



## Naenae Town Centre Hutt City Council

### Movement Economy Modelling & Strategic Design Advice

Draft 04

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Space Syntax

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# **Part 1**

## **Urban Baseline Study**

**Vehicle Spatial Layout Attraction Model**

**Pedestrian Spatial Layout Attraction Model**

**Combined Vehicle + Pedestrian Model**

# Introduction

## **Space Syntax has been commissioned by Hutt City Council to undertake an evaluation of movement patterns in Naenae.**

The focus of the work to date has been on the ‘movement economy’ of the town centre:

- how the spatial layout of the street network influences patterns of pedestrian and vehicle movement
- how these movement patterns support the vitality of retail and other business uses
- how this affects public perception and enjoyment of the centre, and
- how lessons can be learned to inform a future vision for Naenae.

Space Syntax has pioneered a unique, space-based approach to the modelling of human activity patterns in buildings and urban systems.

Space Syntax models integrate multiple influences on behaviour including:

- a) ‘*spatial layout attraction*’, the way that streets connect to create more or less accessible places
- b) ‘*land use attraction*’, in terms of the location and scale of different land uses
- c) ‘*transport attraction*’, including the location of transport nodes and capacity of transport connections.

Space Syntax models can simultaneously analyse pedestrian, cycle and vehicle movement networks and have been applied in urban planning and design projects worldwide.

Applications include the creation and evaluation of proposals for urban and architectural change at every scale, from regional urban analysis and the planning of entire cities to the design of urban neighbourhoods, site layouts, parks and public spaces.

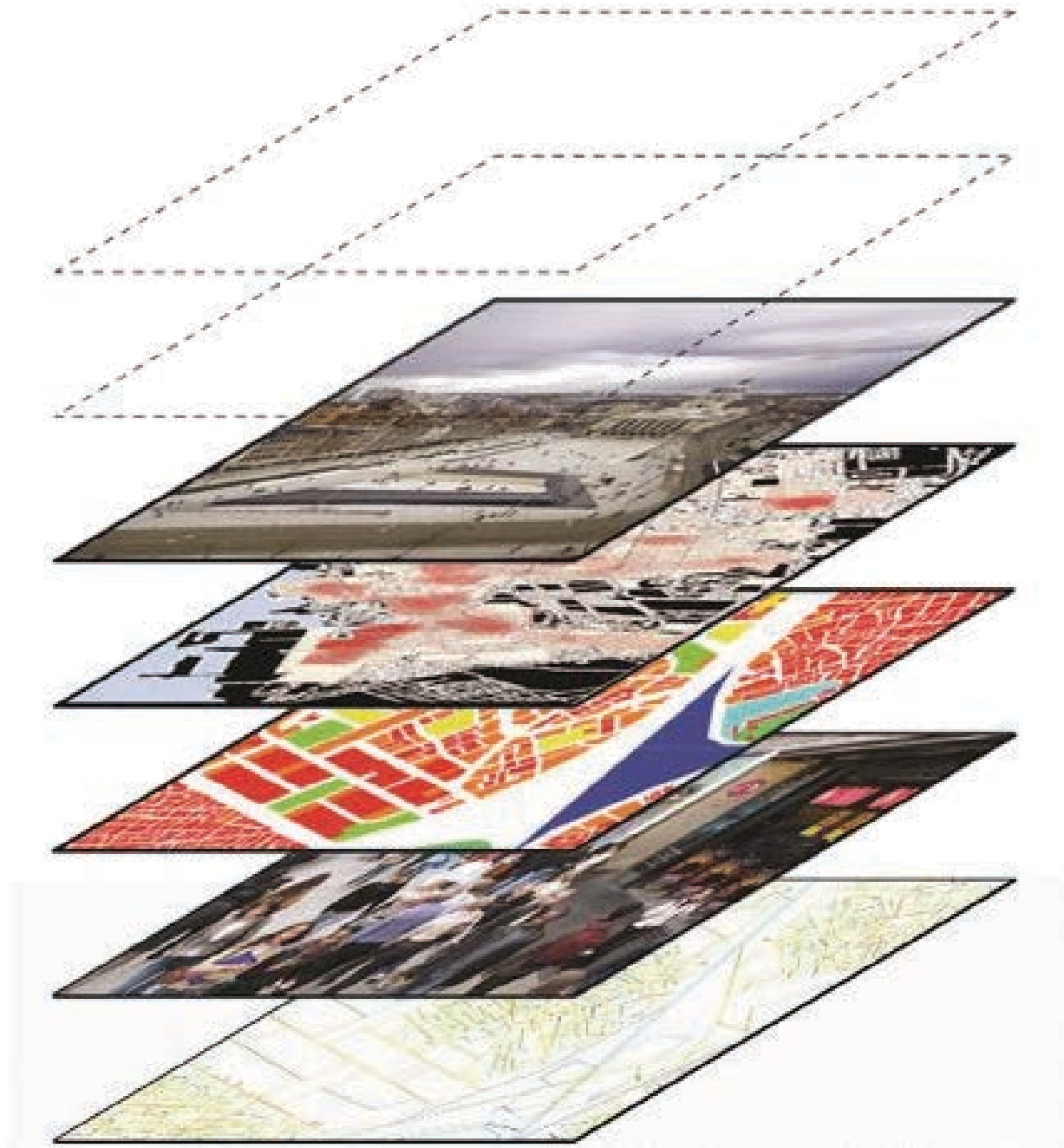
Space Syntax’s approach combines this extensive global experience with robust and continuously developing technologies to forecast the effects of urban planning and design decisions on the movement and interaction of people in buildings and urban areas.

Highly graphic and capable of providing rapid feedback to planners and designers, models are used to test proposals from concept design through to delivery.

*This report summarises the first findings of Space Syntax’s work, in which an initial ‘Spatial Layout Attraction’ model of Naenae has been constructed and has been used to inform the urban design assessment being undertaken by the City and its advisors.*

# Understanding movement patterns in Naenae





**5. Carbon Emissions**

**4. Land Value**

**3. Movement**

**2. Transport Attraction**

**1. Land Use Attraction**

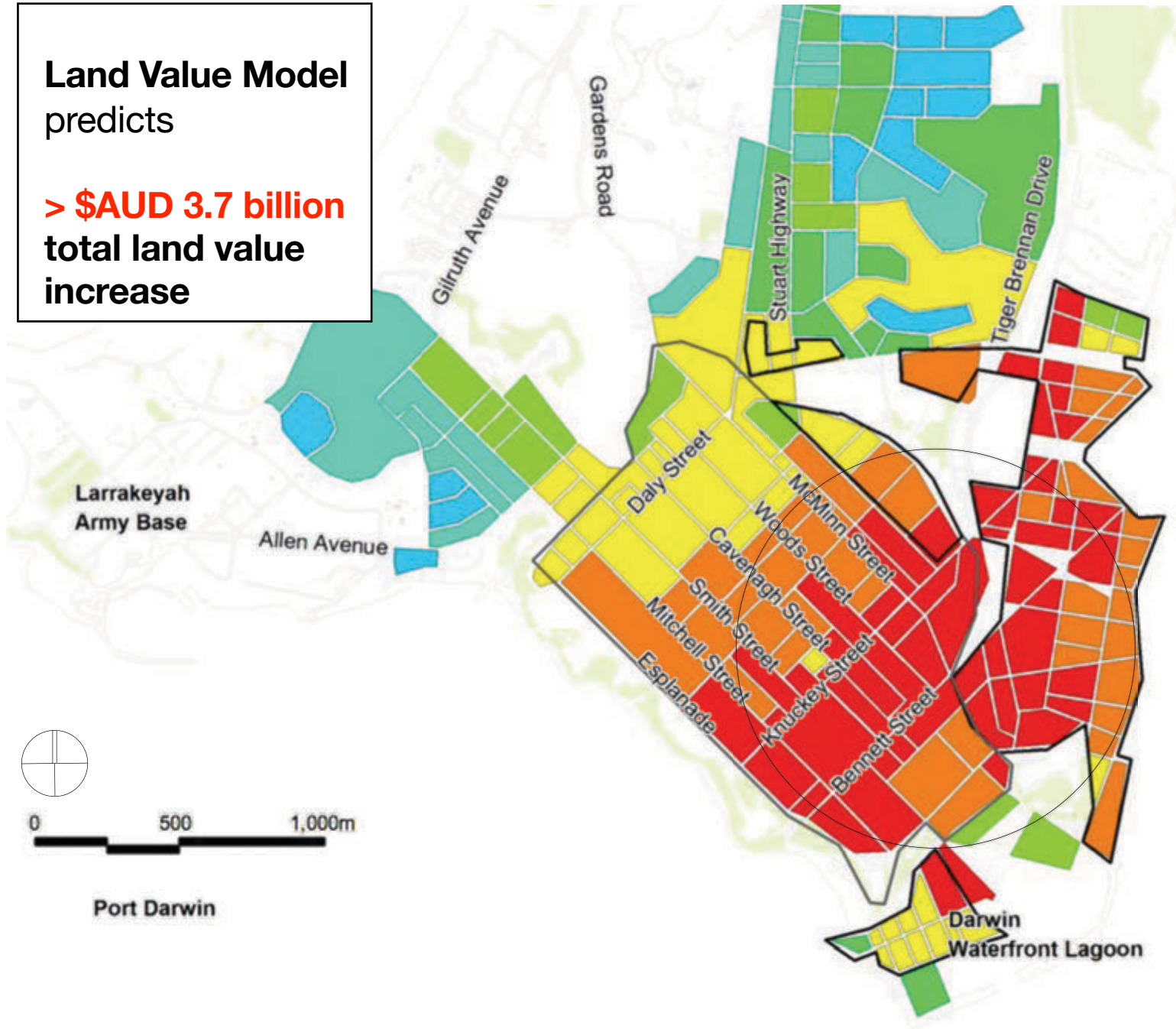
**0. Spatial Layout Attraction**

## Darwin CBD Masterplan, Australia



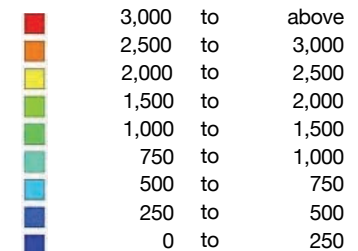
Land Value Model  
predicts

**> \$AUD 3.7 billion**  
total land value  
increase



Existing land value

**Unimproved Capital Value (UCV)**  
\$ per m<sup>2</sup>



□ CBD area

□ New Extension Area (NEA)

# Spatial Layout Attraction modelling

*'Spatial Layout Attraction modelling'* is a technique that identifies the relative importance of each street segment – each piece of street between two intersections - for people moving within towns and cities.

By finding the simplest routes from all origins to all destinations – the shortest routes that involve the fewest twists and turns - an algorithm calculates how likely it is that movement will pass along any individual route.

Segments that are part of straighter, more connected and more central streets tend to be used more frequently as part of journeys across the urban network.

However, the overall importance of any street segment may vary depending on the scale of the journey. Some segments are more likely to be used as part of longer journeys, some as part of shorter journeys, some at both scales and some at neither.

For this reason, Spatial Layout Attraction modelling is undertaken at two different scales: first, for a catchment of 10km, which typically identifies the movement hierarchy of people making longer journeys in vehicles and on bikes; second, for a catchment of 1.2km, which typically picks up the hierarchy of shorter journeys made by people on foot and on bikes.

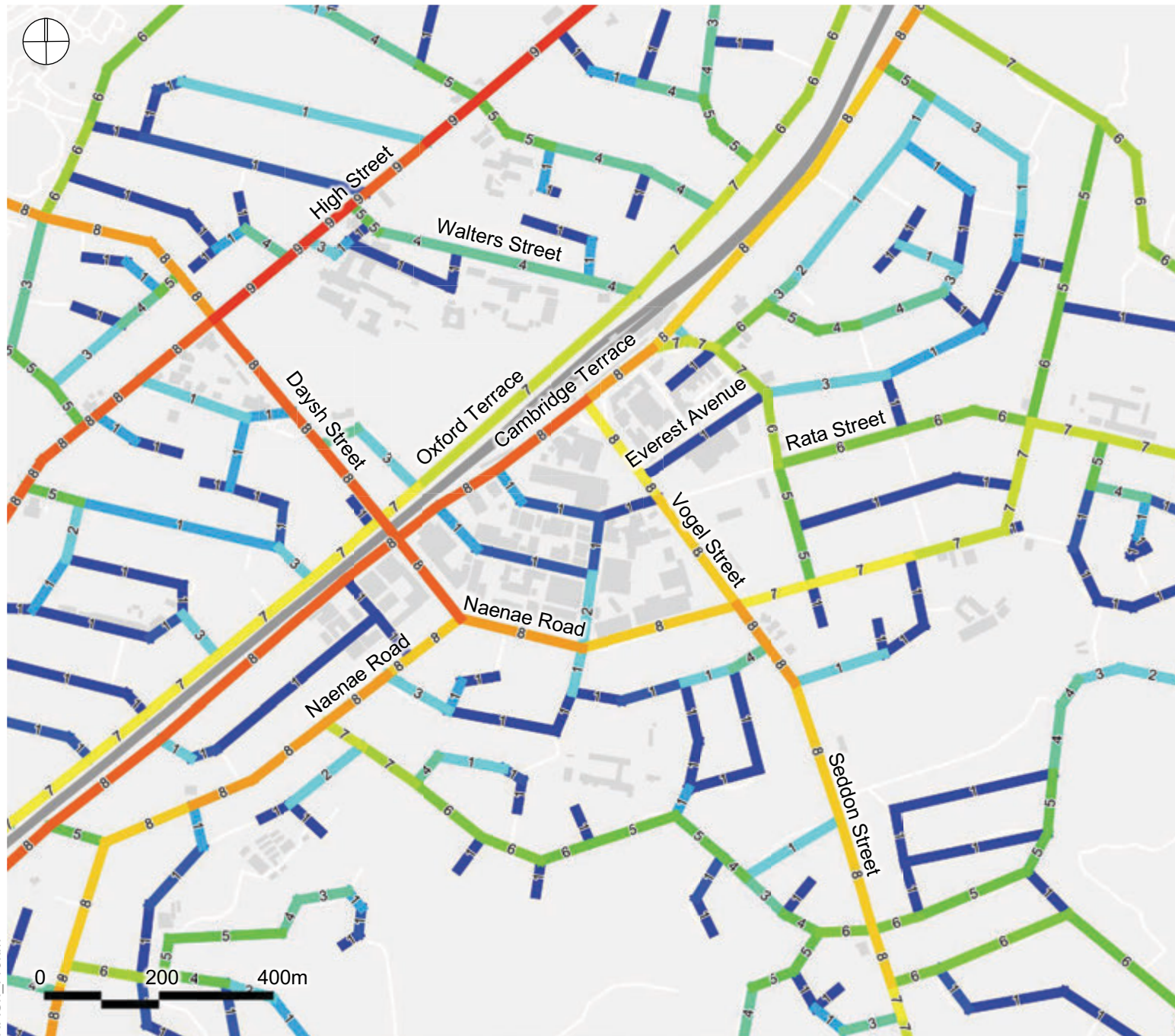
Undertaking this kind of *'multi-scale'* analysis of spatial layouts, allows short- and long-distance journeys to be simultaneously evaluated and shows how different parts of the same network are differently used, depending on the scale of journey.

Frequently, the same parts of the network are used on both short- and long-distance journeys. While this can create conflicts between the needs of different transport modes, land use analysis shows that these *'multi-scale'* places are often successful commercial locations, thus demonstrating the importance of careful spatial layout design in creating multi-scale opportunities for retail and commercial activities to trade to more than one scale of movement.

In the pages that follow, a *'Vehicle'* model will first be presented, which calculates Spatial Layout Attraction for each street segment within a longer journey catchment of 10km. Then a *'Pedestrian'* model will be presented, which does the same for a shorter journey catchment of 1.2km.

Finally, the results of both models are combined in a *'MultiScale'* model. This is then analysed to create a set of 'street types', from those street segments that are more important for longer journeys to those that are important for shorter ones; those that are important for both and those for none.

# Spatial Layout Attraction **Vehicle** 10km Existing



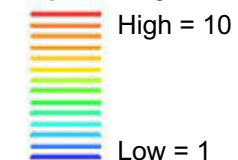
The Vehicle Spatial Layout Attraction Model of Naenae includes vehicle routes and excludes pedestrian-only routes such as Hillary Court. The model measures the vehicle movement potentials of each street segment for a 10km catchment. The analysis identifies that:

- Cambridge Terrace, Naenae Road and Vogel Street are significant vehicle routes around the town centre
- Daysh Street from the north west, Cambridge Terrace and Naenae Road from the south west and Seddon Street from the south form key approaches to the town centre
- the commercial centre at Everest Avenue/Hillary Court is located away from these key routes with consequently low 'through movement' potentials.
- In contrast, the historic route of High Street, further north, has the highest levels of Spatial Layout Attraction.

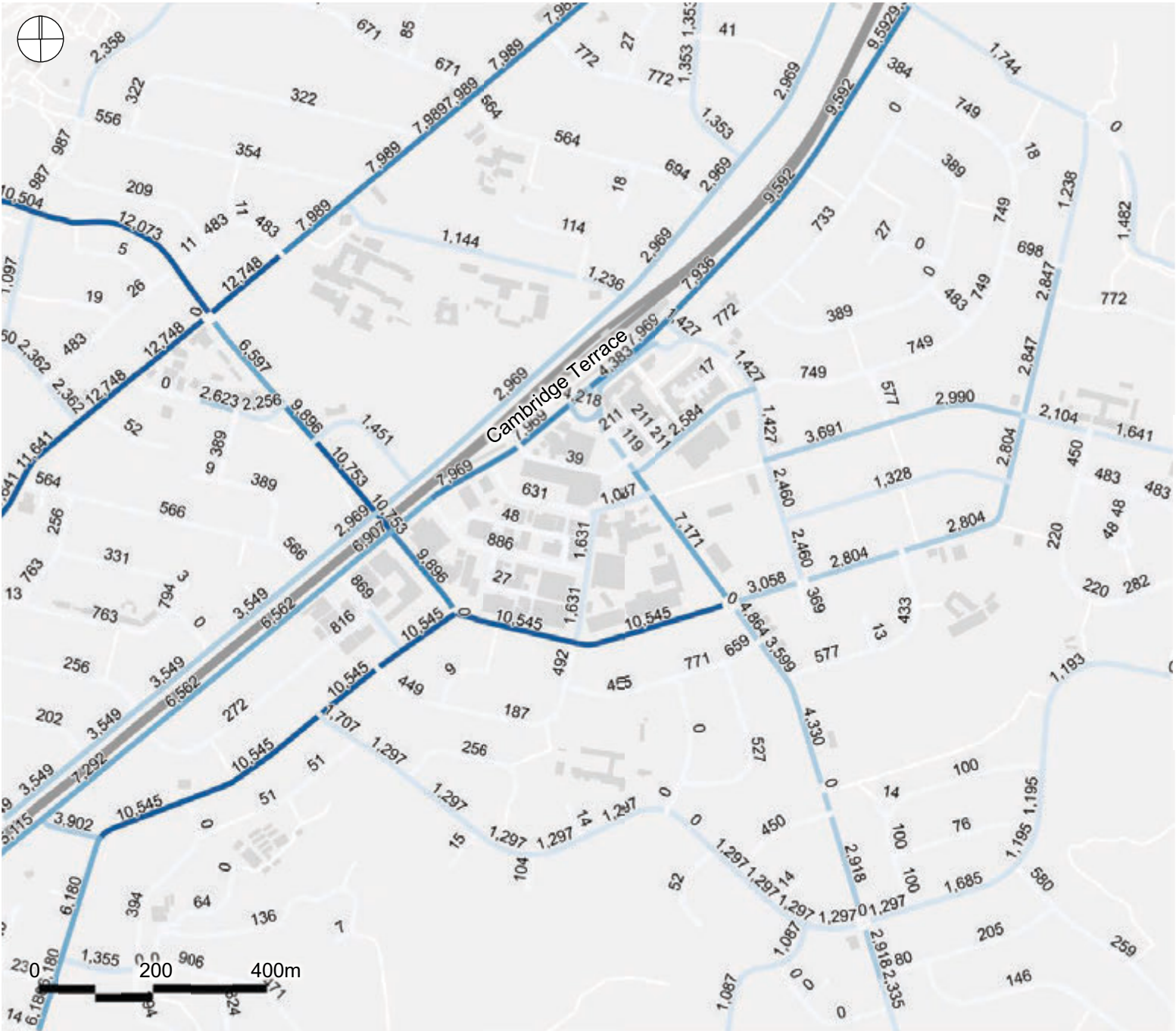
The spatial arrangement of Naenae, with a retail centre that is detached from the movement network, is typical of post-war town planning, unlike in historic towns where the commercial centre would have evolved along through routes/High Streets that captured longer-distance movement.

For these reasons, retail and other commercial uses in post-war towns often perform below the levels of historic high streets.

## Spatial Layout Attraction

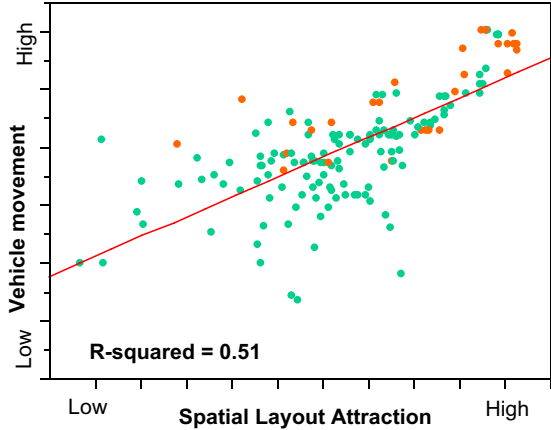


# Vehicle volumes October 2018



Comparison can be made between the results of the Vehicle Spatial Layout Attraction Model and actual vehicle volumes as measured in October 2018.

Visual (left) and statistical (below) comparison of the data shows a close association between levels of Spatial Layout Attraction and actual movement patterns. The key street segments identified by the spatial modelling exercise correspond to those with the highest vehicle flows: Daysh Street, Naenae Road and Vogel Street in the town centre, with highest overall flows on High Street further north.



**Vehicle movement**  
Average cars per day

- 0 – 1,000
- 1,000 – 2,500
- 2,500 – 5,000
- 5,000 – 7,500
- 7,500 – 10,000
- 10,000 – 20,000
- 20,000 – above

Spatial Layout Attraction **Vehicle** 10km Existing



# Spatial Layout Attraction **Pedestrian** 1.2km Existing



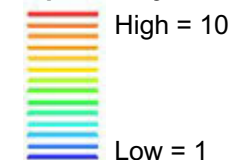
The Pedestrian Spatial Layout Attraction Model includes pedestrian routes and excludes vehicle-only routes such as State Highway 2. The model measures the pedestrian movement potentials of each street segment for a 1.2km catchment. The analysis identifies that:

- the retail centre at Hillary Court and Everest Avenue are relatively spatially isolated within the movement network of the town centre
- greater movement potentials exist on peripheral streets including Daysh Street, Naenae Road, Vogel Street and Seddon Street

As was seen with the Vehicle Model, the spatial arrangement of Naenae is typical of post-war town planning, and not like in historic towns where the commercial centre would have evolved along through routes/High Streets that captured shorter as well as longer-distance movement.

For these reasons, retail and other commercial uses in post-war towns often perform below the levels of historic high streets.

## Spatial Layout Attraction



# Street type analysis

“Street type” analysis combines the results of the Spatial Layout Attraction modelling at the longer and shorter journey catchments of 10km and 1.2km. It identifies different **types** of street, according to the importance of each street segment at one, the other, both or no scales of journey.

The importance of street segments at different scales of journey has implications for the performance of urban systems.

## Important for longer + shorter journeys

Street segments that are important (and very important) for both longer and shorter journeys provide advantageous locations for retail and other uses that benefit from high levels of passing movement of all modes: walking, cycling and driving. These are the busiest routes that support the ‘movement economy’ of an urban system. They typically form the most used, most visited and therefore most civic elements of the movement network of towns and cities, with the highest land values.

## Important for longer journeys only

Street segments that are only important for longer journeys are typically vehicle-dominated and do not support local retail uses. They may provide locations for supermarkets and other car-based uses but such uses may create the lowest paid jobs and typically enhance car-dependence.

## Important for shorter journeys only

Street segments that are only important for shorter journeys can provide useful pedestrian/cycling links and can be the focus for local community activities.

## Isolated

Street segments that are isolated but close to urban centres can be places for quiet residential use.

## Very isolated

Street segments that are very isolated and distant from urban centres can create a number of social, economic and health risks. Such locations can be vulnerable to burglary, can have lower property values and can be associated with higher levels of car-dependency, obesity and loneliness.

### Street types

- Very important (longer + shorter)
- Important (longer + shorter)
- Important (longer only)
- Important (shorter only)
- Isolated
- Very isolated
- Background network

### Important at 10km?

- Yes, very
- Yes
- Yes
- No
- No
- No
- No

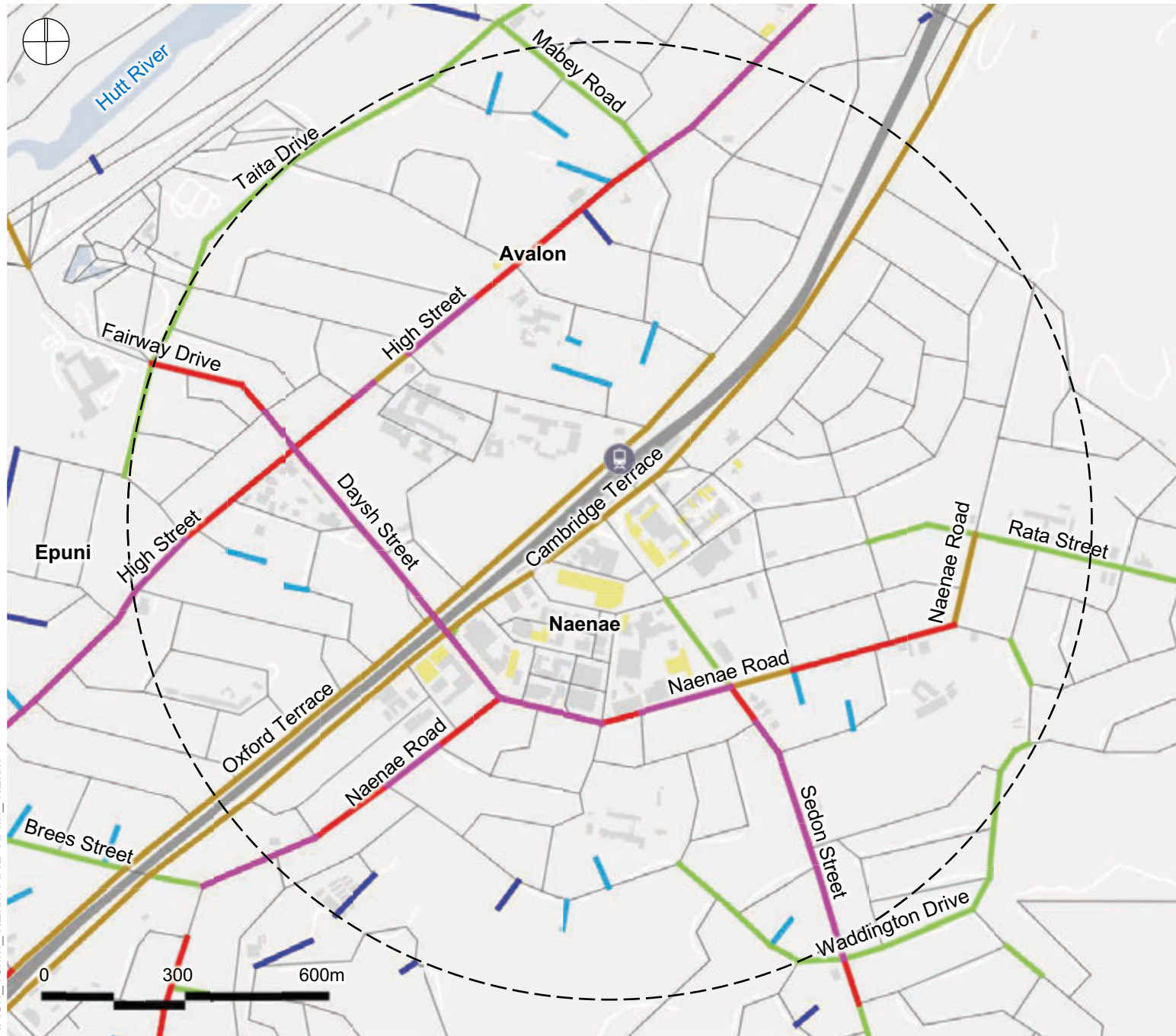
### Important at 1.2km?

- Yes, very
- Yes
- No
- Yes
- No
- No
- No

### Implications for urban performance/movement economy

- Very high potential for walking, driving & cycling
- High potential for walking, driving & cycling
- Key driving & longer-distance cycling link
- Key walking & shorter-distance cycling link
- Unimportant for walking, driving or cycling
- Unimportant for walking, driving or cycling
- Low levels of walking, cycling & driving

# Street type analysis Combined Vehicle + Pedestrian Model



By combining the outputs of the Vehicle and Pedestrian models, 'Street type analysis' provides an assessment of the opportunities and constraints facing the future development of Naenae town centre.

The results suggest that spatial interventions could be made to re-engineer the 'movement economy' of the town. Doing so could mean

- the creation of new walking and driving linkages
- the construction of new commercial uses on the most important street segments
- the relocation of some existing uses.

**Image Source: Google Maps**



Station



Google Live Centres and AOIs

## Street types

- Very important (longer + shorter)
- Important (longer + shorter)
- Important (longer only)
- Important (shorter only)
- Isolated
- Very isolated
- Background network

# Part 2

## Scenario Testing

Vehicle Spatial Layout Attraction Model  
Pedestrian Spatial Layout Attraction Model

# Spatial Layout Attraction Modelling **Scenarios**



## CONNECTIONS MODELLED

1. Direct pedestrian link across the tracks as an extension of Hillary Court.
2. Extension of Hillary Court across Everest Avenue towards the bowling club.
3. Creation of a vehicle as well as pedestrian link between Holland's Crescent and Rata Street.
4. Extension of Everest Avenue to the intersection of Hollands Crescent and Horlor Street.
5. Connection across tracks between Hillary Court and Walters Street.

## SCENARIOS MODELLED

### Vehicle model

2 + 3

2 + 3 + 4

### Pedestrian model

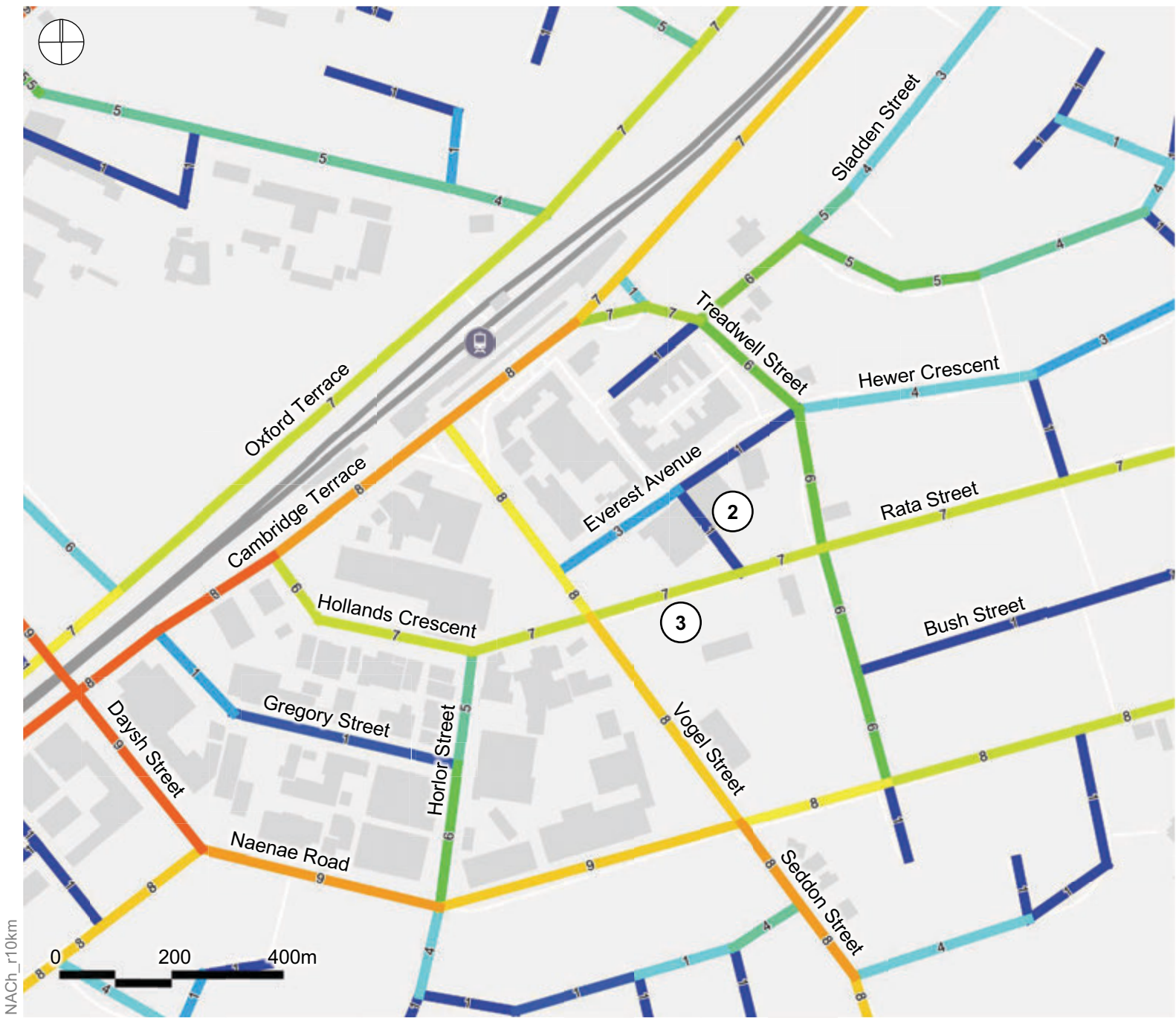
1

1 + 2

1 + 2 + 4

2 + 4 + 5

Spatial Layout Attraction **Vehicle** 10km Scenario 2 + 3



Existing

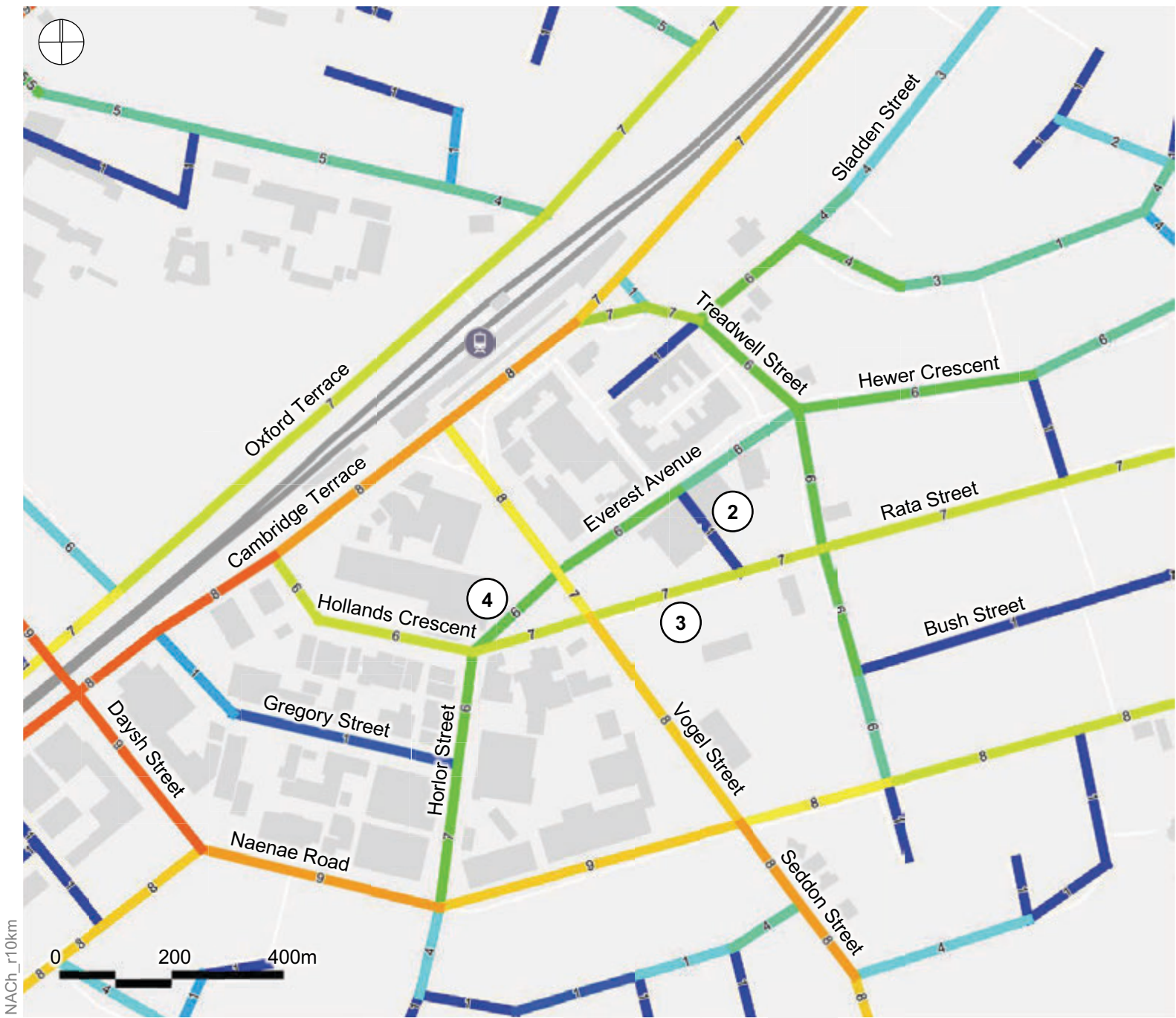
Extension of Hillary Court across Everest Avenue (2) and the creation of a link between Hollands Crescent and Rata Street (3) improves the spatial accessibility of Hollands Crescent and Rata Street.

However, Everest Avenue is unaffected.

Spatial Layout Attraction



# Spatial Layout Attraction Vehicle 10km Scenario 2 + 3 + 4



Existing

A link that directly connects Everest Avenue to Horlor Street (4) improves east-west connectivity and, as a result, Everest Avenue and Hewer Crescent have higher vehicle movement potentials.

## Spatial Layout Attraction



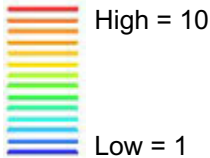
# Spatial Layout Attraction Pedestrian 1.2km Scenario 1



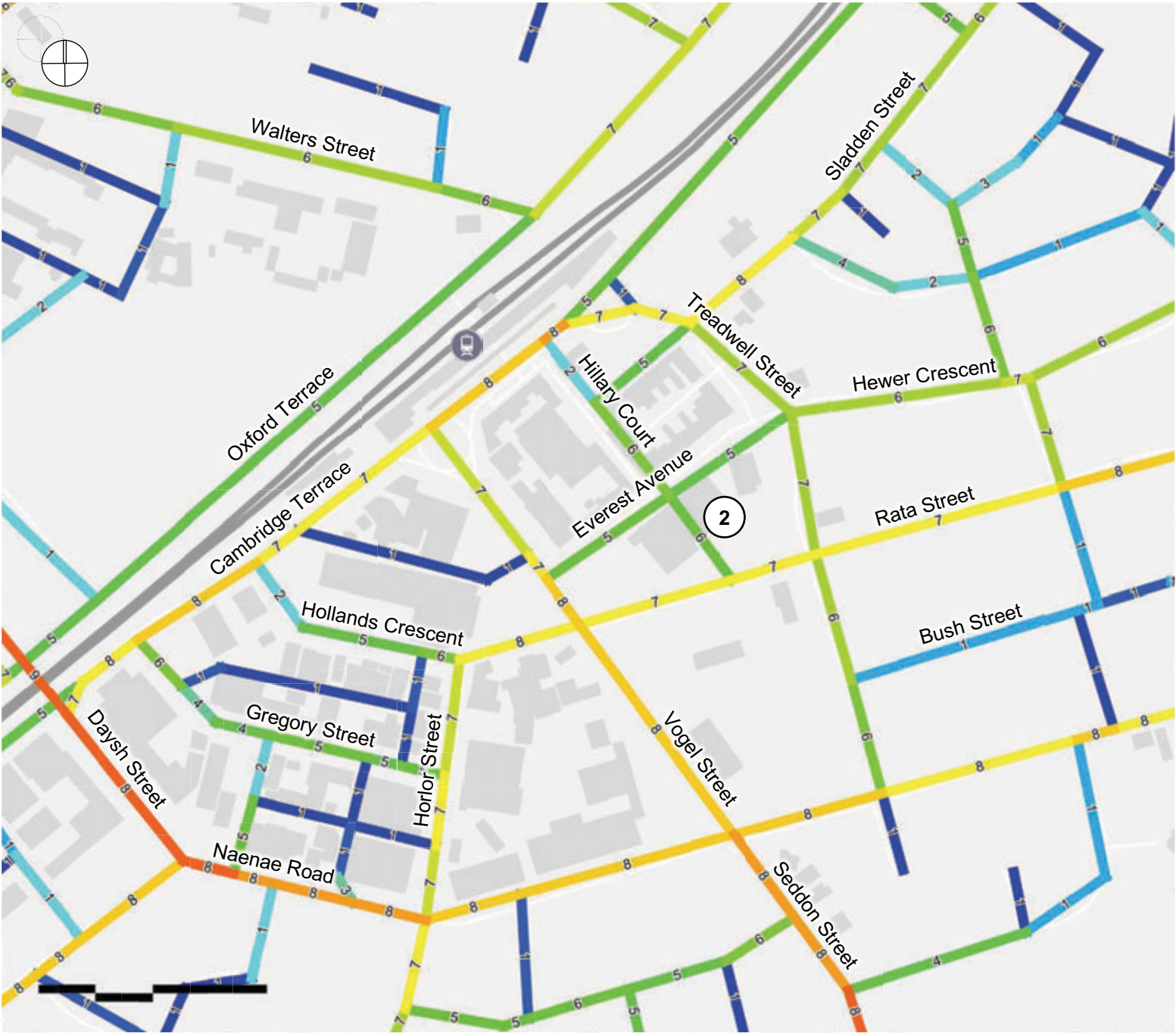
Existing

A direct pedestrian link across the tracks as an extension of Hillary Court (1) would not only improve the movement potentials of Hillary Court and Everest Avenue, but also around the north of the station along Oxford Terrace.

## Spatial Layout Attraction



# Spatial Layout Attraction Pedestrian 1.2km Scenario 2



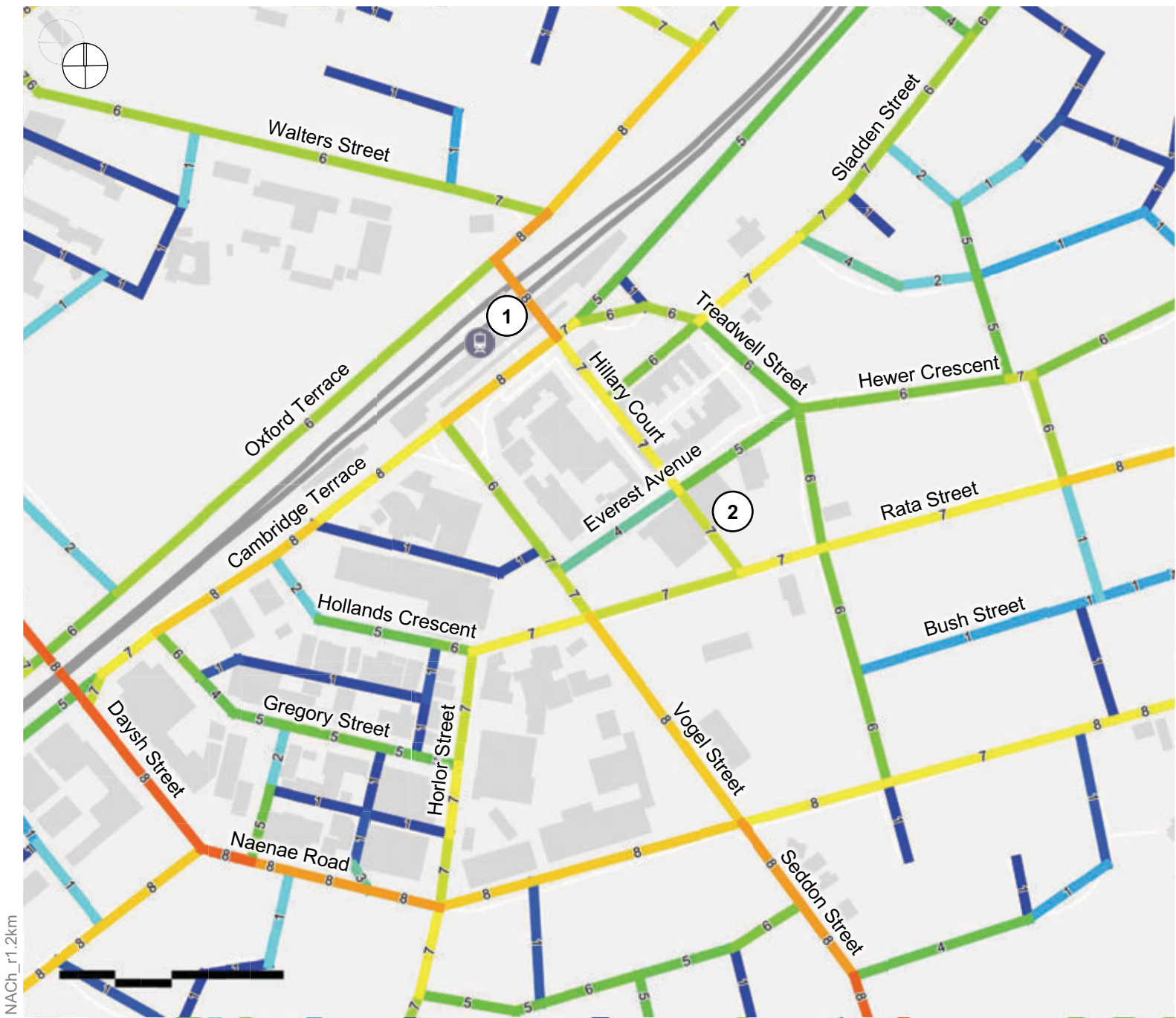
Existing

Extension of Hillary Court across Everest Avenue (2) has the local impact of improving movement potentials along Hillary Court and Everest Avenue, as well as a wider impact on Rata Street and Vogel Street.

### Spatial Layout Attraction



# Spatial Layout Attraction Pedestrian 1.2km Scenario 1 + 2



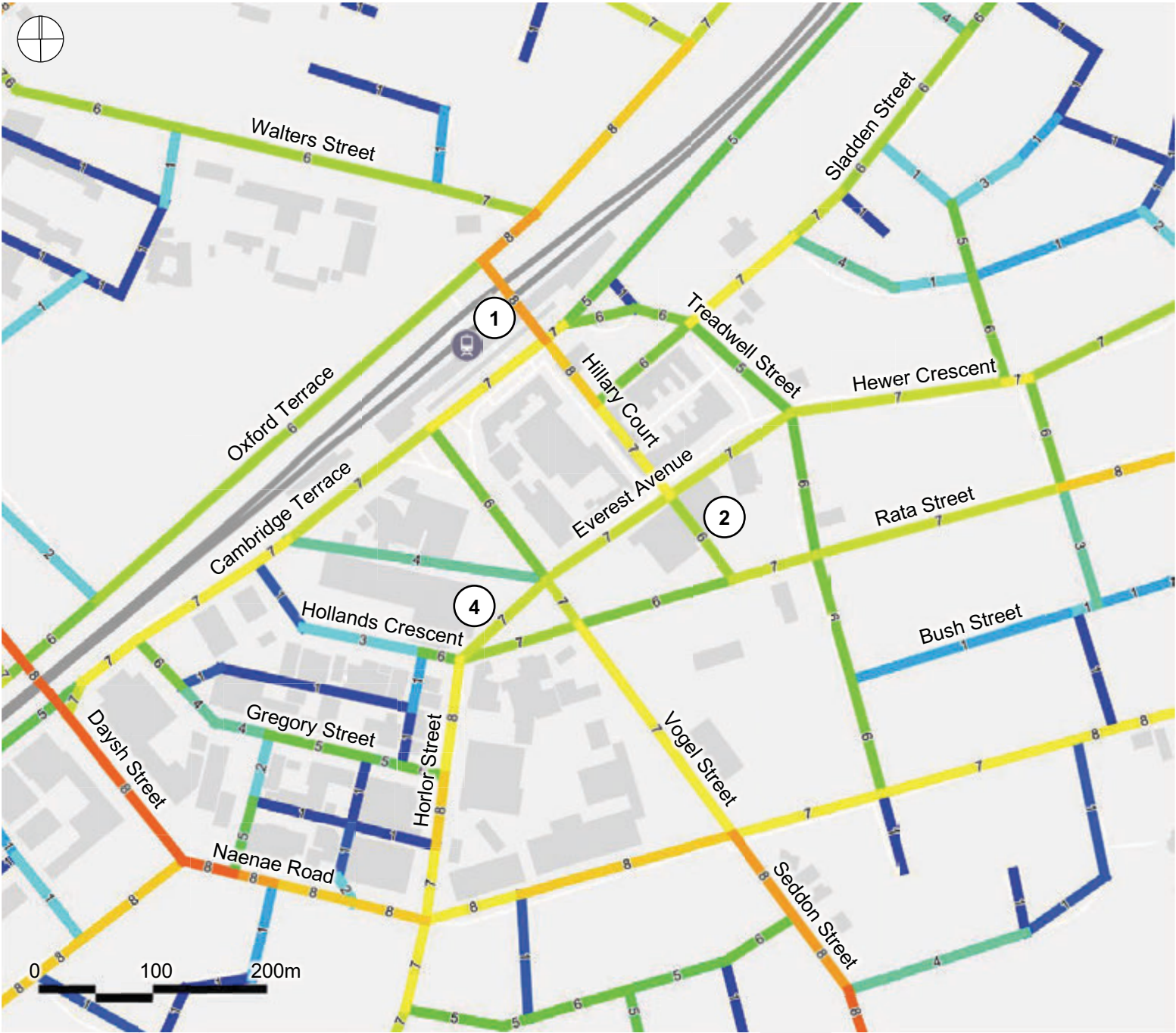
Existing

The combined option of extending Hillary Court across the railway tracks (1) and to the south (2) significantly improves the spatial layout attraction of Hillary Court and of the town centre generally.

## Spatial Layout Attraction



# Spatial Layout Attraction Pedestrian 1.2km Proposed 1 + 2 + 4



Existing

An additional link between Everest Avenue and Horlor Street (4) further improves the spatial layout attraction of the northern part of the town centre as well as the area to its south-west.

### Spatial Layout Attraction



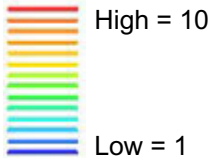
# Spatial Layout Attraction Pedestrian 1.2km Proposed 2 + 4 + 5



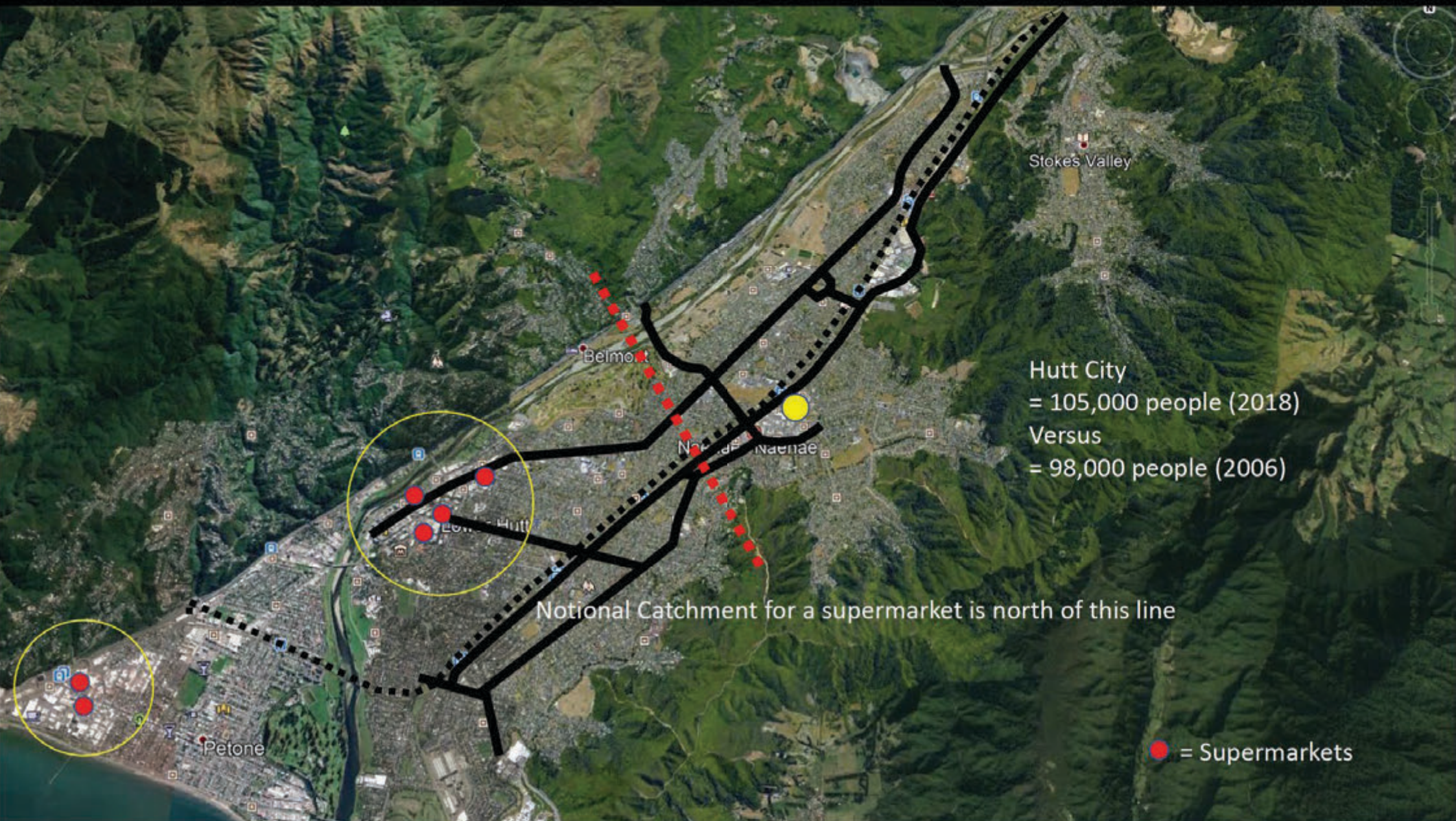
Existing

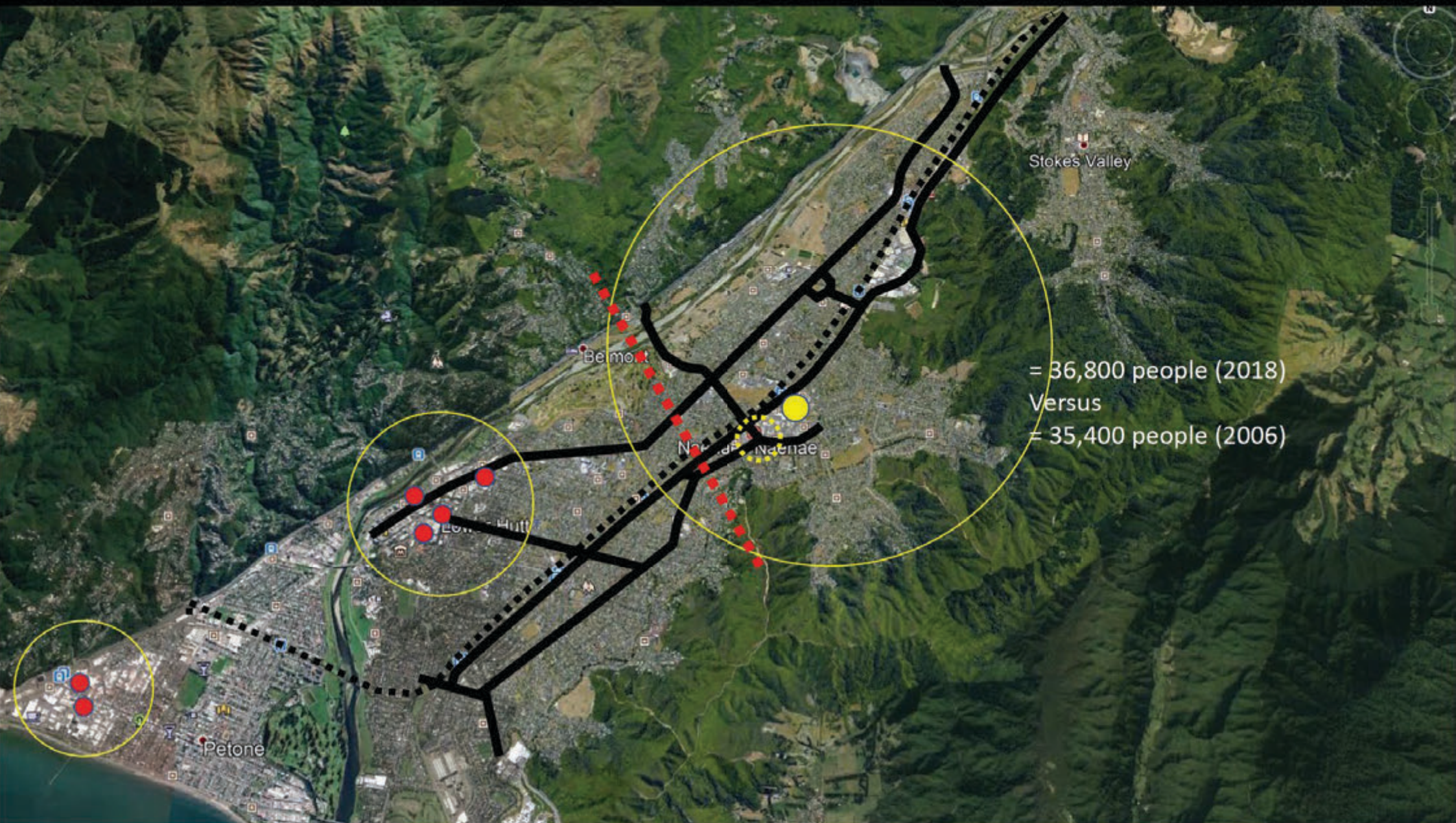
A more direct link across the railway tracks to the junction of Walters Street and Oxford Terrace (5) further improves on movement potentials across the town centre.

## Spatial Layout Attraction



# Catchment analysis



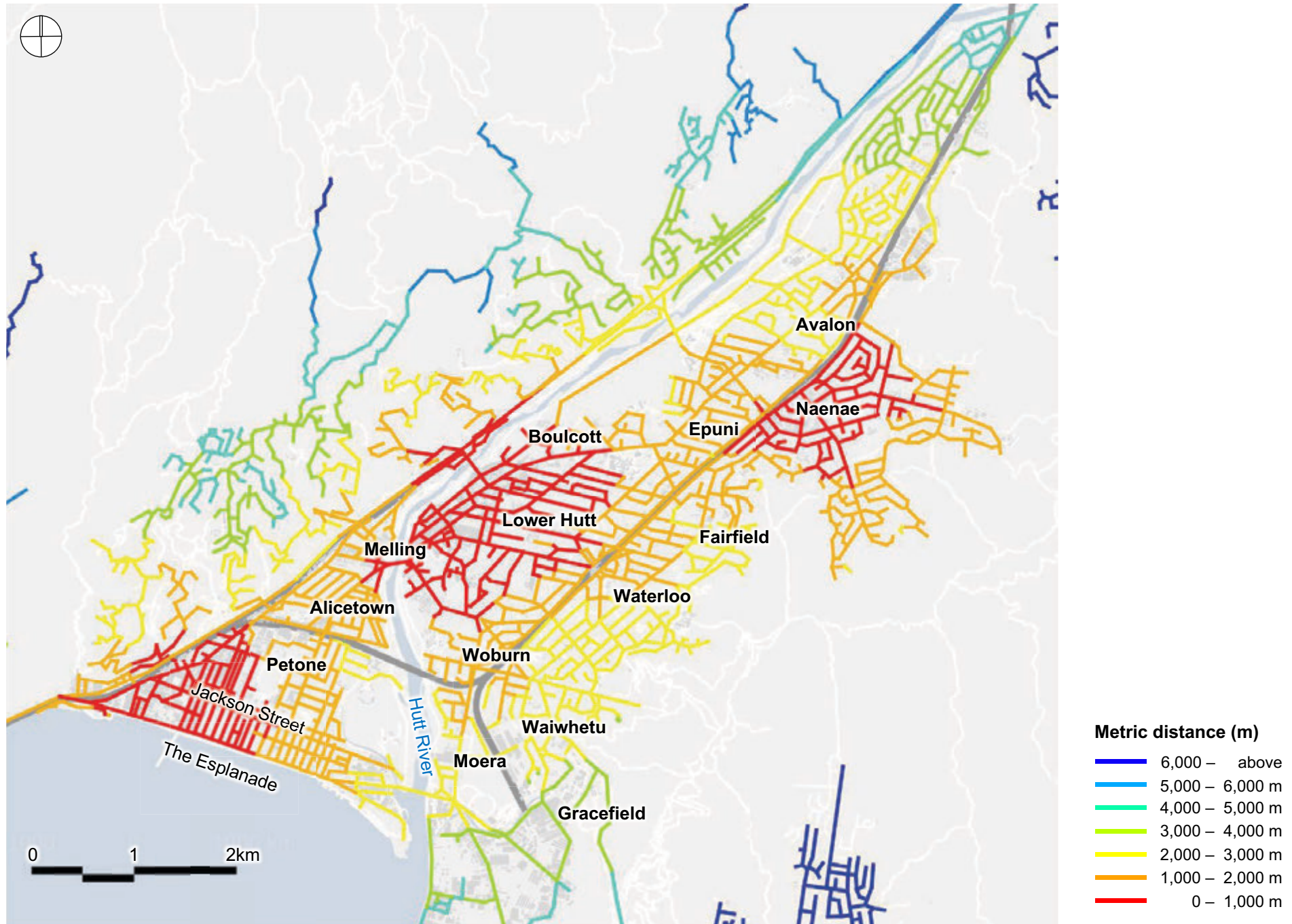


# Catchment analysis **Vehicle** From supermarkets

The catchment analysis from the supermarkets highlights that there is a lack of supermarkets in the Naenae area.



# Catchment analysis **Vehicle** From supermarkets



# Appendix

## Methodology

# Appendix Spatial Layout Attraction Modelling Methodology

## Overview

Space Syntax has pioneered a unique, space-based approach to the modelling of human activity patterns in buildings and urban systems. Space Syntax models integrate multiple influences on behaviour including:

- a) '*spatial layout attraction*', from more accessible to less accessible places
- b) '*land use attraction*', in terms of the location and scale of different land uses
- c) '*transport attraction*', including the location of transport nodes and capacity of transport connections.

Space Syntax models can simultaneously analyse pedestrian, cycle and vehicle movement networks and have been applied in urban planning and design projects worldwide. Applications include the creation and evaluation of proposals for urban and architectural change at every scale, from regional urban analysis and the planning of entire cities to the design of urban neighbourhoods, site layouts, parks and public spaces.

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## Spatial Layout Attraction modelling

The modelling process begins by transforming the street pattern of an urban area into a network '*graph*'. In urban systems, the road centreline map of the area is often used as a starting point, where the network is divided into individual '*segments*' of space, each segment being the street or path between two intersections.

Each segment is then analysed using a mathematical algorithm to calculate its '*spatial accessibility*' within the network, ie how relatively easy or difficult it is to reach that segment from all other segments, or how likely it is that movement between different parts of the network is likely to pass along that segment. In this way, Space Syntax software calculates both the '*to movement*' potentials and the '*through movement*' potentials of each segment.

### Key feature 1

#### Analysis of 'cognitive complexity'

Key to the success of this approach is the discovery that movement in cities often follows a 'least angle' path between origins and destinations. In other words, many people minimise the angular deviation from their origin to their destination, even if this means they sometimes take a slightly longer route.

### Key feature 2

#### Evaluation of 'multi-scale' activity

A second key aspect of the Space Syntax approach is the multi-scale analysis of spatial layouts, allowing short- and long-distance journeys to be simultaneously evaluated and showing how different parts of the same network are differently used, depending on the scale of journey.

Frequently, the same parts of the network are used on short- and long-distance journeys. While this can create conflicts between the needs of different transport modes, land use analysis shows that these '*multi-scale*' places are typically successful commercial locations, thus demonstrating the importance of careful spatial layout design in creating multi-scale opportunities for retail and commercial activities to trade to more than one scale of movement.

### Key feature 3

#### Integration of spatial layout, land use & transport factors

The simultaneous analysis of spatial layout, land use and transport factors is a third key factor in the uniqueness and success of Space Syntax models. By demonstrating the fundamental role of spatial accessibility in determining land use potentials, then showing how the specific location of individual land use attractors and transport attractors exploits these potentials or not, Space Syntax models make it possible to integrate the three essential aspects of planning and design: spatial layout attraction, land use attraction and transport attraction.



1. Unprocessed Spatial Layout Attraction model.

2. Processed Spatial Layout Attraction model, after values are calculated for each street segment.

#### Spatial accessibility

