Trackless Trams in Wyndham
Spatial Network Analysis for Multimodal Urban Transport Systems (SNAMUTS) Report

A report as part of the Wyndham Case study

Research Project No SBEnrc 1.62 Sustainable Centres of Tomorrow: People and Place

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Introduction

This component of the *SBENRC 1.62: Sustainable Centres for Tomorrow* project assesses proposals for an initial Trackless Tram corridor and medium-term Trackless Tram target network in the municipality of Wyndham with regard to spatial accessibility across the multimodal public transport network, and identifies the urban intensification capacity window that makes the introduction of a medium-capacity public transport mode imperative along these corridors.

The accessibility assessment utilises the Spatial Network Analysis for Multimodal Urban Transport Systems (SNAMUTS) tool[1] to quantify and visualise the added value of a Trackless Tram corridor for Wyndham's (and metropolitan Melbourne's) public transport system as a whole. The urban intensification capacity assessment is derived from the SNAMUTS analysis and will assist project proponents in identifying minimum targets for additional residents and jobs in the catchment areas of corridor nodes to inform joint development decisions and value capture funding mechanisms. Appendix 1 has the presentation which summaries this anlaysis.

A stakeholder workshop held in May 2019 served to determine input for the SNAMUTS tool concerning alignment details, operational performance (commercial speed and frequencies), network integration/adjustments and interoperability of Trackless Trams with the existing public transport system. It resulted in the identification of four potential starter lines in the municipality of Wyndham (see Figure 1), together forming a medium-term target network:

[1] *The Spatial Network Analysis for Multimodal Urban Transport Systems (SNAMUTS) tool has been designed and developed since 2008 by Dr Jan Scheurer and Prof Carey Curtis in a collaboration of RMIT University and Curtin University. More detailed information can be found at www.snamuts.com.*

- **Route 1:** Tarneit station to Hoppers Crossing station via Derrimut Road/Pacific Werribee shopping centre;
- **Route 2:** Hoppers Crossing station to Aviators Field via East Werribee Employment Precinct;
- **Route 3:** Williams Landing station to Sayers (Riverdale) station via Sayers Road/Wyndham Village shopping centre
- **Route 4:** Williams Landing station to Aviators Field via Point Cook Road/Sanctuary Lakes shopping centre.

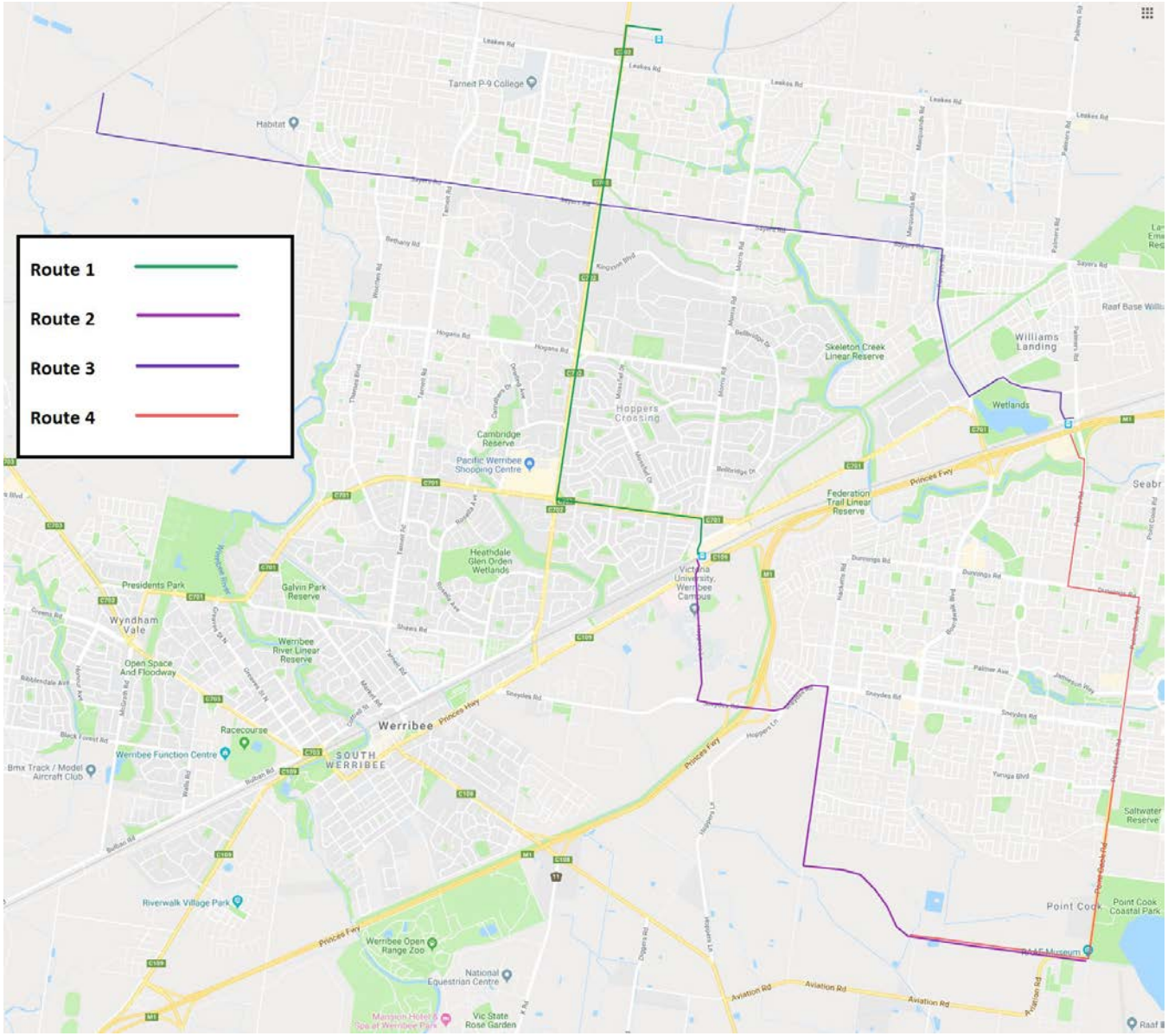


Figure 1: *Overview of potential Trackless Tram starter lines*

In the following section of this report, each of these four potential Trackless Tram starter lines will be assessed separately and comparatively towards its impact on the land use-transport system as projected for the target year 2026.

In the third section of this report, a further projection has been made for the target year 2036 (using the same data sources as in the previous step) on the assumption that all four Trackless Tram routes will be in operation by that time. Two configurational scenarios are assessed: In the Joined Lines scenario, it is assumed that the Trackless Tram will be operated as a continuous, ribbon-shaped line from Tarneit station via Hoppers Crossing, Aviators Field and Williams Landing to Sayers (Riverdale) station. In the Separated Lines scenario, it is assumed that routes 1, 3 and a combined route 2/4 from the 2026 assessment will operate as individual non-continuous lines, necessitating passenger transfers at Hoppers Crossing and Williams Landing while avoiding the need to provide dedicated infrastructure that enables Trackless Trams to cross the rail line at these locations.

In a further step, an estimate is made to quantify the extent of land use intensification (additional residents and jobs) over and beyond the 2036 trend that is required along the Trackless Tram corridors to make the deployment of an intermediate-capacity public transport mode imperative. Or in other words: what is the threshold of population and employment concentration along these routes that would overwhelm the capacity and performance of a bus system?

2026: Comparison of starter lines

This section assesses the accessibility performance of each of the four potential Trackless Tram starter lines shown in Figure 1 against a land use and public transport network projection for the target year 2026.

These projections are based on detailed residential population and employment forecasts from the State Government's Victoria in Future project (VIF; for metropolitan Melbourne outside the City of Wyndham) and the Victorian Integrated Transport Model (VITM; within the City of Wyndham). They are further based on public transport network and service projections derived from the State Government's 2012 Rail Network Development Plan and the rollout of higher-frequency tram and bus services along the Principal Public Transport Network.[2]

In Wyndham, these projections assume that weekday daytime frequencies on the Werribee train line are improved from the current 20-minute intervals to 10 minutes, as per Stage 2 of the Rail Network Development Plan. All other rail and bus routes within Wyndham are assumed to retain their current service frequencies and travel times.

However, when comparing the four Trackless Tram starter lines, it is assumed that the three other lines not assessed in each case are operated by conventional buses without specific infrastructure or traffic priority measures at 20-minute daytime frequencies.

In each case, Trackless Tram operation is assumed to be characterised by:

- 10-minute daytime service frequencies;
- a vehicle capacity of 180 passengers, equivalent to Melbourne's E-class trams;

[2] Public Transport Victoria (2012) Rail Network Development Plan. Available online at http://ptv.vic.gov.au/about-ptv/ptv-data-and-reports/network-development-plan-metropolitan-rail

- travel times calculated on the basis of a commercial speed between 25-30 km/h.

A commercial speed around 25-30 km/h is at the high end of best practice for surface public transport and likely requires reserved Trackless Tram right-of-way along most or all of the route alignment, absolute traffic priority at intersections and direct access paths to interchanges located in immediate proximity to connecting modes at the rail stations of Tarneit, Hoppers Crossing, Williams Landing and Sayers (Riverdale).

The resulting travel time assumptions for the Trackless Tram lines assessed in this section are 15 minutes from terminus to terminus for routes 1, 2 and 4, and 26 minutes for (longer) route 3.

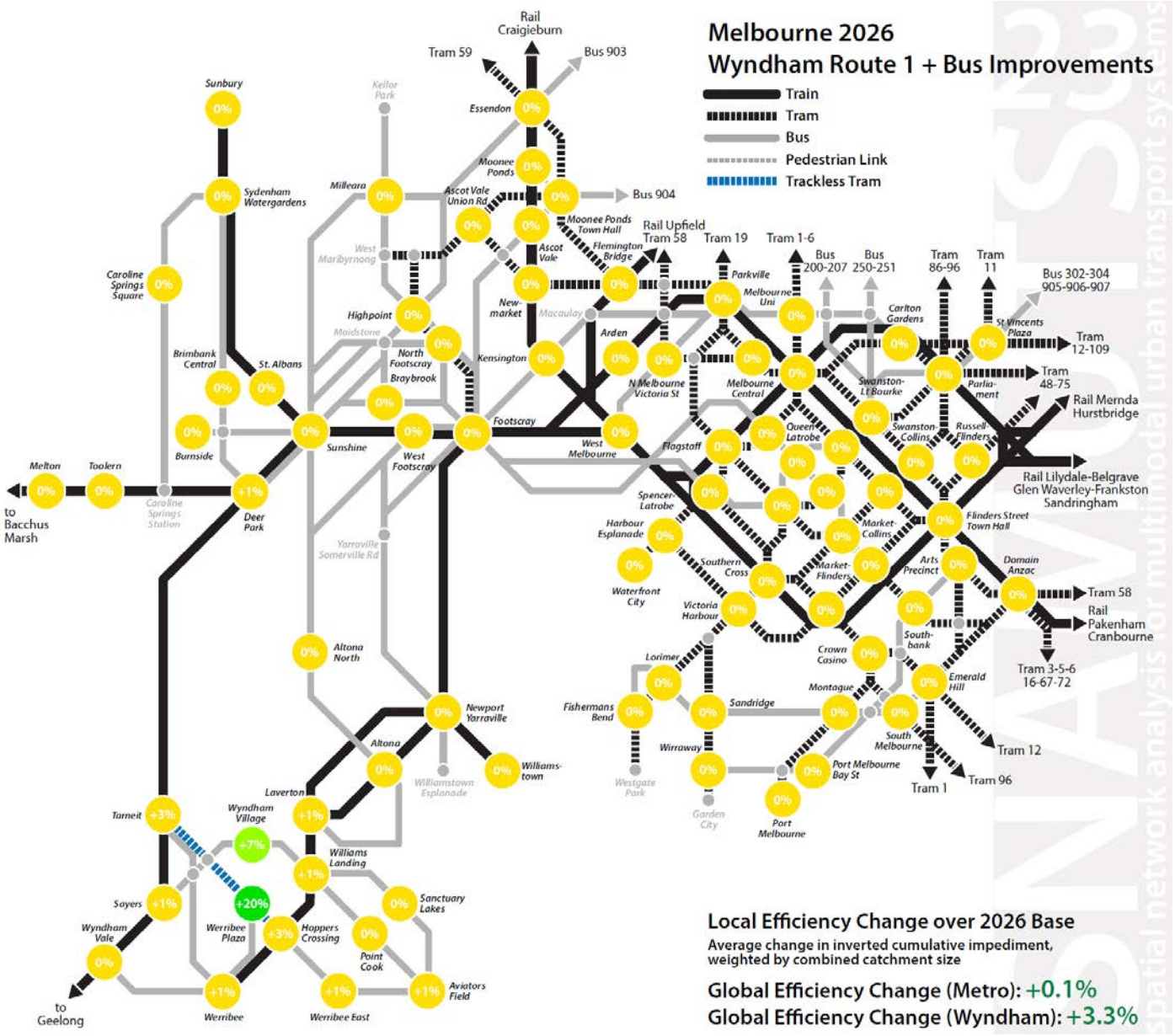
Figures 2-5 show the impact of each starter route on public transport accessibility using the SNAMUTS efficiency change index.

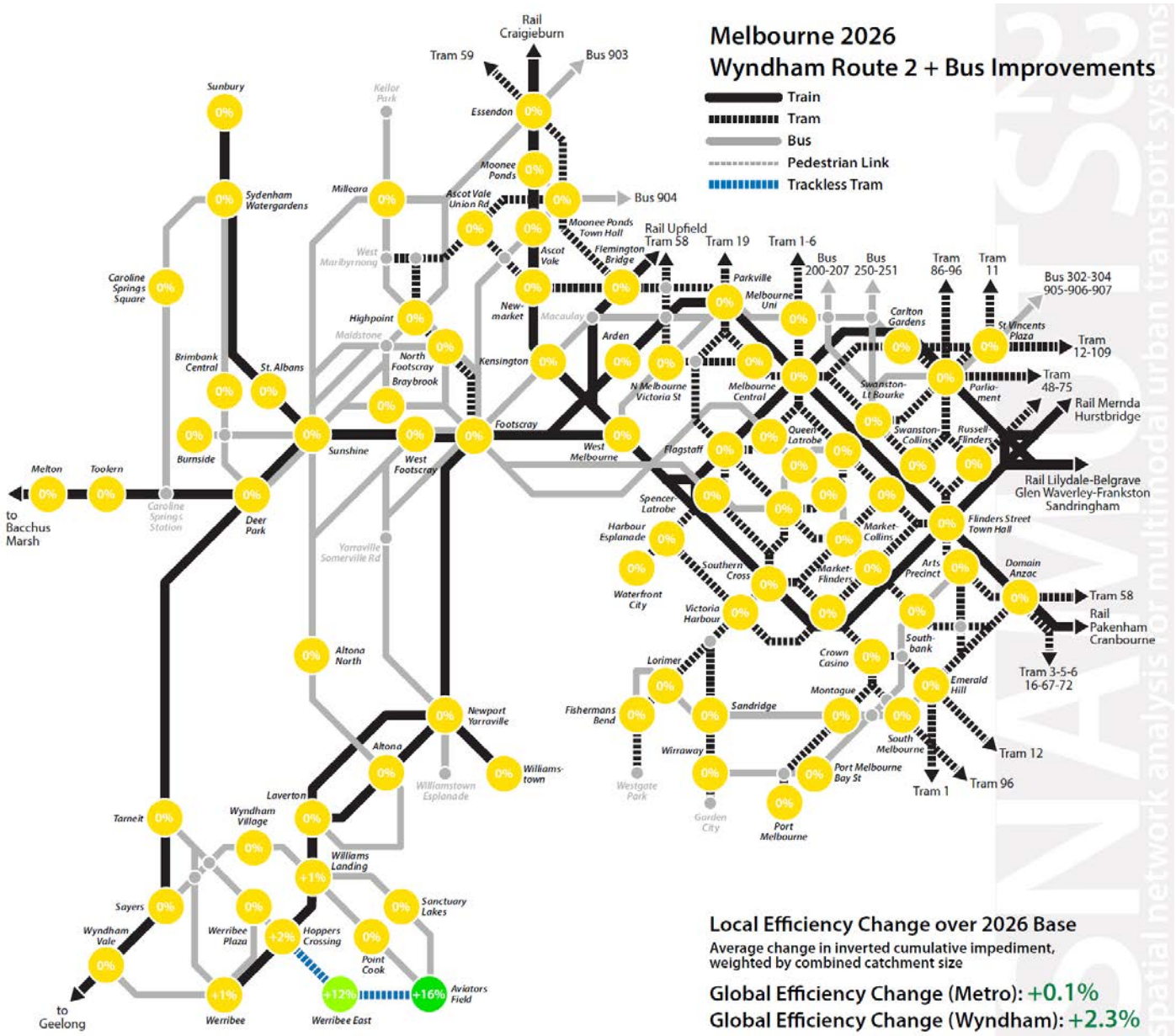
Efficiency change uses values from other SNAMUTS indicators (closeness and betweenness) to quantify how ease of movement in relation to the land use structure changes as a result of specific infrastructure or service measures. Figures are provided across a network (metropolitan Melbourne), across a particular geographical area (City of Wyndham) and for each activity node (in Wyndham these comprise the train stations of Williams Landing, Hoppers Crossing, Werribee, Tarneit, Sayers/Riverdale and Wyndham Vale, as well as the off-rail centres of Werribee Plaza, Sanctuary Lakes, Point Cook, Aviators Field, Werribee East and Wyndham Village). They refer to a comparison between the network including each Trackless Tram starter line option and a base case network where all four lines are operated as non-prioritised bus routes with 20-minute frequencies. The indicator is expressed as a percentage figure, with positive figures indicating an improvement and negative figures a deterioration in accessibility over the comparison case.

Figures 2, 3, 4, 5: *SNAMUTS efficiency change network diagrams for each Trackless Tram starter line option (routes 1-4, see Figure 1)*

Of the four potential starter lines, Route 1 (Tarneit-Hoppers Crossing) records the greatest average improvement to movement efficiency within the City of Wyndham, while Route 3 (Williams Landing-Sayers/Riverdale) records the lowest. Both route options provide links between Wyndham's two non-connected radial rail lines. However, Route 1 does so along a direct path that enhances the attractiveness of transfer connections at both Tarneit and Hoppers Crossing, whereas Route 3 uses a longer route that connects reasonably well to rail at Williams Landing but fails to offer competitive travel times for inbound transfer journeys using the Regional Rail link.

Route 2 (Hoppers Crossing-Aviators Field) and Route 4 (Williams Landing-Aviators Field) are both classic rail feeder lines that primarily facilitate more attractive





radial journeys for residents and employees in the development areas along these routes. Route 4 performs slightly better than Route 2 on the efficiency change index, most likely because it delivers transferring passengers at a rail station closer to central Melbourne (Williams Landing) than route 2 (Hoppers Crossing), saving a few minutes of travel time along the way.

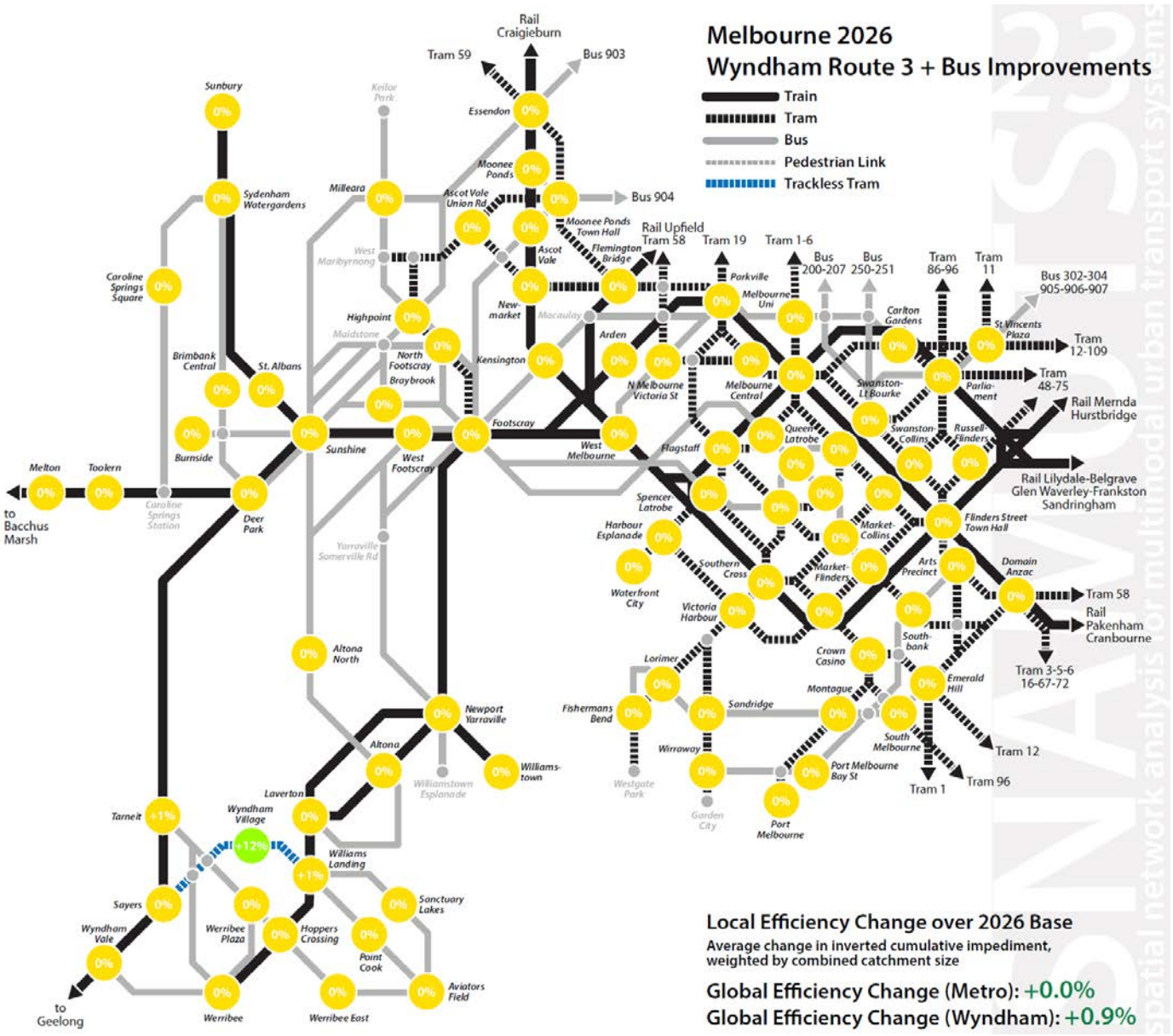
Table 1 compares a suite of other SNAMUTS indicators for the base case and the four Trackless Tram starter line options. It further demonstrates the strength of Route 1 in providing a vital link between existing hubs in Wyndham, expanding the activity radius a public transport user can access within 30 minutes (contour catchment) and increasing the concentration of travel opportunities overall (nodal betweenness) at a greater rate than the other three route options. If the highest policy priority in selecting a route

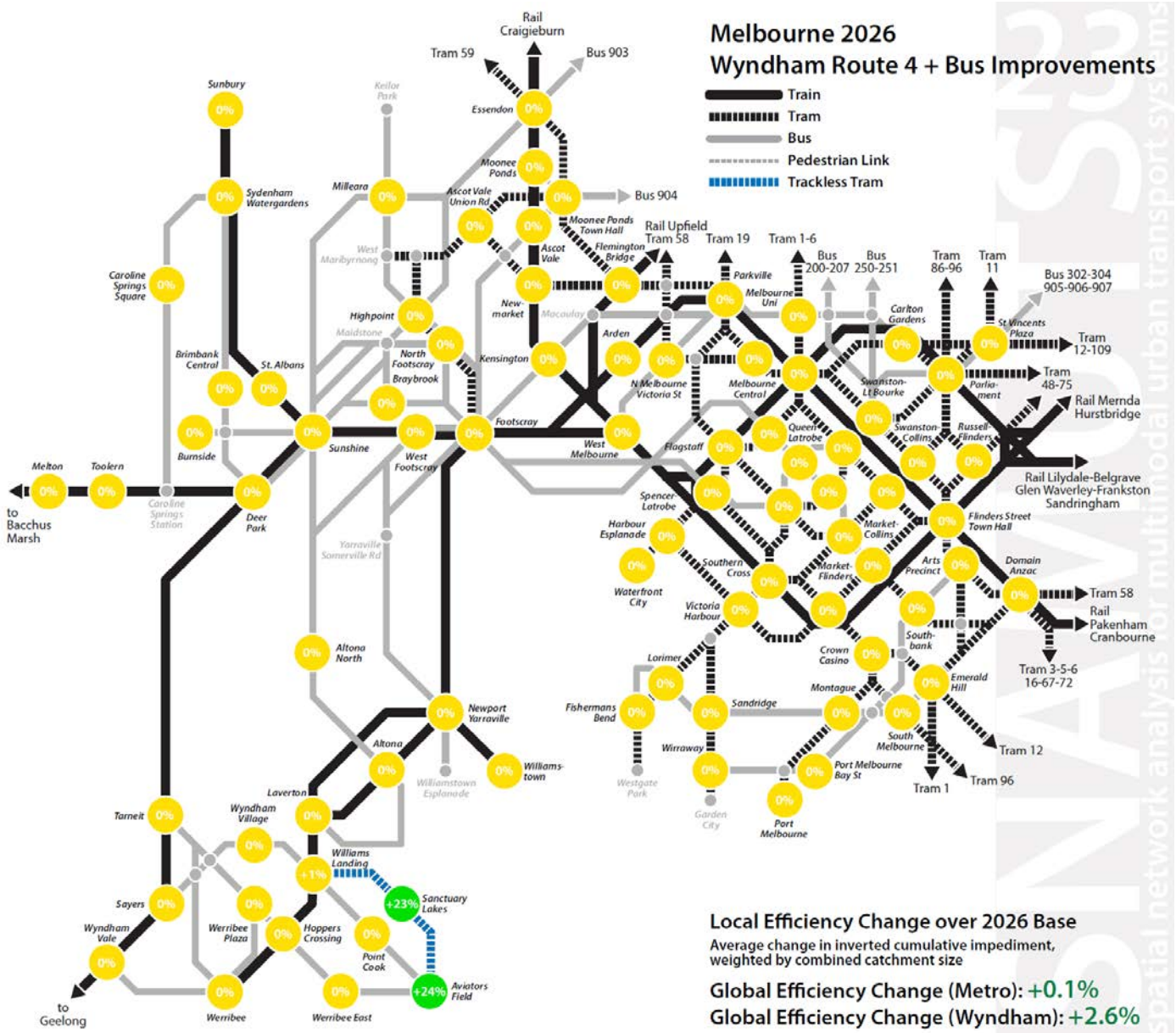
option is to improve connections between disparate activity centres within Wyndham, then Route 1 clearly represents the best choice.

However, if the principal focus is to position a Trackless Tram corridor where it allows for the greatest ease of movement to and from destinations in central Melbourne, then Route 4 has an edge over the alternatives.

Conversely, if the primary objective is to align the first Trackless Tram route where the greatest potential for property development can be found, then Route 2 (through the redevelopment and greenfield areas of Werribee East and Aviators Field) is the most suitable option.

Of the four alternatives, Route 3 performs weakest or equal weakest on most SNAMUTS indicators, though it is likely that its scores would be improved were this line to connect Williams Landing with Tarneit station in lieu of Sayers/Riverdale station. This becomes apparent from the surprisingly positive local efficiency result for Wyndham Village in the





assessment for Route 1 (Figure 2), which is based almost entirely on potential transfer journeys between the Sayers Road bus corridor and the Trackless Tram along Derrimut Road.

Table 1: *Overview of average SNAMUTS indicator results for Trackless Tram starter routes 1-4 and the base cases (buses)*

2026 SNAMUTS *23R*	Base	Route 1	Route 2	Route 3	Route 4
Average Closeness Centrality Wyndham	85.7	84.3	84.2	84.9	83.0
Average 30-min Contour Catchment Wyndham	33.1%	37.3%	35.0%	35.0%	36.3%
Average Nodal Betweenness Wyndham	11.3	11.7	11.6	11.4	11.3
Average Nodal Resilience Wyndham	+1.5	+2.3	+2.5	+2.0	+2.6
Average Nodal Connectivity Wyndham	38	40	39	39	39
Global Efficiency Change Wyndham		+3.3%	+2.3%	+0.9%	+2.6%
Average SNAMUTS Composite Score Wyndham	11.0	11.3	11.3	11.3	11.5

2036: Comparison of network measures

For the SNAMUTS analysis of the public transport network in Wyndham (and beyond), a medium-term time horizon (2036) has been chosen where all four route alternatives are assumed to have been implemented. This horizon not only allows for sufficient time to plan and build the Trackless Tram routes; it also allows for infrastructure-specific land use responses to emerge in the sense that properties around the Trackless Tram corridors may be subject to urban intensification at rates over and beyond the 2036 trend as identified in State Government documents (VIF and VITM). Such additional margins of urban intensification form a significant rationale for and funding source of the Trackless Tram system according to the Entrepreneurial Rail Model.[3]

This section analyses the accessibility effects of a Trackless Tram network in Wyndham consisting of the four routes assessed in the previous section without taking additional land use effects into account. In the following section, we will attempt to quantify the amount of additional land use intensification along the Trackless Tram corridors required to fully justify the provision of a medium-capacity public transport mode, ie. we ask for the threshold of land use concentration whose movement needs would exceed the capacity of a bus system.

In both sections, the analysis is based on two distinct operational and infrastructural scenarios.

The Separate Lines scenario assumes that Route 1 (Tarneit to Hoppers Crossing), Route 3 (Williams Landing to Sayers/Riversdale) and a combined Route 2/4 (Hoppers Crossing to Williams Landing via Aviators Field; see Figure 1) are operated individually, ie. they terminate either side of the rail interchanges at Hoppers Crossing and Williams Landing. Passengers travelling beyond those interchanges on the Trackless Tram system will thus have to transfer to a different vehicle. This scenario saves infrastructural costs in that it does not include dedicated bridges or tunnels allowing Trackless Tram vehicles to traverse the rail alignment (which would likely be required in both locations to bring a continuous Trackless Tram line as close as possible to the rail platforms). In turn,

[3] Newman P, Mouritz M, Davis-Slate S, Jones E, Hargroves K, Sharma R, Adams D (2018) *Delivering Integrated Transit, Land Development and Finance. A Guide and Manual with Application to Trackless Trams.* Sustainable Built Environment National Research Centre (SBENRC), Australia

it influences (and likely reduces) travel flows from one side of the train line to the other by introducing the obstacle of a required transfer.

The Joined Lines scenario overcomes this constraint by providing such infrastructures across the rail alignment and thus allowing for the entire Trackless Tram system in Wyndham to operate as a single, continuous ribbon-shaped line (Tarneit-Hoppers Crossing-Aviators Field-Williams Landing-Sayers/Riverdale). This will result in increased capital costs over the Separate Lines scenario but may reduce operating costs as there will be fewer terminus stations on the network (where vehicles need to spend time shunting and reversing, and in the case of Trackless Trams, recharging batteries). It should also be noted that if service frequencies are high, a Trackless Tram terminus needs to allow for several vehicles to recharge simultaneously, which adds to the space required (and thus to both costs and potential planning conflicts) for each terminus facility.

30-minute contour catchments

Figure 6-8 illustrate the effects of these different scenarios with the help of a localised version of the SNAMUTS 30-minute contour catchment index. This index measures the number of Wyndham residents and jobs within the walkable catchments of nodes that can be reached from the reference node within half an hour on public transport, expressed as a percentage of all residents and jobs within the City of Wyndham as projected for 2036.

Figure 6 depicts a no-build control scenario where no Trackless Tram lines are in place, but where the same corridors are instead operated by buses (with no specific priority measures and thus assuming travel times in line with those found on these bus routes at present - ie. slower than the assumptions for Trackless Trams - and also operated as separate, non-continuous lines).

For all 2036 scenarios, it is anticipated that the Werribee rail line has been extended to connect with the Regional Rail link at Wyndham Vale, and that the Melbourne Metro 2 project has been completed, linking the Werribee line from Newport through Fishermans Bend, Southern Cross and Parkville through to the Mernda line. Both rail lines as well as all high-frequency bus lines in Wyndham are assumed to operate at 10-minute daytime frequencies, equal to the Trackless Tram system.

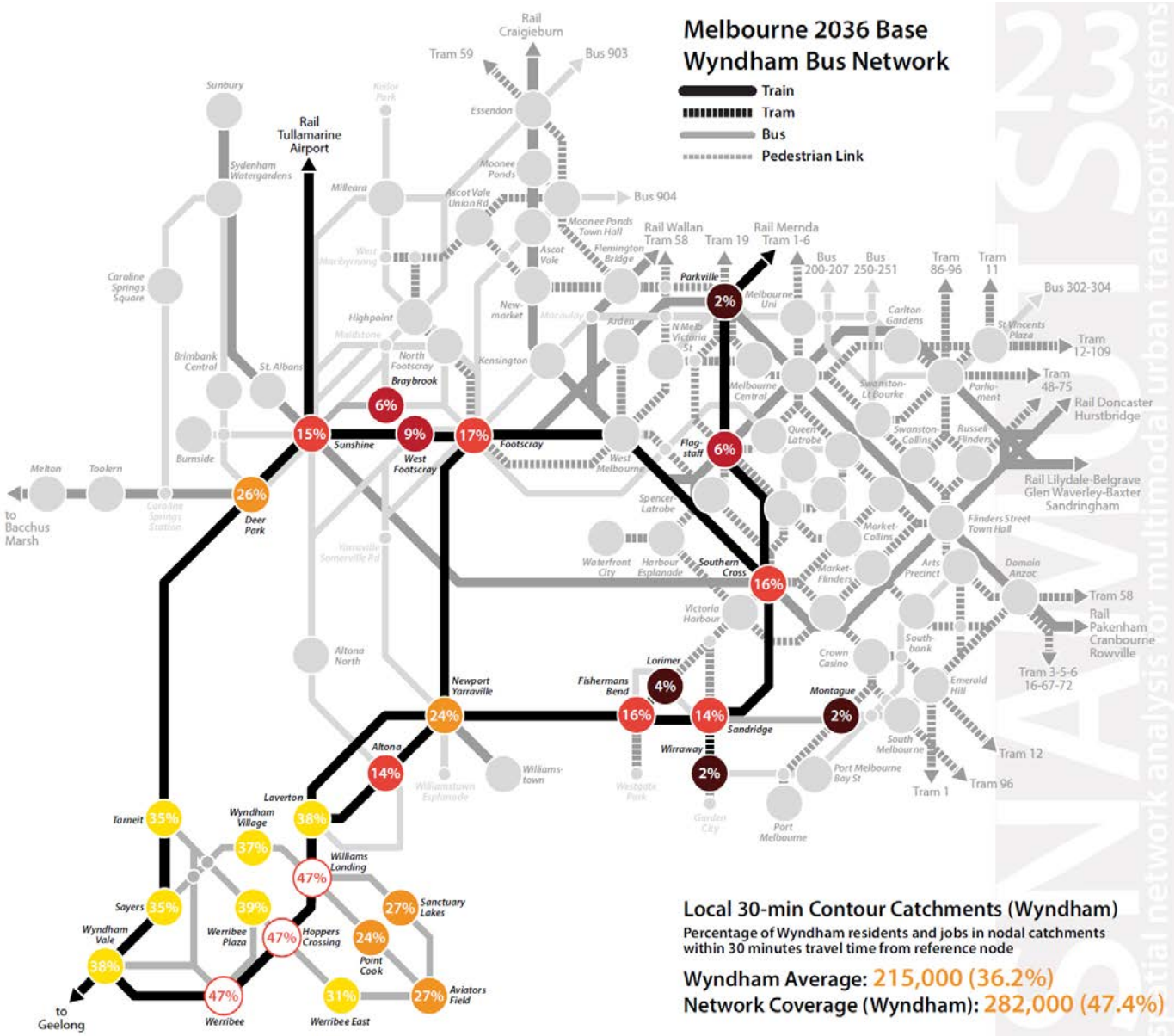
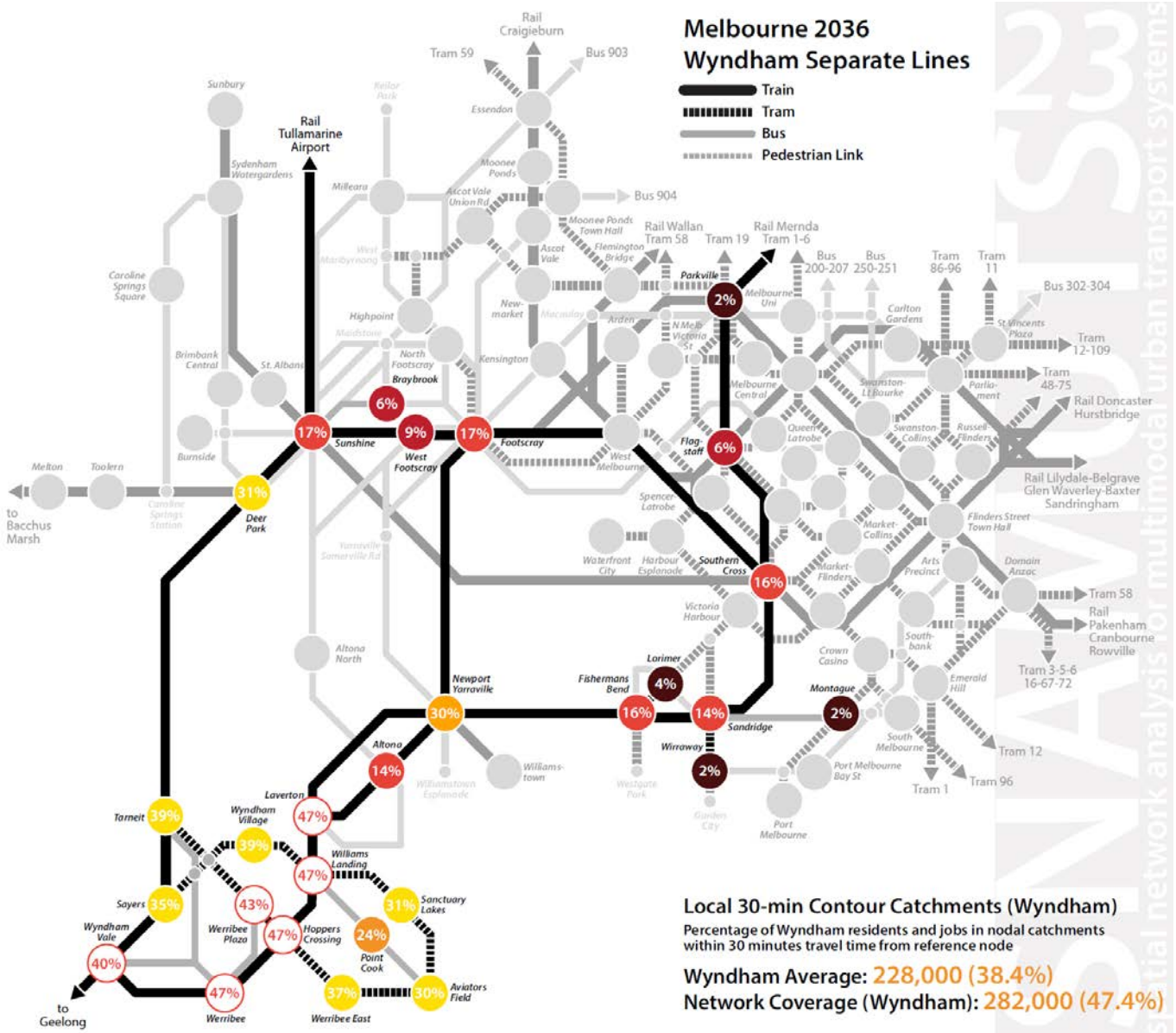
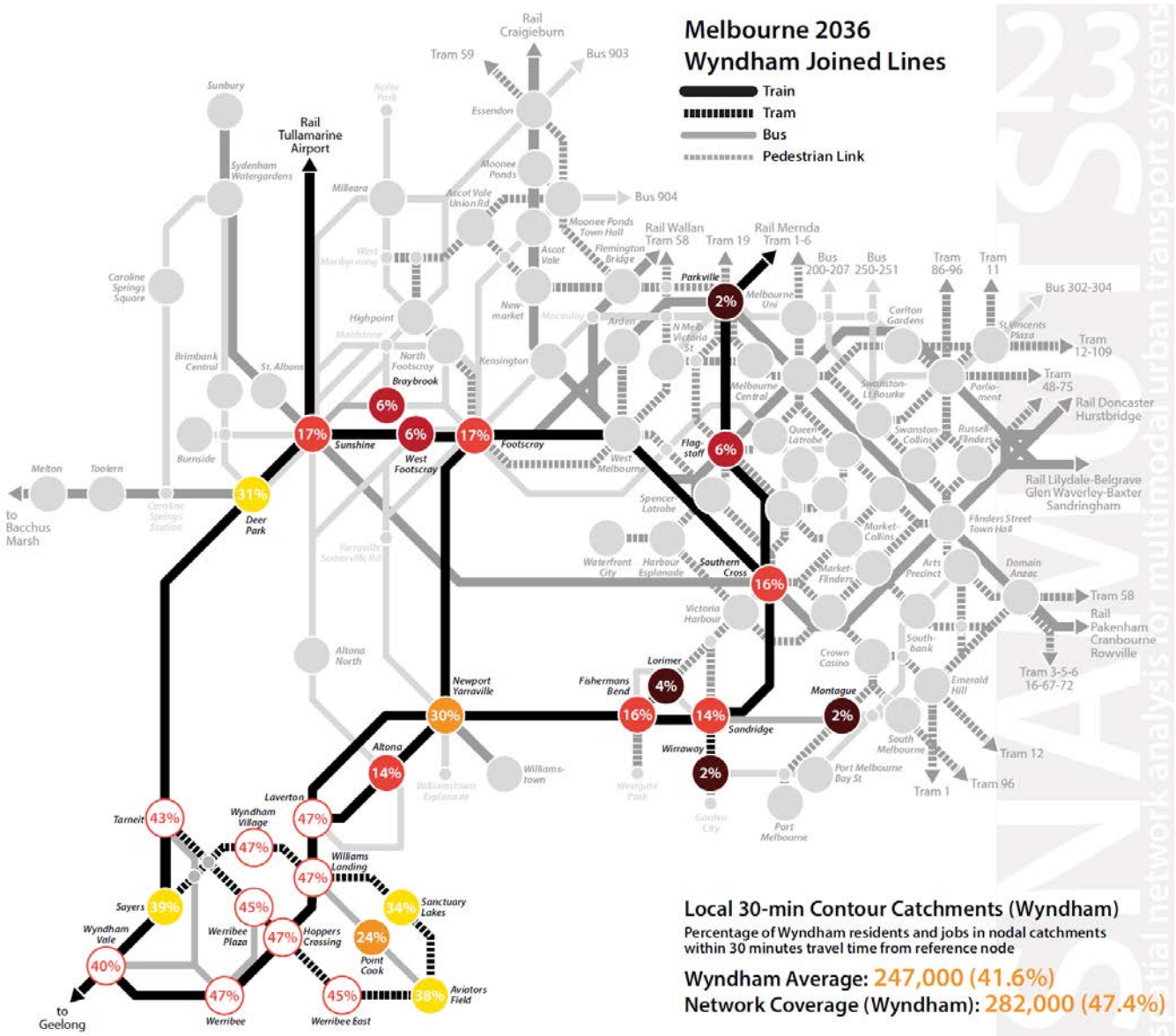


Figure 7 shows how the average catchment of a 30-minute public transport journey to or from a Wyndham node increases by some 13,000 residents and jobs if Trackless Trams replace the bus routes in Figure 6, but still operate as Separate Lines. This effect can be traced to the travel time savings achieved by the better prioritised Trackless Tram system and the resulting greater spatial reach of each 30-minute journey.

In Figure 8, where the Trackless Tram system operates as Joined Lines and passengers can travel between destinations on either side of the Werribee rail line faster, this margin increases to an average 32,000 residents and jobs. Eliminating the need to transfer between different Trackless Tram lines at Hoppers Crossing and Williams Landing alongside the associated delay in travel time thus more than doubles the benefit of introducing the system on this indicator with all other factors, including land use, remaining equal.

Figures 6, 7, 8: *Local 30-minute contour catchment maps for Wyndham in the 2036 Base, Separate Lines and Joined Lines scenarios with no land use modifications beyond the 2036 trend*




Melbourne 2036
Wyndham Joined Lines
Train
Tram
Bus
Pedestrian Link
Rail Craigieburn
Tram 59
Bus 903
Sunbury
Rail Tullamarine Airport
Essendon
Sydenham Watergardens
Moonee Ponds
Bus 904
Melleara
Ascot Vale Union Rd
Moonee Ponds Town Hall
Rail Wallan
Tram 58
Tram 19
Rail Mernda
Tram 1-6
Bus 200-207
Bus 250-251
Tram 86-96
Tram 11
Bus 302-304
Caroline Springs Square
Ascot Vale
Flemington Bridge
Parkville
2%
Melbourne Uni
Carlton Gardens
St Vincents Plaza
Tram 12-109
Highpoint
New-market
Arden
N Melb Victoria St
Brimbank Central
St. Albans
North Footscray
Kensington
Braybrook
6%
Melbourne Central
Swanston-LtBourke
Parlio-ment
Tram 48-75
Rail Doncaster Hurstbridge
17%
Sunshine
6%
West Footscray
17%
Footscray
Flag-staff
6%
Queen Latrobe
Swanston-Collins
Russell-Flinders
Burnside
West Melbourne
Melton
Toolern
31%
Deer Park
to Bacchus Marsh
Spencer Latrobe
Rail Lilydale-Belgrave Glen Waverley-Baxter Sandringham
Flinders Street Town Hall
Market-Collins
Waterfront City
Harbour Esplanade
Southern Cross
16%
Market-Flinder
Arts Precinct
Domain Anzac
Tram 58
Rail Pakenham Cranbourne Rowville
Victoria Harbour
Altona North
Lorimer
4%
Fishermans Bend
16%
14%
Sandridge
Montague
2%
Crown Casino
South-bank
Emerald Hill
Tram 3-5-6 16-67-72
Newport Yarraville
30%
Altona
14%
Wirraway
2%
Williams-town
Williamstown Esplanade
Westgate Park
Port Melbourne Bay St
South Melbourne
Tram 12
Tram 1
Tram 96
Laverton
47%
Tarneit
43%
Wyndham Village
47%
Garden City
Port Melbourne
Williams Landing
47%
Sayers
39%
45%
34%
Sanctuary Lakes
Wyndham Vale
Werribee Plaza
47%
Hoppers Crossing
24%
Point Cook
40%
47%
45%
38%
Aviators Field
to Geelong
Werribee
Werribee East
Local 30-min Contour Catchments (Wyndham)
Percentage of Wyndham residents and jobs in nodal catchments within 30 minutes travel time from reference node
Wyndham Average: 247,000 (41.6%)
Network Coverage (Wyndham): 282,000 (47.4%)

Mode supply capacity assessment

However, does this finding on its own justify the introduction of a Trackless Tram system in Wyndham?

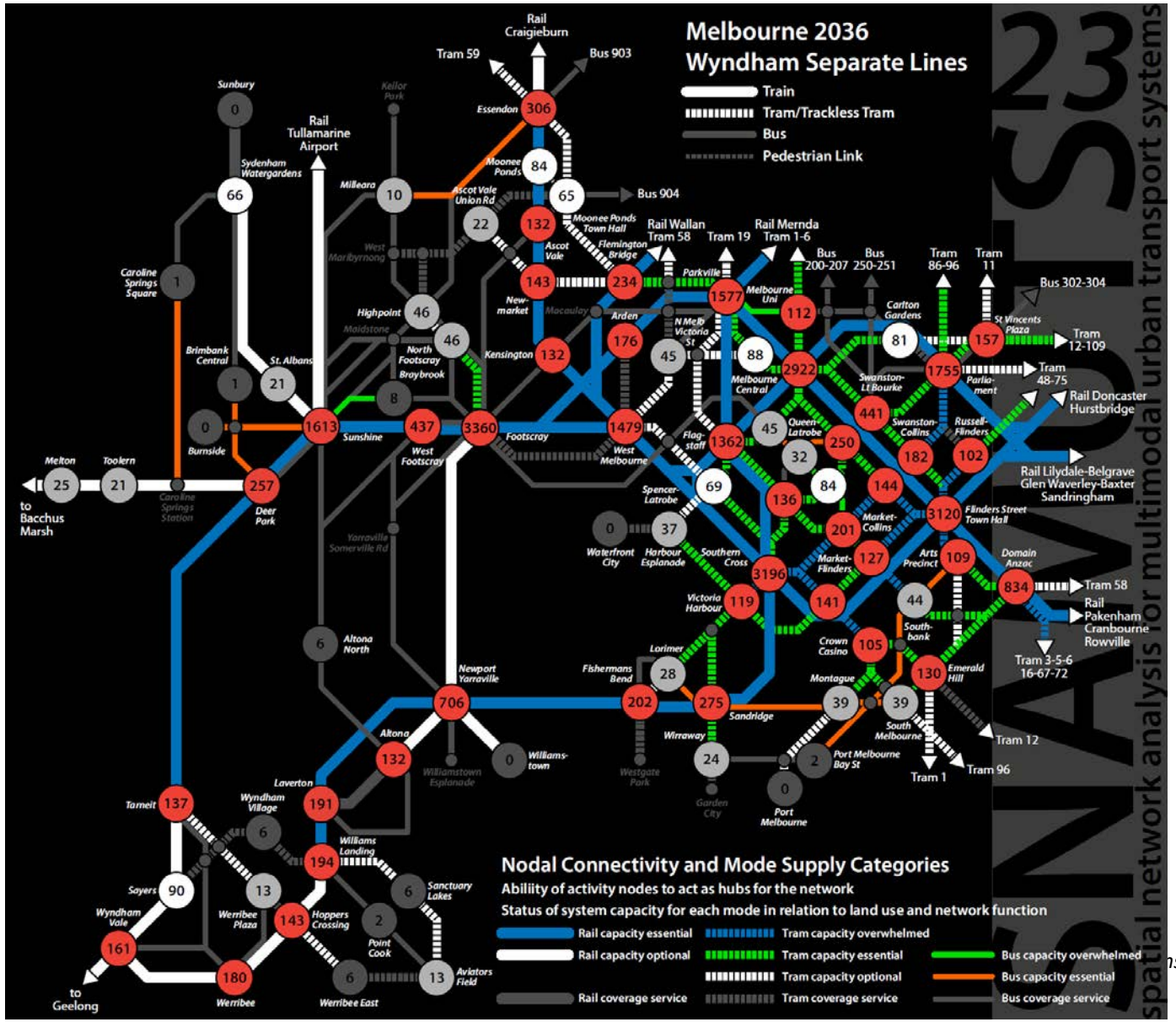
Alternatively, it would be conceivable to provide sufficient traffic priority measures for buses to achieve similar travel speeds as those assumed for Trackless Trams, as well as to provide the dedicated rail-traversing infrastructures included in the Joined Lines scenario but still operate them with conventional buses. The benefit of a medium-capacity public transport system over buses, as the term suggests, is that it continues to perform to a high standard at a level of patronage where a bus system reaches a capacity ceiling and its operation becomes unstable through overcrowding and delays associated with congested boarding and alighting procedures. The SNAMUTS mode supply capacity assessment index attempts to quantify this threshold.

Figures 9 and 10 show the public transport network on the corridors between Wyndham and Melbourne's CBD and categorise each route segment by indicating whether the passenger capacity enabled by the mode that operates it is optional, essential or exceeded/overwhelmed for the functionality of the network as a whole.

If a capacity level is categorised as *optional* (segments depicted in white), this means that the segment in question could theoretically be operated by a lower-capacity mode (eg. tram in place of train or bus in place of tram) without resulting in prohibitive overcrowding.

If a capacity level is categorised as *essential* (bus segments depicted in orange, tram segments in green and train segments in blue) this means that the capacity of the mode offered on the segment is a good match for the number of travel opportunities converging there, and that a mode of lower capacity than the one in place would likely not cope with the transport task.

If a capacity level is categorised as *exceeded/overwhelmed* (bus segments depicted in green and tram segments in blue), this means that the mode offered on the segment is not capable of providing the capacity needed to serve the travel opportunities converging there, at least as long as walking, cycling, driving or detours along other public transport routes don't offer viable and scalable alternatives to using this particular route segment.



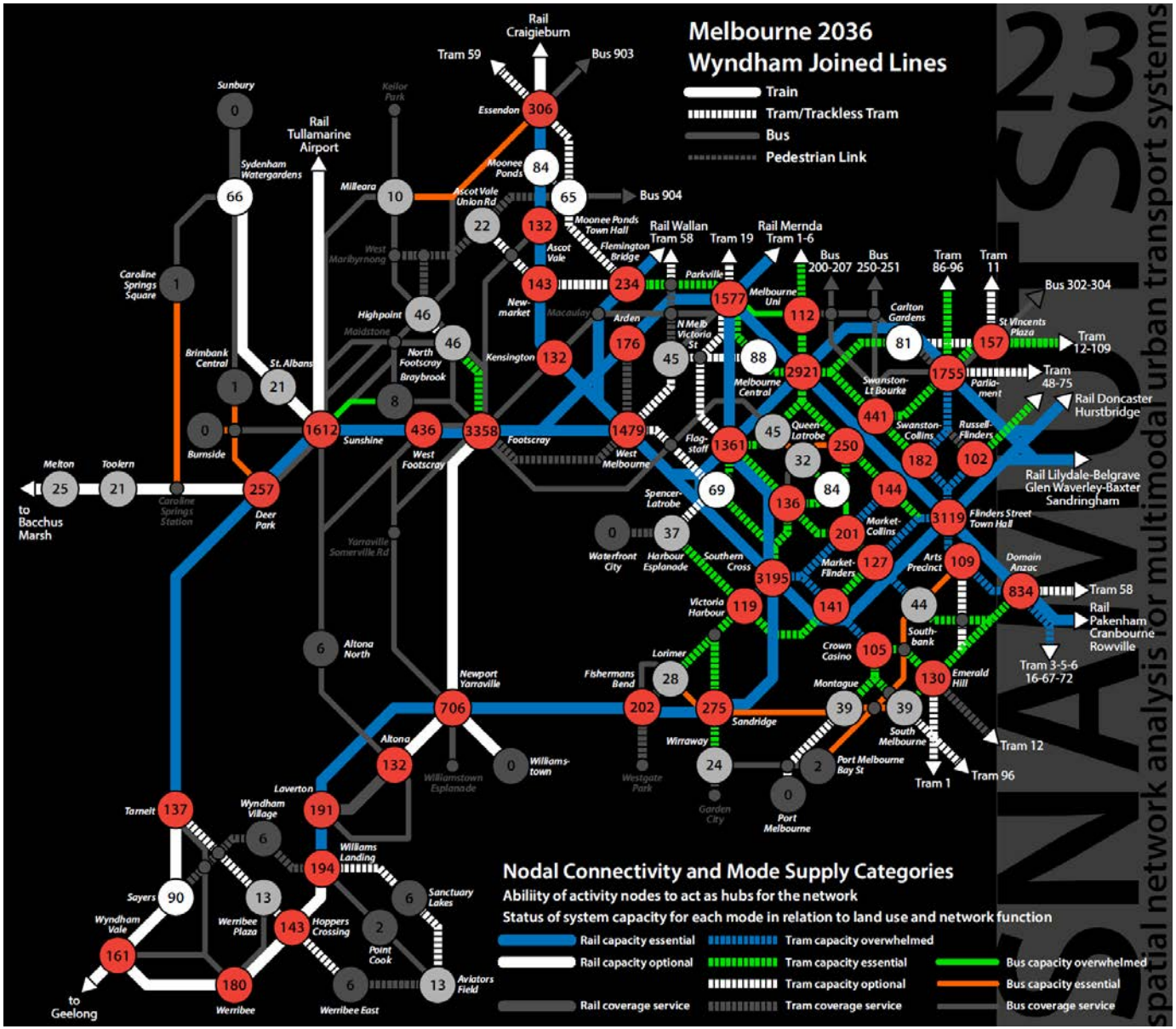
Lastly, segments depicted in grey (on any mode) do not have a network function of moving sizeable numbers of passengers along particular corridors; they are better characterised as a 'coverage service' whose primary rationale is to provide a broad geographical reach for public transport rather than a specific capacity for ridership.[4] Routes or parts of routes fully within this category could conceivably also be operated by non-conventional modes such as open-access autonomous vehicles rather than line-haul public transport if and when such technologies are deployed at equivalent user costs and availability.

Figures 9 and 10 highlight that using trend 2036 land use figures for urban growth in Wyndham (and elsewhere), no segment of the proposed Trackless Tram system meets the threshold where we could confidently assert that a bus system would be overwhelmed by the transport task.

Moreover, the entire length of Route 3 (Williams Landing to Sayers/Riverdale) falls within the coverage service category, meaning it does not offer significant advantages over alternative routes in linking centres of activity (eg. the trip between Williams Landing and Sayers/Riverdale can also be made – and likely faster – by train with a transfer in Wyndham Vale). For this reason, we will exclude Route 3 from the next step of the assessment.

For Routes 1, 2 and 4, the question is how much additional urban intensification is required to ensure that at least one route segment per line falls into the 'essential capacity level' for a (trackless) tram system?

Figures 9, 10: *Nodal connectivity and mode supply categories in the Wyndham corridor in 2036 with trend land use assumptions in the Separate Lines and Joined Lines scenarios*



2036: Comparison of land use measures

The calculation of minimum additional urban intensification targets for nodes along proposed Trackless Tram routes 1, 2 and 4 has been conducted iteratively using the SNAMUTS tool. It is based on the premise that at least one route segment on each line should return an expected patronage level of 7.5 million passengers per year or more (sum of both directions), which has been identified as an approximate capacity ceiling for a bus route operated by conventional-sized vehicles (40-50 seats).

To arrive at such a patronage estimate, the number of travel opportunities on each route segment (as identified in the SNAMUTS betweenness index) has been set in proportion to the actual number of public transport journeys, using the 2016 network as a base. As the number of travel opportunities increases in line with projected urban growth and network and service improvements between 2016 and 2036, potential ridership surges accordingly.

Additionally, the calculation makes assumptions about the expected role of public transport in the mobility mix in 2036. As network and service improvements lead to a greater proliferation of public transport-friendly environments for living and doing business across metropolitan Melbourne, and as urban growth and associated traffic pressures lead to a relative loss of competitive advantage for the private vehicle over public transport, we can expect average public transport trip-making rates to go up between 2016 and 2036.

Using quantifications of the number of residents and jobs in public transport catchments that meet a specific SNAMUTS performance threshold (closeness centrality, 30-minute contour catchment and nodal connectivity) as a proxy for the proliferation of public transport-friendly environments, and taking in the evolution of average resilience of the network as a proxy for the ability of travellers to actually be accommodated on public transport, we anticipate that the number of public transport journeys per person per year in metropolitan Melbourne increases from an average of 120 in 2016 to approximately 160 in 2036 (with minor fluctuations from one scenario to the next).

Note that none of these assumptions represents hard certainties or thresholds. The 7.5 million passengers per year figure for the capacity boundary between bus and tram/medium-capacity mode is somewhat fluid: while the majority of Melbourne’s individual existing tram lines exceed this

patronage level, some remain below it, and successful business cases have been made in other cities for light rail or other medium-capacity modes with patronage projections below this level. Conversely, the use of larger (double-decker or articulated) buses on specific lines can shift the capacity ceiling of a bus system upwards, while poor traffic priority and associated bus congestion can shift it downwards.

The assumption of proportionality between travel opportunities as quantified by the SNAMUTS betweenness index and actual patronage numbers is based on the premise that public transport usage is solely or primarily determined by spatial accessibility. In reality, further factors can be expected to influence the relation between supply and demand, in particular the relative competitiveness of other transport modes, such as the level of traffic congestion and the cost and availability of parking along particular public transport routes, or at shorter distances the quality of the walking and cycling environment.

The following calculations of additional land use intensification requirements should therefore be read as indicative policy guidance rather than hard and fast quantitative recommendations.

Figures 11 and 12 show the outcome of the iterative calculations for land use intensification in the Separate Lines and Joined Lines scenario following the methodology outlined above. The scenarios differ in the total number and geographical distribution of additional activities required to make the three corridors tram-worthy: overall, a greater effort in steering additional urban growth around the Trackless Tram infrastructure is required in the Separate Lines (68,000 residents and jobs) than in the Joined Lines scenario (61,000 residents and jobs).

This is particularly true for Route 1 between Tarneit and Hoppers Crossing, where 46,500 additional residents and jobs are required in the catchment to overwhelm a bus system if the line terminates at Hoppers Crossing, and 39,500 if the line continues south beyond this point without requiring a transfer. This difference is due to the greater attraction and better geographical distribution of travel flows along the north-south corridor achievable in the Joined Lines scenario over the Separate Lines scenario, which will be explored in more detail below.

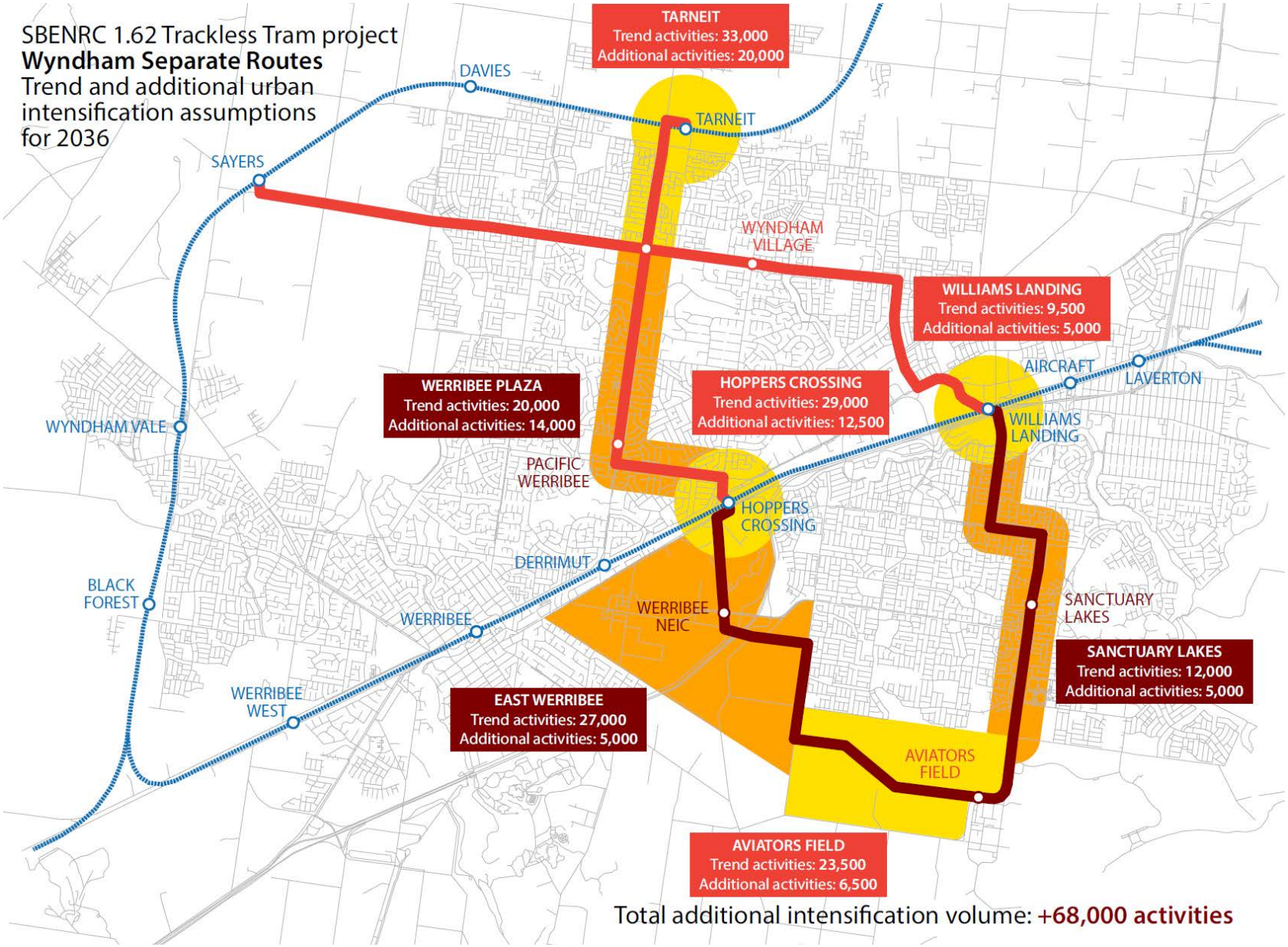
Conversely, a greater degree of additional urban intensification (albeit at a much lower level) is required along Route 4 between Aviators Field and Williams Landing in the Joined Lines (18,000

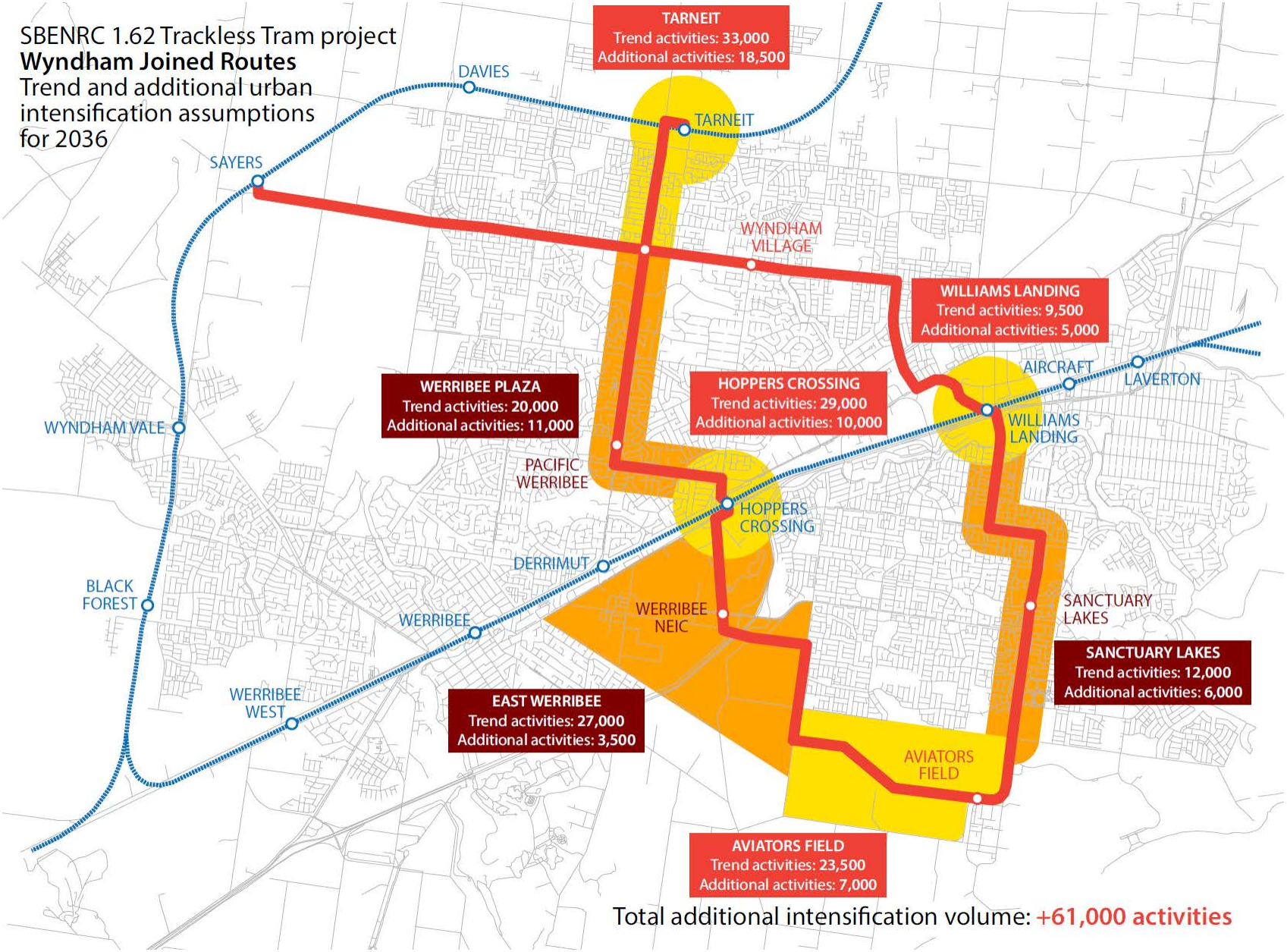
residents and jobs) over the Separate Lines scenario (16,500 residents and jobs). This is primarily because a separate route 2/4 channels a greater number of travel opportunities through the interchange at Williams Landing than a Joined Line that offers the opportunity to reach a greater number of destinations with fewer transfers by making use of the Aviators Field-Hoppers Crossing-Tarneit corridor, and thus reaches the mode capacity threshold sooner.

Note that the numerical estimates for intensification at each node are indicative: to some extent, greater intensification than stated at a specific node can compensate for less intensification at another node along the same route. Note also that the trend catchment size for Aviators Field already assumes that this Greenfield neighbourhood will develop to a significantly denser and multi-functional template that what is currently typical for Greenfield housing estates in the Wyndham area.

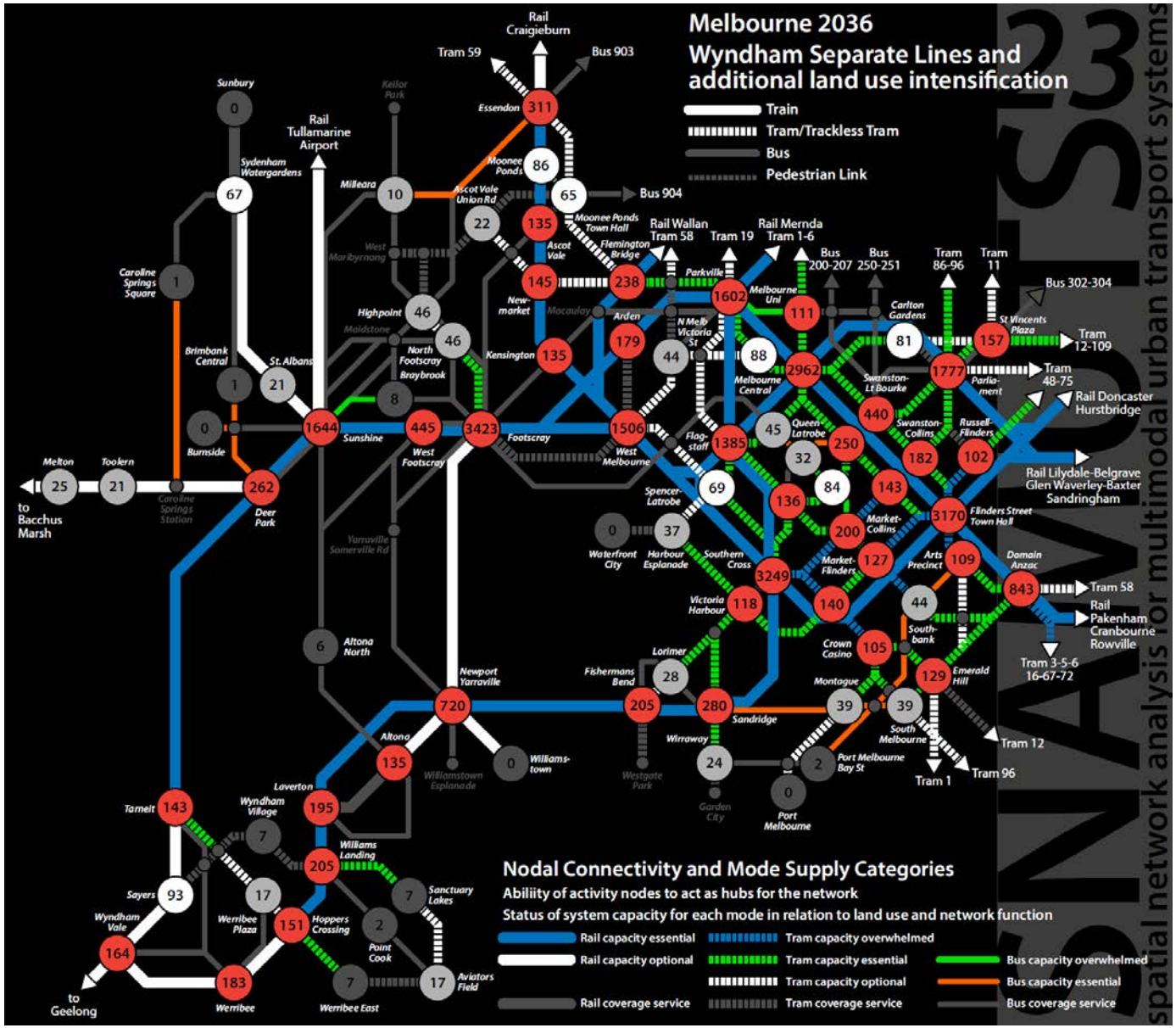
Lastly, all figures for additional urban intensification are predicated on the notion that this process will occur at the expense of (or by delaying beyond 2036) the urbanisation of other Greenfield land within Wyndham that is located outside the walkable catchments of the public transport network assessed here; or in other words, the total 2036 target for residential and employment growth within the City of Wyndham (and indeed metropolitan Melbourne) is assumed to remain constant across all scenarios with or without additional intensification around Trackless Tram corridors.

Figures 11, 12: *Overview of trend and additional urban intensification targets (in numbers of activities = residents + jobs) in nodal catchments around the proposed Trackless Tram routes 1, 2 and 4 in the Separate Lines and Joined Lines scenarios*

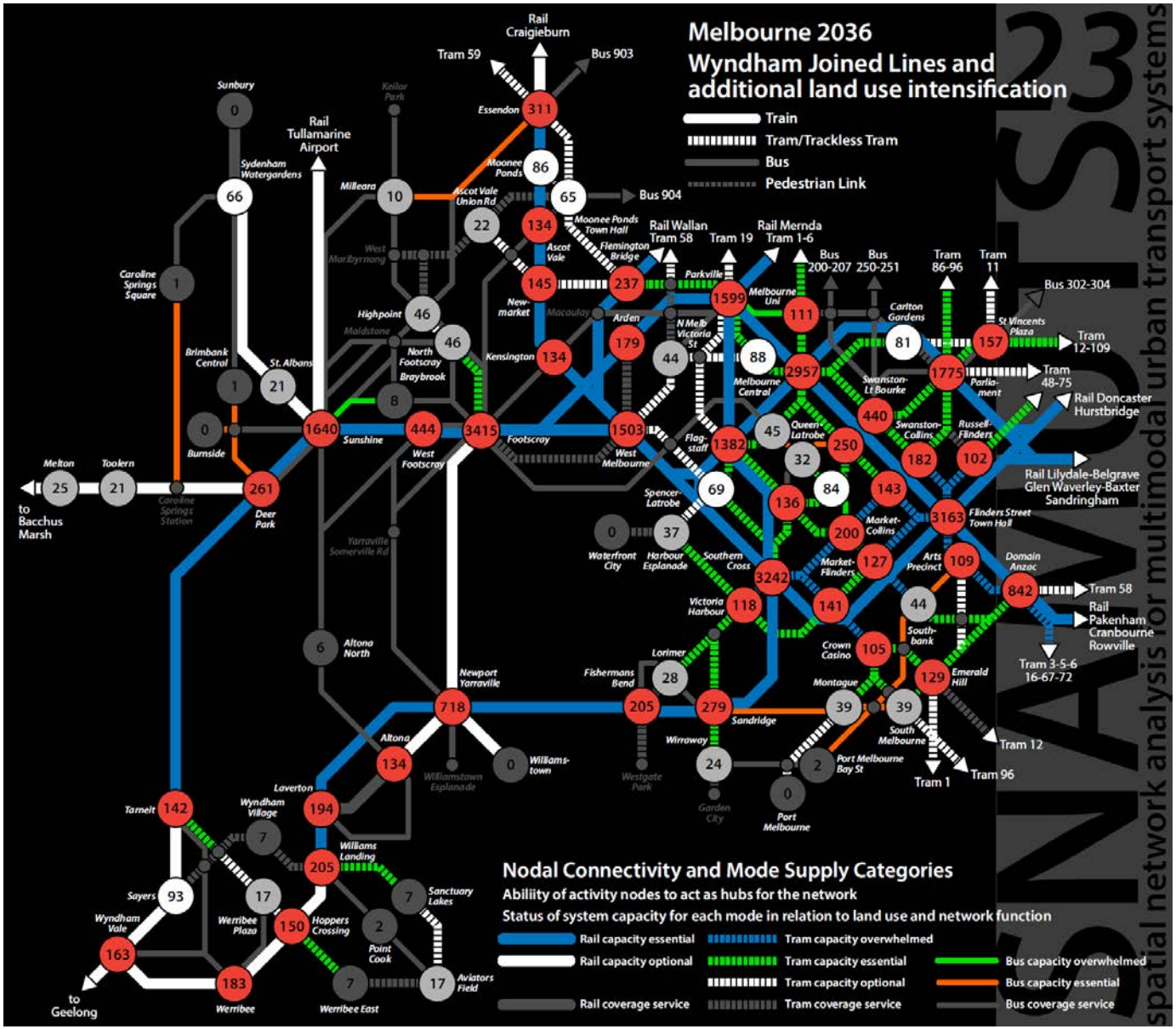

SBENRC 1.62 Trackless Tram project
Wyndham Separate Routes
Trend and additional urban intensification assumptions for 2036
TARNEIT
Trend activities: 33,000
Additional activities: 20,000
DAVIES
TARNEIT
SAYERS
WYNDHAM VILLAGE
WILLIAMS LANDING
Trend activities: 9,500
Additional activities: 5,000
AIRCRAFT
LAVERTON
WERRIBEE PLAZA
Trend activities: 20,000
Additional activities: 14,000
HOPPERS CROSSING
Trend activities: 29,000
Additional activities: 12,500
WYNDHAM VALE
WILLIAMS LANDING
PACIFIC WERRIBEE
HOPPERS CROSSING
DERRIMUT
BLACK FOREST
WERRIBEE
WERRIBEE NEIC
SANCTUARY LAKES
SANCTUARY LAKES
Trend activities: 12,000
Additional activities: 5,000
WERRIBEE WEST
EAST WERRIBEE
Trend activities: 27,000
Additional activities: 5,000
AVIATORS FIELD
AVIATORS FIELD
Trend activities: 23,500
Additional activities: 6,500
Total additional intensification volume: +68,000 activities


SBENRC 1.62 Trackless Tram project
Wyndham Joined Routes
Trend and additional urban intensification assumptions for 2036
TARNEIT
Trend activities: 33,000
Additional activities: 18,500
DAVIES
TARNEIT
SAYERS
WYNDHAM VILLAGE
WILLIAMS LANDING
Trend activities: 9,500
Additional activities: 5,000
AIRCRAFT
LAVERTON
WERRIBEE PLAZA
Trend activities: 20,000
Additional activities: 11,000
HOPPERS CROSSING
Trend activities: 29,000
Additional activities: 10,000
WYNDHAM VALE
WILLIAMS LANDING
PACIFIC WERRIBEE
HOPPERS CROSSING
DERRIMUT
BLACK FOREST
WERRIBEE
WERRIBEE NEIC
SANCTUARY LAKES
SANCTUARY LAKES
Trend activities: 12,000
Additional activities: 6,000
WERRIBEE WEST
EAST WERRIBEE
Trend activities: 27,000
Additional activities: 3,500
AVIATORS FIELD
AVIATORS FIELD
Trend activities: 23,500
Additional activities: 7,000
Total additional intensification volume: +61,000 activities

Figures 13 and 14 show the mode supply capacity assessment (see previous section) for the Separate Lines and Joined Lines scenario once the additional land use intensification assumptions have been incorporated in the calculation. In both scenarios, the segments where Trackless Tram patronage can be expected to exceed the capacity of a bus system are those leading to and from the key rail interchanges: Tarneit to Sayers-Derrimut Roads (Route 1), Hoppers Crossing to Werribee East NEIC (Route 2) and Sanctuary Lakes to Williams Landing (Route 4). However, as seen above, the Separate Lines scenario requires a higher level of urban intensification to achieve this than the Joined Lines scenario.



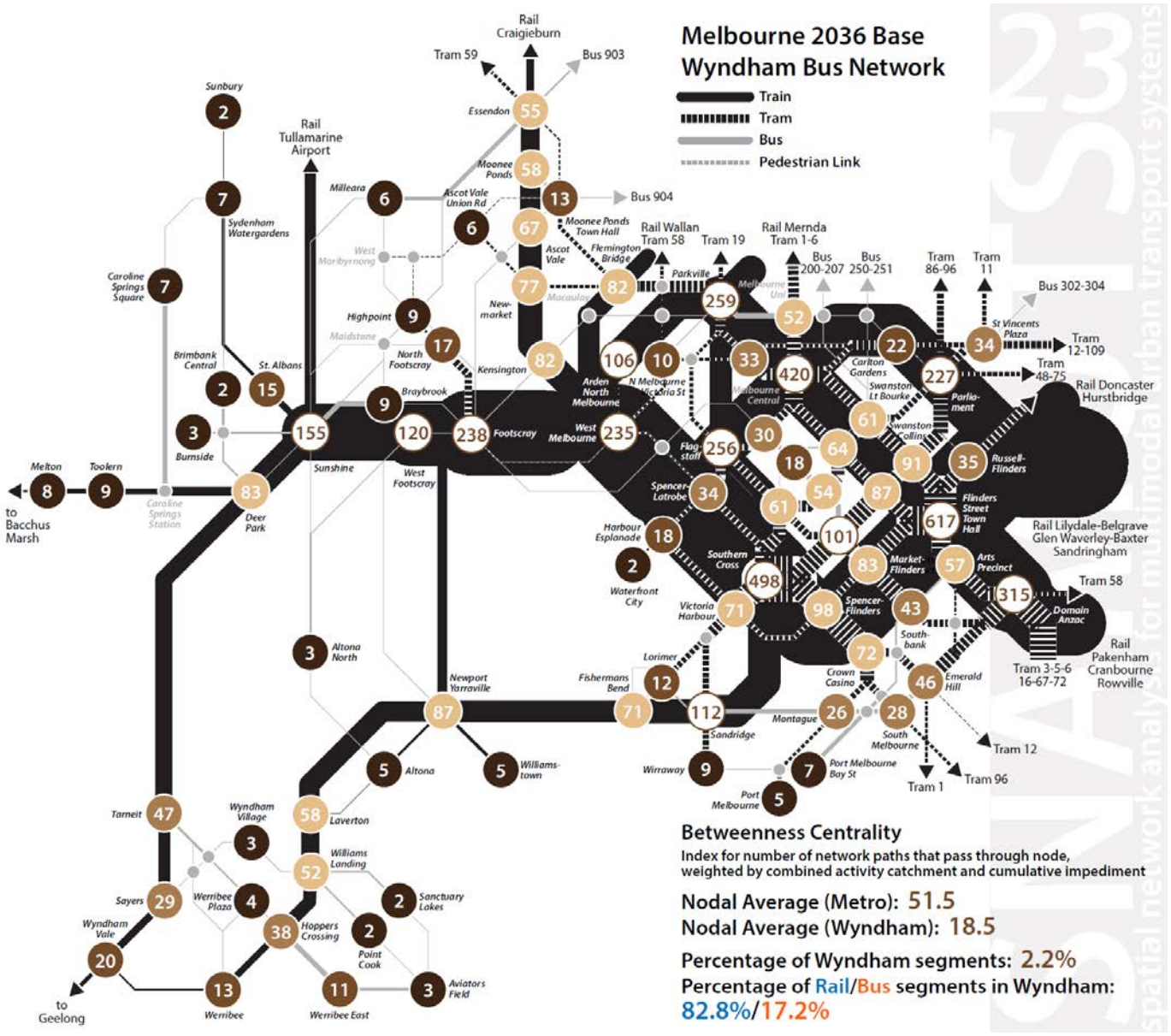
Figures 13, 14: *Nodal connectivity and mode supply categories in the Wyndham corridor in 2036 with additional urban intensification in the Separate Lines and Joined Lines scenarios*

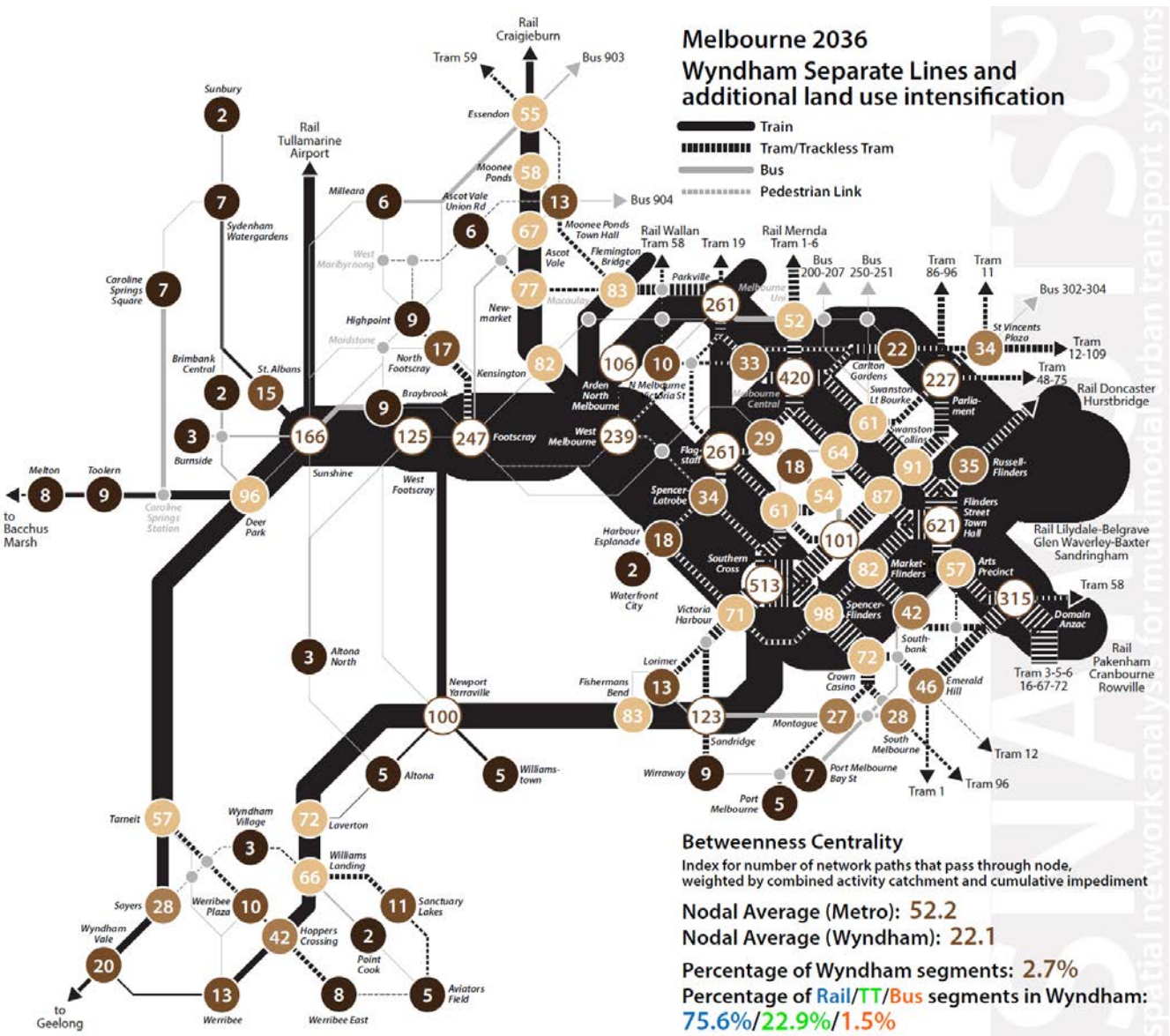

Melbourne 2036
Wyndham Joined Lines and additional land use intensification
Train
Tram/Trackless Tram
Bus
Pedestrian Link
Nodal Connectivity and Mode Supply Categories
Ability of activity nodes to act as hubs for the network
Status of system capacity for each mode in relation to land use and network function
Rail capacity essential
Rail capacity optional
Rail coverage service
Tram capacity overwhelmed
Tram capacity essential
Tram capacity optional
Tram coverage service
Bus capacity overwhelmed
Bus capacity essential
Bus coverage service
Rail Craigieburn
Tram 59
Bus 903
Bus 904
Rail Tullamarine Airport
Rail Wallan Tram 58
Tram 19
Rail Mernda Tram 1-6
Bus 200-207
Bus 250-251
Tram 86-96
Tram 11
Bus 302-304
Tram 12-109
Tram 48-75
Rail Doncaster Hurstbridge
Rail Lilydale-Belgrave Glen Waverley-Baxter Sandringham
Tram 58
Rail Pakenham Cranbourne Rowville
Tram 3-5-6 16-67-72
Tram 12
Tram 96
Tram 1
to Bacchus Marsh
to Geelong
Sunbury
Sydenham Watergardens
Caroline Springs Square
Brimbank Central
St. Albans
Burnside
Melton
Toolern
Caroline Springs Station
Deer Park
Milleara
Highpoint
Maidstone
North Footscray
Braybrook
Sunshine
West Footscray
Footscray
Kensington
Essendon
Moonee Ponds
Ascot Vale Union Rd
Ascot Vale
Moonee Ponds Town Hall
Flemington Bridge
New-market
Macaulay
Arden
Parkville
N Melb Victoria St
Melbourne Uni
Melbourne Central
Carlton Gardens
St Vincents Plaza
Parlia-ment
Swanston-Lt Bourke
Swanston-Collins
Russell-Flinders
Queen-Latrobe
Flag-staff
West Melbourne
Spencer-Latrobe
Waterfront City
Harbour Esplanade
Southern Cross
Market-Collins
Market-Flinders
Arts Precinct
Flinders Street Town Hall
Domain Anzac
Victoria Harbour
Crown Casino
South-bank
Lorimer
Fishermans Bend
Montague
Emerald Hill
Sandridge
Wirraway
South Melbourne
Port Melbourne Bay St
Port Melbourne
Garden City
Westgate Park
Williamstown Esplanade
Williams-town
Newport Yarraville
Altona North
Altona
Laverton
Wyndham Village
Tarneit
Williams Landing
Sanctuary Lakes
Sayers
Wyndham Vale
Werribee Plaza
Hoppers Crossing
Point Cook
Aviators Field
Werribee
Werribee East
Keilor Park
West Maribyrnong
Yarraville Somerville Rd
Caroline Springs Station

Betweenness Centrality

Figures 15, 16, 17: *Betweenness centrality in the Wyndham corridor in 2036 in the Base Case (no additional land use intensification), Separate Lines and Joined Lines scenarios (both with additional land use intensification)*

Betweenness centrality measures the relative importance of an activity node or route segment for facilitating public transport movement across the city. It is derived from the concentration of activities at either end of each journey, and the ease of movement (closeness centrality) along that journey. Higher values indicate that a reference node is located at the 'crossroads' of movement. A network is generally more balanced in operational terms, and accessibility more equitably distributed, where these values follow a smooth decay curve from more central to more peripheral locations and avoid excessive spikes in particular activity nodes or route segments, as these may be associated with congestion. In mature-sized networks, it is also beneficial that





higher-capacity modes (rail) account for a larger share of the citywide betweenness scores than lower-capacity modes (buses).

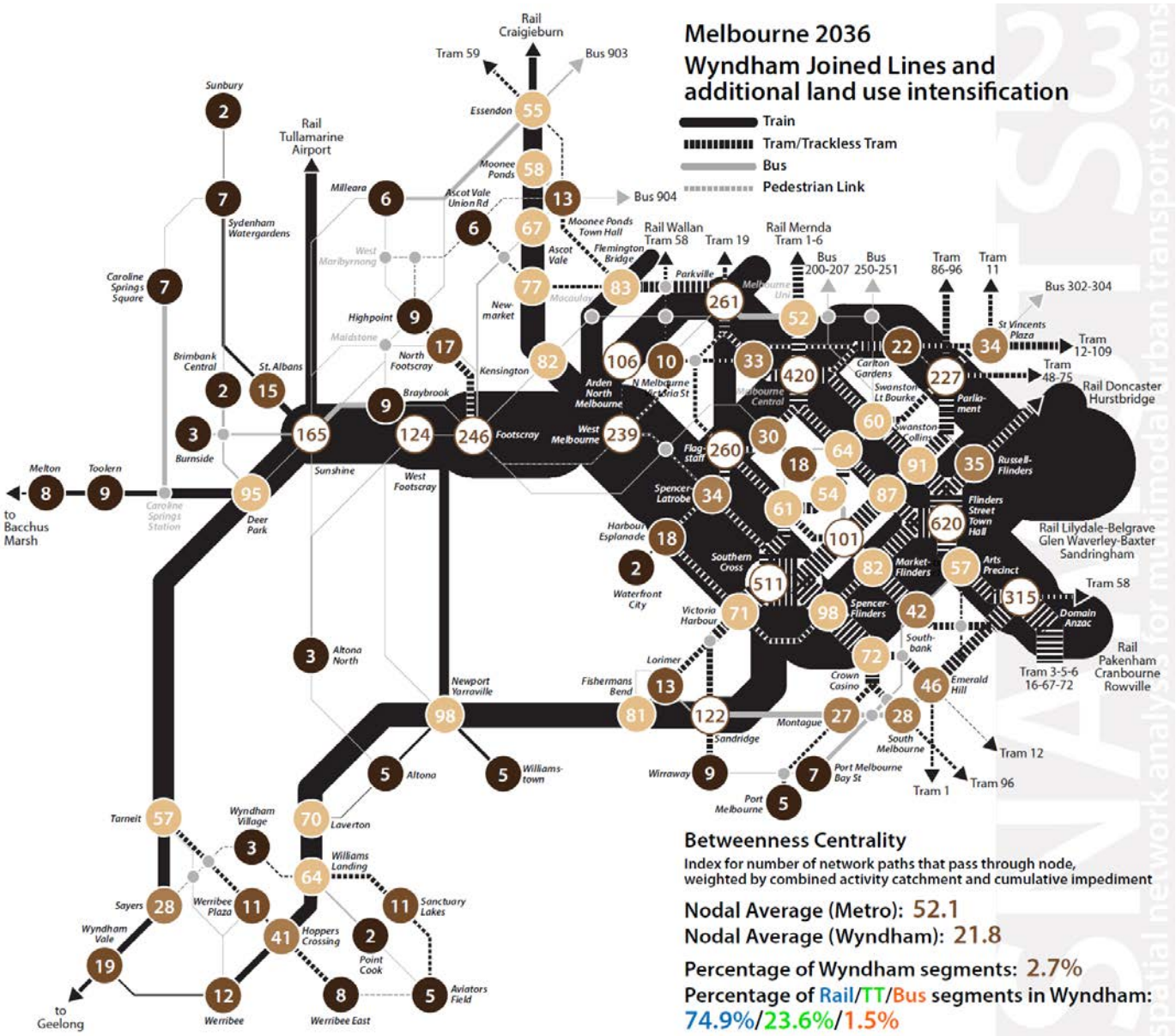
Figures 15, 16 and 17 show the distribution of travel opportunities over network elements in Wyndham and the corridors between Wyndham and central Melbourne in the 2036 base case (with Trackless Tram routes operated by conventional, non-prioritised buses and no land use intensification beyond the 2036 trend), the Separate Lines and Joint Lines scenarios, both with additional land use intensification as quantified above.

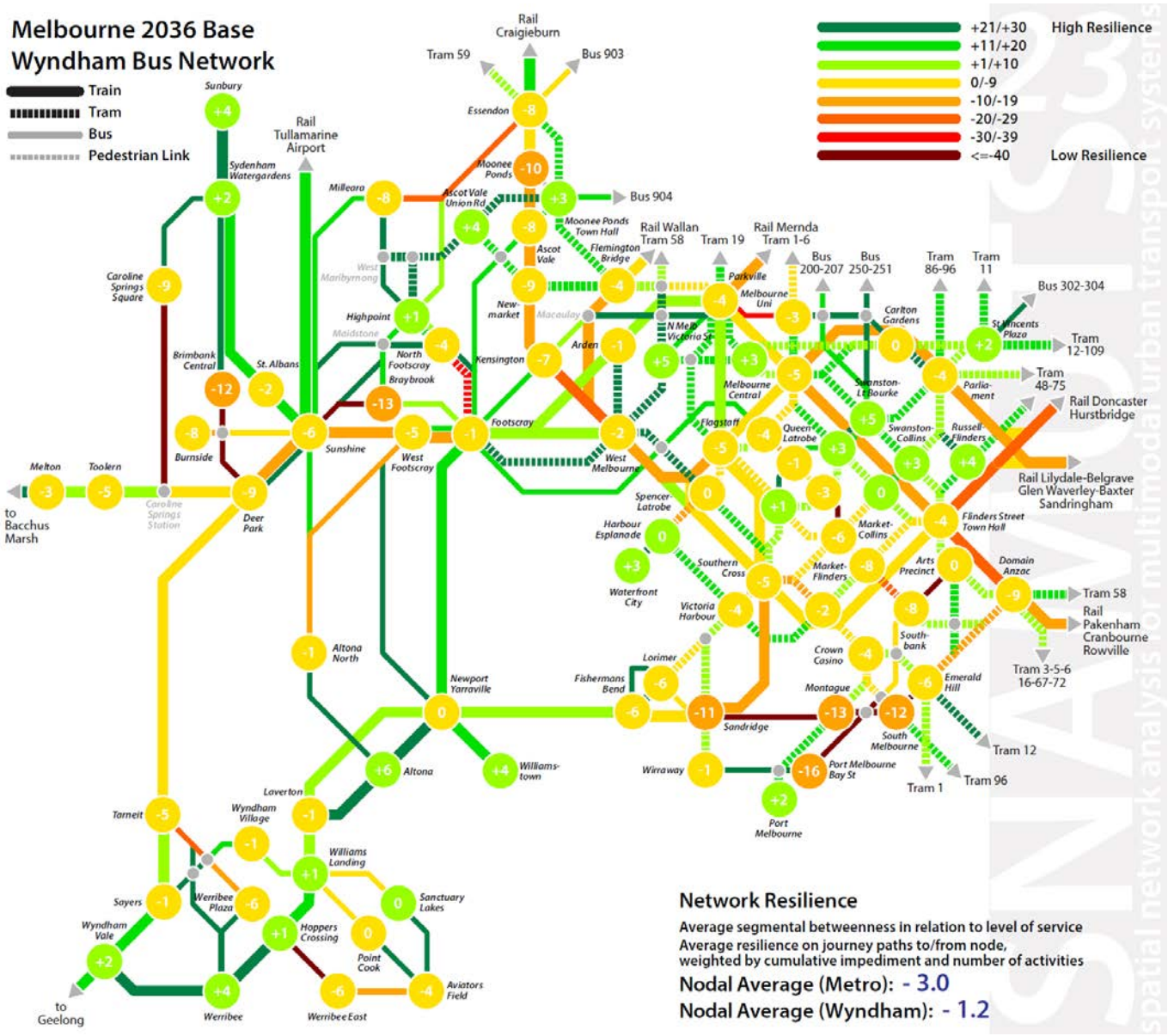
In all three scenarios, it is striking how the radial rail system absorbs the majority of travel opportunities within Wyndham and, in the absence of Trackless Tram or minimum-standard bus routes to and from other municipalities, the entirety of travel opportunities that link Wyndham to other parts of the metropolitan area. The combination of introducing the Trackless Tram routes and concentrating additional urban activities around them, however, reduces the dominance of the rail

system somewhat (from 83% to around 75%). This effect is slightly more pronounced in the Joined Lines than the Separate Lines scenario even though the latter includes a greater degree of urban intensification (as detailed above).

The importance of the rail system for facilitating movement also makes itself felt in the increase of travel opportunities experienced along the radial rail lines in both Trackless Tram scenarios compared to the base case. This increase is derived from greater urban intensification in the rail station catchments of Tarneit, Hoppers Crossing and Williams Landing themselves as well as the greater weight of feeder travel from urban intensification along the Trackless Tram routes away from the rail stations.

These additional travel opportunities add pressure to the radial rail lines and may accelerate the need to upgrade their capacity through further frequency improvements and/or longer trains. The Werribee line (via Newport) appears to be more impacted by this effect than the





Geelong line (via Tarneit), and more so in the Separate Lines than the Joined Lines scenario. This can be traced both to the higher level of urban intensification and to a network configuration that makes it less convenient for many travel paths to transfer to rail at Tarneit in the Separate Lines scenario.

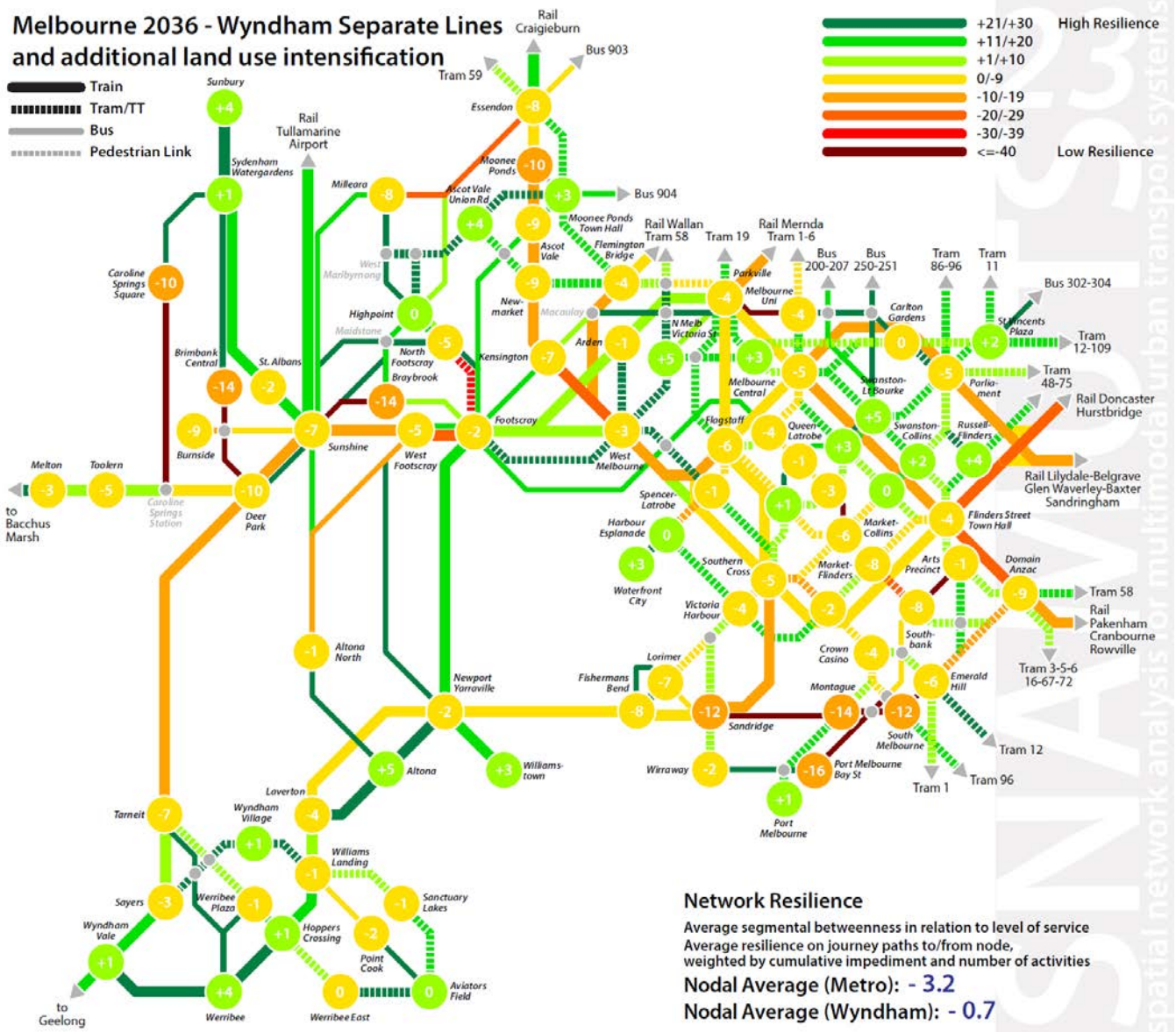
Network resilience

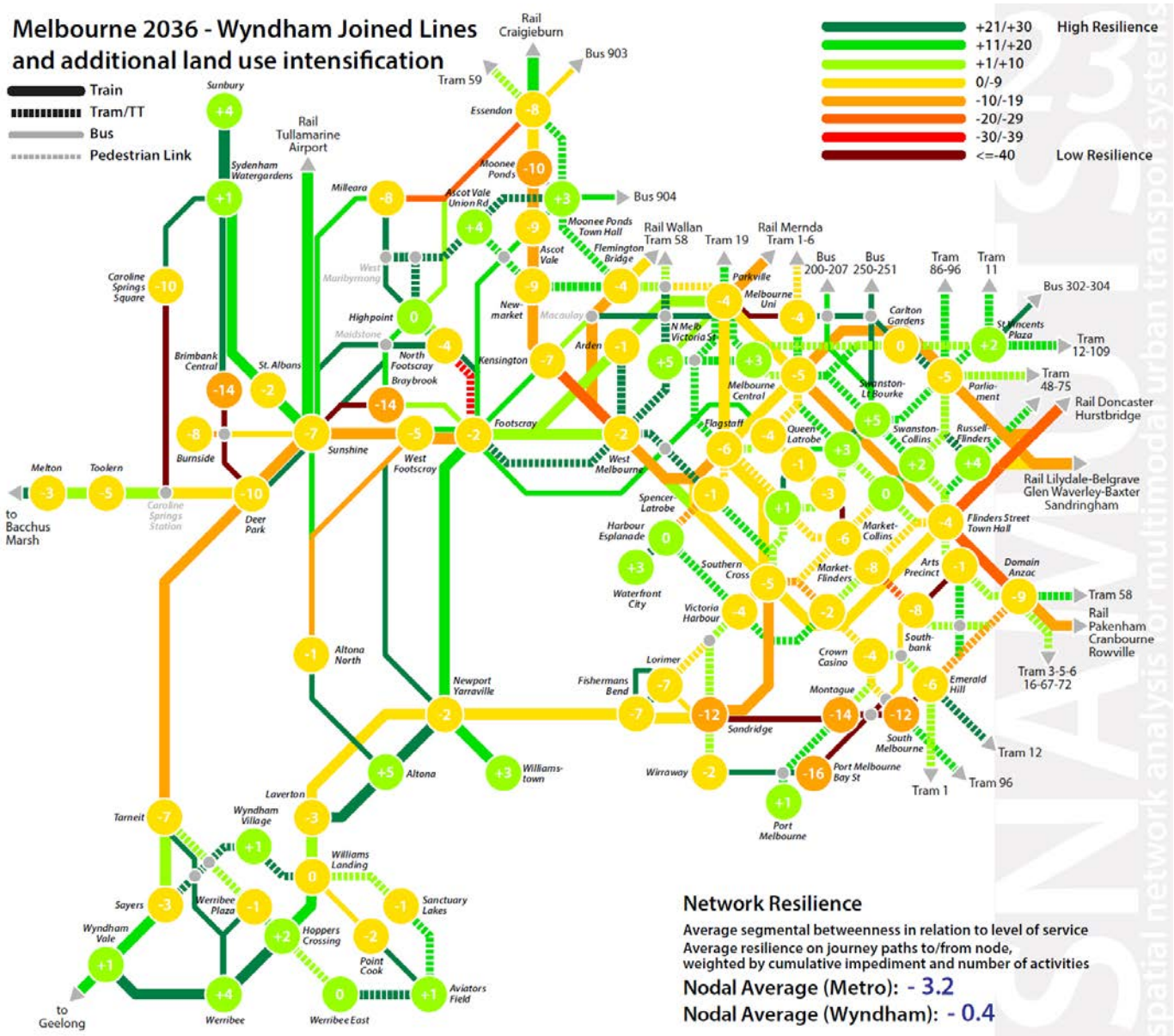
Figures 18, 19, 20: *Network resilience in the Wyndham corridor in 2036 in the Base Case (no additional land use intensification), Separate Lines and Joined Lines scenarios (both with additional land use intensification)*

Resilience acts as a proxy indicator for potential public transport congestion or for unmet, latent demand on public transport. It is calculated by drawing a ratio between the betweenness score and the public transport capacity provided on the journey path in question, on an open-ended downward scale from +30 (with green values from +30 to 0 indicating a good match between betweenness and capacity, yellow and orange

values from 0 to -30 a cause for concern and red and maroon values below -30 a crisis point in resilience). The index helps identify local and global constraints for public transport to accommodate further growth in patronage from either urban intensification/expansion or increasing mode share (or both), and assess how measures to boost the capacity and performance of the system can address these.

Figures 18, 19 and 20 show the resilience scores at activity nodes and along route segments in Wyndham and along the corridors between Wyndham and central Melbourne for the 2036 base case (no additional land use intensification) and the Separate Lines and Joined Lines scenarios (both with additional land use intensification as detailed above). The base case scenario figures suggest that public transport particularly along the Derrimut Road and Werribee East corridor (Trackless Tram routes 1 and 2 in the other two scenarios) would fail to meet its potential if Wyndham's surface network were to rely on conventional bus operation only; this is the case even in the absence of further urban consolidation along the routes. The two





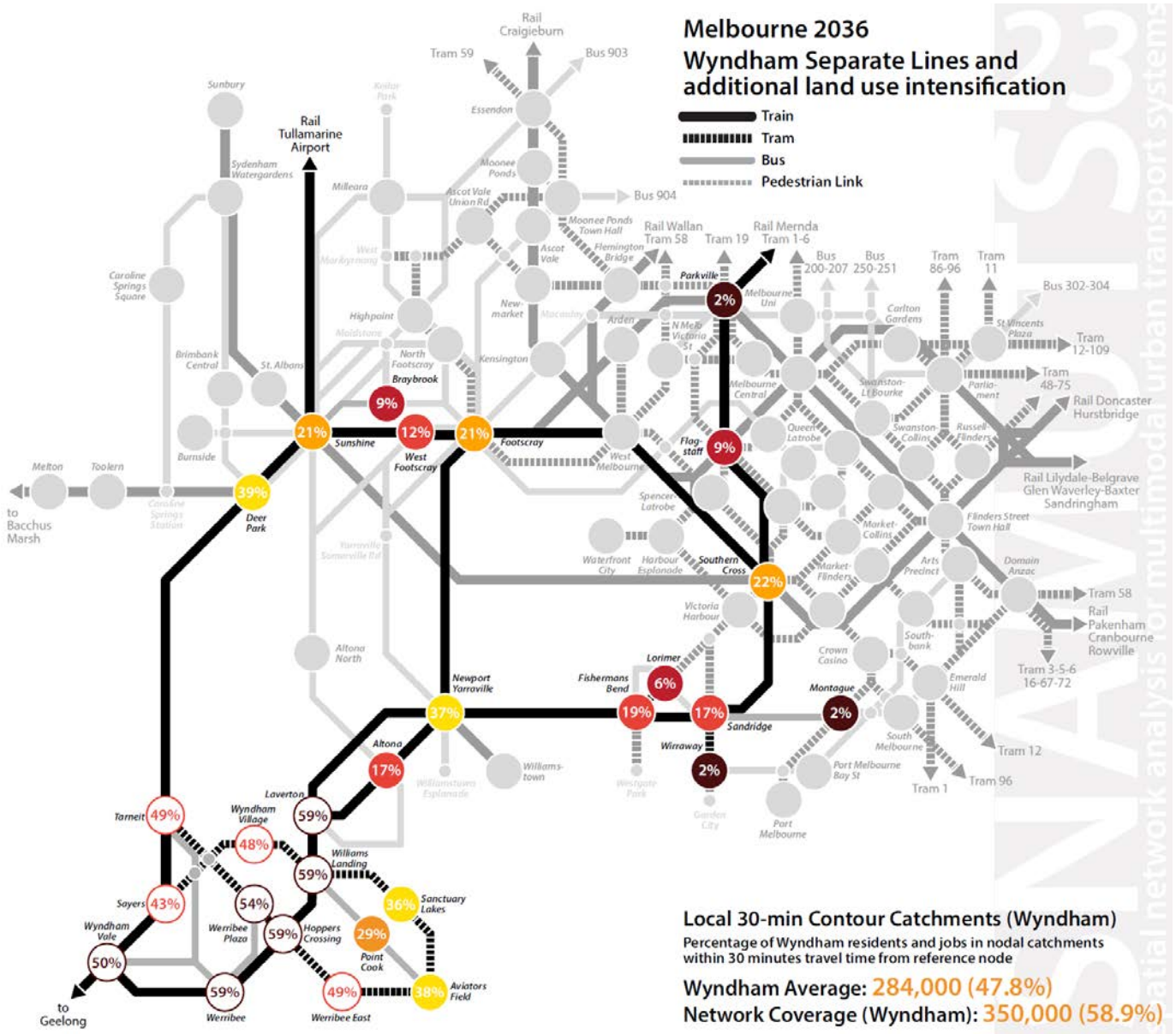
Trackless Tram scenarios resolve this shortfall; however, they tangibly weaken resilience along the radial rail lines linking Wyndham to the rest of metropolitan Melbourne unless these are also subject to capacity improvements (higher frequencies and/or longer trains). This effect is slightly more pronounced in the Separate Lines than the Joined Lines scenario.

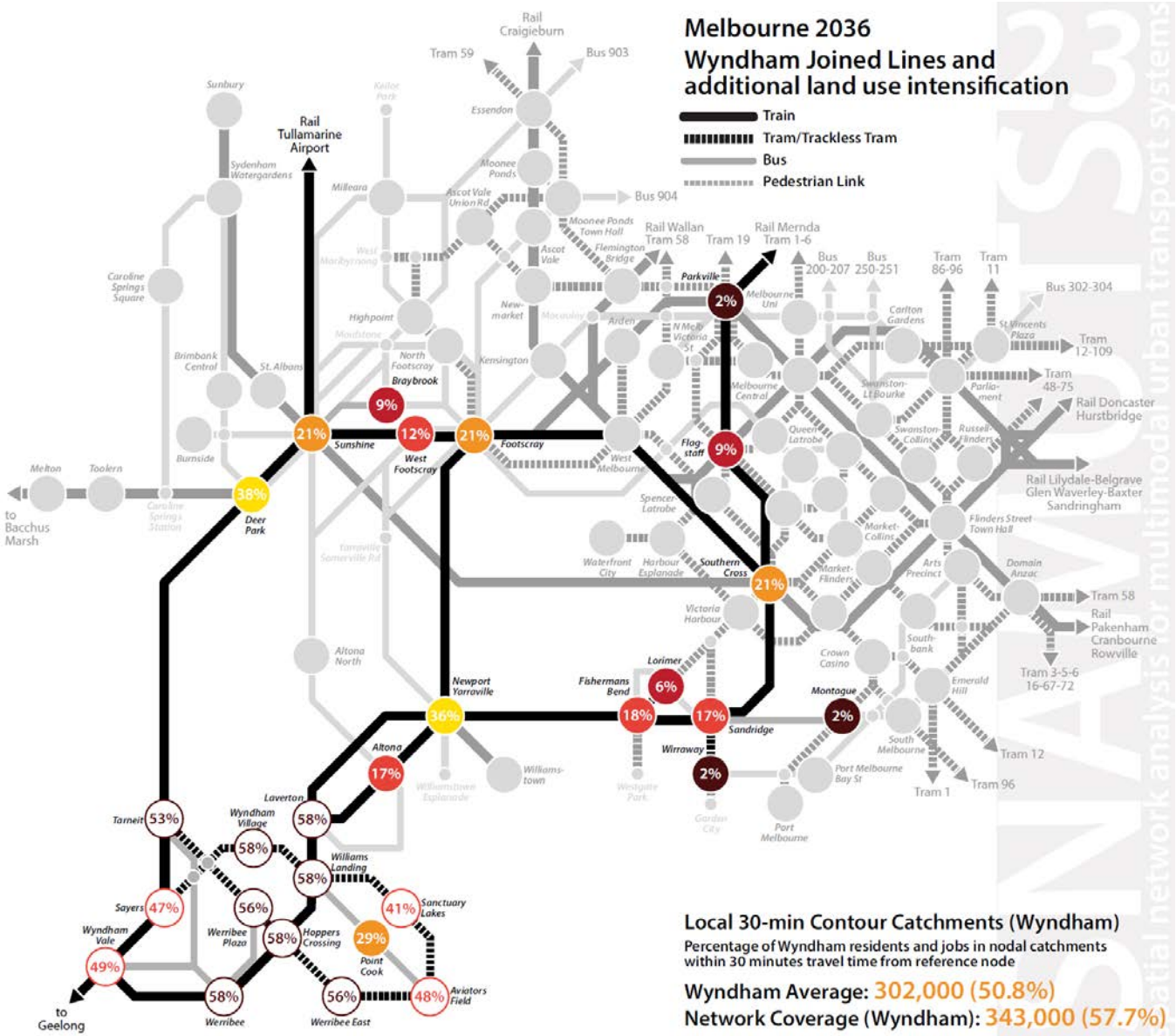
30-minute contour catchments

Figures 21, 22: *Local 30-minute contour catchment maps for Wyndham in the Separate Lines and Joined Lines scenarios including additional land use intensification along the Trackless Trams corridors*

Figures 21 and 22 show the percentage of Wyndham residents and jobs that can be reached from each activity node within a 30-minute public transport travel time window in the Separate Lines and Joined Lines scenarios after additional land use intensification (as detailed above) has been factored in.

Note that the Separate Lines scenario achieves a slightly greater level of network coverage (percentage of Wyndham residents and jobs within walking distance of the public transport network assessed here); this value also represents the maximum 30-minute contour catchment and is due to the slightly greater extent of urban intensification required to make the Separate Lines scenario work (as discussed above).





Owing to the transfer-free Trackless Tram connections between destinations either side of the rail line in Hoppers Crossing and Williams Landing provided in the Joined Line scenario, however, the average 30-minute contour catchment for a Wyndham node is some three percentage points larger than if the Trackless Tram lines were operated separately. This effect is particularly pronounced at Wyndham Village and Aviators Field (+10% each), followed by Werribee East (+7%), Sanctuary Lakes (+5%), and Tarneit and Sayers/Riverdale (+4% each).

The Joined Lines scenario can thus be considered to generate greater network coherence than the Separate Lines scenario. However, this finding still remains somewhat theoretical unless we also investigate how important the associated additional travel opportunities are in the land use-transport system, taking in insights from the betweenness analysis (see above). This is what the last step of this analysis intends to do.

Travel opportunity flow at Trackless Tram-rail interchanges

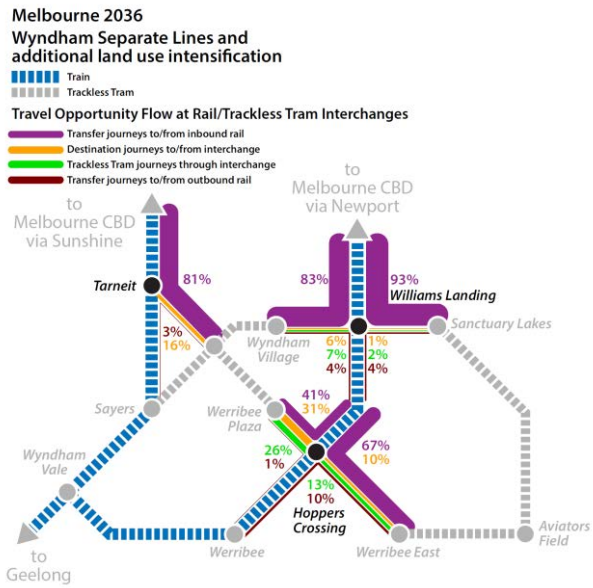
This index delves deeply into the data generated to build the betweenness centrality index, which traces the preferred flow of travel opportunities for every node-to-node relation on the network. The index weights each node-to-node relation by the catchment sizes of the activity nodes at either end (number of residents and jobs) and their proximity to each other in terms of travel impediment (travel time and service frequency). The resulting weighted path figures are then allocated to the network elements they are most likely to pass through, based on comparative travel times factoring in the time it takes to make transfers where necessary.

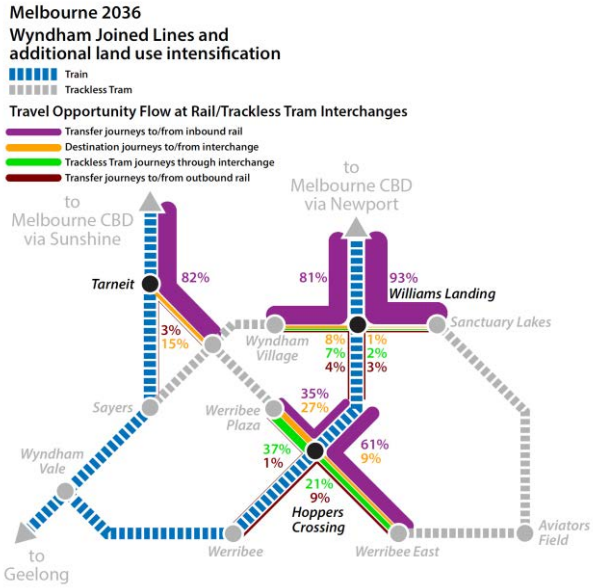
In this way, we can highlight in detail how each interchange point can be expected to function: what percentage of travel opportunities represent through journeys, what percentage of journeys make a transfer there, and in which directions? Interchanges where the transfer function dominates travel opportunity flows through the node require greater attention to the close co-location of travel modes and the quality of the transfer environment than those where the transfer function is relatively marginal.

This assessment helps us to resolve one of the most critical questions in the comparison between the Separate Lines and Joined Lines scenario: How important is it for the functioning of the Wyndham network as a whole to feature transfer-free Trackless Tram connections across the rail interchanges at Hoppers Crossing and/or Williams Landing?

Figures 23 and 24 show the percentage of Trackless Tram travel opportunities on the segments adjacent to each of the rail interchanges of Tarneit, Williams Landing and Hoppers Crossing that represent transfer journeys to rail (purple for inbound and maroon for outbound), destination journeys to and from the interchange (orange) and through journeys between nodes at either side of the interchange (green).

For both scenarios, the diagrams show that the interchanges at Tarneit and Williams Landing are strongly dominated by travel opportunities that follow the template of inbound commuting, ie. the Trackless Tram acts predominantly as a feeder for rail journeys to and from other parts of metropolitan Melbourne. The functions of destination travel to/from the interchanges, transfers to outbound rail (for journeys within Wyndham or to/from Geelong) and, at Williams Landing, through





journeys across the rail corridor are relatively small (with the exception of destination journeys in and out of Tarneit) and do not vary much between the two scenarios.

At Hoppers Crossing, the situation is different. Here, there is a greater diversity of travel directions for transfer journeys between rail and Trackless Tram. The role of Trackless Tram through journeys between nodes on either side of the rail corridor is already significant in the Separate Lines scenario where such journeys require a transfer. In the Joined Lines scenario, where the inconvenience and delay of this transfer have been eliminated, they further increase markedly.

This assessment therefore suggests that to maximise the network benefits and the potential patronage of the Trackless Tram system, the creation of dedicated Trackless Tram infrastructure allowing for transfer-free through services is imperative at Hoppers Crossing, but less important (though still desirable) at Williams Landing.

Figures 23, 24: *Travel opportunity flow analysis at Tarneit, Hoppers Crossing and Williams Landing in the Separate Lines and Joined Lines scenarios with additional urban intensification*

Table 2: *Overview of key findings and average SNAMUTS indicator results for the 2036 Base network (no additional land use intensification), the Separate Lines and Joined scenarios (with additional land use intensification)*

2036 SNAMUTS *23R*	Base (no additional land use intensification)	Separate Lines with additional land use intensification	Joined Lines with additional land use intensification
Additional Residents and Jobs along Trackless Trams corridors	-	68,000	61,000
Average Closeness Centrality Wyndham	75.5	72.2	72.1
Average Degree Centrality (Transfer Intensity) Wyndham	1.48	1.47	1.44
Average 30-min Contour Catchment Wyndham	36.2%	47.8%	50.8%
Average Nodal Betweenness Wyndham	18.5	22.1	21.8
Average Nodal Resilience Wyndham	-1.2	-0.7	-0.4
Average Nodal Connectivity Wyndham	74	83	83
Average SNAMUTS Composite Score Wyndham	13.7	15.2	15.3

Summary and recommendations

Comparative assessment of Trackless Tram starter lines (2026)

This report analysed the accessibility performance of four potential Trackless Tram starter lines in Wyndham:

- Route 1: Tarneit to Hoppers Crossing via Derrimut Road and Pacific Werribee;
- Route 2: Hoppers Crossing to Aviators Field via Werribee East NEIC;
- Route 3: Williams Landing to Sayers/Riverdale via Sayers Road;
- Route 4: Williams Landing to Aviators Field via Sanctuary Lakes.

Of these four alternatives:

- Route 1 offers the greatest 'network effect' benefit by linking centres on Wyndham's two rail lines along a fast and direct route;
- Route 2 offers the greatest potential for transit-oriented property development as it predominantly runs through greenfield and designated redevelopment areas;
- Route 4 promises the fastest build-up of ridership, as it represents a classic radial rail feeder service by the shortest possible route;
- Route 3 performs weakest on most accessibility measures, but this could be improved if its north-western terminus was at Tarneit rather than Sayers/Riverdale station.

Network analysis for 2036 with additional land use intensification around Trackless Tram corridors

A coherent network comprising of all four Trackless Tram routes was assessed for the target year 2036 in two variations: A Separate Lines scenario has routes 1, 3 and 2/4 (combined) operated as individual lines with no through services (transfers required at Hoppers Crossing and Williams Landing), while a Joined Lines scenarios has all routes operating as one continuous, ribbon-shaped line from Tarneit to Sayers/Riverdale, with transfer-free through services across the rail interchanges at Hoppers Crossing and Williams Landing.

Both scenarios were also assessed for the level of additional land use intensification (over and beyond 2036 trend growth projections) that would exceed the capacity of an alternative bus-based system and thus make a medium-capacity mode like the Trackless Tram imperative.

The analysis led to the following key insights:

- The Joined Lines scenario performs slightly better than the Separate Lines scenario on most accessibility indicators, particularly the range of destinations that can be reached within a 30-minute window;
- The Joined Lines scenario overwhelms a bus system (and thus builds a compelling case for a medium-capacity mode) at a lower level of additional land use intensification along the Trackless Tram routes than the Separate Lines scenario;
- The Separate Lines scenario puts greater additional patronage pressure on the radial rail services than the Joined Lines scenario, thus likely necessitating rail frequency and/or capacity upgrades sooner;
- These benefits of the Joined Lines over the Separate Lines scenario hinge predominantly on the creation of a transfer-free Trackless Tram connection across Hoppers Crossing (linking routes 1 and 2) and less so on creating one at Williams Landing (linking routes 3 and 4).

Appendix 1
Workshop presentation

Trackless Trams in Wyndham

Spatial Network Analysis for Multimodal Urban Transport Systems (SNAMUTS)

Dr Jan Scheurer, RMIT University

spatial network analysis for multimodal urban transport systems (snamuts)

SNAMUTS is a GIS-based analytic tool for public transport network performance, spatial accessibility and integrated land use-transport planning.

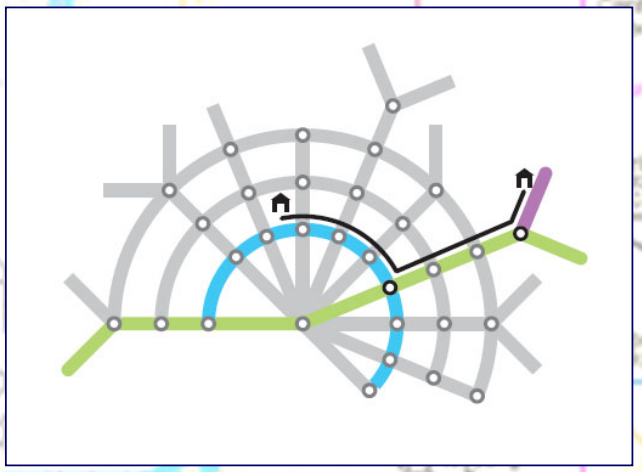
It is inspired by the Space Syntax and Multiple Centrality Assessment methodologies and takes a **supply-side, discursive, network-wide perspective** on trans-disciplinary decision-making tasks:

What is the role of the public transport system in facilitating movement and activity across a city region?

snamuts global

+ Singapore
+ Hong Kong
+ Göteborg
+ Helsinki
+ Stockholm
+ Oslo
+ Zuid Holland
+ Utrecht

‘the network effect’



The performance of a network can be improved through locally optimised routes, good interchange facilities, high and standardised service frequencies, timetable coordination and the presence of routes in different directions (radial, orbital, diagonal).

Map Sources: www.railpage.com.au, www.hitrans.org

how can snamuts help us make better policy decisions?

Network Effect: The utility of a public transport network is greater than the sum of its parts!

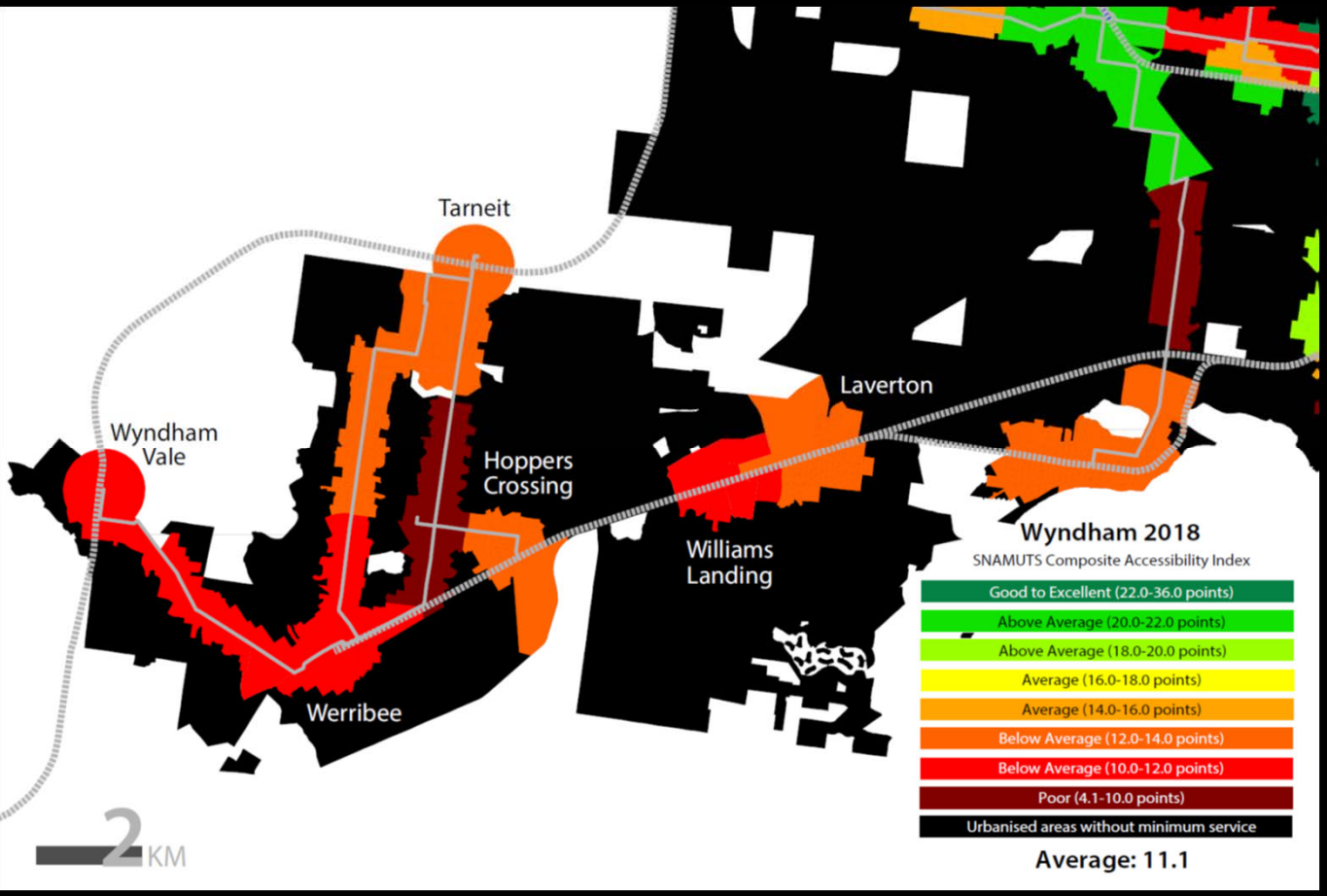
Interplay of Land Use and Transport: How does urban growth translate into added pressure on public transport, and where does it provide new opportunities for movement?

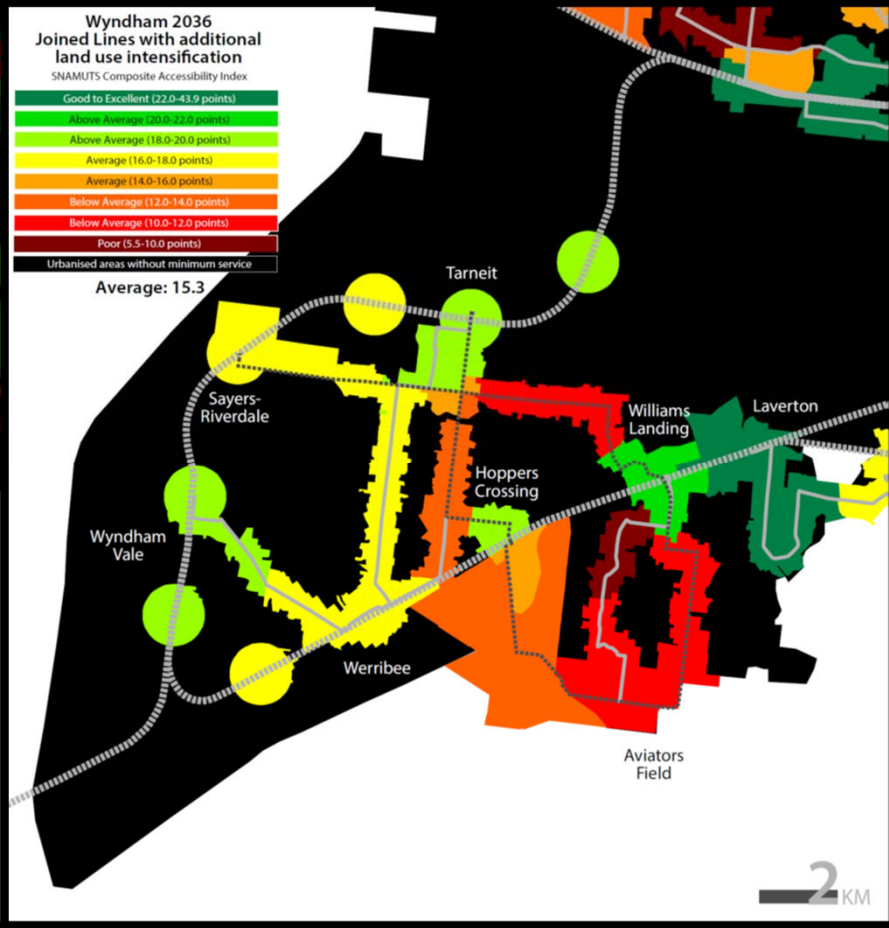
Latent Demand: Identifying public transport market potential in areas where it is currently marginal, and assessing infrastructure and service proposals for their ability to mobilise it

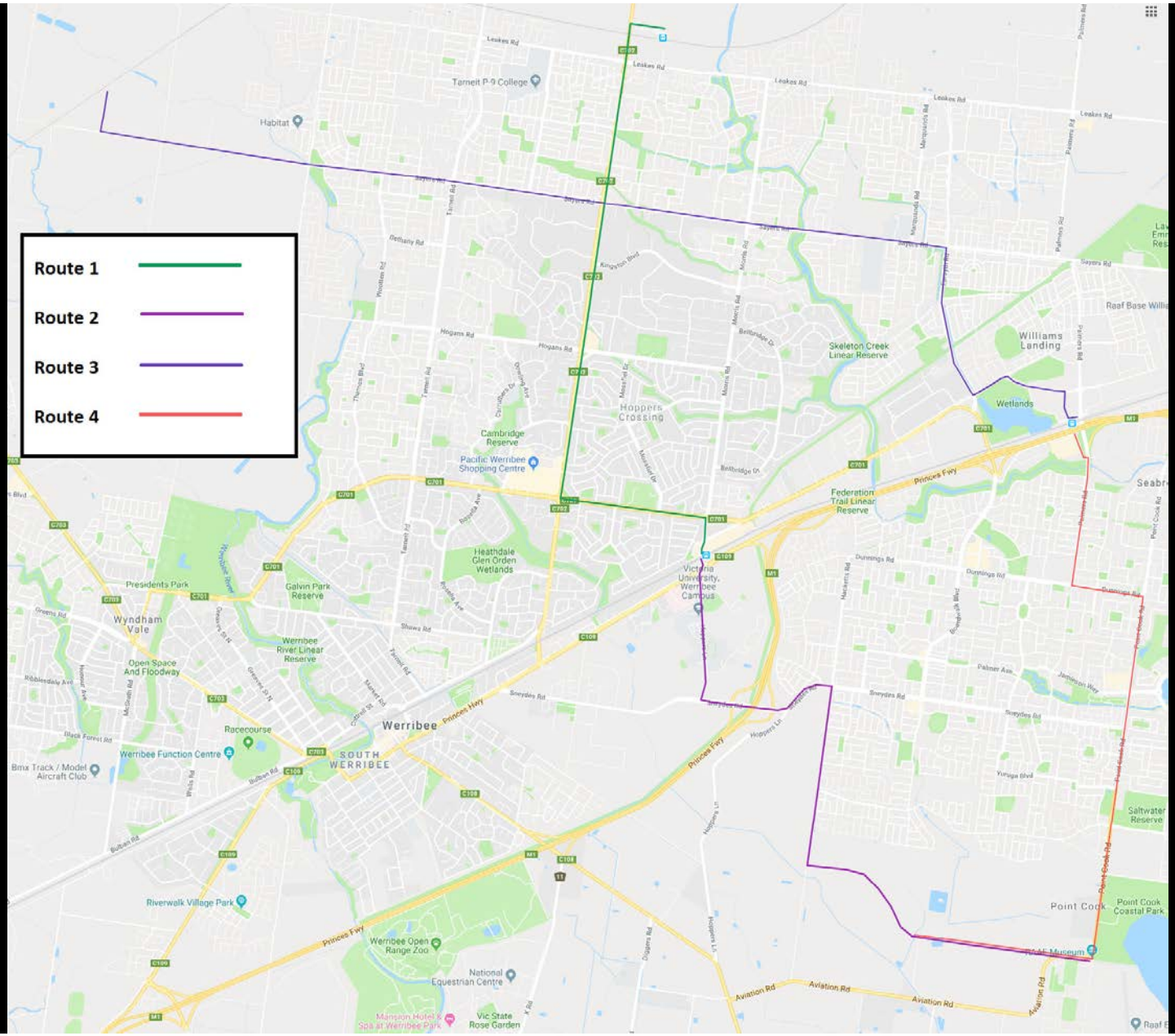
public transport from the user perspective

SNAMUTS accessibility analysis for Trackless Trams in Wyndham

1. What is the most suitable Trackless Tram starter line in Wyndham (2026)?
2. What is the benefit to Wyndham's land use-transport system once a local Trackless Tram network is in place (2036)?


Tarneit
Wyndham Vale
Hoppers Crossing
Laverton
Williams Landing
Werribee
Wyndham 2018
SNAMUTS Composite Accessibility Index
Good to Excellent (22.0-36.0 points)
Above Average (20.0-22.0 points)
Above Average (18.0-20.0 points)
Average (16.0-18.0 points)
Average (14.0-16.0 points)
Below Average (12.0-14.0 points)
Below Average (10.0-12.0 points)
Poor (4.1-10.0 points)
Urbanised areas without minimum service
Average: 11.1
2 KM


Wyndham 2036
Joined Lines with additional land use intensification
SNAMUTS Composite Accessibility Index
Good to Excellent (22.0-43.9 points)
Above Average (20.0-22.0 points)
Above Average (18.0-20.0 points)
Average (16.0-18.0 points)
Average (14.0-16.0 points)
Below Average (12.0-14.0 points)
Below Average (10.0-12.0 points)
Poor (5.5-10.0 points)
Urbanised areas without minimum service
Average: 15.3
Tarneit
Sayers-Riverdale
Williams Landing
Laverton
Hoppers Crossing
Wyndham Vale
Werribee
Aviators Field
2 KM


Route 1
Route 2
Route 3
Route 4
Tarneit P-9 College
Habitat
Leakes Rd
Sayers Rd
Hogans Rd
Skeleton Creek Linear Reserve
Williams Landing
Wetlands
Hoppers Crossing
Cambridge Reserve
Pacific Werribee Shopping Centre
Federation Trail Linear Reserve
Princes Fwy
Heathdale Glen Orden Wetlands
Victoria University, Werribee Campus
Presidents Park
Galvin Park Reserve
Wyndham Vale
Werribee River Linear Reserve
Open Space And Floodway
Werribee
SOUTH WERRIBEE
Racecourse
Werribee Function Centre
Bmx Track / Model Aircraft Club
Riverwalk Village Park
Werribee Open Range Zoo
National Equestrian Centre
Mansion Hotel & Spa at Werribee Park
Vic State Rose Garden
Point Cook
Point Cook Coastal Park
Saltwater Reserve
Aviation Rd


5 KM

SNAMUTS accessibility analysis, Task 1:

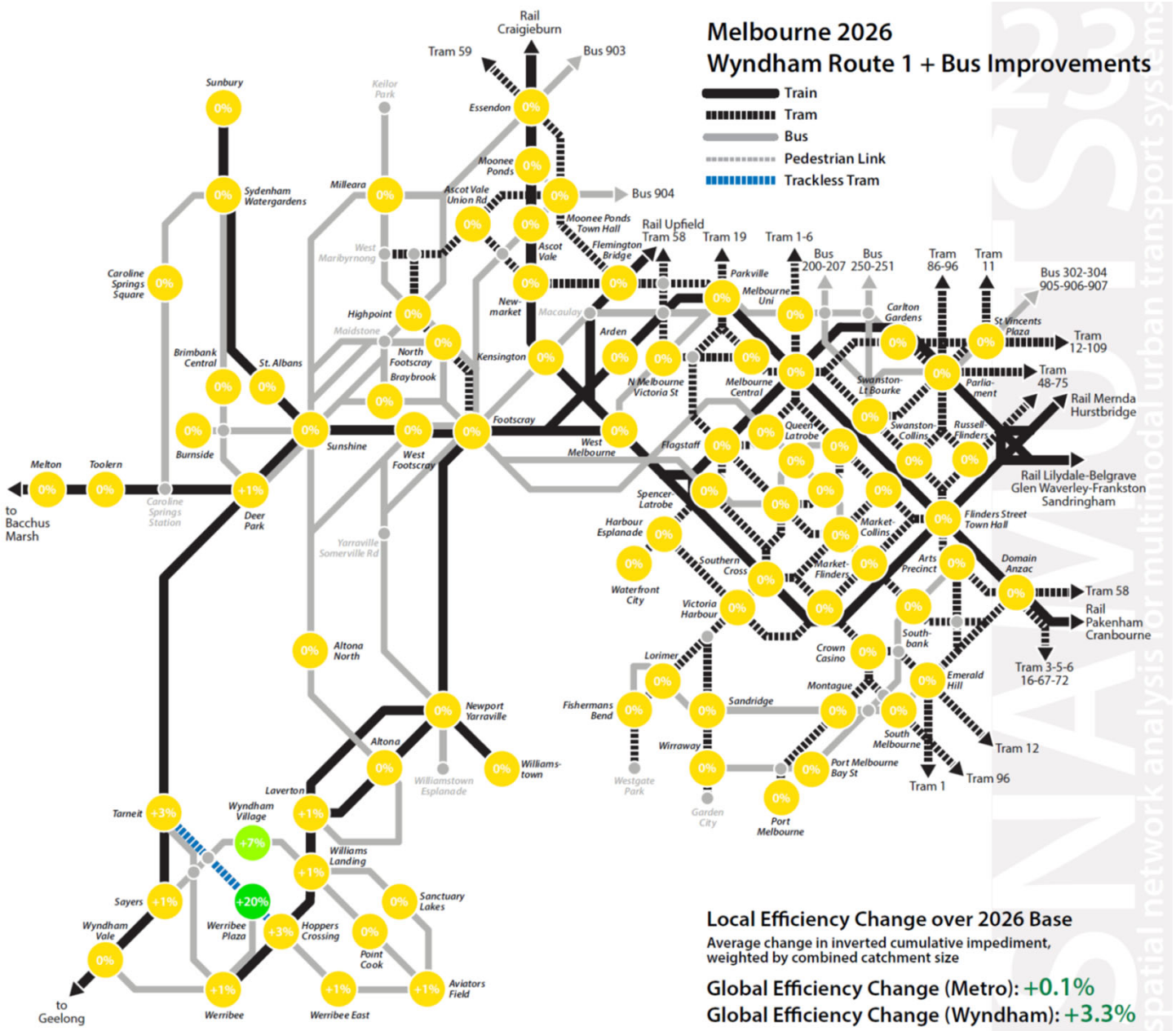
- What is the most suitable Trackless Tram starter route for Wyndham?
- Using trend land use and public transport network projections for 2026
- Assuming an average commercial speed of 25-30 km/h and a daytime service frequency of 10 minutes for each Trackless Tram route
- Comparison against a base case where all four routes operate as conventional, non-prioritised buses (every 20 min)

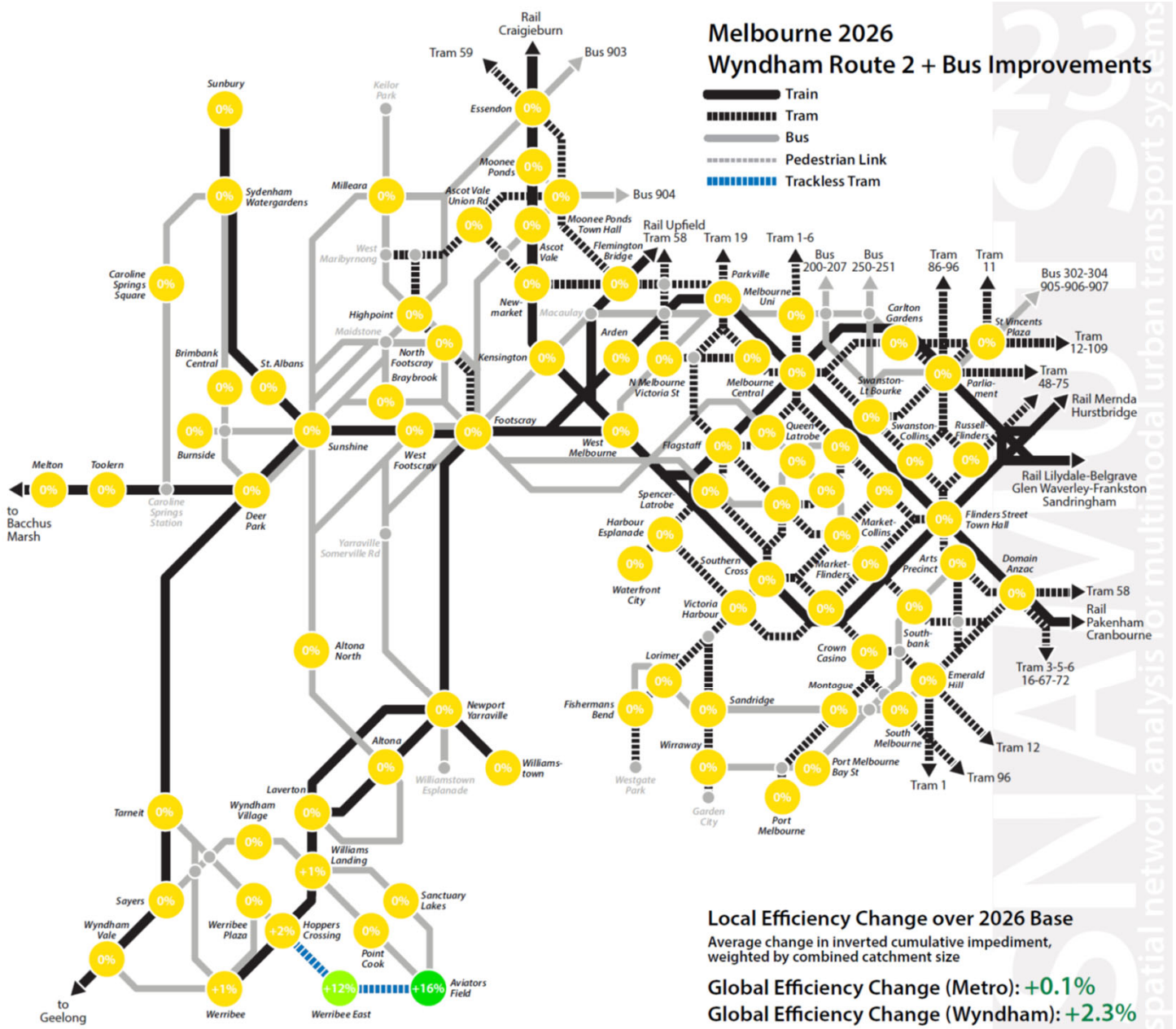
Source: Streetsblog NYC

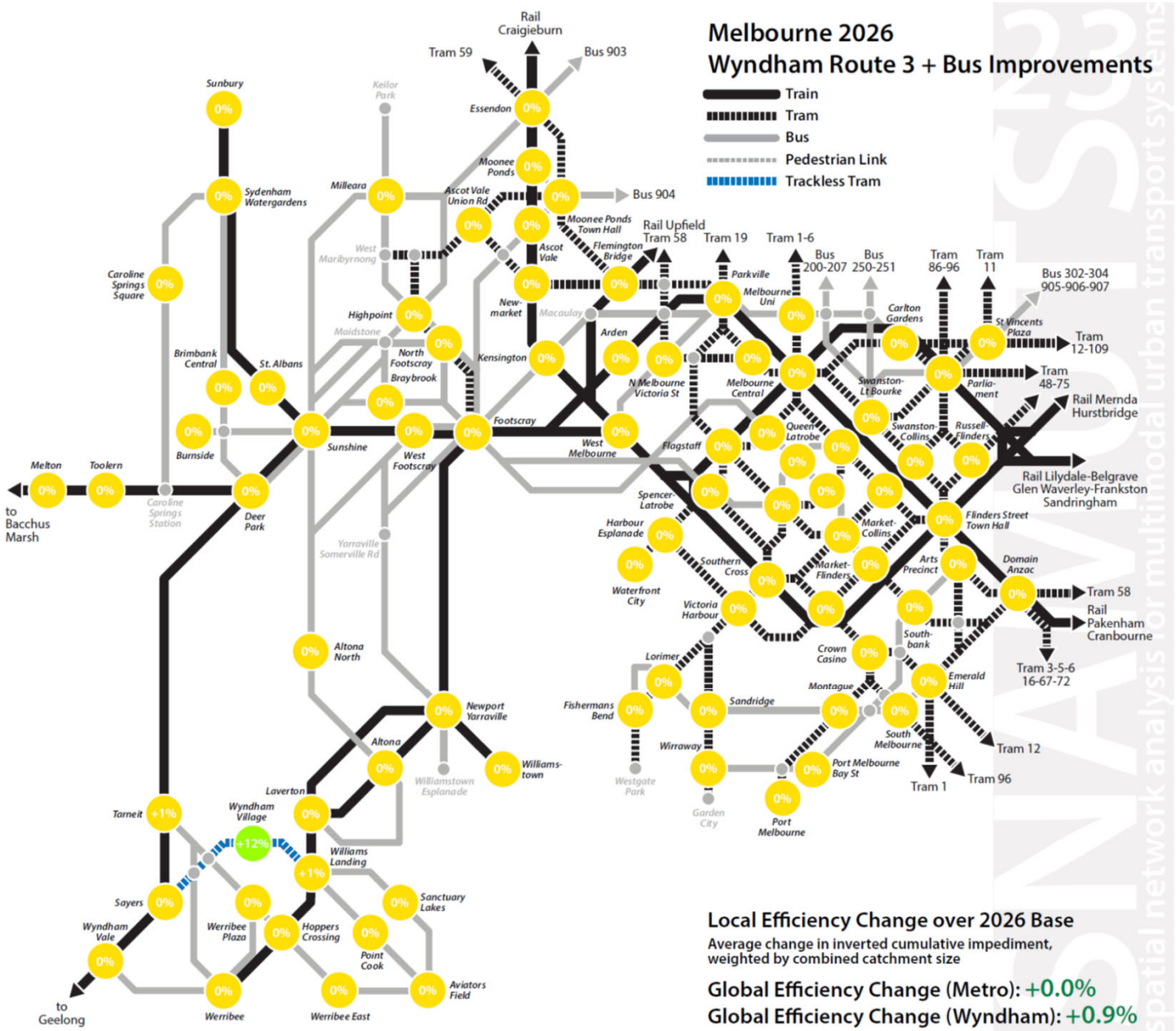
Source: Silicon Valley Business Journal

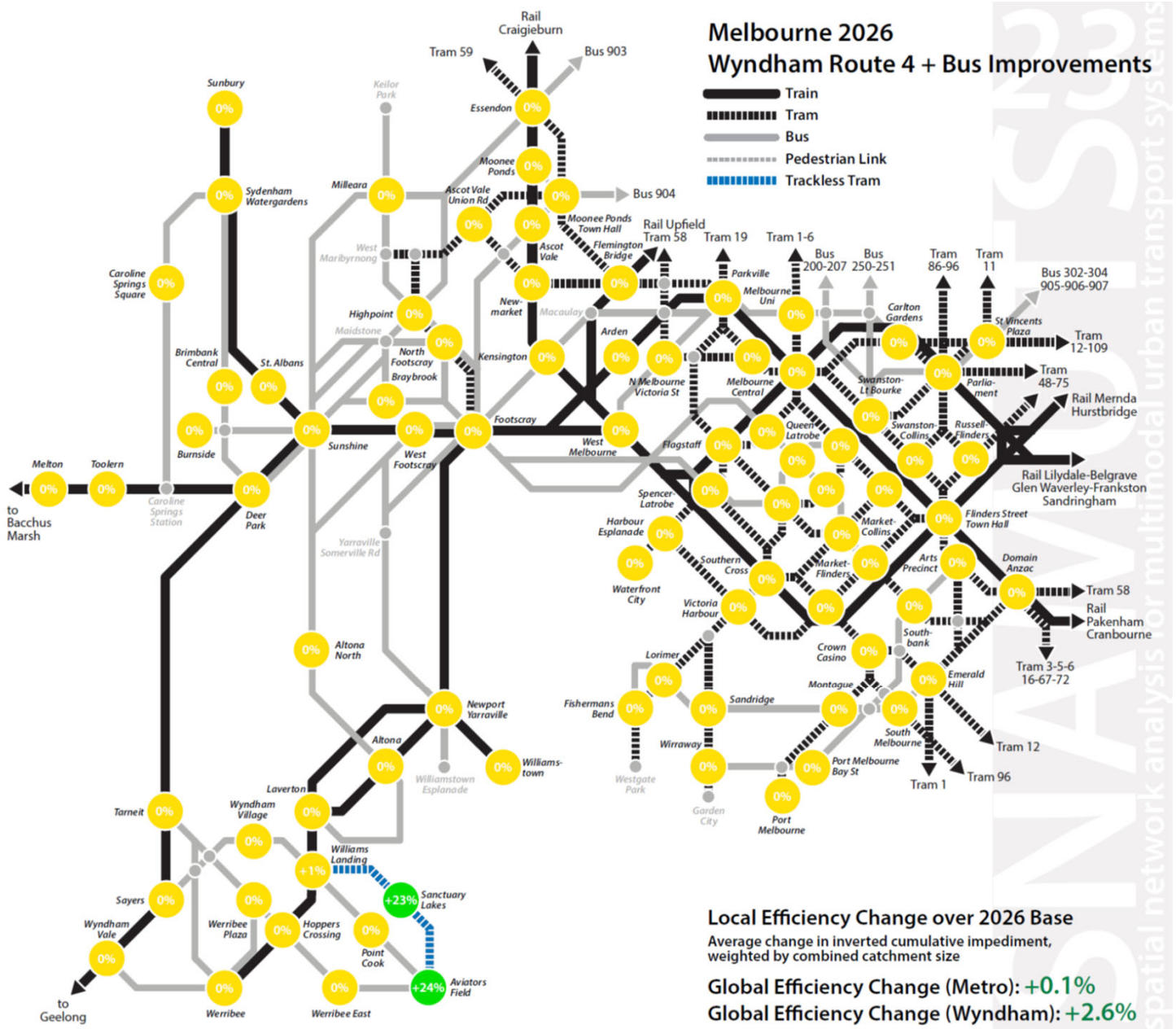
efficiency change:

by how much does the proposed line improve the public transport-land use system across wyndham and at each location?


Melbourne 2026
Wyndham Route 1 + Bus Improvements
Train
Tram
Bus
Pedestrian Link
Trackless Tram
Rail Craigieburn
Tram 59
Bus 903
Bus 904
Sunbury
Keilor Park
Essendon
Moonee Ponds
Sydenham Watergardens
Milleara
Ascot Vale Union Rd
Moonee Ponds Town Hall
Rail Upfield
Tram 58
Tram 19
Tram 1-6
Bus 200-207
Bus 250-251
Tram 86-96
Tram 11
Bus 302-304 905-906-907
Caroline Springs Square
West Maribyrnong
Ascot Vale
Flemington Bridge
Parkville
Melbourne Uni
Carlton Gardens
St Vincents Plaza
Tram 12-109
Highpoint
New-market
Macaulay
Maidstone
Arden
Tram 48-75
Brimbank Central
St. Albans
North Footscray
Kensington
N Melbourne Victoria St
Melbourne Central
Swanston-Lt Bourke
Parlia-ment
Braybrook
Rail Mernda Hurstbridge
Footscray
Queen-Latrobe
Swanston-Collins
Russell-Flinders
Burnside
Sunshine
West Footscray
West Melbourne
Flagstaff
Melton
Toolern
Rail Lilydale-Belgrave Glen Waverley-Frankston Sandringham
to Bacchus Marsh
Caroline Springs Station
Deer Park
Spencer-Latrobe
Flinders Street Town Hall
Harbour Esplanade
Market-Collins
Yarraville Somerville Rd
Southern Cross
Arts Precinct
Domain Anzac
Waterfront City
Market-Flinders
Tram 58
Victoria Harbour
Rail Pakenham Cranbourne
South-bank
Altona North
Lorimer
Crown Casino
Tram 3-5-6 16-67-72
Emerald Hill
Montague
Fishermans Bend
Sandridge
Newport Yarraville
South Melbourne
Altona
Williams-town
Williamstown Esplanade
Wirraway
Tram 12
Port Melbourne Bay St
Tram 96
Laverton
Westgate Park
Tram 1
Tarneit
Wyndham Village
Garden City
Port Melbourne
Williams Landing
Sayers
Sanctuary Lakes
Wyndham Vale
Werribee Plaza
Hoppers Crossing
Point Cook
Aviators Field
to Geelong
Werribee
Werribee East
Local Efficiency Change over 2026 Base
Average change in inverted cumulative impediment, weighted by combined catchment size
Global Efficiency Change (Metro): +0.1%
Global Efficiency Change (Wyndham): +3.3%
SNAMUTS
spatial network analysis for multimodal urban transport systems


Melbourne 2026
Wyndham Route 2 + Bus Improvements
Train
Tram
Bus
Pedestrian Link
Trackless Tram
Rail Craigieburn
Tram 59
Bus 903
Bus 904
Rail Upfield
Tram 58
Tram 19
Tram 1-6
Bus 200-207
Bus 250-251
Tram 86-96
Tram 11
Bus 302-304 905-906-907
Tram 12-109
Tram 48-75
Rail Mernda Hurstbridge
Rail Lilydale-Belgrave Glen Waverley-Frankston Sandringham
Tram 58
Rail Pakenham Cranbourne
Tram 3-5-6 16-67-72
Tram 12
Tram 96
Tram 1
to Bacchus Marsh
to Geelong
Sunbury
Keilor Park
Essendon
Moonee Ponds
Milleara
Ascot Vale Union Rd
Sydenham Watergardens
Moonee Ponds Town Hall
Flemington Bridge
Ascot Vale
West Maribyrnong
Caroline Springs Square
Highpoint
Maidstone
New-market
Macaulay
Parkville
Melbourne Uni
Carlton Gardens
St Vincents Plaza
Brimbank Central
St. Albans
North Footscray
Braybrook
Kensington
Arden
N Melbourne Victoria St
Melbourne Central
Swanston-Lt Bourke
Parlia-ment
Burnside
Sunshine
West Footscray
Footscray
West Melbourne
Flagstaff
Queen Latrobe
Swanston-Collins
Russell-Flinders
Melton
Toolern
Caroline Springs Station
Deer Park
Spencer-Latrobe
Harbour Esplanade
Flinders Street Town Hall
Market-Collins
Yarraville Somerville Rd
Southern Cross
Market-Flinders
Arts Precinct
Domain Anzac
Waterfront City
Victoria Harbour
South-bank
Altona North
Lorimer
Crown Casino
Emerald Hill
Montague
Newport Yarraville
Fishermans Bend
Sandridge
Altona
Williams-town
Williamstown Esplanade
Wirraway
South Melbourne
Port Melbourne Bay St
Westgate Park
Garden City
Port Melbourne
Laverton
Tarneit
Wyndham Village
Williams Landing
Sayers
Sanctuary Lakes
Wyndham Vale
Werribee Plaza
Hoppers Crossing
Point Cook
Werribee
Werribee East
Aviators Field
+1%
+2%
+12%
+16%
0%
Local Efficiency Change over 2026 Base
Average change in inverted cumulative impediment, weighted by combined catchment size
Global Efficiency Change (Metro): +0.1%
Global Efficiency Change (Wyndham): +2.3%


Melbourne 2026
Wyndham Route 3 + Bus Improvements
Train
Tram
Bus
Pedestrian Link
Trackless Tram
Local Efficiency Change over 2026 Base
Average change in inverted cumulative impediment, weighted by combined catchment size
Global Efficiency Change (Metro): +0.0%
Global Efficiency Change (Wyndham): +0.9%
Rail Craigieburn
Tram 59
Bus 903
Bus 904
Rail Upfield
Tram 58
Tram 19
Tram 1-6
Bus 200-207
Bus 250-251
Tram 86-96
Tram 11
Bus 302-304 905-906-907
Tram 12-109
Tram 48-75
Rail Mernda Hurstbridge
Rail Lilydale-Belgrave Glen Waverley-Frankston Sandringham
Tram 58
Rail Pakenham Cranbourne
Tram 3-5-6 16-67-72
Tram 12
Tram 96
Tram 1
to Bacchus Marsh
to Geelong
Sunbury
Sydenham Watergardens
Caroline Springs Square
Brimbank Central
St. Albans
Burnside
Melton
Toolern
Caroline Springs Station
Deer Park
Keilor Park
Milleara
West Maribyrnong
Highpoint
Maidstone
North Footscray
Braybrook
Sunshine
West Footscray
Yarraville Somerville Rd
Altona North
Newport Yarraville
Williamstown Esplanade
Williamstown
Altona
Laverton
Wyndham Village
Tarneit
Williams Landing
Sayers
Wyndham Vale
Werribee Plaza
Hoppers Crossing
Sanctuary Lakes
Point Cook
Werribee
Werribee East
Aviators Field
Essendon
Moonee Ponds
Ascot Vale Union Rd
Moonee Ponds Town Hall
Ascot Vale
Flemington Bridge
New-market
Macaulay
Kensington
Footscray
West Melbourne
Arden
N Melbourne Victoria St
Parkville
Melbourne Uni
Melbourne Central
Flagstaff
Spencer-Latrobe
Harbour Esplanade
Waterfront City
Southern Cross
Victoria Harbour
Lorimer
Fishermans Bend
Westgate Park
Sandridge
Wirraway
Garden City
Port Melbourne
Port Melbourne Bay St
Carlton Gardens
St Vincents Plaza
Swanston-Lt Bourke
Parlia-ment
Queen-Latrobe
Swanston-Collins
Russell-Flinders
Market-Collins
Market-Flinders
Flinders Street Town Hall
Arts Precinct
Domain Anzac
Crown Casino
South-bank
Montague
Emerald Hill
South Melbourne


Melbourne 2026
Wyndham Route 4 + Bus Improvements
Train
Tram
Bus
Pedestrian Link
Trackless Tram
Rail Craigieburn
Tram 59
Bus 903
Bus 904
Rail Upfield
Tram 58
Tram 19
Tram 1-6
Bus 200-207
Bus 250-251
Tram 86-96
Tram 11
Bus 302-304 905-906-907
Tram 12-109
Tram 48-75
Rail Mernda Hurstbridge
Rail Lilydale-Belgrave Glen Waverley-Frankston Sandringham
Tram 58
Rail Pakenham Cranbourne
Tram 3-5-6 16-67-72
Tram 12
Tram 96
Tram 1
to Bacchus Marsh
to Geelong
Sunbury
Keilor Park
Essendon
Moonee Ponds
Milleara
Ascot Vale Union Rd
Moonee Ponds Town Hall
Flemington Bridge
Ascot Vale
West Maribyrnong
Sydenham Watergardens
Caroline Springs Square
Highpoint
Maidstone
New-market
Macaulay
Arden
North Footscray
Braybrook
Kensington
Brimbank Central
St. Albans
Footscray
N Melbourne Victoria St
Melbourne Central
Parkville
Melbourne Uni
Carlton Gardens
St Vincents Plaza
Parlia-ment
Swanston-Lt Bourke
Swanston Collins
Russell-Flinders
Queen-Latrobe
Flagstaff
West Melbourne
Burnside
Sunshine
West Footscray
Melton
Toolern
Caroline Springs Station
Deer Park
Spencer-Latrobe
Harbour Esplanade
Waterfront City
Yarraville Somerville Rd
Southern Cross
Market-Flinders
Market-Collins
Flinders Street Town Hall
Arts Precinct
Domain Anzac
Victoria Harbour
Altona North
Lorimer
Crown Casino
South-bank
Emerald Hill
Fishermans Bend
Sandridge
Montague
Newport Yarraville
Altona
Williams-town
Williamstown Esplanade
Wirraway
South Melbourne
Port Melbourne Bay St
Westgate Park
Garden City
Port Melbourne
Laverton
Tarneit
Wyndham Village
Williams Landing
Sayers
Sanctuary Lakes
Wyndham Vale
Werribee Plaza
Hoppers Crossing
Point Cook
Aviators Field
Werribee
Werribee East
Local Efficiency Change over 2026 Base
Average change in inverted cumulative impediment, weighted by combined catchment size
Global Efficiency Change (Metro): +0.1%
Global Efficiency Change (Wyndham): +2.6%
SNAMUTS
spatial network analysis for multimodal urban transport systems

2026 SNAMUTS *23R*	Base	Route 1	Route 2	Route 3	Route 4
Average Closeness Wyndham	85.7	84.3	84.2	84.9	83.0
Average 30-min Contour Catchment Wyndham	33.1%	37.3%	35.0%	35.0%	36.3%
Average Nodal Betweenness Wyndham	11.3	11.7	11.6	11.4	11.3
Average Nodal Resilience Wyndham	+1.5	+2.3	+2.5	+2.0	+2.6
Average Nodal Connectivity Wyndham	38	40	39	39	39
Global Efficiency Change Wyndham		+3.3%	+2.3%	+0.9%	+2.6%
Average SNAMUTS Composite Score Wyndham	11.0	11.3	11.3	11.3	11.5

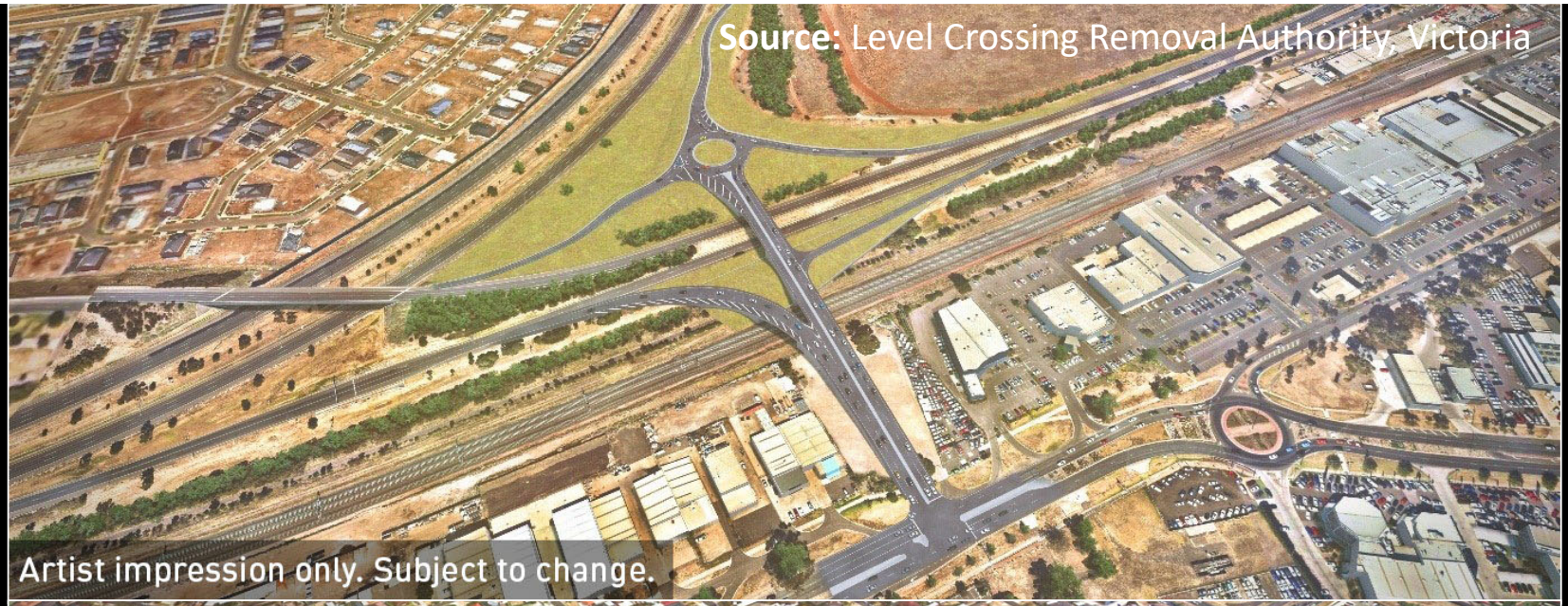
2026 SNAMUTS *23R*	Base	Route 1	Route 2	Route 3	Route 4
Average Closeness Wyndham	85.7	84.3	84.2	84.9	83.0
Average 30-min Contour Catchment Wyndham	33.1%	37.3%	35.0%	35.0%	36.3%
Average Nodal Betweenness Wyndham	11.3	11.7	11.6	11.4	11.3
Average Nodal Resilience Wyndham	+1.5	+2.3	+2.5	+2.0	+2.6
Average Nodal Connectivity Wyndham	38	40	39	39	39
Global Efficiency Change Wyndham		+3.3%	+2.3%	+0.9%	+2.6%
Average SNAMUTS Composite Score Wyndham	11.0	11.3	11.3	11.3	11.5

2026 Starter Lines – Assessment summary

- **Route 1** (Tarneit-Hoppers Crossing) has the most beneficial **network effect**
- **Route 2** (Hoppers Crossing-Aviators Field) has the greatest potential for **land use effects** (redevelopment and greenfield)
- **Route 4** (Williams Landing-Aviators Field) promises the most rapid **ridership growth** (classic rail feeder route)
- **Route 3** (Williams Landing-Sayers/Riverdale) is **the weakest performer** but could be improved if it went Williams Landing-Tarneit instead

SNAMUTS accessibility analysis, Task 2:

- What is the impact on public transport accessibility once all four lines are in place (2036)?
- Using trend land use and transport projections for 2036 (including Melbourne Metro 2, Werribee-Wyndham Vale extension and 10-min daytime frequencies on most rail and key bus lines)
- What additional land use intensification (over and beyond the 2036 trend) is required to make the corridors 'tram-worthy' (ie. a bus system's capacity and performance would be overwhelmed)
- What difference would it make whether the four Tram Trackless lines are joined into one (including purpose-built crossings of the rail line at Hoppers Crossing and Williams Landing) or separated (three distinct lines without purpose-built crossings at the rail interchanges)?

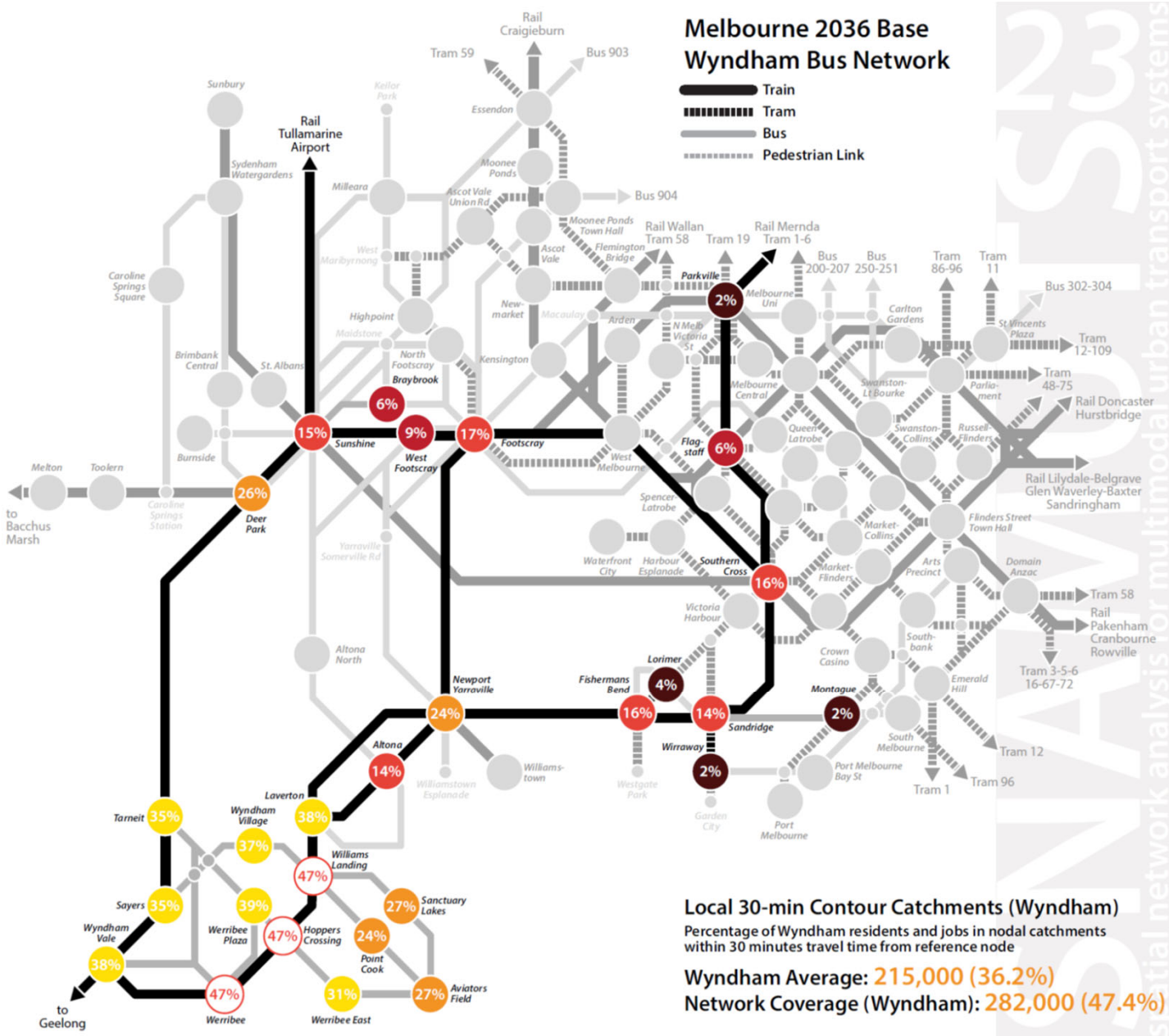

Source: Level Crossing Removal Authority, Victoria
Artist impression only. Subject to change.

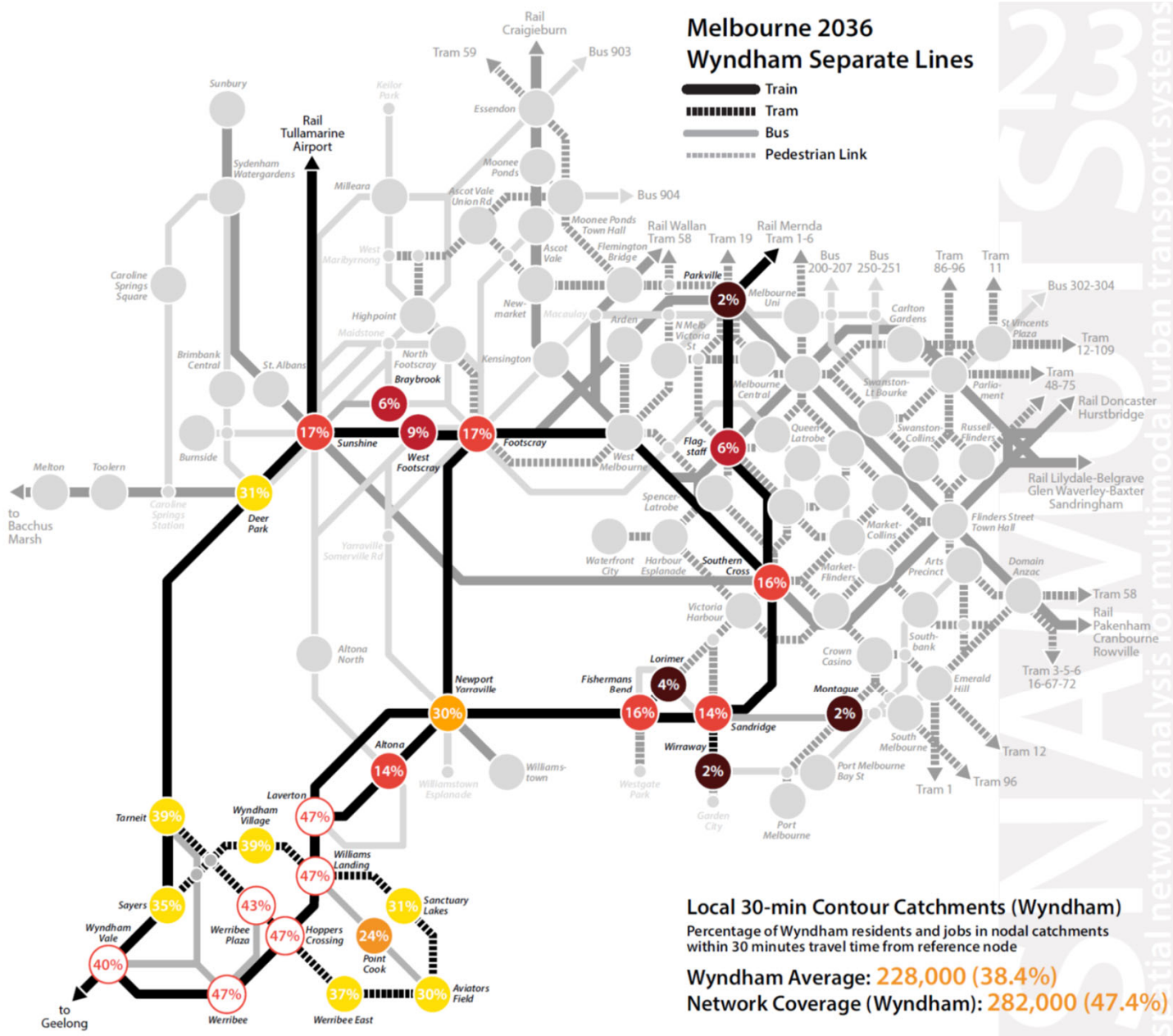

Artist impression only. Subject to change.

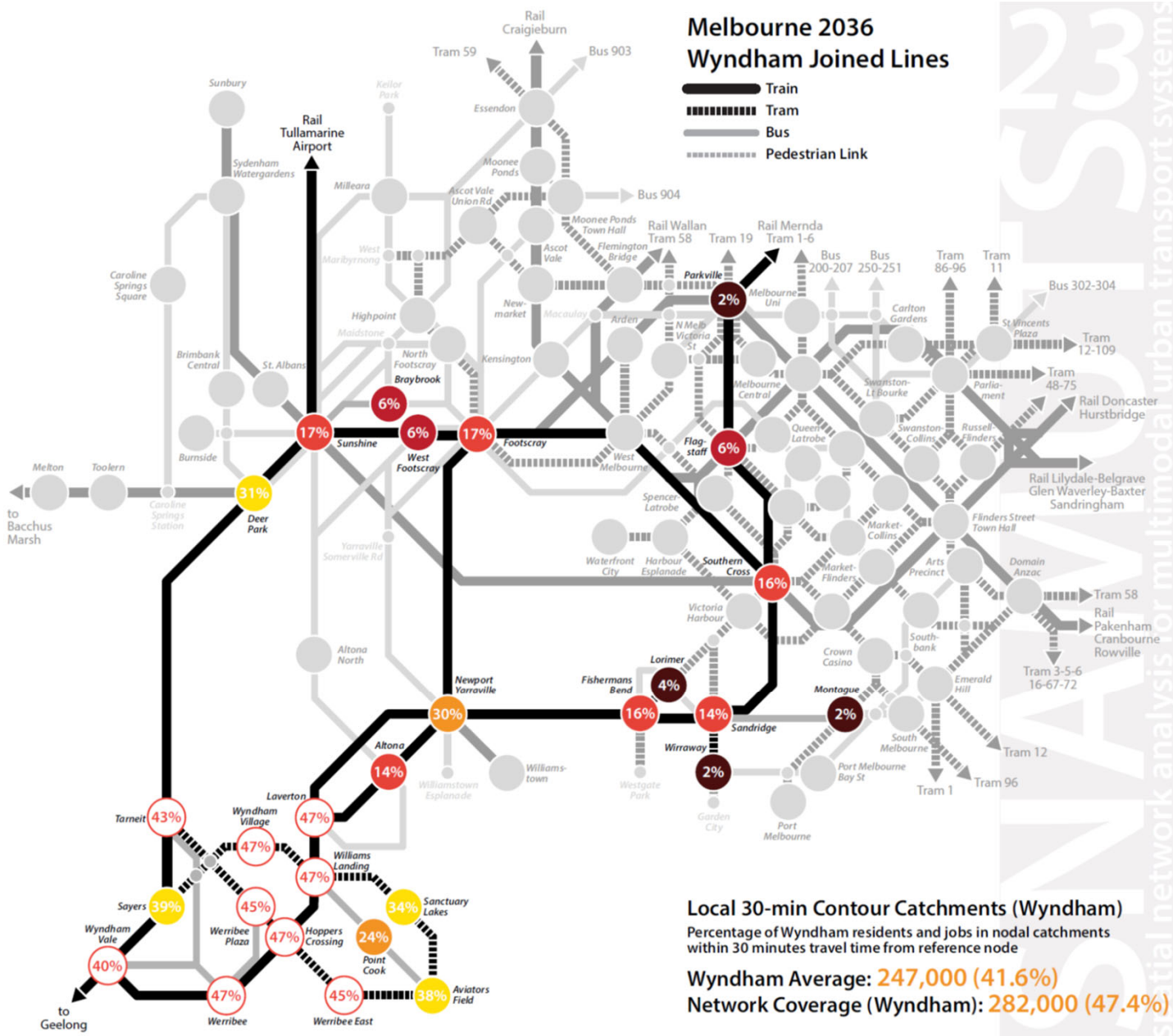
Source: Kölner Stadt-Anzeiger, 19 Jan 2017

contour catchment:

what percentage of wyndham residents and jobs can you reach from each location by way of a public transport journey of 30 min or less?

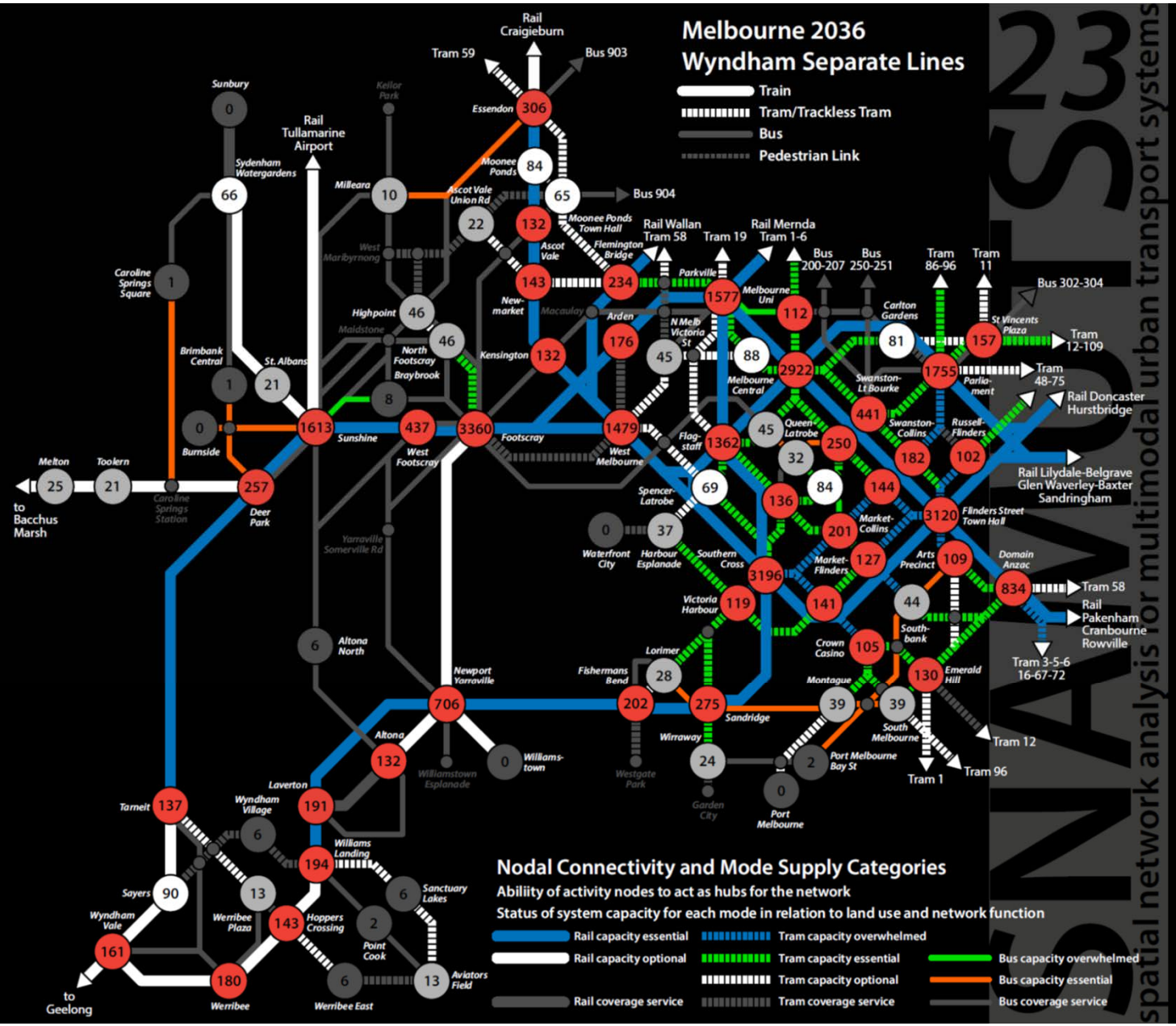

Melbourne 2036 Base
Wyndham Bus Network
Train
Tram
Bus
Pedestrian Link
Rail Craigieburn
Tram 59
Bus 903
Sunbury
Keilor Park
Essendon
Rail Tullamarine Airport
Sydenham Watergardens
Moonee Ponds
Milleara
Ascot Vale Union Rd
Bus 904
Moonee Ponds Town Hall
Rail Wallan Tram 58
Tram 19
Rail Mernda Tram 1-6
Bus 200-207
Bus 250-251
Tram 86-96
Tram 11
Bus 302-304
Caroline Springs Square
West Maribyrnong
Ascot Vale
Flemington Bridge
Parkville
2%
Melbourne Uni
Carlton Gardens
St Vincents Plaza
Tram 12-109
Highpoint
Maidstone
New-market
Macaulay
Arden
N Melb Victoria St
Tram 48-75
Brimbank Central
St. Albans
North Footscray
Braybrook
Kensington
Melbourne Central
Swanston-Lt Bourke
Parlia-ment
Rail Doncaster Hurstbridge
6%
15%
Sunshine
9%
West Footscray
17%
Footscray
Flag-staff
6%
Queen-Latrobe
Swanston-Collins
Russell-Flinders
Burnside
Melton
Toolern
to Bacchus Marsh
Caroline Springs Station
26%
Deer Park
West Melbourne
Spencer Latrobe
Rail Lilydale-Belgrave Glen Waverley-Baxter Sandringham
Flinders Street Town Hall
Market-Collins
Yarraville Somerville Rd
Waterfront City
Harbour Esplanade
Southern Cross
16%
Market-Flinders
Arts Precinct
Domain Anzac
Tram 58
Rail Pakenham Cranbourne Rowville
Victoria Harbour
Altona North
Lorimer
4%
Fishermans Bend
16%
Newport Yarraville
24%
14%
Sandridge
Montague
2%
Crown Casino
South-bank
Emerald Hill
Tram 3-5-6 16-67-72
Altona
14%
Wirraway
2%
Williamstown Esplanade
Williams-town
Westgate Park
Garden City
Port Melbourne
Port Melbourne Bay St
South Melbourne
Tram 12
Tram 1
Tram 96
Laverton
Tarneit
35%
Wyndham Village
38%
37%
Williams Landing
47%
Sayers
35%
39%
27%
Sanctuary Lakes
Wyndham Vale
Werribee Plaza
47%
Hoppers Crossing
24%
Point Cook
38%
47%
31%
27%
Aviators Field
to Geelong
Werribee
Werribee East
Local 30-min Contour Catchments (Wyndham)
Percentage of Wyndham residents and jobs in nodal catchments within 30 minutes travel time from reference node
Wyndham Average: 215,000 (36.2%)
Network Coverage (Wyndham): 282,000 (47.4%)


Melbourne 2036
Wyndham Separate Lines
Train
Tram
Bus
Pedestrian Link
Rail Craigieburn
Tram 59
Bus 903
Sunbury
Keilor Park
Essendon
Rail Tullamarine Airport
Sydenham Watergardens
Moonee Ponds
Milleara
Ascot Vale Union Rd
Bus 904
Moonee Ponds Town Hall
Rail Wallan Tram 58
Tram 19
Rail Mernda Tram 1-6
Bus 200-207
Bus 250-251
Tram 86-96
Tram 11
Bus 302-304
Caroline Springs Square
West Maribyrnong
Ascot Vale
Flemington Bridge
Parkville
2%
Melbourne Uni
Carlton Gardens
St Vincents Plaza
Tram 12-109
Highpoint
Maidstone
New-market
Macaulay
Arden
N Melb Victoria St
Tram 48-75
Brimbank Central
St. Albans
North Footscray
Kensington
Braybrook
6%
Melbourne Central
Swanston-Lt Bourke
Parlia-ment
Rail Doncaster Hurstbridge
17%
Sunshine
9%
West Footscray
17%
Footscray
Flag-staff
6%
Queen-Latrobe
Swanston-Collins
Russell-Flinders
Burnside
West Melbourne
Melton
Toolern
31%
Deer Park
Rail Lilydale-Belgrave Glen Waverley-Baxter Sandringham
to Bacchus Marsh
Caroline Springs Station
Spencer Latrobe
Flinders Street Town Hall
Market-Collins
Yarraville Somerville Rd
Waterfront City
Harbour Esplanade
Southern Cross
16%
Market-Flinders
Arts Precinct
Domain Anzac
Tram 58
Rail Pakenham Cranbourne Rowville
Victoria Harbour
Altona North
Crown Casino
South-bank
Tram 3-5-6 16-67-72
Lorimer
Fishermans Bend
4%
Newport Yarraville
30%
16%
14%
Sandridge
Montague
2%
Emerald Hill
Altona
14%
Williamstown Esplanade
Williams-town
Wirraway
2%
Westgate Park
Port Melbourne Bay St
South Melbourne
Tram 12
Tram 1
Tram 96
Laverton
47%
Tarneit
39%
Wyndham Village
39%
Williams Landing
47%
Garden City
Port Melbourne
Sayers
35%
43%
Sanctuary Lakes
31%
Wyndham Vale
Werribee Plaza
47%
Hoppers Crossing
24%
Point Cook
40%
47%
37%
30%
Aviators Field
to Geelong
Werribee
Werribee East
Local 30-min Contour Catchments (Wyndham)
Percentage of Wyndham residents and jobs in nodal catchments within 30 minutes travel time from reference node
Wyndham Average: 228,000 (38.4%)
Network Coverage (Wyndham): 282,000 (47.4%)
SNAMUTS
spatial network analysis for multimodal urban transport systems


Melbourne 2036
Wyndham Joined Lines
Train
Tram
Bus
Pedestrian Link
Rail Craigieburn
Tram 59
Bus 903
Sunbury
Keilor Park
Essendon
Rail Tullamarine Airport
Sydenham Watergardens
Moonee Ponds
Milleara
Ascot Vale Union Rd
Bus 904
Moonee Ponds Town Hall
Rail Wallan Tram 58
Tram 19
Rail Mernda Tram 1-6
Bus 200-207
Bus 250-251
Tram 86-96
Tram 11
Bus 302-304
Caroline Springs Square
West Maribyrnong
Ascot Vale
Flemington Bridge
Parkville
2%
Melbourne Uni
Carlton Gardens
St Vincents Plaza
Tram 12-109
Highpoint
Maidstone
New-market
Macaulay
Arden
N Melb Victoria St
Brimbank Central
St. Albans
North Footscray
Kensington
Braybrook
6%
Melbourne Central
Swanston-Lt Bourke
Parlia-ment
Tram 48-75
Rail Doncaster Hurstbridge
17%
Sunshine
6%
West Footscray
17%
Footscray
Flag-staff
6%
Queen-Latrobe
Swanston-Collins
Russell-Flinders
Burnside
West Melbourne
Melton
Toolern
31%
Deer Park
to Bacchus Marsh
Caroline Springs Station
Spencer-Latrobe
Rail Lilydale-Belgrave Glen Waverley-Baxter Sandringham
Flinders Street Town Hall
Market-Collins
Yarraville Somerville Rd
Waterfront City
Harbour Esplanade
Southern Cross
16%
Market-Flinders
Arts Precinct
Domain Anzac
Tram 58
Rail Pakenham Cranbourne Rowville
Victoria Harbour
Altona North
Crown Casino
South-bank
Tram 3-5-6 16-67-72
Lorimer
4%
Fishermans Bend
16%
14%
Sandridge
Montague
2%
Emerald Hill
Newport Yarraville
30%
Altona
14%
Wirraway
2%
Williams-town
Williamstown Esplanade
Westgate Park
Garden City
Port Melbourne
Port Melbourne Bay St
South Melbourne
Tram 12
Tram 1
Tram 96
Laverton
47%
Tarneit
43%
Wyndham Village
47%
47%
Williams Landing
Sayers
39%
45%
34%
Sanctuary Lakes
Wyndham Vale
Werribee Plaza
47%
Hoppers Crossing
24%
Point Cook
40%
to Geelong
47%
Werribee
45%
Werribee East
38%
Aviators Field
Local 30-min Contour Catchments (Wyndham)
Percentage of Wyndham residents and jobs in nodal catchments within 30 minutes travel time from reference node
Wyndham Average: 247,000 (41.6%)
Network Coverage (Wyndham): 282,000 (47.4%)
SNAMUTS
spatial network analysis for multimodal urban transport systems

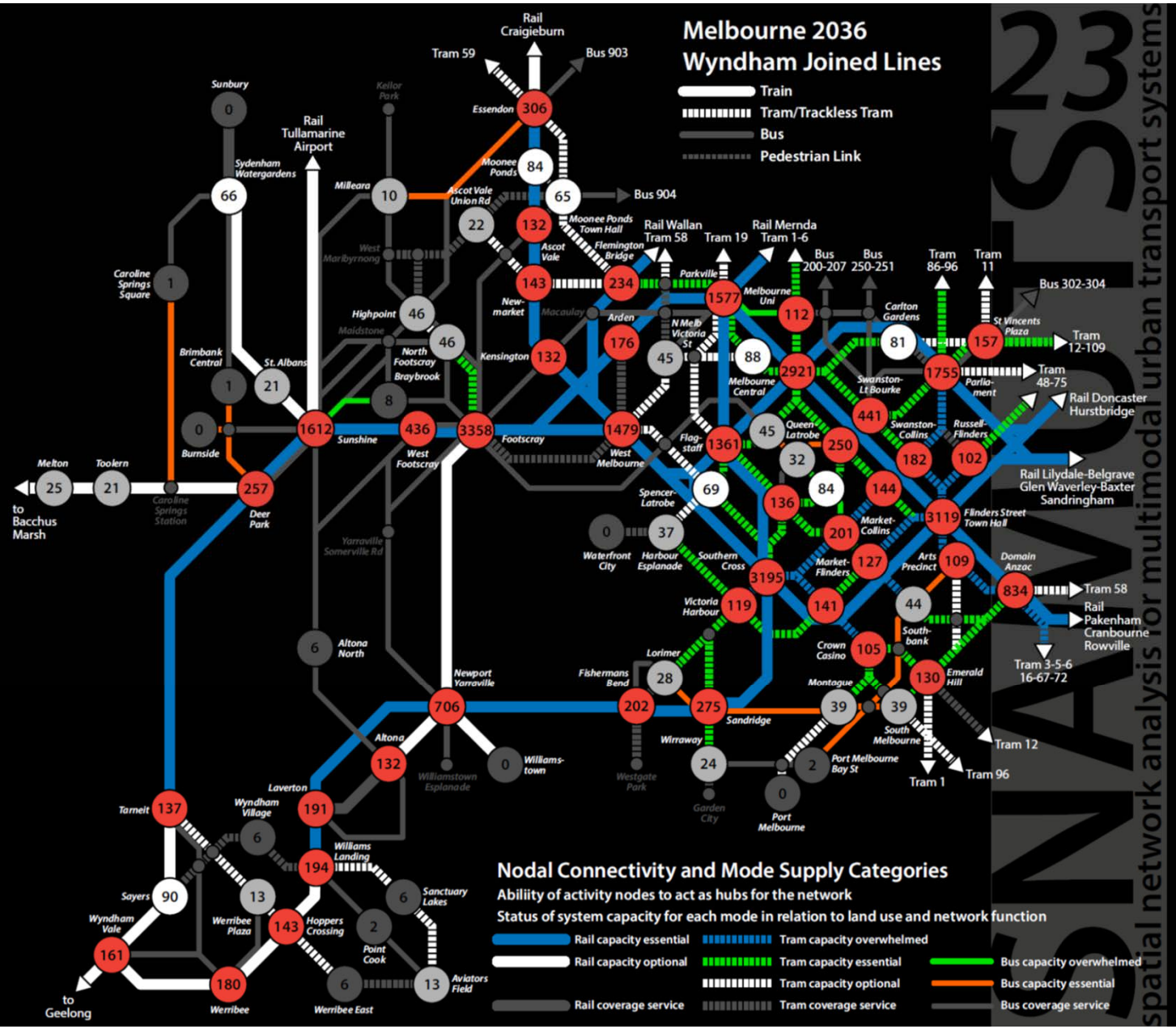
mode supply categories:

do wyndham's proposed trackless tram routes exceed the capacity of a bus system, and if not, how much urban intensification is required before they do?



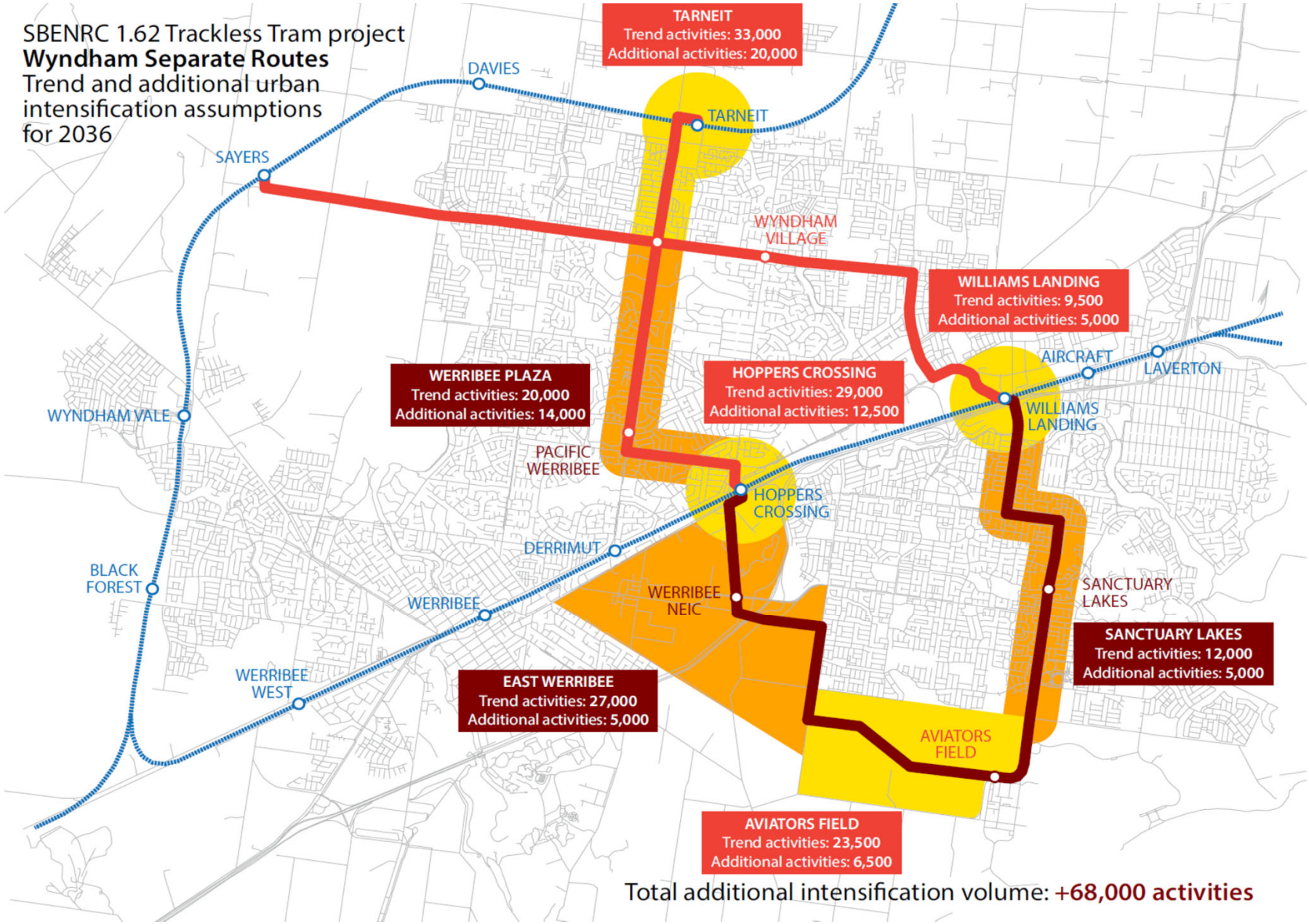
SNAMUTS 23

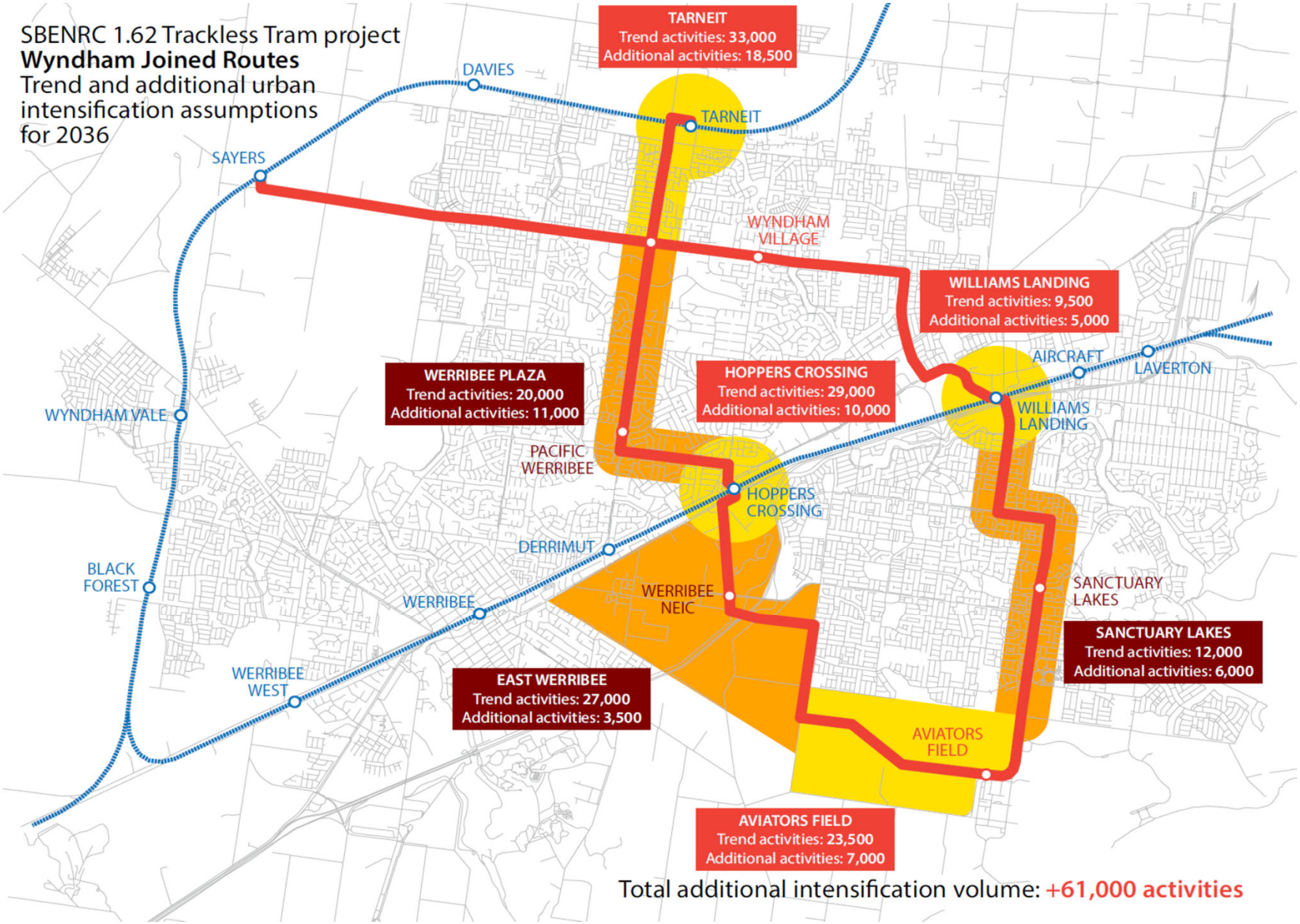
spatial network analysis for multimodal urban transport systems

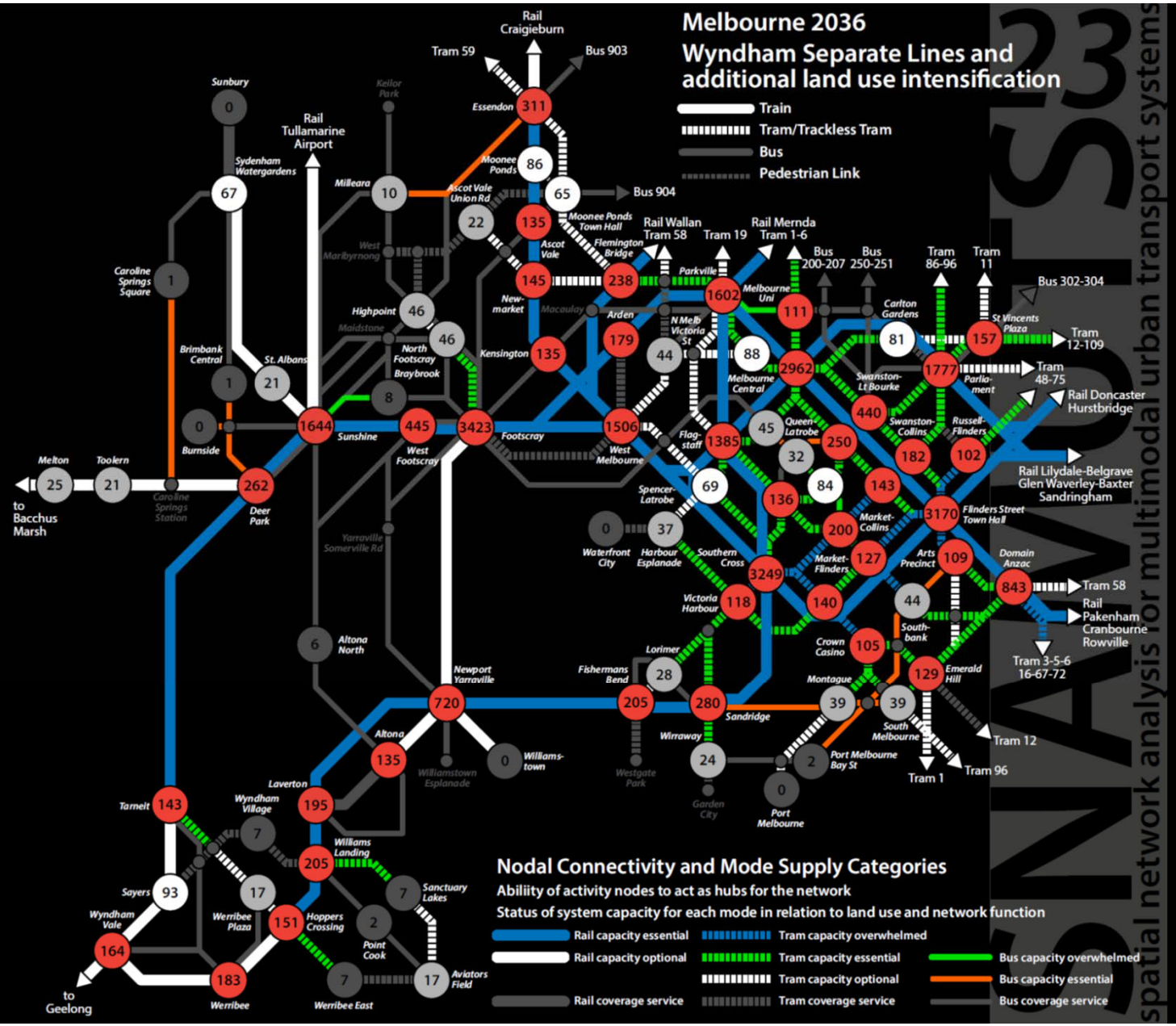


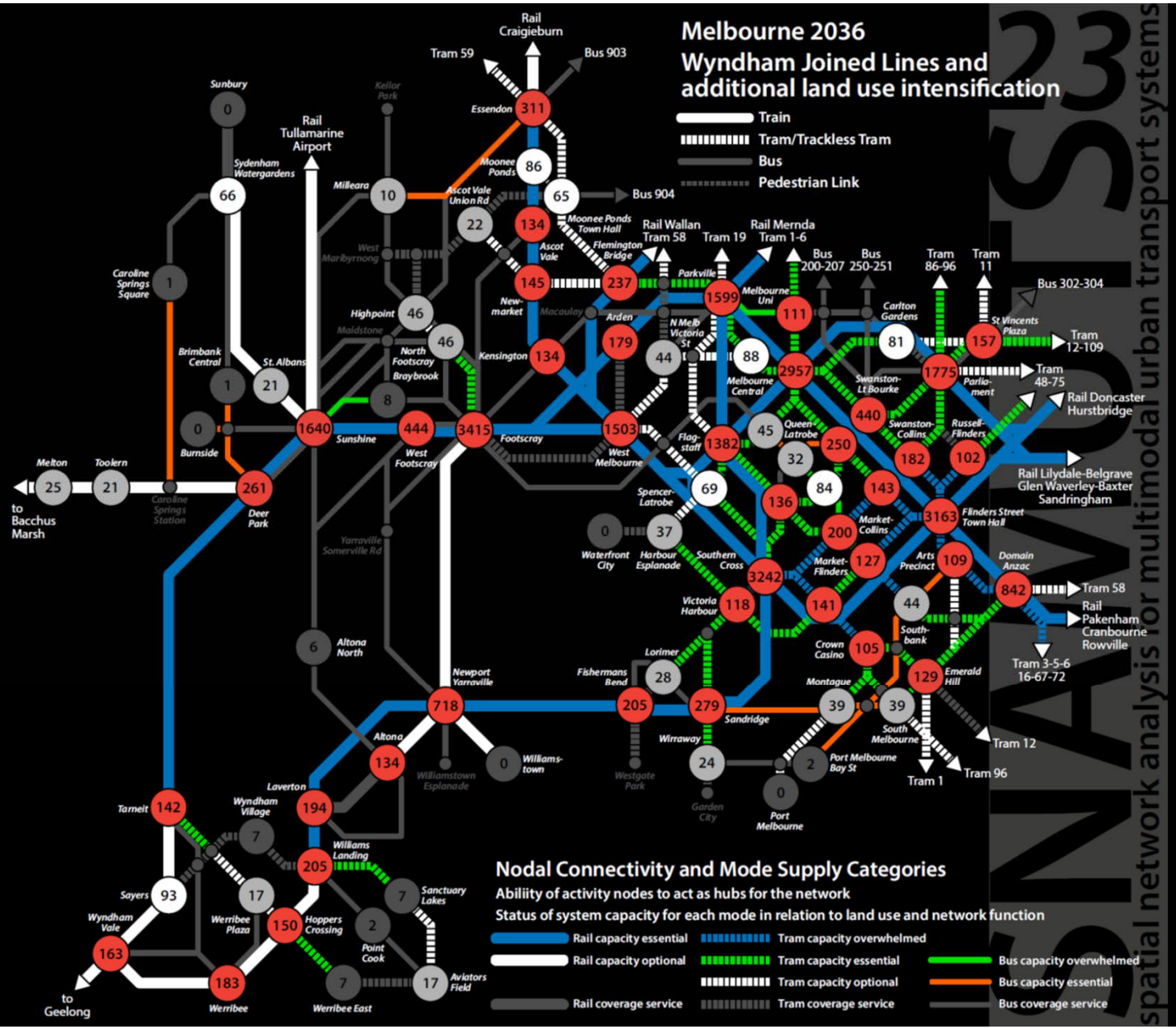
SPATIAL NAVIGATORS 23

spatial network analysis for multimodal urban transport systems


SBENRC 1.62 Trackless Tram project
Wyndham Separate Routes
Trend and additional urban intensification assumptions for 2036
TARNEIT
Trend activities: 33,000
Additional activities: 20,000
DAVIES
TARNEIT
SAYERS
WYNDHAM VILLAGE
WILLIAMS LANDING
Trend activities: 9,500
Additional activities: 5,000
AIRCRAFT
LAVERTON
WILLIAMS LANDING
WERRIBEE PLAZA
Trend activities: 20,000
Additional activities: 14,000
HOPPERS CROSSING
Trend activities: 29,000
Additional activities: 12,500
WYNDHAM VALE
PACIFIC WERRIBEE
HOPPERS CROSSING
DERRIMUT
BLACK FOREST
WERRIBEE
WERRIBEE NEIC
SANCTUARY LAKES
SANCTUARY LAKES
Trend activities: 12,000
Additional activities: 5,000
WERRIBEE WEST
EAST WERRIBEE
Trend activities: 27,000
Additional activities: 5,000
AVIATORS FIELD
AVIATORS FIELD
Trend activities: 23,500
Additional activities: 6,500
Total additional intensification volume: +68,000 activities


SBENRC 1.62 Trackless Tram project
Wyndham Joined Routes
Trend and additional urban intensification assumptions for 2036
TARNEIT
Trend activities: 33,000
Additional activities: 18,500
DAVIES
TARNEIT
SAYERS
WYNDHAM VILLAGE
WILLIAMS LANDING
Trend activities: 9,500
Additional activities: 5,000
AIRCRAFT
LAVERTON
WERRIBEE PLAZA
Trend activities: 20,000
Additional activities: 11,000
HOPPERS CROSSING
Trend activities: 29,000
Additional activities: 10,000
WYNDHAM VALE
WILLIAMS LANDING
PACIFIC WERRIBEE
HOPPERS CROSSING
DERRIMUT
BLACK FOREST
WERRIBEE
WERRIBEE NEIC
SANCTUARY LAKES
SANCTUARY LAKES
Trend activities: 12,000
Additional activities: 6,000
WERRIBEE WEST
EAST WERRIBEE
Trend activities: 27,000
Additional activities: 3,500
AVIATORS FIELD
AVIATORS FIELD
Trend activities: 23,500
Additional activities: 7,000
Total additional intensification volume: +61,000 activities


Melbourne 2036
Wyndham Separate Lines and additional land use intensification
Train
Tram/Trackless Tram
Bus
Pedestrian Link
Nodal Connectivity and Mode Supply Categories
Abiliity of activity nodes to act as hubs for the network
Status of system capacity for each mode in relation to land use and network function
Rail capacity essential
Rail capacity optional
Rail coverage service
Tram capacity overwhelmed
Tram capacity essential
Tram capacity optional
Tram coverage service
Bus capacity overwhelmed
Bus capacity essential
Bus coverage service
Rail Craigieburn
Tram 59
Bus 903
Bus 904
Rail Tullamarine Airport
Rail Wallan Tram 58
Tram 19
Rail Mernda Tram 1-6
Bus 200-207
Bus 250-251
Tram 86-96
Tram 11
Bus 302-304
Tram 12-109
Tram 48-75
Rail Doncaster Hurstbridge
Rail Lilydale-Belgrave Glen Waverley-Baxter Sandringham
Tram 58
Rail Pakenham Cranbourne Rowville
Tram 3-5-6 16-67-72
Tram 12
Tram 96
Tram 1
to Bacchus Marsh
to Geelong
Sunbury
Sydenham Watergardens
Caroline Springs Square
Brimbank Central
St. Albans
Melton
Toolern
Burnside
Caroline Springs Station
Deer Park
Milleara
Kellor Park
West Maribyrnong
Highpoint
Maidstone
North Footscray Braybrook
Sunshine
West Footscray
Yarraville Somerville Rd
Altona North
Newport Yarraville
Altona
Williamstown Esplanade
Williamstown
Laverton
Wyndham Village
Tarneit
Sayers
Wyndham Vale
Werribee Plaza
Werribee
Hoppers Crossing
Williams Landing
Point Cook
Sanctuary Lakes
Aviators Field
Werribee East
Essendon
Moonee Ponds
Ascot Vale Union Rd
Ascot Vale
Moonee Ponds Town Hall
New-market
Macaulay
Flemington Bridge
Kensington
Footscray
Arden
Parkville
N Melb Victoria St
Melbourne Uni
Melbourne Central
Carlton Gardens
St Vincents Plaza
Parlia-ment
Swanston-Lt Bourke
Swanston-Collins
Russell-Flinders
Queen-Latrobe
Flag-staff
West Melbourne
Spencer-Latrobe
Waterfront City
Harbour Esplanade
Southern Cross
Market-Collins
Market-Flinders
Flinders Street Town Hall
Arts Precinct
Domain Anzac
Victoria Harbour
Lorimer
Fishermans Bend
Westgate Park
Wirraway
Sandridge
Garden City
Port Melbourne
Port Melbourne Bay St
Montague
South Melbourne
Crown Casino
Southbank
Emerald Hill
Spatial network analysis for multimodal urban transport systems
SNAMUTS 23

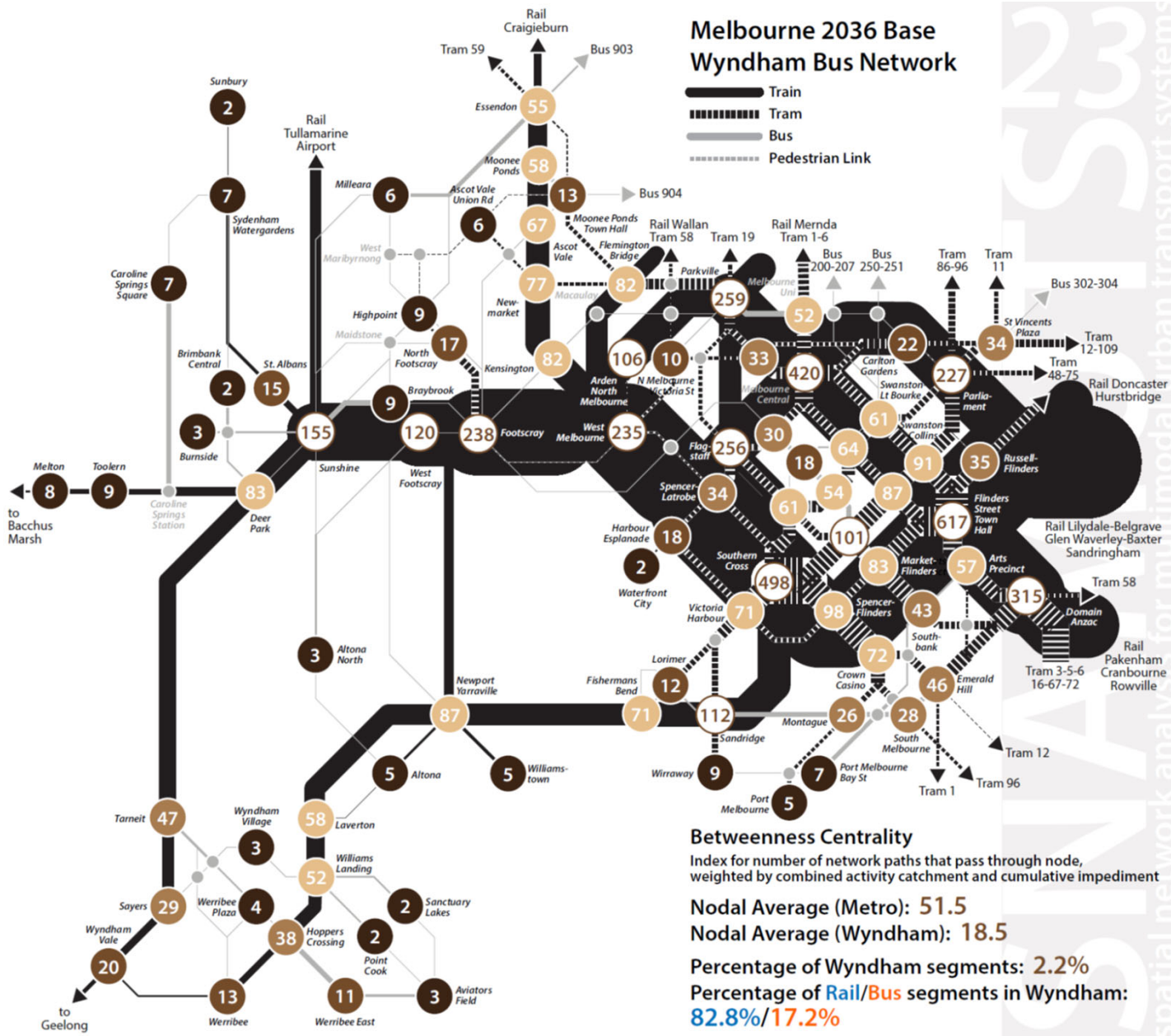


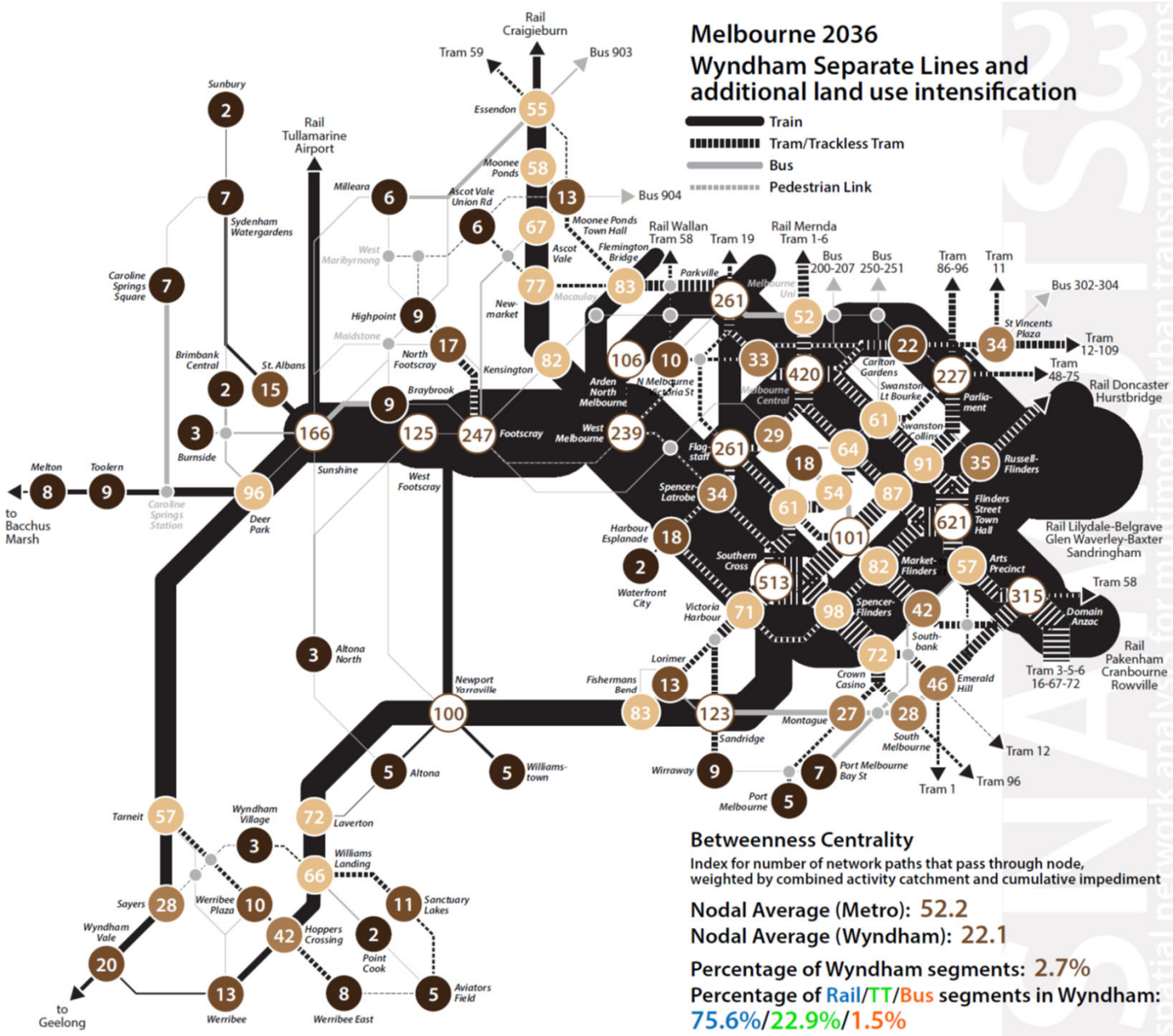
SNAMUTS 23

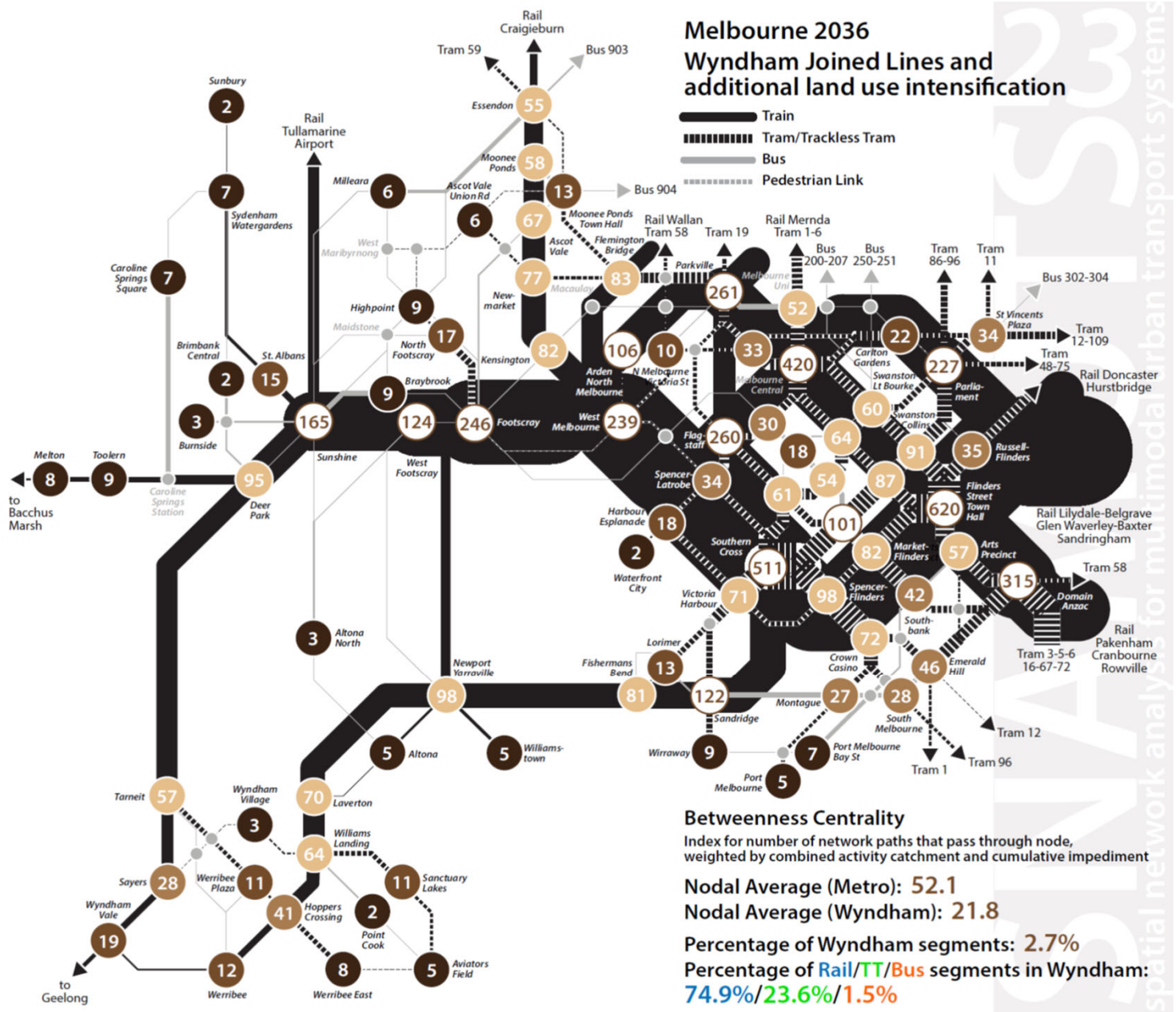
spatial network analysis for multimodal urban transport systems

betweenness centrality:

where does the trackless tram system add travel opportunities, within wyndham and beyond?

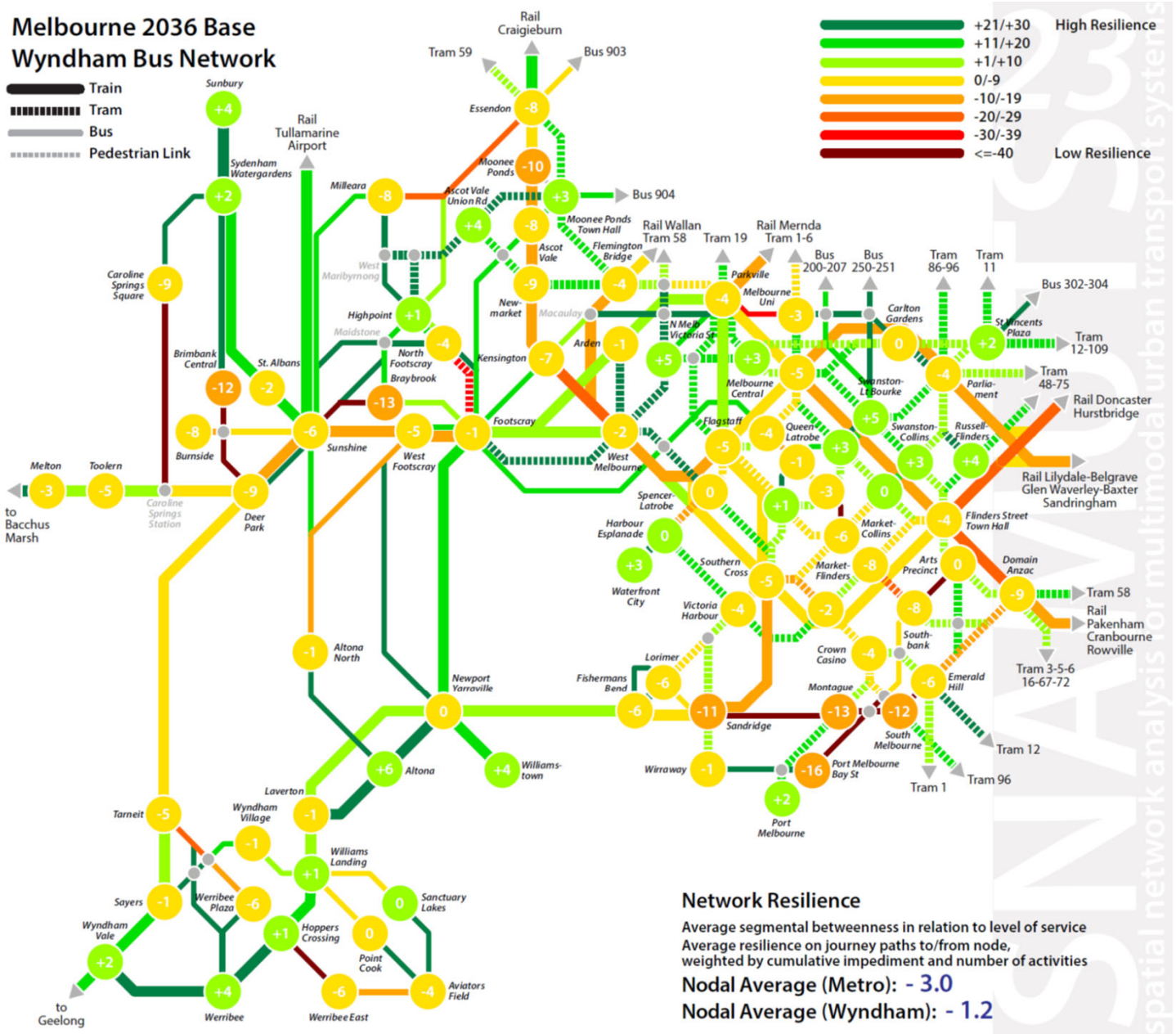

Melbourne 2036 Base
Wyndham Bus Network
Train
Tram
Bus
Pedestrian Link
Rail Craigieburn
Tram 59
Bus 903
Bus 904
Rail Tullamarine Airport
Sunbury
Essendon
Moonee Ponds
Milleara
Ascot Vale Union Rd
Sydenham Watergardens
Caroline Springs Square
West Maribyrnong
Highpoint
Maidstone
North Footscray
Brimbank Central
St. Albans
Braybrook
Burnside
Melton
Toolern
to Bacchus Marsh
Caroline Springs Station
Sunshine
Deer Park
West Footscray
Footscray
Kensington
New-market
Ascot Vale
Moonee Ponds Town Hall
Flemington Bridge
Macaulay
Rail Wallan Tram 58
Tram 19
Rail Mernda Tram 1-6
Parkville
Melbourne Uni
Arden North Melbourne
N Melbourne Victoria St
West Melbourne
Flag-staff
Spencer-Latrobe
Harbour Esplanade
Waterfront City
Southern Cross
Victoria Harbour
Lorimer
Fishermans Bend
Newport Yarraville
Sandridge
Wirraway
Port Melbourne
Bus 200-207
Bus 250-251
Tram 86-96
Tram 11
Bus 302-304
St Vincents Plaza
Tram 12-109
Tram 48-75
Rail Doncaster Hurstbridge
Carlton Gardens
Swanston Lt Bourke
Melbourne Central
Parlia-ment
Swanston Collins
Russell-Flinders
Flinders Street Town Hall
Rail Lilydale-Belgrave Glen Waverley-Baxter Sandringham
Market-Flinders
Arts Precinct
Tram 58
Domain Anzac
Spencer-Flinders
South-bank
Rail Pakenham Cranbourne Rowville
Tram 3-5-6 16-67-72
Crown Casino
Emerald Hill
Montague
South Melbourne
Port Melbourne Bay St
Tram 12
Tram 1
Tram 96
Altona North
Altona
Williams-town
Tarneit
Wyndham Village
Laverton
Williams Landing
Sayers
Werribee Plaza
Sanctuary Lakes
Wyndham Vale
Hoppers Crossing
Point Cook
Aviators Field
to Geelong
Werribee
Werribee East
Betweenness Centrality
Index for number of network paths that pass through node, weighted by combined activity catchment and cumulative impediment
Nodal Average (Metro): 51.5
Nodal Average (Wyndham): 18.5
Percentage of Wyndham segments: 2.2%
Percentage of Rail/Bus segments in Wyndham:
82.8%/17.2%
SNAPS 23
spatial network analysis for multimodal urban transport systems


Melbourne 2036
Wyndham Separate Lines and additional land use intensification
Train
Tram/Trackless Tram
Bus
Pedestrian Link
Rail Craigieburn
Tram 59
Bus 903
Bus 904
Rail Tullamarine Airport
Sunbury
Essendon
Moonee Ponds
Milleara
Ascot Vale Union Rd
Sydenham Watergardens
Caroline Springs Square
West Maribyrnong
Moonee Ponds Town Hall
Ascot Vale
Flemington Bridge
Rail Wallan Tram 58
Tram 19
Rail Mernda Tram 1-6
Bus 200-207
Bus 250-251
Tram 86-96
Tram 11
Bus 302-304
Parkville
Macaulay
New-market
Highpoint
Maidstone
North Footscray
Kensington
Brimbank Central
St. Albans
Braybrook
Arden North Melbourne
N Melbourne Victoria St
Melbourne Uni
Melbourne Central
St Vincents Plaza
Tram 12-109
Tram 48-75
Rail Doncaster Hurstbridge
Carlton Gardens
Swanston Lt Bourke
Parlia-ment
Swanston Collins
Russell-Flinders
Burnside
Sunshine
Footscray
West Melbourne
Flag-staff
Melton
Toolern
to Bacchus Marsh
Caroline Springs Station
Deer Park
West Footscray
Spencer-Latrobe
Flinders Street Town Hall
Harbour Esplanade
Southern Cross
Market-Flinders
Arts Precinct
Rail Lilydale-Belgrave Glen Waverley-Baxter Sandringham
Waterfront City
Victoria Harbour
Spencer-Flinders
Tram 58
Domain Anzac
Altona North
Lorimer
South-bank
Rail Pakenham Cranbourne Rowville
Newport Yarraville
Fishermans Bend
Crown Casino
Emerald Hill
Tram 3-5-6 16-67-72
Montague
Sandridge
South Melbourne
Tram 12
Altona
Williams-town
Wirraway
Port Melbourne Bay St
Tram 1
Tram 96
Port Melbourne
Tarneit
Wyndham Village
Laverton
Williams Landing
Sayers
Werribee Plaza
Sanctuary Lakes
Wyndham Vale
Hoppers Crossing
Point Cook
Aviators Field
to Geelong
Werribee
Werribee East
Betweenness Centrality
Index for number of network paths that pass through node, weighted by combined activity catchment and cumulative impediment
Nodal Average (Metro): 52.2
Nodal Average (Wyndham): 22.1
Percentage of Wyndham segments: 2.7%
Percentage of Rail/TT/Bus segments in Wyndham:
75.6%/22.9%/1.5%
SNAPS3
spatial network analysis for multimodal urban transport systems


Melbourne 2036
Wyndham Joined Lines and additional land use intensification
Train
Tram/Trackless Tram
Bus
Pedestrian Link
Rail Craigieburn
Tram 59
Bus 903
Bus 904
Rail Tullamarine Airport
Sunbury
Essendon
Moonee Ponds
Milleara
Ascot Vale Union Rd
Moonee Ponds Town Hall
Ascot Vale
Flemington Bridge
Rail Wallan Tram 58
Tram 19
Rail Mernda Tram 1-6
Bus 200-207
Bus 250-251
Tram 86-96
Tram 11
Bus 302-304
Sydenham Watergardens
Caroline Springs Square
West Maribyrnong
Highpoint
Maidstone
North Footscray
New-market
Macaulay
Parkville
Melbourne Uni
St Vincents Plaza
Tram 12-109
Tram 48-75
Rail Doncaster Hurstbridge
Brimbank Central
St. Albans
Braybrook
Kensington
Arden North Melbourne
N Melbourne Victoria St
Carlton Gardens
Swanston Lt Bourke
Parlia-ment
Melbourne Central
Swanston Collins
Burnside
Footscray
West Melbourne
Flag-staff
Russell-Flinders
Melton
Toolern
Sunshine
West Footscray
Spencer-Latrobe
Flinders Street Town Hall
to Bacchus Marsh
Caroline Springs Station
Deer Park
Harbour Esplanade
Rail Lilydale-Belgrave Glen Waverley-Baxter Sandringham
Waterfront City
Southern Cross
Market-Flinders
Arts Precinct
Tram 58
Victoria Harbour
Spencer-Flinders
Domain Anzac
Altona North
South-bank
Lorimer
Fishermans Bend
Crown Casino
Emerald Hill
Rail Pakenham Cranbourne Rowville
Tram 3-5-6 16-67-72
Newport Yarraville
Sandridge
Montague
South Melbourne
Tram 12
Altona
Williams-town
Wirraway
Port Melbourne Bay St
Tram 1
Tram 96
Port Melbourne
Tarneit
Wyndham Village
Laverton
Williams Landing
Sayers
Werribee Plaza
Sanctuary Lakes
Wyndham Vale
Hoppers Crossing
Point Cook
Aviators Field
to Geelong
Werribee
Werribee East
Betweenness Centrality
Index for number of network paths that pass through node, weighted by combined activity catchment and cumulative impediment
Nodal Average (Metro): 52.1
Nodal Average (Wyndham): 21.8
Percentage of Wyndham segments: 2.7%
Percentage of Rail/TT/Bus segments in Wyndham:
74.9%/23.6%/1.5%
SNAPS
spatial network analysis for multimodal urban transport systems

network resilence:

are the travel opportunities well-catered for by public transport capacity? where can we see problems?


Melbourne 2036 Base
Wyndham Bus Network
Train
Tram
Bus
Pedestrian Link
+21/+30 High Resilience
+11/+20
+1/+10
0/-9
-10/-19
-20/-29
-30/-39
<=-40 Low Resilience
Rail Craigieburn
Tram 59
Bus 903
Sunbury
Rail Tullamarine Airport
Essendon
Moonee Ponds
Bus 904
Sydenham Watergardens
Milleara
Ascot Vale Union Rd
Moonee Ponds Town Hall
Rail Wallan Tram 58
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Tram 11
Bus 302-304
Caroline Springs Square
West Maribyrnong
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Parkville
Melbourne Uni
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Brimbank Central
St. Albans
Melbourne Central
Swanston-Le Bourke
Parlia-ment
Tram 48-75
Rail Doncaster Hurstbridge
Footscray
Flagstaff
Queen-Latrobe
Swanston-Collins
Russell-Flinders
Burnside
Sunshine
West Footscray
West Melbourne
Melton
Toolern
Rail Lilydale-Belgrave Glen Waverley-Baxter Sandringham
to Bacchus Marsh
Caroline Springs Station
Deer Park
Spencer-Latrobe
Flinders Street Town Hall
Harbour Esplanade
Market-Collins
Waterfront City
Southern Cross
Market-Flinders
Arts Precinct
Domain Anzac
Tram 58
Victoria Harbour
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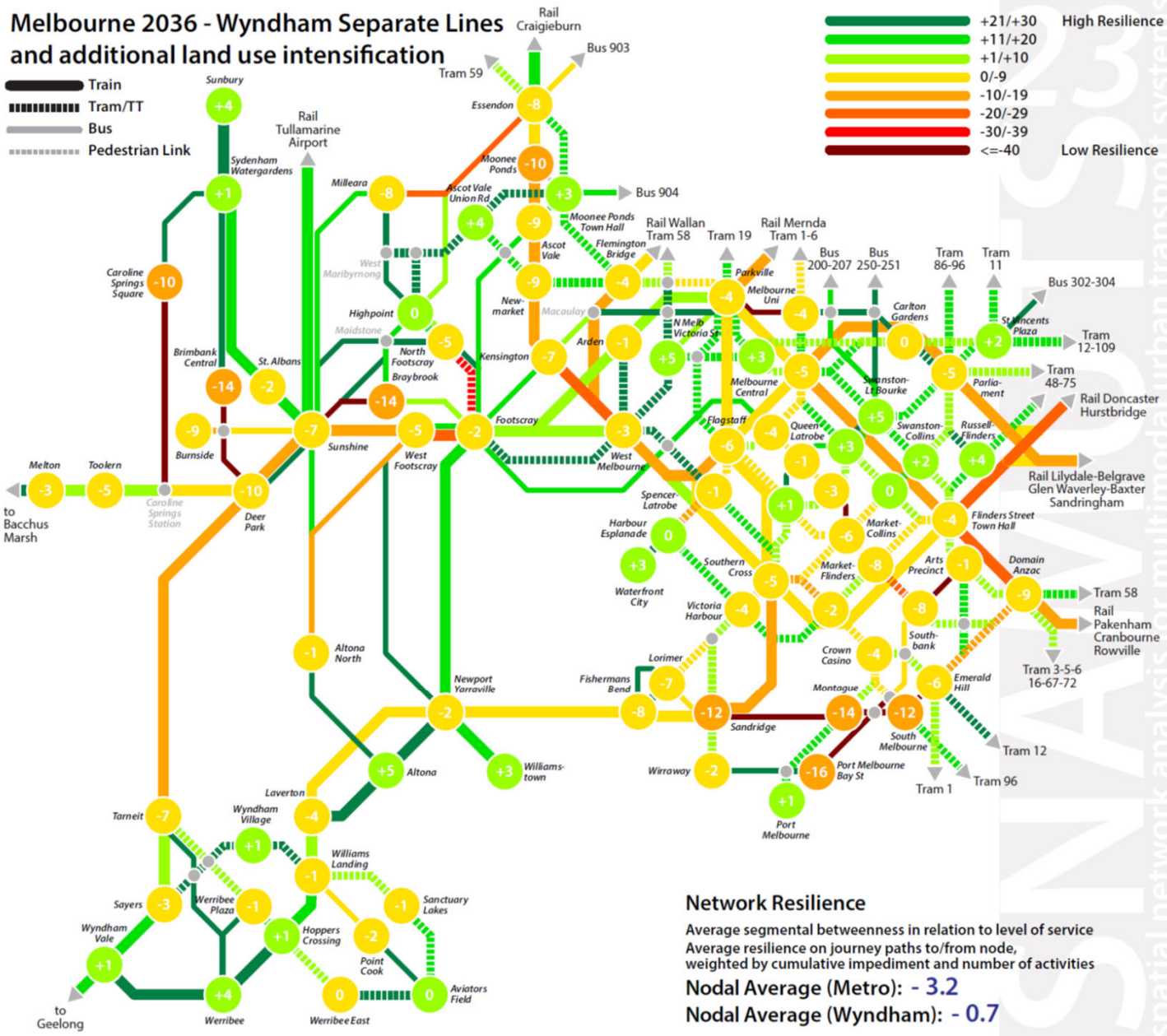
Tram 3-5-6 16-67-72
Fishermans Bend
Newport Yarraville
Montague
Emerald Hill
Sandridge
South Melbourne
Tram 12
Altona
Williams-town
Wirraway
Port Melbourne Bay St
Tram 96
Tram 1
Laverton
Port Melbourne
Tarneit
Wyndham Village
Williams Landing
Sayers
Werribee Plaza
Sanctuary Lakes
Wyndham Vale
Hoppers Crossing
Point Cook
Aviators Field
to Geelong
Werribee
Werribee East
Network Resilience
Average segmental betweenness in relation to level of service
Average resilience on journey paths to/from node, weighted by cumulative impediment and number of activities
Nodal Average (Metro): - 3.0
Nodal Average (Wyndham): - 1.2
SNAMUTS
spatial network analysis for multimodal urban transport systems

Melbourne 2036 - Wyndham Separate Lines and additional land use intensification



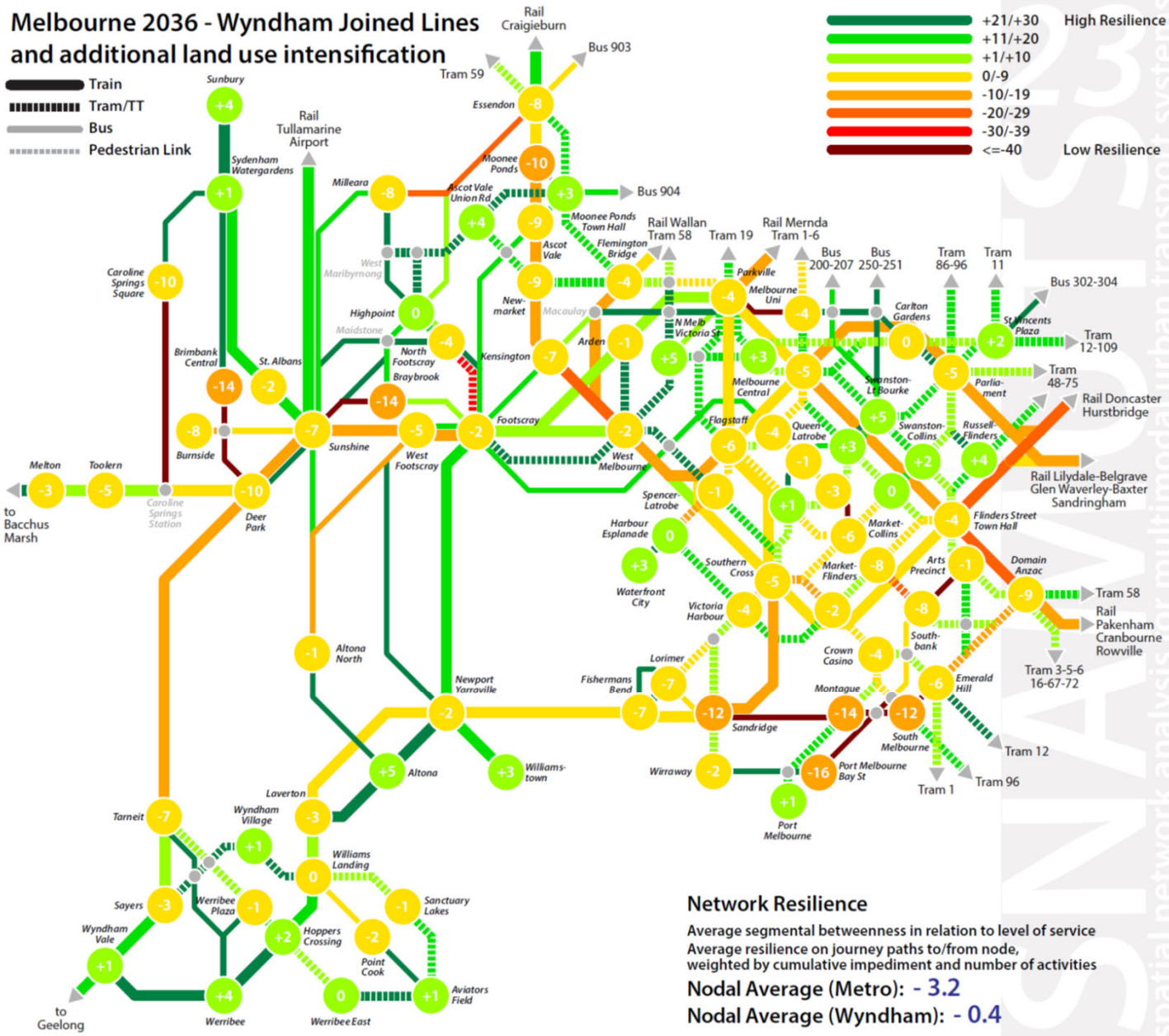
Network Resilience

Average segmental betweenness in relation to level of service
Average resilience on journey paths to/from node, weighted by cumulative impediment and number of activities

Nodal Average (Metro): - 3.2

Nodal Average (Wyndham): - 0.7

Melbourne 2036 - Wyndham Joined Lines and additional land use intensification



Network Resilience

Average segmental betweenness in relation to level of service
Average resilience on journey paths to/from node, weighted by cumulative impediment and number of activities

Nodal Average (Metro): - 3.2

Nodal Average (Wyndham): - 0.4

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spatial network analysis for multimodal urban transport systems

travel opportunity flow:

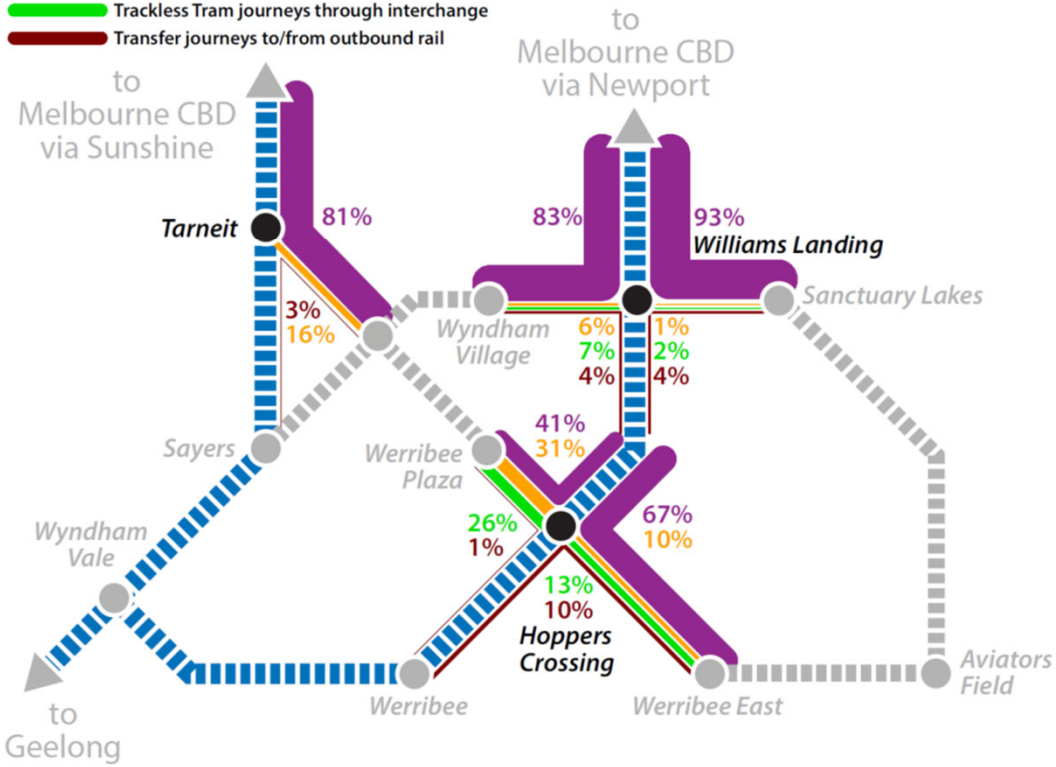
what actually happens at the trackless tram-rail interchanges?

Melbourne 2036
Wyndham Separate Lines and additional land use intensification

Train
Trackless Tram

Travel Opportunity Flow at Rail/Trackless Tram Interchanges

Transfer journeys to/from inbound rail
Destination journeys to/from interchange
Trackless Tram journeys through interchange
Transfer journeys to/from outbound rail

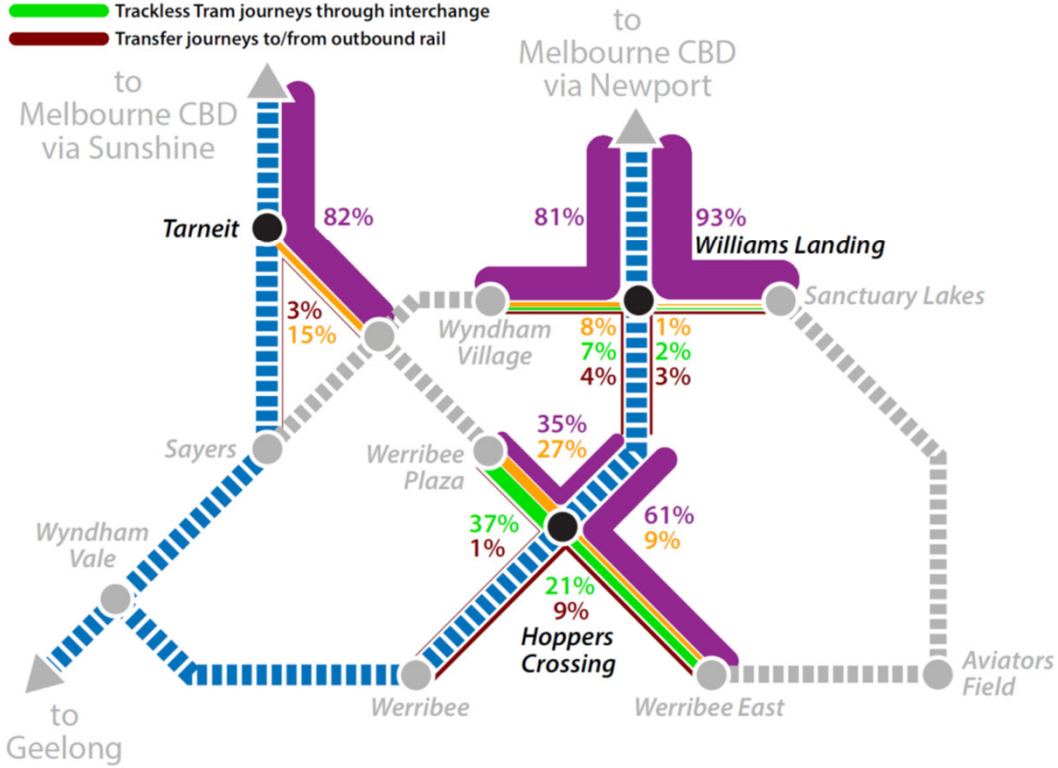


Melbourne 2036
Wyndham Joined Lines and additional land use intensification

Train
Trackless Tram

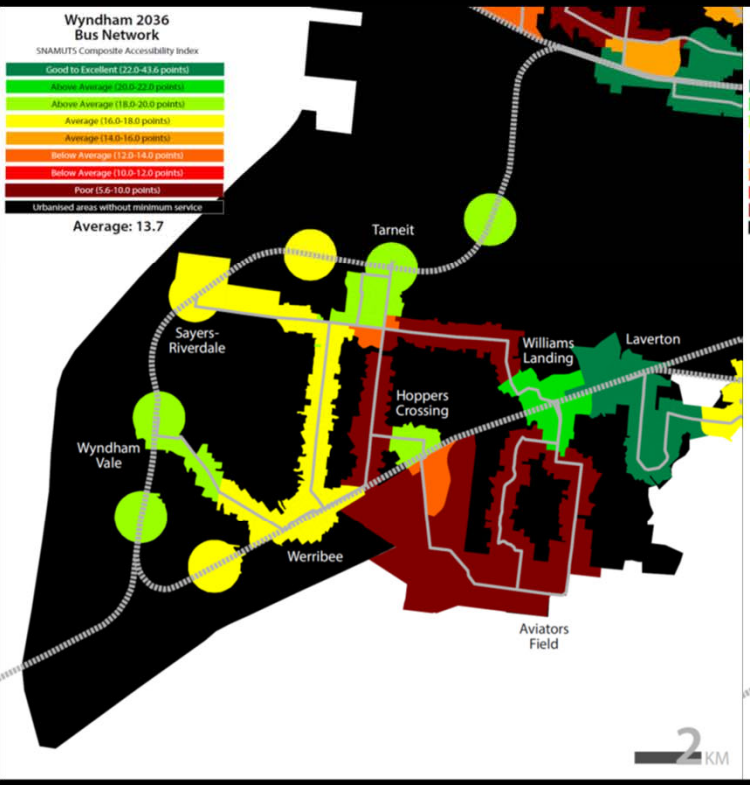
Travel Opportunity Flow at Rail/Trackless Tram Interchanges

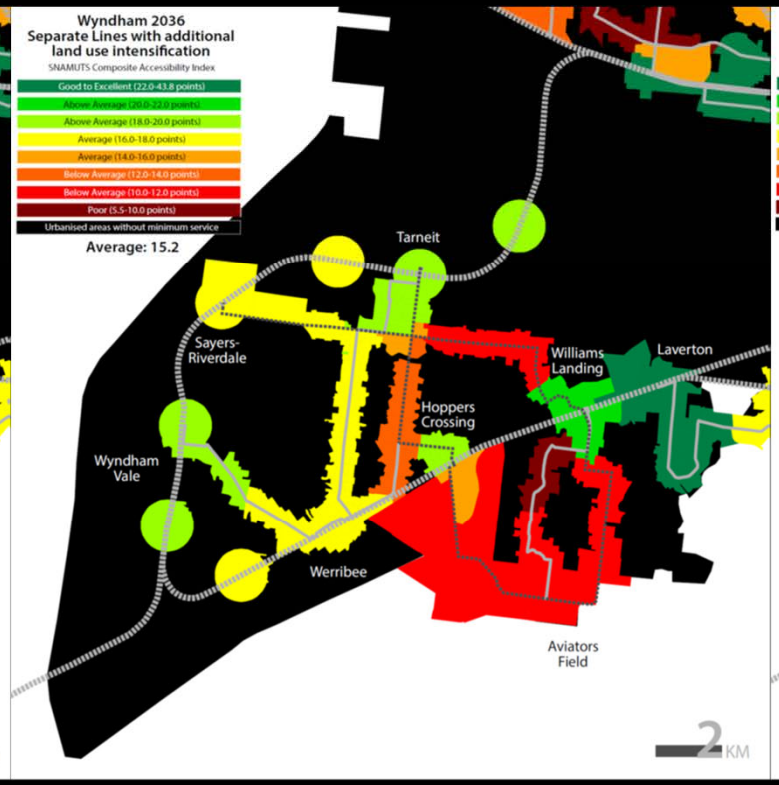
Transfer journeys to/from inbound rail
Destination journeys to/from interchange
Trackless Tram journeys through interchange
Transfer journeys to/from outbound rail

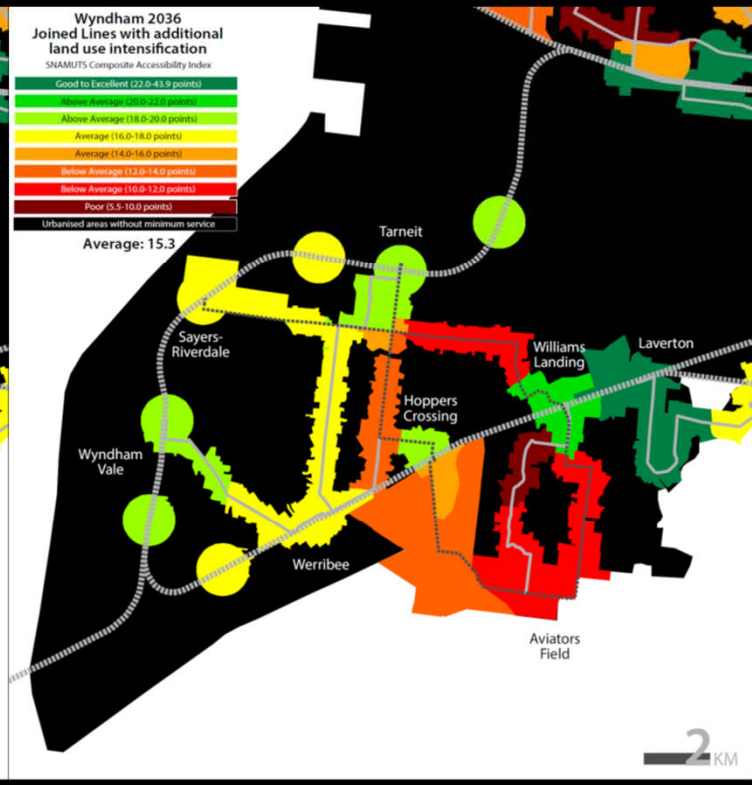


2036 SNAMUTS *23R*	Base	Separate Lines	Joined Lines
Additional Residents and Jobs along Trackless Tram corridors	-	68,000	61,000
Average Closeness Centrality Wyndham	75.5	72.2	72.1
Average Degree Centrality (Transfer Intensity) Wyndham	1.48	1.47	1.44
Average 30-min Contour Catchment Wyndham	36.2%	47.8%	50.8%
Average Nodal Betweenness Wyndham	18.5	22.1	21.8
Average Nodal Resilience Wyndham	-1.2	-0.7	-0.4
Average Nodal Connectivity Wyndham	74	83	83
Average SNAMUTS Composite Score Wyndham	13.7	15.2	15.3

snamuts composite index







2036 Network: Assessment summary

- The Joined Lines scenario has an accessibility performance edge over the Separate Lines scenario, particularly on 30-min travel contours
- The Joined Lines scenario requires less urban intensification than the Separate Lines scenario to justify a Trackless Tram over a bus system
- The Separate Lines scenario puts greater pressure on the radial rail routes, accelerating the need to upgrade them further
- The Joined Lines scenario depends on a transfer-free link across Hoppers Crossing station more than across Williams Landing (though both are desirable)


Target
Thank you!
www.snamuts.com