

Redland City Council: Road Infrastructure Planning

TRAFFIC FORECASTS AND ASSESSMENTS (2014)

October 2014



(12-043)

**REDLAND CITY COUNCIL
- ROAD INFRASTRUCTURE PLANNING**

**TRAFFIC FORECASTS
AND ASSESSMENTS (2014)**

Project Name	Project No.	Report Name	Version	Date	1^o Author
Redland City Council: Road Infrastructure Planning	12-043	Traffic Forecasts And Assessments (2014)	V.3	October 2014	G. Hunter

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Appendix A (a separate volume) contains all Figures.

1.0 Introduction

1.1 Background

The *Sustainable Planning Act 2009* previously required all planning schemes to include a Priority Infrastructure Plan (PIP). The purpose of the PIP was to:

- Integrate and co-ordinate land use planning and infrastructure planning
- Ensure that trunk infrastructure is provided in an efficient and timely manner
- Provide a transparent, equitable system for funding the trunk infrastructure.

As a key process within the current Planning Scheme Review leading to 'City Plan 2015', Redland City Council engaged Veitch Lister Consulting Pty (VLC) to assist with preparation of the 'road infrastructure' component of the new PIP.

In particular, VLC were asked to use their Zenith model of South-east Queensland to assist with the identification of transport infrastructure improvements needed to support the planned development in the City to a horizon of 2031, and to use the model's outputs to apportion the expected costs of the required infrastructure to future users (i.e. produce a schedule of infrastructure charges).

To undertake this study, VLC have updated and refined a series of detailed transport models previously established for the Southern Regional Roads Group. The refined models, which represent Redland City and the rest of the southern roads region at relatively detailed levels (within a broader SEQ framework) comprise 3 modelling horizons - 2011, 2021 and 2031. While the 2021 and 2031 models were used to assess future transport infrastructure needs in the City, the principal purpose of the 2011 'base year' model is to demonstrate that the Zenith model can replicate 'existing' transport demands and operating conditions.

NB. In June 2014, after VLC had completed their traffic forecasts and assessments, the State Government introduced the *Sustainable Planning (Infrastructure Charges) and Other Legislation Amendment Act 2014*, in June 2014. This amendment now requires the preparation of a Local Government Infrastructure Plan (LGIP) rather than a PIP, and sets out slightly different requirements and procedures.

1.2 Purpose of this Report

The purpose of this report is to document the principal methods and assumptions used by Veitch Lister Consulting (VLC) in producing the traffic forecasts and subsequent assessments of road infrastructure requirements in Redland City.

1.3 Contents of this Report

This report has 7 chapters and a separate appendix. The remaining contents are:

- **Chapter 2** describes the heritage of the Redland transport demand model and its further refinement for this PIP study;
- **Chapter 3** provides details of the validation of the base year (2011) model;
- **Chapter 4** presents the demographic projections used in the future year models;
- **Chapter 5** presents the traffic forecasts and assessments leading to the proposed transport network for 2021;
- **Chapter 6** presents the traffic forecasts and assessments leading to the proposed transport network for 2031;
- **Chapter 7** reviews the study findings and suggests matters for further investigation;
- **Chapter 8** describes an analysis of road capacity usage within the City at 2031;
- **Appendix A** (a separate volume) contains Figures.

2.0 Further Background

2.1 VLC's Zenith Software

Veitch Lister Consulting are specialists in multi-modal travel demand forecasting. To support this role, the company has developed travel models of all of Australia's state capital cities, using their proprietary 'Zenith' software.

'Zenith' is at the leading edge internationally, in terms of its sophistication and capabilities as a fully integrated (4 stage) multi-modal travel demand-forecasting package. As such, it forecasts the demands for individual travel modes, rather than use estimated or 'target' mode shares as an input. The structure of the 'Zenith' package, including its various sub-models, is shown in **Figure 2.1**.

The primary inputs to each Zenith model are:

- Detailed demographic estimates
- A transport infrastructure network, plus
- Public transport services and stop locations

In addition, the models use comprehensive sets of empirically derived parameters (for differing travel purposes), which are utilised within the differing sub-models, e.g.:

- Trip rates,
- Trip distribution parameters,
- Time period factors,
- Mode share parameters, and
- Vehicle occupancy rates.

Most of these parameters are city specific and have been produced by self-funded research and analysis of publicly available information.

2.2 Ancestry of the Redland PIP Model

The 'Redland PIP' models reported herein are locally refined and updated versions of the 'SouthRoC' series of travel models that VLC produced for the Southern Regional Organisation of Councils (SouthRoC) in 2008-2009. These 'SouthRoC' models were, in turn, local refinements of VLC's proprietary 'Zenith' models of South-east Queensland.

All of VLC's models of SEQ, including the SouthRoC and Redland PIP derivatives, utilise an extensive 'buffer' area, which (as shown in **Figure 2-2**) extends north of Gympie, west of Toowoomba and southward into NSW. VLC's use of such a large buffer area largely eliminates the need to make assumptions about 'external trip making' by land uses within the 'core' area of the model.

The primary difference between the Redland PIP model and its parent SouthRoC model is the increasing level of detail used for the model 'zone system' within Redland City. To better represent the land use patterns and accessibility within Redland City, both at 2011 and in the future scenarios, the 'SouthRoC' model zone system has been substantially refined. The new zone system within Redland now comprises 503 zones, which are based on 'Statistical Areas – Level 1' (SA1) from the 2011 Census; whereas the previous 267 zones used within the SouthRoC models were based on Census Collector Districts from the 2006 Census. The new more detailed zone system within Redland City is shown underneath the older SouthRoC system in **Figure 2-3**.

The new 'Redland PIP' models still use the same travel demand parameters (e.g. trip rates, etc) that VLC have previously derived from Household Travel Surveys in SEQ and which are used in the regional SEQ model.

2.3 Approach to the PIP Modelling and Assessments

The transport modelling and assessments undertaken by VLC, to assist with the preparation of the Redland PIP, has involved 5 basic stages:

- i. Establish and validate the 2011 (base year) model
- ii. Establish demographic projections (2021 & 2031) at model zone system level of detail
- iii. Establish a 2021 base model and use it to identify road network improvements
- iv. Establish a 2031 base model and use it to identify road network improvements
- v. Use the 2031 model to ascertain the 'value of road capacity consumed' by differing areas of the City, at that future horizon.

It should be noted that VLC's assessments of future road network performance are largely based on an indicator known as the Volume/Capacity ratio. These V/C ratios, which are calculated for each direction of each modelled road link in each peak hour, are an indirect indicator of 'Level of Service'. The relationship between 'V/C ratios', 'Levels of Service' and 'Design Traffic Volumes' is discussed in the next section.

2.4 Design Traffic Volumes and Levels of Service

The term 'Level of Service' is used to categorise traffic operating conditions. It was originally developed in the USA in the 1960s to assess freeway operations, for which the six categories or bands ('A' to 'F') were originally defined in terms of traffic density (e.g. cars/lane/kilometre). In practical applications, it is common to express the band limits in terms of Volume/Capacity ratio, as in Table 2.1, below.

Table 2.1: The 'Level of Service' Bands

LOS	Description of Typical Conditions	Typical ⁽¹⁾⁽²⁾ V/C Limits (Austroads)
LOS A	<i>LOS A describes free-flows operations.</i>	< 0.35
LOS B	<i>LOS B represents reasonably free flow, and free flow speeds are maintained. The ability to manoeuvre within traffic is only slightly restricted and general level of physical and psychological comfort provided to drivers is still high.</i>	0.35 – 0.55
LOS C	<i>LOS C provides for flow with speeds at or near free flow speed of the road. Freedom to manoeuvre within the traffic stream is noticeably restricted, and lane changes require more care and vigilance on the part of the driver.</i>	0.55 – 0.70
LOS D	<i>LOS D is the level at which speeds begin to decline slightly. Freedom to manoeuvre within the traffic stream is noticeably limited, and the driver experiences reduced physical and psychological comfort levels</i>	0.70 – 0.87
LOS E	<i>LOS E reflects operational capacity. Operations at this level are volatile because there are virtually no usable gaps in the traffic stream. Vehicles are closely spaced leaving little room to manoeuvre within the traffic stream.</i>	0.83 – 1.00
LOS F	<i>LOS F Describes total flow breakdown in vehicular flow. Such conditions generally exist within queues forming behind breakdown points, such as merge or weaving segments and lane drops, where the number of vehicles arriving is greater than the number of vehicles being discharged.</i>	> 1.0

Notes: 1. Actual limits vary by road type, by %HV, by gradient, etc, etc, etc.
2. The 'Capacity' is the 'maximum service volume' (in passenger-car equivalents per hour)

As a guide, the photographs in **Figure 2-4** indicate the approximate traffic densities at the mid-point of each Level of Service (for the traffic travelling toward the camera).

In urban road networks, however, it is usually the intersections (rather than the mid-block segments) that dictate or limit the capacity of a road link or even a whole route. The 'Level of Service' provided at an intersection is normally assessed via the average delay experienced by vehicles. However, the average delay can vary between differing approaches and movements, and for the same movement at differing times of the day.

The problem with assessing the performance of intersections is that the capacity of individual movements (and hence the average delays incurred by them) are dependent on other conflicting movements at the intersection. The average delay and hence level of service provided to traffic on one approach is generally influenced, if not dictated, by the volumes on other approaches. This consequence is particularly evident:

- at roundabouts, where traffic on the main road may need to give way to traffic entering from a side road, and
- at priority controlled intersections, where traffic on a side road has limited or no chance of turning onto the main road, if volumes on the latter are high.

The link capacities that VLC encode (for higher order roads) in its model networks attempt to reflect the 'practical' or 'design' capacity of the road / route concerned. Clearly, it is not practical for VLC to numerically assess the capacity of every intersection approach. The link capacities that are encoded in the models are very much a matter of 'engineering judgement' – this judgement, which is under-pinned by years of SIDRA analyses, needs to consider intersection types, fronting land use, and potential side road volumes.

VLC encode the lower order roads in their networks with commensurately lower capacities, reflecting functional requirements rather than physical capacity, e.g:

- Collectors: the encoded capacity reflects the volume at which side road traffic would experience problems turning on to one at a priority controlled intersection.
- Access Streets: safety and amenity limits apply.

The table below presents the uni-directional capacities (hourly) that VLC typically encode in their models for differing link types.

Table 2.2: Typical VLC Modelled Link Capacities (2 Way Roads)

Rural	Urban	Uni-directional Hourly Capacity
Primary	Arterial	900-1100 vplph
	Sub-Arterial	800 vplph
Secondary	Collector	600 vplph
Tertiary	Access St	300 vplph

Notes: 1. 'vplph' = vehicles per lane per hour

It should be noted that the road hierarchy nomenclature used above is a 'capacity-based' hierarchy adopted and used by VLC. These terms do not necessarily correlate with 'functional based' hierarchical terms used by various agencies (including Redland's own Planning Scheme), as below.

Table 2.3: Differing Functional Classifications

Functional Hierarchy	Queensland Main Roads ⁽¹⁾	Queensland Streets	A.R.R.B	AustRoads
Highway	State Strategic Rd ⁽²⁾	Freeway	Arterial	Freeway
Arterial	Regional Road	Major Arterial	Sub-Arterial	Primary Arterial
Distributor	District Road	Arterial	Distributor	Secondary Arterial
		Sub-Arterial		Distributor

Notes : 1. Road Planning and Design Manual
2. Includes 'National Highways'

3.0 Development & Validation of the 2011 Model

3.1 Introduction

A pre-requisite step in producing any series of travel forecasting models is to prepare and validate a 'base year' model. The intent of this is to demonstrate that the model system (and its various inputs) can replicate observed travel demands with sufficient accuracy (i.e. proven 'fit for purpose').

It is VLC's practice to adopt the latest Census year (in this case 2011) as the 'base year' for any series of models. This is because:

- the population and employment data obtained from the Census survey are considered more accurate than the 'estimates' produced for intervening years;
- a more comprehensive set of traffic counts can be sourced and collated for a horizon that is 1-2 years in the past.

The remaining sections of this chapter describe the development of this 'base year' model and its validation against regional and local traffic counts.

3.2 Representation of Redland City within the 2011 Model

The key technical elements used to represent Redland City within the Zenith model are the zone system, the demographic attributes of each zone and the model transport system linking each zone. These are described, as follows:

Zone System

As mentioned in the previous chapter, a completely new model zone system (within Redland City) has been developed for use in the PIP model. This much more disaggregate system (503 zones, compared to 267 previously) is based on the SA1 geographies from the 2011 Census.

Demographics

The demographics used (in the Zenith model) to represent Redland City land uses at 2011 are primarily derived from 2011 Census data, source from the Australian Bureau of Statistics. The key demographic variables were sourced / processed as follows:

- *Residential Data* – VLC utilise the age profiles and workforce attributes of persons usually resident in each 'SA1', along with details of the number of occupied dwellings and car ownership, as their base data. This 'Usually Resident Population' (URP) data is then factored up to 'Estimated Resident Population' (ERP) levels, before being apportioned to the model zone system (using cadastral information).
- *Education Data* – enrolment data for every educational institution in South-east Queensland in 2011 has been sourced from the Australian Curriculum Assessment and Reporting Authority (ACARA) and then geocoded into the model framework / zone system. VLC have also encoded nominal 'pre-school' enrolments at each kindergarten and child care centre in Redland City.
- *Employment Data* – VLC use the Census 'Place of Work' data (at DZN/SA2 level) as their base data. In addition to the POWP jobs having stated / discernible locations:
 - VLC apportion the additional 'Place of Work' jobs for which the location was 'Not Stated', 'Undefined' or had 'No Fixed Address'. Spreading these extra jobs of 'uncertain location' (across the 3 levels of their aggregation; being Greater Brisbane, Queensland, and Australia) raises the number of estimated jobs in Redland City by 16%, from 35,460 to 41,181, and

- As a final step, VLC further adjust the 2011 employment data from the above 'URP' based levels to an 'ERP' based number. This raises the estimated employment in Redland City by 3.5% to 42,657 jobs. This latter adjustment not only keeps the 'as modelled' workforce and job numbers balanced, but (by including 'absent' workers) is consistent with how the model's trip rates, etc, were derived.

The Redland City demographics, as derived and used in the 2011 model, are summarised by Statistical Area (Level 2), below.

Table 3-1: Summary of 2011 "As Modelled" Demographics in Redland City

Statistical Area (SA2)	Population	Enrolments (1^o / 2^o)	Employment
Alexandra Hills	17,286	2,154 / 1,408	2,553
Birkdale	14,950	1,990 / -	2,288
Capalaba	17,480	1,639 / 559	11,221
Cleveland	15,046	887 / 1,097	10,207
Ormiston	5,925	1,013 / 727	1,346
Redland Bay	14,006	981 / -	2,198
Sheldon – Mt Cotton	6,665	1,304 / 601	1,987
Thorneside	3,669	40 / -	374
Thornlands	13,249	1,137 / 904	2,193
Victoria Point	15,280	1,848 / 1,545	4,498
Wellington Point	11,380	1,304 / 1,555	1,872
Redland Islands	8,686	547 / 82	1,827
TOTAL	143,622	14,844 / 8,478	42,657

Transport System

The transport system encoded within the Zenith model comprises both a representation of the road network that existed in mid-2011 along with a representation of the public transport services that operated at that time:

- *Road Network* – The 2011 model road network in Redland area is shown, in terms of its 'capacity-based road hierarchy', in **Figure 3-1**.
- *Public Transport* – The 2011 public transport system that operated in the Redland area is shown, in terms of route coverage and stop locations, in **Figure 3-2**. It should be noted that the modelled PT system not only includes all individual bus/rail/ferry routes, but their operating frequencies during the 3 modelled time periods (AM peak / off-peak / PM peak).

3.3 Validation of the 2011 Model

Prior to commencing this study, the 2011 Zenith model of SEQ was validated against observed traffic volumes crossing a set of 46 screen-lines throughout SEQ. The traffic counts at the 335 sites on these screen-lines were commissioned by DTMR's Model Data and Analysis Centre (MDAC) and were undertaken in early to mid-2012. VLC subsequently used these counts to refine the validation of the SEQ model, at a 'strategic' level. The results of this 'strategic level' validation are shown in **Figure 3-3a** and **Figure 3-3b**.

To validate the 2011 model locally within Redland City, VLC also obtained further traffic count data from both Redland City Council and DTMR. The data received and processed was as follows:

- *Redland City* – Council initially provided VLC with a spreadsheet summarizing historic counts undertaken by Council, during 1999-2012. This dataset included site locations, month/year of count, and the AADT and % commercial vehicles. While this data was useful in identifying sites at which ‘relevant’ counts were available, VLC subsequently requested and received the raw ‘traffic logger’ files, from which more detailed data, such as Average Weekday Traffic (AWDT) and peak hour volumes by direction, were extracted for the various desired sites.
- *DTMR* – On request, DTMR’s Road System Operations section provided VLC with every ‘coverage count’ undertaken during 2010-2012 on State Controlled Roads in Redland City, plus the 2011 count data for their ‘permanent’ count sites.

The resulting combined dataset of ‘relevant’ traffic counts in the Redland area comprised 158 sites. Unidirectional data was extracted at 115 of these sites, with only 2-way data being extracted for the 43 lower order roads. The ‘age’ of the counts and ownership of the roads are summarised, below.

Table 3-2: Profile of the Traffic Count Data Assembled for the Redland Area

Year	Road Authority / Source of Data	
	DTMR	Redland City
2008	-	13
2009	-	13
2010	-	15
2011	28	60
2012	17	12
TOTAL	45	113

From these counts, VLC were able to identify 3 screen-lines within or on the periphery of Redland City that could be used for ‘higher level’ validation. These 3 screen-lines and the 158 count sites are shown in **Figure 3-4**.

The results of the validation of the more detailed 2011 PIP model against these various count datasets is now presented at both the daily and peak period levels:

Average Weekday Traffic

- *Screen-lines* – The forecast and observed daily volumes at each screen-line crossing site are tabulated in **Figure 3-5**, along with the calculated deviations, etc. This shows an extremely good level of correlation, with 2 of the 3 screen-line totals being within 5% of the observed and all 3 Mean Absolute Weighted Deviations (MAWD) being less than 10%.
- *All Sites* – A scatter graph showing the forecast and observed daily volumes at all 158 count sites is shown in **Figure 3-6**. This also shows extremely good correlation, with the ‘line of best fit’ having a slope within 6% of unity and an R² in excess of 0.95.

Peak Period Traffic

The Zenith model tends to over-predict counter-peak traffic volumes. This is a general problem in ‘gravity’ models, and Zenith is no exception. However, from the perspective of forecasting traffic conditions in the peak periods, it is the volumes travelling in the peak (or main commuting) direction which dictate the V/C ratios and influence the performance of the road links and intersections in the network.

The following peak period validation results relate to the volumes observed / forecast in the ‘critical direction’ of each link for the peak period in question.

- *Screen-lines* – The traffic volumes observed and forecast in the peak directions of each screen-line are tabulated for both the AM and PM peak periods, in **Figure 3-7a** and **Figure 3-7b**, respectively. These show an excellent replication of the total screen-line volumes and a good level of correlation across the individual crossing points. A 'MAWD' less than 15% is considered 'good' and a 'MAWD' less than 10% is considered excellent.
- *All Sites* – the traffic volumes observed and forecast in the peak directions at each of the 115 count sites (for which unidirectional count data was extracted) is shown via scatter graphs for each peak period in **Figure 3-8a** and **Figure 3-8b**. Again, these show an extremely good correlation, with each 'line of best fit' having a slope within 7% of unity and an R^2 greater than 0.95.

Based on the above comparisons of the model's forecasts against the observed traffic volumes, the 2011 PIP model is considered more than adequately validated and therefore a suitable platform for predicting future traffic demands in Redland City.

4.0 Future Demographic Projections

4.1 Introduction

VLC's Zenith models need detailed demographic estimates and profiles to represent the 'current' and future land uses in each and every 'zone' in the modelled area. To enable VLC to establish the future demographic projections within Redland City at 2021 and 2031 at the zonal level, Council provided VLC with a set of 'high level' population and employment projections within the City, in 5 year increments to 2031, produced by Urbis. VLC needed to disaggregate this higher level data down to the models' zone system and to derive other modelled attributes such as 'household profiles'.

4.2 Information Received

VLC were provided with separate projections of residential usage and employment levels across the City. The actual data received was as follows:

Residential Data

VLC were provided with 2 tables; presenting population and dwelling projections by suburb, in 5 year increments (see **Figures 4-1a** and **4-1b**). In addition, VLC were provided with a GIS file (MapInfo) containing selected 'lots' within the city, on which residential development or redevelopment was expected. This file, which included data fields quantifying future dwelling numbers, net yields, and expected timing, gave indication as to where (within each suburb) the residential growth was anticipated. These lots (on which residential growth is expected by 2031) are shown in **Figure 4-2**.

Employment Data

VLC were provided with two reports relating to future employment within Redland City:

- *Redland City Centres & Employment Strategy (SGS, September 2010)*, and
- *Redland City Centres & Employment Strategy Review (Urbis, April 2013)*

The latter (Urbis) report provided an updated appraisal of projected 2031 employment levels by industry (as reproduced in **Figure 4-3a**) but, despite reviewing the SGS projections by location, made no new locality-based forecasts themselves. Accordingly, the employment growth pattern estimated by SGS (as reproduced in **Figure 4-3b**) remains the latest locality-based employment projections.

4.3 Review of the High Level Residential Projections

Before formulating how to disaggregate the residential projections down to the level of the Zenith models' zone system, VLC first examined the Urbis data for compatibility with its own data sources and formats.

Residential Definitions

It should be noted that 'resident population' can be measured / defined in two ways:

- *Usually Resident Population (URP)* – This comprises the 'local' population that were 'recorded' in their residences on Census Night, plus those who were elsewhere in Australia (e.g. on holiday or business) and who stated that they normally reside in part of Redland. This URP data does not include those who were overseas on Census Night or persons in households that failed to complete any census forms.
- *Estimated Resident Population (ERP)* – This is a measure of 'total' population and includes those persons 'not captured' by the Census 'net'. An ERP for any specific area is typically about 3-7% higher than the URP recorded on Census Night. (The higher percentage differences are related to areas with higher census non-compliance).

VLC utilise ERP-based residential data as input to their Zenith models. This is primarily because the 'estimated resident population' is the most commonly quoted measure of 'existing' population and the only measure used to express future populations. To derive the ERP-based residential data for the models, VLC simply factor the number of (occupied private) dwellings in an area or zone by its 'ERP / URP' ratio. The modelled ERP household profile (i.e. average workers per dwelling, dependent children per dwelling, retirees per dwelling, etc.) is retained unchanged from the URP-based profile.

Review of the 2011 Residential Data

VLC reviewed the Urbis residential data by comparing it, at suburb level, with their own 2011 population / dwelling numbers that they had obtained from ABS. The comparison (in **Figure 4-4**) indicated:

- *Population* – The two city-wide populations match; confirming that the Urbis projections are ERP-based. While most of the suburb populations also match, there are 4 that differ. VLC have reconfirmed its original data for these suburbs against more recent data (May 2013) available from the ABS web-site.
- *Occupied Private Dwellings* – The VLC dwelling numbers shown are 'occupied private dwellings' that were occupied by 'usual residents' on census night (i.e. they exclude unoccupied dwellings and those occupied by 'visitors only'). Except for the relatively small number of 'other' dwellings, the Urbis dwelling numbers almost match the VLC numbers at city-wide level; suggesting that Urbis have used the same 'occupied by residents' definition. However, it can be noted that the dwelling numbers differ in the same 4 suburbs for which the populations differed.

Review of the Future Dwelling Occupancies

VLC's review of the Urbis residential projections included calculating the forecast growth in each dwelling type, during each 5 year increment, and then calculating the average dwelling occupancies underlying their population growths. The latter indicated that Urbis have assumed generic average occupancies for 3 differing groups of future dwellings:

- 2.7 persons per dwelling for most detached dwellings, except
- 2.1 persons per dwelling for detached dwellings on the Southern Moreton Bay Islands, and
- 1.7 persons per dwelling for any attached or semi-detached dwellings

VLC had some initial concern at the use of just 3 dwelling occupancy rates, largely independent of location and housing density. VLC considered all 3 average occupancies to be a bit low for newly established dwellings. VLC would expect average occupancies that are 10-15% higher, when the dwellings are first established; but which fall away toward the Urbis estimates after around 20 years. VLC would also expect the average occupancies of existing dwellings to gradually fall, which Urbis did not.

To alleviate their concerns, VLC tested the sensitivity of the future population distribution to a set of alternative dwelling occupancy assumptions. These alternative estimates assumed higher occupancy rates for the future, new dwellings but, conversely, assumed that the average occupancies of 'existing' dwellings would reduce with time. This alternative computation (as summarised in **Figure 4-5**) suggested that:

- There could be about 6,900 less persons occupying existing dwellings, than in 2011;
- The future dwellings might yield about 3,200 more occupants than forecast by Urbis;
- Overall, VLC expect about 3,700 (or 2%) less population in 2031 than forecast by Urbis;
- At suburb level, there would be variations about this average (from -7% to +2%) depending on the amounts of future development relative to existing dwellings

These alternative computations show that the Urbis population forecasts are 'within reasonable limits', in the context of the traffic forecasting application.

Comparison with the Lot-level Projections

The GIS file of lot-based dwelling projections received from Council contained:

- *Dwelling_Yield* = the number of dwellings that the lot could yield when developed or redeveloped in accordance with permitted densities.
- *Net_dwellings* = the 'dwelling_yield' less the existing number of dwellings on the lot.
- *Timing* = the estimated 5-year period (2011-2016, 2016-2021, 2021-2026, 2026-2031 or 2031+) for development / redevelopment of the lot.

VLC aggregated the 'Net_Dwelling' yields (by the two 10-year periods) to suburb level and compared these growths in dwellings with that underlying the Urbis projections, as shown in **Figure 4-6**. This comparison showed some reasonably big differences, for individual suburbs at the individual 10-year intervals, but these deviations tended to cancel each other out at the overall (20-year) level – suggesting there were differences in timing estimates (either side of 2021) between the two data sources.

On raising the above inconsistency with Council, VLC were advised that the growth in dwelling numbers within the Urbis tabulations should be taken as the 'control' totals.

4.4 Development of the Detailed Residential Projections

Despite having a differing opinion on appropriate future average dwelling occupancies, VLC have developed its more detailed (zone-level) projections of residential land use to be fully consistent with the growths in population forecast by Urbis, as in Figure 4-1a. In summary, this involved adding the growth in dwellings and population forecast by Urbis onto VLC's ERP-based data for 2011.

Despite this relatively simple principle, more complex processes were needed to apportion the Urbis growth to the model's zone system and to also derive the future dwelling profiles. The more specific processes were:

- a) Start with the Zenith ERP-based data for 2011, at zonal level, including average dwelling profiles (determined from the 'parent' SA1),
- b) Use the 2011 dwelling profiles of selected areas/zones to identify an appropriate average profile to be used to represent the composition of each of the Urbis future dwelling types (i.e. the 1.7, 2.1, and 2.7 persons per dwelling), on first occupation,
- c) Calculate the growth in dwelling numbers (by type) in each model zone in each 10-year interval, using the GIS file of lot-based dwelling projections, then factor these to match the suburb level growth projections shown in Figure 4-1b.
- d) Apply a set of profile adjustments to the composition of all the existing 2011 dwellings, to represent the anticipated 'ageing and empty-nesting' effects over 10 or 20 years, respectively. (NB. These adjustments reduced the proportion of workers and children, and increased the proportions of retirees, but kept the average dwelling occupancy unchanged).
- e) Add the additional dwellings, as calculated in (c), along with corresponding population sub-groups, determined after applying 'ageing and empty-nesting' adjustments to the 'on first occupation' dwelling profiles identified in (b)..
- f) VLC then checked the resulting city-wide community profile (i.e. % workers, % under 18 years, % over 65 years) against 'target' proportions (e.g. as estimated by the Queensland Statistician in their '*Population and Dwelling Profile*' for Redland City, dated April 2012) and adjusted the 'ageing and empty-nesting' factors slightly, to improve the 'match'.

The various steps of the process are summarised (by dwelling types in aggregate), for 2021 and 2031 respectively, in **Figures 4-7a** and **4-7b**. The following comments are relevant to both computations:

- the 'existing' dwelling numbers are in terms of 'equivalent dwellings', a variable used by VLC in its modelling to include additional hypothetical dwellings in which occupants of non-private dwellings (i.e. hospitals and aged care facilities) are assumed to reside. Naturally, these 'as modelled' dwelling numbers are higher than the URP or census night numbers quoted in Figure 4-4.
- the dwelling profiles of the future dwellings are progressively 'aged' from the profiles estimated for them 'on first occupation'.
- the city-wide population totals don't match the Urbis targets (due to 'rounding' errors)
- a by-product of the increased proportion of the population being of retirement age is a reduced proportion of the population being in the workforce. This will tend to moderate future peak hour traffic demands.

4.5 Review of the High Level Employment Projections

Before formulating how to disaggregate the employment projections down to the level of the Zenith models' zone system, VLC have first examined the data for compatibility with its own data sources and formats.

Review of the 2011 Employment Data

On examining the Urbis employment forecasts (as in Figure 4-3a), VLC immediately noted that the total 2011 employment (35,575 jobs) only includes those jobs within the Census 'Place of Work' database for which a discernible location was stated by the census respondent. The Census 'Place of Work' database also includes jobs for which the location was 'Not Stated', 'Undefined' or had 'No Fixed Address'.

It is VLC's practice to apportion the extra jobs of 'uncertain location' over the top of those for which the location was (adequately) stated. This process raises the number of jobs in Redland City by 16% to an estimated 41,180 jobs. Additionally, for modelling purposes, VLC further adjust these 'URP-based' job numbers upwards to an 'ERP-based' level. In the case of Redland City, this raises the estimated job numbers by a further 3.5% to 42,656 jobs. Both these adjustments are needed to keep the 'as modelled' workforce and job numbers in balance (over the whole of SEQ). NB. There is still an imbalance within Redland City; with 0.61 local jobs per resident worker (as derived from VLC's 'as modelled' ERP-based numbers).

The derivation of VLC's estimated job numbers for 2011 are summarised and compared with the Urbis data, by industry category, in **Figure 4-8a**. The middle sub-table indicates that the 'Construction' category has a particularly high percentage of jobs with 'unspecified' locations, as many construction workers would have worked at multiple sites in 'the week prior to Census night' and would have stated 'No Fixed Address'.

VLC's estimated job numbers for 2011 are summarised and compared with the Urbis data, by Statistical Area – Level 2 (SA2), in **Figure 4-8b**. Relevant comments are:

- *Sub-table 1 (comparison with Urbis)* – VLC suspect that the 128 jobs difference on the Redland Islands is due to Urbis including data for Moreton Island; which is part of SA2 '31010', but which is in Brisbane City. This would also explain the various differences noted in Figure 4-8a.
- *Sub-table 2* – the extra jobs of 'uncertain' location have been apportioned across those of known location in the same industry group. This industry-based adjustment results in minor variations in the percentage increase by suburb or SA2.
- *Sub-table 4 (Transient Jobs)* – it should be noted that before factoring the URP job numbers up to ERP levels, VLC adjust the locations of the 1,535 Construction jobs of 'uncertain' locations, so as to better correspond with the areas and zones in which construction activity was occurring in 2011. These jobs can move around in future years, to where-ever development/redevelopment is forecast at that horizon. The balance or 'fixed' employment is the true base level of employment for each area.

Review of the Forecast Growth in Employment (By Industry)

VLC have reviewed the growths in employment (by industry) forecast by Urbis, in **Figure 4-9a**. While these 'growths' & 'ratios' are generally in line with VLC's expectations, a number are worthy of comment:

- *Overall Growth (sub-table 2)* – the overall employment growth, between 2011 and 2031, outstrips the equivalent population growth by 32%. This may require economic initiatives by Council.
- *Construction* – VLC would not expect Construction jobs to rise by 9% on a 'per capita' basis. VLC would expect the rate of development/redevelopment in Redland to be reasonably constant and comparable with recent historic rates of growth.
- *Finance and Business* – While VLC expect technology based professions to grow faster than others, the high per capita growth in Categories 'K' to 'N' seem a bit high.
- *Education and Training* – school-aged children in the city will only increase by 9% in total between 2011 and 2031, and will reduce as a proportion of the total population. VLC would expect Education jobs per capita to be constant or reduce marginally.
- *Health Care* – given the doubling of aged persons in Redland City (from 13% to 26% of the population), the 15% increase in health jobs per capita is not unreasonable.
- *Arts & Recreation* – a future increase in recreational activity is reasonable; but a 32% increase on a per capita basis seems excessive.
- *Transport* – increased transport services (resulting from 'e-tailing') is reasonable.
- *Mining* – The sand mining leases on North Stradbroke were expected to expire by 2031 (two of them by 2021), with most of the 180 or so mining jobs being lost.

Review of the Forecast Growth in Employment (By Locality)

As noted in Section 4.2, the latest 'Centres and Employment Strategy Review' (by Urbis in 2013) did not present any new locality-based employment projections. Although Urbis appraised recent employment trends (by locality) against the respective growths forecast by SGS in 2010, they suggested that further analysis of land supply would be needed before updated locality-based forecasts of employment could be made.

VLC have also reviewed the SGS employment forecasts, using the same basic approach as Urbis did, in **Figure 4-9b**. Relevant findings are:

- a) *Sub-table 2* – Overall job growth in the city (between 2006 & 2011) was consistent with SGS' forecasts (i.e. 20% of their forecast 25-year growth). Despite this, the proportion of the forecast job growth achieved in individual suburbs varied about this average, with three SA2's actually experiencing job losses.
- b) *Sub-table 3* – this sub-table calculates the 'remaining' growth in employment between the '2011 actual' and the 'original 2031 forecasts'. A cursory review of the implied growth, as a percentage of the new 2011 base levels, shows that implied growth in most suburbs are within +/- 10% of the city-wide average of 40%. The 'outliers' are considered as follows:
 - *Alexandra Hills* – the high percentage growth (needed to achieve the SGS forecast) is a direct result of the job loss that occurred between 2006 and 2011. There are grounds to reconsider the expected growth and the 2031 forecast.
 - *Redland Bay* – Given the development potential in the Business Enterprise Area, the above average growth rate is not unreasonable (and the additional 992 jobs is well within the area's capacity).
 - *Sheldon - Mt Cotton* – the below average growth may be reasonable given that the predominantly rural area offers few opportunities for significant growth.
 - *Thorneside* – Again, the high growth rate (needed to achieve the 2031 forecast) is a direct result of the job loss between 2006 and 2011. The 2031 employment forecast should be reconsidered.
 - *Victoria Point* – the below average (percentage) growth may be appropriate, as it seems that much of the forecast growth to 2031 has already occurred by 2011.

4.6 Development of the Detailed Employment Projections

VLC's review of the employment forecasts provided by Council identified two matters needing confirmation:

- *Base Employment Levels* – As previously explained, VLC's 'as modelled' 2011 employment differs from the Urbis 2011 employment. In fact, VLC's estimated 42,656 jobs in 2011 almost match the 42,951 jobs forecast by Urbis in 2021. VLC agreed with Council that the 'as modelled' employment for the future scenarios would be produced by adding the job growth forecast by Urbis to VLC's 'as modelled' 2011 employment.
- *Overall Growth Target* – Urbis have forecast slightly less employment (48,908 jobs) in the city in 2031 than SGS originally forecast (50,008 jobs). VLC agreed with Council that the growth in employment forecast by Urbis between 2011 and 2031 (+13,331 jobs) should be taken as the 'target' growth for traffic modelling purposes, and that the SGS forecasts by locality would need to be adjusted to match.

Derivation of the zone-level employment estimates for the two future modelling horizons (2021 and 2031) was not simply a matter of adding 'growth', however. This growth had three dimensions – by locality, by industry group and by time period. VLC removed the third dimension (time period) from the 'equation' by developing the full 2011-2031 growth pattern first; then just interpolating the 2011-2021 growth pattern.

Derivation of Growth Targets

Prior to producing the detailed employment forecasts for the individual traffic zones, VLC developed a set of 'targets' for job growth between 2011 and 2031, as in **Figure 4-10**.

- *Target Growth By Industry* – these targets were as derived from Urbis' Table 5.6, but with 160 of the 183 sand-mining jobs removed from North Stradbroke.
- *Target Growth by SA2* – The 'rebased' growth pattern (i.e. the SGS 2031 forecasts minus the 2011 'stated') was adjusted to the new overall target of 13,171 jobs, in two steps. In the 1st 'draft', the rebased growth was retained in most areas, except:
 - In the 3 areas experiencing job losses in 2006-2011, the new estimated growth for 2011-2031 was set as 80% of the growth that SGS had estimated for 2006-2031.
 - The growth on North Stradbroke was reduced by 160 jobs (from 646 to 486 jobs)

The 2nd step involved factoring the draft pattern down, to yield 13,171 extra jobs overall.

Derivation of the Zone-level Growth to 2031

VLC's subsequent preparation of the detailed 2011-2031 employment growth pattern (at zone level) involved a mixture of 'across the board' factoring and a few rounds of manual amendments, as follows:

- a) *Initial SA2 percentage growth* – the first step was to express the SA2-based growth targets (as in Figure 4-10) as a percentage of VLC's 2011 employment levels for each SA2. This desired percentage growth was then applied to all job types in all zones in the respective SA2's, to derive an initial 2011-2031 growth pattern by zone by industry.
- b) *Review and amend 'Exceptions'* – the next step in the process was to review and amend location specific situations. These included:
 - erasing (via 'negative growth') any 2011 employment that would be displaced by planned residential development or cessation of sand-mining on Stradbroke, and
 - adding a 'local centre' in Kinross Road, a 'neighbourhood centre' in South-east Thornlands, and an expansion of the Industrial Enterprise Area at Redland Bay.
- c) *Industry-based growth targets* - the next step was to check and amend the above growth pattern, relative to the industry-based targets (as established in Figure 4-10). To amend the industry totals, without corrupting the SA2-based growths already achieved, VLC adjusted the growth 'balance' between pairs of industries within individual SA2's. For example, excessive 'Retail' growth in Capalaba was moderated and replaced with comparable growth in 'Finance/Business' sector jobs in Capalaba (but not necessarily in the same 'zone' from which the 'Retail' jobs were moderated).

The finalised VLC job numbers for 2031 (and growth relative to 2011), are summarised and appraised in **Figure 4-11a**. Some of the deviations from target are worthy of comment:

Comparison with SA2 Growth Targets

- *Birkdale* – there are limited opportunities (outside existing commercial areas) to accommodate growth, without drastically changing the mix of employment types.
- *Capalaba and Cleveland* – these were the two areas where a majority of the future increase in ‘Finance/Business’ jobs were accommodated.
- *Redland Bay* – the extra jobs (above target) are predominantly in the Business Enterprise Area; which would still have unused capacity.
- *Thornlands* – it was difficult to ‘suppress’ job growth in the SA2, given the two proposed ‘centres’ and the growth in schools needed to support the growing local population.
- *Wellington Point* – again, there are limited opportunities to accommodate growth, without introducing new land use zoning or changing the existing mix of job types.

Comparison with Industry Growth Targets

- *Manufacturing* – it was difficult to suppress the overall growth to just 275 jobs, even with some Manufacturing assumed to be ‘displaced’ out of Capalaba by ‘Finance/Business’
- *Wholesale* – VLC believe some growth can be expected.
- *Finance and Business* – although VLC managed to accommodate the target growth (largely in Cleveland and Capalaba), we are ‘uncomfortable’ with the resulting 25% increase in the per capita rate.
- *Public Administration* – it was difficult to suppress these job numbers, without drastic changes to the mix of job types in Cleveland.
- *Education and Training* – unless a new tertiary campus is established, school staff numbers are likely to maintain the existing ‘per capita’ rate.

2031 Overview

VLC have attempted to replicate the 2 dimensional growth pattern forecast by Urbis/SGS. In doing so, we have tried to give priority to matching the locations of the growth rather than the industry types. VLC believe that the growth summary presented in Figure 2-11a is a reasonable compromise. Given the vagaries of future economic and market forces, employment forecasts will always have more uncertainty than the population and dwelling forecasts.

Derivation of the 2021 Employment

Table 5.3 of the Urbis report (their Page 41) forecasts total employment in the city at 5-year intervals from 2011 to 2031. These forecasts suggest that 55% of the 20-year growth in employment would occur in the first 10-years (by 2021). However, the Urbis population forecasts (as in Figure 4-1a) indicate that only 47% of the overall population growth would occur in the first 10-years. The latter suggests that job growth in the two 10-year periods is likely to be more balanced (i.e. closer to 50/50).

VLC have derived their 2021 zonal employment estimates by assuming linear growth (i.e. simply adding half the 2011-2031 growth in each zone to their 2011 ERP-based employment). After this, the ‘exceptions’ were again revisited:

- both the Kinross Road and South-east Thornlands Structure Plan Areas would be about half developed (in terms of numbers of residential lots) by 2021, so having half their respective centres established was accepted as a reasonable assumption.
- expansion of Mt Cotton Village would be substantially complete by 2021, so VLC have added the full 2011-2031 growth at the Mt Cotton local centre (instead of 50%).
- Two of the three mining leases were expected to expire in 2019, so halving the mining job losses on North Stradbroke was considered a reasonable approximation.

The resulting 2021 employment growth and growth pattern is summarised in **Figure 4-11b**. It can be noted that (because the target growths are basically halved); VLC's deviations from the targets are consistent with those discussed for the 2031 scenario.

Again, the VLC employment growth matches the SA2 targets reasonably well; and the deviations at industry level are also reasonable.

4.7 Graphical Overview

GIS files containing the 'as modelled' 2011, 2021 and 2031 demographics have been separately provided to Council. The distribution of the residential and employment growth is graphically summarised in the following figures:

Residential Growth

- **Figure 4-12a** – Growth in Dwellings (2011-2021)
- **Figure 4-12b** – Growth in Dwellings (2021-2031)
- **Figure 4-12c** – Growth in Dwellings (2011-2031)

Employment Growth

- **Figure 4-13a** – *Growth in Employment (2011-2021)*
- **Figure 4-13b** – *Growth in Employment (2021-2031)*
- **Figure 4-13c** – *Growth in Employment (2011-2031)*

5.0 Traffic Forecasts & Assessments – 2021

5.1 Introduction

The future year modelling and network assessment strategy adopted by VLC was to:

- a) Run a 2021 'base' model; identify network deficiencies and performance issues; test network improvements and confirm a 2021 network improvement strategy.
- b) Run a 2031 'base' model (using the improved 2021 network); identify network deficiencies and performance issues; test network improvements and confirm a 2031 network improvement strategy.
- c) Apportion the value of future road space consumed to specific areas or catchments

To commence this modelling process, it was agreed with Council that the transport system (both roads and public transport) to be assumed in the 2021 base model would, within Redland City at least, be a 'do minimum' system.

5.2 Confirmation of the 2021 Base Road Network

The 2021 base model was to be a 'local' refinement of the 2021 model established for the Southern Regional Roads Group (SRRG). Accordingly, outside the Redland City boundary, the base model assumed the same road infrastructure and public transport improvements by 2021 that were assumed in the 2021 'SouthRoC' model.

For the record, the road improvements anticipated in the Brisbane City / Logan City area by 2021 are shown in **Figure 5-1**. Those of most relevance to Redland City are:

- Rickertt Road – Greencamp Road = upgrade to 4-lane arterial
- New Cleveland Road = upgrade to 4-lane sub-arterial
- Tilley Road = upgrade to 4-lane sub-arterial & extend to Manly Road
- Old Cleveland Road = 4-lane overpass at Tilley Road
- Rochedale Master Plan Area = various new roads and upgrades
- Pacific Motorway (Gateway M'way to Daisy Hill) = upgrade & busway extension
- Eastern Busway (Stage 2: Main Ave to Bennetts Rd), in time for C'wealth Games.
- Port Motorway (Gateway M'wy to Fisherman's Island) = upgrade to 4-lane motorway

It was agreed that the base or 'starting' network within Redland City would be the existing network with a minimum of improvements (i.e. only those which are financially committed or are necessary to access/support specific subdivisions, etc.). The various road network additions and improvements assumed to be implemented by 2021 (including those already implemented since 2011) are shown in **Figure 5-2** and are:

Completed Works (Network Additions and Improvements)

- Mt Cotton Road (Broadwater Rd to just east of Ney Rd) = 4-lane arterial
- Cleveland-Redland Bay Rd (north of Ziegenfusz Rd to south of Dinwoodie Rd) = 4-lane arterial
- Cleveland-Redland Bay Rd (nth of Beveridge Rd to Boundary Rd) = 4-lane arterial
- Baythorn Drive Extension (King St to Cleveland-Redland Bay Rd) = 2-lane collector
- Heinemann Rd (from reservoir to German Church Rd) = form & seal as 2-lane collector

Future Works (Subdivisions)

- Kinross Road (full length) = upgrade to 2-lane collector
- New Link Road (Kinross Rd to Panorama Dr) = 2-lane access street
- New Collector Roads (South-east Thornlands) = 2-lane collectors
- Beveridge Road = upgrade to 2-lane collector
- Muller Street (400m west of Unwin Rd) = form & seal as 2-lane access street

Other Arterial Road Works

- Boundary Rd / Kinross Rd Intersection = install traffic signals (completed early 2014)
- Cleveland-Redland Bay Rd / New SE Thornlands Access Rd = install traffic signals

5.3 Confirmation of the 2021 Public Transport System

In addition to road network improvements, some changes to the public transport system serving Redland City are planned or can reasonably be foreseen. The changes made to the 2011 model PT system, to represent what might exist in 2021, included:

Recent Changes (2012)

A number of low-patronage routes were abandoned in 2012:

- Routes 257, 271, 278 and 285 were all deleted from the future models

Planned Changes (2014)

About 25 changes to services in the eastern suburbs were proposed by TransLink, earlier in 2014. However, as a result of public consultation, not all of these changes will necessarily proceed. Only some of the more likely changes have been incorporated in the base model for 2021, as follows:

- Route 250 – split into a city-bound service in the peaks and a service terminating at Carindale in the off-peak.
- Route 272 – frequency increased to a 20 minute headway in the peaks and 30 minutes in off-peak
- Deletion of low-patronage routes (256, 259, 268 and 283) – only route 268 has been deleted from the future models
- Minor changes in routes, stopping locations – only changes to Route 265 were effected (within the future models)
- Decreases in off-peak frequencies – none have been effected (in the future models)

Future Growth Areas

Some of the areas in which residential growth is expected by 2021 will justify new or modified services. VLC's suggestions (for modelling purposes) are as follows:

- Mt Cotton Village – with residential development expanding further from Valley Way, VLC suggest that Route 282 be modified to penetrate further into the village (via Seeana Dr) and increased in frequency (to peaks = 20 mins, off-peak = 30mins)
- South-east Thornlands – the new developments will generally be within 400m of Cleveland-Redland Bay Rd, which is well served by Route 250. No change needed.
- Kinross Road Precinct – VLC suggest that:
 - Route 270 (currently a low-frequency route, operating between Capalaba and Victoria Point Ferry) be diverted in and out of Kinross Road and its frequency increased (to peaks = 20 mins, off-peak = 30 mins)
 - Creation of a new route from the precinct, up Panorama Drive (past the Industrial Estate and hospital) and then via Cleveland town centre to the station.

Except for the five deleted routes, the bus routes that were added/amended within the 2021 base model are shown in **Figure 5-3**.

5.3 Initial Traffic Forecasts and Network Performance

Key Travel Indicators

Before examining the traffic volumes and network performance forecast across Redland City, in this 2021 base scenario, VLC have extracted a number of key travel indicators from the model and compared it with those from the 2011 model, in Table 5-1 on the next page.

Table 5-1: Key Travel Indicators (Average Weekday within Redland City)

Travel Parameter	2011	2021	% change
<i>Demographics (as modelled):</i>			
Population	143,622	162,056	+12.8%
Employment	42,656	49,240	+15.4%
<i>Person-trips (trip-ends):</i>			
By Car	858,299	946,776	+10.3%
By PT	46,228	49,335	+ 6.7%
By Foot/Cycle	201,047	230,807	+14.8%
TOTAL	1,128,930	1,251,891	+10.9%
<i>Vehicle-kilometres:</i>			
TOTAL (all vehicle types)	2,054,811	2,397,382	+16.7%
<i>Vehicle-Hours:</i>			
TOTAL	41,771	49,747	+19.0%
<i>Person-Hours:</i>			
TOTAL	58,788	70,057	+19.2%
<i>Average Speed (km/hr):</i>			
Overall	49.2	48.2	-2.0%

The relative changes in some of the above parameters are worthy of comment:

- The number of person-trips does not grow by as much as the population. This reflects the increasing proportion of the population that is expected to be over 65 years of age.
- Vehicle-kilometres increase by more than the increase in person-trips by car. This means the average car trip length increases; probably as a result of much of the future population growth occurring in comparatively remote areas (eg. Thornlands and Redland Bay).
- The high percentage increase in walk/cycle trips is a reflection of the employment growth rate. These trips include a high number of short trips within the various business precincts.

Forecast Traffic Volumes

The traffic volumes forecast on the base road network in Redland City in 2021 are presented in the following figures:

- **Figure 5-4:** Average Weekday Traffic (AWDT)
- **Figure 5-4a:** AM Peak Hour Volumes & V/C Ratios
- **Figure 5-4b:** PM Peak Hour Volumes & V/C Ratios

The forecast growth in traffic volumes, between 2011 and 2021, are shown in the following figures:

- **Figure 5-5:** Growth in AWDT (2021 Base vs. 2011)
- **Figure 5-5a:** Growth in AM Peak Hour Traffic (2021 Base vs. 2011)
- **Figure 5-5b:** Growth in PM Peak Hour Traffic (2021 Base vs. 2011)

It can be noted from the latter set of figures that the upgraded roads planned by Brisbane City in the Gumdale / Wakerley area are expected to attract traffic to/from external areas toward the more northern routes. The saturated conditions forecast on the city's two southern external connections (Mt Cotton Road and Broadwater Road) would also contribute to this shift in route choice toward the northern external links.

Network Performance Review

Using the above forecasts as a reference, the study working group undertook a multi-faceted review of road network performance. This review not only took account of the forecast peak hour volumes and V/C ratios, but also considered the forecast levels of growth in relative to existing conditions and road geometrics.

Such a review requires close knowledge of the geometric details of the existing network and of current functional and operational problems. It does, however, permit a full range of network deficiencies to be identified; involving not just capacity restraints or level of service issues, but functional inadequacies (e.g. a need for wider shoulders or parking lanes) and safety issues that will be magnified as traffic volumes increase.

Using the previous PIP's schedule of works as a reference, the working group identified or reconfirmed the improvements to Redland City roads, listed in **Figure 5-6**, as being desirable by 2021. It should be noted that the capacity / level of service problems identified via the forecasts also included a number of road segments controlled by the State (through DTMR). All of anticipated capacity problems identified by the working group are highlighted in **Figure 5-7**, and commented on below:

Redland City Road Segments

- A.** Mt Cotton Road (Moreton Bay Rd to School Rd) – problems for 'right-turners' are anticipated at the priority controlled intersections and the signalised intersections may need minor capacity improvements.
- B.** Panorama Drive (Boundary Rd to Ziegenfusz Rd) – will require further intersection improvements likely to justify a full upgrade to a 4-lane divided standard.

DTMR Road Segments

- C.** Finucane Road (Old Cleveland Rd to Cambridge Dr.) – increasing problems for right-turners at the priority controlled intersections and the signalised intersections may need minor capacity improvements.
- D.** Redland Bay Road (Moreton Bay Rd to Windermere Rd) – the intersections, particularly with Moreton Bay Rd, are expected to operate at or near their capacities.
- E.** Broadwater Road (Mt Cotton Rd to Alpertown Rd) – deserving of an upgrade to a 4-lane divided standard.
- F.** Mt Cotton Road (Ney Rd to Lyndon Rd) – deserving of an upgrade to a 4-lane divided standard.
- G.** Cleveland – Redland Bay Road (either side of Thornlands Dr.) – deserving of an upgrade to a 4-lane divided standard
- H.** Cleveland – Redland Bay Road (Dinwoodie Rd to Beveridge Rd) – deserving of an upgrade to a 4-lane divided standard.
- I.** Colburn Avenue (from shopping centre to Link Rd) – will operate at or near its 2-lane capacity. The intersections with Link Road and with the 3 priority controlled accesses may all need improvement.
- J.** Cleveland – Redland Bay Road (Magnolia Pde to Boundary St) – deserving of an upgrade to a 4-lane divided standard.

Redland City Intersections

- 1.** Wellington St / Weippin St – likely to require an upgrade (RT lanes on Weippin St)
- 2.** Bunker Rd / Kingfisher Rd – likely to require an upgrade or change in priority
- 3.** Double Jump Rd / Bunker Rd – likely to require upgrade and/or change in priority
- 4.** Double Jump Rd / Heinemann Rd – likely to require minor upgrade (auxiliary lanes)

DTMR Intersections

- 5.** Mt Cotton Road / Valley Way – likely to need signalisation. Duplication of the remaining 2-lane section of Valley Way would seem an appropriate associated work.
- 6.** Cleveland-Redland Bay Road / Giles Rd – may need signalisation.
- 7.** Birkdale Road / Old Cleveland Road East - needs further investigation
- 8.** Birkdale Rd/ Collingwood Rd – likely to require an upgrade (separate L/R lanes on Collingwood Rd).

5.4 Testing of a 2021 Road Network Improvement Strategy

After reviewing the full set of road improvements desired by 2021, the study working group concluded that:

- It would be unlikely that any further improvements to the State controlled roads or intersections would be effected in the medium term, and
- It would be unlikely that Council could implement all of the improvements listed in Figure 5-6 by 2021. Those that would provide capacity and level of service benefits and therefore more likely to be effected would be:
 - Road Segment B - Panorama Drive (Boundary Rd to Ziegenfusz Rd) => 4-lanes
 - Intersection 2 – Bunker Road / Kingfisher Road
 - Intersection 3 – Double Jump Road / Bunker Road
 - Intersection 4 – Double Jump Road / Heinemann Road
 - Intersection 8 – Birkdale Road / Collingwood Road

Although Council could be expected to implement some of the other improvements listed in Figure 5-6, none of the others would provide a discernible increase in capacity.

Traffic Forecasts – Improved 2021 Network

Only the improvements listed above were assumed to be implemented and therefore encoded into the 2021 'improved network'. Additionally, contrary to their initial opinion (when formulating the 2021 base network), the working group now doubted that the connection between the Kinross Road Precinct and Panorama Drive would be established by 2021. This link was therefore deleted from the 'improved' network.

The 2021 traffic volumes forecast on the improved network are shown in the following:

- **Figure 5-8:** Average Weekday Traffic (AWDT)
- **Figure 5-8a:** AM Peak Hour Volumes & V/C Ratios
- **Figure 5-8b:** PM Peak Hour Volumes & V/C Ratios

6.0 Traffic Forecasts & Assessments – 2031

6.1 Confirmation of the 2031 Base Road Network

The transport system assumed to exist in this 2031 base scenario was as follows:

- *External to Redland City* – again, improvements to the external road network were consistent with those included in the 2031 ‘SouthRoC’ model and are shown in **Figure 6-1**. The improvements of most relevance to the Redland City environ were:
 - Beenleigh-Redland Bay Road (California Creek Rd to Mt Cotton Rd) = upgraded to 4-lane arterial
 - Pacific Motorway (Daisy Hill to Logan Motorway) = upgrade plus an extension of the busway to Loganholme.
- *Within Redland City* – the improved 2021 network was used as the starting network, and then just the additional ‘structure plan’ roads (as shown in **Figure 6-2**) added:
 - The secondary link, from the Kinross Road Precinct to Panorama Drive, and
 - The remaining Collector roads in SE Thornlands were assumed to be completed.
- *Public Transport* – no new bus routes were added in Redland, but most of the bus services were increased in frequency slightly (by 1 extra bus per hour in the peaks). The major change was an increase in the frequency of rail services on the Cleveland line (down to 10 minute frequencies in the peaks and to 20 minutes in the off-peak).

6.2 Initial Traffic Forecasts and Network Performance

Key Travel Indicators

Before examining the traffic volumes and network performance forecast across Redland City, in this 2031 base scenario, VLC have again examined some of the key travel indicators from the model and compared them with those from the 2021 model, below.

Table 6-1: Key Travel Indicators (Average Weekday within Redland City)

Travel Parameter	2021	2031	% change
<i>Demographics (as modelled):</i>			
Population	162,056	183,058	+13.0%
Employment	49,240	55,826	+13.4%
<i>Person-trips (trip-ends):</i>			
By Car	946,776	1,050,724	+11.0%
By PT	49,335	62,970	+27.6%
By Foot/Cycle	230,807	269,878	+16.9%
TOTAL	1,251,891	1,410,780	+12.7%
<i>Vehicle-kilometres:</i>			
TOTAL (all vehicle types)	2,397,382	2,674,244	+11.5%
<i>Vehicle-Hours:</i>			
TOTAL	49,747	56,348	+13.3%
<i>Person-Hours (by vehicle):</i>			
TOTAL	70,057	79,357	+13.2%
<i>Average Speed (km/hr):</i>			
Overall	48.2	47.5	-1.5%

The relative changes in the various travel parameters are generally in line with the population growth, except:

- Trips by public transport grow at a greater rate than those by car; partly as a result of the increased frequencies (on the rail system) relative to the generally increased congestion on the roads. This small mode shift will have moderated the growth in vehicle-kilometres and the negative impact on average speeds.
- The percentage increase in walk/cycle trips is, again, a reflection of the employment growth rate. These trips include a high number of short trips with the various business precincts.

Forecast Traffic Volumes

The traffic volumes forecast on the base road network in Redland City in 2031 are presented in the following figures:

- **Figure 6-3:** Average Weekday Traffic (AWDT)
- **Figure 6-3a:** AM Peak Hour Volumes & V/C Ratios
- **Figure 6-3b:** PM Peak Hour Volumes & V/C Ratios

The forecast growth in traffic volumes, between 2021 and 2031, are shown in the following figures:

- **Figure 6-4:** Growth in AWDT (2031 Base vs. 2021 Improved)
- **Figure 6-4a:** Growth in AM Peak Hour Traffic (2031 Base vs. 2021 Improved)
- **Figure 6-4b:** Growth in PM Peak Hour Traffic (2031 Base vs. 2021 Improved)

It can be noted from the latter figures that traffic growth is spread widely across the Redland network. NB. The traffic reductions on roads/streets in the Loganholme area are a result of upgrading the Pacific Motorway.

Network Performance Review (2031 Base)

The performance of the 2031 Base network has been reviewed, using the (maximum) modelled peak hour Volume/Capacity ratios, as shown in **Figure 6-5**. This shows that the majority of the seriously deficient road segments (i.e. v/c > 1.15) are State Controlled Roads ('S1' to 'S10'). The only seriously deficient road segment controlled by the City is the north end of Mt Cotton Road ('R1'); although, looking beyond the modelled V/Cs, there will be other road segments and intersections that will deserve intervention by 2031.

The dilemma, in now planning a road network to support Redland City's anticipated growth, is 'what improvements can be reasonably be assumed to be completed by the State by 2031'? Clearly, if these major arterials were all upgraded, some improvements on the minor arterials and secondary road network might be deferred or even avoided.

Given the State's current financial limitations, it was considered prudent by the working group to consider 2 scenarios:

- i. If most of the State road deficiencies were alleviated, how would the City's roads fare? (i.e. what would still need to be upgraded?).
- ii. If Council addressed the apparent problems on its own roads, would the overall network outcome be acceptable?

6.3 Improvement Scenario 1 – Upgrade State Controlled Roads

In this scenario, it was assumed that 5 of the 10 State Controlled Road segments (S3, S4, S5, S6 and S9) are upgraded/duplicated. The reasons for omitting the other five segments are:

- S1 – may be relieved, if traffic shifts to the Broadwater Road corridor (S3 & S4)
- S2 – may be relieved, if traffic shifts to the Broadwater Road corridor (S3 & S4)
- S7 – the solution lies in the configuration of the two bounding intersections, rather than simply upgrading to 6-lanes.
- S8 – likely to need intersection improvements, rather than full duplication
- S10 – may be relieved, if traffic shifts to the Broadwater Road corridor (S3 & S4)

2031 Traffic Forecasts – Improvement Scenario 1

The average weekday traffic volumes forecast on the amended DTMR road network are shown in **Figure 6-6**. The changes in 2031 weekday volumes (relative to the Base network) are shown in the following figures:

- **Figure 6-6a:** Changes in AWDT – this shows some moderately large shifts in traffic (of up to 8,000 vpd) toward the upgraded roads; although the relief is widely spread.
- **Figure 6-6b:** Percentage Change in AWDT – this shows that some Council roads (e.g. Double Jump Rd) would experience substantial relief, which would allow Council improvements to be deferred. The percentage reductions on the primary roads in and around Capalaba are relatively small, however.

The peak hour traffic volumes and modelled V/C ratios forecast in this amended road network scenario are shown in the following figures:

- **Figure 6-7a:** AM Peak Hour Traffic, 2031
- **Figure 6-7b:** PM Peak Hour Traffic, 2031
- **Figure 6-7c:** Maximum V/C Ratios (Scenario 1 – DTMR Upgrades)

Comparing the V/C ratios in the latter figure with those in Figure 6-5, indicates there would not only be significant improvements in performance on the five upgraded DTMR road segments, but some noticeable improvements on many other arterials. However, while the upgrading of Broadwater Road ('S3'/S4') provides a degree a relief to Finucane Road ('S1'), Redland Bay Road ('S2') and Mt Cotton Road North ('R1'), all these roads providing access to or through Capalaba would still need improvement, as would Mt Cotton Road South ('S10').

6.4 Improvement Scenario 2 – Upgrade Council Roads/Intersections

Again, using the 2031 base network forecasts (in Figures 6.3a and 6.3b) as a reference, and also considering existing road geometries and intersection configurations, the working group identified a list of improvements (to Council's own roads) that seem justified by 2031. These are listed in **Figure 6-8**, along with a 'carry-over' list from 2021.

Again, many of the additional improvements relate to safety or 'geometrics', which would involve improving the 'road-side environment' to a standard commensurate with the forecast volumes and future road function (i.e. shoulder widening or parking lanes, etc).

Only the road network improvements that would result in increased network capacity have been encoded in the 'Scenario 2' model. These are shown, relative to the Base network conditions, in **Figure 6-9** and described below:

- A.** Mt Cotton Road: upgraded to 4 lanes, with some new signalised intersections
- B.** Sturgeon Street; multiple intersection improvements (add'l approach lanes) and improved cross-section (shoulders).
- C.** Wellington Street: extend 4 lanes to just beyond Coburg St and upgrade signals at Russell St
- D.** Wellington St: improvements to all intersections, from Bay St to South St, effectively resulting in 4-lane standard.
- E.** Panorama Drive: upgrade to 4 lanes, from Ziegenfusz Rd to Wellington St.
- F.** Springacre Rd - Double Jump Rd route: upgrade to 2-lane sub-arterial standard, with a new 'short realignment' from Heinemann Rd to Bunker Rd.
- G.** Bunker Rd: upgrade remainder of this road to urban 2-lane sub-arterial standard.
- H.** School of Arts Road: upgrade to 2-lane sub-arterial standard
- I.** German Church Road: upgrade to 2-lane sub-arterial standard.
- J.** Valley Way: upgrade western-most segment to 4-lane (divided) sub-arterial.

The average weekday traffic volumes forecast on this amended Council road network are shown in **Figure 6-10**. The changes in 2031 weekday volumes (relative to the Base network) are shown in the following figures:

- **Figure 6-10a:** Changes in AWDT – this shows small shifts in traffic (of up to 2500 vpd) toward the upgraded roads; providing a degree of relief to parallel DTMR roads.
- **Figure 6-10b:** Percentage Change in AWDT – this indicates that the relative change on most road segments is small ($< \pm 10\%$).

The peak hour traffic volumes and modelled V/C ratios forecast in this amended road network scenario are shown in the following figures:

- **Figure 6-11a:** AM Peak Hour Traffic, 2031
- **Figure 6-11b:** PM Peak Hour Traffic, 2031
- **Figure 6-11c:** Maximum V/C Ratios (Scenario 2 – RCC Upgrades)

Comparing the V/C ratios in the latter figure with those in Figure 6-5, it can be noted that there would be improvements in operating conditions on the upgraded RCC roads but that there would be insufficient traffic attracted to them to effect any improvement on the deficient State road segments.

7.0 Recommendations

7.1 Introduction

Based on the traffic forecasts and assessments in the previous chapters, the study working group has identified a list of improvements to the Council's own road network, which are considered necessary / desirable by 2031. The full schedule of improvement projects, along with their estimated costs (2013\$) and desired completion dates, are listed in **Figure 7-1**.

It should be borne in mind, when considering this list, that:

- Most of the suggested time-frames are indicative rather than definitive, and
- The need for a number of these projects is brought forward as a result of the poor level of service forecast on the (unimproved) State road network.

7.2 Future Refinement of the Road Network Improvement Strategy

Clearly, any road network improvement strategy for Redland City should aim to address the core network deficiencies rather than just the symptoms. A key element of the strategy should involve upgrades to segments of the State controlled roads.

Referring back to the principal deficiencies identified in the 2031 base network (as in Figure 6-5), ten out of eleven of the highlighted road segments are controlled by DTMR. Given that most of these problem segments were evident in the 2021 forecasts (see Figure 5-7) and some even evident on the road today, VLC suggest the following priorities:

Highest Priorities

The DTMR road segment that is most deserving of early treatment is:

S9: Cleveland-Redland Bay Road (Giles Rd - Magnolia Pde.); upgrade to 4-lane arterial

Prioritisation of the treatment of the other segments should depend on what can be done, cost-effectively. In this respect, VLC recommend the following early studies:

S1-S2-R1: *A Detailed Road Network Plan for Capalaba.*

The problems anticipated on these 3 approaches to Capalaba are a reflection of increased through traffic (to/from Brisbane) superimposed on the additional traffic attracted to / generated by the more intensive commercial uses that have been assumed to develop at Capalaba. A detailed study of the local area network, including all intersection and access configurations, would seem to be needed.

However, a brief examination of the traffic volumes forecast in and around Capalaba in 2031 indicates that of the 229,300 vehicles per day crossing a cordon around the main commercial precinct on the 6 approach roads, only 71,500 are to/from the internal zones. The balance (157,800 vehicle movements) represents 78,900 through trips.

Other than upgrade S3: Broadwater Road, which only provided a small amount of relief to the Capalaba approach roads (see Figure 6-6b), there seems little opportunity for external traffic to avoid passing through Capalaba. Any new corridor across Tingalpa Creek would appear fraught with environmental issues (and also very expensive).

Accordingly, the detailed network study should be mindful of the need to maximize 'throughput' of the 'through traffic' movements at the key intersections. This might be facilitated by 'redesigning' development access and circulation movements to minimize 'double movements' resulting from left-in / left-out access, etc.

S7: A Victoria Point 'Throughput' Study

The capacity of link 'S7' is limited by the capacity of the 2 bounding intersections. A study is needed to examine and assess layouts, which provide the maximum reasonable capacity at each intersection. This may well involve replacing the roundabout at Boundary Road with signals. This study would then provide guidance as to the optimal timing of other road network improvements in the area (e.g. There would be little benefit in upgrading segment S6, to the north, if south-bound queues from the roundabout in the PM peak extended back well past S6 to Dinwoodie St)

Next Highest Priority (ideally by 2021, preferably by 2026)

S3: Mt Cotton Road (Mt Gravatt-Capalaba Rd–Mt Cotton Rd); upgrade to 4-lane arterial

S4: Mt Cotton Road (Lyndon Rd – Ney Rd); upgrade to 4-lane arterial

S10a: Mt Cotton Road South; signalise intersection with Valley Way

Other State Network Improvements (ideally by 2031)

S5: Cleveland-Redland Bay Road (Ziegenfusz Rd – South St); upgrade to 4-lane arterial

S6: Cleveland-Redland Bay Rd (Dinwoodie St–Beveridge Rd); upgrade to 4-lane arterial

S8: Colburn Ave; upgrade intersections with various side roads and access roads

S10b: Mt Cotton Road South; upgrade intersection with Wuduru Rd

8.0 Assessments of Road Space Consumption

8.1 Introduction

VLC have previously developed a specialist sub-module within their 'Zenith' software package which makes it possible to identify which areas are forecast to use each link in the future model road network. Then, by assigning a (dollar) value to each link in the model network, this data can be used to assess:

- Which areas of Redland would 'consume' more road space than others (in \$ terms)?
- Which areas would 'consume' the capacity provided by specific links or projects?

Assessments such as these can be used to guide and underpin decisions made in preparing a schedule of transport infrastructure charges.

8.2 Definition of the Traffic Catchments (Sectors)

For these assessments of road space consumption, Redland City was subdivided into 15 areas or traffic catchments called 'sectors'. These sectors generally defined in terms of Level 2 Statistical Area (SA2) boundaries, although Sheldon-Mt Cotton and the Islands were further subdivided. This sector system (which was defined via the model zone system) could also be aggregated up to the 13 sector system used in the 2009 PIP infrastructure charges schedules. The 15 sectors are shown in **Figure 8-1** and listed in Table 8.1, along with their forecast traffic growth.

Table 8.1: Forecast Traffic Growth (2011-2031) by Sector

No.	Sector Name	Total Daily Trip-ends		Growth in Daily Trip-ends	% of RCC Growth
		2011	2031		
1	Alexandra Hills	64,211	68,756	+4,545	3.4%
2	Birkdale	51,648	59,476	+7,828	5.8%
3	Capalaba	132,420	156,342	+23,922	17.7%
4	Cleveland	92,811	119,425	+26,614	19.7%
5	Mt Cotton	17,192	23,448	+6,256	4.6%
6	Ormiston	22,900	27,628	+4,728	3.5%
7	Redland Bay	44,510	55,579	+11,069	8.2%
8	Sheldon	7,829	7,901	+71	0.1%
9	Thorneside	10,113	10,516	+404	0.3%
10	Thornlands	42,920	62,353	+19,432	14.3%
11	Victoria Point.	73,584	89,402	+15,818	11.7%
12	Wellington Point	38,247	43,624	+5,377	4.0%
13a	North Stradbroke Island	8,323	9,383	+1,060	0.8%
13b	Coochiemudlo Island	1,590	2,108	+518	0.4%
13c	Sth. Moreton Bay Islands	11,594	19,374	+7,780	5.7%
	Total	619,893	755,314	+135,421	100%

8.3 Value of Capacity Consumed by the Traffic Catchments

The assessments of the value of road space 'consumed' by the 15 individual traffic catchments (in 2031) was under-taken as follows:

- Every link in the Redland model network, within Redland City, was encoded with an owner (based on who funded its construction) and also a cost or valuation.
- To assist with this process, Council provided VLC with a spreadsheet containing road values and project cost estimates, as follows:
 - *Existing RCC Roads* – a list of 115 existing (trunk) road segments, with valuations based on a generic unit rate approximating current day construction costs, but with no value assigned to the underlying land.

- *RCC Road Upgrades* – a list of 42 road improvement projects, with estimated construction costs, including land resumption if needed
 - *Intersection Upgrades* – a list of 21 intersection upgrades, with estimated implementation costs, including land resumption if needed.
 - *Other Roads* – other ‘non-trunk’ roads that were ‘owned’ by Council or would be constructed by developers at their own cost were assigned a ‘zero’ value.
- c) All roads ‘owned’ by the State were assigned a value based on the same generic rate used for existing RCC roads (i.e. \$1.5m per lane-km)
- d) Each direction of 2-way roads was valued and then assessed separately, using the critical peak hour demands (in 2031) for the particular direction.
- e) For each direction of each model road link, the proportion of its total capacity (and value) that would be ‘consumed’ by traffic was apportioned to the forecast users in each sector (half to the trip origin, half to the trip destination).
- f) The total value of road space consumed by each ‘sector’ was determined by aggregating the consumption of each direction of each link, by road ‘ownership’.

The total value (2013\$) of trunk road capacity consumed by each traffic catchment in 2031 is summarised by road owner / type in the left hand side of **Figure 8-2**. (NB. The values in this table exclude road space consumption attributable to the ‘external’ end of trips between Redland City and elsewhere). It can be noted from the summary computation at the bottom that (on average) the upgraded roads and intersections would have 41-44% spare capacity at 2031 (i.e. the capacity implemented is only partly used by 2031).

The right hand side of this figure shows the value of road capacity consumed by an average vehicular trip, originating or ending in each traffic catchment. These values are calculated by dividing the total values consumed by the total vehicular trip-ends generated by each sector in 2031.

