

Appendix 13 - Sustainability and Infrastructure Study

PARRAMATTA CBD PLANNING REVIEW

SUSTAINABILITY AND INFRASTRUCTURE STUDY

PREPARED BY KINESIS FOR PARRAMATTA CITY COUNCIL

9 NOVEMBER 2015





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Note: This report is provided subject to some important assumptions and qualifications:

The results presented in this report are modelled estimates using mathematical calculations. The data, information and scenarios presented in this report have not been separately confirmed or verified. Accordingly, the results should be considered to be preliminary in nature and subject to such confirmation and verification.

Energy, water and greenhouse consumption estimates are based on local climate and utility data available to the consultant at the time of the report. These consumption demands are, where necessary, quantified in terms of primary energy and water consumptions using manufacturer's data and scientific principles.

Generic precinct-level cost estimates provided in this report are indicative only based on Kinesis's project experience and available data from published economic assessments. These have not been informed by specific building design or construction plans and should not be used for design and construct cost estimates.

The Kinesis software tool and results generated by it are not intended to be used as the sole or primary basis for making investment or financial decisions (including carbon credit trading decisions). Accordingly, the results set out in this report should not be relied on as the sole or primary source of information applicable to such decisions.

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INTRODUCTION

The Parramatta CBD Planning Strategy was adopted by Council in April 2015 and sets the vision for the growth of the Parramatta CBD:

“Parramatta will be Australia’s next great city, defined by landmark buildings and high quality public spaces with strong connections to regional transport. It will respect its heritage, be an exemplar in design excellence, facilitate job growth and ensure its streets are well activated.” (Parramatta CBD Planning Strategy – Vision)

To deliver on this vision, the strategy establishes principles and actions to guide a new planning framework.

The purpose of this study is two-fold:

1. Analyse and understand the impact of Parramatta CBD Planning Review on the delivery of infrastructure and sustainability outcomes for the development of the Parramatta CBD.
2. Identify opportunities and strategies that support the delivery of the Planning Strategy Vision and supporting principles.

OUR APPROACH

Our approach integrates both planning and environmental data with predictive analytics to help the City of Parramatta understand the implications of growth years before development begins. In addition, the integration of demand forecasting across energy, water, sewer, peak demand, transport patterns and financial modelling provides a unique and joined-up approach to infrastructure delivery opportunities to help enable the future of the Parramatta CBD.

Analysis was undertaken using a combination of Parramatta City Council’s CCAP City tool alongside CCAP Precinct. CCAP Precinct is a strategic infrastructure and urban design tool, used in the analysis of key performance metrics of precincts, integrating land use and development inputs with demographic, utility, transport and affordability models.

KEY FINDINGS OF THIS REPORT

1. THE IMPLICATIONS OF GROWTH ARE SIGNIFICANT

Under a business as usual scenario (assuming current building compliance requirements such as BASIX, Section J of the building code and existing Council parking ratios are met) the growth across the Parramatta CBD within the next 20 years is expected to:

- Triple electricity demand and water consumption
- Increase peak electricity demand by over 100 MW (nearly twice the existing demand)
- Increase sewer loads by nearly 4 times
- More than double parking spaces

However, increased growth delivered with the current building standards is also expected to deliver significant benefits and resident efficiencies. When compared to the existing Parramatta CBD, a new resident living in the study area is expected to:

- Consume 10% less stationary greenhouse gas emissions
- Consume 30% less water
- Drive 40% less
- Save 30% in household operating cost from energy, water and transport (equivalent to approximately \$5,500).

2. OPTIMISING THE GROWTH AND DEVELOPMENT OF THE PARRAMATTA CBD CAN DELIVER SIGNIFICANT SAVINGS AND IMPROVED URBAN OUTCOMES

It is recommended that Parramatta City Council pursue the following strategies to optimise the development of the Parramatta CBD:

1. High performance building requirements can mitigate this growth and deliver more affordable and sustainable development outcomes.
2. Recycled water integrated with public domain improvements will provide a more resilient and cooler urban experience
3. Strategic Parking Strategies will improve development feasibility and deliver a more pedestrianised and future proofed CBD

Compared to the BAU growth scenario, the combination of these strategies is expected to deliver:

- 60% reduction in electricity demand, effectively ensuring no net increase in electricity demand.
- 55% reduction in peak electricity demand, effectively reducing the need for major electricity infrastructure augmentation.
- 35% reduction in per person stationary greenhouse gas emissions.
- 50% reduction in water consumption.
- 30% reduction in sewer loads.
- Significant reductions in urban heat island.
- 50% reduction in car use.
- Significant opportunities for investment in car share for improved mobility choice.
- 40% reduction in household operating costs from energy, water and transport, equivalent to a household saving of over \$5,000 per year.



UNDERSTANDING THE PARRAMATTA CBD

The Parramatta CBD study area is outlined in Figure 1 and extends from Boundary Street to the south and, crossing the Parramatta River to Isabella Street to the north. The Parramatta CBD study area is currently estimated to include approximately 1.2 million m² of floor space, translating to approximately 6,300 dwellings and 685,000 m² of non-residential floor space.

Development and growth in the Parramatta CBD should respond to and build on the unique patterns and demographics of the area. In order to understand these patterns, existing and future trends were analysed. For the scope of this project, five key trends have been identified that require particular consideration:

1. Car ownership trends
2. Travel patterns and containment
3. Urban heat
4. Cost of housing and living
5. Building performance trends

These trends are explored and discussed below.

PARRAMATTA CBD PLANNING REVIEW STUDY AREA

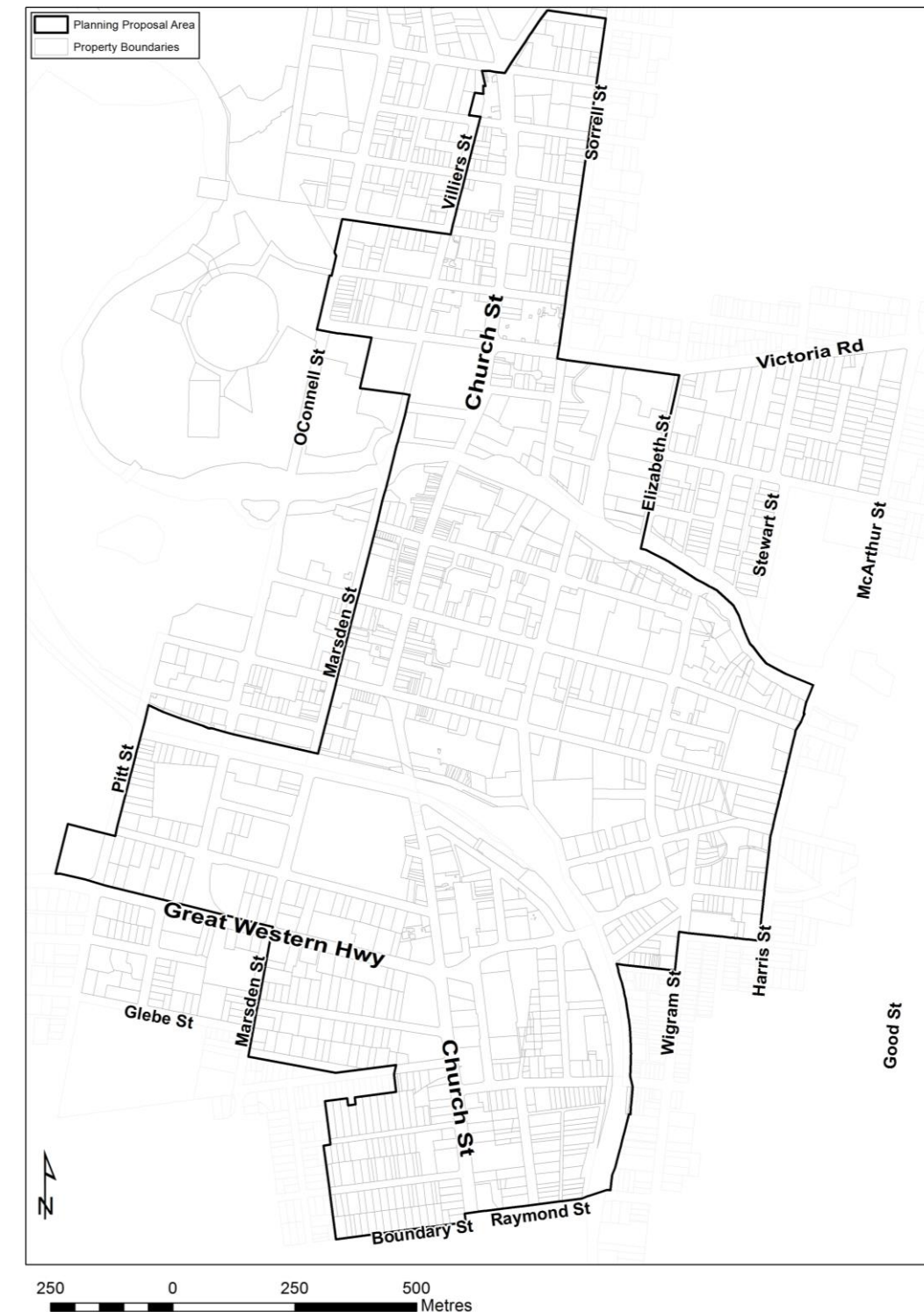


Figure 1: Parramatta CBD Planning Review Study Area boundary



1. CAR OWNERSHIP – A TREND THAT CAN BE PLANNED FOR

Vehicle ownership in the Parramatta CBD is low and trends at the Metropolitan level highlight that these rates are falling.

- Car ownership rates were analysed by ABS Census statistical area (SA) 1 zones. Data is shown for 2011.
- While varying significantly across the Parramatta LGA, average household car ownership rates in the Parramatta CBD are between 0.5 to 1 vehicles per household (Figure 2).
- This is further highlighted when looking at households with no vehicles. Within the Parramatta CBD, there are currently between 30% and 35% of households who do not own a vehicle (Figure 3).
- This low car ownership rate is reflective of the significant accessibility of the study area, including access to high frequency rail and bus services, local employment and retail services. This level of car ownership is comparable to other accessible centres including Granville, Strathfield and Ashfield (Figure 4).
- At a metropolitan level, additional trends can also be considered:
 - Vehicle license rates for younger demographic are falling. Across the Sydney Metropolitan Area, 1 in 4 people aged 18 to 35 do not have a license or own a car (Bureau of Transport Statistics, 2009).
 - Currently, approximately 8% of City of Sydney residents are car share members. This is as high as 20% in high density, highly accessible locations such as Darlinghurst and Surry Hills.

EXISTING CAR OWNERSHIP

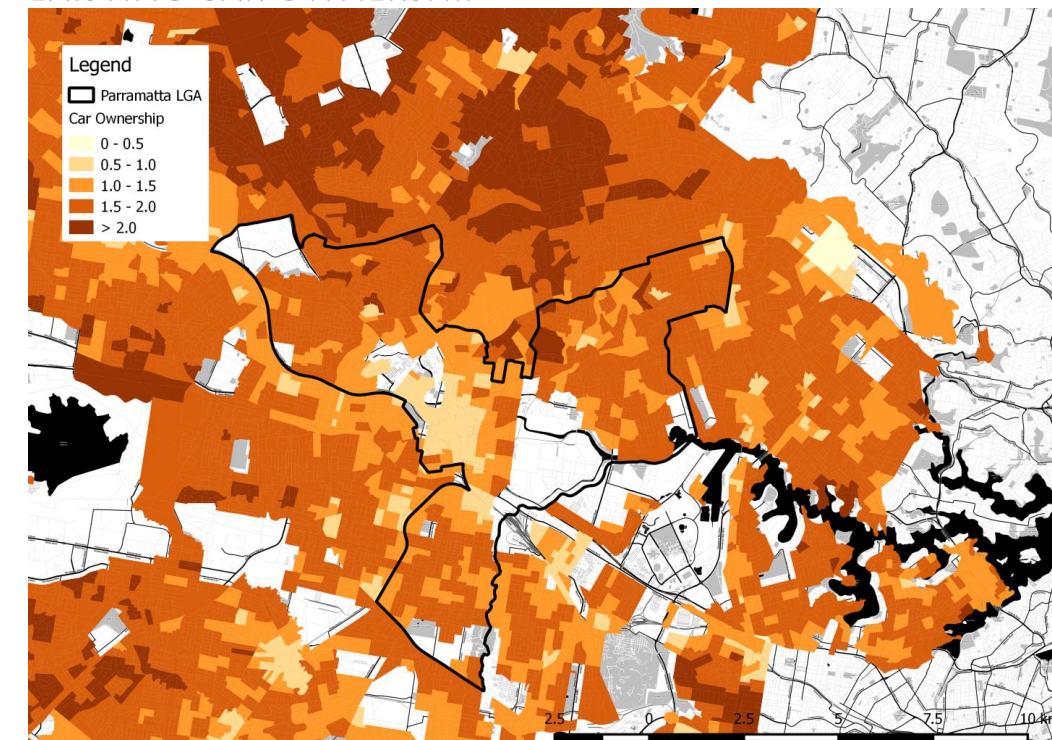


Figure 2: Average car ownership rates (source: ABS Census 2011)

HOUSEHOLD WITH NO CARS

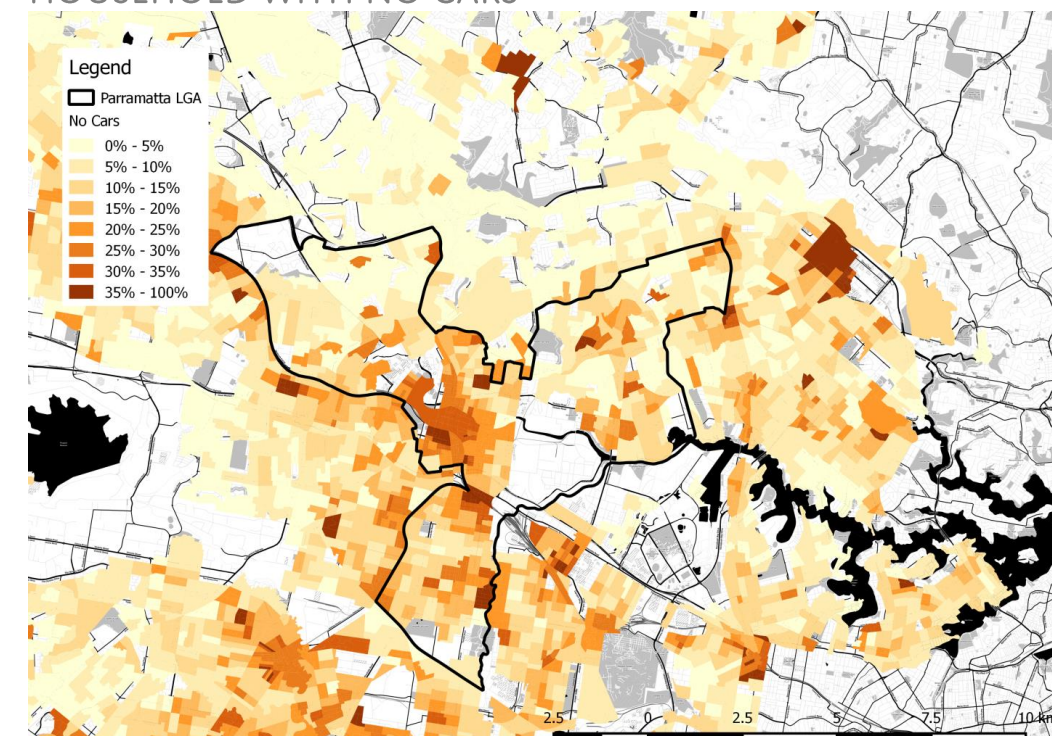


Figure 3: Percent of households with no vehicles (source: ABS Census 2011)



2. TRAVEL PATTERNS AND CONTAINMENT

There is a high level of trip containment in the Parramatta CBD, reflecting access to jobs and services. New development in the CBD should respond to and build on the levels of walking and cycling in the city.

- Travel patterns were analysed to understand travel and containment patterns in the Parramatta CBD. This data was sourced from the Bureau of Transport Statistic's Household Travel Survey and the ABS Census Journey to Work (2011).
- Employment containment can be measured by the percent of the population who walk or cycle to work. Within the Parramatta CBD, approximately 20% to 25% of people walk or cycle to work, reflecting the significant levels local and accessible employment (Figure 5).

COMPARISON OF MAJOR CENTRES

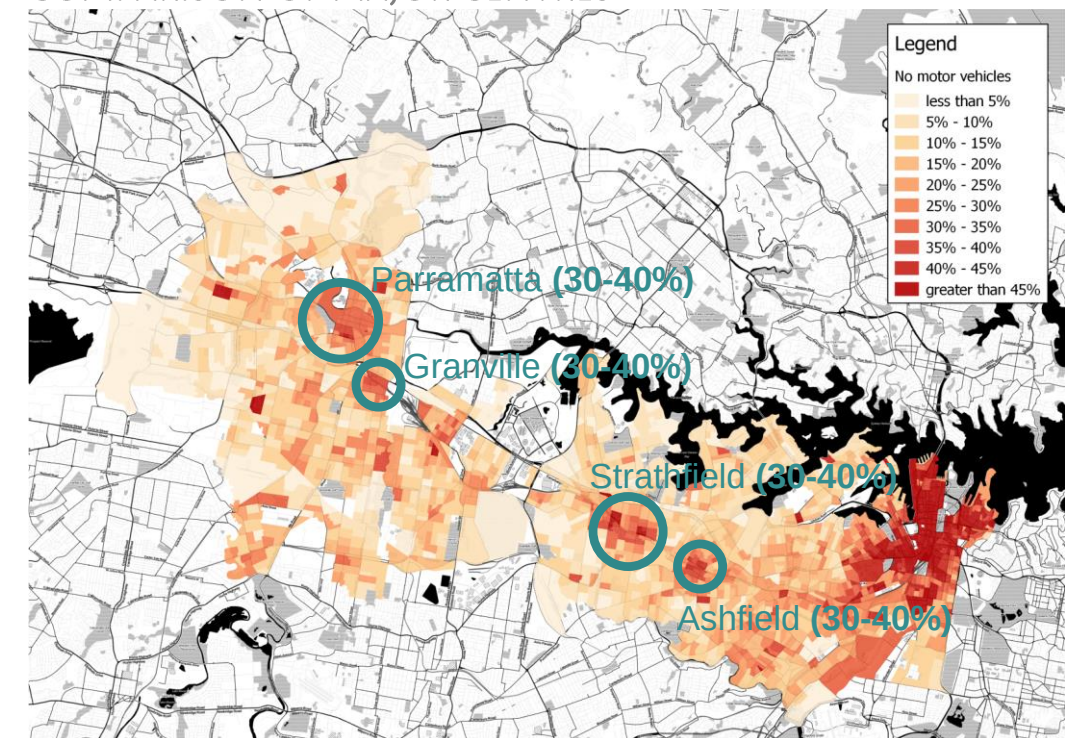


Figure 4: Comparison of centres with high percent of households with no vehicles (source: ABS Census 2011)

WALK + CYCLE TO WORK

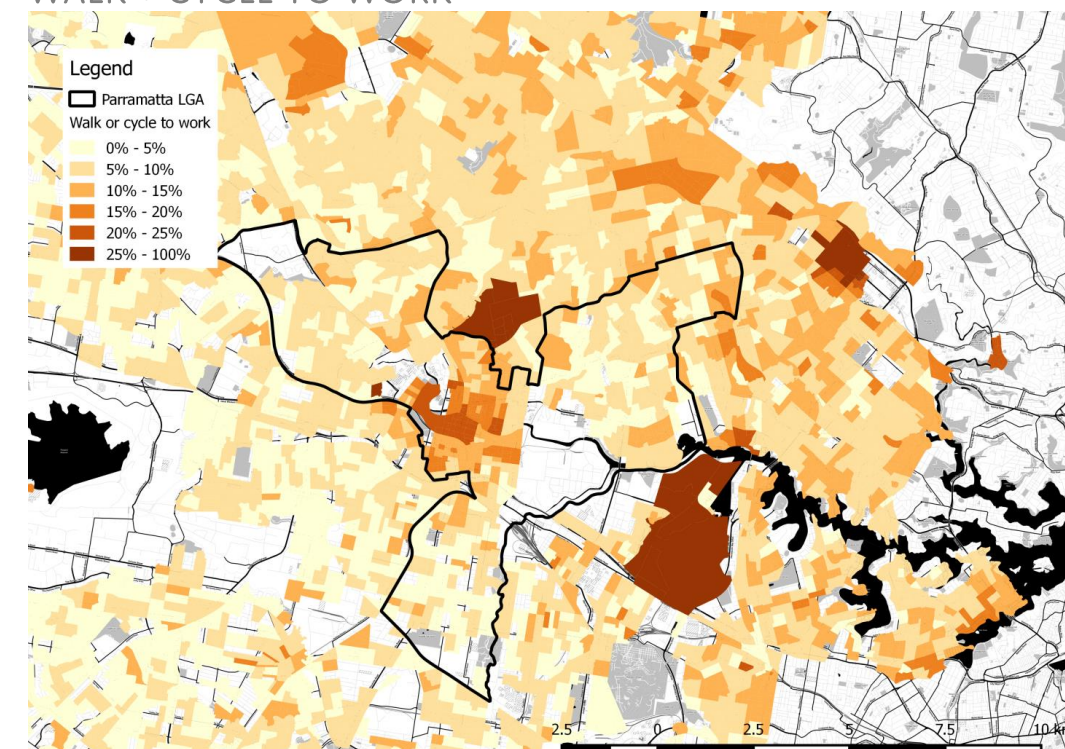


Figure 5: Percent of persons who walk or cycle to work (source: ABS Census 2011)

3. URBAN HEAT

The number of hot days in Parramatta is increasing higher than coastal areas and future climate projections will accelerate this trend.

- The impact of local climate can be considered across three key areas: local existing climate, future climate projections and the urban heat island.
- Without the cooling sea breeze off the coast, Western Sydney residents feel the full effect of heatwave conditions and this gap is widening. Analysis of temperature records over the last 40 years shows that Parramatta has seen a rise in annual temperatures above that experienced in coastal parts of the city (Figure 6).
- From a climate projection perspective, the Parramatta CBD is located in the East Coast South sub-cluster. Climate projections published by the Department of Environment in partnership with CSIRO and the Bureau of Meteorology outline the following changes for this sub-cluster:
 - Average temperatures will continue to increase in all seasons (very high confidence).
 - More hot days and warm spells are projected with very high confidence. Fewer frosts are projected with high confidence.
 - Decreases in winter rainfall are projected with medium confidence. Other changes are possible but unclear.
 - Increased intensity of extreme rainfall events is projected, with high confidence.
 - Mean sea level will continue to rise and height of extreme sea-level events will also increase (very high confidence).
 - A harsher fire-weather climate in the future (high confidence).
 - On annual and decadal basis, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years and for rainfall.
- Major heat waves are Australia's deadliest natural hazards. Major heat waves have caused more deaths since 1890 than bushfires, cyclones, earthquakes, floods and severe storms combined (Department of Infrastructure and Regional Development (2013) State of Australian Cities). People living in urban environments can be more susceptible than non-urban dwellers to the effects of heatwaves as a result of the urban heat island. The urban heat island is effectively the difference between the land surface temperature and the average air temperature. This is caused by the prevalence in cities of heat-absorbing materials such as dark coloured pavements and roofs, concrete, urban canyons trapping hot air, and a lack of shade and green space in dense urban environments.
- Studies undertaken by the Parramatta City Council highlight a strong correlation between surface types and vegetation with lower land surface temperatures. Figure 11 outlines the land surface temperature in and around the Parramatta CBD, highlighting the temperature variation between the less vegetated CBD environment compared to surrounding streets with more street trees and vegetation.
- In addition, the increase in both local temperatures, heat island and extreme heat events has a direct impact on electricity demand for air conditioning which is expected to increase peak electricity demands and household electricity costs. This is further analysed in the *Implications of Parramatta CBD Growth* section of this report.

CLIMATE TRENDS SYDNEY V PARRAMATTA

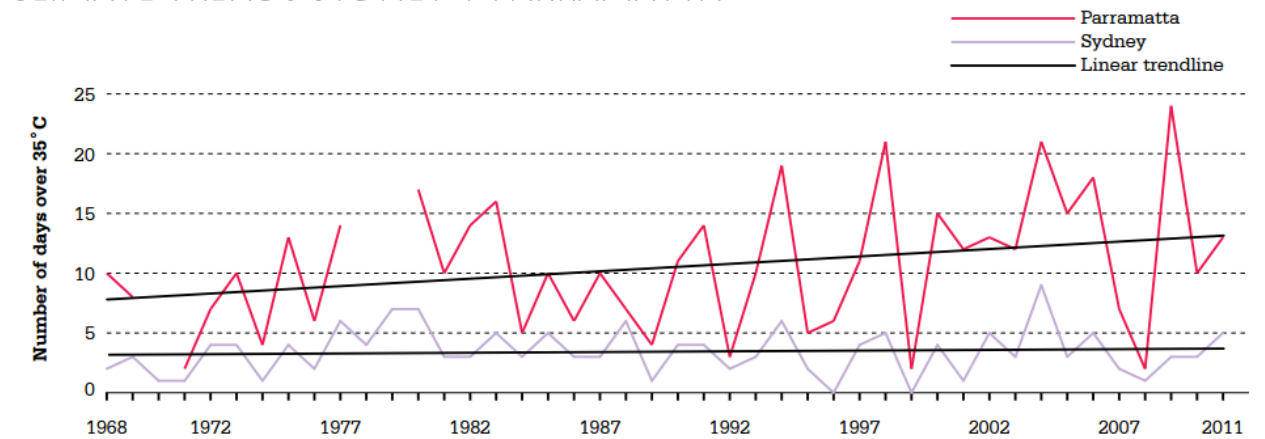


Figure 6: Measured days of 35 degrees for Parramatta and Sydney from 1968 to 2011 (Source: BOM)

URBAN HEAT MAPPING OF THE PARRAMATTA CBD

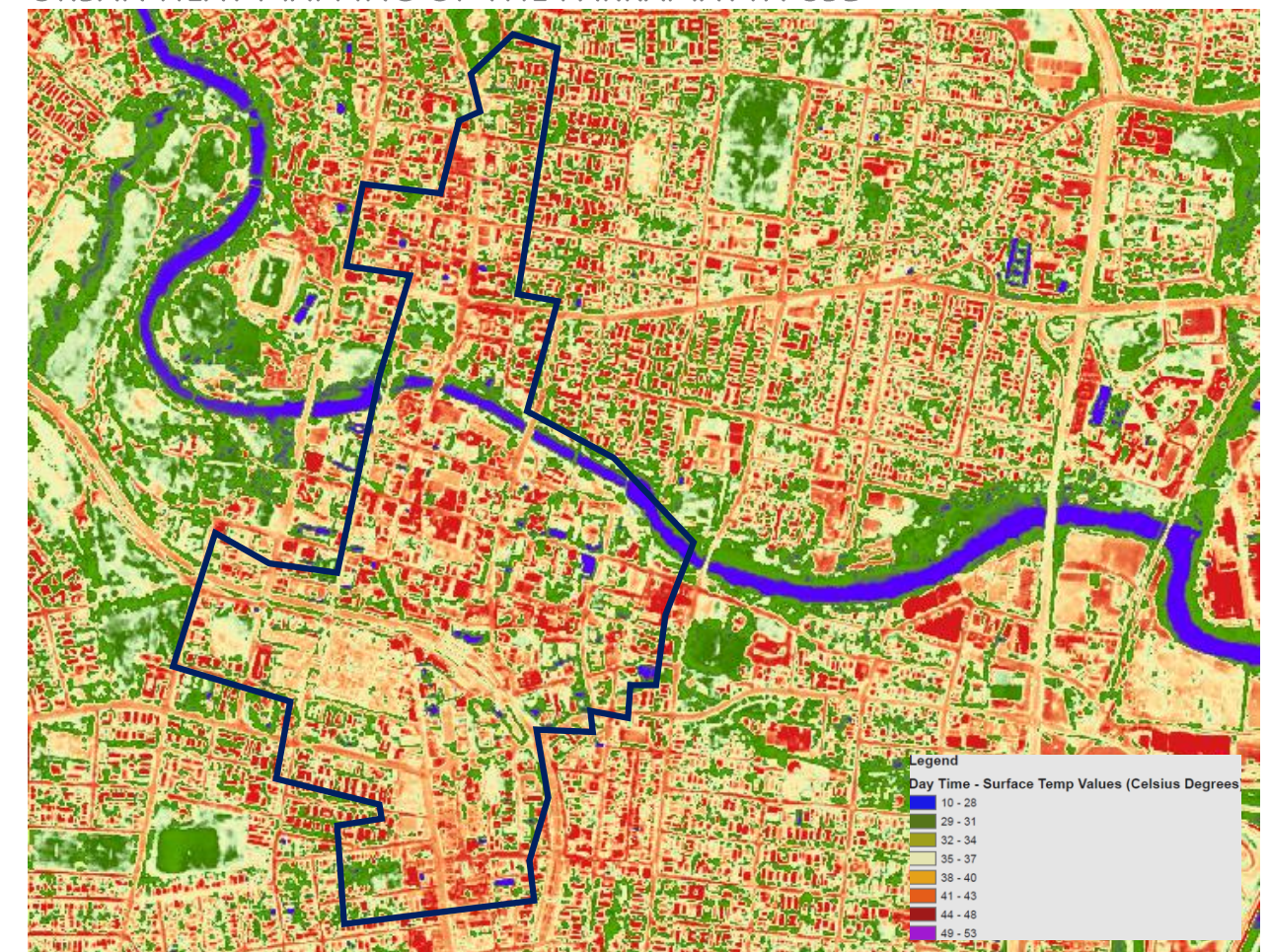


Figure 7: Relative land surface temperature from thermal imagery (aerial imagery acquired on 08/02/2013, 1.35 - 2.21pm)



4. COST OF HOUSING AND COST OF LIVING

Transport is second only to housing as the highest household cost in Parramatta. How we affect transport can deliver significant affordability benefits.

- Affordability is often considered only in the context of the cost of housing. However, when looking at average household expenditure, transport costs associated with car ownership and fuel consumption can be as high as housing costs (see Figure 8). Like housing, expenditure on transport is highly context specific.
- It is also important to understand how planning for new development can affect household expenditure. For the Parramatta CBD, how our buildings are designed and where development occurs will affect household costs related to housing, transport and utilities (energy and water).
- To better understand this variable for the Parramatta CBD, housing, transport and utility expenditure analysis was undertaken across the Parramatta LGA and incorporated the following:
 - Housing costs were calculated based on the purchase of a home at the median house and unit sales price in the LGA for the last 12 months, assuming 5% deposit, 30 year loan, 5% interest rate.
 - Transport costs were calculated based on existing car ownership and travel patterns (car use and public transport use) in the LGA.
 - Utility costs were calculated based on existing average energy and water consumption for the average household in the LGA, assuming current retail tariffs.
 - For the purpose of this analysis, all other household expenditure including food, clothing, household items, medical and recreation was based on the average expenditure reported in the ABS Household Expenditure Survey.
- The results of this analysis are shown in Figure 9 and highlight the following:
 - Recent housing sales highlight the significant costs associated with the purchase of a home in the Parramatta LGA.
 - After housing, transport is the highest household cost and the ability to affect transport costs can drive significant affordability outcomes.
 - Utility costs are low when compared to housing and transport costs. However, significant household savings can still be achieved through more efficient housing design.

AVERAGE HOUSEHOLD EXPENDITURE ACROSS NSW

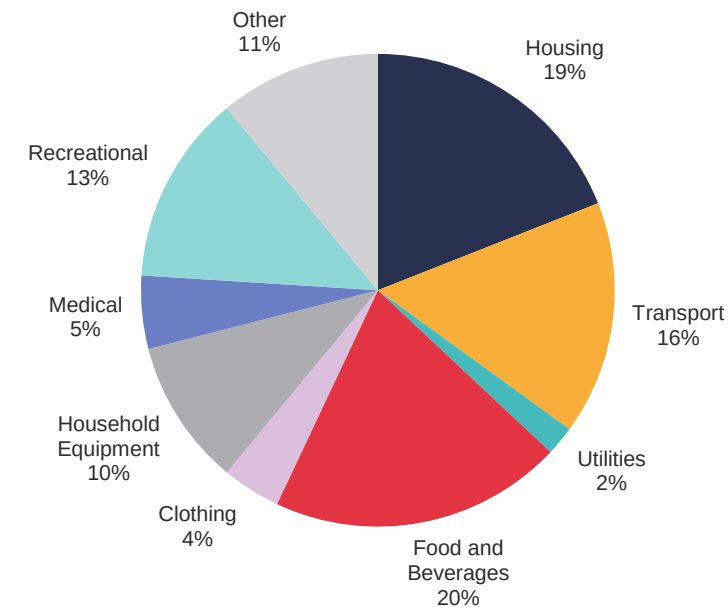


Figure 8: NSW average household expenditure (ABS Household Expenditure Survey 2009-10).

ESTIMATED HOUSEHOLD EXPENDITURE FOR THE PARRAMATTA LGA

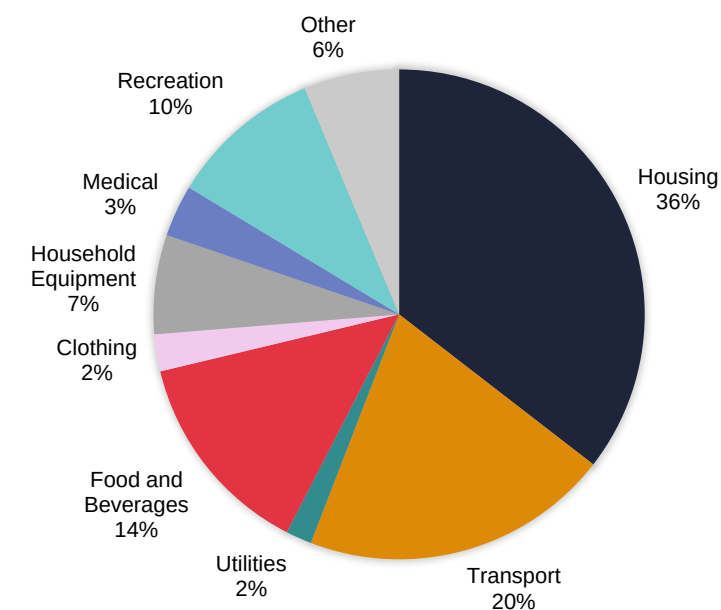


Figure 9: Estimated Parramatta LGA average household expenditure assuming the purchase of a new home (ABS Household Expenditure Survey 2009-10 and analysis by Kinesis of transport and property data).



5. BUILDING PERFORMANCE TRENDS

There is a trend towards higher building performance across Parramatta, reflecting the building industry’s capacity to deliver more efficient buildings.

- Environmental sustainability was analysed across energy, greenhouse gas emissions and water consumption. Data for existing consumption profiles was sourced from Parramatta City Council’s CCAP City tool which incorporates the latest energy and water profiles from Endeavour Energy, Jemena and Sydney Water.
- On average, residents in the Parramatta CBD consume approximately:
 - 2,150 kWh per person of electricity per year (approx. equal to the Sydney Metropolitan Average)
 - 4,000 MJ per person of gas per year (approx. equal to the Sydney Metropolitan Average)
 - 225 L per person of water per day (5% lower than the Sydney Metropolitan Average)
- Analysis also showed that solar PV installations were relatively high across the Parramatta LGA, but low in the high density Parramatta CBD location (Figure 10). This is largely due to the high density built form of the Parramatta CBD.
- Finally, Department of Planning BASIX data highlights the outcomes of new developments. Since the introduction of BASIX, Sydney and Parramatta has seen increasing trends in over-compliance, particularly in BASIX Energy outcomes, i.e. new developments are achieving higher BASIX targets. Over compliance can be attributed to both the increasing efficiency and lower costs of market available technologies (such as lighting and solar PV). It should be noted that trends in over-compliance are less significant in apartments which are generally flat (see Figure 12) highlighting the need to establish higher performance requirements for this dwelling typology.

COMPARISON OF SOLAR PV INSTALLATIONS

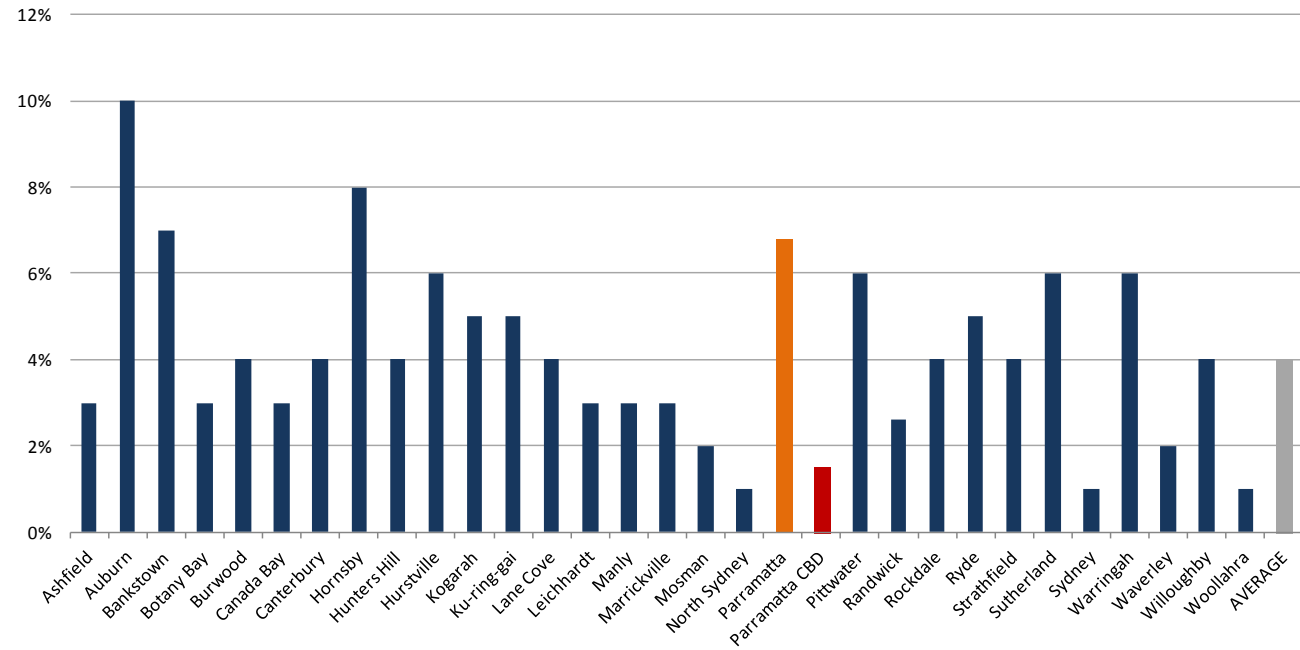


Figure 10: Comparison of solar PV installations by local government area, highlighting both the Parramatta LGA and CBD
(Source: Clean Energy Regulator, 2015)

BASIX OVER COMPLIANCE SCORES FOR ALL DWELLINGS (PARRAMATTA)

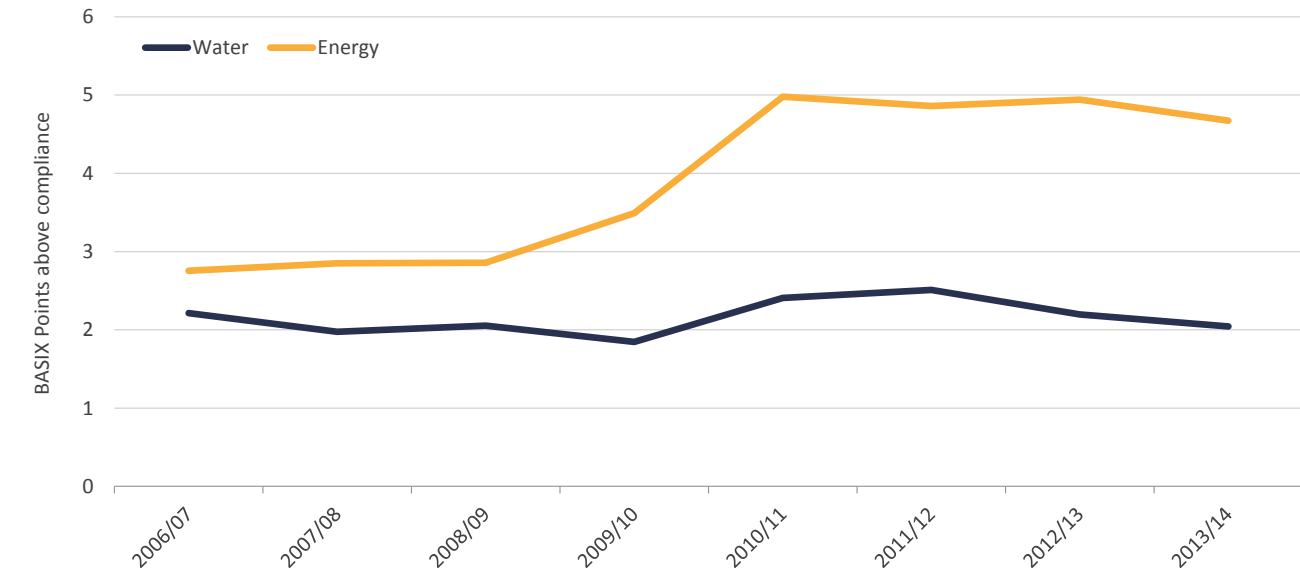


Figure 11: Annual Average Points above BASIX Compliance for all new dwellings across the Parramatta LGA
(Source: NSW Department of Planning, 2015)

BASIX OVER COMPLIANCE FOR APARTMENTS (SYDNEY METRO AREA)

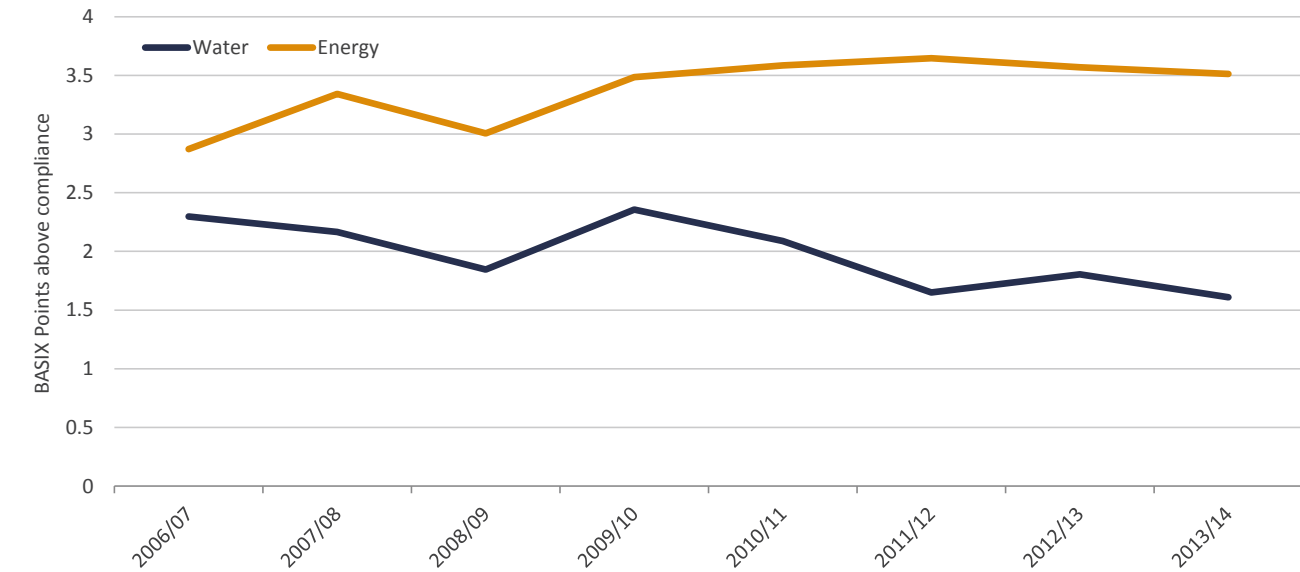


Figure 12: Annual Average Points above BASIX Compliance for new apartments across the Sydney Metropolitan Region. Data for the entire Sydney Metro Area is shown here as the sample size for the Parramatta LGA is too low to identify trends.
(Source: NSW Department of Planning, 2015)



KEY TRENDS AND ISSUES FOR THE PARRAMATTA CBD

The analysis above has highlighted seven key trends and issues that should be considered in the development and growth of the Parramatta CBD:

1. Vehicles ownership in the Parramatta CBD is low and Sydney Metropolitan trends highlight that vehicle ownership is falling, reflecting shifts in mobility preferences that is occurring across our major metropolitan regions.
2. These shifts are driven by changing consumer preferences and technology (including car share, combined with access to public transport). If you add to this the disruption posed by the emergence of the of the autonomous vehicle within the development timeframe of the Parramatta CBD, it is clear that our planning has to be agile and respond to a city's agenda that is unlike anything Sydney has ever faced before.
3. After housing, transport is the highest household cost and the ability to affect transport costs can drive significant affordability outcomes.
4. Utility costs are low when compared to housing and transport costs. However, significant household savings can still be achieved through more efficient housing design. Australians have experienced significant electricity price growth in recent years. According to a Grattan Institute report (Wood & Carter 2014), the average household power bill has risen 70% in the five years to 2013. However, it is expected that future price increases will moderate or even fall as network cost pressures are stabilising (Figure 13). Similarly, NSW retail gas prices have risen significantly from 2013/14 to 2014/15, however future increases are expected to be moderate (Independent Pricing and Regulatory Tribunal [IPART] 2014).
5. Shifts in energy generation, use (such as electric vehicles) and battery storage represents a significant opportunity for the way energy is delivered to cities allowing for more efficient and optimised peak demand profile and infrastructure delivery management.
6. Parramatta has seen a rise in annual temperatures above that experienced in coastal parts of the city and this scenario is expected to get worse for the Parramatta CBD with climate change projections and the impact of the urban heat island. The increase in both local temperatures, heat island and extreme heat events has a direct impact on electricity demand for air conditioning which is expected to increase peak electricity demands and household electricity costs.
7. There is a trend towards higher building performance across Parramatta, reflecting the building industry's capacity to deliver more efficient buildings.

SYDNEY UTILITY PRICE GROWTH

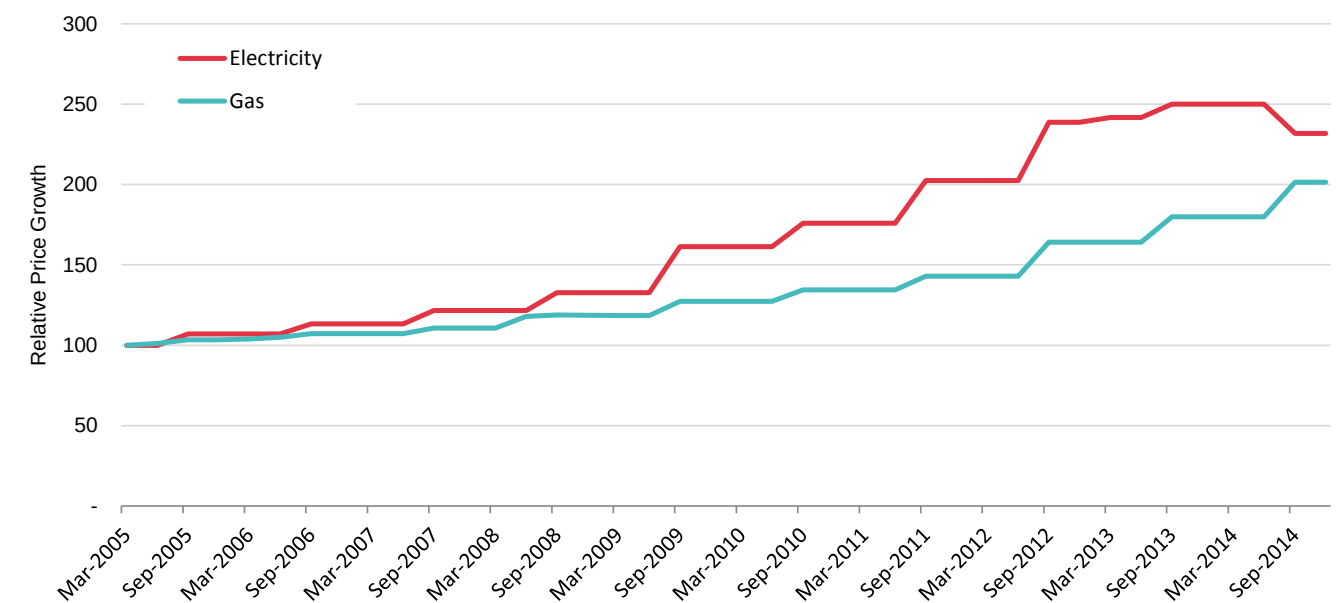


Figure 13: Sydney electricity and gas relative price increases from a base value of 100.

ELECTRIC VEHICLES AND BATTERY STORAGE



Figure 14: The emergence of new technologies represent a significant opportunities to the way energy is delivered to a city.



PARRAMATTA CBD PLANNING SCENARIOS

Scenario analysis was undertaken using key planning and development information for the study area. Kinesis worked closely with the Parramatta City Council planning teams to understand:

- Existing Floor Space within the study area
- Projected floor space under Existing Planning Controls
- Project floor space under two Proposed Planning Control scenarios:
 - Proposed Controls 1 assumes no residential in the CBD commercial core
 - Proposed Controls 2 assumes residential in the CBD commercial core

Summary planning and land use information used in the scenario analysis is documented in Tables 1 and 2 and is shown spatially in Figures 15 to 18.

Please note: Proposed controls assume two-thirds of the total potential floor space yield will be taken up as per SGS advice.

Notes on adopted floor space

- Additional floor space outlined in Table 1 was provided by the Parramatta City Council and is current at 3/7/2015.
- Existing floor space was calculated by Kinesis adopting the following method and assumptions developed in discussion with Parramatta City Council:
 - Current zoning FSR was calculated for each lot
 - Existing development deductions were then subtracted from the current zoning assuming B1, R2, R3 and R4 adopted a 1:1 deduction and B3, B4 and B5 adopted a 2:1 deduction.
- Total floor space and dwellings equate to the existing floor space plus the additional floor space outlined in Table 1, assuming 100m2 per apartment and two-thirds of potential floor space yield will be taken up as per SGS advice.

PARRAMATTA CBD FLOOR SPACE UNDER TESTED VARIOUS SCENARIOS

Scenario	Additional Residential Floor Space (m2)	Additional Residential dwellings (approx.)	Additional Commercial Floor Space (m2)	Additional jobs (approx.)
Existing controls	832,756	5,552	835,655	23,213
Proposed Controls 1 (no residential on commercial core)	2,517,845	16,786	2,205,622	61,267
Proposed Controls 2 (residential in commercial core)	2,905,636	19,371	1,817,832	50,495

Table 1: Additional floor space, dwellings and jobs for the study area.

TOTAL FLOOR SPACE AND DWELLINGS MODELLED IN EACH SCENARIO

Scenario	Residential Dwellings	Commercial Floor Space (m2)*
Existing Development (estimated)	6,301	685,238
Existing Controls	11,853	1,242,981
Proposed Controls 1 (no residential on commercial core)	23,087	2,156,291
Proposed Controls 2 (residential in commercial core)	25,672	1,897,765

Table 2: Total floor space and dwellings modelled under each scenario for the study area.

***Note:** As per residential dwelling projections, the commercial floor space modelled for the Existing Controls and the Proposed Controls scenarios assume two-thirds of the total potential floor space yield (as outlined in Table 1) will be taken up as per SGS advice.



EXISTING FLOOR SPACE

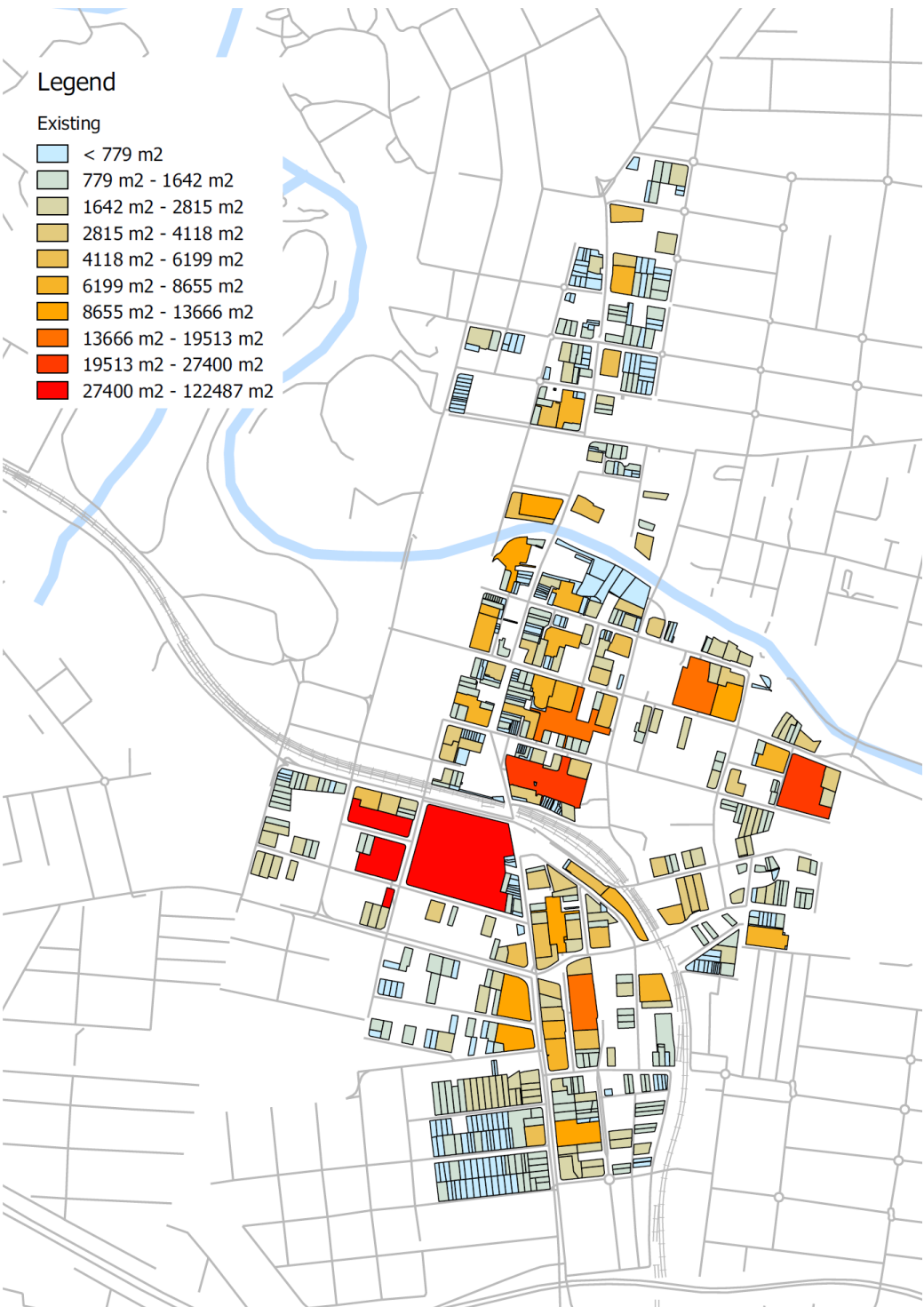


Figure 15: Estimated existing floor space across the study area

FLOOR SPACE GROWTH UNDER CURRENT CONTROLS

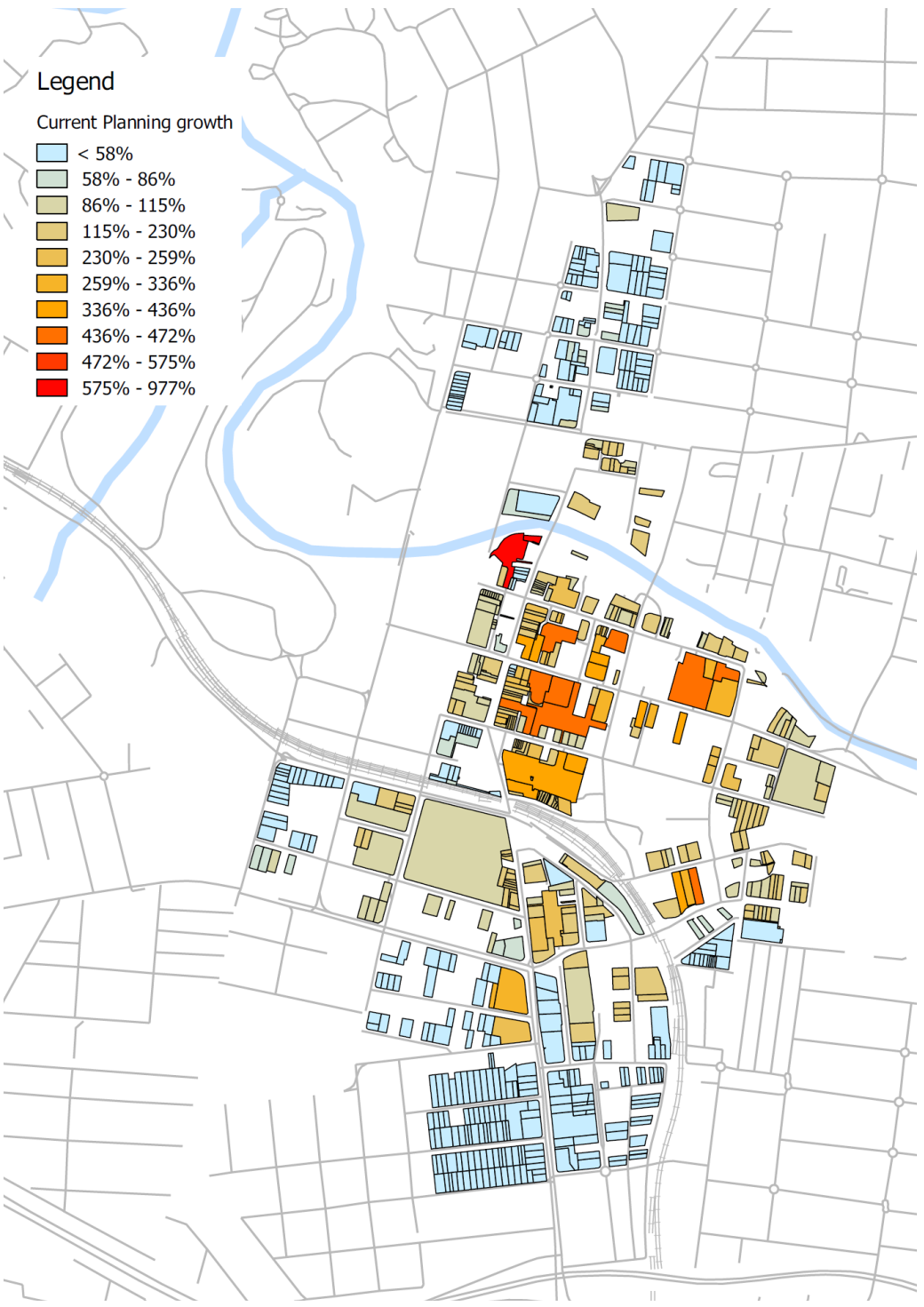


Figure 16: Estimated floor space under Current Planning Controls across the study area



PROPOSED 1 FLOOR SPACE

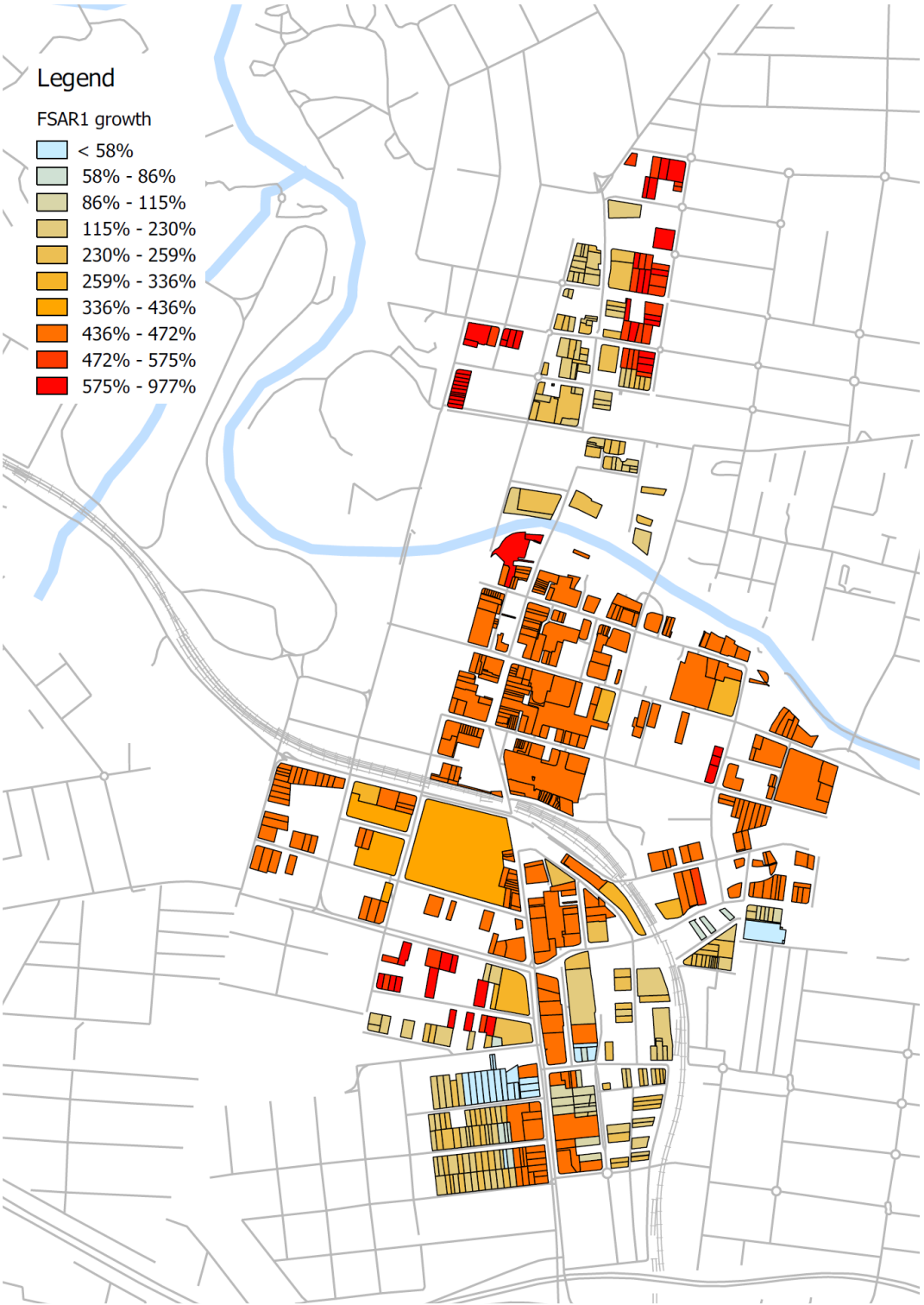


Figure 17: Estimated floor space under Proposed Controls 1 (no residential in core)

PROPOSED 2 FLOOR SPACE

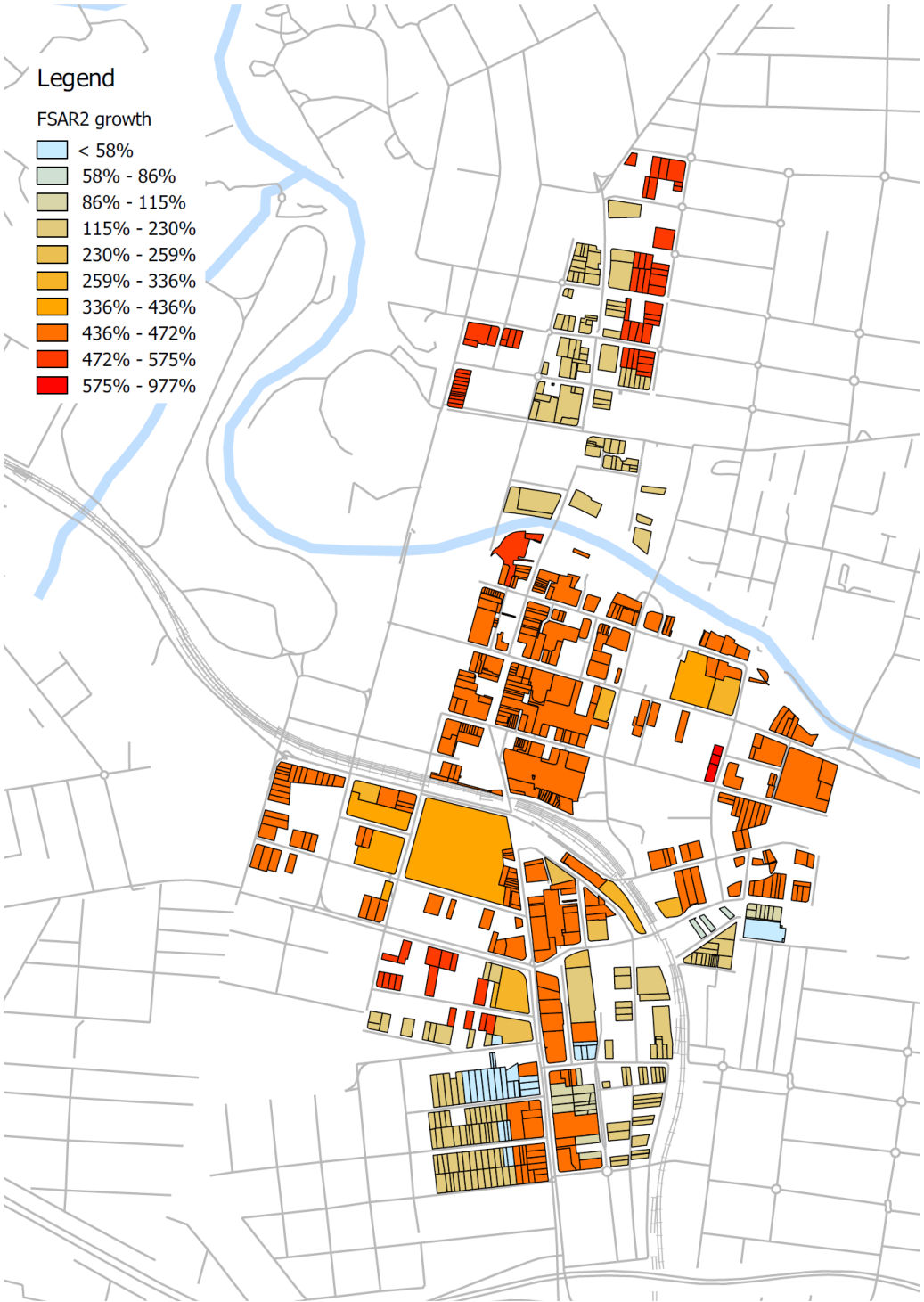


Figure 18: Estimated floor space under Proposed Controls 2 (residential in core)



IMPLICATIONS OF PARRAMATTA CBD GROWTH

Scenario analysis of the Parramatta CBD was analysed under each planning scenario to understand the implications of the Parramatta CBD growth on:

- Energy demand and infrastructure
- Water and sewer infrastructure
- Greenhouse gas emissions
- Transport and car dependence
- Cost of living

Modelling was first undertaken for a **Business As Usual scenario**, which assumes that all new development under each planning scenario achieves building compliance (with BASIX and Section J of the Building Code) as well as conforms with existing Parramatta City Council parking controls.

Analysis was undertaken using a combination of Parramatta City Council's CCAP City tool alongside CCAP Precinct. CCAP Precinct is a strategic infrastructure and urban design tool, used in the analysis of key performance metrics of precincts, integrating land use and development inputs with demographic, utility, transport and affordability models.

ENERGY DEMAND AND INFRASTRUCTURE IMPLICATIONS

The Parramatta CBD is currently serviced by Endeavour Energy (electricity) and Jemena (gas). Electricity is delivered from large, regionally located coal and gas fired power plants located over 85 km from the Parramatta CBD.

Under the proposed planning scenarios, the energy implications are significant:

- **Electricity demand is expected to nearly triple** when compared to existing demands (see Figure 19).
- **Peak day electricity demand is expected to increase by over 100 MW** (twice the existing demand), see Figure 20.
- **Gas demand is expected to more than triple** when compared to existing demands.

Peak electricity demand is driven by the hour or series of days where hot temperatures require significant air conditioning loads. To further test the implications of the planning scenarios, peak day electricity demand was also modelled under the following climate and urban heat island scenarios:

- A 2 degree temperature rise
- Street level, un-vegetated temperature settings

This sensitivity testing showed a further 10% increase in peak electricity demand under a 2 degree temperature rise and more significant increase and change in the peak day load profile if the Parramatta CBD is further affected by the urban heat island effect (see Figure 20).

ELECTRICITY DEMAND (MWH PER YEAR)

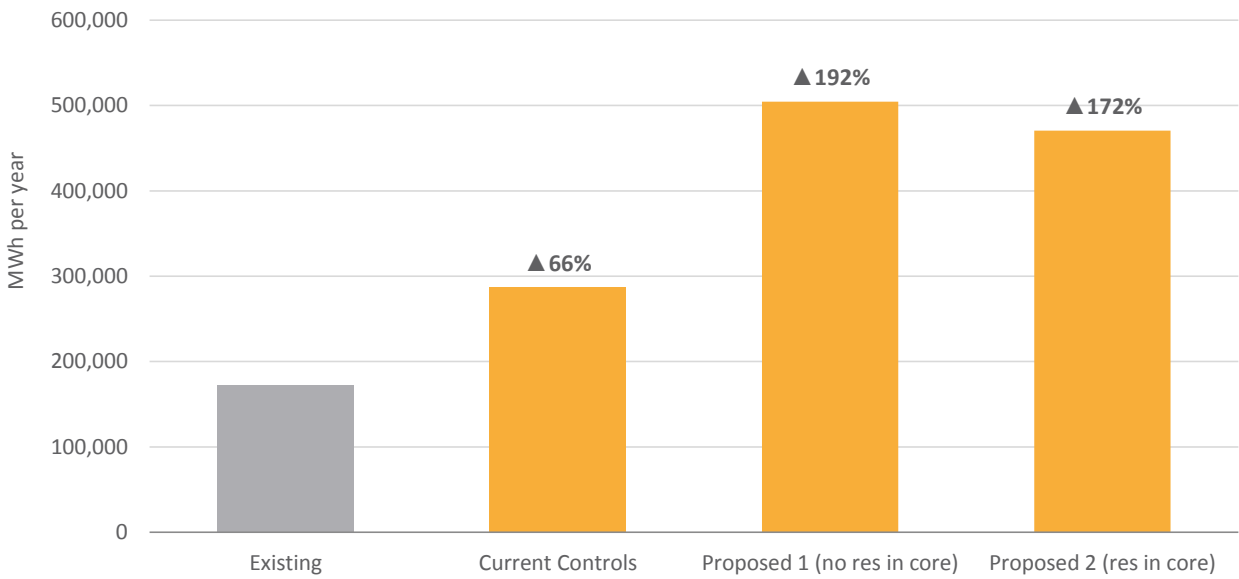


Figure 19: Expected electricity demand under each planning scenario (in comparison to existing demands)

PEAK DAY ELECTRICITY DEMAND (MW)

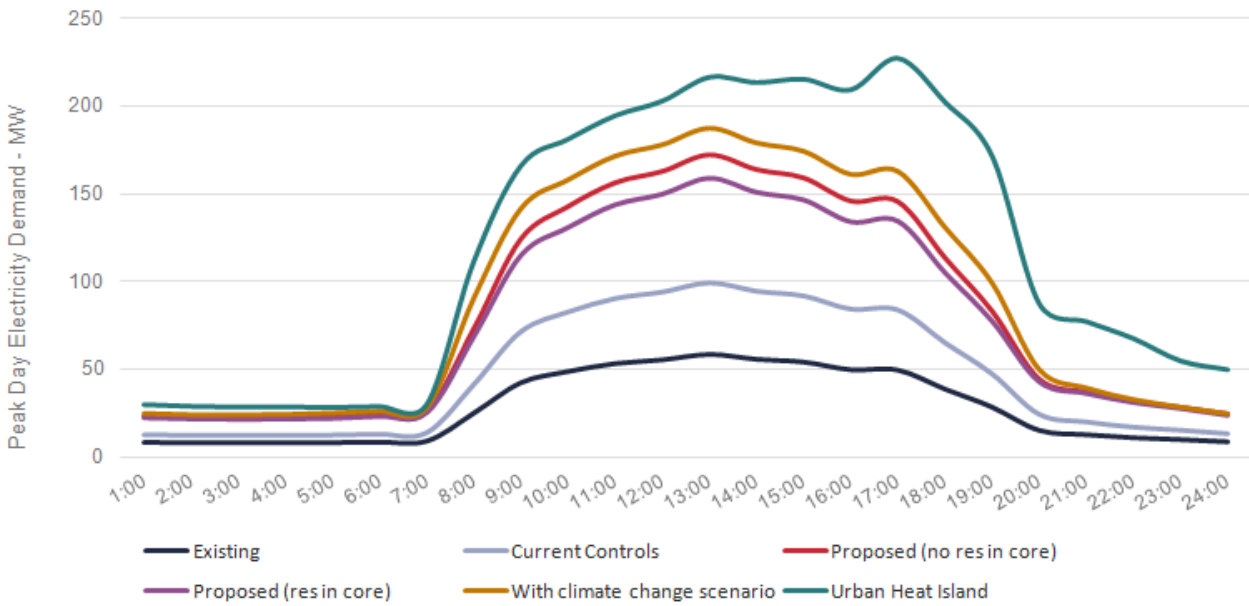


Figure 20: Expected peak day electricity demand profile under each planning scenario as well as under various climate change scenarios.



WATER DEMAND AND INFRASTRUCTURE IMPLICATIONS

The Parramatta CBD is currently serviced by Sydney Water for potable water and sewer. Water is delivered from several regional dams, including Warragamba, Nepean, Coreaux and Cataract. Sewer is collected and pumped 25 km to the Sydney Water's North Head Wastewater Treatment Plant at Manly which disposes of the treated wastewater through an ocean outfall. The Parramatta CBD is not currently serviced by recycled water.

Under the proposed planning scenarios, the water and sewer implications are significant:

- Water demand is expected to triple when compared to existing demands (Figure 21). The higher residential component in the Proposed Controls 2 scenario reflects the higher water demands from the residential sector.
- Sewer loads are expected to increase by nearly 4 times (Figure 22).

TRANSPORT AND PARKING IMPLICATIONS

Under the proposed planning scenarios, the transport implications are two-fold:

1. All scenarios are expected to deliver a 30% to 35% reduction in per person car use. This is delivered through the expected lower car ownership rates driven by Council's existing parking rates.
2. Despite this, all scenarios will deliver significantly more vehicles into the Parramatta CBD. Under existing parking controls, the planning scenarios are expected to more than double parking and associated vehicles.

Parramatta City Council recently completed a parking survey of the Parramatta CBD and additional analysis was undertaken to understand the current supply and expected demand for parking under each planning scenario (Table 3 and Figure 23).

This analysis reviewed the parking survey which counted on and off-street parking across the study area. On average existing off-street parking had an average occupancy of 69% when counted (i.e. 31% of spaces were vacant).

To understand how this compares to existing parking ratios, the existing floor space was multiplied by Parramatta City Council's existing parking ratios for various building typologies. This generated a parking supply that is approximately 26% less than current supply i.e. if the Parramatta CBD was rebuilt today, the city would require 26% less parking than is currently in the study area.

If current rates are assumed for the Existing Planning Controls and the Proposed Planning Controls, parking rates are expected to increase by 23% and over 100% respectively, creating over 50,000 parking spaces across the study area.

WATER CONSUMPTION (ML PER YEAR)

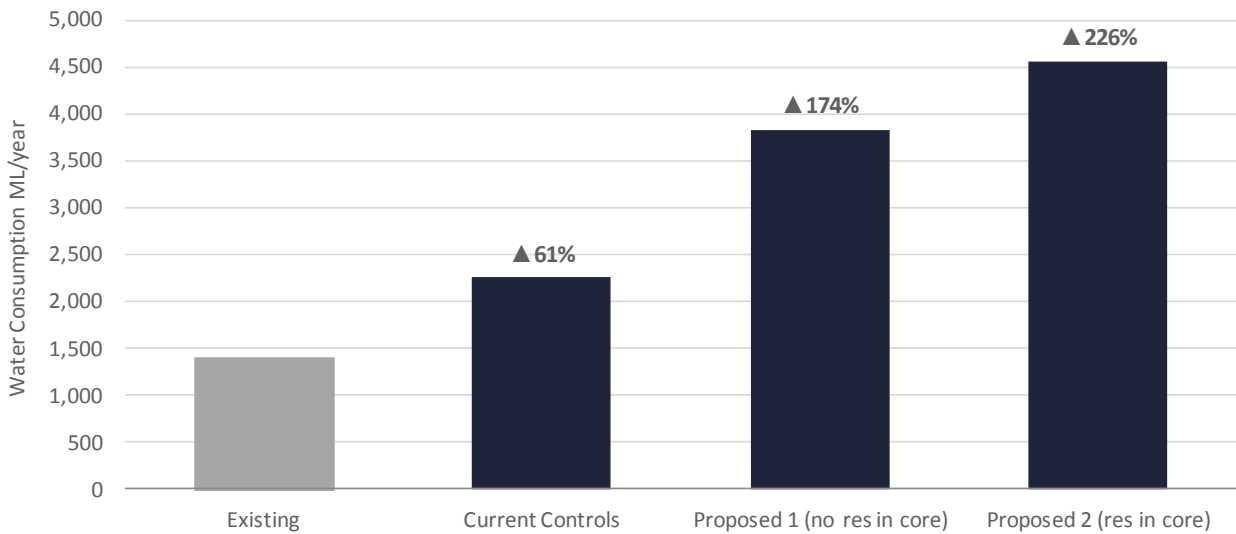


Figure 21: Expected water demand under each planning scenario (in comparison to existing demands)

SEWER LOADS (ML/YEAR)

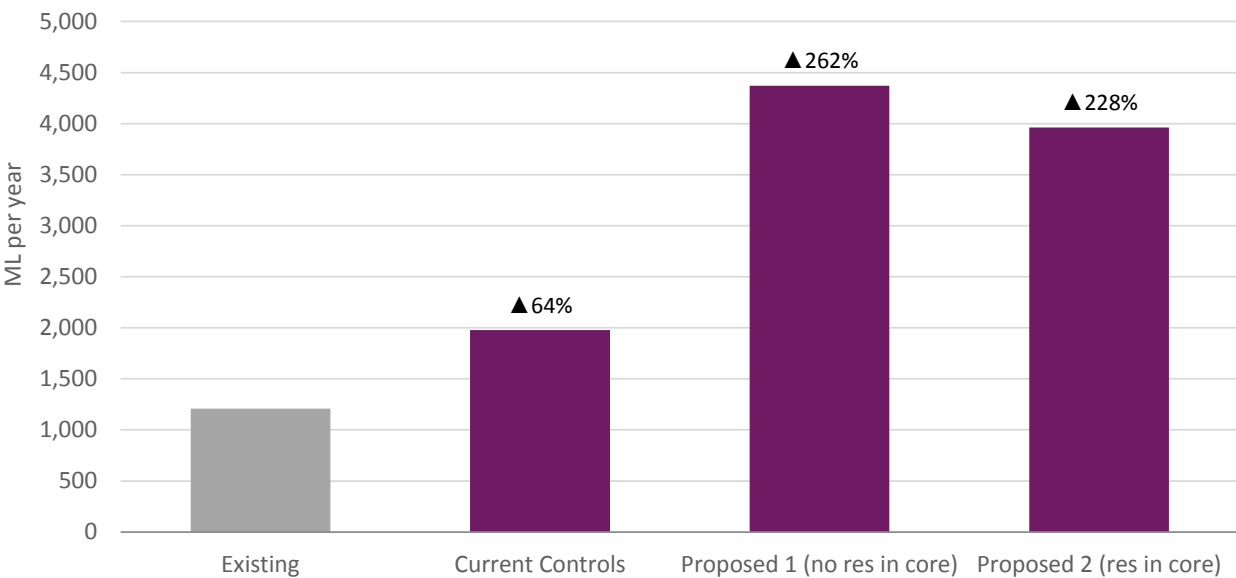


Figure 22: Expected sewer loads under each planning scenario (in comparison to existing demands)



PARRAMATTA CBD PARKING COUNTS

Parking Type	Total Spaces	% Utilisation
Parking Off-Street	23,908	69%
Public (Council) Off-Street	3,461	n/a
On-Street	1,849	n/a
Total	29,218	n/a

Table 3: Existing parking counts for the study area

PARRAMATTA CBD PARKING RATIOS

Building Use	Maximum Parking Spaces
Commercial	1 space for every 100m2
Shops	1 space for every 30m2
Multi-Dwelling	1 space for every dwelling (plus 1 visitor space for every 5 dwellings)

Table 4: Existing parking controls used in parking analysis (Parramatta City Centre LEP 2007)

PARKING SPACES (NUMBER)

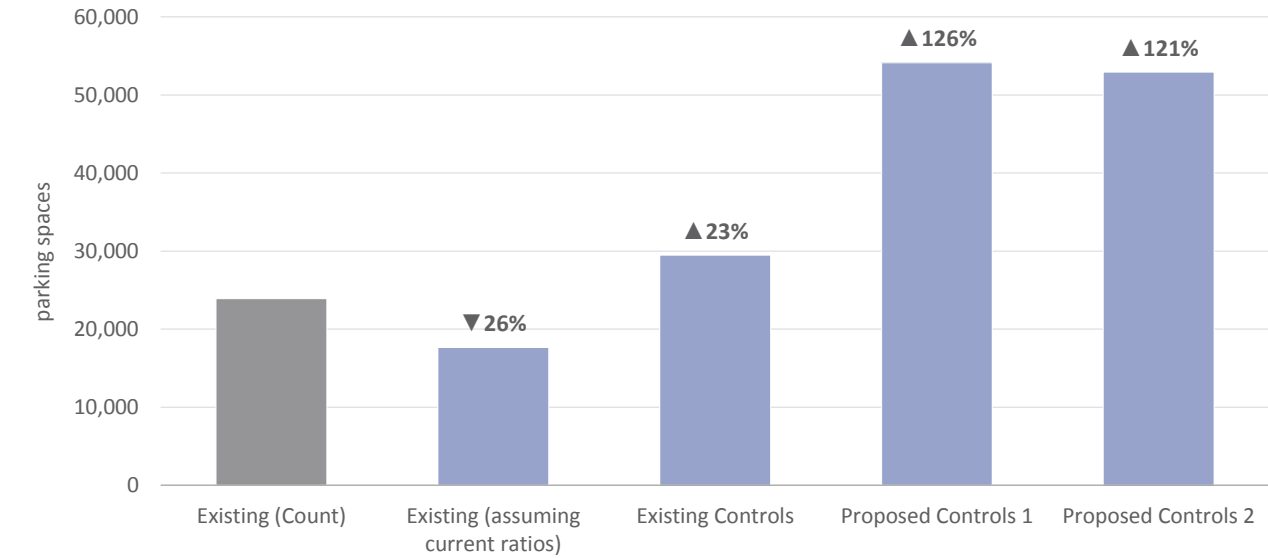


Figure 23: Parking space across the study area under various scenarios

CAR USE (KM PER PERSON PER DAY)

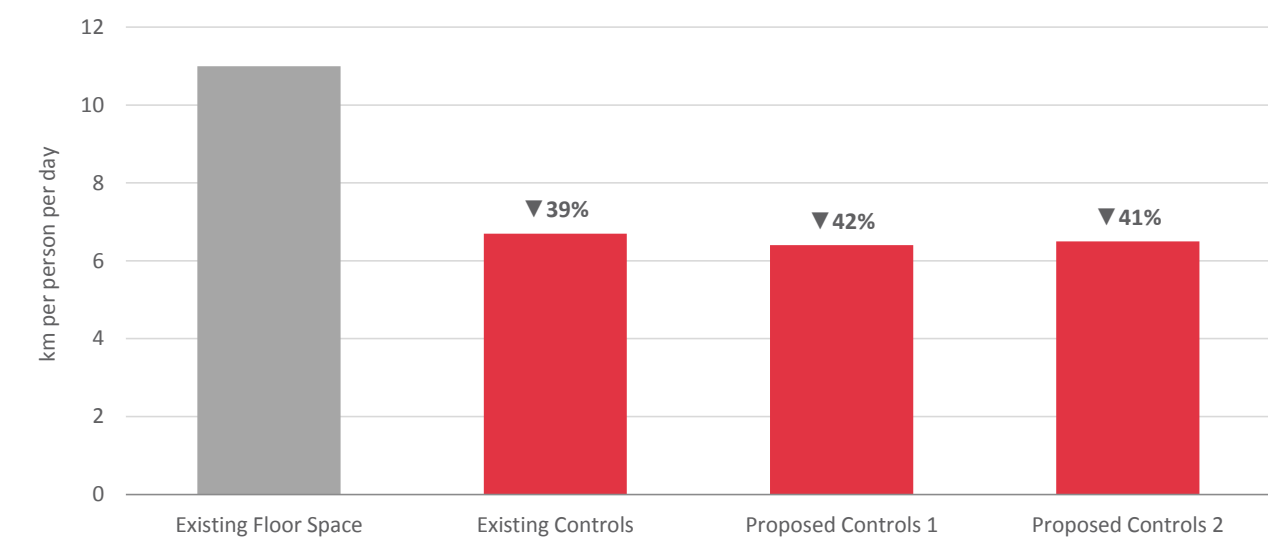


Figure 24: Expected car use for residents living in the study area under various scenarios

CAR SHARE TAKE-UP (% OF HOUSEHOLDS)

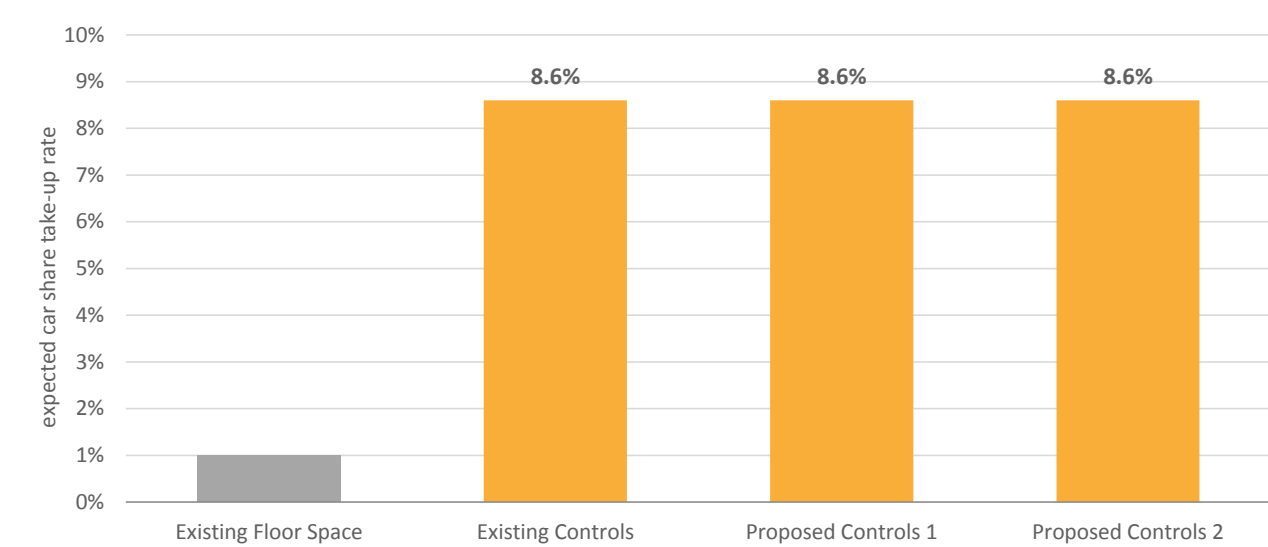


Figure 25: Expected car share take-up (percent of households who would take-up car share) under various scenarios



COST OF LIVING OUTCOMES

Household costs and affordability is often considered only in the context of the cost of housing. However, as shown in the previous section of this report, transport costs associated with car ownership and fuel consumption can be as high as housing costs in Parramatta.

New development can have a significant impact on the cost of transport as well as utility costs for energy and water. For the study area, how buildings are designed will affect household costs related to transport and utilities (energy and water).

To better understand this transport and utility expenditure analysis was undertaken for the study area. This analysis assumed the following:

- Transport costs were calculated based on existing and projected car ownership and travel patterns (car use and public transport use) in the LGA.
- Utility costs were calculated based existing average and projected energy and water consumption for the average household in the LGA, assuming current retail tariffs.

Under the Existing Controls and Proposed Controls, new residents in the Parramatta CBD are expected to spend approximately \$5,500 less per year in transport costs (due to lower car use and expected car ownership rates) and approximately \$150 less in energy and water utility costs (due to BASIX requirements).

KEY FINDINGS

Under a business as usual scenario (assuming current building compliance requirements, such as BASIX, Section J of the building code and existing Council parking ratios are met), the growth across the Parramatta CBD is expected to:

- Triple electricity demand and water consumption
- Increase peak electricity demand by over 100 MW (nearly twice the existing demand)
- Increase sewer loads by nearly 4 times
- More than double parking requirements

However, increased growth is also expected to deliver significant benefits and resident efficiencies. When compared to the existing Parramatta CBD, a new resident living in the study area is expected to:

- Consume 10% less stationary greenhouse gas emissions
- Consume 30% less water
- Drive 40% less
- Save 30% in household operating cost from energy, water and transport (equivalent to approximately \$5,500).

COST OF LIVING

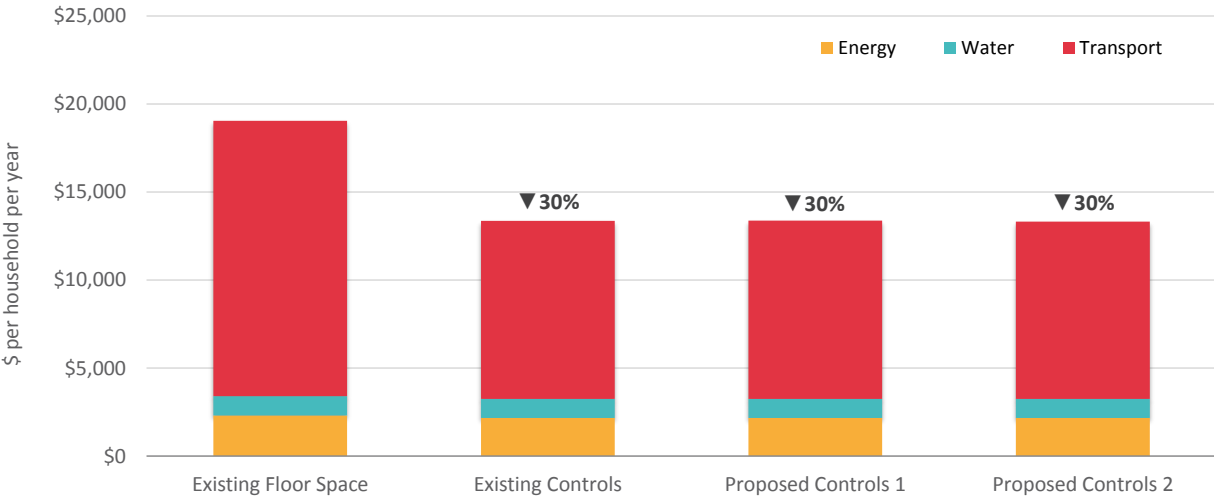


Figure 26: Expected households costs for energy, water and transport under various scenarios.



KEY OPPORTUNITIES AND RECOMMENDATIONS

Based on the findings of this study and the vision and principles that have been identified by Parramatta City Council to guide the development of the Parramatta CBD, Kinesis modelled a series of **Optimised Parramatta CBD growth scenarios** which incorporate a suite of recommendations outlined below.

1. HIGH PERFORMANCE BUILDINGS

High performance building requirements can mitigate this growth and deliver more affordable and sustainable development outcomes.

Compared to a business as usual approach, the delivery of high performance buildings (through increased BASIX targets and NABERS ratings) is expected to deliver:

- **60% reduction in electricity demand**, effectively ensuring no net increase in electricity demand (Figure 27)
- **55% reduction in peak electricity demand**, effectively reducing the need for major electricity infrastructure augmentation (Figure 28)
- **35% reduction in per person stationary greenhouse gas emissions**
- **50% reduction in per person water consumption**

Please note – high performance building outcomes can be delivered through building by building technology and efficiency upgrades and/or precinct level energy and water solutions (see discussion on precinct scale infrastructure below).

We have seen that the development of the Parramatta CBD will require significant energy, water and sewer infrastructure augmentation. The delivery of high performance buildings that use less energy and water will mitigate this impact, reducing development costs and disruption to the CBD. We have also seen that there is an appetite from the development industry to deliver buildings that exceed BASIX and building code compliance. Based on this, it is recommended that Parramatta City Council:

1. Seek mandatory or incentive based higher BASIX targets.

Councils have established planning controls that provide incentives to developments that exceed BASIX compliance. Bankstown Councils LEP 2015, Clause 4.4A provides for a FSR Bonus of 0.5:1 in the Bankstown CBD where developers can demonstrate that commercial buildings achieve 5-star NABERS Energy rating and 4.5-star NABERS Water rating and residential buildings achieve 10-point increase for BASIX Energy and BASIX Water 60 (see Case Study, page 20). For Parramatta City Council, this could be linked to a FSR Bonus proposed for the CBD. Preliminary analysis by Kinesis suggests that new development in the CBD could achieve:

REDUCING ELECTRICITY DEMAND (MWH PER YEAR)

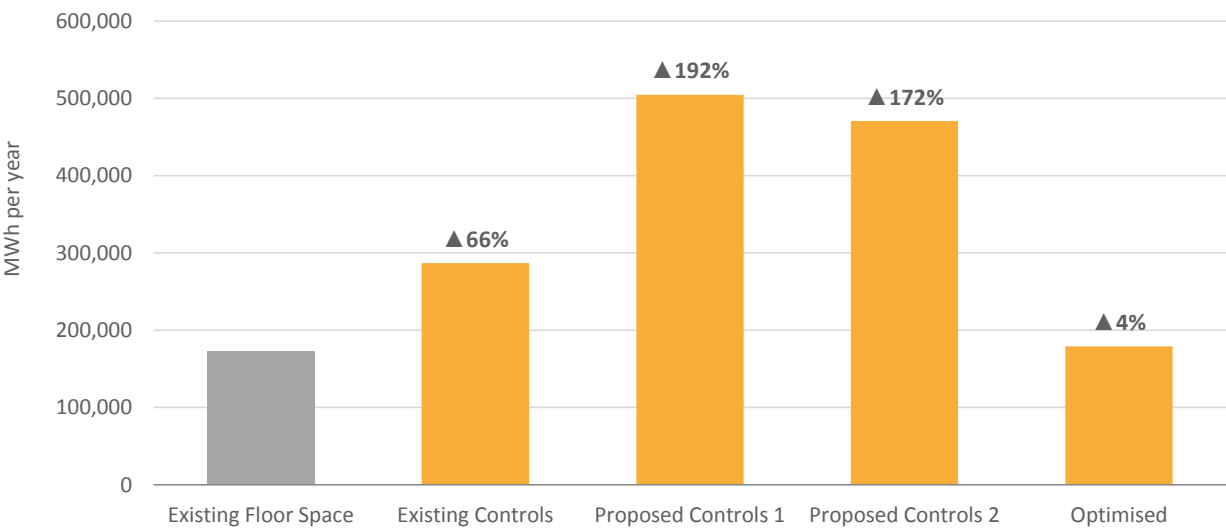


Figure 27: Expected electricity demand under each planning scenario (in comparison to existing demands)

REDUCING PEAK DAY ELECTRICITY DEMAND (MW)

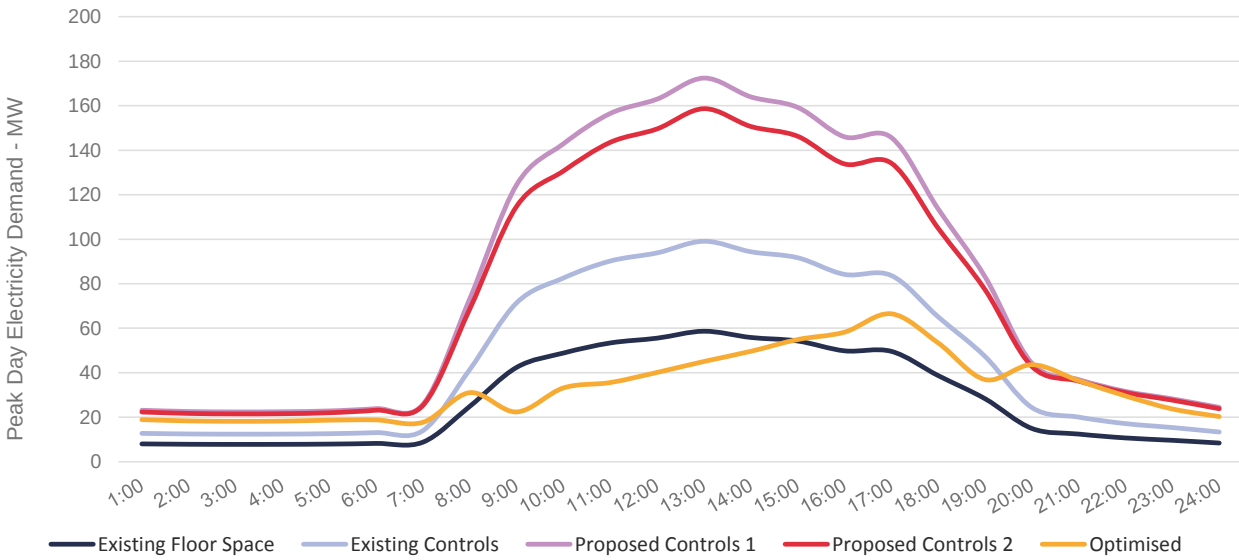


Figure 28: Expected peak day electricity demand profile under each planning scenario as well as under various climate change scenarios.



Residential buildings

- BASIX Energy: increase current targets by up to 20 BASIX points
- BASIX Water: increase the target from 40 to 60 BASIX points

Non-Residential buildings (greater than 2,000 m2)

- NABERS Energy: minimum 5-star performance
- NABERS Water: minimum 5-star performance

Next Steps - Detailed studies and cost-benefit analysis has been undertaken by both the NSW Department of Planning as part of the BASIX Target Review which proposed, for most developments, a 5 to 10 point increase in BASIX Water and Energy targets¹. The City of Sydney also conducted a study on BASIX Energy Targets for multi-unit dwellings proposed a 20 to 25 point increase in BAIX Energy targets².

To ensure appropriate targets are established for the Parramatta CBD, is it recommended that specific building upgrades for new builds in the Parramatta CBD are defined in order to develop quantity surveyor cost estimates for increased residential and non-residential building performance targets.

2. Future proof all new buildings with dual reticulation for recycled water.

Given the 30-100 year life of new buildings in the Parramatta CBD, it would be considered prudent to ensure these assets are future proofed to connect to precinct level recycled water system (see Strategy 2 below). This would require dual reticulation for recycled water for both internal and external uses.

Next steps – Quantity Surveyor cost estimates for cost per m2 for dual reticulation in new development to build the case for establishing the requirement for dual reticulation in all new buildings.

3. Require electric vehicle and battery storage infrastructure in new buildings.

New buildings should consider and plan for the growth of new trends including electric vehicle charging points and space and electrical wiring to enable battery storage in the future.

Next steps – define the technical specifications for EV and battery “ready” solutions in new buildings and determine cost estimated with quantity surveyor.

CASE STUDY - LINKING ENVIRONMENTAL PERFORMANCE TO DEVELOPMENT INCENTIVES

Clause 4.4A of Bankstown Local Environmental Plan (LEP) 2015 provides for Floor Space Ratio (FSR) Bonus of 0.5 on the FSRs allowed under the Local Area Plan for the Bankstown CBD on the condition that they achieve the following environmental design standards:

Residential component of a building:

- Energy target is a minimum 10-point increase in the BASIX score compared to current requirements.
- Water target is a minimum BASIX 60.

Non-Residential component of a building:

- Energy target is a maximum 135 kg of CO2/m2 per year (equivalent to a 5-star NABERS rating for commercial buildings)
- Water target is a maximum 0.47 kL/m2 per year for office (equivalent to a 4.5-star NABERS rating for commercial buildings)

As the FSR Bonus will increase the size of new buildings this will lead to increased environmental impact, in terms of increased greenhouse gas emissions from energy consumption and increased water consumption. The environmental performance standards established by Council seek to offset the impact of the increased floor space so that buildings which receive the FSR Bonus have the same environmental performance as buildings which do not.

¹ <http://www.basix.nsw.gov.au/basixcms/images/4050pdfs/BASIX-Target-Review-supporting-research.pdf>

² http://planspolicies.planning.nsw.gov.au/?action=view_submission&job_id=6332&submission_id=92318



2. RESILIENT INFRASTRUCTURE AND PUBLIC DOMAIN

Recycled water integrated with public domain improvements will provide a more resilient and cooler urban experience. This could be delivered as an Integrated Utility Solution incorporating both precinct water and energy solutions.

Compared to a business as usual approach under the proposed controls, the combination of this strategy is expected to deliver:

- **50% reduction in water consumption**
- **30% reduction in sewer**, delivered through the recycled water system
- **Significant reductions in urban heat island**, delivered through the improved public domain

No new additional green space (public parks) are proposed as part of the Parramatta CBD growth. This places even more importance on increasing street tree and building façade ‘greening’ to deliver a cooler urban environment that is more pleasant and walkable on hot summer days.

Left to chance, the Parramatta CBD experience an increase in days over 35 degrees, exacerbated by the urban heat island due to the increased development in the CBD. To ensure a more active and resilient CBD environment for both residents, workers and retail activity, the following is recommended:

1. Parramatta CBD incorporates green streets in key pedestrian and retail activity areas.

Significant, additional greening is delivered through increased street tree canopy and green walls throughout the CBD. This green public domain is linked to the delivery and management of the recycled water system.

2. Recycled water is enabled throughout the Parramatta CBD.

All new building incorporate dual reticulation for recycled water for both internal and external uses. Such a requirement would significantly enhance the business case for a recycled water scheme. Recycled water will deliver unlimited water to irrigate the increased green canopy and green facades throughout the CBD, as well as significantly reducing any sewer infrastructure upgrades required.

Next steps – Quantity Surveyor cost estimates for cost per m2 for dual reticulation in new development to build the case for establishing the requirement for dual reticulation in all new buildings.

3. Parramatta City Council seeks collaboration with a utility to develop and manage recycled water.

Both public and private utilities can develop and manage the delivery of recycled water across the Parramatta CBD. However, without coordination with development and infrastructure delivery, a business as usual approach to water and sewer connection is expected. Parramatta City Council is in a unique position to coordinate and enable a precinct level recycled water scheme and ensure new buildings are configured to connect to this system.

In addition, due to the link between the business case for recycled water and irrigation demands, it is proposed that this partner is also involved in the management of improved public domain (see Case Studies, Page 22).

REDUCING WATER CONSUMPTION (ML PER YEAR)

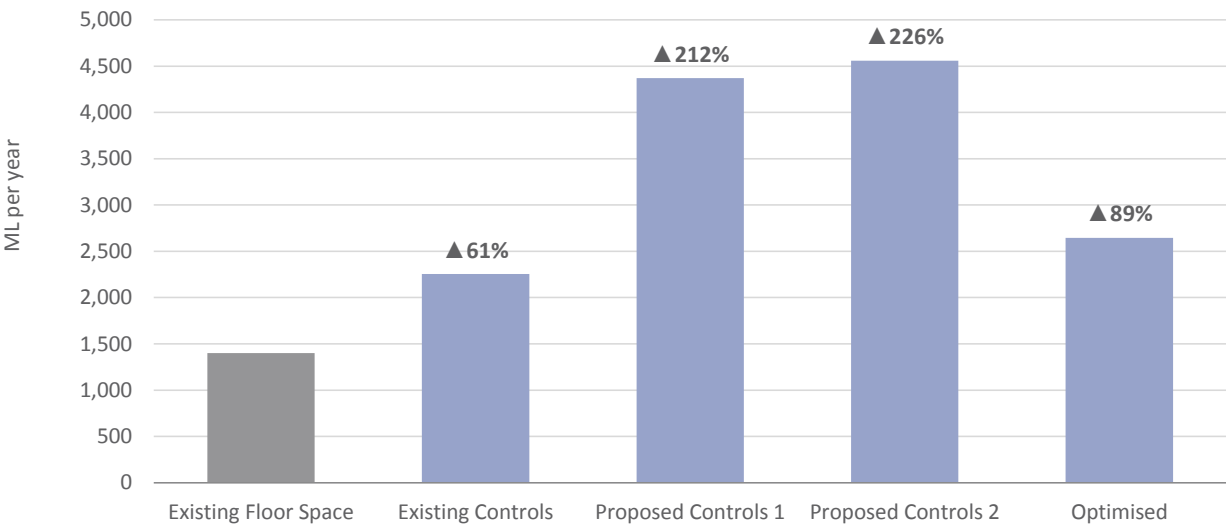


Figure 29: Expected water demand under each planning scenario (in comparison to existing demands)

REDUCING SEWER LOADS (ML/YEAR)

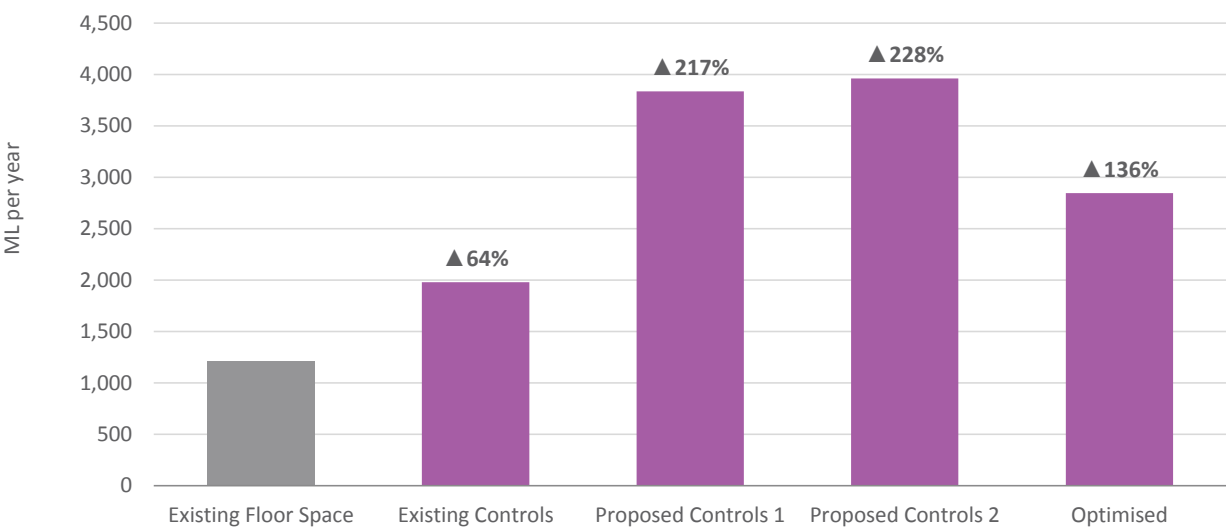


Figure 30: Expected sewer loads under each planning scenario (in comparison to existing demands)



4. Parramatta City Council plan for and coordinate infrastructure augmentation to reduce disruption to the CBD.

We have seen that the development of the Parramatta CBD will require significant energy, water and sewer infrastructure augmentation. The delivery of high performance buildings and recycled water will mitigate this impact. However, some infrastructure augmentation is inevitable and to ensure this augmentation is done in an efficient and timely manner it is recommended that Parramatta City Council work closely with both private (as required) and public utilities to coordinate this to ensure minimum disruption to streets and associated retail activity.

5. Precinct Scale Energy Infrastructure

It is clear that there are benefits to be explored by coupling district energy solutions with district water recycling in CBD development areas. The analysis for high performance buildings was done agnostic of the way energy services are delivered, i.e. building by building or precinct solutions (or combinations of both). It would be considered prudent to ensure that given the 30-100 year life of these urban assets that they are designed to accommodate district energy to future proof their owners and tenants against a rapidly changing energy services environment. There are clear examples globally where significant buildings are required to install appropriate services and plant space for ground or roof connection to accommodate the energy services provider of tomorrow.

Next steps for the Delivery of Precinct Scale Energy and Water

Additional planning and analysis on the delivery of precinct infrastructure could be undertaken through the development of an Integrated Utility Master Plan. The development of a Master Plan creates a vision and attracts interest from both public and private utility providers.

However, it is the opinion of Kinesis that the urgency and risk associated with the delivery of infrastructure to the Parramatta CBD is better managed through a more collaborative process that clearly outlines Councils role in the delivery of community infrastructure. To achieve this, it is recommended that Council establish and publish a set of commitments and standards that Council could provide to a public or private utility if the right performance outcomes are achieved. These standards or commitments could include opportunities to use Council land or assets (such as car parks) and dual reticulation requirements in new developments.

Given the learnings from the City of Sydney and Parramatta City Council's recent Parramatta Square development, this document should establish the next set of engagement and collaborative strategies between local governance and community infrastructure delivery.

CASE STUDIES – RECYCLED WATER AND URBAN GREEN SPACE

Precinct scale recycled water systems are currently in operation in two locations across Sydney:

1. **Central Park**, currently supplying 1,400 customers with water for irrigation, toilet flushing and laundry use. A private water utility operates and maintains all water related infrastructure across the precinct. The recycled water system is housed in a Local Water Centre, built over four basement levels under the residential buildings. For more information see flowsystems.com.au/communities/central-park-water.
2. **Discovery Point**, is designed to serve 1,800 apartments, capturing 100% of wastewater from the apartments and non-residential and used for irrigation, toilet flushing and laundry as well as adjacent council parks and sporting fields. For more information see www.metrowater.nsw.gov.au/recycling/australand-discovery-point-wolli-creek.





3. STRATEGIC PARKING MANAGEMENT

Reduced parking rates alongside decoupled parking will improve development feasibility and deliver a more pedestrianised and future proofed CBD.

Compared to a business as usual approach, the combination of this strategy is expected to deliver:

- 50% reduction in car use (Figure 31)
- Enabling significant opportunities for investment in car share for improved mobility choice (Figure 32)
- 40% reduction in household operating costs from energy, water and transport, equivalent to a household saving of over \$5,000 per year (Figure 33)

The development of Parramatta’s CBD must plan for and adapt to trends in car ownership rates. Given the 30 to 100 year life of new buildings, we are at risk of developing underground parking that, in 10 to 20 years’ time, may be a worthless asset. Studies have already identified an oversupply of parking in accessible locations.

The RMS update to Guide to Traffic Generating Developments (2013) surveyed 10 high-rise residential buildings around Sydney that were close to public transport, greater than six storeys and almost exclusively residential in nature. While only a small sample, this survey showed an oversupply of car parking compared to demonstrated demand for car parking in all the surveyed high-density residential buildings³.

Based these trends, it is recommended that Parramatta City Council:

1. Reduce parking rates across the CBD and across all building typologies by 50%.

It is recommended that, on average, current parking ratios are reduced by 50% (refer Table 4, p17). The benefits of reduced parking rates in new development is clear:

- Reduced vehicle traffic in the CBD.
- Lower construction costs associated with excavation and construction of underground parking.
- Reducing parking by 1 space per dwelling could equate to \$50,000 to \$70,000 off the sales price of a new apartment.
- Less energy demands for parking lighting and ventilation equates to lower compliance costs with BASIX Energy Targets and lower energy costs and strata fees for an apartment body corporate.
- The reduction in parking provides a business case for private investment in the provision of car share.

³ RMS (2013) Updated Traffic Surveys, <http://www.rms.nsw.gov.au/trafficinformation/downloads/td13-04a.pdf>

DELIVERING A LOW CAR USE CBD

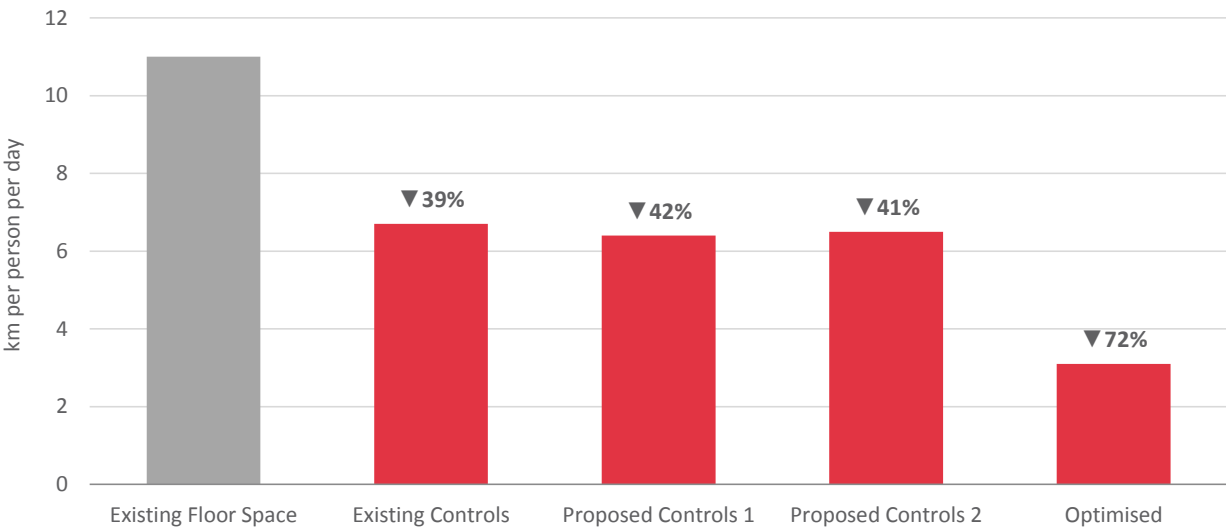


Figure 31: Expected car use for residents living in the study area under various scenarios

ENABLING MOBILITY CHOICE THROUGH CAR SHARE

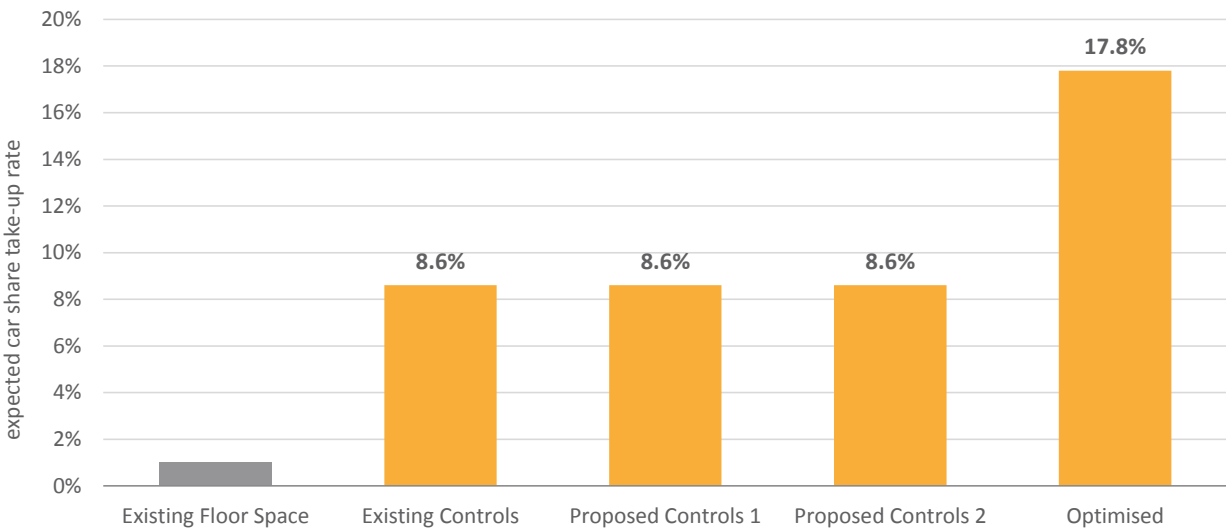


Figure 32: Expected car use for residents living in the study area under various scenarios

2. Enable on-site parking to be decoupled from the building lot (delivered through a centralised parking station or through parking available on another site).



To mitigate the risk of providing low off-street parking ratios, decoupled, adaptable and temporary car parking strategies are recommended.

Council or privately owned and operated parking stations at the periphery of the precinct (as opposed to the centre of the precinct) would address short term parking needs and to reduce the need for individual developments to supply car parking on-site and minimise the impact of traffic in order to deliver a highly pedestrianised precinct. This could be funded by a development fee in lieu of providing parking on-site.

3. **Enable a CBD Parking Trading Scheme to manage new parking requirements with under-utilised parking across the CBD**

To ensure the most efficient use of existing and new parking across the CBD, it is proposed that a CBD Parking Trading Scheme is establishing by Parramatta City Council. Similar to a floor space trading scheme, this scheme would allow and encourage new developments to seek decoupled parking from existing under-utilised parking across the CBD.

Next Steps: The recent parking survey undertaken by Council identifies parking utilisation at a block by block level across the CBD. It is recommended that further analysis of this data is undertaken to:

- Inform existing potential parking that could be used for new development
- Establish rules and requirements for the Parking Trading Scheme.

It is proposed that the Parking Trading Scheme is managed by Parramatta City Council through a web-based portal which matches supply and demand for parking across the precinct.

4. **Provision of End of Trip Facilities in Commercial Buildings**

To complement lower parking rates and facilitate increased active transportation options, it is proposed that end of trip facilities are encouraged in new commercial development across the Parramatta CBD. To encourage this, it is recommended that end of trip facilities are excluded from the floor space ratio (FSR) calculation). In effect, commercial premises that incorporate end of trip facilities are eligible for additional floor space equal to the floor space provided for end of trip facilities. An example of this type of provision is Clause 6.6 of the City of Sydney LEP 2012.

5. **Develop a plan to transition Parramatta City Council parking station assets over time.**

As the Parramatta CBD develops, existing and future Council above-ground parking assets should be managed as transitional and adaptable multi-use spaces that could house decoupled parking, precinct energy or water infrastructure as well as open space.

New Council parking assets should be built to enable this asset for adaptable use over time, including increasing floor to ceiling heights to transition parking to other residential, commercial or retail uses.

The emergence of autonomous vehicles will further reduce the need for parking and investment in underground parking, in particular, may lose value as an asset as vehicles no longer need to be parked or housed at origin or destination locations. The recommendations in this report seek to minimise underground parking and the emergence of autonomous vehicles should further support the approach to more flexible and agile parking structures that can be adapted over time.

COST OF LIVING

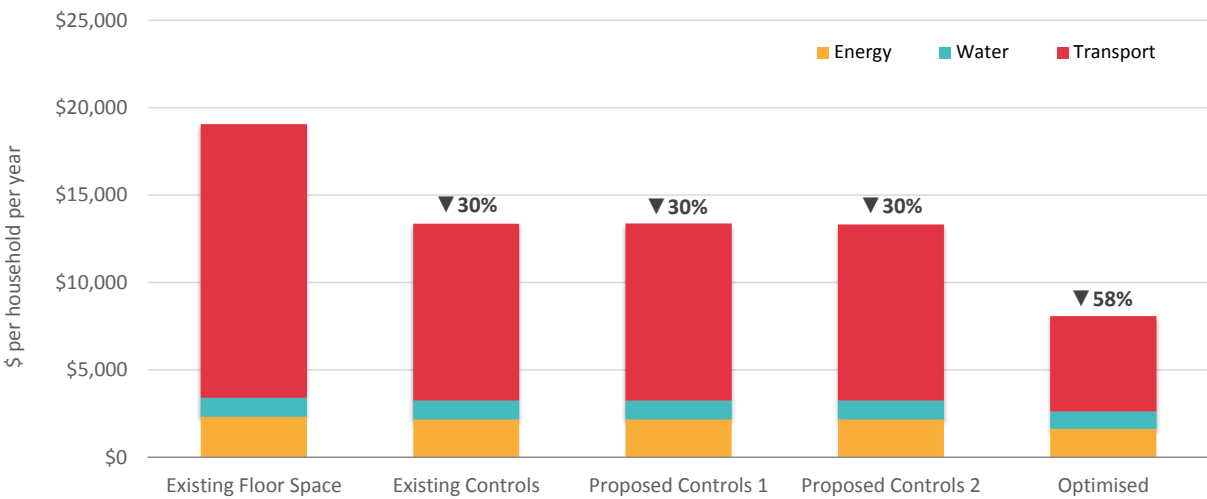


Figure 33: Expected households costs for energy, water and transport under various scenarios.

Note – Energy and water cost savings delivered from High Performance Building strategies is also shown in this graph. Under the Optimised Scenario, new residents in the Parramatta CBD are expected to spend approximately \$10,000 less per year in transport costs (due to lower car use and expected car ownership rates) and approximately \$750 less in energy and water utility costs (due to high performance building requirements).



SUMMARY OF RECOMMENDATIONS AND NEXT STEPS

The following table summarises the benefits, implementation mechanisms and next steps for each recommendation discussed above.

RECOMMENDATION	DETAILS	POTENTIAL BENEFIT	POTENTIAL IMPLEMENTATION MECHANISM	RECOMMENDED NEXT STEPS
High Performance Buildings	- Increased BASIX targets for residential dwellings. - Increased performance targets (e.g. NABERS) for non-residential buildings. - Dual reticulation in all buildings. - Battery and EV ready buildings.	- No net increased in electricity demand - Less need for major peak electricity upgrades - Reduction in stationary greenhouse gas emissions and water consumption - Reduction in energy and water utility costs	- NSW Department of Planning BASIX - Parramatta City Council Design Excellence guidelines - LEP for dual reticulation and EV/battery ready requirements	- Meet with NSW Department of Planning regarding increased BASIX targets whether mandatory or enabled through LEP FSR Bonus scheme. - Quantity Surveyor cost estimates for increased BASIX targets, dual reticulation and EV/Battery storage ready requirements. - Consider the use of the Design Excellence process to capture non-BASIX sustainability requirements.
Resilient Infrastructure and Public Domain	- Recycled water integrated with public domain improvements will provide a more resilient and cooler urban experience. - Could be delivered as an Integrated Utility Solution incorporating both precinct water and energy solutions.	- Reduction in water consumption - Reduction in sewer, delivered through the recycled water system - Significant reductions in urban heat island, delivered through the improved public domain	Collaboration with public or private integrated utility and public domain management plan.	- Meet with utilities to discuss key infrastructure demands and constraints in the CBD and augmentation plans. - Establish Council commitments and performance standards for integrated utility partnership/collaboration for public domain management and maintenance. - Develop coordinated infrastructure augmentation plan.
Strategic Parking Management	- Reduce existing parking rates by 50%. - Enable on-site parking to be decoupled from the building lot. - Enable a CBD Parking Trading Scheme. - Provision of End of Trip Facilities in Commercial Buildings.	- Responding to key trends. - Reduction in parking requirements and associated car use. - Enabling significant opportunities for investment in car share. - Reduction in household costs.	- LEP for revised parking ratios and car share allowances. - LEP to enable decoupled parking allowances. - LEP for end of trip facility floor space allowance.	- Establish Parking Trading Scheme. - Develop a plan to transition Parramatta City Council parking station assets over time.

Table 5: Summary of recommendations and next steps.



KEY ASSUMPTIONS

Metropolitan Sydney average benchmarks

Electricity	2,132 kWh per person/year
Gas	3,888 MJ per person/year
Water	237.8 L per person/day
Transport	19.98 km per person/day

Tariffs and rates

Household cost savings outlined in this report are based on current tariffs outlined below:

Residential Water	Rate	Unit
Mains tariff	2.232	\$/kL
Recycled water tariff	2.068	\$/kL
Service charge per dwelling	765	\$/yr
Recycled water service charge	0	\$/yr
Residential Grid Electricity	Rate	Unit
Applied tariff	0.2514	\$/kWh
Solar feed-in tariff	0.06	\$/kWh
Service charge per dwelling	289.16	\$/yr
Residential Gas	Rate	Unit
Gas (first 3,775 MJ per qtr/remaining)	0.041/0.023	\$/MJ
Service charge per dwelling	207	\$/yr
Residential Transport	Rate	Unit
Fuel	1.50	\$/L
Annual capital costs (devaluation)	6,642	\$/yr
Annual registration/insurance	2,172	\$/yr

KEY DATA SOURCES

- ACADS-BSG Australian Climatic Data (Reference Meteorological Year, RMY) for hourly temperature, insulation and humidity.
- Bureau of Meteorology local rainfall and evaporation data
 - Data is from the representative weather station for the local climate zone
 - The RMY (Representative Meteorological Year) is synthesized from a composite of 12 typical meteorological months that best represent the historic average of the specified location using post-1986 data in addition to the earlier weather data for each of the 69 climate zones in Australia.
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