Our City Tomorrow

Wellington City Spatial Plan & Draft District Plan

Johnsonville walkable catchment testing

2 December 2021

Overview

Travel rate models (such as walkable catchment models) are commonly used to understand the dynamics of individuals' movement through space. This type of analysis has many applications within city planning, emergency evacuation routes and community service provision planning.

Wellington City Council reviewed and updated its walking network in late 2020/early 2021 using pedestrian infrastructure pathways (footpaths, crossings, tracks), topography, and walking rate calculations.

This network was used to create walkable catchments for the Wellington City Spatial Plan (adopted by the Pūroro Āmua - Planning and Environment Committee on 24 June 2021) in line with the guidance[1] produced by the Ministry for the Environment to support implementation of the intensification provisions of the National Policy Statement on Urban Development 2020 (NPS-UD 2020).

Policy 3(c) of the NPS-UD requires Tier 1 local authorities to amend their district plans to enable building heights of at least six storeys within walkable catchments of existing and planned rapid transit stops and the edge of both city centre zones and metropolitan centre zones.

Consistent with the NPS-UD intensification requirements, walkable catchments are used to identify areas suitable for intensification based on their access to amenities such as public transport, commercial activities, and community services. More information on the generation of the walking catchments used in the Spatial Plan is available here. These walkable catchments provide the basis for the areas identified as Medium Density Residential Zone in the Draft District Plan.

During the 24 June Committee meeting to adopt the Spatial Plan, a resolution was passed for Council officers to prepare additional evidence to support the 10-minute walking catchments applied in Johnsonville, particularly where it extends beyond the existing Medium Density Residential Area 2 Johnsonville (MDRA) in the operative District Plan. This document explains what walkable catchments are, how they have been calculated, the difference between the operative District Plan MDRA areas in Johnsonville and the 2021 walkable catchments, and outlines the additional specific work undertaken by officers in Johnsonville in response to the Committee's resolution.

[1] Ministry for the Environment. 2020. *Understanding and implementing intensification provisions for the National Policy Statement on Urban Development.* Wellington: Ministry for the Environment. The guidance is intended to help local authorities understand and implement the requirements of the intensification provisions in the National Policy Statement on Urban Development 2020 (NPS-UD). The intensification provisions are Objective 3, Policies 3 to 5, and clauses 3.31 to 3.34 of subpart 6.

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Summary of key points

- The NPS-UD came into effect in August 2020. It contains a series of requirements the Council must implement through its District Plan.
- Policy 3 of the NPS-UD requires Council to enable intensification of at least 6 storeys within walkable catchments of existing and planned rapid transit stops and the edge of both city centre zones and metropolitan centre zones (unless NPS-UD 'qualifying matters' apply, e.g. natural hazards, public open space, heritage, designations, etc).
- Johnsonville centre is identified as a metropolitan centre in the Spatial Plan (adopted 24 June 2021) and is zoned Metropolitan Centre in the Draft District Plan (2021).
- The Council has reviewed and updated its city-wide walking network model using pedestrian infrastructure pathways (footpaths, crossings, tracks), topography and walking rate calculations.
- In July 2021, Council officers conducted a further 17.8km of walking network catchment testing in Johnsonville to collect additional evidence for the walking network calculations.
- The updated walking network underpins the walkable catchments used in the Spatial Plan. The walkable catchments are consistent with Ministry for the Environment guidance supporting the implementation of the NPS-UD.
- The walkable catchments in the Spatial Plan provide the basis for the areas identified as Medium Density Residential Zone in the Draft District Plan.
- There are a number of differences between the between the operative District Plan MDRA in Johnsonville and the 2021 Johnsonville walkable catchments and the draft Medium Density Residential Zone areas in the Draft District Plan.
- The Johnsonville MDRA in the operative District Plan are based on walking catchments but walkability was only one of the considerations in the development of the MDRA and the walking catchments (and the method to develop them) predate the NPS-UD and the implementation guidance developed by the Ministry for the Environment. They are also based on walking network data dated from 2010.
- There has been significant change in the resource management policy environment since the Environment Court decision in 2013 on the Johnsonville MDRA. This includes the NPS-UD intensification requirements the Council must implement through its District Plan.

Wellington City Walking Network and Walkable Catchments

What is a walkable catchment?

The implementation guidance produced to support the NPS-UD intensification requirements defines a walkable catchment as "the area an average person could walk from a specific point to get to multiple destinations". The guidance states that a walkable catchment shows where and how far pedestrians can travel from a certain start point in any given direction, and that this can be done in two ways: using distance (e.g. 800m) or using time (e.g. 10-minutes).

Wellington City Council has used time to create walkable catchments because this can account for factors such as slower walking speeds caused by steep topography and delays/wait times at intersections and crossing points, and therefore provides a more accurate 'real world' result using a walking network model. In contrast, using distance (e.g. 800m) to define walking catchments does not take into consideration factors such as topography, walking speed, and the presence of pedestrian road crossings etc, and as a result, is less accurate.

What is the difference between walkability and accessibility?

The NPS-UD requires intensification to be enabled within walkable catchment areas, but it is acknowledged that not all of these catchment areas will be accessible for all people because of particular physical and built environment conditions. For example: areas with steps will not be accessible for people in wheelchairs and will be difficult to access by people using pushing prams; narrow footpaths may be difficult to access by wheelchairs and prams; some road crossings and pathways will be difficult for people with impaired vision to navigate.

Therefore, whilst not every part of a walkable catchment will be accessible for all people, it does not invalidate the walking catchment or mean that certain areas must be excluded from medium density development enablement. The approach to enabling increased opportunities for housing intensification is a whole of city approach, with a range of different housing typologies provided across the city, catering for a range of lifestyles, ages, mobility, and accessibility needs.

The use of walkable catchments is a planning tool required by the NPS-UD to ensure intensification is located close to amenities and services; it is not intended to be a measure of accessibility for all people within the catchment.

What is a walking network?

A walking network is a collection of paths and tracks a pedestrian uses when travelling to different locations. Information, such as walking speed and slope, is added to these paths to model 'real-world' conditions. This allows estimates of walkable catchment areas to be calculated.

What does the Wellington City walking network include?

The walking network for Wellington City contains the following information:

- Footpaths, pathways, park tracks, and popular walking routes through open space/reserves
- Pedestrian tunnels and bridges
- Controlled road crossing points with an average wait time (e.g. traffic signals)
- Uncontrolled road crossing points
- Residential or Local Roads with low average daily traffic (ADT), including roads without footpaths
- Paths or routes with evidence of pedestrian use
- Slope gradient
- Low, moderate, and high walking speed estimates based on direction of travel, for example walking uphill versus downhill

What does the Wellington City walking network not include?

The walking network model does not account for the quality or perceived safety of walking routes and pathways. Path quality is a subjective measure that is not defined within the NPS-UD 2020 or the associated implementation guidance. Variation within the physical and social environment can influence the walking patterns of individuals, by providing incentives or deterrents that can affect people differently. Variations such as path quality, width,

lighting, perceptions of safety, or accessibility (which can act as a path deterrents) have not been modelled within the walkable catchment calculations because of the inconsistent ways these factors may affect people. The model does not currently identify steps separately from pathways due to the complexities of modelling steps. However the incorporation of steps is intended for inclusion into future iterations of the walking network model.

Walkable Catchment Calculations

Walking speed is highly variable. There is no such thing as an "average" walking speed that can be applied to everyone.

Waka Kotahi (NZTA) currently uses an average walking speed between 1.3m/s (4.7km/hr) and 1.5m/s (5.4km/hr) for fit, healthy adults[2]. However, this speed does not model the impact of slope and has been found to be too fast for low and moderate speed walkers when compared to scientific literature.

Wellington City Council developed a model of walking speed calculations using scientific papers that measured walking speed ranges for different age groups and abilities. These included international studies of population groups such as young children and retirees, as well as papers that analysed the effect of path slope on walking speed.

To create this walking network model for Wellington, anonymised fitness tracking data was used – collected using the application Strava. To supplement this, Wellington City Council staff (covering a range of fitness abilities, ages, and genders) tracked their walking movements over a period of two weeks, covering approximately 48km of Wellington's walkable areas across all Wellington City Council wards. This data was compared to the international walking speed literature to determine an accurate model of walking speed for the Wellington city context.

The outcome of this was values on flat topography for low (0.93m/s, 3.4km/hr), moderate (1.1m/s, 4.0km/hr) and high (1.35m/s, 4.9km/hr) walking speeds. A Lorentz function was used to interpolate speeds across different slope gradients, using the data of walking movements in Wellington (see **Figure 1** below).

[2] Waka Kotahi NZTA. 2009. *Pedestrian Planning and Design Guide. The Principals of Pedestrian Network Planning - Pedestrian Characteristics Preference and Activity, 3.4 Walking Speeds. https://www.nzta.govt.nz/assets/resources/pedestrian-planning-guide/docs/chapter-3.pdf*

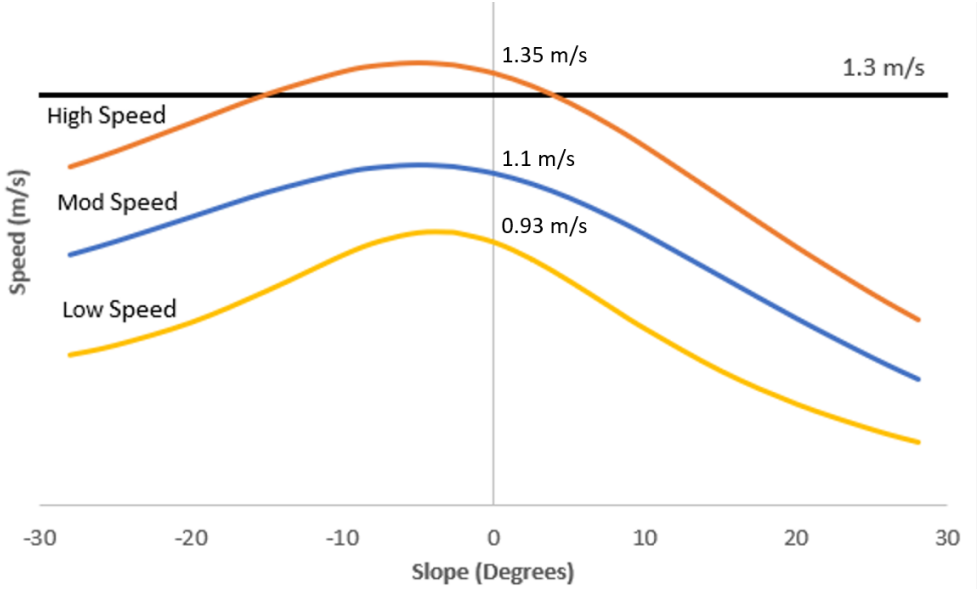


Figure 1. Graph of low, medium, and high-speed walking modes variation with slope from the WCC walking network model.

Figure 2 below includes the Lorentz function equation and function variables of the graph in **Figure 1**. Any value of slope angle θ (in degrees) can be used in the Lorentz equation (with the corresponding variables) to create estimates of walking speed based on the WCC walking network model.

$$v_{Lorentz} = c\left(\frac{1}{\pi b\left[1+\left(\frac{\theta-a}{b}\right)^2\right]}\right) + d + e\theta$$

Walking travel mode	a	b	c	d	e
Low	-3	17.43432277	30.242975	0.402487708	-0.00293
Moderate	-2.4	29.90745947	71.3670039	0.351300386	-0.00424
High	-2.4	29.87685812	84.778458	0.4548466	-0.00529

Figure 2. Lorentz function and variable table used in the WCC walking network model; including Low, Moderate, and High walking travel modes.[3] Use the variables of each travel mode in the Lorentz function to calculate speeds for low, moderate, and high walking speed modes.

The WCC Walking Network uses slope values from the 2020 WCC Digital Elevation Model as the input slope for each path segment. The resultant speed determines how quickly the network travels along each path segment.

Walkable catchments were created using an average of low and moderate walking speed outputs, traveling towards and away from each point of interest (e.g., rapid transit stop, metropolitan centres). This was to ensure the final walkable catchment represents and average of traveling in both directions. These were refined to align with parcel boundaries and road centrelines.

[3] Campbell *et al.* 2019. "*Using crowdsourced fitness tracker data to model the relationship between slope and travel rates*"

Johnsonville Walkable Catchments

The Johnsonville walkable catchment was determined as a 10-minute walkable catchment area from:

- The boundary of the Johnsonville Metropolitan Centre Zone (MCZ)
- Johnsonville Railway Station
- Raroa Railway Station

The walkable catchment extends from Kitchener Tce and Haumia St in the south, Chesterton St in the east, Burdendale Gr in the north, and the intersection of Cortina Ave and Broderick St in the west (see **Appendix 1** for a map of the Johnsonville walkable catchment).

Johnsonville Walkable Catchment Testing (2021)

Of the anonymised Strava data used to develop the walking speed model, 302km of movements were specifically recorded within the Johnsonville area. In addition to this, 5km of walking calculation testing was completed in Johnsonville by Wellington City Council staff (see **Appendix 2** for a map of the anonymised Strava data for Johnsonville exported from Strava Metro).

In July 2021, Council officers conducted a further 17.8km of walking network catchment testing in Johnsonville to collect additional evidence of the walking network calculations. This testing focused on the walking routes along Middleton Rd, Broderick Rd, Woodland Rd (via Frankmoore Ave), Sheridan Tce (via Disraeli St underpass), and Dominion Park St (via Fraser Avenue). **Appendix 1** provides a map of the Johnsonville walking catchment testing routes taken by officers.

Figure 3 below shows the results of walkable catchment testing by Council officers.

Appendix 5 contains photos taken by Council officers during the July 2021 Johnsonville walking network ground testing.

Johnsonville Walkable Catchment Testing	Average Distance (km)	Average Elevation Change (m)	Average Walking Time (mins)
Middleton Rd	0.57	31	**8.30**
Broderick Rd	0.59	11	**7.88**
Woodland Rd (via Frankmoore Ave)	0.53	34	**8.71**
Sheridan Tce (via Disraeli St underpass)	0.62	50	**9.64**
Dominion Park Street (via Fraser Ave)	0.6	37	**9.77**

Figure 3. Summary table of Johnsonville walkable catchment testing by Council officers. Collected in July 2021 using Strava.

Differences between the operative District Plan Johnsonville MDRA (2014) and the Spatial Plan (2021) walkable catchments and Draft District Plan (2021) medium density areas

Following the adoption of the 2006 Urban Development Strategy, work was undertaken to identify areas suitable for intensification. This led to District Plan Change 72 (Residential Review, notified in 2009) which proposed medium density residential areas in Kilbirnie and Johnsonville. The Kilbirnie MDRA became operative in 2010. The Johnsonville MDRA was appealed to the Environment Court and the Court's decision[4] became operative in 2014. The Johnsonville MDRA boundary shown in the operative District Plan reflects the Court's decision.

It is important to note that the Johnsonville MDRA are based on walking catchments (refer maps in **Appendix 4**), but walkability was only one of the considerations in the development of the MDRA and these areas (and the method to develop them) predate the NPS-UD 2020 and the associated implementation guidance developed by the Ministry for the Environment. These walking catchments used are also based on walking network data from 2010.

In recognition of the age of the city-wide walking network model, and in response to submissions received on the Draft Spatial Plan querying the calculation and extent of the walking catchments, Council completed a 'first principles' review of its walking network model (and the resulting walking catchments produced by the model) as part of the finalisation of the Spatial Plan to ensure it is as up to date as possible, fit for purpose, and in alignment with the walking catchment guidance provided by the Ministry for the Environment.

The decision made by the Environment Court on the Johnsonville MDRA and the extent of the zone is acknowledged. However it is important to note that the Council is not bound by this decision in its planning for the future growth of the city, addressing the city's current issues including our housing shortage, and the responses now required (for example) in terms of implementing the specific national direction in the NPS-UD. The Court's decision reflects a point in time and was made in the context of the information available at the time. Given the amount of change since the decision was made (summarised below) and the new national direction to be given effect to through the District Plan, a different decision by the Court could be reasonably expected in today's environment.

There has been a significant amount of change in the resource management policy environment since the Environment Court decision in 2013 on the Johnsonville MDRA areas. This includes a series of specific planning requirements that the Council must implement through its District Plan.

Of most significance is the National Policy Statement on Urban Development 2020 (NPS-UD 2020) and its requirements for Tier 1 local authorities (Wellington City Council is one of these) to enable increased intensification in specific locations. This includes the requirement to amend district plans to enable building heights of at least six storeys within walkable catchments of existing and planned rapid transit stops and the edge of both city centre zones and metropolitan centre zones. This is a mandatory requirement for the Council to implement. The Spatial Plan's walkable catchment areas (within which intensification of at

[4] *Johnsonville Community Association Incorporated v Wellington City Council* [2013] NZEnvC 159.

least six storeys is enabled) were the first step in responding to this, with these areas forming the basis for the Medium Density Residential Zone areas in the Draft District Plan.

Council must also implement the National Planning Standards. The National Planning Standards (the planning standards) outline specific requirements for the structure and format of the District Plan, including for example standards specifying the zone framework, spatial layers and mapping (including colours and shading), and certain definitions. The planning standards aim to provide a consistent structure and format for all district (and regional) plans across the country. The Draft District Plan has been developed to be consistent with the planning standards.

In addition, and as explained in detail above, the Council has undertaken significant work to update and improve its city-wide walking network model so that it is more accurate and realistic, and ensure it accounts for changes in the city's walking network (e.g. new subdivisions, footpath and walking path connections and improvements, new road crossings etc) that have occurred since 2013.

The updated city walking network model has been used as the basis for the calculation of the Spatial Plan's walkable catchment areas. The calculation of walkable catchment areas is consistent with the guidance provided by the Ministry for the Environment on the implementation of the NPS-UD intensification requirements. This guidance was released by the Ministry in September 2020 to support the implementation of the NPS-UD. The Council's previous walking network model (circa 2010) was developed well before this guidance was available and it does not include changes and additions to the walking network over the last 10 years, therefore it cannot be relied upon anymore.

Appendix 3 includes a map showing the difference in spatial extent between the operative District Plan Johnsonville MDRA and the Spatial Plan's Johnsonville walkable catchment area, with the Spatial Plan's walkable catchment covering a much larger area of Johnsonville.

In summary, the differences between these areas can be attributed to:

- The range of improvements in Wellington City Council Walking Network calculation methods since 2013 and the specific analysis and ground-truth testing undertaken in Johnsonville.

- The differences in where the walkable catchments are calculated from. The catchment for the operative District Plan MDRAs in Johnsonville was calculated from the "Johnsonville Triangle" of Moorefield Road, Broderick Road, and Johnsonville Road. By comparison the NPS-UD 2020 requires the walkable catchment to be calculated from the edge of the Metropolitan Centre Zone (MCZ). The Johnsonville MCZ encompasses a larger area than the "Johnsonville Triangle"; the difference between these boundaries is up to 300m along the southern area of Johnsonville Road.

- Inclusion in the adopted Spatial Plan (2021) and Draft District Plan (2021) of areas which were identified as being within the 10-minute walkable catchment in 2013 but were eventually excluded from the MDRA by the Court for reasons not related to walkability. In 2013, a 10-minute walking catchment analysis was one of the considerations underpinning the operative District Plan MDRA areas (see **Appendix 4** evidence maps showing the 2013 10-minute walkable catchment calculations). Other

considerations that informed the size and shape of the MDRA areas included streetscape character and natural boundaries such as open spaces. This resulted in the MDRA differing from the 2013 walking catchment analysis in areas such as Ironside Road. The final (operative) Johnsonville MDRA was further altered by the Environment Court which directed the Council to exclude certain areas (towards Middleton Road and east of the motorway) even though these areas were within the walkable catchment. The NPS-UD 2020 Policy 3(c) now gives statutory weight to walkable catchment areas and requires that these areas be enabled for intensification unless it can be justified that a 'qualifying matter' (as defined by the NPS-UD) applies. This change has resulted in areas that were omitted from the operative District Plan MDRA areas decided by the Court now being included within the walkable catchment and enabled for medium density development.

- The application of a 10-minute walking catchment from the Raroa railway station has increased the walkable catchment extent in the Raroa area. This expanded walking catchment area is a result of the 24 June 2021 Committee decision on the Spatial Plan to extend walking catchments around all rapid transit stops from 5 minutes to 10 minutes.

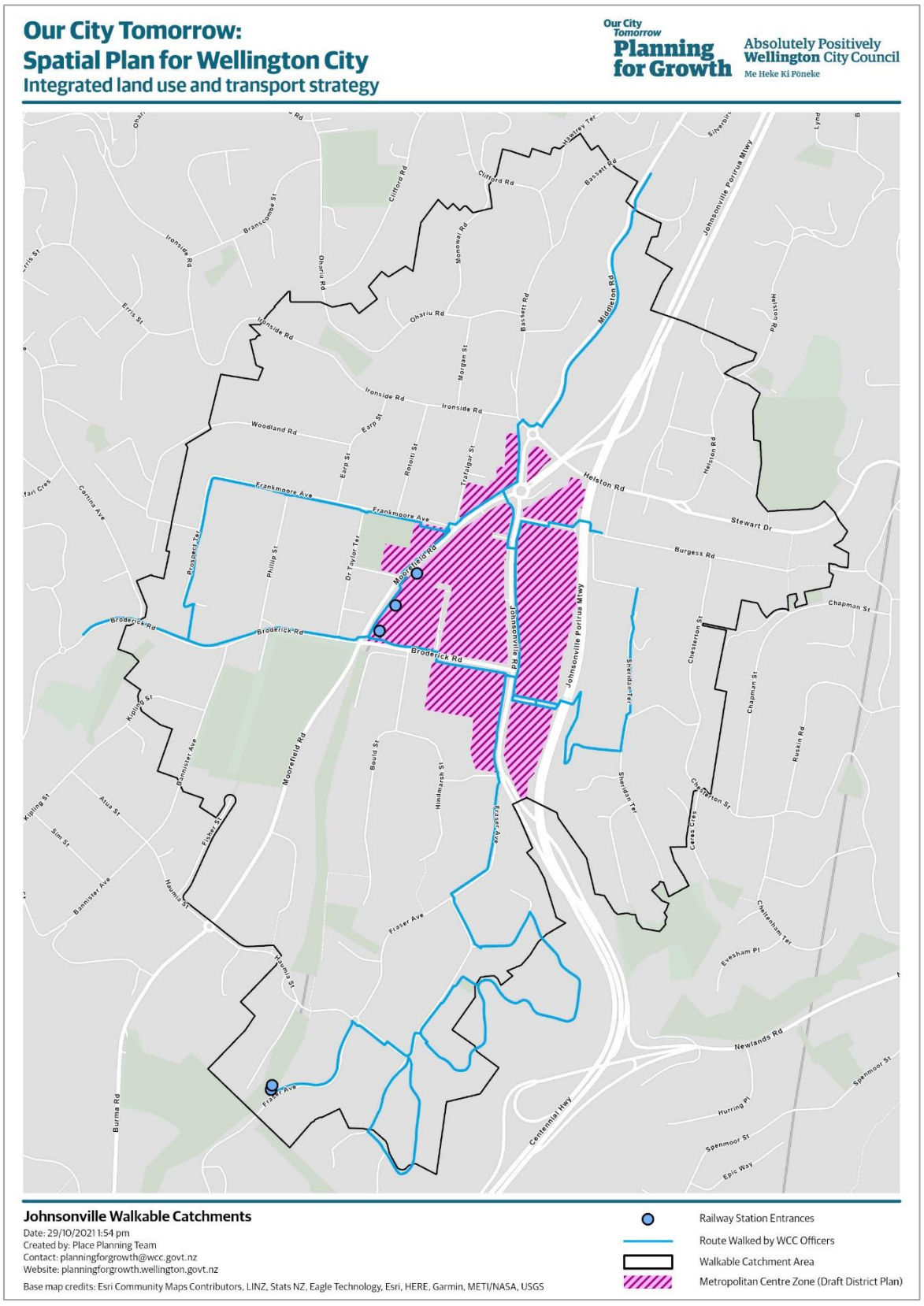
Conclusion

This document responds to the resolution from the 24 June 2021 Planning and Environment Committee meeting requesting that Council officers prepare additional evidence to support the 10-minute walking catchment applied in Johnsonville, particularly where it extends beyond that approved for the Medium Density Residential Area (MDRA) in the currently operative District Plan.

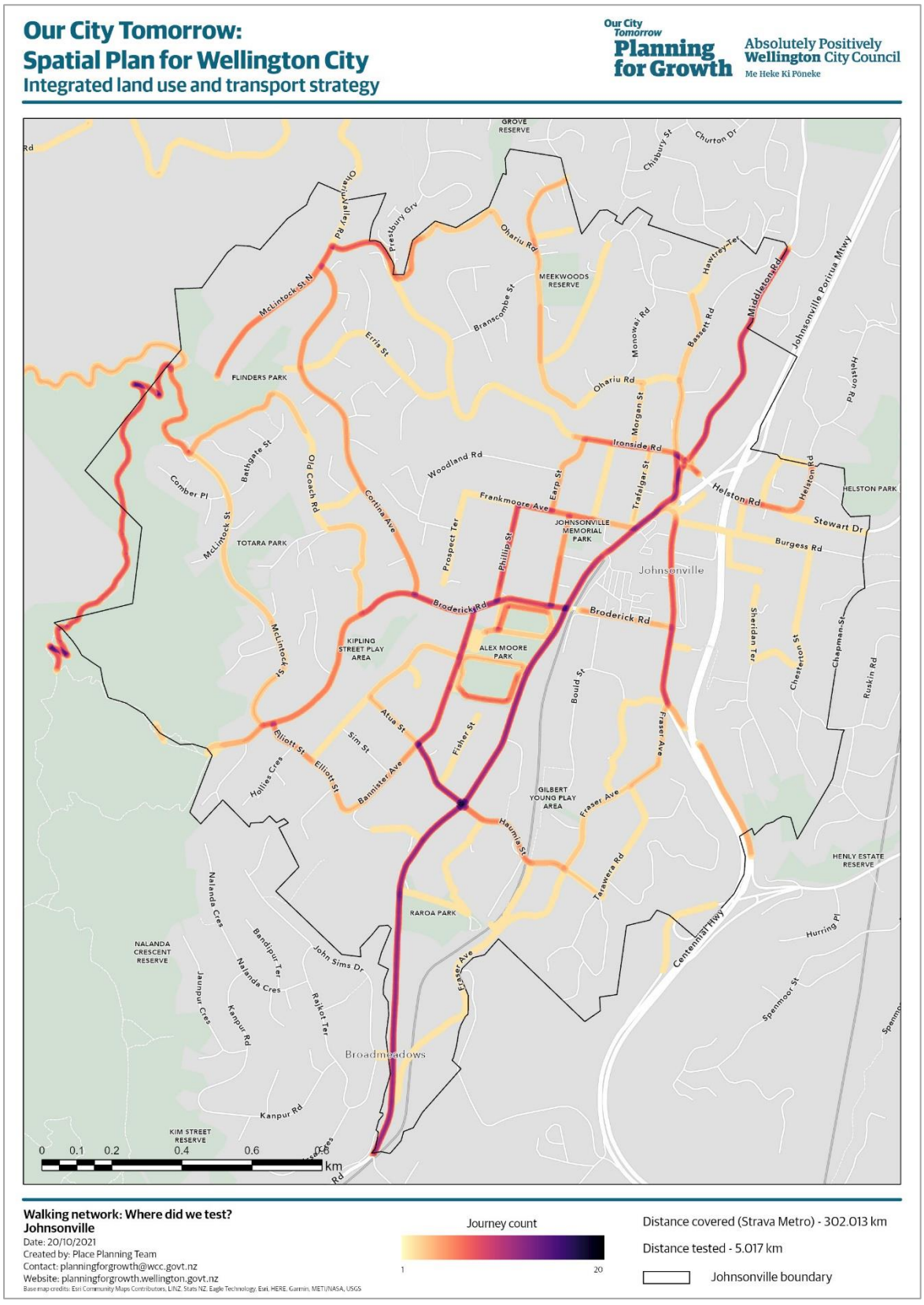
In summary, this document:

- Explains the NPS-UD (2020) requirements for Tier 1 councils to enable intensification within walkable catchments
- Details what walkable catchments are and how they have been calculated within the Wellington City context
- Explains why the extent of the 2021 walking catchment for Johnsonville differs to earlier walking catchment modelling and the extent of the MDRA in the operative District Plan, and
- Outlines the additional specific work undertaken by officers in Johnsonville in response to the Committee's resolution.

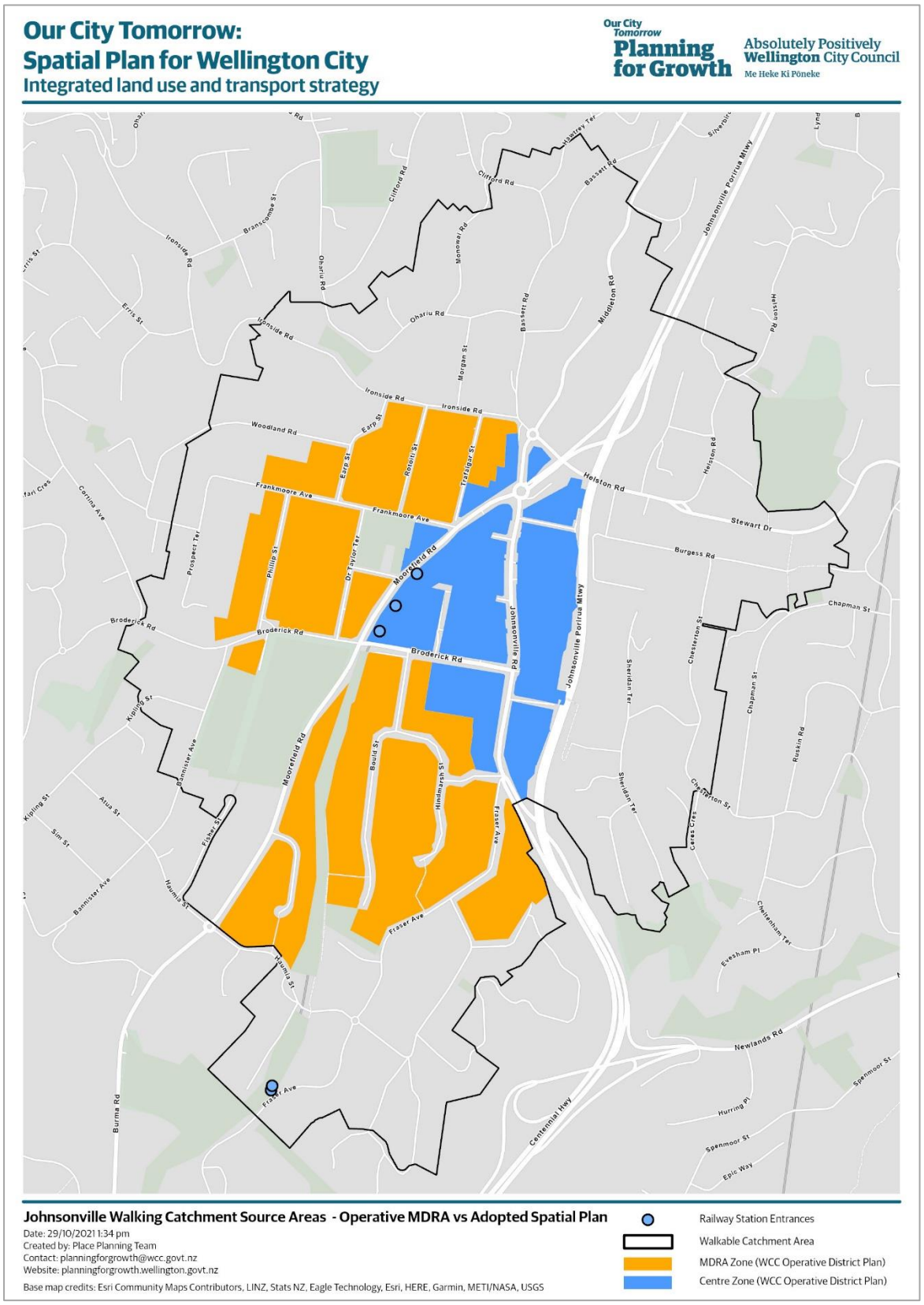
Appendix 1: Map of Johnsonville walkable catchments and Council officer testing routes (2021)



Appendix 2: WCC Walking Network Model, Johnsonville Data Coverage (2021)



Appendix 3: Spatial Plan Walkable Catchment area compared to Operative District Plan MDRA Zone



Appendix 4: 2013 10-minute Johnsonville Walking Analysis

Top map: Away from "Johnsonville Triangle"; **Bottom map:** Towards "Johnsonville Triangle".

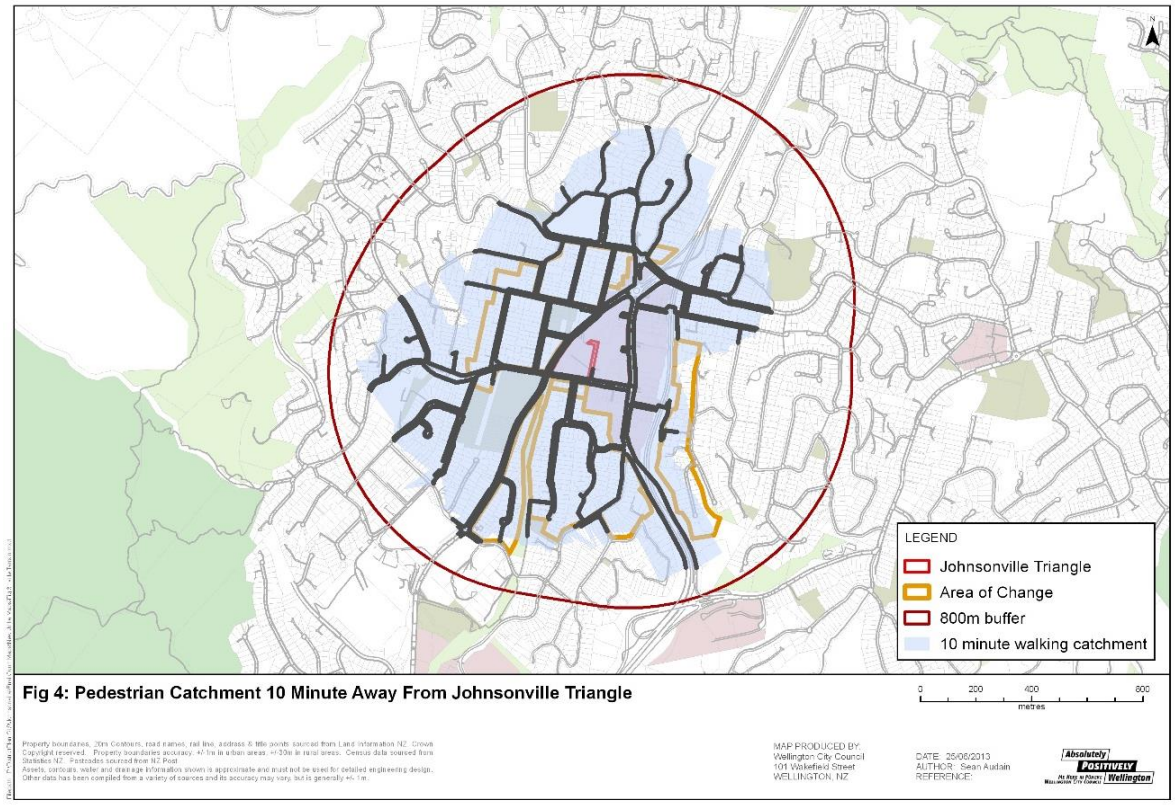


Fig 4: Pedestrian Catchment 10 Minute Away From Johnsonville Triangle

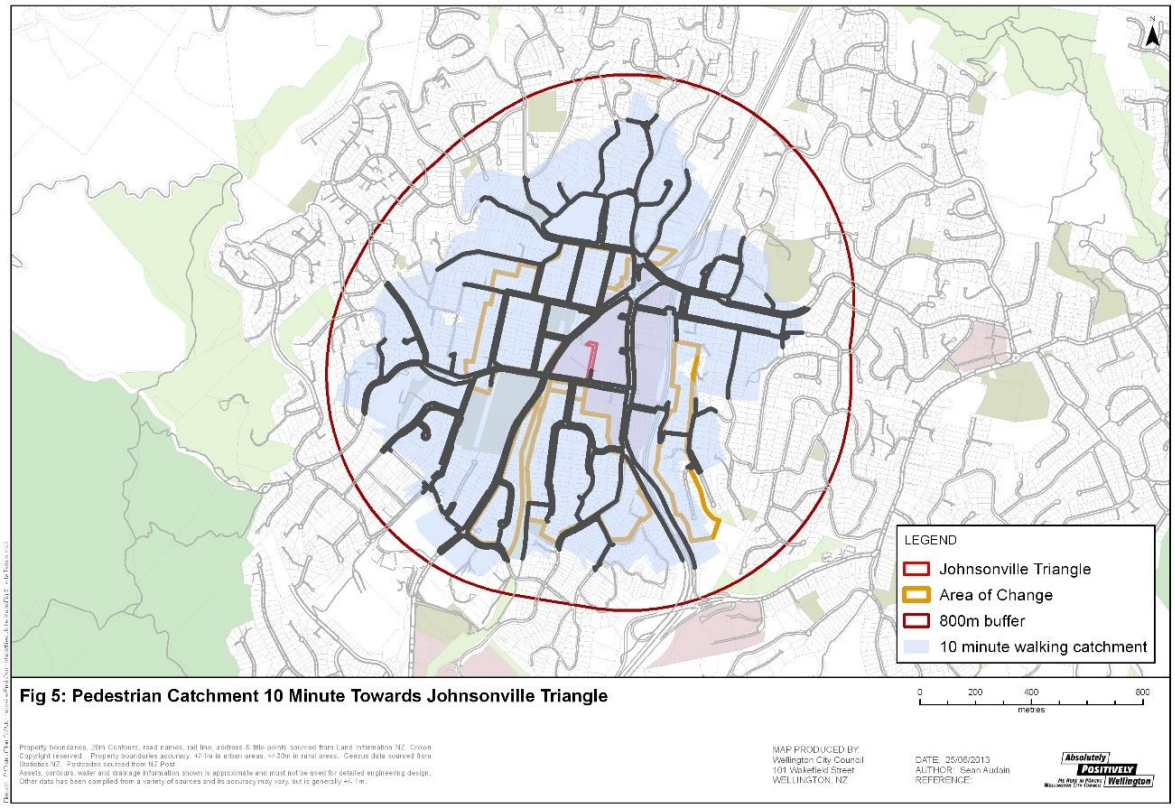
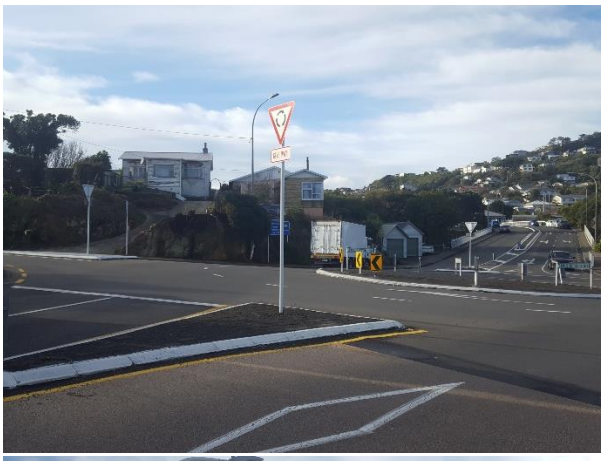
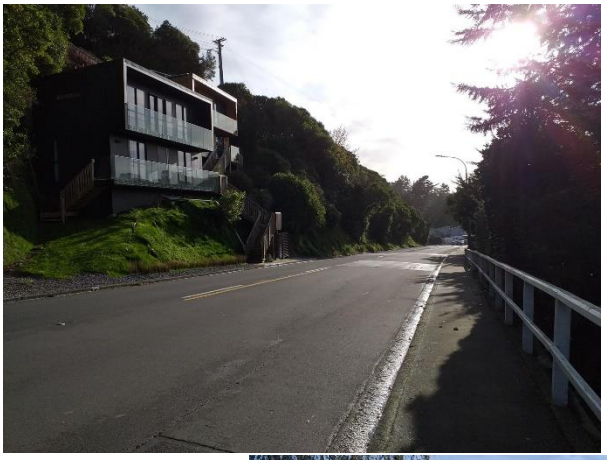


Fig 5: Pedestrian Catchment 10 Minute Towards Johnsonville Triangle

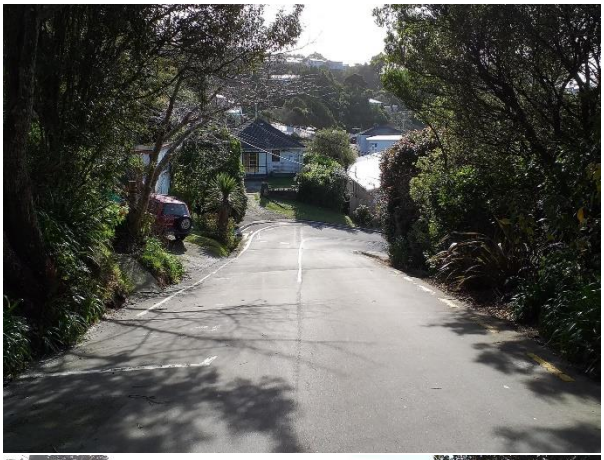
Appendix 5: Wellington City Council Johnsonville Walking Network Testing Photos (July 2021)

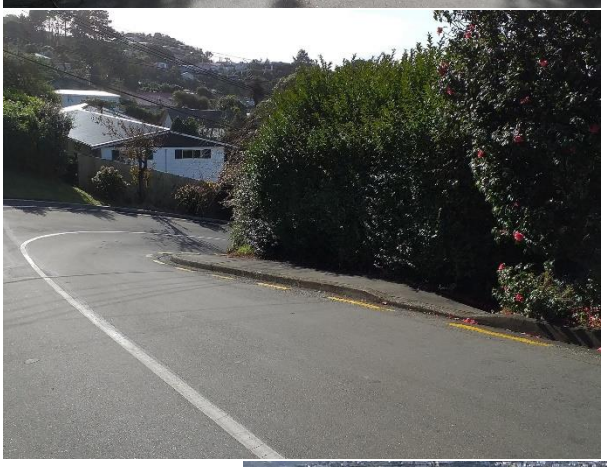
Middleton Road

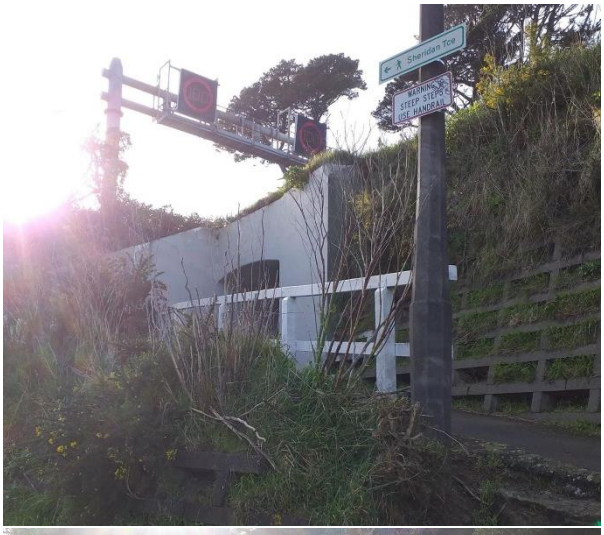
Broderick Road

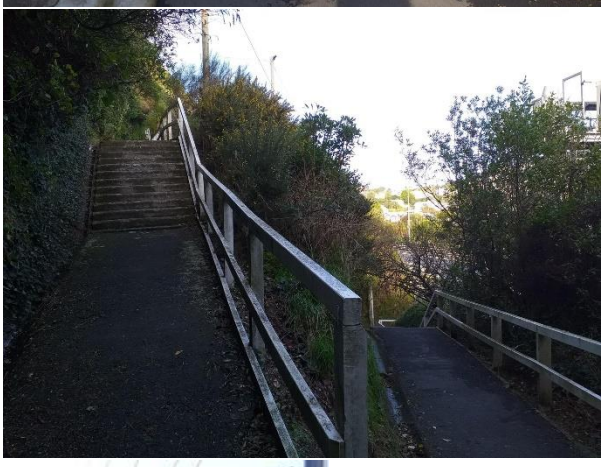
Woodland Road (via Frankmoore Avenue)





Sheridan Terrace (via Disraeli Street underpass)





Dominion Park Street Area and Surrounds