Abstract

Four laning a two lane road through a residential area in a way that benefits road users and doesn’t impact on the people who live along the road is a challenge. Northcote Road in Christchurch carries 24,000 vehicles per day and four laning has been on the books for years. A designation exists on both sides of the road; unfortunately many of the houses are very close to this designation.

This paper examines the way in which projects to improve traffic capacity for road users need to move towards a greater appreciation of the communities who live along these roads. Northcote Road is used as a case study due to the complex nature of the road and how a number of cross sections developed addressed the community aspects better than others.

This paper will be of interest from a historical perspective and of use to those who plan and design schemes to improve capacity but require careful consideration of local community needs. It provides a basis for discussion and concludes that research into the needs of residents would be worthwhile so that design guides can incorporate aspects beyond purely the road users and integration with land use.
INTRODUCTION

“Traffic environments are complex phenomena, consisting not only of technical structure elements such as physical street characteristics and traffic modes, but also of people with a range of different interests, needs and demands” (Wahl et al, 2012).

Many arterial streets in New Zealand towns and cities are getting busier and ways to increase their capacity are being investigated and implemented when funds permit. A good proportion of these arterial streets run through residential areas. The focus of the design of these streets are generally the people who use the street (e.g. pedestrians, cyclists and drivers), and also the vehicle types (e.g. buses, cars and trucks). The people who reside on the street are considered to some extent as ultimately they become road users once they enter the road space. But what about while they are at home and how would their needs influence the design? This question arose in the author’s minds when given the task of designing the road layout for Northcote Road, a busy arterial street in a residential area of Christchurch.

Northcote Road had been functioning as an arterial road for many years with a road widening designation in place anticipating the time when traffic volumes create safety and congestion issues. That time is close and with it comes the dilemma of how to overcome these issues in a tighter fiscal environment than ever imagined when the designation was established.

Historically the lead author has designed local streets (low volume) through residential areas, arterial streets through town centres and arterial roads through residential areas albeit with limited access status and wide buffers between the road and the houses. This project was new territory!

This paper firstly examines the historic and current approaches to designing arterial roads with multiple needs. A discussion on ‘capacity’ examines when four lanes are necessary and then the ‘community’ aspects are discussed. Northcote Road is used as a case study of a road that if the widening designation is used could leave some property owners being confronted with the scenario shown in Figure 1.

![Figure 1: The age old dilemma of ‘improving the street’](image)
HISTORICAL AND CURRENT DESIGN APPROACHES

In New Zealand we don’t have the legacy of medieval lanes as exists in some English towns and likewise we don’t have the wide, grand boulevards of European cities such as Paris. The town planners and surveyors who developed our towns and cities in the 1800’s generally created networks of one chain wide (20.1 metre) road reserves. In Christchurch the streets built within that 20.1 metre road reserve were generally 14 metres wide, enough for a horse and cart to do a U-turn perhaps? Over time as road hierarchies were established and kerb and channel was upgraded the width was decreased for local streets but was generally maintained for collector and arterial roads.

By the 1950s traffic was increasing and regional authorities began preparing transportation plans. In the Christchurch of 1959 it was considered “that a continuing and very large increase in vehicles and traffic on Christchurch streets could be expected in the near future” (Christchurch Regional Planning Authority, 1965). A Master Transportation Plan was prepared to predict the amount of increase and put forward design solutions to overcome the deficiencies. As well as creating motorways into and out of the bigger NZ cities, more space was deemed necessary on existing arterial roads and the process of upgrading them, or at least designating land for future widening, commenced.

The design of the new streets and upgraded streets was generally directed by local or national guidelines perhaps influenced by international practice. The streets that were four-laned in Christchurch were done so with wide solid medians accommodating turning bays and large street trees. Figure 2 shows the almost complete Memorial Ave upgrade in 1959, note that the large number of street lights was required because car lights were not very powerful at that time.

![Figure 2: Memorial Ave in 1959 (Source: Christchurch Libraries)](image)

The traffic lanes were generally wide with on-street parking retained resulting in road reserves over 30 metres wide. Only in the last 10 years were marked cycle lanes added to the layout of four lane urban roads as shown on Pages Road in Figure 3.
To achieve these layouts the frontage of residential properties were acquired. Figure 4 illustrates how close this left many of the houses to four lane roads.

The last road to be four laned in Christchurch was Fendalton Road. Since 1945 the Council had tried to establish four lanes on Fendalton Road and finally succeeded in 2002. The key aspect of this project was the protection of mature trees over on-street parking. The character of the street was important as in conjunction with Memorial Avenue, Fendalton Road provides a gateway to the city from the airport. The resulting street layout is shown in Figure 5.
However, not all the busy roads were widened. Curletts Road for example was part of the Living Streets programme in Christchurch in the early 2000s and influenced by the 1990s US practice of ‘Road Diets’ the design team retained two lanes and incorporated a flush median, pedestrian crossing facilities and kerb build-outs with landscaping. Overall creating a great busy street despite some criticism at the time for not four laning the road. Ironically since the Canterbury earthquakes the high traffic volumes have required the road to be operated as a tidal three lane road and NZTA are currently investigating long term options including clearways.

The ‘Road Diet’ was a new term applied to slimming up patients (streets) into leaner, more productive members of society. The ideal roadway patient is considered to be a four-lane road carrying 12-18,000 vehicles per day which was reduced to two lanes allowing the remaining space for wider footpaths, cycle facilities and landscaping. It was found that the upper comfort range for these type of arterial conversions appeared to be between 20-25,000 vehicles per day (Burden and Lagerway, 1999).

In New Zealand engineers and planners continue to use local design guidance with input from the Austroads Guide to Road Design series and other international guides. In Auckland for example a great deal of effort has been put into a Liveable Arterials Plan (Auckland City Council, 2009). The Liveable Arterials Plan sets out the issues affecting the street and the land use interface, the latter touches on residential amenity.

In the UK the Manual for Streets (Department for Transport, 2007) is used predominantly for the design of new residential streets, but it is also applicable to existing residential streets subject to re-design. It considers that streets have five principal functions; place; movement; access; parking; and drainage, utilities and street lighting. Beyond access and parking for adjacent residents the place aspect is focused on how streets should be fitted around significant buildings, public spaces, important views, topography, sunlight and microclimate. There is limited consideration of the other needs that residents may have in relation to their street.

In the US there are two key street design approaches, ‘Complete Streets’ advocated by Smart Growth America and ‘Context Sensitive Solutions’ (CSS) supported by the Institute of Transportation Engineers. These two approaches appear to be complementary. The differences between the two are subtle and as a result there is sometimes confusion about how they differ from each other. Complete Streets is a process-oriented approach that works to change everyday practice in how streets are designed and planned. Community context is one of ten elements of a comprehensive Complete Streets policy. The focus of Complete Streets is about transportation and accommodating the different types of road users who use the street. In comparison CSS is at its root a project-oriented approach with a focus on meaningful collaborative stakeholder involvement in road design projects. In addition to transportation, CSS looks at uses adjoining the road, the historical perspective, and how to integrate roads better with the surrounding environment.

THE CAPACITY ASPECT

The 2000 edition of the US Highway Capacity Manual (HCM) (TRB 2000), provides detailed information on capacity analysis and is the primary reference document for traffic engineering guidance such as the Austroads series. Capacity is defined in the HCM as “the maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time period under the prevailing roadway, traffic and control conditions”. Capacity is determined differently for uninterrupted flow and interrupted flow, both terms describe the type of road facility and not the quality of traffic flow on it.

In the urban environment most roads are ‘interrupted flow facilities’ as the traffic flow conditions are subject to the influence of fixed elements such as traffic signals, stop signs or other controls which cause traffic to stop periodically, irrespective of the total amount of traffic (Austroads, 2009). The capacity of an urban street is therefore largely related to the type and density of intersections. At unsignalised intersections, the major road traffic normally has priority over the minor road. From that perspective, unsignalised intersections cause neither reduced capacity nor delay. When the volumes of cross and turning traffic at intersections with minor roads are small, capacity considerations are usually not significant.
The traffic engineer’s rule of thumb is that four lanes are required once the street is carrying more than 20,000 vehicles per day. This is coarse as the time period used in capacity analyses should be one hour, or some cases the analysis could focus on a 15 or 30 minute period of the peak hour, rather than a 24 hour period.

As shown in Figure 6 Northcote Road’s highest hourly traffic flows occur in the morning weekday peak with westbound traffic the heaviest. The maximum hourly flow is close to 1400 vehicles per hour per lane which exceeds the typical mid-block capacity of 900 vehicles per hour per lane for an urban road with interrupted flow (Austroads, 2009).

![Figure 6: Northcote Road daily traffic profile in each direction](image)

It is noted that peak period mid-block traffic capacities may increase to 1200 to 1400 vehicles per lane per hour when a number of conditions exist or can be implemented (Austroads, 2009):

- adequate flaring at major upstream intersections
- uninterrupted flow from a wider carriageway upstream of an intersection approach and flowing at capacity
- control or absence of crossing or entering traffic at minor intersections by major road priority controls
- control or absence of parking
- control or absence of right turns by banning turning at difficult intersections
- high volume flows of traffic from upstream intersections during more than one phase of a signal cycle

Some of these conditions do exist on Northcote Road and some could be implemented (e.g. banning parking and right turns) to improve the capacity for current flows.

THE COMMUNITY ASPECT

What makes a street liveable and appealing to residents? The answer is likely to be a combination of streetscape features and social factors, particularly on low volume streets where there is generally a reasonable level of effort made consulting with the residents over street design. But can these features/factors also contribute to high quality arterial streets? There appears to be limited research into this question and how it could help designers achieve a balance between road users and residents.

The work of companies and individuals such as Urbanism Plus, David Engwicht, Dan Burden and others have promoted the creation of vibrant public spaces and walkable communities and often these approaches are applied to the design of local streets and streets in town centres. The Living Streets programme in Christchurch for example applied Engwicht’s approaches to several of the pilot projects by collaborating with the residents early; essentially using a blank canvas approach; and good outcomes were achieved.

Arterial streets are different in terms of the traffic function and the designers work within a series of
givens but can still create valuable public spaces.

A Swedish study (Wahl et al, 2012) investigated factors influencing resident’s estimate of traffic related phenomena in their street but this focused on accident frequency, incident frequency, difficulty of crossing the street, traffic flow and speed level and how they could depend on factors such as gender, age, how frequently they walk along the street or on the characteristics of the street. The research consisted of survey data from over 900 residents living on four major arterial streets in Malmö, Sweden. The results showed that respondents who stated they often walk along their street seemed to make higher estimates of the occurrence of the tested factors. This suggests that asking a series of residents about what is important to them the responses will vary.

In NZ an investigation was undertaken into the effect of heavy vehicle traffic on residents (Luther et al, 2004). The study focused on sixteen roads in four North Island communities. The roads selected were predominantly regional arterial roads and had heavy vehicle volumes ranging from 2.1% to 32% of total traffic volume. Results showed that traffic in general was the main community concern on the roads surveyed. Heavy vehicles were most likely to concern women, households with children, and people at home during the day. The level of concern was not related to the actual volume of heavy vehicles but to the perceived volume, especially any perceived change in volume. The main concern about heavy vehicles appeared to be the nuisance that they caused.

Given the lack of research the authors propose that the following issues, in no particular order, are likely to be important to residents beyond their roles as road users;

- **Safety** (e.g. feeling safe from traffic when in their front yard)
- **Aesthetics** (e.g. outlook from their property, this is important so that people don’t feel the need to construct high fences)
- **Health** (e.g. absence of emissions from congested vehicles)
- **Noise** (e.g. absence of speeding, idling or braking vehicles)
- **Social** (e.g. the ability to cross the road to visit neighbours or local destinations in the street)
- **Convenience** (e.g. access, parking, where to locate their wheelie bins)

Further research is required to determine if these issues are in fact important and also which issues residents would value more over another. For example on Fendalton Road the retention of the mature trees was valued more by residents than on-street parking, this may differ between streets. Research could involve reviewing past consultation findings for a number of arterial road projects to determine common factors or developing specific surveys of resident’s views. In the meantime some ways in which the design of streets can ensure issues such as these are addressed are suggested in Table 1. It is acknowledged that these range from expensive (in some cases cost prohibitive) to simple measures all of which need to be balanced with the road user and legal requirements.

Table 1: Likely resident’s issues

<table>
<thead>
<tr>
<th>Issues</th>
<th>Ways to address through design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td>• Good geometric design to ensure vehicles (particularly on bends) have limited potential to leave the road, ensuring a reasonable separation between the kerb and the property boundary.</td>
</tr>
<tr>
<td>Aesthetics</td>
<td>• Landscaping treatments, not positioning signs, bus shelters and other large road side objects in front of dwelling windows.</td>
</tr>
<tr>
<td>Health</td>
<td>• Ensuring street trees are located to avoid blocking sunlight to dwelling windows.</td>
</tr>
<tr>
<td>Noise</td>
<td>• Ensuring setbacks from traffic lanes, road surfacing treatments.</td>
</tr>
<tr>
<td>Social</td>
<td>• Providing street crossing opportunities, providing areas for interaction (“linger nodes”).</td>
</tr>
</tbody>
</table>

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Convenience

• Providing space for waste collection bins so residents are not forced to place bins in awkward locations.

THE CASE STUDY

Background

Northcote Road is a major arterial that forms part of the inner ring road along with QEII Drive to the east and Greers Road to the west. Figure 7 shows the location of the case study in the context of the north-west area of Christchurch.

Figure 7: Project Location Map

The potential four laning of Northcote Road was identified some years ago when a road widening designation was placed in the City Plan. Prior to the earthquakes the Northern Options Scoping Study (NROSS) (Christchurch City Council (CCC), 2002) determined that the traffic volumes on Northcote Road were predicted to rise irrespective of the Northern Arterial implementation and that upgrading to four lanes should be planned for prior to 2021. The subsequent Christchurch Northern Access Transport Investigation (CNATI) also confirmed that the four lanes would be necessary as part of the CNATI package of works. The post-earthquake analysis (i.e. using revised travel patterns) of traffic volumes also concluded that the current two lane road would not have sufficient capacity to accommodate the traffic demands for the next 20 years. Figure 8 shows the past and predicted traffic volumes.
Appendix A includes further background information on the Northcote Road case study including the strategic context, description of the adjacent land use and road environment. The following sections discuss the operational and widening options considered and how they would impact the capacity, the road user requirements and the adjacent residents.

**Is there an operational solution?**

A Network Management Plan (NMP) has been developed for Christchurch (CCC, NZTA, ECan, 2013). This is an interim document that sets out an approach that aims to better manage and plan for the transport system enabling better optimisation and unlocking use potential. The Plan establishes the key operational principles considering priority of modes, levels of service and land use. These principles when applied to the transport network identify network deficiencies and inform the type of operational options that can mitigate current and potential congestion and inefficiency issues. The Plan is based on the SmartRoads approach developed by VicRoads in Australia.

The NMP has identified the intersections with deficiencies, it does not at this stage identify corridor deficiencies. The mode priorities for Northcote Road as per the NMP are shown in Table 2 and illustrates that not one mode has priority over the other modes. Parking is not included as a mode and on arterial roads is considered as the lowest priority.

**Table 2: Network Management Plan Mode/Place/Time of Day status**

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>Pedestrians (street surrounding a school)</th>
<th>Public Transport (not a Core PT route)</th>
<th>Cycleways (a local cycleway)</th>
<th>Freight (not a strategic or local freight route)</th>
<th>General Traffic (a District Arterial)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM Peak</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
</tr>
<tr>
<td>High off peak</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
</tr>
<tr>
<td>PM Peak</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
<td>↔</td>
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<tr>
<td>Off peak</td>
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</tbody>
</table>

**Key**

- Encourage
- Strongly Encourage

![Figure 8: Northcote Road daily traffic volumes (past and predicted)](image-url)
Using the existing carriageway could be considered the most 'optimised' in terms of use of the funds. A clearway option was developed for assessment based on the peak traffic flows in Figure 6. The cross section included 3.8m wide kerbside lanes so these could be operated as a clearway arrangement (2m parking plus 1.8m cycle lane). The option would also include shared paths so when the road is operating with four lanes at peak times the cyclists have an alternative provision. The cross section is shown in Figure 9.

From a capacity perspective the clearway option would work for several years but as seen earlier in Figure 8 it is unlikely to cater for future traffic flows on the road.

From a road user perspective this option does not afford cyclists equal priority with the other modes as required by the NMP, particularly as the arrangement removes existing cycle lanes at peak times of the day. A shared path alternative is not considered an acceptable solution given it would be adjacent to multiple driveways. There are also no pedestrian crossing facilities, consequently safety issues are likely to arise with this option.

From a residents perspective this option means that no land is taken for road widening so dwellings would remain the same distance from the carriageway, albeit the traffic is travelling closer to the kerb for parts of the day. On-street parking would be retained for the majority of the time and turning right into driveways would be unimpeded. The significant issues that arise for residents is this layout provides no landscaping and in fact removes the grass berm and therefore aesthetics would be low. Social interactions within the street may become limited by the lack of road crossings.

If this option had been acceptable from a capacity and road user perspective then discussions with the residents would have been required around the benefits and dis-benefits they would experience.

If the four lanes were to be in full time operation then the wider kerbside lanes could be reduced to 3.2m and a 1.2m wide flush or solid median added. In this scenario shared paths would be critical for cyclists. This option would also allow for no landscaping, poor pedestrian crossing facilities, shared paths adjacent to multiple driveways and overall have low amenity. Again this option is not considered acceptable from a capacity and road user perspective.

Widening solutions

A number of options were developed using both or one side only of the designation only. Two of the options are discussed below.

The option of only taking one side of the designation is shown in Figure 10. The south side would be taken given the offset of the designation at the railway line provides more space on the south side. This option offers the benefit of retaining on-road cycle lanes and providing a solid median.
On-street parking would not be provided as the overall width available is allocated to road users and for the safety and amenity benefits gained from the solid median.

![Figure 10: Cross section taking one side of designation only (dimensions in metres)](image)

From a capacity perspective this option caters for future traffic flows on the road.

From a road user perspective this option affords cyclists equal priority with the other modes as required by the NMP. Bus stops will be ‘in-line’ stops and this is supported by bus operators. The solid median allows for frequent pedestrian crossing facilities and there are sufficient footpaths on each side of the road.

From a residents perspective this option means that the dwellings on the south side of the road will be closer to moving traffic lane. Although this is not ideal there are less dwellings affected than if the designation on the north side was used instead. There are better opportunities for pedestrians to cross the road. This option allows for higher amenity outcomes given the central tree planting. The width of the solid median is not sufficient to accommodate exclusive right bays or U-turn slots so access to the properties becomes limited. Gaps in the median could be provided at the intersections however this would not allow right turns out of the side streets to be undertaken in a safe manner.

This option is acceptable from a capacity and road user perspective however discussions with the residents are required around the benefits and dis-benefits they would experience.

The option of taking both sides of the designation is shown in Figure 11. This option provides a balanced approach where some parking is retained on each side of the road and street trees are possible on both sides of the road whilst taking 1.25m less than the full designation on each side.

There would be cycle lanes on each side of the road which is an appropriate treatment for a ‘local cycleway’. The solid median is of sufficient width to cater for U-turn slots and right turn bays.

![Figure 11: Cross section taking both sides of the designation (dimensions in metres)](image)

From a capacity perspective this option caters for future traffic flows on the road.
From a road user perspective this option affords cyclists equal priority with the other modes as required by the NMP. The solid median allows for frequent pedestrian crossing facilities and U-turns.

From a resident's perspective the option means that dwellings on both sides of the road will be closer to the moving traffic lane. Some on-street parking is retained and access is improved as U-turns will be possible. There are better opportunities for pedestrians to cross the road and wider areas between the kerb and the property boundaries that would provide opportunity to create landscape areas. Overall this option allows for higher amenity outcomes given the central and side tree planting.

This option is acceptable from a capacity and road user perspective however discussions with the residents are required around the benefits and dis-benefits they would experience. Overall the options provide residents with more benefits than the previously discussed options however their dwellings will be located closer to the road.

The next stage of the project involves assessing the options against the budget as this may be a limiting factor. Discussions with the community can then commence.

CONCLUSIONS

Given the apparent lack of research into what the people who reside on arterial streets consider important and how that would influence the design, the authors propose that the following aspects, in no particular order, are likely to be important to residents beyond their roles as road users; safety, aesthetics, health, noise, social and convenience.

Further research is required to determine if these aspects are in fact important and also which issues residents value over another. Research could involve reviewing past consultation findings for a number of arterial road projects to determine common factors and/or developing focused resident's surveys. In the meantime some ways in which the design of streets can ensure issues such as these are addressed are suggested in this paper.

In the case study a number of cross sections were developed to provide capacity and address the needs of road users. These were also considered from the likely perspective of the residents. Although the road widening options are acceptable from a capacity and road user perspective a number of benefits and dis-benefits would be experienced by residents and these require discussion with them.

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APPENDIX A – CASE STUDY BACKGROUND INFORMATION

Strategic Context
The development of transport programmes and projects should be guided by and consistent with local, regional and national strategies and plans. The Christchurch Transport Strategic Plan (CTSP) (CCC, 2012) is a non-statutory Plan that updates Christchurch’s local transport policy in relation to relevant statutory plans, in particular the Canterbury Regional Land Transport Strategy, Regional Policy Statement, Greater Christchurch Urban Development Strategy and Regional Public Transport Plan. The CTSP places a strong emphasis on travel choice by establishing strong networks for all transport options during the next 30 years.

The CSTP outlines a series of network maps that define each roads’ role in the overall network. Within the Strategic Road Network, Northcote Road is a District Arterial route that runs between Johns Road and Main North Road. Sawyers Arms Road is also part of this route. This is a shift away from the current main arterial route of Northcote Road, Greers Road and Harewood Road. Under the CTSP Greers Road and Harewood Road become minor arterial roads. District Arterials provide for traffic travelling across the City and are connections to the State Highway. They reflect high demand for longer distance travel at a metropolitan (city) level of significance.

Northcote Road is not part the freight network. The road carries heavy vehicles of which some will be freight related however there is no driver to provide for freight reliability or ensure design caters for larger volumes of freight. Northcote Road is a ‘local cycleway’. A local cycleway provides safe connections for people who wish to access the major cycle routes and will offer most school pupils in Christchurch a safe environment in which to travel. It is intended that they are either off-road paths, on-road cycle lanes or follow quiet local streets. Northcote Road is a bus route but is not part of the Core Public Transport network. The aim of the Core Public Transport routes are to ensure direct connections to the Central City.

Project Objectives
Develop a four lane corridor treatment that:

1. Caters for future traffic growth as reflected in the CAST\(^1\) model flows
2. Reflects the CTSP Strategic Road Network classification of Northcote Road as a ‘District Arterial’
3. Includes a cross section that balances the needs of the road users and need for land within the designation
4. Provides a safe road environment for all users
5. Caters appropriately for cyclists given that Northcote Road is a ‘local cycleway’
6. Does not compromise the interface with the Railway Cycleway which is part of a Major Cycleway Route
7. Caters appropriately for pedestrians given the proximity to schools and the Key Activity Areas of Papanui

Surrounding Land Use
The surrounding land use is predominately residential in nature as shown in Figure 12. There are business activities to the south which include some retail near the Main North Road intersection. There is a distribution centre south of the residential properties between Lydia Street and Main North Road and some business activities to the south, both east and west of the railway corridor.

There is a kindergarten in the western section of the road and several schools in the vicinity of the project. Casebrook Intermediate is to the north of Northcote Road. This school has vehicle access from Veitches Road however there is pedestrian/bicycle access from Northcote Road with a pedestrian crossing island on Northcote Road. St Bedes College is located to the east of Main North Road and St Joseph’s School is located nearby on Vagues Road.

\(^1\) Christchurch Assignment and Simulation Traffic Model (a SATURN model)
Figure 12: Overview of adjacent land use

The land adjacent to the road is zoned Living 1 Residential except for the business zone at the east end and open space zone to the west of the railway. There is a road widening designation within the City Plan for Northcote Road between Main North Road and the railway. The designation is 5.5m on each side of the road except near the railway where it decreases on the north side and increases on the south side. Council has purchased a small number of the property frontages over recent years.

Description of Northcote Road

Northcote Road has two distinct road reserve layouts either side of the railway corridor, each is described below. The Railway Cycleway crosses Northcote Road at the railway via a signalised crossing.

The road reserve between Main North Road and the railway is 20.1m wide. There are 3m berms/footpaths either side of a 14m wide carriageway. The carriageway is generally made up of two 2m wide parking lanes, two 1.5m wide cycle lanes, two 3m wide traffic lanes and a 1m wide flush median as shown in Figure 13. There are four streets intersecting with Northcote Road in this section and parking demand is low.

Figure 13: Existing road between Main North Road and the Railway

The road reserve between the railway and Sawyers Arms Road (west) is around 33m wide. There is a 6m wide service lane on the south side of the street separated from the main carriageway by a grass median of varying width as shown in Figure 14. The main carriageway consists of a 2m wide parking lane on the north side, two 1.5m wide cycle lanes, two 3m wide traffic lanes and a 2m wide flush median. There is a 3m berm/footpath on the north side. There is no land required between
the railway Line and the Sawyers Arms Road intersection as the road reserve is sufficient for the four laning to be implemented. There are three streets intersecting with Northcote Road in this section and the parking demand is higher due to the school and kindergarten.

Figure 14: Existing road between the Railway and Sawyers Arms

The majority of the motor vehicles using Northcote Road are light vehicles. On average the heavy vehicle component of the traffic is 5%. The heavy vehicle proportion is generally consistent between 7am and 4pm and is generally the same in both directions with eastbound heavy vehicle flows slightly higher.