173kms</td>
<td>51 million</td>
</tr>
<tr>
<td>Total</td>
<td>173kms</td>
<td></td>
</tr>
</tbody>
</table>

54 Route kms of the Rapid Transit network is within freeway medians
Between 1992 and 2002, the assignment for modal preference for given routes was completely reversed.

1992 - Rail to Fremantle
   Buses to Perth

1994 - Compromise
   A bit of each

2002 - Railway to Perth
   Buses to Fremantle
Density of Activity - (Thousand Jobs + Population) per Hectare, at the Metropolitan Scale.

Source: G Glazebrook, University of Technology, Sydney
### Extent of Private Vehicle Dependency in Perth

<table>
<thead>
<tr>
<th>City</th>
<th>Metres of Road per person</th>
<th>CBD Car Parking spots</th>
<th>Car passengers per 1000 people</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perth</td>
<td><strong>10.7</strong></td>
<td><strong>631</strong></td>
<td><strong>658</strong></td>
</tr>
<tr>
<td>Melbourne</td>
<td><strong>7.7</strong></td>
<td>-</td>
<td><strong>594</strong></td>
</tr>
<tr>
<td>Sydney</td>
<td><strong>6.2</strong></td>
<td>-</td>
<td><strong>516</strong></td>
</tr>
<tr>
<td>Australia average</td>
<td><strong>8.3</strong></td>
<td><strong>489</strong></td>
<td><strong>591</strong></td>
</tr>
<tr>
<td>USA average</td>
<td><strong>6.9</strong></td>
<td><strong>468</strong></td>
<td><strong>587</strong></td>
</tr>
<tr>
<td>Europe average</td>
<td><strong>2.4</strong></td>
<td><strong>238</strong></td>
<td><strong>396</strong></td>
</tr>
</tbody>
</table>
Characteristics of Sydney

- One of the largest urban systems in the world
- More than 300 stations
- 900,000 passenger trips per weekday
- Highest public transport usage in Australia
- Critical in the morning peak and carries the equivalent of 35/40 freeway lanes into the city

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Hong Kong</th>
<th>Sydney</th>
<th>Perth</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Stations</td>
<td>80</td>
<td>320</td>
<td>69</td>
</tr>
<tr>
<td>Trips per day</td>
<td>3.7 million</td>
<td>0.9 million</td>
<td>0.18 million</td>
</tr>
<tr>
<td>Route kilometres</td>
<td>175</td>
<td>900</td>
<td>173</td>
</tr>
<tr>
<td>Activity Density / hectare</td>
<td>440</td>
<td>In the 20’s</td>
<td>In the 20’s</td>
</tr>
</tbody>
</table>

Note: Density of Activity - Jobs + Population

Source: Glazebrook with some by Martinovich
### Sustainability and Public Transport
### Sydney v Singapore

Source: Simon Lane

<table>
<thead>
<tr>
<th></th>
<th>Sydney</th>
<th>Singapore</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP per Capita</td>
<td>29.9</td>
<td>26.8</td>
</tr>
<tr>
<td>Percentage of Household Income spent on Transport</td>
<td>16</td>
<td>4.1</td>
</tr>
<tr>
<td>Car ownership per 1,000 people</td>
<td>475</td>
<td>65</td>
</tr>
<tr>
<td>Percentage of trips by Public Transport</td>
<td>6</td>
<td>55</td>
</tr>
<tr>
<td>Percentage of Home Ownership</td>
<td>74</td>
<td>90</td>
</tr>
<tr>
<td>Activity Density / hectare</td>
<td>In the 20’s</td>
<td>140</td>
</tr>
</tbody>
</table>
Urban Rail in Australia
Benchmarking Australasian Urban Rail Systems

Source: Peter Thornton, General Manager – Planning and Strategy, Worley Parsons Rail
Urban Rail in Australia
Benchmarking Australasian & International Urban Rail Systems

Source: Peter Thornton, General Manager – Planning and Strategy, Worley Parsons Rail
Jeffery Zupan (2004). “The basic point is that you need density to support public transit. --- once you get above a certain density two things happen. --- you get a decrease in trips by auto and an increase in trips by transit. That threshold seems to be around seven dwellings per acre. Once you cross that line, a bus company can put buses out there, because they know they’re going to get enough passengers to support a reasonable frequency of service.

Seven dwellings per acre at a reasonable dwelling occupancy is equivalent to around 35 to 40 persons per hectare.”

Newman and Kenworthy 2006. “The redevelopment of new development of urban areas can facilitate the reduction of automobile dependence if Ped Sheds of 300 hectares (1 kilometre radius) are used around local Centres / public transit nodes and 3,000 hectares around town centres. These would have minimum development goals of 10,000 and 100,000 people and jobs respectively.”

Source for all the above: Urban design to Reduce Automobile Dependence; Opolis, Vol 2, Issue1, 2006 Article 3, Peter Newman & Jeffery Kenworthy
**King Cushman.** To support local neighbourhood transit service, a minimum threshold of seven dwellings per acre --- should be present.

To make a transit system productive when homes are not intensely concentrated, facilities like park-and-ride lots should be provided to encourage people to get themselves concentrated, but on their time, not the transit system’s. In this way, a transit system can start out well loaded, offering reasonably fast, high quality service that will be productive even in low density areas.

Whether the public will want to ride transit depends more on the density at the other end of the trip -- . The minimum desirable employment -- concentrations --- would be at least 50 employees per net employment acre and greater than 10,000 jobs at those centres.

Source; Exploring the Land Development and Transit Connection, A Walk in the Past, a Challenge for the Future: (from Transit, Land Use & Urban Form); King Cushman, circa 1978
Since 70% of Commuting households now have two or more workers, this suggests that living near work is no longer a simple option to achieve.

This has created greater pressure on time, increasing what is referred to as “chained” trip making; linking the work trip to day care, to food shopping, errands etc. in an effort to reduce travel time on multiple trip purposes has become a central feature.

60% of employed women (and 46% of men) make one or more stops on a typical drive home from work.

Source; Trend Affecting Public Transits Effectiveness; A study prepared for the American Public Transportation Association; Bendon Hemily, Ph.D, November 2004.

This may put Park-and-Ride into an understandable context
A traditional mass transit railway achieves its “mass” through penetration of high urban densities. In low urban densities the “masses” must be brought, or come to the railway in their own way. The stations become the concentration areas of population density.

To achieve the objectives, the following provisions were made:

- Strategically located stations at wider intervals than older systems (minimum average spacing interval about three kilometres)
- Well designed, large station precincts that are good modal interchanges to serve very large motorised catchments
- Frequent services
- Provide high standard rollingstock

Another way of describing this is development orientated transit - on a metropolitan scale.
• Perth’s low density settlement
• Severely limits the number of people living within walking distance of station
• To a maximum of about 500 daily.

• This is the real challenge, and opportunity, for TOD
Transport & Land Use Integration
Typical Transit Station Marketplace

Warwick Park & Ride Catchment – 35 km² - 90,000 people
Transport & Land Use Integration
Designing Mass, Rapid Transit Rail for Low Density

**Relationship between Station Spacing, Journey Time, Train Speed and Rollingstock required for a given Task**

- Rapid Transit - 20 stations (Mandurah to Clarkson) provide 59% of Total Patronage
- The Other 49 suburban stations provide the remaining 41% of Patronage
Perth’s low density settlement, limits the number of commuters who walk to a train station, to a maximum of about 500 daily.
Transport & Land Use Integration
Warwick Station - Feeder Characteristics

Bus/Train (2) includes a 10 minute "frequency penalty"
In grappling with TOD conflicting demands can arise between the needs of the immediate precinct and the wider catchment.

The requirements of Development Oriented Transit on the Metropolitan, System Wide Scale should not be lost in the quest for Transit Orientated Development at the local Station Level.
Serving a catchment of around 40 km²
<table>
<thead>
<tr>
<th><strong>Catchment Area</strong></th>
<th><strong>Hectares</strong></th>
<th><strong>4,000</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average Dwelling Density</strong></td>
<td><strong>10 / ha</strong></td>
<td><strong>40,000</strong></td>
</tr>
<tr>
<td><strong>Population</strong></td>
<td><strong>2.6 persons / dwelling</strong></td>
<td><strong>104,000</strong></td>
</tr>
<tr>
<td><strong>Total trips</strong></td>
<td><strong>3.3 / person / weekday</strong></td>
<td><strong>343,200</strong></td>
</tr>
<tr>
<td><strong>Total public transport trips</strong></td>
<td><strong>5% of total trips</strong></td>
<td><strong>17,160</strong></td>
</tr>
<tr>
<td><strong>Total, all day, weekday, rail trips</strong></td>
<td><strong>Say 60% of total trips</strong></td>
<td><strong>10,296</strong></td>
</tr>
<tr>
<td><strong>Total rail boardings / weekday</strong></td>
<td><strong>50% of (6)</strong></td>
<td><strong>5,148</strong></td>
</tr>
<tr>
<td><strong>Total rail boardings / 1000 people</strong></td>
<td></td>
<td><strong>49.5</strong></td>
</tr>
<tr>
<td><strong>Total rail boardings / hectare</strong></td>
<td></td>
<td><strong>1.3</strong></td>
</tr>
</tbody>
</table>
Murdoch Station Catchment Area
One that provides sufficient patronage from a broader catchment well before that patronage could be achieved through development of sufficiently high settlement density within walking distance of the station.

<table>
<thead>
<tr>
<th></th>
<th>Park ‘n’ Ride</th>
<th>Car Drop Off</th>
<th>Bus</th>
<th>Walk / cycle</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stage One</strong></td>
<td>560</td>
<td>470</td>
<td>770</td>
<td>100</td>
<td>1900</td>
</tr>
<tr>
<td><strong>Final Stage</strong></td>
<td>560</td>
<td>470</td>
<td>770</td>
<td>800</td>
<td>2600</td>
</tr>
</tbody>
</table>
Transport & Land Use Integration For Low Density
A New TOD Model

Cockburn Station and New Town Centre
New MetroRail Project
The Railway in the Kwinana Freeway

Greater, vision, foresight & objectivity may have seen this approved in the mid 1990’s

- A ready made surface route
- Risk Analysis was critical to approve the concept
- A holistic approach to risk was adopted – rather than a railway in a freeway
- The primary activity to be assessed was commuter travel by all modes
- New standards were developed, verified and validated
- Now the subject of International attention

The concept that emerged was that of a Combined Transportation Corridor
New MetroRail Project
Perth Underground Railway

Key User Benefits
- Optimised accessibility to the Perth CBD with two underground stations
- Major stimulant for city revitalisation

Operational Benefits
- Seamless connection of northern and southern rapid transit services through the heart of the city
- Integration with bus services

Engineering
- Major success for tunnel boring in soft ground conditions
Performance of the Perth - Mandurah Line
Six Months after Commissioning

Projected v Actual Patronage - July 2008

Master Plan Projection for Year 1

Source: PTA 2008 passenger data
## Station Arrivals at Three Key Stations – July 2008

<table>
<thead>
<tr>
<th>Station</th>
<th>All Day Boardings</th>
<th>Commuter Arrival mode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Master Plan</td>
<td>March 2008</td>
</tr>
<tr>
<td>Bull Creek</td>
<td>3,110</td>
<td>3,800</td>
</tr>
<tr>
<td>Murdoch</td>
<td>4,980</td>
<td>6,300</td>
</tr>
<tr>
<td>Mandurah</td>
<td>3,490</td>
<td>3,200</td>
</tr>
</tbody>
</table>
Perth – Mandurah Railway
Patronage and Modes of Arrival – April 2008

Boardings

![Graph showing passenger boardings at different times of the day for Mandurah, Murdoch, and Bullcreek stations.](image)
We hope we have shown that:

- With a proper understanding of the market
- And good application of basic fundamentals
- Rail can be successfully applied to low density settlement