NSW Treasury

NSW Treasury supplemental Transport submission

December 2023

NSW GOVERNMENT

Acknowledgement of Country

We acknowledge that Aboriginal and Torres Strait Islander peoples are the First Peoples and Traditional Custodians of Australia, and the oldest continuing culture in human history.

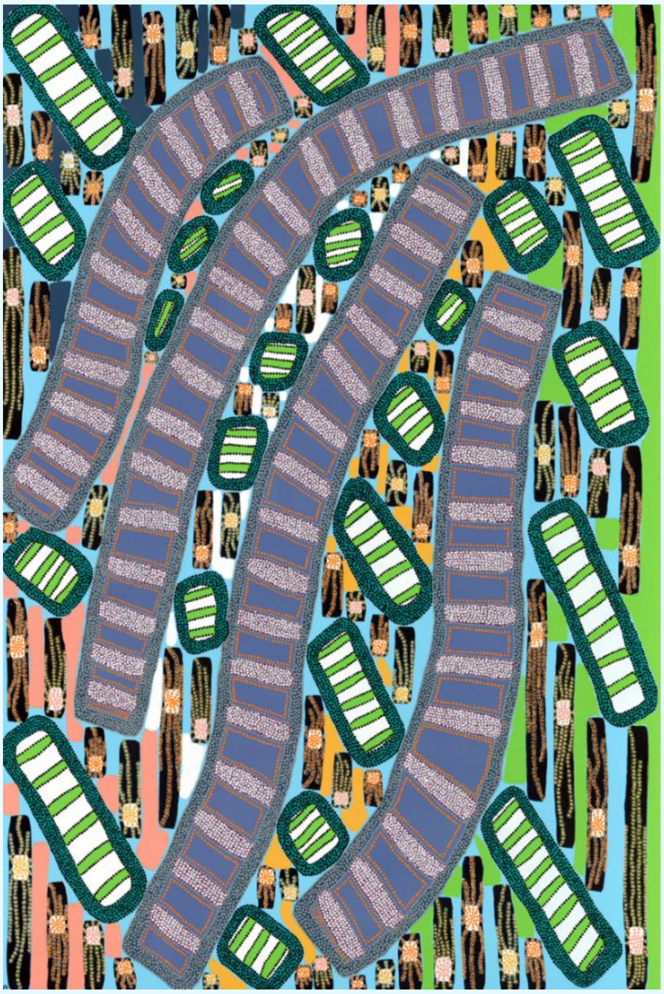
We pay respect to Elders past and present and commit to respecting the lands we walk on, and the communities we walk with.

We celebrate the deep and enduring connection of Aboriginal and Torres Strait Islander peoples to Country and acknowledge their continuing custodianship of the land, seas and sky.

We acknowledge the ongoing stewardship of Aboriginal and Torres Strait Islander peoples, and the important contribution they make to our communities and economies.

We reflect on the continuing impact of government policies and practices, and recognise our responsibility to work together with and for Aboriginal and Torres Strait Islander peoples, families and communities, towards improved economic, social and cultural outcomes.

Artwork:
Regeneration by Josie Rose



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List of Acronyms

PWD:	Population Weighted Density
SA1:	ABS Statistical Area 1
SA2:	ABS Statistical Area 2
SA3:	ABS Statistical Area 3
SA4:	ABS Statistical Area 4
SUA:	ABS Significant Urban Area
UCL	ABS Urban Centres and Localities

NSW response to other states' submissions on Transport assessment

NSW Treasury has drafted the following response to arguments raised by other states which broadly assert that the Commission's Transport model is flawed. While we accept that formal submissions have already been made, the relative newness of the Transport assessment makes it particularly contested. We feel that a response to issues raised by multiple states, especially those that make claims about New South Wales, is justified.

NSW Treasury position

Several states have suggested in their Tranche 1 submissions that the existing urban centre characteristics model is flawed and that it undermines the achievement of fiscal equalisation. We believe many of these arguments are incomplete, misleading, or wrong. This submission addresses the key issues raised by other states which can be broadly categorised into the following themes:

1. The model outcomes effectively recognise cost diseconomies associated with increasing population weighted density (PWD). The existence of such cost diseconomies is not supported by any evidence.
2. Low levels of cost recovery and inefficiencies in the provision of public transport in Sydney increases its net costs and results in the coefficient of the PWD variable being over-estimated.
3. The calculation of population weighted density is flawed.

NSW Treasury strongly rejects the assertion that the current urban transport model reflects an assumption that there are cost diseconomies associated with increases in PWD. We believe this assertion reflects a fundamental misunderstanding of the current urban transport model. Under the current model, higher per capita costs in densely populated cities reflects higher intrinsic per capita demand for public transport services - not higher unit costs of providing individual public transport services. We accept there are economies of scale in the delivery of public transport services, but these are overwhelmed by the need to provide higher per capita service levels in densely populated areas.

We also note that no evidence has been presented by other states that cost inefficiencies are restricted to the provision of public transport services in Sydney and that the provision of public transport in Sydney is excessive.

While we continue to believe that PWD should be used as an explanatory variable within the urban public transport model, we share some of the concerns expressed by other states about the appropriateness of measuring PWD using ABS SA1 boundaries. As reflected in our main submissions to Tranche 1 and the 2024 New Issues Update, we believe the CGC should measure PWD using larger geographic areas that are more consistent with public transport planning and less sensitive to arbitrary census boundary changes.

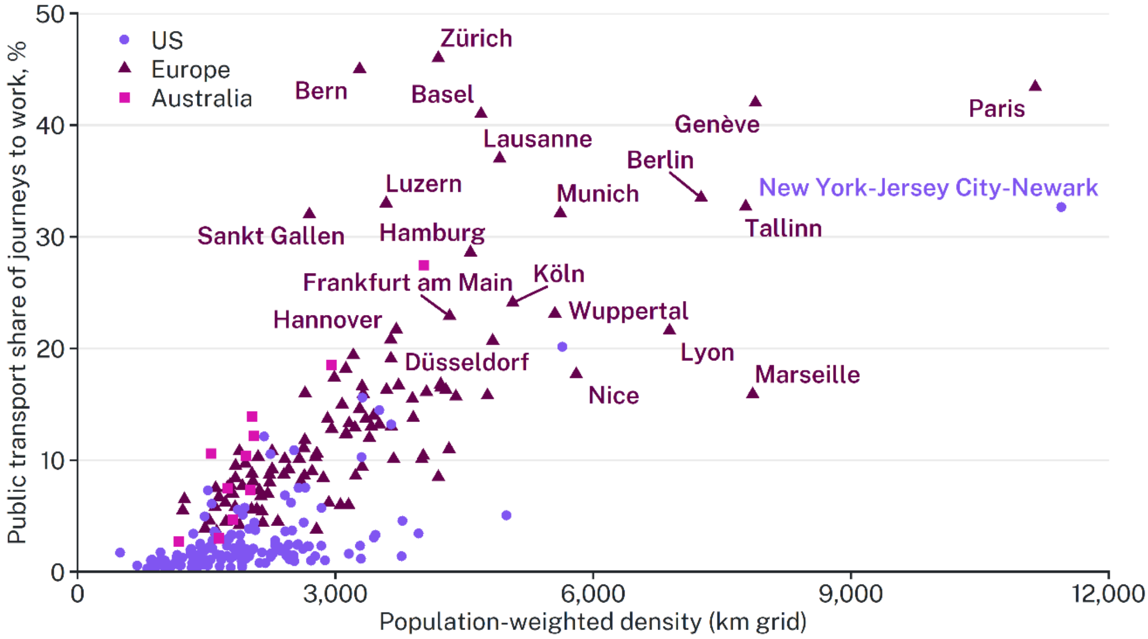
1 Public transport demand and population density

In its 2020 Review, the Commission referenced the international literature showing that demand for public transport is expected to be higher in cities with higher densities. This is a function of the generally positive relationship between urban population and density, the impacts of congestion (driven by density), and the surface area of urban centres (urban sprawl undermines public transport by diffusing population and encouraging private car use).

NSW Treasury supports this analysis and continues to believe that any assessment of the need for public transport expenditure must include the impact of varying levels of population density on the demand for services.

We compiled journey to work data[1] for major cities in Australia, the United States and Europe, and found that there is clearly a strong link between density and public transport usage (Figure 1). While American cities are generally known for their car-centricity for historical and cultural reasons[2] they also tend to be relatively low density. The relationship between density and public transit is stronger in Europe, although there appears to be significant variation in urban characteristics and/or policy arrangements. For example, Swiss cities have a much higher level of public transit use than the rest of Europe. The effect of density in Australia appears even stronger, and there is less deviation from the trend. This implies that there is relatively low variation in other urban centre characteristics and/or transport policy in Australia.

Figure 1: International comparison of density and public transport, population over 250,000



Note: 2016 Functional Urban Area (FUA) data used for Europe. Limited to Germany, France, Switzerland, Finland and Estonia due to availability.

Source: U.S. Census Bureau, Eurostat, ABS

Since public transport mode share increases with population density, more densely populated cities are required to spend more on transport infrastructure and services. Any model based on per capita (not per user) spending within an urban area will result in a positive coefficient on a density variable.

Given the above, it is not surprising that Sydney and Melbourne have higher per capita urban public transport expenditures. The suggestion by some states that the CGC should assume the same level of per capita demand and expenditure for each urban area runs contrary to evidence and intuition. Such an assumption would be equivalent to not recognising the higher health service delivery costs associated with remote communities.

Some states have suggested that the relationship between density and public transport passenger numbers is overstated by higher passenger numbers in the capital cities. This was presented as

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[1] Year of journey to work data: Australia 2016; Europe 2016; US 2019.

[2] https://www.bloomberg.com/news/articles/2014-02-04/9-reasons-the-u-s-ended-up-so-much-more-car-dependent-than-europe

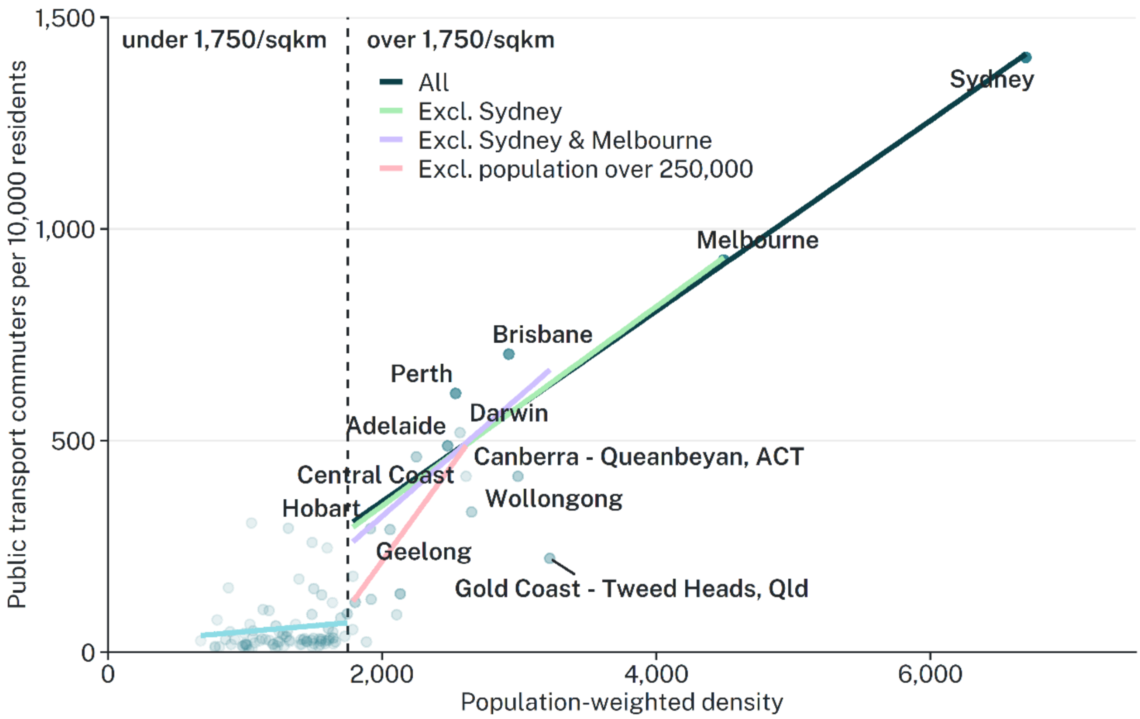
undermining the explanatory validity of density as a driver of public transport demand. However, this ignores that:

- The overwhelming need for public transport provision is within capital cities, and that capital cities themselves make up 75 per cent of the total urban population in the Commission's data. It is reasonable that they have significant weight in the estimation of the impact of density.
- At a certain level of population and population density, heavy or metro-style rail becomes the only viable option to address congestion issues. The CGC's analysis reflects this reality.
- Below a certain threshold, population density does not cause congestion. NSW Treasury's submission to Tranche 1 contended that density only drives public transport demand above a certain threshold which is associated with increasing congestion. This is intuitively reasonable and evidenced in both Australian and US data.

In smaller urban areas where density is lower, congestion is lower. In these cases, public transport provision is more likely to be driven by policy choice – or not provided at all.

NSW Treasury replicated the analysis of the relationship between PWD and public transport users per capita undertaken by other states, accounting for the implications of the above points (Figure 2). We find that, contrary to the claims made, the slope coefficient on PWD (above the 1,750 threshold) is effectively unchanged when excluding Sydney from the sample. Moreover, the slope coefficient on PWD actually increases when removing all cities with populations over 250,000; this is accompanied by a lower intercept coefficient which is expected given the exclusion of cities with heavy rail systems. While we do not propose that these cities should be excluded, we do submit that, once an intuitively reasonable lower threshold for congestion is taken into consideration, the relationship between density and public transport usage is clear and unaffected by 'extreme' observations.

Figure 2: Public transport commuters and population density, 2019-20



Source: CGC calculations, NSW Treasury

2 Population density and government policy decisions

In previous submissions we have addressed the issue of whether higher relative population density in Sydney results from government policy decisions. We believe we have provided sufficient evidence to reject such a conclusion. However, we again point out that should our conclusions be rejected, it would be incumbent on the Commission to adjust transfer duty and land tax assessments to remove the impact of higher population densities on property values as well as potentially adjusting the current payroll tax assessment.

3 Principles of equalisation

The Commission equalises to average state policy (efficiency and service standards), having regard to individual and unavoidable state characteristics and circumstances. To the extent that states are either more or less efficient than average or provide a higher or lower than average standard of services, jurisdictions should neither be rewarded nor punished. The Commission's role is not to determine GST relativities based on setting externally determined efficiency benchmarks or service provision standards.

Given the potential 'dominant state' position of Sydney and Melbourne in determining the PWD urban transport model coefficient, concerns have been raised as to whether higher per capita costs in densely populated cities reflect relative cost inefficiencies and/or excess service provision, rather than underlying need.

Despite assertions to the contrary, evidence of significant jurisdictional differences in levels of efficiency in the provision of urban transport services has not been provided.[3] Similarly, no evidence of excessive service provision in Sydney has been provided. Given the load factors on Sydney's public transport system and levels of road congestion, suggestions of excessive public transport service provision appear implausible. In fact, the overwhelming weight of evidence supports the case that higher urban transport costs in Sydney are primarily attributable to higher per capita intrinsic public transport demand.[4]

4 Economies of scale

International literature suggests possible economies of scale in the delivery of public transport services. While this is not specific to the Australian context, there is some cause to believe that Australian transport networks would also exhibit economies of scale.

This is exactly what the Commission's model finds. The Commission's Transport assessment reflects economies of scale in the provision of transport services through the inclusion of the log of passenger numbers as an explanatory variable in the transport cost model. This functional form implies that total costs grow progressively more slowly as passenger numbers increase. This modelling result is consistent with international literature.

Claims that the Commission's model is at odds with international research on economies of scale and density fundamentally misunderstand what the Commission's model does. While other states have presented evidence that public transport networks globally exhibit cost economies of scale and/or density, these studies are not directly relevant to the Commission's model which considers costs per capita across urban areas based on the entire population of those areas taking into account differences in intrinsic demand, not the cost of delivery per user or some other direct input.

Taking Graham et al (2003)[5] as an example, the authors find persistent economies of density. They define economies of density as the relationship between outputs and inputs with the rail network held

[3] Some evidence of public transport inefficiency in NSW has been presented by other states. However, no evidence has been presented that the position in other states is different.

[4] Higher unit costs in Sydney also arise from its unique topographical and geographical features (a significant harbour, mountains to the west, extensive national parklands to the south, and the ocean to the east).

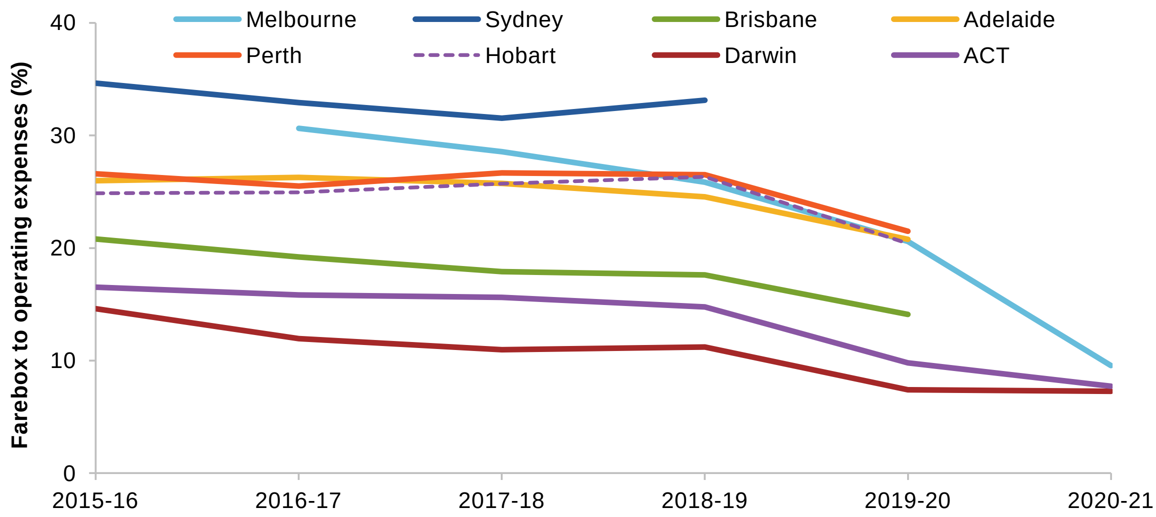
[5] D. Graham, A. Fidalgo do Couto, W. Adeney, & S. Glaister 2003. "Economies of scale and density in urban rail transport: effects on productivity." Transportation Research Part E: Logistics and Transportation Review.

fixed. In other words, positive economies of density mean that for a fixed transport network, the ratio of outputs (eg passenger kilometres) to inputs (eg total expenses) increases with higher population density as, for example, load factors on public transport increase. This has little direct relevance to the Commission's assessment which includes a density variable to capture the total relationship between population density and overall government investment in transport. That is, the PWD variable captures both changes in unit costs per service as well as changes in the required volume of services.

5 Interstate comparisons of public transport cost recovery

It has been asserted that public transport cost recovery in Sydney is low and that this results in the over-estimation of the PWD coefficient. We point to a research paper published by the Productivity Commission[6] which indicates that cost recovery in Sydney exceeds that of other capital cities by a considerable margin (Figure 3). While Sydney data was not available for COVID affected years, it can be reasonably assumed that cost recovery fell during this time. We expect, however, that cost recovery will approximately return to pre-COVID levels over time.

Figure 3: Public transport fares as a share of operating expenses



Source: Productivity Commission

6 Measuring population density

NSW Treasury continues to believe that PWD is the best and most appropriate indicator for use in the urban transport model. Nevertheless, states have identified various issues with the PWD variable used by the Commission, particularly in relation to its reliance on SA1 data. These issues include:

1. Inconsistencies in the treatment of non-residential land affect PWD
2. Inconsistencies in the classification of ABS boundaries affect PWD
3. New developments disproportionately affect PWD
4. Geographic factors affect PWD.

Common to all these issues is that arbitrary decisions concerning SA1 boundaries can materially change the measured PWD. Examples might include golf courses which, in some states, make up an

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[6] Productivity Commission, *Public transport pricing*, December 2021.

entire SA1, while in other states are included within an SA1 with other residential areas. In the latter case, measured PWD for that state is lowered.

To some extent, any measure of PWD will have an element of arbitrariness linked to where geographic boundaries are drawn. However, NSW believes that the extent of this arbitrariness, and its impact on the distribution of GST grants, should be minimised where possible.

When measuring PWD, the most appropriate sub-area must be identified. In our submission to the 2024 Update, we argued that measuring PWD using SA1 sub-areas was too sensitive to boundary changes.

Conceptually, the level of geography used in the PWD calculation should reflect the level at which people "experience" density[7]. We have argued that this is best captured at the SA2 level. Urban transport congestion is a function of neighbourhood characteristics. The SA2 level of geography aligns more closely to the "neighbourhood" level and therefore represents the level on which urban transport decisions are made – both by the individual and by transport planners.

In suggesting SA2 as the building block for PWD, we note that transport planning is not determined at an SA1 level – which, in major urban centres, can represent only a portion of a street block. High concentrations of population in such small areas need to be surrounded by other high concentrations of population for the provision of public transport infrastructure to be necessary.

While our views on the use of SA2 geography was conceptual, it was also prompted by anomalous results in the data presented in the 2024 New Issues paper. The analysis of other states has focused on various practical issues associated with SA1 data and its inconsistent application across states. We believe that their analysis bolsters our position that PWD should be calculated based on SA2 sub-areas.

In suggesting SA2 data for measuring PWD, we believe that most, if not all, of the concerns regarding practicality and inconsistency raised by other jurisdictions will be addressed (noting that only populations residing in the intersection of an SA2 and relevant urban centres and localities (UCL) will be counted). Where SA2s encompass broadly rural areas, populations from those areas are unlikely to be allocated to UCLs. SA2 areas are large enough that non-residential areas (golf clubs, parks, industrial areas etc) will be consistently included in broader SA2 areas across all states. We note that Sydney's relative density will decrease if PWD is calculated based on SA2 boundaries.

Ideally, PWD would be calculated based on consistently sized and shaped sub-areas. This would eliminate any concern regarding the comparability of sub-area boundary shape and size between states. Unfortunately, the SUAs identified by the Commission are based on the Australian Statistical Geography Standard. This means that SUAs are based on aggregations of SA1s which vary in size (as do SA2s).

The ABS has released a population grid. While the grid will not exactly align to SUA boundaries, it allowed us to calculate the PWD of the different capital cities based on a perfectly consistent grid. This gives a good sense of the actual relative PWD of the cities, free of any concern regarding boundaries[8]. We have provided an illustration of the population grid aligned with Sydney's SUA and UCL boundaries in Figure 4.

This grid-based analysis reveals that Sydney is significantly more dense than other Australian capital cities. This finding is broadly consistent with the Commission's existing calculations based on SA1 data and potential calculations based on SA2 data. In fact, Sydney is found to be more dense than other capital cities regardless of the size of the sub-area chosen. This is shown in Figure 5. Of course,

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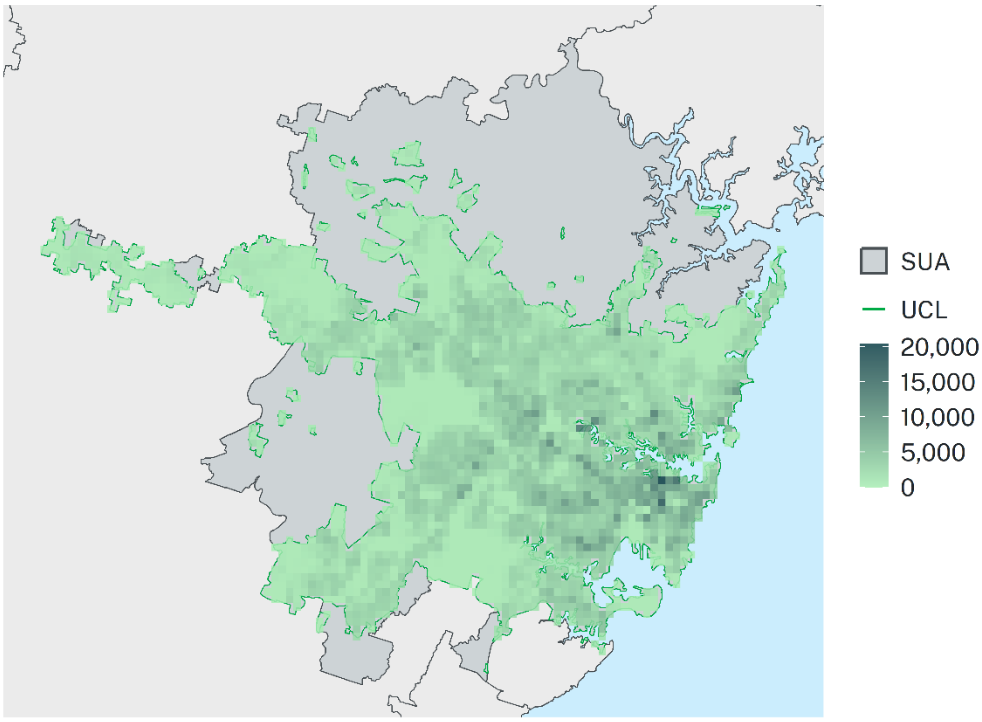
[7] Ottensmann, J.R., *The Use (and Misuse) of Population-Weighted Density*, 2021. Available at SSRN 3970248.

[8] We note that the size of the grid can still impact the calculated PWD. The grid is nonetheless highly reliable for assessing relative densities of different cities.

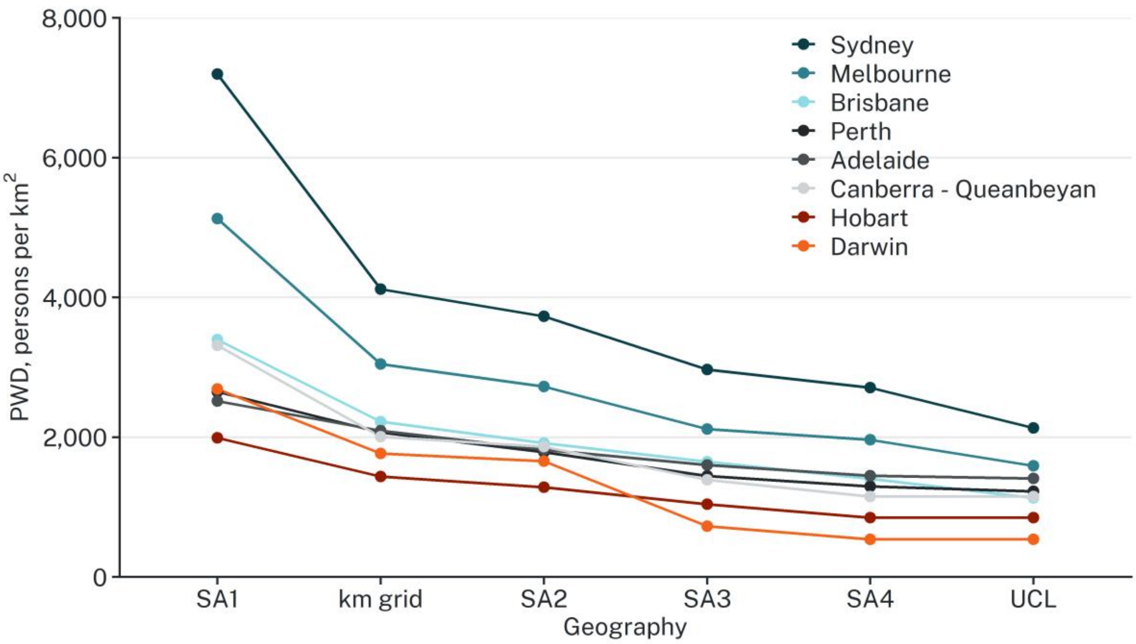
as the size of the sub-area increases beyond that at which people experience density and make public transport decisions, the usefulness of the PWD calculation diminishes.

Figure 4: Sydney density from 1km population grid, 2021-22



Source: ABS 1km population grid

Figure 5: Weighted density of capital cities using alternative geography structures, 2021-22



Note: PWD at all geographies (except the km grid) calculated from SA1 level data. All geographies have been split by UCL.

Source: ABS regional population

Queensland raised concerns with possible inconsistencies in UCL classifications, noting that the inclusion of low density SA1s in UCL areas can "substantially dilute PWD". No evidence was provided to support the materiality of this claim. We compared estimates of PWD for the capital cities when including all SA1s in an SUA, and only including SA1s within a UCL (Table 1). This illustrates that the inclusion of a large volume of low density SA1s (all of those that are not located in a UCL) would only decrease the PWD estimate by 2% on average. Therefore, the inclusion of residential areas such as Elimbah, Bribie Island, Upper Caboolture, Mount Nebo, Thagoona and Mount Cotton in the PWD calculation likely has a negligible effect for Brisbane. We note that the effect is larger for Hobart, which likely reflects a higher share of its population residing outside of urban centres.

Table 1: Alternative PWD estimates of capital cities, 2021-22

	Syd	Mel	Bri	Per	Ade	Can	Hob	Dar	Ave
SA1									
All SUA	7,099.1	5,069.9	3,314.9	2,609.7	2,476.3	3,314.3	1,861.1	2,596.8	3,542.8
UCL only	7,195.9	5,125.4	3,396.7	2,648.6	2,518.2	3,315.5	1,990.5	2,690.0	3,610.1
% Diff.	1.4	1.1	2.5	1.5	1.7	0.0	7.0	3.6	1.9
km grid									
All SUA	4,117.0	3,046.0	2,221.2	2,070.9	2,090.5	2,005.8	1,436.3	1,766.8	2,344.3
UCL only	4,206.5	3,115.1	2,298.4	2,130.0	2,147.6	2,013.4	1,581.3	1,835.5	2,416.0
% Diff.	2.2	2.3	3.5	2.9	2.7	0.4	10.1	3.9	3.1
SA2									
All SUA	3,679.4	2,694.2	1,869.2	1,762.1	1,792.7	1,863.8	1,200.7	1,598.2	2,057.5
UCL only	3,729.5	2,723.6	1,915.3	1,788.5	1,823.6	1,864.5	1,284.1	1,655.7	2,098.1
% Diff.	1.4	1.1	2.5	1.5	1.7	0.0	6.9	3.6	2.0
SA3									
All SUA	2,929.0	2,092.1	1,610.4	1,423.7	1,573.4	1,390.6	972.8	703.7	1,587.0
UCL only	2,968.9	2,114.9	1,650.2	1,445.1	1,600.5	1,391.2	1,040.2	728.2	1,617.4
% Diff.	1.4	1.1	2.5	1.5	1.7	0.0	6.9	3.5	1.9
SA4									
All SUA	2,673.8	1,943.4	1,372.3	1,276.4	1,422.7	1,150.7	792.4	520.7	1,394.0
UCL only	2,710.2	1,964.7	1,406.3	1,295.6	1,447.2	1,151.1	847.3	538.6	1,420.1
% Diff.	1.4	1.1	2.5	1.5	1.7	0.0	6.9	3.4	1.9

Note: UCL - Urban Centres and Localities. All measures split parcels according to UCL designation.

Finally, Queensland has noted that the assessed urban transport need associated with PWD is non-intuitive. This was on the basis that the assessed need of individual SA1s was at times unbelievably large. NSW Treasury rejects this analysis. The urban transport model has been designed to calculate transport needs at the SUA level, based on the PWD of the SUA and cannot be applied to derive transport needs for an individual SA1. Had the cost regression been run on costs in individual SA1s (if it were possible to obtain cost data at this level), the estimated coefficients would be significantly different. There would also be intracity variation in the distance to work variable. Only then could transport needs for individual SA1s be inferred.

7 Contemporaneity

Queensland and South Australia raised concerns with the impact of the COVID-19 pandemic on the conceptual validity of the urban transport assessment. While NSW Treasury agrees that the pandemic had significant effects on urban transport net expenditure and the 2021 Census journey to work statistics, this has not changed the underlying drivers of urban transport services. Moreover, we do not expect that the 2021 Census journey to work data would have been radically different from the 2016 Census in the absence of the pandemic.

Since average state policy was to continue with relatively normal levels of public transport availability during the pandemic, we believe that the urban centre characteristics model remained valid during this period. Accordingly, the model remains valid now and into the foreseeable future.