APPENDIX 3

West Appin Strategic Infrastructure Investigation
Reports as follows:

- Preliminary Traffic and Transport Model (prepared by WSP Parsons Brinkerhoff)
- Infrastructure Servicing Strategy (prepared by civil engineering firm BG&E)
- Social Infrastructure Assessment (prepared by Elton Consulting)
- Business case (prepared by Elton Consulting)

West Appin—

Infrastructure Servicing High Level Investigation

FOR / Civil Engineering Services

CLIENT / Elton Consulting

DOCUMENT NO / S14041-REP-A-001 REV / D DATE 18/03/2015

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Document *Control*

Revision	Date	Description	Prepared	Reviewed	Approved
C	17/12/14	Draft	PH	PH	
D	18/03/15	Preliminary Issue	PH	PH	

EXECUTIVE SUMMARY

The West Appin Investigation Area lies between the villages of Appin and Douglas Park and comprises land currently used for rural or rural residential purposes. West Appin forms part of the Macarthur South Investigation Area for a future Growth Centre.The proposed West Appin development represents an opportunity to create an estimated 15,500 to 18,000 new dwellings over the next 40 years

Initial transport modelling (Parson Brinkerhoff) suggests 15,500 additional dwellings could be accommodated within the West Appin development area. Further investigations of the Macarthur South Area for a future Growth Centre should refine the ultimate number of additional lots that could be developed at West Appin.

The proponent has consulted with Sydney Water Corporation (SWC), Endeavour Energy (EE) and Sydney Catchment Authority, copies of correspondence received from SWC and EE are attached at Appendix B. It is evident that whilst there is limited capacity in the existing infrastructure networks, sufficient for only the early stages, there are no identified physical constraints to the amplification or augmentation of existing infrastructure or the implementation of new infrastructure. Opportunity exists for the orderly development of infrastructure services to meet the needs of the development.

Appropriately, the funding for the additional infrastructure capacity is not currently budgeted, however, the funding of infrastructure could be resolved with the release of West Appin land in isolation or as part of a future Macarthur South Growth Centre for development. The issue of funding infrastructure within current five year budget programs can be dealt with under the mechanism of Commercial Agreements.

Opportunities exist for service authorities to deal with wider sub regional infrastructure issues in conjunction with the West Appin project as part of the investigation of the future Macarthur Growth Centre.

An outline of the existing and required infrastructure for West Appin is:

Infrastructure	Existing	Required
Water	Limited capacity in existing system	Initial minor upgrades to distribution systems. Staged upgrades to existing Filtration plant and augmentation of existing reservoir system
Recycled Water	None	Utilisation of recycled water to reduce potable demand and reduce surplus of treated water requiring disposal. Creation of new distribution system
Waste Water	Some existing capacity requires construction of a transfer main to Glenfield-Malabar system	New STP either Sydney Water or WICA
Electricity	Capacity for up to 800 lots	Additional infrastructure required staged over life of the development, no physical impediments
Gas	Available in Appin	Augmentation required to meet staged and ultimate needs
Telecommunications	NBN available in Appin	Augmentation required to meet staged and ultimate needs

Table 1 –Existing and Required Service Infrastructure

The costs associated with the service infrastructure upgrades for West Appin are:

Stage	Total Development Yield	Timing	Potable Water	Recycled Water	Waste water	Electricity	Gas	Stormwater	TOTAL
Stage 1 & 2	**4,000 dwellings**	2016-2021	$22m	$21m	$8m	$60m	Commercial Arrangement with Gas provider	Developer funded – Directly with development or under s94 plan	**$111m**
Stage 3 & 4	+ 6,000 dw (**10,000 dw**)	2022-2031	$13m	$44m	$30m	$50m			**$137m**
Stage 5 & 6	+ 5,000 dw (**15,000 dw**)	2032-2041	$15m	$25m	$30m	$10m			**$80m**
Stage 7 & 8	+ 3,000 dw (**18,300 dw**)	2042-2051	$13m	$21m	$10m	$0m			**$44m**
TOTAL	**18,000 dwellings**		**$63m**	**$111m**	**$78m**	**$120m***			**$372m**
Trunk Cost Per Dwelling			**$3,500**	**$6,167**	**$4,333**	**$6,667**			**$20,667**

Table 2 –Infrastructure Upgrade Costs

*$120m is the estimated headworks costs to be funded by Endeavour Energy for the Bulk supply of Electricity in the establishment of Trunk mains and zone substations

Further development in the vicinity of the West Appin land, part of a future Macarthur South Growth Centre would face similar start up infrastructure constraints. Notwithstanding, a future Macarthur South Growth Centre would provide the critical mass to establish a regional Wastewater Treatment facility with economy of scale and the opportunity to potentially release capacity, or delay upgrades at the Glenfield Wastewater Treatment Facility, which has around 11,000 dwellings of remaining capacity in its current configuration.

With respect to road infrastructure, the existing network has been assessed as operating at Levels of Service D or better. However, implementing the State Government population and employment forecasts only, and assessing the road network in 2036 the following road are found to require upgrades or new construction:

Upgrades

- Appin Road between Narellan Road and Appin Village.
- Appin-Bulli Road between the M1 Motorway and Appin Village.
- Wilton Road between Picton Road and Appin village.
- Picton Road east of the Hume Motorway.
- Narellan Road.
- Camden Valley Way.
- The Northern Road.
- Hume Motorway / Picton Road interchange.

New Construction:

- Spring Farm Parkway:

    - Construct interchange with Hume Motorway.
    - Construct arterial road to/from west of Hume Motorway.
    - Construct arterial road between Hume Motorway and Appin Road.
- M9 Outer Sydney Orbital
    - Construct interchange with Hume Motorway.
    - Construct motorway to/from west of Hume Motorway.
    - Construct motorway between Hume Motorway and Appin-Bulli Road.

Development of the West Appin site, in isolation or in conjunction with a future Macarthur South Growth Centre, creates the need for further road upgrades. The ultimate road network requirements for a future Macarthur South Growth Centre, Parsons Brinckerhoff have assessed the following roads, in addition to those outlined above, to require upgrades or new construction:

- North-South Link Road, located between and parallel to Hume Motorway and Appin Road, linking West Appin and Spring Farm Parkway.

The estimated costs of the required road upgrades are outlined in table 72 below, costs have been separated into two categories:

- infrastructure that is identified as required to deal with background growth, National route significance and having a significant benefit to the existing users and road network
- infrastructure that is only required because of the development of West Appin, and a future Macarthur South Growth Centre

Further refinement of the infrastructure requirements scope and staging should be undertaken with the investigations into the future Macarthur South Growth Centre. The required road infrastructure will be able to be staged to occur as demand increases over time.

Based on the development related works, it is anticipated that a cost of road infrastructure per dwelling of between $20,000 and $25,000 would be required, which could be levied under a similar arrangement as currently applies in the Western Sydney Growth Centres.

Road Infrastructure Requirements	2036 (Background Growth, Existing Development Benefit and National Highway) Cost of Works	2036 (With West Appin and Macarthur South) Cost of Works
Hume Highway	$225,880,000	$0
Spring Farm Parkway Interchange and upgrade between Spring Farm Parkway and Narellan Road	$65,650,000	$0
Moreton Park Road Interchange and upgrade between Moreton Park Road to Spring Farm Parkway	$93,670,000	$0
M9 Interchange and upgrade M9 between M9 and Moreton Park Road	$66,560,000	$0
Appin Road	$63,250,000	$66,550,000
Spring Farm Parkway Intersection and upgrade between Spring Farm Parkway and Narellan Road	$6,000,000	$24,100,000
Appin Bypass Intersection and upgrade between Appin Bypass and Spring Farm Parkway	$25,900,000	$42,450,000
Between Appin-Bulli Road Interchange with M9 and Appin Bypass	$31,350,000	$0
Appin Bypass	$54,600,000	$0
M9 to Appin Road Bypass Interchange	$54,600,000	$0
M9 - Outer Sydney Orbital	$199,600,000	$83,600,000
Hume Highway to Appin-Bulli Road	$199,600,000	$83,600,000
Wilton Road	$48,262,500	$128,667,500
Appin-Bulli Road Intersection to Almond Street	$48,262,500	$128,667,500
Spring Farm Parkway	$76,959,000	$0
Between Hume Highway and Appin Road	$76,959,000	$0
North South Link Road	$0	$166,207,000
Between Spring Farm Parkway and LGA Boundary	$0	$166,207,000
Between LGA Boundary and M9	$0	$46,259,000
Moreton Park Link Road	$0	$102,608,000
Between Moreton Park Road Interchange and Appin Road	$0	$102,608,000
	$668,551,500	$593,891,500
Assuming 24,000 lots in a future Macarthur South Growth Centre		
Rate per lot (dwelling)		$24,745

Table 3 –Road Infrastructure Upgrade Costs

1 INTRODUCTION

1.1 Objective of this report

This report has been prepared for a landowner group comprising Walker Corporation, Mir Group and Ingham Rural Property Group, which is seeking to initiate high level assessment to inform the strategic infrastructure strategy for land at West Appin. The report presents the outcomes of a high level investigation into essential services infrastructure requirements for West Appin, based upon a potential yield of up to 18,000 dwellings and associated employment lands.

This investigation has been undertaken in accordance with the Terms of Reference issued by the Department of Planning and Infrastructure, now NSW Department of Planning and Environment (DP&E), which is seeking to ensure that there are no threshold issues that would prevent the development of West Appin, prior to committing to a joint master planning process. DP&E has issued Terms of Reference for the Strategic Infrastructure Investigation.

This report is one of three reports:

- Infrastructure Servicing High Level Investigation;
- Strategic Investigation of Social Infrastructure Requirements;
- Transport Assessment,

that inform the business case and are submitted in accordance with the Terms of Reference.

The Terms of Reference state:

1. The Proponent will prepare a High Level Investigation & Business Case to determine, at a strategic level the required infrastructure, servicing, staging and cost. The proponent investigation may be considered as an input into a broader infrastructure investigation for West Appin and surrounds to by lead by the DP&I. The investigation is required prior to any further consideration of a proposed rezoning of land for urban purposes at West Appin.

Appendix A outlines the items addressed in each of the reports, this report addresses the following elements from the Terms of Reference

2. The proponent investigation will document the existing infrastructure services and condition at West Appin including:
    - Transport conditions on the surrounding road network (including but not limited to the State Roads with a particular focus on intersections, important local council roads, and bus and rail services, stations and interchanges);
    - Stormwater detention and treatment for water quality (including infrastructure maintenance for future Council assets);
    - Public and private school services (primary and secondary);
    - Community health and hospital services;
    - Emergency services infrastructure including Fire, Rural Fire Service, Ambulance, Police and SES;
    - Recreational and sporting needs; and

- **Essential services (potable water; Sewage treatment and disposal of effluent; Recycled water and water reuse if proposed; Electricity; Gas; and telecommunications).**

3. The proponent investigation will detail the infrastructure required to service the ultimate development, including:

    - Road upgrades and augmentation for access and capacity generated by the development with due regard to the need for the maintenance of higher speed key freight routes through the area;
    - Public transport;
    - Stormwater detention and treatment for water quality (including infrastructure maintenance for future Council assets);
    - Public and private school services (primary and secondary);
    - Community health and hospital services;
    - Emergency services infrastructure including Fim, Rural Fire Service, Ambulance, Police and SES;
    - Recreational and sporting needs;
    - **Essential services (Potable water; Sewage treatment and disposal of effluent; Recycled water and water reuse if proposed; Electricity; Gas; and telecommunications)**

6. The investigation will broadly outline an infrastructure delivery strategy identifying major infrastructure requirements and the related development thresholds which trigger their delivery, provide details of proposed staging of works, costs and Net Present Value cash flows for the life of the release area.

9. The Proponent will consult with Wollondilly Council, the relevant public authorities and service providers as necessary to inform its investigation and confirm the specific scope requirements of each agency. The relevant public authorities and service providers are listed as follows:

    - Transport for NSW
    - Roads and Maritime Services
    - Sydney Water Corporation
    - Department of Education and Communities
    - NSW Ministry of Health
    - Housing NSW
    - Fire & Rescue NSW
    - Rural Fire Service
    - Police Property Group
    - Ambulance Service of NSW
    - Department of Justice & Attorney General
    - State Emergency Service
    - Endeavour Energy & Transgid

1.2 Staging objectives

The following objectives have underpinned the preparation of a staging plan for development at West Appin to ensure the efficient roll out of infrastructure and to maximise the delivery of housing and jobs:

- **Coordinated delivery.** The Landowners Group will work together and with Government (State and Local) to bring forward integrated land development and coordinated infrastructure delivery.
- **Realistic lot and dwelling production.** Of a potential total of 2500 dwellings per year in South West Sydney, lot and dwelling production in West Appin will be able to deliver 20% of this market, or produce a maximum of 550 lots per annum.
- **Equal opportunity for market entry.** The Landowners Group proposes to allow equal and coordinated opportunity for market entry across the development to stimulate competition and to ensure integrated infrastructure delivery (e.g. road access and connections).
- **Best used of pre-existing and committed investment in infrastructure**. Enabling infrastructure at Appin will support development to between 2,300 and 4,000 dwellings, (in approximately 2021) and various utilities can be augmented to support considerable additional development at minimal cost.
- **Efficient roll out of infrastructure for Government**. The trunk infrastructure staging has been completed in what we believe to be the most efficient manner. The provision of multiple development fronts allows the lead in costs to be borne by the developers with no additional cost to Government.

1.2.1 Development Yield

The development and construction of housing is proposed to be staged over the next 40 years as set out in the table below. Based on preliminary investigations infrastructure is able to support up to 18,000 dwellings on the West Appin land, preliminary transport modelling indicates, when West Appin is considered in isolation up to 15,500 dwellings could be accommodated.

It is noted that investigation of Macarthur South as a future Growth Centre, will allow the overall regional road network to be considered in a coordinated manner. The Macarthur South investigations will provide refinement to the analysis of the capacity of the regional road infrastructure to support and funded where required by development.

Stage	Total Development Yield	Timing
Stage 1 & 2	**2,300-4,000 dwellings** (dw)	2021
Stage 3 & 4	+ 6,000 -6,350 dw (**8,650-10,000 dw**)	2031
Stage 5 & 6	+ 5,000 - 5,850 dw (**14,000-15,000 dw**)	2041
Stage 7 & 8	+ 1,000-3,500 dw (**15,500-18,000 dw**)	2051
TOTAL	**15,500-18,000 dwellings**	

Table 4 -Dwelling and Population Growth

For the purpose of this Infrastructure Servicing High Level Investigation, the upper limit development yield has been adopted, as a worst case infrastructure provision requirement. Any reduction in the infrastructure requirements would have create an overall reduction in the infrastructure funding requirements.

With respect to Transport and Road Infrastructure, the transport models and infrastructure requirements were becoming inefficient when considering West Appin in isolation beyond 15,500 dwellings. It is expected that further refinement of the Transport Infrastructure models will occur as part of the investigation of the Macarthur South area as a future Growth Centre.

Further modelling may find that infrastructure upgrades to support 18,000 dwellings become efficient when considered in the context of the broader future Growth Centre.

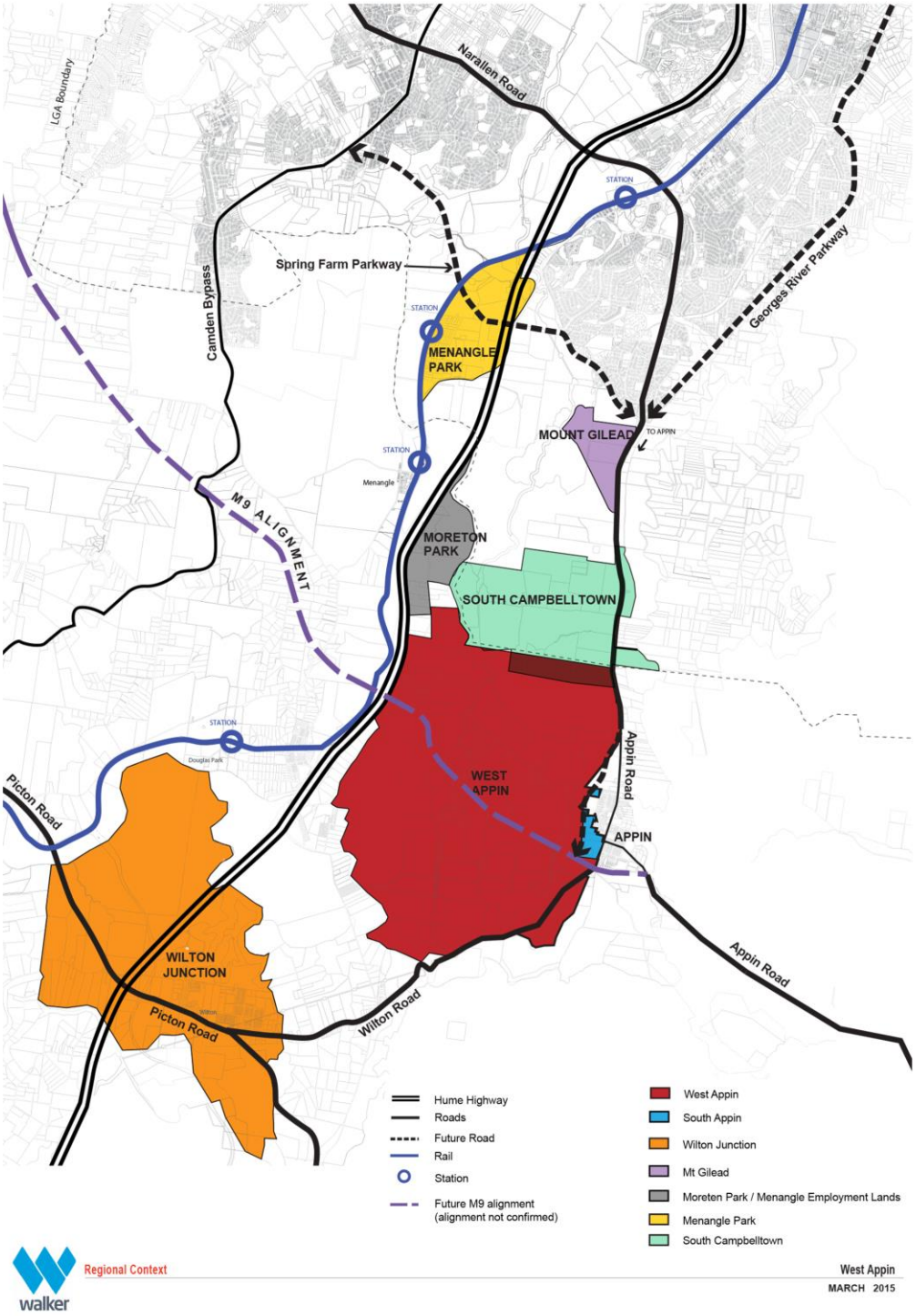


Figure 1 West Appin – Regional Context (Source:Walker Corporation)

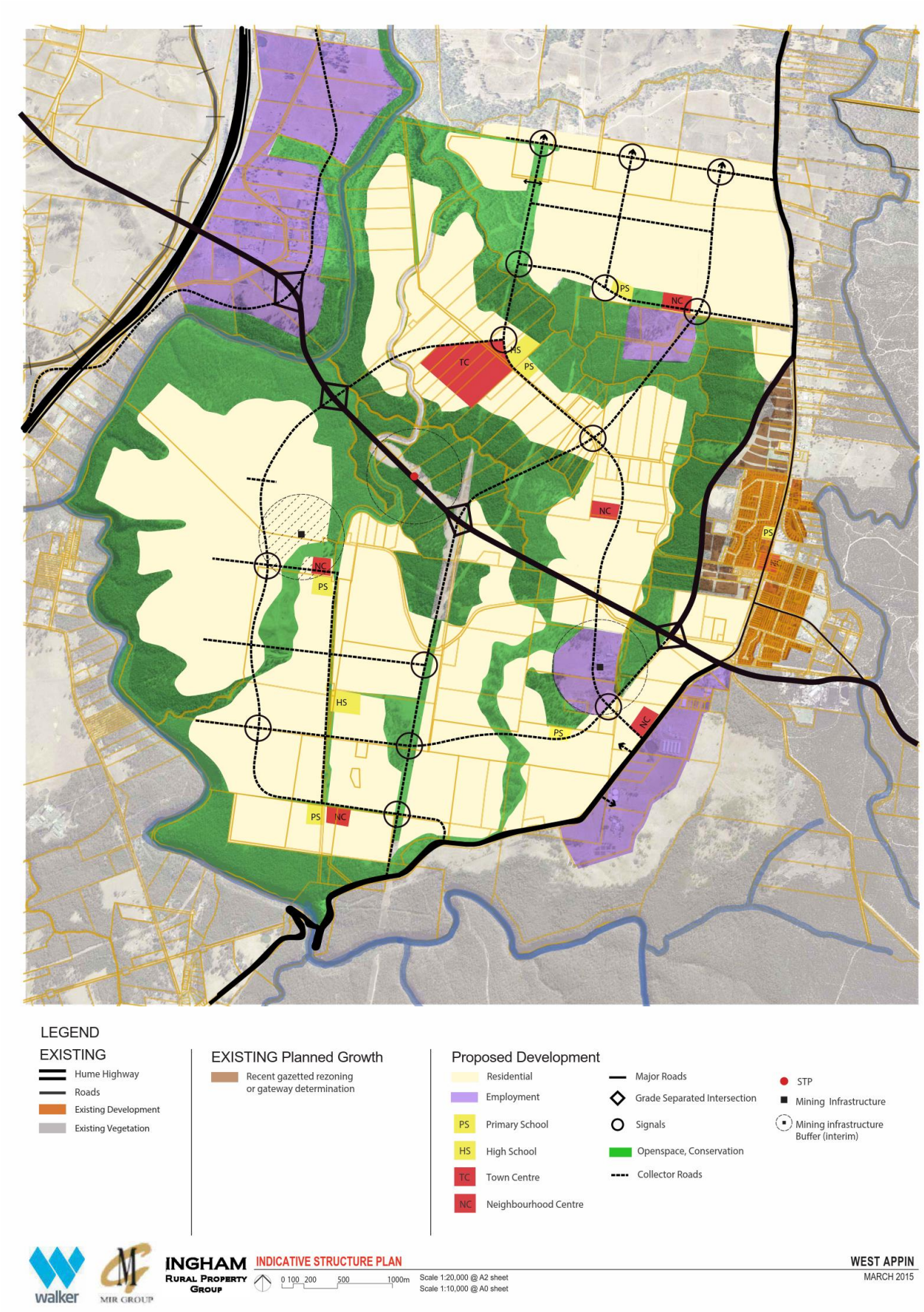


Figure 2 West Appin – Indicative Structure Plan (Source:Walker Corporation)

2 EXISTING INFRASTRUCTURE

Substantial work has been undertaken on investigations of services for the West Appin Investigation Area. Previous studies include:

Appin Sewage Treatment Plant and Recycled Water Proposal – Review of Environmental Factors prepared for Sydney Water by Planning Workshop Australia, August 2006

Macarthur South Water, Wastewater & Recycled Water Integrated Servicing Strategy prepared for Walker Corporation by Maunsell/AECOM October 2007

Appin and Wilton Review of Water Servicing Strategy prepared for Walker Corporation 2010 by AECOM Australia Pty Ltd

2.1 Water

The following information has been extracted from the **Appin and Wilton Review of Water Servicing Strategy** prepared by AECOM Australia Pty Ltd for Walker Corporation 2010, which reviewed the **Water, Wastewater & Recycled Water Integrated Servicing Strategy** prepared for Walker Corporation by Maunsell/AECOM in October 2007 for the revised urban development areas of Appin and Wilton.

Headworks - Water Filtration Plants (WFP)

Two Water Filtration Plants (WFP) are currently located in the vicinity of the Macarthur South Region, the Macarthur WFP and Nepean WFP. These are part of a network of nine WFPs which supply water within the Sydney Water area.

Macarthur WFP

The Macarthur Water Filtration Plant (WFP) provides potable water to the Macarthur Delivery Area and services developments in the Campbelltown, Camden and Wollondilly LGA's, is located on Appin Road, between Brighton's Pass and Appin about 20 km south of the Campbelltown Central Business District.

It is operated by Macarthur Water Pty Ltd, which is owned by Trility. The plant began operating in 1996. The plant treats raw water from Broughton's Pass Weir, sourced from Cataract, Cordeaux or Nepean Dams and supplies filtered water to the Campbelltown, Camden and Appin regions south-west of Sydney.*

Sydney Water has indicated that the Macarthur plant has spare capacity. (Confirmed by Sydney Water, April 2010). The latest Sydney Water Asset Management Plan states that the plant has:

- *a Maximum Day capacity ~ 160 MLD*
- *a Design Maximum Day Capacity = 265 MLD*
- *a 2030 projected Maximum Day Demand ~ 210 MLD*

No major amplification works are identified at this stage at the Macarthur WFP in the future, due to the spare capacity available at the plant.

Nepean WFP

The Nepean WFP is located near Bargo in the Southern Highlands and treats water from the Nepean Dam. The plant was upgraded in 1993, and at this time the maximum operating capacity was of 36 ML/day, with an average flow of 25ML/day. This plant does not currently supply potable water to any of the Macarthur South region.

Water Distribution - Pipelines and Reservoirs

Within the Macarthur South region, the Macarthur WFP currently supplies potable water to the towns of Appin, Wilton and Douglas Park. Potable water is pumped from the Macarthur WFP to Appin Reservoir (WS412, 10ML storage capacity) via a 300mm pipeline. When the pumps at the Macarthur WFP are not operating, the villages of Appin, Wilton and Douglas Park are supplied with water from a gravity supply from Appin Reservoir (Appin Wilton Douglas Park Integrated Servicing Plan, Sydney Water, June 2006, p12).

The pipeline from Appin Reservoir runs in a south-west direction along Appin Road to supply Appin. This pipeline has a 200 to 300mm diameter, and branches off to supply Douglas Park, running northerly along Douglas Park Drive.

A 1200mm pipeline also travels north from the Macarthur WFP to supply Narellan Reservoir and Campbelltown South Water Supply Systems.

In accordance with the Terms of Reference, consultation has occurred with Sydney Water Corporation.

Sydney Water (July 2014) has advised that *West Appin study area is located within the Macarthur Water Delivery System.*

Raw water from Nepean, Avon, Cordeaux and Cataract Dams flows into the Broughtons Pass Weir. The water is then pumped to Macarthur Water Filtration Plant (WFP).

Macarthur WFP is situated within the vicinity of the study area. It services the Local Government Areas (LGA) of Wollondilly, Camden, Campbelltown and Liverpool. The WFP has a design rating of 265 ML/d.

Sydney Water went on to say,

However, the treatment capacity is limited to around 130 ML/d due to the raw water quality. The existing customers within Macarthur system uses around 70 ML/d on average, with a maximum daily demand of 128 ML/d. There is no spare capacity to service additional growth from this system.

It is understood and further confirmation should be sought from Sydney Water and the Macarthur WFP operator, in the context of the investigation into the future Macarthur South Growth Centre, that the WFP is able to increase potable water treatment and service not only West Appin but also Macarthur South.

Sydney Catchment Authority in a meeting on 27 June 2014 advised that:

- there is adequate bulk raw water available
- The extraction site would be from Broughton Crossing, in the same location as the Macarthur Water Treatment Plant draws water
- It would make sense to utilise the capacity of the existing Macarthur Water Treatment Plant (the spare capacity is questioned, see advice from Sydney Water)
- Bulk water could be provided for a private plant to be constructed to supply potable water to West Appin

The Macarthur Filtration Plant fact sheet published by the owner Trility* espouses the plants additional capacity and advises that the plants modular configuration allows for capacity to be doubled (additional 265ML/Day) over the life of the plant, refer Appendix B.

It is evident that resolution of the actual capacity of the Macarthur Plant in its current configuration and expanded configuration is required and should be ascertained as step 1 in a more detailed assessment of infrastructure provision.

* Trility is a division of Brookfield Multiplex

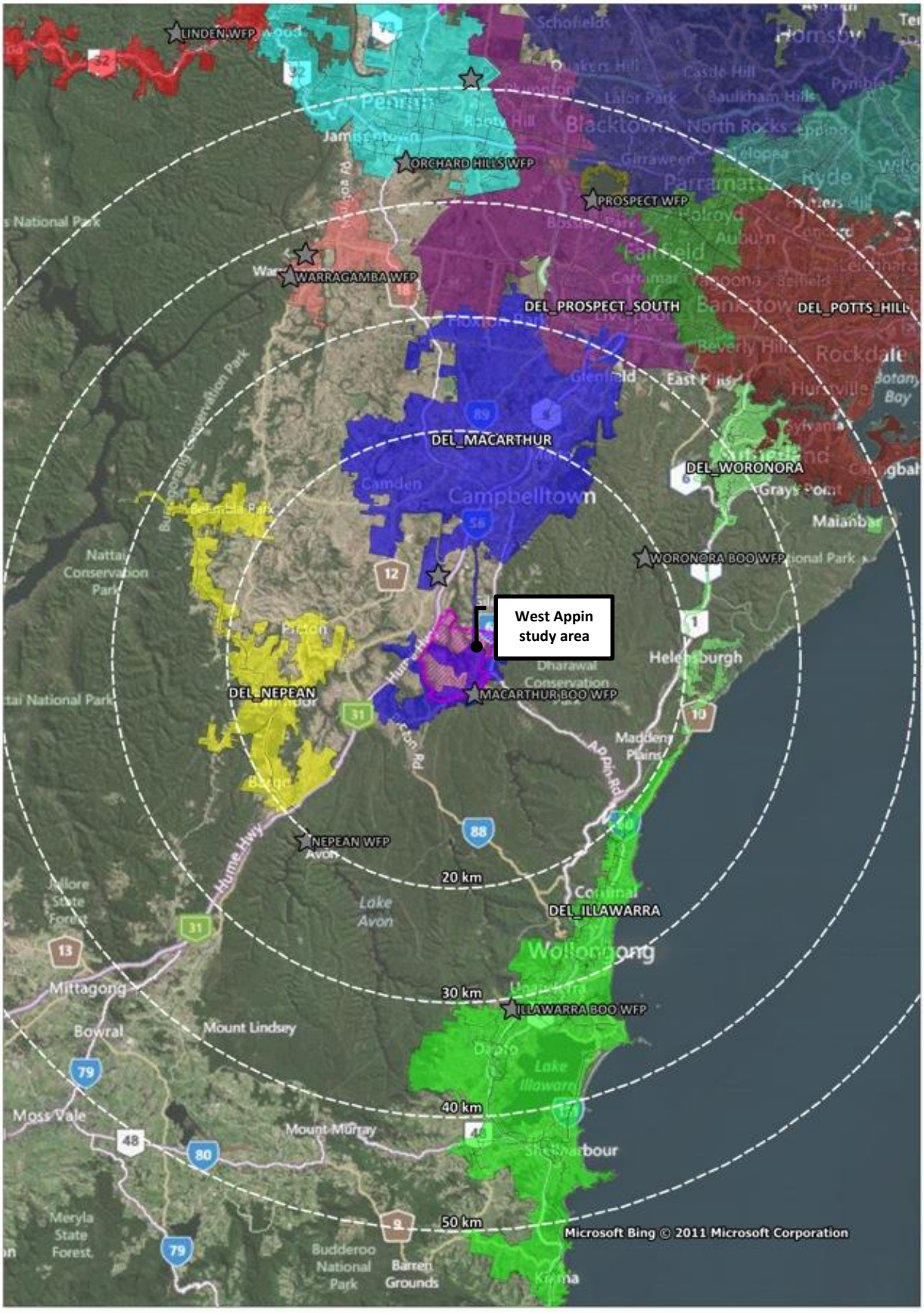


Figure 3 Existing water delivery systems surrounding West Appin (Source:SWC)

2.2 Wastewater

The existing wastewater infrastructure was investigated as part of the **Appin and Wilton Review of Water Servicing Strategy** prepared by AECOM Australia Pty Ltd for Walker Corporation 2010. The following is extracted from that report:

Wastewater Services

The village of Appin within the Macarthur South region was serviced under Stage 2 of the NSW Government's Priority Sewerage Program (PSP).

The Appin Priority Sewerage Scheme

The scheme provides a reticulated sewerage service to approximately 550 existing and 1100 future lots in Appin. An allowance has also been made in the design of the transfer system for growth in the vicinity of Appin, including the North Appin development area.

The scheme includes a subsidised pressure sewerage collection system for the existing village, a new transfer sewage pumping station (SPS) and a 300mm main (approx 11km long) to transfer flows from Appin to Rosemeadow. An SPS at Rosemeadow will pump flows to the existing Glenfield system.

The scheme is designed to service flows from an estimated EP of 4800 (1600 lots) which is equivalent to 0.9MLD based on 180L/EP/day.

Existing Capacity of Glenfield STP

Glenfield STP services Campbelltown, Minto, Ingleburn, Macquarie Fields and Glenfield. Sydney Water has advised that the Glenfield STP has a rating of 46ML/day ADWF, and a current gauged inflow of 40ML/day ADWF. Treated effluent from the STP is pumped to Liverpool STP and then to the North Georges River Submain discharging at Malabar Ocean Outfall. However, during periods of wet weather, when the capacity of the system is exceeded, treated sewage from this plant may be discharged into the Georges River. Recently treated effluent was made available via the Liverpool/Ashfield pipeline for a reuse scheme. It is also planned that the STP will be the source for treated non potable water for the Hoxton Park Recycled Water Scheme.

Based on 180L/EP/day, Glenfield has the capacity to service a further 11,000 dwellings approximately before upgrades are required. Malabar STP downstream treats and discharges 430MLD.

Sydney Water previously advised that the modelled wet weather overflow frequency for the downstream Glenfield sewage collection system at several points exceed the wet weather performance of 40 overflows in 10 years stipulated in the DECCW license.

In accordance with the Terms of Reference, consultation has occurred with Sydney Water Corporation.

Sydney Water (July 2014) has advised that there are three existing wastewater systems around the proposed West Appin development area. They are Glenfield-Malabar system, West Camden system and Picton system.

Glenfield Water Recycling Plant (WRP) and its trunk system has short-term spare capacity to service the forecast growth until 2020. How the West Appin initial customers potentially connected up to 2020, are serviced beyond 2020, will need to be considered.

Glenfield WRP has short term (until 2020) spare capacity to service West Appin growth along with other growth developments considered in Growth Servicing Strategy. Continuation of the potential initial development from West Appin will need to be considered by 2020.

2.3 Electricity

In accordance with the Terms of Reference, consultation has occurred with Endeavour Energy. Endeavour Energy has advised that:

The existing zone substation at Appin is of a rural standard and can only supply an additional 800 residential lots.

2.4 Gas

Jemena has a policy to extend gas mains into all new residential areas wherever possible, depending upon economic viability.

Jemena has installed an off take station off their main trunk line (near Appin Village) and reticulated mains to supply natural gas to Bingara Gorge Estate and the township of Appin in 2010.

The West Appin study Area is located within the Jemena AGN supply area, as outlined in the Jemena NSW Gas Networks DEVELOPER GUIDE (JDG-000) DEVELOPER GUIDE TO NATURAL GAS Revision 1 – 24/08/2007.

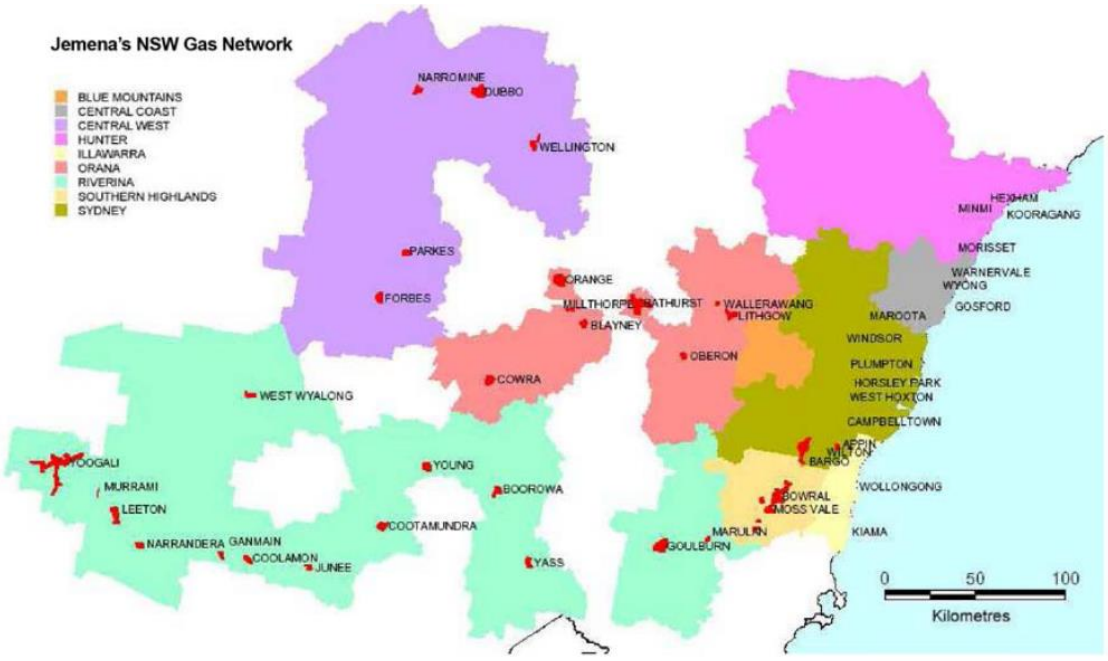


Figure 4 Jemena's NSW Gas Network (Source:Jemena)

2.5 Telecommunications

NBN are currently working on the Appin Gateway project and have existing infrastructure in the area.

2.6 Stormwater

There is no Stormwater infrastructure, quantity and quality, in place to cater for urban development in the West Appin Investigation Area.

3 FUTURE INFRASTRUCTURE REQUIREMENTS

This section sets out the need for infrastructure in terms of that which is already present in the area, the quantum of development proposed for West Appin, proposed staging, and the approach to infrastructure provision and funding.

3.1 Water

Whilst limited capacity exists in the existing infrastructure in its current configuration, upgrades to the infrastructure can be undertaken to service the development area.

It is noted that Sydney Water Corporation have no provision for upgrades to service the West Appin development in its current forward budget. The proponents propose that a Commercial arrangement could be entered into with Sydney Water Corporation to manage the funding gap in the intervening period.

The Macarthur Water Filtration Plant on the outskirts of Sydney was designed to filter 265 megalitres of water per day. A feature of the modular design is the capability to double this capacity during the 25-year life of the operation

Within the Macarthur Water Delivery System, West Appin study area can be supplied from Appin Water Supply Zone. Water from Macarthur WFP is pumped to Appin Reservoir (WS0412) and then distributed to the villages of Appin, Douglas Park and Appin.

Even though there is no current spare capacity to service West Appin, the Appin zone can potentially be amplified further to include new trunk infrastructure.

Another potential supply is the DN1200 trunk main from Macarthur WFP to Sugarloaf, which runs through the West Appin study area (refer to Appendix C). This trunk main is the single supply feed to the northern part of Macarthur Water Delivery System and has not been assessed as part of this study. Capacity of this main can be assessed in subsequent planning studies to determine its feasibility to service West Appin.

The total Maximum Day Demand for the Appin area is estimated to be 15 ML/day for potable water and 34 ML/day for recycled water. Refer to Table 7 below.

Water Demands	Potable Water	Recycled Water
Average Day Demand [MLD]	10	10
Max Day Demand [MLD]	15	34

Table 5 Summary of Potable Water and Recycled Water Demands

The West Appin site can be serviced from two new reservoirs (a potable and a recycled water reservoir) to the south of Appin in the vicinity of an unnamed hill (adjacent to Myrtle Gully) at approximately 260m AHD in addition to utilising the existing 10ML Appin Potable Reservoir. The total additional storage size required is 5ML for potable and 25ML for recycled water. Refer Figures 3 and 4.

The potable water will be sourced from the Macarthur WFP, where additional pumping capacity will need to be added in order to supply the additional demand to Myrtle Hill Reservoir.

The existing 10ML potable reservoir at Appin can service up to 16,700 residential dwellings before the additional 5ML reservoir is required. This means that the new 5ML potable reservoir is not required to be commissioned until 2031 approximately.

Recycled water for Appin zone will be supplied from the Appin STP, from where it will be pumped through approximately 5km of 750mm rising main to the 25ML Myrtle Hill RW Reservoir.

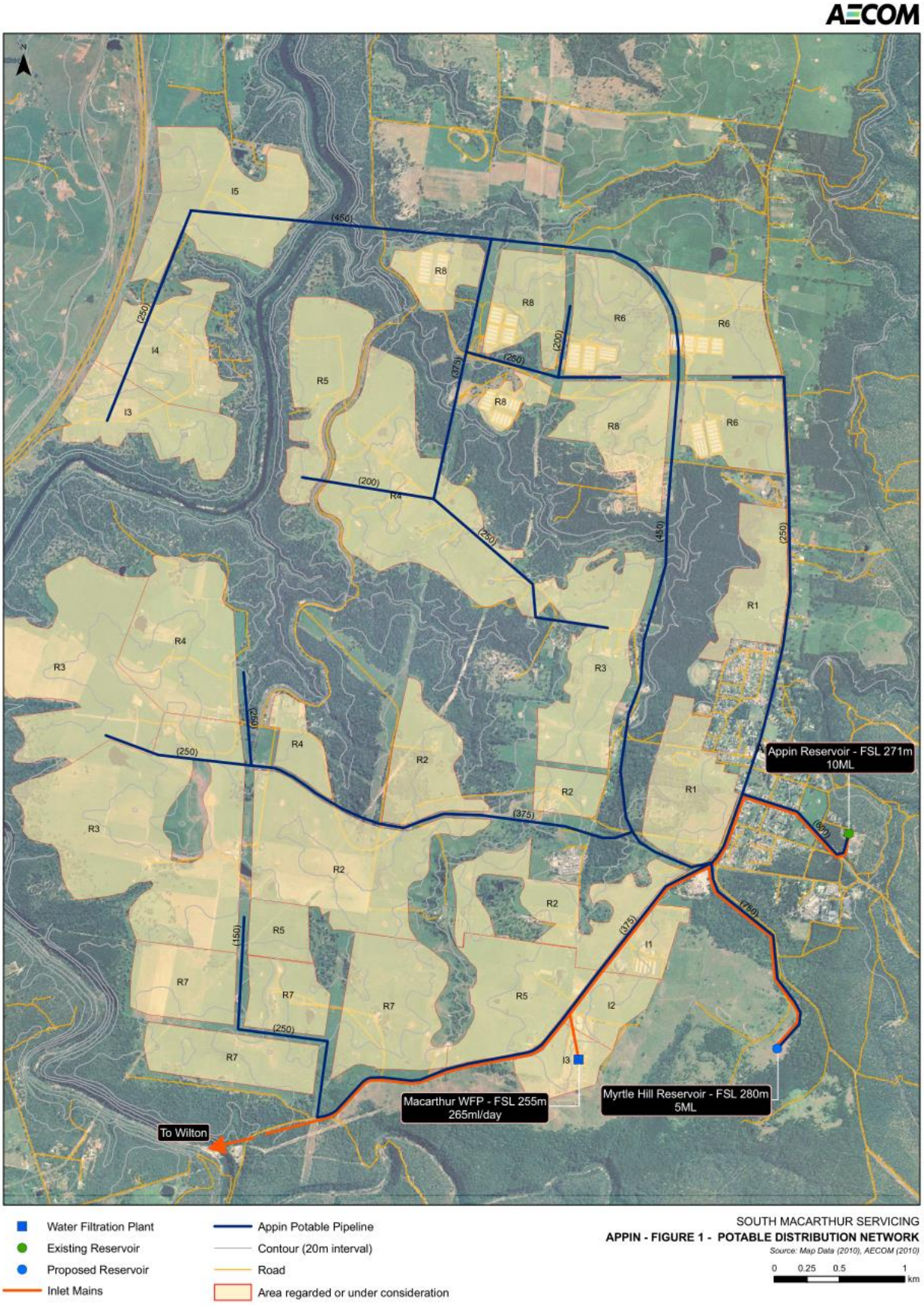


Figure 5 Potable Water Distribution Network (Source:AECOM)

Table 5 outlines the anticipated potable water trunk infrastructure required to service the West Appin Investigation Area.

Stage	Total Development Yield	Timing	Potable Water Infrastructure
Stage 1 & 2	**4,000 dwellings** (dw)	2021	Utilise existing 10ML potable water reservoir at Appin. Maximum day demand assuming potable top up is 8MLD. Resolution of upgrades to MFP to be sought to increase capacity.
Stage 3 & 4	+ 6,000 dw (**10,000 dw**)	2031	Maximum day demand = 6.4MLD. Utilise existing Appin 10ML PW reservoir
Stage 5 & 6	+ 5,000 dw (**15,000 dw**)	2041	Maximum day demand = 12.3MLD. Utilise existing Appin 10ML PW reservoir plus construct a new 5ML PW reservoir at Myrtle Hill including pumps.
Stage 7 & 8	+ 3,300 dw (**18,000 dw**)	2051	Maximum day = 15.4MLD. Utilise 15ML of total potable storage at Appin and Myrtle Hill.
TOTAL	**18,000 dwellings**		

Table 6 Proposed Potable Water Upgrades

3.2 Recycled Water

Table 6 outlines the anticipated recycled water trunk infrastructure required to service the West Appin Investigation Area.

Stage	Total Development Yield	Timing	Potable Water Infrastructure
Stage 1 & 2	**4,000 dwellings** (dw)	2021	Dual Reticulation serving new development will need to be supplied by potable top up. If SWC does not support potable top up for this length of time, rainwater tanks will also need to be considered initially.
Stage 3 & 4	+ 6,000 dw (**10,000 dw**)	2031	Maximum day demand = 14.4MLD. Construct 15ML RW reservoir at Myrtle Hill and RWPS and RM at STP
Stage 5 & 6	+ 5,000 dw (**15,000 dw**)	2041	Maximum day demand = 26MLD. Construct second 15ML RW reservoir at Myrtle Hill.
Stage 7 & 8	+ 3,300 dw (**18,000 dw**)	2051	Maximum day demand = 34MLD. Utilise 30 ML RW water storage reservoirs at Myrtle Hill.
TOTAL	**18,000 dwellings**		

Table 7 Proposed Recycled Water Upgrades

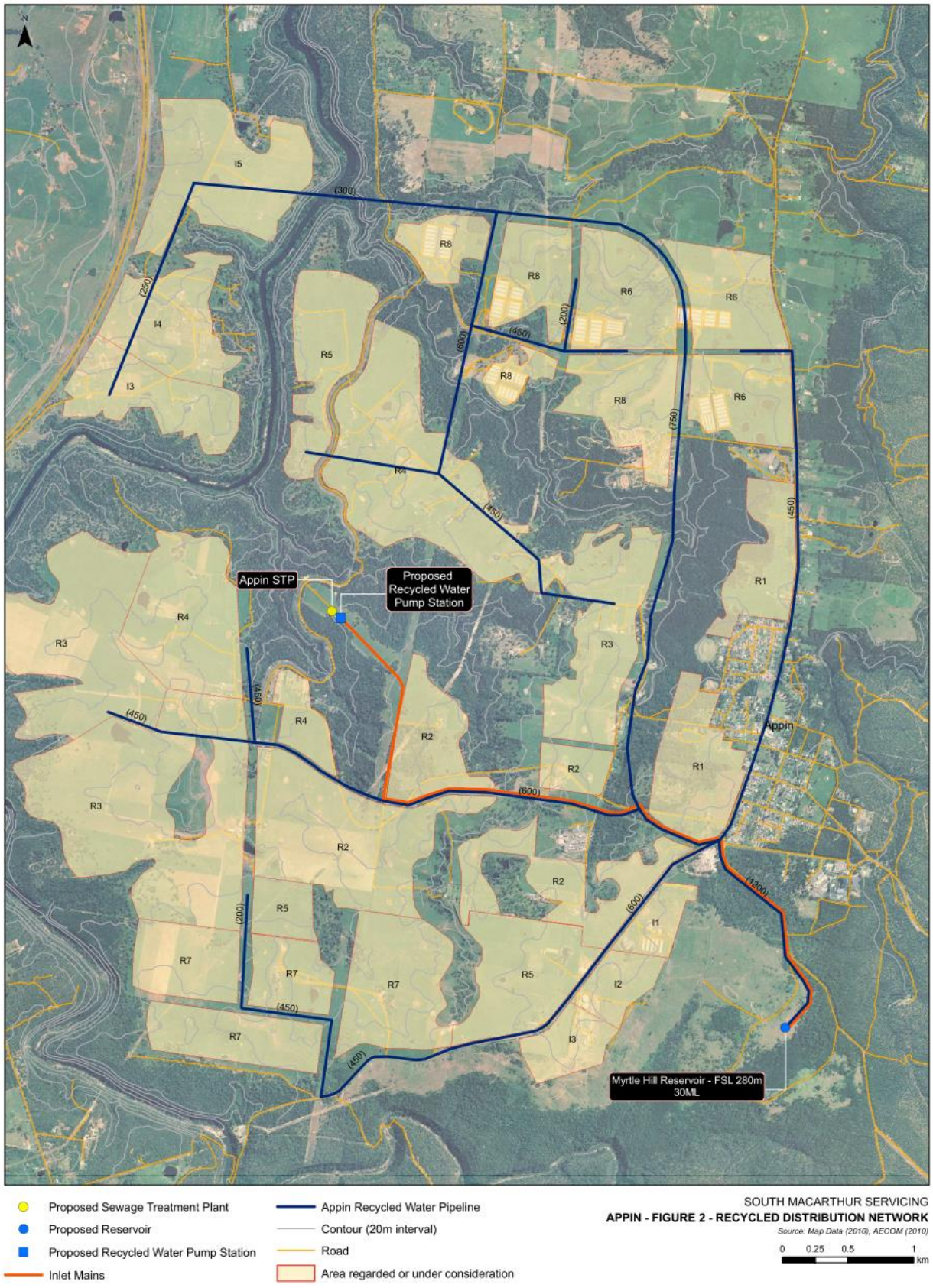


Figure 6 Recycled Water Network (Source:AECOM)

3.3 Wastewater

Whilst Sydney Water Corporation has no provision for upgrades to service the West Appin development in its current forward budget, there are a number of potential options to service the proposed development in both the short and long term.

Wastewater servicing can be provided by:

3.3.1 Stage 1 The Glenfield Malabar System

There is potential short-term spare capacity until 2020 for approximately 8,000 EP adequate to service initial development within West Appin.

This would require construction of an 11km transfer main to Rosemeadow.

There is limitation as the Glenfield system is forecasted to reach capacity by 2021. How the West Appin initial customers potentially connected up to 2020, are serviced beyond 2020, will need to be considered.

There is potential to explore the amplification of the Glenfield plant to cater for additional flows from West Appin, or alternatively utilise capacity that may exist as slower than expected uptake rates in the balnce of the existing catchment.

3.3.2 Stage 2 – Option 1

New Sydney Water Treatment Plant at West Appin

In 2010 Sydney Water Corporation prepared an REF for a Sewage Treatment Plant at West Appin that could service the entire South Macarthur Release area.

Following Stage 1, this plant could be constructed with recycled water to homes for toilet flushing and garden use.

In later years once the capacity of the recycled system has reached its maximum potential the initial transfer main could be used to transfer excess recycled water from an MBR plant to the Glenfield system.

Alternatively water quality could be managed to enable discharge in accordance with environmental requirements and licencing to the Nepean River to provide environmental flows.

A Commercial arrangement could be entered into with Sydney Water Corporation to manage the funding gap in the intervening period to allow this system to be funded by Sydney Water in future years.

3.3.3 Stage 2 – Option 2

New WICA Licenced Treatment Plant at West Appin

Under the current regulatory framework it is possible for a private Sewage Treatment Plant at West Appin to be constructed to service the development.

Following Stage 1, this plant could be constructed with recycled water to homes for toilet flushing and garden use.

In later years once the capacity of the recycled system has reached its maximum potential the initial transfer main could be used to transfer excess recycled water from an MBR plant to the Glenfield system.

Alternatively water quality could be managed to enable discharge in accordance with environmental requirements and licencing to the Nepean River to provide environmental flows.

A Commercial arrangement could be entered into with Sydney Water Corporation to manage the funding gap in the intervening period to allow this system to be funded by Sydney Water in future years.

In all cases there are two options for the collection of effluent prior to transfer to the treatment plant:

- A conventional gravity wastewater collection system; or;
- Low pressure sewer system (LPSS)

The benefit of utilisation of a LPSS is greatly reduced peak flows through the plant and reduced volumes of treated effluent for disposal. For the purposes of this assessment LPSS has been assumed.

Table 7 outlines the anticipated waste water trunk infrastructure required to service the West Appin Investigation Area. Note trunk mains internal to development have not been included.

Stage	Total Development Yield	Timing	Wastewater Infrastructure
Stage 1	**4,000 dwellings** (dw)	Up to 2021	Service the first 4,000 lots (includes existing Appin township) via the proposed Appin to the Glenfield system via a 300mm diameter transfer main.
Stage 2	+ 6,000 dw (**10,000 dw**)	Up to 2031	Construct the first stage of Appin STP (either SWC or WICA) as an MBR plant with a capacity of 5MLD. Transfer excess treated water to Glenfield Sewerage System via the 300mm transfer main estimated to be 2MLD. ADWF estimated to be 2MLD.
Stage 3	+ 5,000 dw (**15,000 dw**)	Up to 2041	Construct Stage 2 of Appin STP (either SWC or WICA) + RO plant with a capacity of 7MLD.
Stage 4	+ 3,000 dw (**18,000 dw**)	Up to 2051	Construct Stage 3 (additional 5MLD) of STP + RO add on bringing total capacity to 10 MLD. Transfer brine concentrate to Glenfield STP via 300mm main. Estimated flow of 3MLD.
TOTAL	**18,000 dwellings**		

Table 8 Waste Water Upgrades

3.4 Electricity

Initial advice on the ability to service the ultimate development has been received from Endeavour Energy.

The proposed development would result in significant step change in electrical infrastructure as it represents an ultimate load of 90MVA. There are constraints on the upstream sub-transmission network and preliminary studies indicate supply to West Appin would ultimately require:

- Establishment of a new 132kV/66kVTransmission Substation at Douglas Park
- Major augmentation and establishment of new 132kV transmission lines to Douglas Park from Nepean Transmission Substation.
- Two new 66/11 kV Zone Substations plus associated 66kV feeders from the Douglas Park Transmission Substation.

3.5 Gas

Preliminary advice has been received from Jemena for development in the Appin area. Jemena have infrastructure in the area including an off take that services the existing Walker Corporation development at Appin.

The most likely avenue to provide supply to these new proposed developments would be reinforcements to the existing network. Natural gas is available in the vicinity and can be made available to any sized developments in the area.

On developments of this size, early involvement of Jemena in the process is important to ensure a timely and cost effective outcome is achieved for all parties. I look forward to assisting you in this endeavour.

3.6 Telecommunications

NBN has advised that the proposed development can be serviced.

A formal application will need to be submitted and an agreement entered into with NBN Co., including in relation to pit and pipe infrastructure at the development.

NBN will agree to procure the installation of fibre infrastructure at the development.

3.7 Stormwater

Stormwater infrastructure, quantity and quality, for the site can be provided by:

- Direct provision by individual developers, conditioned under Development Consent; or;
- Establishment of a section 94 contribution plan.

There would be no capital costs to Government, State or Local as a result of the development of the West Appin Investigation Area.

4 STAGING AND COST OF DELIVERY

As outlined above there are no physical or geographical impediments to the provision of infrastructure to service development within the West Appin Investigation Area.

The capital costs of providing infrastructure to service development has been determined on the basis of a high level assessment and should be further refined in consultation with the relevant service authorities.

4.1 Potable Water

Stage	Total Development Yield	Timing	Potable Water Infrastructure	Cost Estimate*
Stage 1 & 2	**4,000 dwellings** (dw)	2021	Macarthur Filtration Plant Upgrade to Increase treatment capacity for raw water. Installation of Pipe Mains	$10m[#] $12m
Stage 3 & 4	+ 6,000 dw (**10,000 dw**)	2031	Maximum day demand = 6.4MLD. Utilise existing Appin 10ML PW reservoir Installation of Pipe Mains	 $13m
Stage 5 & 6	+ 5,000 dw (**15,000 dw**)	2041	Construct a new 5ML PW reservoir at Myrtle Hill Installation of Pipe Mains	$2.5m $12.5m
Stage 7 & 8	+ 3,000 dw (**18,000 dw**)	2051	Maximum day = 15.4MLD. Utilise 15ML of total potable storage at Appin and Myrtle Hill. Installation of Pipe Mains	 $13m
TOTAL	**18,000 dwellings**			**$63m**

* Cost Estimate based derived from:

- AECOM Appin Wilton Review of Water Servicing Strategy - Part 3A Application May 2010
- Macarthur South Water, Wastewater & Recycled Water Integrated Servicing Strategy prepared for Walker Corporation by Maunsell/AECOM October 2007

(Costs escalated at 3% per annum)

[#] Allowance only, AECOM reports do not identify any upgrade requirements

Table 9 Proposed Potable Water Upgrade Costs

4.2 Recycled Water

Stage	Total Development Yield	Timing	Potable Water Infrastructure	Cost Estimate*
Stage 1 & 2	**4,000 dwellings** (dw)	2021	Installation of Pipe Mains	$21m
Stage 3 & 4	+ 6,000 dw (**10,000 dw**)	2031	Construct 15ML RW reservoir at Myrtle Hill and RWPS and RM at STP Installation of Pipe Mains	$44m
Stage 5 & 6	+ 5,000 dw (**15,000 dw**)	2041	Construct second 15ML RW reservoir at Myrtle Hill. Installation of Pipe Mains	$3.5m $21.5m
Stage 7 & 8	+ 3,000 dw (**18,000 dw**)	2051	Utilise 30 ML RW water storage reservoirs at Myrtle Hill. Installation of Pipe Mains	$21m
TOTAL	**18,000 dwellings**			**$111m**

* Cost Estimate based derived from:

- AECOM Appin Wilton Review of Water Servicing Strategy - Part 3A Application May 2010
- Macarthur South Water, Wastewater & Recycled Water Integrated Servicing Strategy prepared for Walker Corporation by Maunsell/AECOM October 2007

(Costs escalated at 3% per annum)

Table 10 Proposed Recycled Water Upgrade Costs

4.3 WasteWater

Stage	Total Development Yield	Timing	Waste Water Infrastructure	Cost Estimate
Stage 1 & 2	**4,000 dwellings** (dw)	2021	Appin to Glenfield system via a 300mm diameter transfer main. SPS and Rising Main	$8m
Stage 3 & 4	+ 6,000 dw (**10,000 dw**)	2031	Construct the first stage of Appin STP (either SWC or WICA) as an MBR plant with a capacity of 5MLD.	$30m
Stage 5 & 6	+ 5,000 dw (**15,000 dw**)	2041	Construct Stage 3 Appin STP (additional 2MLD) of STP + RO	$30m
Stage 7 & 8	+ 3,000 dw (**18,000 dw**)	2051	Construct Stage 3 Appin STP (additional 3MLD) of STP + RO	$10m
TOTAL	**18,000 dwellings**			**$78m**

* Cost Estimate based on sewer treatment plant costs treating effluent collected via LPSS

Table 11 Proposed Waste Water Upgrade Costs

4.4 Electricity

The works outlined in section 3.4 would require an investment of $120 million by Endeavour Energy and exclude distribution reticulation (11 kV and Low Voltage) which are contestable works funded by the developer.

Endeavour Energy has advised that there is no funding provision for any of the works required to service the West Appin Investigation Area in the current 10 year forward capital works program.

The development may also bring forward augmentation requirements to Transgrid's network, in particular the Macarthur Bulk Supply Point. This has not been allowed for in these preliminary estimates.

The requirements for each phase of upgrade will need to be considered as part of a detailed investigation to ensure that infrastructure provision best matches development and housing production and minimises ultimate and staged infrastructure costs.

Stage	Total Development Yield	Timing	Electricity	Cost Estimate
Stage 1 & 2	**4,000 dwellings** (dw)	2021	Establishment of a new 132kV/66kVTransmission Substation at Douglas Park Construction of Substation 1 – Stage 1	$60m
Stage 3 & 4	+ 6,000 dw (**10,000 dw**)	2031	Construction of Substation 1 – Stage 2 Construction of Substation 2 – Stage 1	$50m
Stage 5 & 6	+ 5,000 dw (**15,000 dw**)	2041	Construction of Substation 2 – Stage 1	$10m
Stage 7 & 8	+ 3,000 dw (**18,000 dw**)	2051		
TOTAL	**18,000 dwellings**			**$120m**

Table 12 Proposed Electricity Upgrade Costs

4.5 Gas

The proponents will need to enter into a Commercial Agreement with Jemena for the provision of gas to the development.

There is no cost to Government.

4.6 Telecommunications

The proponents will need to enter into an Agreement with NBN Co. for the provision of telecommunications to the development.

There is no cost to the NSW Government.

4.7 Stormwater

Stormwater infrastructure, quantity and quality, for the site can be provided by:

- Direct provision by individual developers, conditioned under Development Consent; or;
- Establishment of a section 94 contribution plan.

There would be no capital costs to Government, State or Local as a result of the development of the West Appin Investigation Area.

5 TRANSPORT INFRASTRUCTURE

This section sets out the key transport improvements proposed to service the development in terms of roads, public transport and walking and cycling.

Parsons Brinckerhoff have prepared a report, West Appin Strategic Infrastructure Investigation Preliminary traffic and transport assessment,31 March 2015, that analyses:

- Existing 2013 Traffic – Current Road Network
- Future 2036 Traffic (without West Appin) – Road Network augmented to maintain satisfactory Levels of Service.
- Future 2036 Traffic (including West Appin) – Road Network further augmented to maintain satisfactory Level of Service
    - Two options:
        - With an M9 Outer Sydney Orbital
        - Without the Outer Sydney Orbital

The Outer Sydney Orbital is identified in A PLAN FOR GROWING SYDNEY, December 2014. Refer figure below:

SYDNEY'S SOUTH WEST SUBREGION **129**

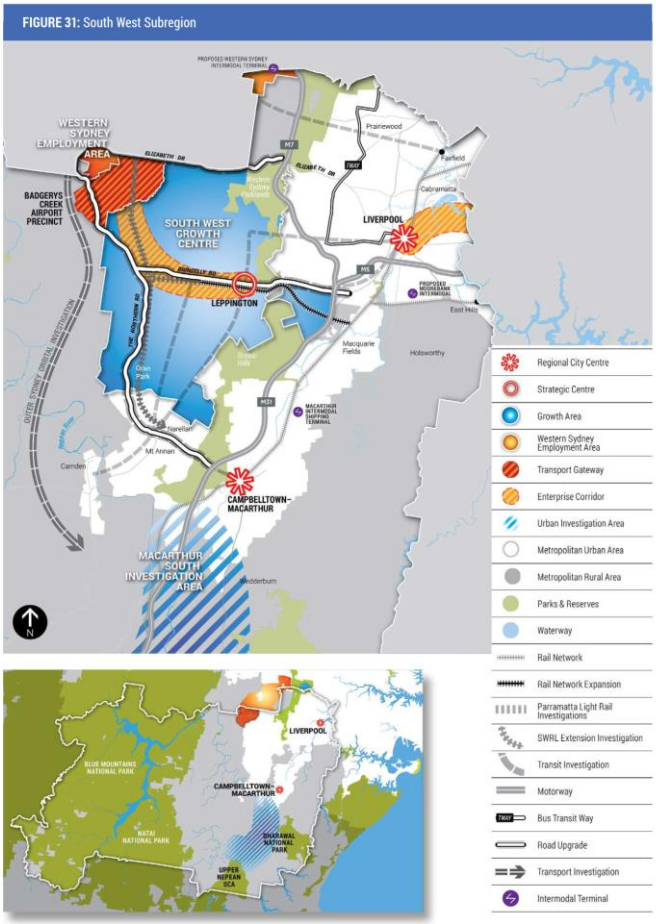


Figure 7 Outer Sydney Orbital Context (Source: A Plan for Growing Sydney 2036, DPE)

5.1 Road network

5.1.1 Existing arrangements

The proposed site for West Appin is located in the northern section of the Wollondilly LGA immediately south of the LGA boundary with the City of Campbelltown. The site lies between two north south Arterial roads the Hume Highway (Motorway) and Appin Road.

The functionality of the existing road network is described in Section 2 of the West Appin Strategic Infrastructure Investigation Preliminary traffic and transport assessment, Parsons Brinckerhoff, 31 March 2015.

Parsons Brinckerhoff have analysed the performance of the existing road network based on current conditions and concluded that the current network is operating at varying Level of Service ranging from LoS A through to LoS E, as shown below:

Existing Mid-block LoS on key roads (2013 weekday)

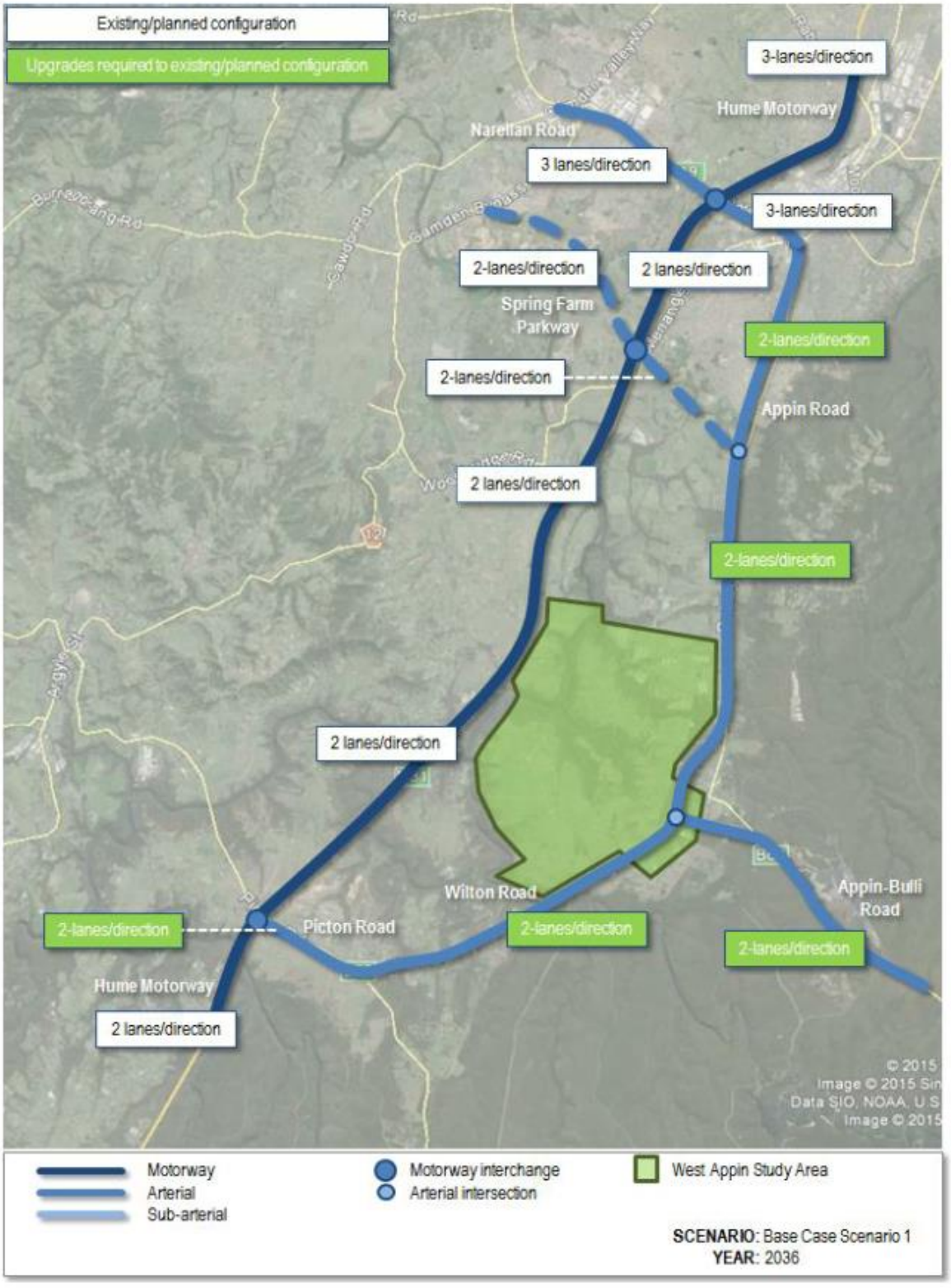
Route / Location / Direction		Configuration[1]		AM peak		
		Road type	Number of lanes	Total PCUs	PCU/ lane	LoS
Hume Motorway (M31)						
North of Narellan Road	NB	Motorway	3	4,145	1,380	C
	SB		3	2,610	870	B
South of Narellan Road	NB	Motorway	2	2,175	1,090	B
	SB		2	1,870	935	B
South of Picton Road	NB	Motorway	2	1,350	675	A
	SB		2	1,370	685	A
Appin Road / Appin Bulli Road						
North of Appin village	NB	2-lane, 2-way	2	1,305	655	D
	SB					
East of Appin Village	WB	2-lane, 2-way	2	1,265	635	D
	EB					
Wilton Road						
South of Appin Village	NB	2-lane, 2-way	2	220	110	A
	SB					
Narellan Road						
East of Hume Motorway	WB	Multi-lane arterial	2	2,010	1,005	C
	EB		2	2,475	1,240	C
West of Hume Motorway	WB	Multi-lane arterial	3	2,005	670	B
	EB		2	3,720	1,860	E
Picton Road						
East of Hume Motorway	WB	2-lane, 2-way	2	2,230	1,115	E
	EB					

Table 13 –Existing Traffic Conditions 2013 (Source: Parsons Brinckerhoff)

5.1.2 Proposed Road Network

Parsons Brinckerhoff have modelled the requirements and prepared the following table based on the road network requirements to meet the background growth on the regional roads.

It is noted that the following table excludes any Traffic from the West Appin Investigation Area



Source: Parsons Brinckerhoff, adapted from Google Earth imagery (Google Earth, extracted March 2015)

Figure 6.1 Mid-block lane requirements overview (Base Case Scenario 1, 2036)

Figure 8 2036 Road Infrastructure Requirments exluding West Appin and M9 (Source:Parsons Brinckerhoff)

Mid-block LoS on key roads (2036 weekday, excluding West Appin, including M9)

Route / Location / Direction		Configuration[1]		AM peak			PM peak		
		Road type	Number of lanes	Total PCUs	PCU/ lane	LoS	Total PCUs	PCU/ lane	LoS
Hume Motorway (M31)									
North of Narellan Road	NB	Motorway	3	5,000	1,665	C	3,100	1,035	B
	SB		3	3,300	1,100	B	3,700	1,235	C
South of Narellan Road	NB	Motorway	2	3,400	1,700	C	2,400	1,200	B
	SB		2	2,100	1,050	B	3,600	1,800	D
South of Spring Farm Parkway	NB	Motorway	2	3,100	1,550	C	2,100	1,050	B
	SB		2	1,800	900	B	2,600	1,300	C
South of M9 Motorway	NB	Motorway	2	3,000	1,500	C	2,400	1,200	B
	SB		2	2,100	1,050	B	2,500	1,250	C
South of Picton Road	NB	Motorway	2	1,800	900	B	2,100	1,050	B
	SB		2	1,800	900	B	1,700	850	B
Appin Road / Appin Bulli Road									
North of Spring Farm Parkway	NB	2-lane, 2-way	2	1,600	800	D	1,000	500	C
	SB								
South of Spring Farm Parkway	NB	2-lane, 2-way	2	1,500	750	D	1,000	500	C
	SB								
East of AppinVillage	WB	Multi-lane arterial	2	1,100	550	A	1,000	500	A
	EB		2	1,300	650	B	1,500	750	B
Wilton Road									
South of Appin Village	NB	Multi-lane arterial	2	100	50	A	100	50	A
	SB		2	100	50	A	200	100	A
Narellan Road									
East of Hume Motorway	WB	Multi-lane arterial	3	2,900	965	C	4,900	1,635	D
	EB		3	4,200	1,400	D	3,300	1,100	C
West of Hume Motorway	WB	Multi-lane arterial	3	2,600	865	B	4,200	1,400	D
	EB		3	5,000	1,665	D	3,200	1,065	C
Picton Road									
East of Hume Motorway	WB	Multi-lane arterial	2	1,100	550	A	700	350	A
	EB		2	700	350	A	700	350	A
M9 Outer Orbital Motorway									
East of Hume Motorway	WB	Motorway	2	1,200	600	A	1,000	500	A
	EB		2	900	450	A	1,300	650	A
West of Hume Motorway	WB	Motorway	2	900	450	A	1,000	500	A
	EB		2	1,100	550	A	900	450	A
Spring Farm Parkway									
East of Hume Motorway	NB	Multi-lane arterial	2	0	0	A	200	100	A
	SB		2	200	100	A	200	100	A
West of Hume Motorway	NB	Multi-lane arterial	2	200	100	A	800	400	A
	SB		2	400	200	A	100	50	A
New North South Link Road									
South of Spring Farm Parkway	NB	-	-	-	-	-	-	-	-
	SB		-	-	-	-	-	-	-

Table 14 – Mid Block Level of Service (Source: Parsons Brinckerhoff)

The data shown shaded orange indicates the road network upgrades and new links that are required to service the background growth.

In addition further modelling has reviewed the regional road network requirements in two scenarios:

1. **Including the proposed Outer Sydney Orbital:**

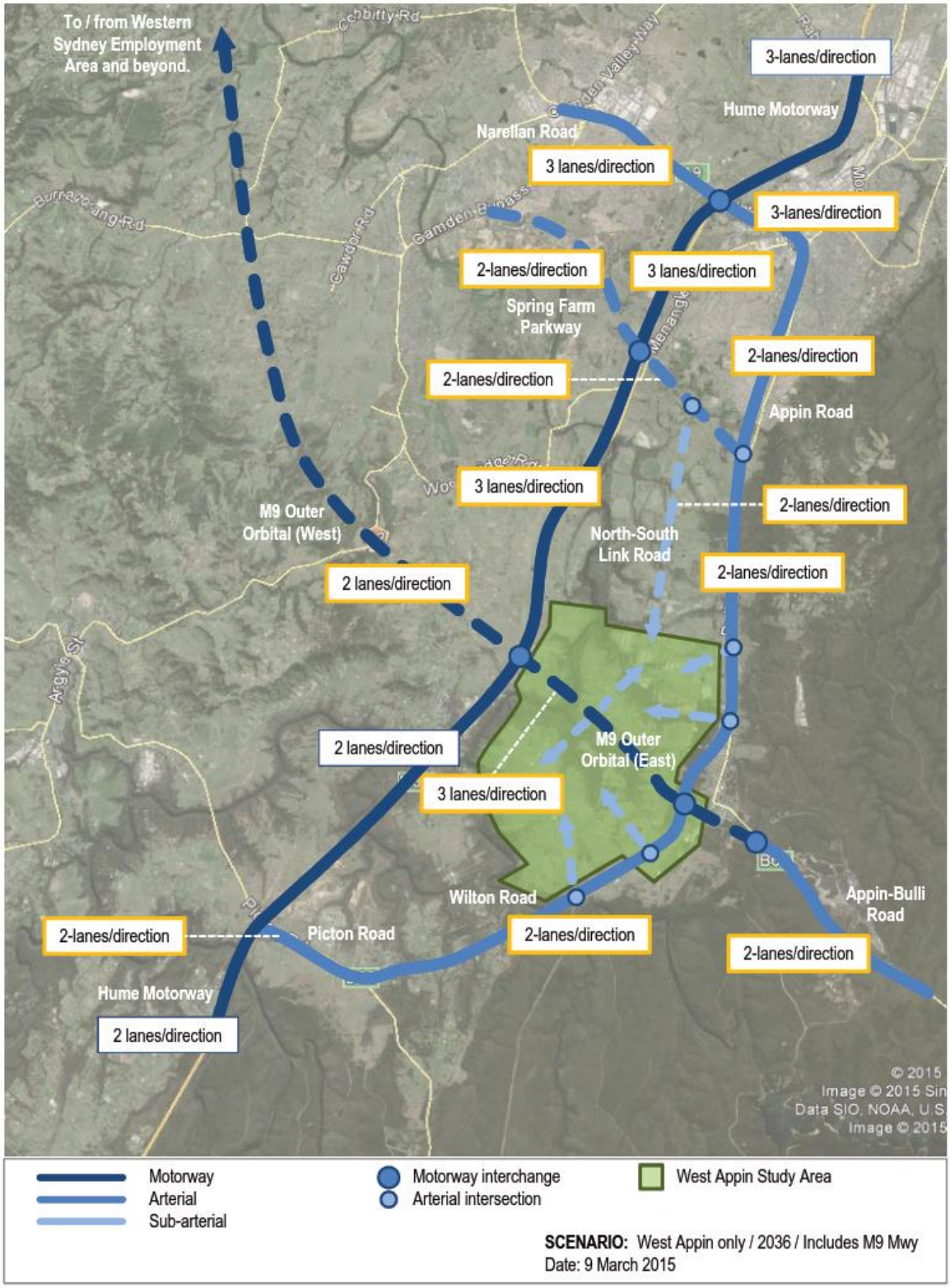


Figure 9 2036 Road Infrastructure Requirments including West Appin, and M9 (Source:Parsons Brinckerhoff)

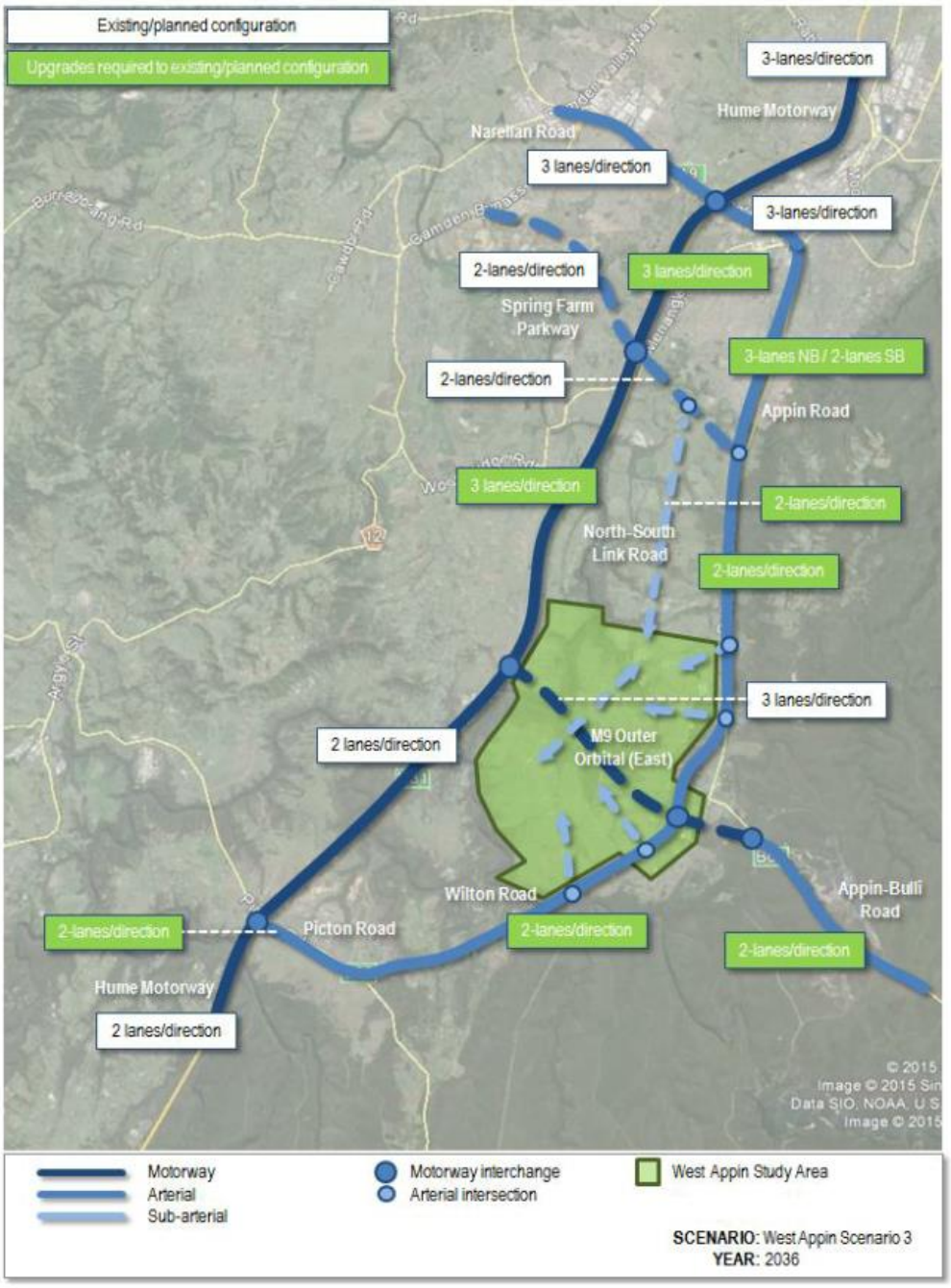
Mid-block LoS on key roads (2036 weekday, including West Appin, including M9)

Route / Location / Direction		Configuration[1]		AM peak			PM peak		
		Road type	Number of lanes	Total PCUs	PCU/ lane	LoS	Total PCUs	PCU/ lane	LoS
Hume Motorway (M31)									
North of Narellan Road	NB	Motorway	3	5,100	1,700	C	3,300	1,100	B
	SB		3	3,700	1,235	C	4,100	1,365	C
South of Narellan Road	NB	Motorway	3	4,500	1,500	C	3,900	1,300	C
	SB		3	3,900	1,300	C	4,400	1,465	C
South of Spring Farm Parkway	NB	Motorway	3	4,300	1,435	C	3,000	1,000	B
	SB		3	3,400	1,135	B	3,400	1,135	B
South of M9 Motorway	NB	Motorway	2	3,000	1,500	C	2,300	1,150	B
	SB		2	2,300	1,150	B	2,400	1,200	B
South of Picton Road	NB	Motorway	2	1,700	850	B	2,100	1,050	B
	SB		2	1,900	950	B	1,700	850	B
Appin Road / Appin Bulli Road									
North of Spring Farm Parkway	NB	Multi-lane arterial	2	2,700	1,350	D	1,900	950	C
	SB		2	1,500	750	B	2,100	1,050	C
South of Spring Farm Parkway	NB	Multi-lane arterial	2	2,300	1,150	C	1,800	900	C
	SB		2	1,700	850	B	2,700	1,350	D
East of Wilton Village	WB	Multi-lane arterial	2	1,700	850	B	1,400	700	B
	EB		2	1,700	850	B	1,800	900	C
Wilton Road									
South of Wilton village	NB	Multi-lane arterial	2	300	150	A	400	200	A
	SB		2	300	150	A	500	250	A
Narellan Road									
East of Hume Motorway	WB	Multi-lane arterial	3	2,900	965	C	4,700	1,565	D
	EB		3	4,100	1,365	D	2,900	965	C
West of Hume Motorway	WB	Multi-lane arterial	3	2,500	835	B	4,600	1,535	D
	EB		3	4,600	1,535	D	2,500	835	B
Picton Road									
East of Hume Motorway	WB	Multi-lane arterial	2	900	450	A	800	400	A
	EB		2	600	300	A	800	400	A
M9 Outer Orbital Motorway									
East of Hume Motorway	WB	Motorway	3	4,700	1,565	C	4,300	1,435	C
	EB		3	4,400	1,465	C	3,900	1,300	C
West of Hume Motorway	WB	Motorway	2	1,600	800	B	1,700	850	B
	EB		2	1,800	900	B	1,500	750	A
Spring Farm Parkway									
East of Hume Motorway	NB	Multi-lane arterial	2	300	150	A	400	200	A
	SB		2	400	200	A	1,300	650	B
West of Hume Motorway	NB	Multi-lane arterial	2	300	150	A	500	250	A
	SB		2	300	150	A	800	400	A
New North South Link Road									
South of Spring Farm Parkway	NB	Multi-lane arterial	2	600	300	A	100	50	A
	SB		2	200	100	A	300	150	A

Table 15 – Mid Block Level of Service (Source: Parsons Brinckerhoff)

The data shown shaded orange indicates the road network upgrades and new links that are required to service the new development and background growth.

2. Excluding the Outer Sydney Orbital:



Source: Parsons Brinckerhoff, adapted from Google Earth imagery (Google Earth, extracted March 2015)

Figure 6.3 Mid-block lane requirements overview (West Appin Scenario 3, 2036)

Figure 10 2036 Road Infrastructure Requirments exluding West Appin and M9 (Source:Parsons Brinckerhoff)

Mid-block LoS on key roads (2036 weekday, including West Appin, excluding M9 Motorway west of Hume Highway)

Route / Location / Direction		Configuration[1]		AM peak			PM peak		
		Road type	Number of lanes	Total PCUs	PCU/ lane	LoS	Total PCUs	PCU/ lane	LoS
Hume Motorway (M31)									
North of Narellan Road	NB	Motorway	3	5,300	1,765	D	3,400	1,135	B
	SB		3	4,000	1,335	C	4,400	1,465	C
South of Narellan Road	NB	Motorway	3	4,700	1,565	C	4,100	1,365	C
	SB		3	4,200	1,400	C	5,200	1,735	C
South of Spring Farm Parkway	NB	Motorway	3	5,200	1,735	C	3,800	1,265	C
	SB		3	3,800	1,265	C	4,500	1,500	C
South of M9 Motorway	NB	Motorway	2	2,900	1,450	C	2,200	1,100	B
	SB		2	2,100	1,050	B	2,400	1,200	B
South of Picton Road	NB	Motorway	2	1,700	850	B	2,100	1,050	B
	SB		2	2,000	1,000	B	1,600	800	B
Appin Road / Appin Bulli Road									
North of Spring Farm Parkway	NB	Multi-lane arterial	3	3,600	1,200	C	2,500	835	B
	SB		2	1,400	700	B	2,200	1,100	C
South of Spring Farm Parkway	NB	Multi-lane arterial	2	2,700	1,350	D	2,700	1,350	D
	SB		2	2,300	1,150	C	2,700	1,350	D
East of Wilton Village	WB	Multi-lane arterial	2	1,700	850	B	1,600	800	B
	EB		2	1,900	950	C	1,800	900	C
Wilton Road									
South of Wilton village	NB	Multi-lane arterial	2	400	200	A	300	150	A
	SB		2	300	150	A	700	350	A
Narellan Road									
East of Hume Motorway	WB	Multi-lane arterial	3	3,000	1,000	C	4,800	1,600	D
	EB		3	3,200	1,065	C	2,300	765	B
West of Hume Motorway	WB	Multi-lane arterial	3	3,000	1,000	C	4,900	1,635	D
	EB		3	4,300	1,435	D	2,600	865	B
Picton Road									
East of Hume Motorway	WB	Multi-lane arterial	2	900	450	A	800	400	A
	EB		2	500	250	A	700	350	A
M9 Outer Orbital Motorway									
East of Hume Motorway	WB	Motorway	3	4,000	1,335	C	3,200	1,065	B
	EB		3	3,400	1,135	B	3,500	1,165	B
West of Hume Motorway	WB	-	-	-	-	-	-	-	-
	EB		-	-	-	-	-	-	-
Spring Farm Parkway									
East of Hume Motorway	NB	Multi-lane arterial	2	700	350	A	1,400	700	B
	SB		2	2,500	1,250	C	1,700	850	B
West of Hume Motorway	NB	Multi-lane arterial	2	600	300	A	1,500	750	B
	SB		2	1,900	950	C	1,600	800	B
New North South Link Road									
South of Spring Farm Parkway	NB	Multi-lane arterial	2	1,600	800	B	700	350	A
	SB		2	700	350	A	600	300	A

Table 16 – Mid Block Level of Service (Source: Parsons Brinckerhoff)

The data shown shaded orange indicates the road network upgrades and new links that are required to service the new development and background growth.

Both scenarios consider a development yield of 15,500 dwellings and associated employment within the West Appin lands. It is noted that further modelling is being undertaken to review the regional road network requirements when West Appin is considered in the broader context of a future Macarthur South Growth Centre.

5.1.3 Strategic cost estimates

A summary of the cost estimate is shown in **Error! Reference source not found.** below. These cost estimates provided preliminary and based only on preconcept designs.

Based on the modelling undertaken by Parsons Brinckerhoff the required road upgrades have been costed at a strategic level based on:

- RMS indicative costings for new motorway works

- $3,500/lane/m where augmenting existing roads (includes allowance for traffic management)
- $3,000/lane/m for new motorway works

- SIC Practice note costings for arterial Road links, NorthWest and SouthWest Growth Centres
  - $2,500/lane/m where augmenting existing roads (includes allowance for traffic management)
  - $2,200/lane/m for new roads

The following road upgrades should be considered for implementation under a SIC arrangement for a future Macarthur South Growth Centre.

WEST APPIN - Major Roads			TOTAL COSTS	EXISTING REQUIREMENT*	NATIONAL ROAD COST	DEVELOPMENT ATTRIBUTABLE COST	NOTES
Road Description		**Length (m)**					
Identifier	**MS Sector**						
MS1	Hume Highway	22160	$ 225,880,000		$ 225,880,000		National Highway
MS2	Appin Road	15860	$ 129,800,000	$ 63,250,000	$	$ 66,550,000	Existing upgrade requirements and apportionable to development
MS3	Appin Bypass	3900	$ 81,400,000	$ 81,400,000		$	Existing upgrade requirements
MS4	M9	7800	$ 256,400,000	$ 172,800,000		$ 83,600,000	Base provision of 4 lanes State Cost , additional 2 lanes apportionable to development
MS5	Wilton Road	9785	$ 176,930,000	$ 48,262,500		$ 128,667,500	Existing upgrade requirements and apportionable to development
MS6	North South Link Road	11070	$ 212,466,000	$		$ 212,466,000	West Appin and Macarthur South GC
MS7	Spring Farm Parkway	3905	$ 76,959,000	$ 76,959,000		$	Provides Relief to Narellan Road, services Spring Farm and Menangle South
MS8	Moreton Park Link Road	4910	$ 102,608,000	$		$ 102,608,000	Macarthur South GC Cost not related to West Appin
	Miscellaneous -off site road and upgrades						
	Total	**127960**	**$ 1,262,443,000**	**$ 442,671,500**	**$ 225,880,000**	**$ 593,891,500**	

Existing Requirements relate to either an upgrade that is required to meet background growth or infrastructure that services other release areas

Table 17 - Transport Infrastructure Cost Estimate Summary

A more detailed breakdown of costs is shown in the following table:

Item	Length	Existing Lanes	2036 No West Appin Lanes	Total Cost to Govt. Based on Background Growth	Utlimate Lanes	Total Cost	Fully Developed Govt. Cost	Fully Developed Cost to Development
Hume Highway	22,160			$76,420,000		$225,880,000	$225,880,000	$0
North of Narellan Road		6	6	$0	6	$0	$0	$0
Narellan Road Interchange				$0		$0	$0	$0
Spring Farm Parkway to Narellan Road	4370	4	4	$0	6	$30,590,000	$30,590,000	$0
Spring Farm Parkway Interchange				$35,060,000		$35,060,000	$35,060,000	$0
Nepean River to Spring Farm Parkway	2640	4	4	$0	6	$18,480,000	$18,480,000	$0
Nepean River Crossing				$0		$34,650,000	$34,650,000	$0
Moreton Park Road to Nepean River	2780	4	4	$0	6	$19,460,000	$19,460,000	$0
Moreton Park Road Interchange				$0		$21,080,000	$21,080,000	$0
M9 to Moreton Park Road	3600	4	4	$0	6	$25,200,000	$25,200,000	$0
M9 Interchange				$41,360,000		$41,360,000	$41,360,000	$0
Nepean River Bridge to M9 Interchange	2930	4	4	$0	4	$0	$0	$0
Nepean River Bridge				$0		$0	$0	$0
Wilton Northern Ramps to Nepean River Bridge	5230	4	4	$0	4	$0	$0	$0
Wilton Northern Ramps				$0		$0	$0	$0
Picton Road to Wilton Northern Ramps	610	4	4	$0	4	$0	$0	$0
Picton Road Interchange				$0		$0	$0	$0
Appin Road	15,860			$63,250,000		$129,800,000	$63,250,000	$66,550,000
Spring Farm Parkway to Narellan Road	4820	2	2	$0	4	$24,100,000	$0	$24,100,000
Spring Farm Road Intersection		2	2	$6,000,000	4	$6,000,000	$6,000,000	$0
Moreton Park Link Road to Spring Farm Road	3000	2	2	$0	4	$15,000,000	$0	$15,000,000
Moreton Park Link Road Intersection		2	2	$0	4	$6,000,000	$0	$6,000,000
Appin Bypass to Moreton Park Link Road	4290	2	2	$0	4	$21,450,000	$0	$21,450,000
Appin Bypass Interchange		2	2	$25,900,000	4	$25,900,000	$25,900,000	$0
Appin Bulli Road to Appin Bypass	2500	2	2	$0	2	$0	$0	$0
Appin Bulli Road Intersection		2	2	$6,000,000	2	$6,000,000	$6,000,000	$0
M9 Interchange to Appin Bulli Road Intersection	1250	2	4	$6,250,000	4	$6,250,000	$6,250,000	$0
M9 Interchange		2	4	$19,100,000	4	$19,100,000	$19,100,000	$0
Appin Bypass	3,900			$81,400,000		$81,400,000	$81,400,000	$0
M9 to Appin Road	3900	0	4	$54,600,000	4	$54,600,000	$54,600,000	$0
M9 Interchange		0	2	$26,800,000	4	$26,800,000	$26,800,000	$0
M9	7,800			$172,800,000		$256,400,000	$172,800,000	$83,600,000
Hume Motorway to Employment Land Interchange	1170	0	4	$14,040,000	6	$21,060,000	$14,040,000	$7,020,000
Employment Land Interchange		0	4	$0	6	$9,200,000	$0	$9,200,000
Employment Land Interchange to Nepean Bridge	670	0	4	$8,040,000	6	$12,060,000	$8,040,000	$4,020,000
Nepean Bridge		0	4	$49,500,000	6	$49,500,000	$49,500,000	$0
Town Centre West Interchange to Nepean River	410	0	4	$4,920,000	6	$7,380,000	$4,920,000	$2,460,000
Town Centre West Interchange		0	4	$0	6	$9,200,000	$0	$9,200,000
Water Supply Crossing to Town Centre West Interchange	500	0	4	$6,000,000	6	$9,000,000	$6,000,000	$3,000,000
Water Supply Crossing		0	4	$13,860,000	6	$13,860,000	$13,860,000	$0
Town Centre East to Water Supply Crossing	1060	0	4	$12,720,000	6	$19,080,000	$12,720,000	$6,360,000
Town Centre East Interchange		0	4	$0	6	$9,200,000	$0	$9,200,000
Picton Bypass Interchange to Town Centre East Interchange	2170	0	4	$26,040,000	6	$39,060,000	$26,040,000	$13,020,000
Wilton Road to Picton Bypass Interchange	560	0	4	$6,720,000	6	$19,280,000	$6,720,000	$12,560,000
Wilton Road Flyover		0	4	$15,840,000	6	$15,840,000	$15,840,000	$0
Appin Bulli Road to Wilton Road Flyover	1260	0	4	$15,120,000	6	$22,680,000	$15,120,000	$7,560,000
Wilton Road	9,785			$48,262,500		$176,930,000	$48,262,500	$128,667,500
Appin Bulli Road Intersection to Intersection 1	1620	2	2	$0	4	$8,100,000	$0	$8,100,000
Intersection 1		2	2	$0	4	$6,400,000	$0	$6,400,000
Intersection 2 to Intersection 1	2650	2	2	$0	4	$13,250,000	$0	$13,250,000
Intersection 2		2	2	$0	4	$6,400,000	$0	$6,400,000
Intersection 2 to Broughton Pass Bridge	905	2	2	$0	4	$4,525,000	$0	$4,525,000
Broughton Pass Bridge		1	2	$48,262,500	4	$96,525,000	$48,262,500	$48,262,500
Broughton Pass Bridge to Douglas Park Drive	1460	2	2	$0	4	$7,300,000	$0	$7,300,000
Douglas Park Drive Intersection		2	2	$0	4	$3,400,000	$0	$3,400,000
Macarthur Drive to Douglas Park Drive Intersection	220	2	2	$0	4	$1,100,000	$0	$1,100,000
Macarthur Drive Intersection		2	2	$0	4	$3,400,000	$0	$3,400,000
Clements Creek to Maracthur drive	290	2	2	$0	4	$1,450,000	$0	$1,450,000
Clements Creek Bridge		2	2	$0	4	$5,940,000	$0	$5,940,000
Third Point Creek to Clements Creek	1720	2	2	$0	4	$8,600,000	$0	$8,600,000
Third Point Creek Bridge		2	2	$0	4	$5,940,000	$0	$5,940,000
Almond Street to Third Point Creek	920	2	2	$0	4	$4,600,000	$0	$4,600,000
North South Link Road	11,070			$0		$212,466,000	$0	$212,466,000
Spring Farm Parkway Intersection		0	0	$0	4	$5,680,000	$0	$5,680,000
Spring Farm Parkway to Menangle Creek	2630	0	0	$0	4	$23,144,000	$0	$23,144,000
Menangle Creek Crossing		0	0	$0	4	$29,700,000	$0	$29,700,000
Moreton Park Link to Menangle Creek	1960	0	0	$0	4	$29,128,000	$0	$29,128,000
Moreton Park Link Intersection		0	0	$0	4	$5,680,000	$0	$5,680,000
Water Supply Crossing to Moreton Park Road Link	410	0	0	$0	4	$15,488,000	$0	$15,488,000
Water Supply Crossing		0	0	$0	4	$10,395,000	$0	$10,395,000
West Appin Boundary to Water supply Crossing	2640	0	0	$0	4	$46,992,000	$0	$46,992,000
Town Centre to West Appin Boundary	1850	0	0	$0	4	$16,280,000	$0	$16,280,000
Town Centre Intersection		0	0	$0	4	$5,680,000	$0	$5,680,000
Water Supply Channel to Town Centre Intersection	1030	0	0	$0	4	$9,064,000	$0	$9,064,000
Water Supply Crossing		0	0	$0	4	$10,395,000	$0	$10,395,000
M9 Interchsnge Town Centre West to Water Supply Crossing	550	0	0	$0	4	$4,840,000	$0	$4,840,000
Spring Farm Parkway	3,905			$76,959,000		$76,959,000	$76,959,000	$0
Spring Farm Interchange Hume Motorway		0	4	$0	4	$0	$0	$0
Menangle Road Interchange to Hume Motorway	275	0	4	$2,420,000	4	$2,420,000	$2,420,000	$0
Menangle Road Interchange		0	4	$20,840,000	4	$20,840,000	$20,840,000	$0
North South Link Road to Menangle Road	400	0	4	$3,520,000	4	$3,520,000	$3,520,000	$0
Water supply Crossing to North South Link Road	330	0	4	$2,904,000	4	$2,904,000	$2,904,000	$0
Water Supply Crossing		0	4	$10,395,000	4	$10,395,000	$10,395,000	$0
Englorie Park Drive to Water supply Crossing	310	0	4	$2,728,000	4	$2,728,000	$2,728,000	$0
Englorie Park Drive Intersection		0	4	$5,680,000	4	$5,680,000	$5,680,000	$0
Glendower Street to Englorie Park Drive	1320	0	4	$11,616,000	4	$11,616,000	$11,616,000	$0
Glendower Street Intersection		0	4	$5,680,000	4	$5,680,000	$5,680,000	$0
Appin Road to Glendower Street	1270	0	4	$11,176,000	4	$11,176,000	$11,176,000	$0
Moreton Park Link Road	4,910			$0		$102,608,000	$0	$102,608,000
Hume Highway Interchange to Nepean River	1760	0	0	$0	4	$15,488,000	$0	$15,488,000
Nepean River Bridge		0	0	$0	4	$59,400,000	$0	$59,400,000
North South Link Road to Nepean River	760	0	0	$0	4	$6,688,000	$0	$6,688,000
Appin Road to North South Link Road	2390	0	0	$0	4	$21,032,000	$0	$21,032,000
								$0
Total				$519,091,500		$1,262,443,000	$668,551,500	$593,891,500

Table 18 - Transport Infrastructure Cost Estimate Summary

5.1.4 Road network staging

The proposed transport network will allow incremental staging over the project duration as new land development is released to market. An assessment of the proposed staging should be undertaken in conjunction with the investigation of a future Macarthur South Growth Centre.

Opportunities to utilise existing infrastructure should be explored where possible, the existing Moreton Park Road (North) overpass may present the opportunity for an early connection to the Hume Highway from West Appin which has lower capital costs.

6 CONCLUSION

Any proposed development in the West Appin Investigation area site is likely to be outside of the current infrastructure planning for the relevant service Authorities.

This is not to say that the development cannot be serviced. There exists some limited capacity in critical services of water, wastewater and electricity, sufficient to service initial stages of development at West Appin.

Beyond the initial stages it is clear that an infrastructure delivery plan will need to be implemented.

It is right and proper management of funds and assets for Endeavour Energy and Sydney Water Corporation not to have surplus capacity in their existing systems to be able to service a development the size of West Appin with augmentation. Further, it is appropriate for funding to have not been set aside to fund capacity for yet to be released land.

It is however possible, with appropriate planning and land release strategy to utilise existing capacity and implement planning to service the proposed development at West Appin.

It is noted that, should there be a timing mismatch for funding of infrastructure with the delivery of early stages, within the first five years, of development, well established mechanisms exist for the implementation of Commercial Agreements.

The release of land to satisfy housing needs and the orderly growth within the Sydney basin should not be limited where feasible physical and technical solutions exist, on the basis of there not being a plan for the implementation of the required infrastructure.

If the land at West Appin were to be rezoned on the basis of sound environmental assessment then the respective service authorities would need to implement the necessary plans and allocate appropriate resources to cater for the infrastructure.

In the intervening period, should development proceed ahead of the implementation of appropriate budgets and programs, the use of Commercial Agreements is appropriate.

There are no physical impediments or limitations on the infrastructure that prohibits its expansion or augmentation to service the West Appin Investigation Area.

The consideration of West Appin as part of a broader future Macarthur South Growth Centre creates an opportunity to implement regional infrastructure solutions and amortise capital costs across a broader cost base.

APPENDIX A

List of Technical Reports

Infrastructure category	Item
Water	Appin Sewage Treatment Plant and Recycled Water Proposal – Review of Environmental Factors prepared for Sydney Water by Planning Workshop Australia, August 2006 Macarthur South Water, Wastewater & Recycled Water Integrated Servicing Strategy prepared for Walker Corporation by Maunsell/AECOM October 2007 Appin and Wilton Review of Water Servicing Strategy prepared for Walker Corporation 2010 by AECOM Australia Pty Ltd APPIN AND WILTON – PRELIMINARY WSUD PRINCIPLES, AECOM, May 2010
Transport	West Appin Strategic Infrastructure Investigation Preliminary traffic and transport Assessment, Parsons Brinckerhoff, 31 March 2015
Social infrastructure	Social Infrastructure Rezoning Report, Elton Consulting , August 2014

APPENDIX B

Authority Engagement

West Appin servicing assessment

Capacity of existing water and wastewater systems
29 July 2014

Department of Planning and Environment (DP&E) is leading a high level infrastructure study for the proposed West Appin development. DP&E requested Sydney Water to advise on the capacity of existing water and wastewater system to service the proposed development.

A high level investigation was carried out on a number of systems surrounding the West Appin study area. For drinking water service, the West Appin study area is proximate to the Appin Water Supply Zone within the Macarthur Water Delivery System. However, there is no existing spare capacity within Appin and Macarthur systems and significant amplification would be required. For wastewater service, Glenfield Water Recycling Plant (WRP) and its trunk system has short-term spare capacity to service the forecast growth until 2020. How the West Appin initial customers potentially connected up to 2020, are serviced beyond 2020, will need to be considered.

Table 1 Drinking water system capacity

Drinking water system	2015-2020	2020-2025	2025-2036	Notes
Trunk system capacity				
Macarthur Water Delivery System	✘	✘	✘	• There is no existing spare capacity to service West Appin • This system is the preferred bulk water supply due to its close proximity to the study area • Sydney Water recently commenced studies on required amplification to Macarthur Water Filtration Plant (WFP) to service existing customer and forecast growth
Reticulation system capacity				
Appin Water Supply Zone	✘	✘	✘	• There is no existing spare capacity to service West Appin • There is upstream constraint at Macarthur WFP (treatment capacity and pumping capacity to Appin Reservoir) • DN1200 trunk main from Macarthur WFP to Sugarloaf (not yet assessed) is located within the study area. Further planning studies may include capacity assessment of this main, however it is still constrained by Macarthur WFP capacity

Note: Assumed low growth scenario for 2020, 2025 and 2030

Table 2 Wastewater system capacity

Wastewater system	2015-2020	2021-2025	2026-2036	Notes
Treatment plant				
Malabar WWTP	✓	✓	✓	• Flow to Malabar WWTP comes via Glenfield WRP. Malabar WWTP has capacity to service West Appin development.
Glenfield WRP	✓	✗	✗	• Glenfield WRP has short term (until 2020) spare capacity to service West Appin growth along with other growth developments considered in Growth Servicing Strategy. Continuation of the potential initial development from West Appin will need to be considered by 2020.
West Camden WRP	✗	✗	✗	• Short-term available spare capacity is reserved for servicing Oran Park and Catherine Fields PAP area.
Picton WRP	✗	✗	✗	• Current upgrade proposal for Picton WRP is allocated to other developments within Picton-Thirlmere-Tahmoor (PTT) excluding West Appin. .
Trunk main				
Malabar	✓	✪	✪	• Trunk main has short-term spare capacity to service West Appin until 2020.
Glenfield	✓	✪	✪	• Trunk main has short-term spare capacity to service West Appin until 2020.
West Camden	✓	✪	✪	• Trunk main has short-term spare capacity to service West Appin until 2020.
Picton	✗	✗	✗	

Note: ✪ Not assessed; assumed high growth scenario for 2020, low growth scenario for 2025 and 2030

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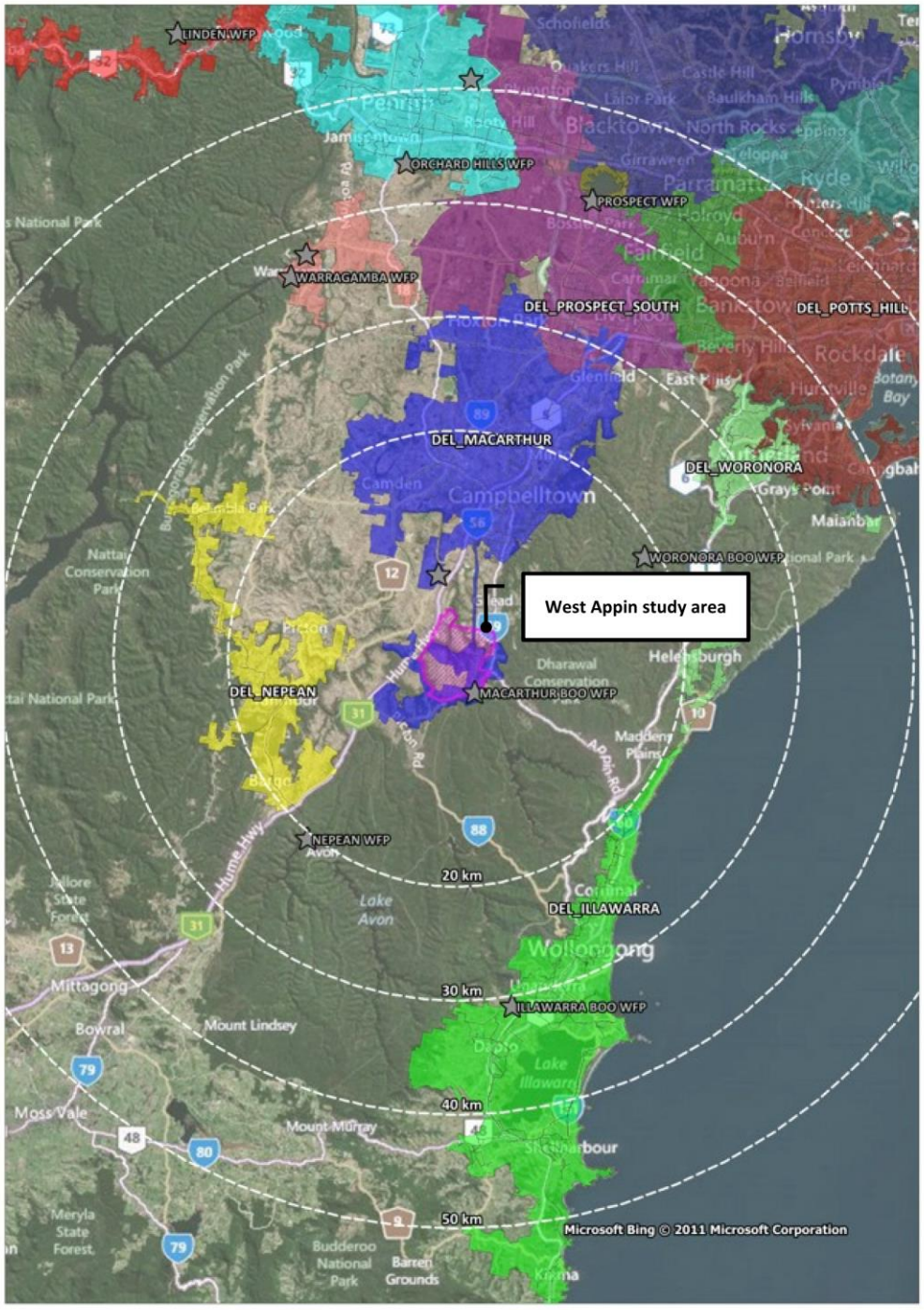

Figure 1 **Existing water delivery systems surrounding West Appin**

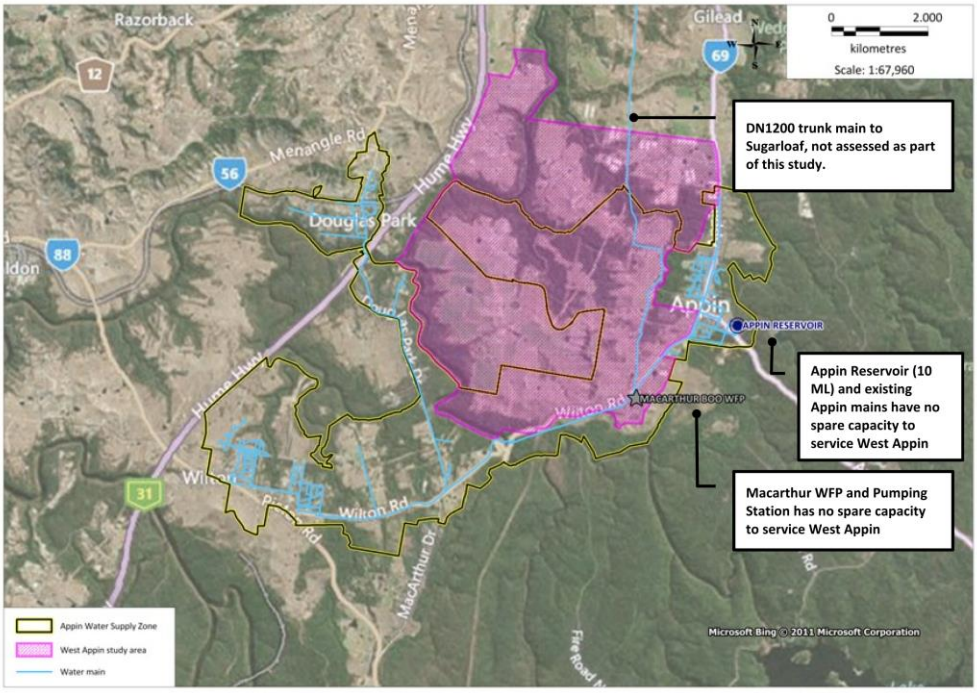

Figure 2 Existing drinking water infrastructure surrounding West Appin

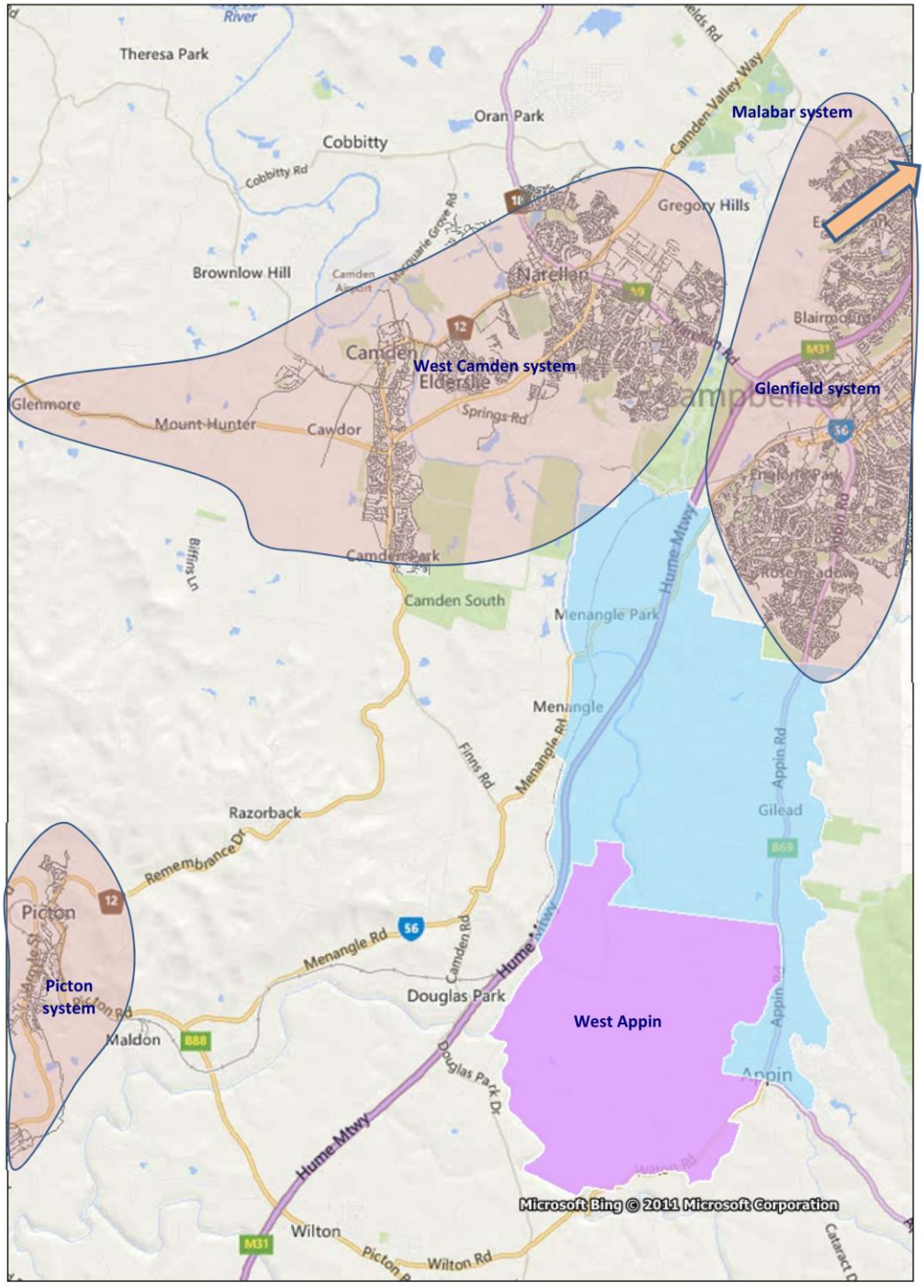

Figure 3 Existing wastewater systems surrounding West Appin

1 Background

Purpose

The Department of Planning and Environment (DP&E) is leading a high level infrastructure investigation on proposed urban development at West Appin. The stakeholders include Wollondilly Council, relevant state agencies and landowners. AECOM has been engaged by DP&E to carry out this investigation.

Additionally, West Appin proponents have also engaged Elton Consulting to carry out their own study, which will be peer reviewed by AECOM.

Sydney Water met with DP&E, Wollondilly Council, the proponents and their consultant on 7 July 2014. Following this meeting, Sydney Water was asked to assess the capability of the existing system to service West Appin.

Study area

West Appin study area is around 3,440 ha in size with potential dwelling yield of 18,000 (refer to Figure 4). The study area is situated between the existing villages of Appin and Douglas Park and made up of several discreet development sites. The proposed developments and growth forecast provided by DP&E are outlined in Tables 3-4.

Table 3 Proposed developments within West Appin study area

Proposed development	Area (ha)	Proposed dwellings	Equivalent Population (EP)	Notes
West Appin	600	6,500	19,500	Fragmented development
Appin Road	301	4,000	12,000	
Appin Vale	517	4,000	12,000	
Brooks Point	253	3,500	10,500	
TOTAL	**1,671**	**18,000**	**54,000**	

Note: Dwelling growth forecast based on DP&E, and assume dwelling occupancy rate of 3 EP/dwelling

Table 4 Growth scenarios for West Appin study area

Year	High growth		Medium growth		Low growth	
	Dwelling	EP	Dwelling	EP	Dwelling	EP
2020	1,800	5,400	1,125	3,375	500	1,500
2025	5,800	17,400	3,125	9,375	1,500	4,500
2030	10,600	31,800	5,525	16,575	2,700	8,100

Note: Dwelling growth forecast based on DP&E, and assume dwelling occupancy rate of 3 EP/dwelling

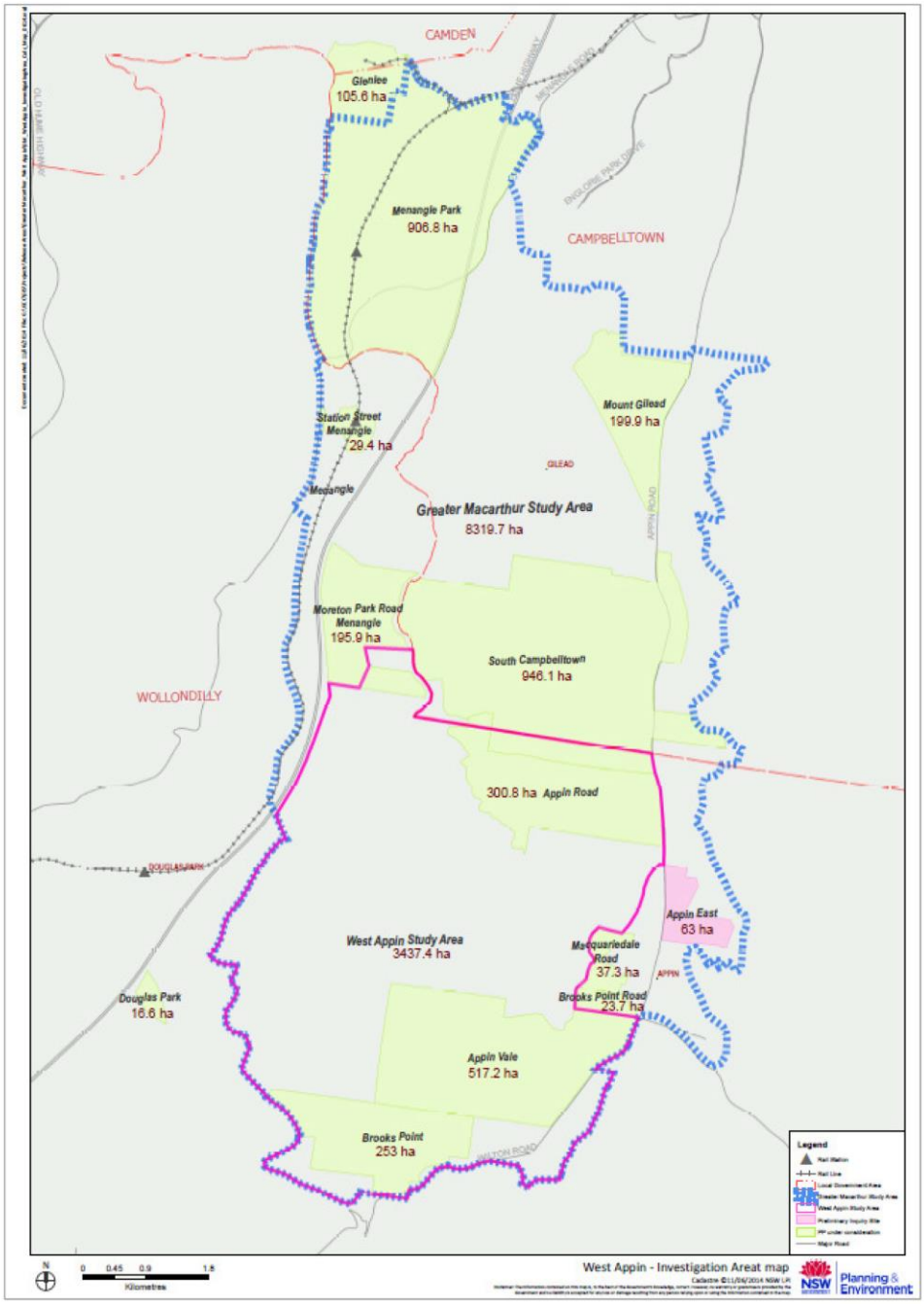

Figure 4 **West Appin investigation area (source: DP&E)**

2 Drinking water

2.1 Trunk system

There are four potential bulk water supplies to the West Appin study area, namely Macarthur, Nepean, Prospect South and Illawarra Water Delivery Systems.

Macarthur Water Delivery System

West Appin study area is located within the Macarthur Water Delivery System.

Raw water from Nepean, Avon, Cordeaux and Cataract Dams flows into the Broughtons Pass Weir. The water is then pumped to Macarthur Water Filtration Plant (WFP).

Macarthur WFP is situated within the vicinity of the study area. It services the Local Government Areas (LGA) of Wollondilly, Camden, Campbelltown and Liverpool. The WFP has a design rating of 265 ML/d. However, the treatment capacity is limited to around 130 ML/d due to the raw water quality. The existing customers within Macarthur system uses around 70 ML/d on average, with a maximum daily demand of 128 ML/d. There is no spare capacity to service additional growth from this system.

Macarthur system is proposed to service the southern half of the South West Growth Centre. Additionally, there is potential for significant growth within Wollondilly LGA on top of West Appin (eg Wilton Junction and South Campbelltown). Sydney Water is currently investigating options to increase the plant capacity to service existing customers and forecast growth.

It is recommended that the West Appin study area is serviced from Macarthur system. To ensure Macarthur WFP is designed appropriately, it is critical that Sydney Water receives growth forecast for all proposed developments within the Macarthur region. Additionally, substantial trunk infrastructure (reservoir and trunk main) would also be required.

Nepean Water Delivery System

Nepean Water Delivery System services the townships of Buxton, Picton, Bargo and The Oaks. Raw water from Nepean Dam is supplied to Nepean WFP. Nepean WFP has a design capacity of 36 ML/d. Significant growth is expected within the Nepean system, with Max Day Demand (MDD) forecast to increase to 45 ML/d by 2036.

Nepean WFP is located around 20 km away from West Appin study area. Substantial amplification would be required on the WFP and new trunk infrastructure would be required along Hume Highway towards the West Appin study area. If Nepean is assessed as a potential bulk water supply to West Appin, it is critical that Sydney Water receives growth forecast for all proposed developments within the Macarthur region. At this stage, Nepean is not recommended as the bulk water provider for West Appin due to the greater distance between Nepean WFP and the study area, compared to Macarthur WFP.

Prospect South Water Delivery System

Prospect South Water Delivery System services the suburbs of Minchinbury, Eastern Creek, Liverpool, Badgerys Creek, Hoxton Park and Cecil Park. Prospect South is supplied from Prospect WFP, located around 45 km away from West Appin study area. Prospect WFP also supplies Prospect North, Prospect East, Ryde and Potts Hill systems.

Prospect South borders the northern boundary of Macarthur system. The closest distribution reservoir to the West Appin study area is Liverpool Reservoir, located 35 km to the north of the study area. Prospect South is proposed to service the western portion of North West Growth Centre and the northern portion of South West Growth Centre.

Prospect South is not recommended as the bulk water provider for West Appin due to the substantial distance between the system and West Appin study area. There is potential for additional investigation into the capacity of Prospect South to service a greater portion of the South West Growth Centre. If feasible, this would relieve some future capacity in the Macarthur system to service West Appin.

Illawarra Water Delivery System

Illawarra WFP is located around 31 km south east of the study area. The closest trunk infrastructure is Woonona Heights Reservoir (4.5 ML) and its 250 mm trunk main. Illawarra system is not recommended as the bulk water provider for West Appin due to its distance from the study area, lack of large trunk infrastructure and mountainous terrain between the Illawarra system and the study area.

2.2 Reticulation system

Within the Macarthur Water Delivery System, West Appin study area can be supplied from Appin Water Supply Zone. Water from Macarthur WFP is pumped to Appin Reservoir (WS0412) and then distributed to the villages of Appin, Douglas Park and Wilton.

Sydney Water is currently undertaking detail planning to service Bingara Gorge (adjacent to Wilton village) and several urban development sites in the northern part of Appin village. Investigation result indicates that the existing system does not have the capacity to service these sites and requires to be amplified.

Even though there is no current spare capacity to service West Appin, the Appin zone can potentially be amplified further to include new trunk infrastructure.

Another potential supply is the DN1200 trunk main from Macarthur WFP to Sugarloaf, which runs through the West Appin study area (refer to Figure 2). This trunk main is the single supply feed to the northern part of Macarthur Water Delivery System and has not been assessed as part of this study. Capacity of this main can be assessed in subsequent planning studies to determine its feasibility to service West Appin.

3 Wastewater

There are three existing wastewater systems around the proposed West Appin development area. They are Glenfield-Malabar system, West Camden system and Picton system. A high level investigation for treatment and trunk (2020 only) capacity for each system is provided below.

3.1 Malabar-Glenfield system

Malabar WWTP, a primary plant with capacity of 1,600,000 EP, is capable of meeting EPA license requirements up to 1,000 ML/d. This will increase to 2,700,000 EP and 1,300 ML/d once the Process and Reliability Renewal (PARR) project is partly completed. Malabar WWTP will have sufficient capacity to meet current sludge stabilisation requirements and sufficient capacity to meet projected hydraulic demand up to 2036 based on current projected growth once the PARR works are complete in 2018.

Glenfield WRP has a nominal ADWF secondary treatment capacity of 46 ML/D, designed for 260,000 EP. The plant has a primary treatment capacity of 120 ML/d and total peak wet weather capacity of 302 ML/D. The existing 220,000 EP is forecasted to increase to 252,000 EP by 2020 considering other major developments in the catchment. That means there is potential short-term spare capacity until 2020 for approximately 8,000 EP adequate to service initial development within West Appin. The system is forecasted to reach capacity by 2021. How the West Appin initial customers potentially connected up to 2020, are serviced beyond 2020, will need to be considered.

3.2 West Camden system

West Camden WRP has a treatment capacity for 134,000 EP and currently meets STS licence requirements. The 134,000 EP capacity is achieved with both the IDALs and the MLE stream of the plant. The plant has short-term available spare capacity, however this spare capacity is reserved for servicing Oran Park, Catherine Fields PAP growth area until upgrade of West Camden WRP or build a new treatment plant for Lowes Creek catchment. Therefore West Camden WRP capacity is inadequate to service proposed West Appin development.

3.3 Picton system

Currently, Picton WRP is not performing within the limits in the current environment protection licence for the Picton sewage treatment system (EPL no.10555). It exceeded the limit of total suspended solids and BOD loads being released to Stonequarry Creek by 286% and 310% respectively in 2011-12 with loads of 2,818 kg and 2,994 kg. There is also limitation in effluent management. Proposed treatment plant upgrade for Picton WRP is based on the allocation of other developments that exclude West Appin. Therefore Picton WRP is not an option to service proposed West Appin development.

Endeavour Energy

4 July 2014

Paul Hedge
Principal Civil Engineer
L2, 8 Windmill St Sydney 2000

Dear Mr Hedge

WEST APPIN HIGH LEVEL STRATEGIC INFRASTRUCTURE INVESTIGATION

I refer to your request to review electricity distribution network capacity to service the proposed West Appin Precinct which has an ultimate residential lot potential of 18,000. Thank you for the opportunity to provide comment on this proposal.

There is very limited existing power infrastructure in the precinct as the area is rural in nature. The existing zone substation at Appin is of a rural standard and can only supply an additional 800 residential lots.

This proposed development would result in significant step change in electrical infrastructure as it represents an ultimate load of 90MVA. There are constraints on the upstream sub-transmission network and preliminary studies indicate supply to West Appin would ultimately require:

- Establishment of a new 132kV/66kVTransmission Substation at Douglas Park
- Major augmentation and establishment of new 132kV transmission lines to Douglas Park from Nepean Transmission Substation.
- Two new 66/11kV Zone Substations plus associated 66kV feeders from the Douglas Park Transmission Substation.

The above works would require an investment of $120 million and exclude distribution reticulation (11kV and Low Voltage) which are contestable works funded by the developer.

There is no funding allowed for any of the above works in the current Endeavour Energy 10 year forward capital works program.

This development may also bring forward augmentation requirements to Transgrid's network, in particular the Macarthur Bulk Supply Point. This has not been allowed for in these preliminary estimates.

51 Huntingwood Drive Huntingwood NSW 2148
PO Box 811 Seven Hills NSW 1730
T: 131 081 F: 61 2 9853 6000

www.endeavourenergy.com.au

ABN 59 253 130 878

We trust that this information will satisfy your requirements for a high level investigation. Please contact me directly on (02) 9853 5003 should you wish to discuss further.

Yours faithfully

Jason Lu
Capacity Planning Manager
Asset and Network Planning
Endeavour Energy

In reply quote: 2014/00120/001

17 JUL 2014

SYDNEY CATCHMENT AUTHORITY

PO Box 323 Penrith NSW 2750
Level 4, 2-6 Station Street
Penrith NSW 2750
Tel 1300 722 468 Fax 02 4725 2599
Email info@sca.nsw.gov.au
Website www.sca.nsw.gov.au

Ref: D2014/57819

Mr Stephen McIntyre
Deputy Director General, Planning Strategies Housing and Infrastructure
Department of Planning and Environment
GPO Box 39
Sydney NSW 2001

Dear Mr McIntyre

West Appin High Level Strategic Infrastructure Investigation

I refer to the West Appin High Level Strategic Infrastructure Investigation being undertaken in the vicinity of the Appin village.

The study area includes the Upper Canal which is owned and managed by the Sydney Catchment Authority (SCA). The southern sector of the precinct also borders SCA owned land and the Metropolitan Special Area.

Upper Canal
The Upper Canal is a critical part of the Sydney drinking water supply system. The Upper Canal begins at Pheasants Nest Weir on the Nepean River and transfers water from the Upper Nepean Dams to the Prospect water filtration plant. It is essential that any development within the vicinity of the Upper Canal or crossing it, in no way compromises its functionality and safe operations.

The Upper Canal corridor is owned by the SCA and public access is prohibited.

Heritage Issues
The Upper Canal is listed on the State Heritage Register (Item Number 01373). Within the study area, the Upper Canal includes the Cataract tunnel from Broughton Pass weir in the south, and sections of open canal. There are four creek and gully crossings at Simpsons, Elladale, Ousedale and Mullaly Creeks (see attached map, Tab 1).

Impacts from Urban Infrastructure
It is essential that any new urban infrastructure accommodates the Upper Canal without restricting its operation or maintenance, or opportunities for the SCA to install new or modify existing infrastructure. New development should not increase security or water quality risks. Heritage impacts will also need to be considered. For any infrastructure crossing, an easement and associated management arrangement will need to be negotiated between the proponent and the SCA. A copy of the SCA's *Guidelines for development adjacent to the Upper Canal and Warragamba Pipelines* is attached for your information (Tab 2). Any development should be consistent with Section 3 of the Guidelines.

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Specific SCA requirements will also apply at the time the development is proposed.. This will involve the consideration of impacts such as from erosion and sedimentation or stormwater as well as issues of public safety and asset security.

Metropolitan Special Area

The West Appin Precinct Study Area borders the Sydney drinking water catchment and specifically SCA-owned land and the Metropolitan Special Area. The land in question is designated Schedule 1 Special Area under the *Sydney Water Catchment Management Act 1998* and *Sydney Water Catchment Management Regulation 2013* where public access is excluded. While most Special Area in the study area is owned by the SCA, the Special Area extends over several private properties to the north of Wilton Road (see map, Tab 1). The exact boundary of the study area needs to be refined in consultation with the SCA to ensure that the precinct excludes all SCA-owned and Special Area land.

The SCA will be seeking specific requirements be applied to the study area at its boundary with Metropolitan Special Area and SCA-owned land. Details of those requirements can be raised at later stages when the study area is finalised and at the time the development is proposed.

West Appin High Level Strategic Infrastructure Investigation - Maps

The SCA requests that any infrastructure strategies arising from the West Appin High Level Strategic Infrastructure Investigation include maps depicting the position of the Upper Canal and proposed crossing areas for key infrastructure. The SCA also requests that such maps show the location of the SCA-owned land and Schedule 1 Metropolitan Special Area lands. The SCA can provide the necessary GIS shape files upon request.

Consultation

The SCA requests that the Department consult with it as the investigation progresses, and also place this requirement on the landowner group. This will provide us with the opportunity to elaborate on the issues raised in this letter and ensure that Sydney's water supply system and catchment protection are accommodated.

Should you have any questions, or wish to discuss the Upper Canal in more detail with, please contact Malcolm Hughes, Senior Manager, Planning and Environment, on 4724 2452 or malcolm.hughes@sca.nsw.gov.au.

Yours sincerely

GRAHAM BEGG 14/7/19
General Manager Catchments

Cc: Gerry Beasley
Executive Planner - Walker Corporation

Macarthur Water Treatment Plant

TRILITY

Partnering with Sydney Water to achieve long term desirable financed water treatment solutions

The scope of the project includes the design, build, finance and 35 year operation and maintenance of the facilities.

The major municipal water authority Sydney Water identified the need for a privately financed water treatment plant to supply the Camden, Campbelltown and Wollondilly areas of New South Wales.

Wholly owned by TRILITY, the Macarthur Water Treatment Plant (WTP) supplies over 250,000 Sydney Water customers.

Raw water is sourced from Broughton's Pass Weir located on the Cataract River. The raw water is transported three km through low and high lift pumps to raw water storage tanks on-site. The raw water then flows by gravity through the plant.

During the process, coagulants and flocculants are added to the raw water so that particles of sediment join together facilitating removal. The material is collected and dried on-site and can be used for a variety of beneficial reuse purposes.

The water passes through filters containing sand and anthracite coal. Chlorine is dosed for primary disinfection after the filters, and fluoride is added for dental protection. Lime and carbon dioxide are added to the water to correct the pH levels. Chlorine and ammonia are also dosed into the gravity main to form chloramine, a long lasting disinfectant.

Who

Sydney Water provides drinking water, recycled water, wastewater services and storm water services to more than four million people in Sydney, Illawarra and the Blue Mountains. It is Australia's largest water utility with over 3,000 staff and a coverage area of 12,700km.

What

A $123m, 265 ML/day Water Treatment Plant (WTP), built to improve water quality and supply water to over 250,000 Sydney Water customers. The plant operates to an exceptionally high standard and is one of the most efficient in Australia.

Where

The historic town of Appin, 70km southwest of Sydney in the Macarthur region of New South Wales. A relatively small volume of treated water is used locally, with most gravitating to storage reservoirs supplying the fast-growing Campbelltown and Narellan areas.

Why

The plant was built to improve drinking water quality and overcome variable source water characteristics. During storms, fast flowing creeks which feed local water storages pick up sediments and make the raw water turbid. The filtration process removes sediments and colour, eliminating these as sources of water quality problems.

Snapshot

Client	Sydney Water
Type of Contract	Design, Build, Finance, Operate (DBFO)
Facilities	Water Treatment Plant (WTP) and pumping station
Technology	Direct filtration
Design Capacity	265 ML/d
Term	35 years
Capital Cost	c. $123m

TRILITY

leading the way in water utility solutions

For further information

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E: adloffice@trility.com.au

Visit us online at:
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APPENDIX C

Terms of Reference

NSW GOVERNMENT | Planning & Infrastructure

Mr Gerry Beasley
Executive Planner
Walker Corporation
Level 21, Governor Macquarie Tower
1 Farrer Place
Sydney NSW 2000

13/20740

Dear Mr Beasley,

I refer to ongoing discussions between Walker Corporation, Mir Group, Ingham Rural Property Group (landowner group) and Wollondilly Council (Council) regarding the landowner group's proposal for a masterplanning approach to investigate urban development at West Appin.

On 3 December 2013 the Minister for Planning and Infrastructure informed Wollondilly Council that Government wants to ensure that there are no threshold issues that would prevent the development of West Appin. In particular an early investigation into infrastructure requirements of West Appin is required to prior to committing to a joint masterplanning process.

The Department of Planning and Infrastructure (DP&I) is to lead the infrastructure investigation involving Council, relevant state agencies and landowners. As part of the investigations there is an opportunity for landowners to undertake a high level study which DP&I will accept as an input for consideration.

DP&I in discussion with state agencies and Council has prepared a Terms of Reference to inform the landowner work. I have attached a copy for your information. It is important to note that the outcomes of the landowner study and any recommendations made by the landowners will not alone determine DP&I recommendations on West Appin and will be prepared by the landowners at their own cost and risk.

Should you have any further enquiries about this matter, I have arranged for Mr Andrew Jackson, Executive Director Infrastructure and State Strategies of the Department of Planning and Infrastructure to assist. Mr Jackson can be contacted on 9228 6445.

Yours sincerely

23/12/13

Stephen McIntyre
Deputy Director General, Planning Strategies Housing Infrastructure

Bridge St Office 23-33 Bridge St Sydney NSW 2000 GPO Box 39 Sydney NSW 2001 DX 22 Sydney
Telephone: (02) 9228 6111 Facsimile: (02) 9228 6191 Website planning.nsw.gov.au

WEST APPIN HIGH LEVEL STRATEGIC INFRASTRUCTURE INVESTIGATION
DRAFT TERMS OF REFERENCE FOR PROPONENT SUBMISSION

Investigation	Proponent input to a high level strategic investigation of infrastructure requirements for a proposed urban development at West Appin.
Location	West Appin Stud Area in the vicinity of Appin Village in the Wollondilly Local Government Area, as identified on the attached Map.
Proponent	Consortium of Landowners comprising Walker Corporation Pty Ltd, Mir Group of Companies and Ingham Rural Property Group Pty Ltd
Date of Issue	**20 December 2013**
Terms of Reference	1. The Proponent will prepare a High Level Investigation & Business Case to determine, at a strategic level the required infrastructure, servicing, staging and cost. The proponent investigation may be considered as an input into a broader infrastructure investigation for West Appin and surrounds to by lead by the DP&I. The investigation is required prior to any further consideration of a proposed rezoning of land for urban purposes at West Appin. 2. The proponent investigation will document the existing infrastructure services and condition at West Appin including: • Transport conditions on the surrounding road network (including but not limited to the State Roads with a particular focus on intersections, important local council roads, and bus and rail services, stations and interchanges); • Stormwater detention and treatment for water quality (including infrastructure maintenance for future Council assets); • Public and private school services (primary and secondary); • Community health and hospital services; • Emergency services infrastructure including Fire, Rural Fire Service, Ambulance, Police and SES; • Recreational and sporting needs; and • Essential services (Potable water; Sewage treatment and disposal of effluent; Recycled water and water reuse if proposed; Electricity; Gas; and telecommunications). 3. The proponent investigation will detail the infrastructure required to service the ultimate development, including: • Road upgrades and augmentation for access and capacity generated by the development with due regard to the need for the maintenance of higher speed key freight routes through the area; • Public transport; • Stormwater detention and treatment for water quality (including infrastructure maintenance for future Council assets); • Public and private school services (primary and secondary); • Community health and hospital services; • Emergency services infrastructure including Fire, Rural Fire Service, Ambulance, Police and SES; • Recreational and sporting needs; • Essential services (Potable water; Sewage treatment and disposal of effluent; Recycled water and water reuse if proposed; Electricity; Gas; and telecommunications) 4. The proponent investigation will provide details of potential urban development

	scenarios including estimated annual housing production (including consideration of affordable and seniors housing products) and employment floor space production (including mixed use, commercial, business, retail and industrial floor space) and demonstrate the economic feasibility of the estimated annual production. In establishing the estimated annual production, the Business Case must consider two different ultimate development scenarios with sensitivity testing, including: • Full delivery of housing (up to 18,000 dwellings) and employment lands potential for the West Appin Precinct, plus estimated take-up elsewhere in Wollondilly LGA and other land in the vicinity of the West Appin Precinct under existing planning provisions; and • Full delivery of housing (up to 18,000 dwellings) and employment lands potential for the West Appin Precinct, plus full delivery of housing and employment lands potential for the Wilton Junction Precinct and all other rezoning proposals in Wollondilly LGA and on other land in the vicinity of the West Appin Precinct which have been released for community consultation but not yet finalised. 5. The investigation will provide details of area of influence on infrastructure associated with the estimated annual housing and employment floor space production. In establishing an area of influence, the Business Case must consider two different ultimate development scenarios including: • Full delivery of housing (up to 18,000 dwellings) and employment lands potential for the West Appin Precinct, plus estimated take-up elsewhere in Wollondilly LGA and other land in the vicinity of the West Appin Precinct under existing planning provisions; and • Full delivery of housing (up to 18,000 dwellings) and employment lands potential for the West Appin Precinct, plus full delivery of housing and employment lands potential for the Wilton Junction Precinct and all other rezoning proposals in Wollondilly LGA and on other land in the vicinity of the West Appin Precinct which have been released for community consultation but not yet finalised. 6. The investigation will broadly outline an infrastructure delivery strategy identifying major infrastructure requirements and the related development thresholds which trigger their delivery, provide details of proposed staging of works, costs and Net Present Value cash flows for the life of the release area. 7. The investigation will provide details of proposed funding for staging and the entire cost of delivery of required infrastructure. This will include any proposed funding mechanism such as a planning agreement or other. The proponent will need to explicitly address the Government policy of no additional cost to Government. 8. The investigation will identify and respond to the provisions applying to infrastructure, servicing and staging contained in relevant environmental planning instruments, policies and guidelines, including: • NSW 2021: A plan to make NSW number one • Draft Metropolitan Strategy for Sydney to 2013 and relevant draft Subregional Strategies • The NSW Long Term Transport Master Plan • Wollondilly Draft Growth Management Strategy • *Wollondilly Local Environmental Plan 2011* • Wollondilly Development Contributions Plan

	9. The Proponent will consult with Wollondilly Council, the relevant public authorities and service providers as necessary to inform its investigation and confirm the specific scope requirements of each agency. The relevant public authorities and service providers are listed as follows: • Transport for NSW • Roads and Maritime Services • Sydney Water Corporation • Department of Education and Communities • NSW Ministry of Health • Housing NSW • Fire & Rescue NSW • Rural Fire Service • Police Property Group • Ambulance Service of NSW • Department of Justice & Attorney General • State Emergency Service • Endeavour Energy & Transgid Additional specific investigation terms of reference for transport infrastructure are also provided at attachment 1. The final scope of the transport infrastructure component is to be agreed by the proponent with Transport for NSW.
	The Business case/investigation undertaken by the proponent will be prepared and submitted to DP&I, agencies listed in point 9 above and Wollondilly Council in accordance with an agreed probity plan. DP&I requests that the proponent provide an update on the progress of the investigation no later than the end of February 2014. The DP&I may consider the investigation as an input into a broader infrastructure investigation for West Appin and surrounds the outcome of which will be reported to Government during the 1st Quarter of 2014. It is important to note that these terms of reference and the outcome/recommendations made by the proponent investigations/business case will not alone determine DP&I recommendations for West Appin and will be prepared by the proponent at their own cost and risk.

ATTACHMENT 1

West Appin Transport Infrastructure Investigations

Purpose

A strategic transport assessment is required to assess the future transport infrastructure and service needs of an urban release area of some 18,000 dwellings at West Appin.

Outputs / Outcomes

A transport assessment must be undertaken in consultation with Transport for NSW, which addresses the following (final scope to be agreed with Transport for NSW):

- Documents the existing transport conditions on the surrounding road network (including, but not limited to State Roads, important local council roads, and bus
and rail services, stations and interchanges).

- Outline of the future development scenarios at the relevant design horizons including the cumulative yield of adjacent or nearby known or future development (within the region of likely influence) including details of forecast lot numbers and any mixed use or commercial development.

- Identifies the transport demands and travel patterns associated with the subject
development (and adjacent development) across transport modes.

- Identifies the impact of the additional travel demand associated with the proposal
(and any other surrounding development) on the existing transport networks / services at the relevant design horizons.

- Develops staged infrastructure and servicing strategies for the development and
other proposals. This will require a considered approach that looks at the need for
additional links in and augmentation of the transport network and appropriate triggers and staging of the construction/introduction of those works.

- Specific project proposals need to be discussed and agreed with Transport for
NSW. At a minimum high level strategic / concept engineering plans need to be
developed in order to better understand the magnitude of costs involved.

- Develop an initial infrastructure project by project cost apportionment schedule
for TfNSW consideration.

Consultation/Governance

A transport working group should be formed with the proponent and including DP&I, TfNSW, RMS, Wollondilly Council and potentially NSW Treasury representatives.

Base Assumptions
Base assumptions and targets relating to population, employment, transport generation, degree of employment self containment and travel mode splits are to be generally agreed by TfNSW prior to the commencement of the Study.

Modelling Approach:
The assessment will comprise a two part model approach, as follows:

- Strategic transport modelling undertaken by TfNSW using existing model resources to identify travel demand and mode splits
- Assignment and assessment of the transport network at a mesoscopic level undertaken by the proponent (in consultation with TfNSW).

Strategic Transport Model
TfNSW will undertake the strategic modelling component of the assessment with inputs developed by the proponent using the Sydney Strategic Transport Model (STM). The STM shall be used to determine the likely growth in travel demand and to assist to refine the mode split between vehicular trips and public transport trips.

Prior to the use of the STM, the proponent will undertake high level calibration and validation of the base year matrices and review future year growth in the sub-region in consultation with TfNSW.

TfNSW will undertake the final model development with the intent that base and future year matrices will be utilised in the next stage of mesocopic modelling.

TfNSW will define the study area for the assessment in discussion with the proponent.

Mesoscopic Modelling
The proponent will develop a transport model at a mesoscopic level for the car mode to the satisfaction of Transport for NSW.

The mesoscopic model shall be based on the output of the strategic transport modelling and used (amongst other things) for the purpose of determining route assignment and identifying infrastructure upgrades as a result of the impacts of the future development. . For the highway assignment component of the model, Transport for NSW requests that this be undertaken using the Aimsun modelling package.

The model area that should be examined should be agreed with TfNSW prior to model Development.

The model should include, but not be limited to:

- All relevant state roads (i.e. Freeways, Motorways and arterial roads) in accordance with Transport for NSW requirements.
- All the sub-arterial road links and any road or street that carries over 12,000 vehicles per day (two-way).
- Any local road that could potentially be used to access the State Road network
  from the West Appin development site should be included.

- Any new significant road or transport connections that are established within the
  development area, or adjacent developments
- The mesoscopic model must be able to demonstrate that due consideration has
  been given to a range of factors including weave movements and merge/diverge
  lengths.

The mesoscopic model developed will be handed over to TfNSW to own and potentially:

- add to;
- distribute to others (including other developers);
- modify and change at the total discretion of TfNSW.

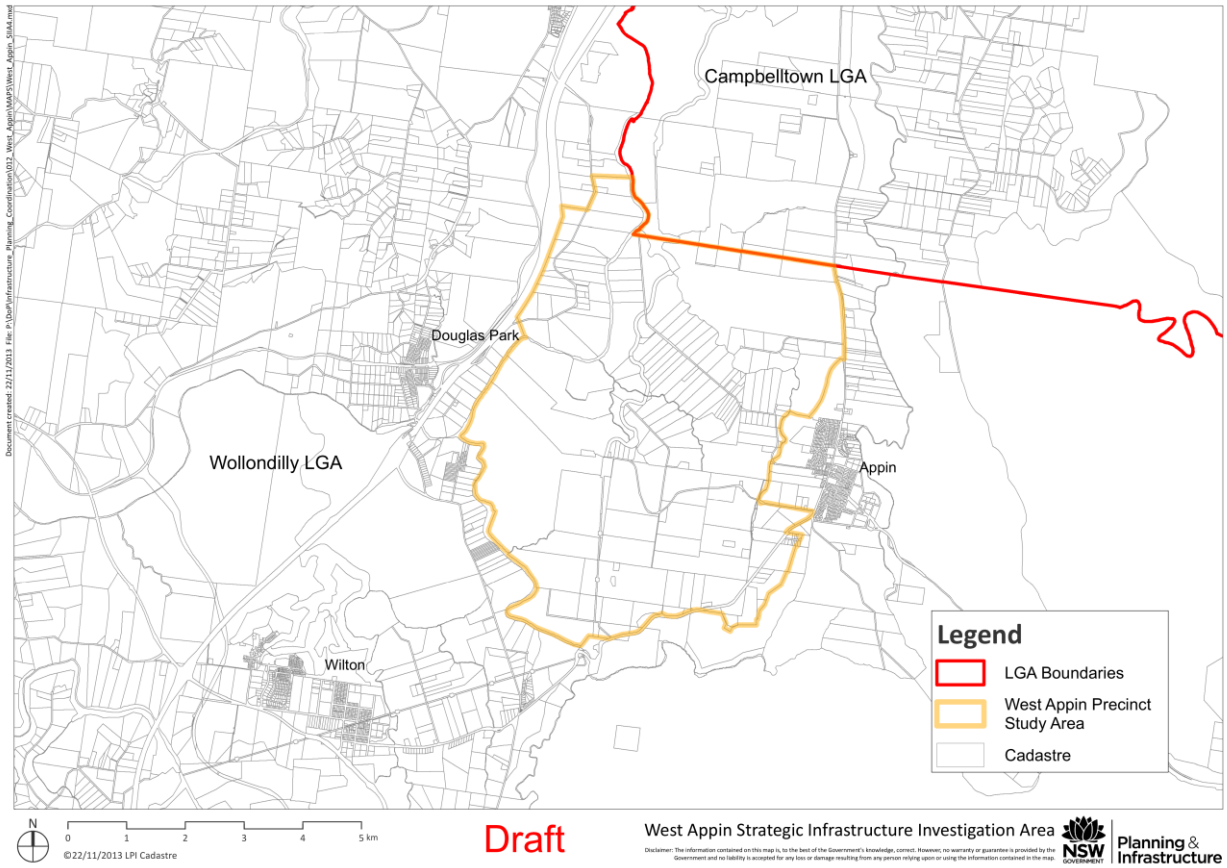
The handover to TfNSW must also include documentation of all model development and calibration procedures.

Design Horizons

For modelling and infrastructure trigger purposes all development within West Appin (understood to be 18,000 lots) will be presumed to have occurred by 2046.
Potential design horizons for model scenarios include 2016 (base), 2026 (mid) and 2036 (ultimate).

Mapping

The proponent will prepare a study area map that shows the key transport links including highways and arterial roads and interchanges as well as arterial and sub-arterial links into and out of the area. The map should also show existing railway lines and any existing local and regional bus routes. The area of the mapping should be discussed and agreed with TfNSW.


Campbelltown LGA
Douglas Park
Wollondilly LGA
Appin
Wilton
Legend
LGA Boundaries
West Appin Precinct Study Area
Cadastre
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2
3
4
5 km
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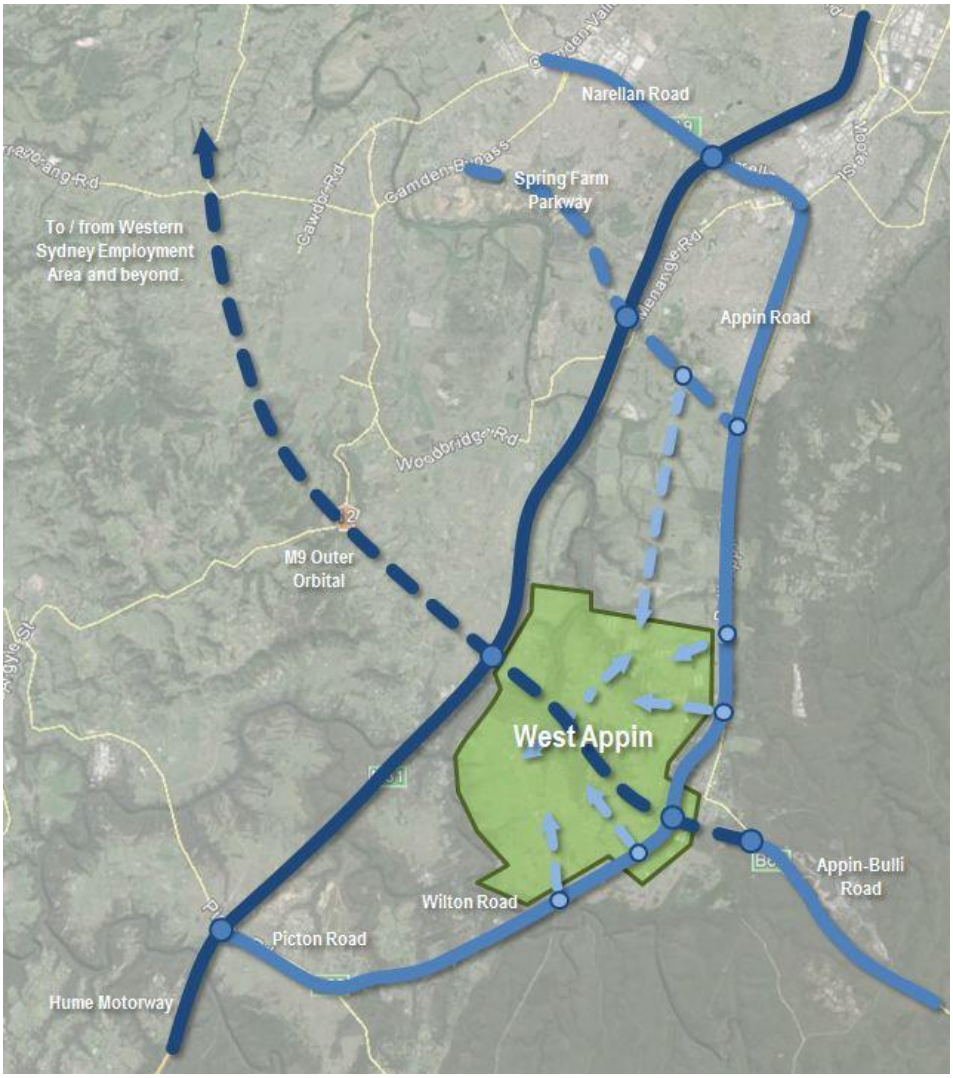
Draft
West Appin Strategic Infrastructure Investigation Area
Planning & Infrastructure

West Appin Strategic Infrastructure Investigation

Preliminary traffic and transport assessment

18 March 2015



PARSONS BRINCKERHOFF

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Rev	Date	Details
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Author, Reviewer and Approver details			
Prepared by:	David Bohm	Date: 18/03/2015	Signature:
Reviewed by:	Graeme Inglis	Date: 18/03/2015	Signature:
Approved by:	Graeme Inglis	Date: 18/03/2015	Signature:

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1. Introduction

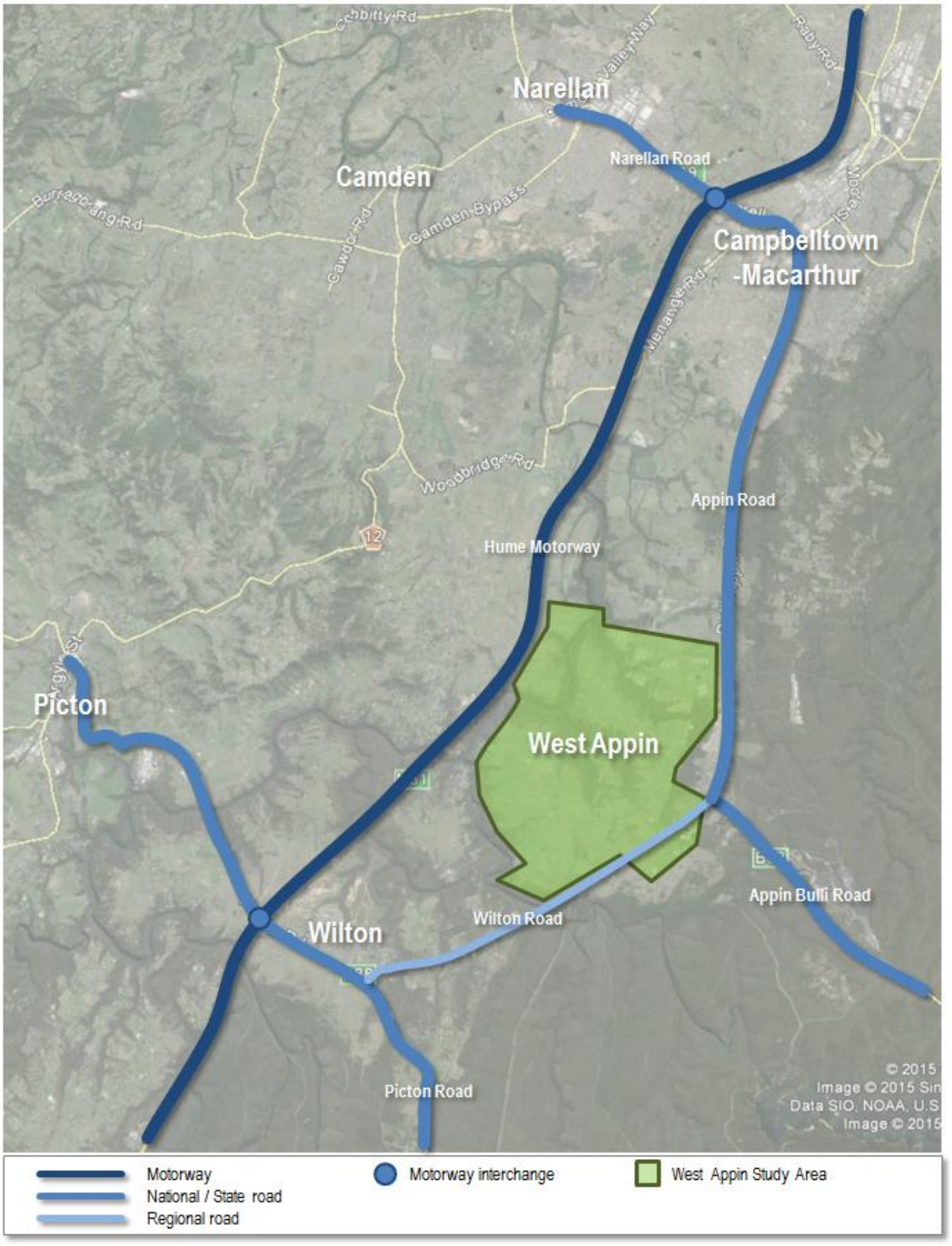
This report documents a preliminary traffic and transport assessment in support of the proposed development of the West Appin Precinct. The precinct comprises several land holdings located between the Hume Motorway and Appin Road in south-west Sydney for a new community including around 15,500 residential dwellings and creating over 15,500 jobs within a town centre, schools, enterprise employment areas, retail and light industrial areas. The West Appin Study Area, surrounding centres, and existing road network is illustrated in Figure 1.1.

Parsons Brinckerhoff have been commissioned by the West Appin Landowners Group to assess the transport impacts of the proposed new development and provide advice on traffic and transport measures that could be implemented to support the growth proposed.

The report has been prepared to provide a preliminary assessment of key road, traffic and transport-related issues raised in the *West Appin High Level Strategic Infrastructure Investigation Draft Terms of Reference* (Department of Planning & Environment (DP&E), 2013), summarised in section 1.4.

The assessment presented in this report has been undertaken based on indicative draft plans for the proposed development of West Appin. These plans will be refined and finalised through further investigation and appropriate planning and approval processes. Specifically, further detailed traffic and transport assessments will jointly consider and inform the detailed integrated land use and transport planning process.

Importantly this preliminary assessment investigates and addresses the most critical issues and fundamental features and requirements of the development. It is proposed that the ongoing traffic and transport assessment will continue to be developed and finalised in collaboration with Government to refine the preliminary findings presented in this report. Following the finalisation of the fundamental features of the development, the final traffic and transport assessment will include the additional level detail required to fully satisfy the draft terms of reference for the study.



Source: Parsons Brinckerhoff, adapted from Google Earth imagery (Google Earth, extracted March 2015)

Figure 1.1 West Appin study area and surrounds

1.1 Project background

In December 2013 the former Deputy Director General Planning (now Secretary) issued a letter to the Proponents (Walker Corporation, Mir Group and Ingham Rural) regarding the landowner's group proposal to investigate development at West Appin. This was as a result of the Department of Planning and Infrastructure (now Department of Planning and Environment) informing Wollondilly Council on 3 December 2013 that the then Minister for Planning and Infrastructure wants to ensure there are no threshold issues, in particular infrastructure requirements, to prevent West Appin from being developed, prior to committing to a joint master planning process.

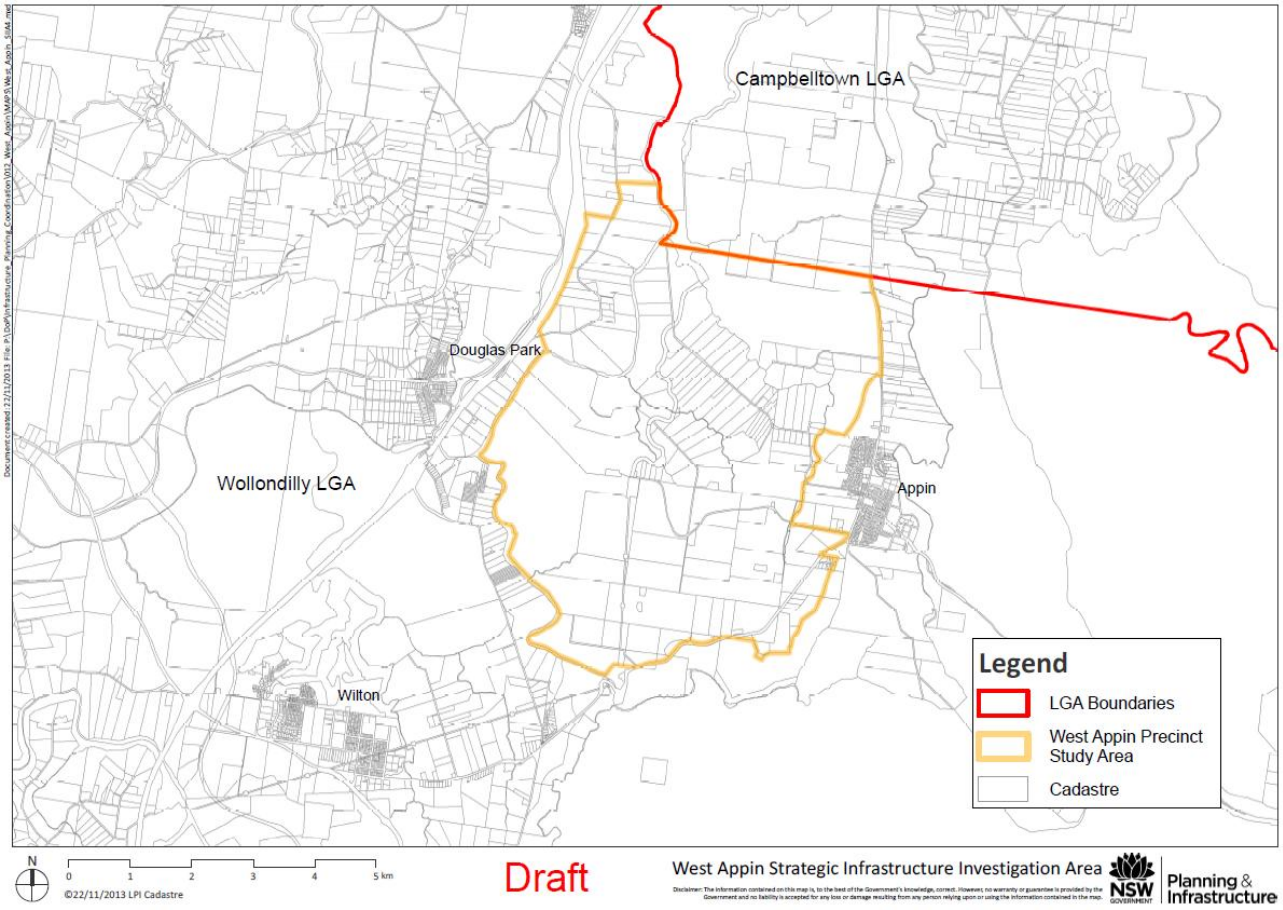
On 23 December 2013 the former Deputy Director General Planning issued the Proponents with 'Draft Terms of Reference' for the development of a high level investigation and Business case for a study area to be known as West Appin (see section 1.2 and section 1.3).

The Plan for Growing Sydney released in December 2014 has identified, as a priority, to investigate 'the suitability of the Macarthur South Investigation Area for future Growth Area'. West Appin Investigation Area falls within this future Growth Area, and will provide a substantial component into this priority action.

Due to the timeframe associated with the Macarthur South Investigation Area, this report informs the Proponents' initial response in relation to future traffic and transport infrastructure requirements.

1.2 Study area

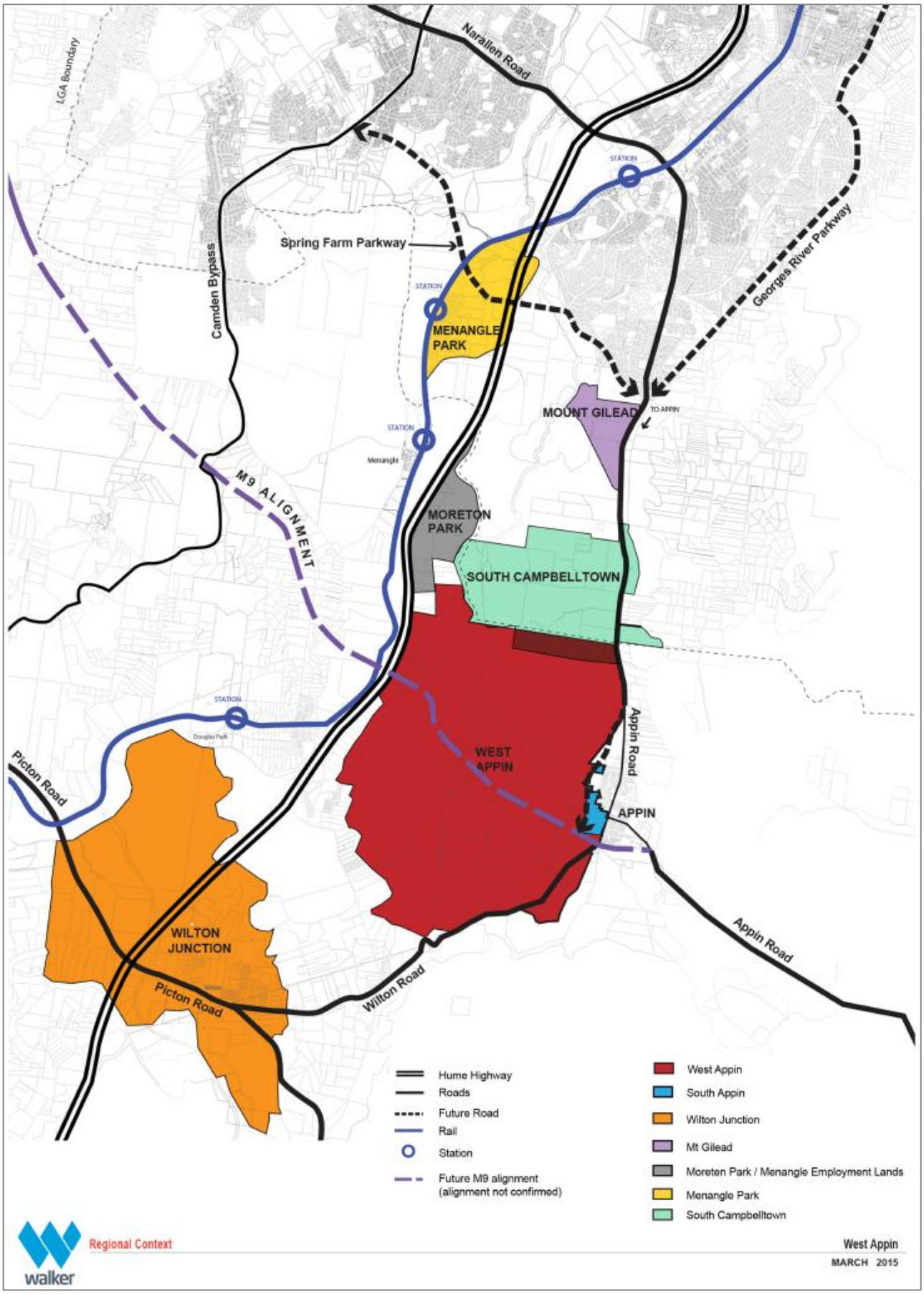
West Appin is located within Wollondilly Shire Council Local Government Area (LGA) and is approximately 70 km from Sydney's Central Business District, and 35 km north-west of Wollongong. The development area is located west of the existing village of Appin and east of Douglas Park. The West Appin Strategic Infrastructure Investigation Area, as defined by the draft terms of reference, is illustrated in Figure 1.2.



Source: West Appin Strategic Infrastructure Investigation terms of reference (DP&E, December 2013)

Figure 1.2 West Appin Strategic Infrastructure Investigation Area

Figure 1.3 illustrates the wider regional planning context of the study area. West Appin is located south of the South West Growth Centre focussed around Leppington. The Precinct is traversed by the preferred alignment for the proposed east coast high-speed rail line between Melbourne, Canberra and Sydney. It is also located in the approximate area of the proposed M9 Outer Orbital Motorway alignment illustrated in the *NSW Long Term Transport Master Plan* (Transport for NSW, December 2012).



Source: Walker Corporation (March 2015)

Figure 1.3 Regional context

1.3 Study objectives and requirements

This study has been undertaken to address the most critical issues and identify the fundamental features and traffic and transport requirements of the development. The outputs and outcomes and study requirements defined in the draft terms of reference are summarised in Table 1.1. This table also provides a reference to the relevant section of this report, and/or provides comments and indicates where further assessment is required and ongoing.

Table 1.1 Study requirements, outputs and outcomes

Details	Reference/comments
Study requirements	
Consultation/Governance A transport working group should be formed with the proponent and including DP&E, TfNSW, Roads & Maritime Services (RMS), Wollondilly Council and potentially NSW Treasury representatives.	A transport working group has been formed and working group meetings including the proponent, DP&E, TfNSW, and Wollondilly Council have occurred throughout the duration of the assessment.
Base assumptions Base assumptions and targets relating to population, employment, transport generation, degree of employment self-containment and travel mode splits are to be generally agreed by TfNSW prior to the commencement of the Study.	Base assumptions and targets have been extensively discussed, revised, and agreed through the project working group process.
Modelling approach The assessment will comprise a two part model approach, as follows: ■ Strategic transport modelling undertaken by TfNSW using existing model resources to identify travel demand and mode splits. ■ Assignment and assessment of the transport network at a mesoscopic level undertaken by the proponent (in consultation with TfNSW).	 Section 5 – the required two-part modelling approach has been adopted by the assessment. (As above)
Strategic Transport Model TfNSW will undertake the strategic modelling component of the assessment with inputs developed by the proponent using the Sydney Strategic Transport Model (STM). The STM shall be used to determine the likely growth in travel demand and assist to refine the mode split between vehicular trips and public transport trips. Prior to the use of the STM, the proponent will undertake high level calibration and validation of the base year matrices and review future year growth in the sub-region in consultation with TfNSW. TfNSW will undertake the final model development with the intent that base and future year matrices will be utilised in the next stage of mesoscopic modelling. TfNSW will define the study area for the assessment in discussion with the proponent.	 Section 5.2 – STM modelling has been undertaken by TfNSW and incorporated as appropriate during the mesoscopic traffic modelling process. Section 5 – this was also addressed through extensive discussions as part of the working group process. Section 5.2 – STM modelling has been undertaken by TfNSW and incorporated as appropriate during the mesoscopic traffic modelling process. The Precinct Study Area has been defined by DP&E. The mesoscopic model area is illustrated in section 5.3. The modelled area was discussed at length as part of the working group process.

Details	Reference/comments
Mesoscopic modelling	
The proponent will develop a transport model at a mesoscopic level for the car mode to the satisfaction of Transport for NSW.	Section 5.3 – the mesoscopic modelling undertaken will be provided to TfNSW for review following finalisation. The modelling will be documented in a model calibration and validation report.
The mesoscopic model shall be based on the output of the strategic transport modelling and used (amongst other things) for the purpose of determining route assignment and identifying infrastructure upgrades as a result of the impacts of the future development. For the highway assignment component of the model, Transport for NSW requests that this be undertaken using the Aimsun modelling package.	Section 5.2 and section 5.4 – STM modelling has been undertaken by TfNSW and incorporated as appropriate during the mesoscopic traffic modelling process. Detailed assignment has been undertaken in AIMSUN.
The model area that should be examined should be agreed with TfNSW prior to model development.	The mesoscopic model area is illustrated in section 5.3. The modelled area was discussed at length as part of the working group process.
The model should include, but not be limited to:	
▪ All relevant state roads (i.e. Freeways, motorways and arterial roads) in accordance with Transport for NSW requirements.	Section 5.3 – all relevant major and local roads in the study area are included in the AIMSUN model.
▪ All the sub-arterial road links and any road or street that carries over 12,000 vehicles per day (two-way).	(As above)
▪ Any local road that could potentially be used to access the State Road network from the West Appin development site should be included.	(As above)
▪ Any new significant road or transport connections that are established within the development area, or adjacent developments.	(As above)
▪ The mesoscopic model must be able to demonstrate that due consideration has been given to a range of factors including weave movements and merge/diverge lengths.	Section 6 – preliminary modelling has considered merge and diverge movements and defined strategic interchange requirements as a result. A detailed analysis will be undertaken following finalisation of strategic access arrangements.
The mesoscopic model developed will be handed over to TfNSW to own and potentially:	The mesoscopic modelling undertaken will be provided to TfNSW following finalisation.
▪ Add to; ▪ Distribute to others (including other developers); and ▪ Modify and change at the total discretion of TfNSW.	**Note:** The mesoscopic modelling has been undertaken on behalf of and for the sole use of the proponents. Parsons Brinckerhoff makes no representation, undertakes no duty and accepts no responsibility to any third party who may use or rely upon the model provided.
The handover to TfNSW must also include documentation of all model development and calibration procedures.	The final modelling will be documented in a model calibration and validation report.
Design Horizons	
For modelling and infrastructure trigger purposes all development within West Appin (understood to be 18,000 lots) will be presumed to have occurred by 2046. Potential design horizons for model scenarios include 2016 (base), 2026 (mid) and 2036 (ultimate).	Section 5.1 – horizon years have been defined as 2013 (Base), 2026 (Interim), and 2036 (Ultimate). It is noted that full development is estimated at around 15,500 dwellings, 15,600 employees, and 84,150m^2 GFA of commercial floor space. This preliminary assessment addresses the Base and Ultimate scenarios. As the Interim scenario is dependent on the Ultimate yield, the Interim scenario will be assessed following finalisation of details of the Ultimate scenario.

Details	Reference/comments
Mapping The proponent will prepare a study area map that shows the key transport links including highways and arterial roads and interchanges as well as arterial and sub-arterial links into and out of the area. The map should also show existing railway lines and any existing local and regional bus routes. The area of the mapping should be discussed and agreed with TfNSW.	Relevant mapping of the study is presented throughout this report.
Outputs/outcomes	
Document existing transport conditions on the surrounding network (including, but not limited to State Roads, important local council roads, and bus and rail services, stations and interchanges).	Section 2.
Outline the future development scenarios at the relevant design horizons including the cumulative yield of adjacent or nearby known or future development (within the region of likely influence) including details of forecast lot numbers and any mixed use or commercial development.	Section 3.3, section 3.4, section 4.2.
Identify the transport demands and travel patterns associated with the subject development (and adjacent development) across transport modes.	Section 5.4 – forecast transport demands and patterns for West Appin are detailed in this preliminary assessment. The final assessment will include equivalent information for adjacent developments, as required to finalise the AIMSUN modelling for these scenarios.
Identify the impact of the additional travel demand associated with the proposal (and any other surrounding development) on the existing transport networks/services at the relevant design horizons.	Section 6, section 7 – impacts of future travel demand with and without West Appin, and corresponding infrastructure requirements are detailed in this preliminary assessment. The final assessment will include additional scenario testing including adjacent developments.
Develop staged infrastructure and servicing strategies for the development and other proposals. This will require a considered approach that looks at the need for additional links in and augmentation of the transport network and appropriate triggers and staging of the construction/introduction of those works.	The staging of transport infrastructure requires the modelling of the Interim (2026) scenario. This preliminary assessment addresses the Base and Ultimate scenarios. As the Interim scenario is dependent on the Ultimate yield, the Interim scenario will be assessed, and staging strategy consequently developed, following finalisation of details of the Ultimate scenario.
Specific project proposals need to be discussed and agreed with Transport for NSW (TfNSW). At a minimum high level strategic/concept engineering plans need to be developed in order to better understand the magnitude of costs involved.	Section 5.1 – core traffic and transport assumptions (e.g. Spring Farm Parkway) are consistent with the direction provided by TfNSW. Section 6, section 7 – additional upgrade requirements proposed to achieve acceptable network performance presented in this preliminary assessment have been used to develop strategic engineering plans and cost estimates for consideration by TfNSW.

Source: West Appin High Level Strategic Infrastructure Investigation Draft Terms of Reference (DP&E, 2013)

1.4 Report structure

This report is structured as follows:

- Section 2 presents existing traffic and transport conditions in the study area.
- Section 3 details the proposed development of West Appin.
- Section 4 provides an overview of the context of the study area.
- Section 5 describes the modelling methodology used for the assessment.
- Section 6 assesses the impacts and infrastructure requirements of alternative scenarios.
- Section 7 summarises identified transport infrastructure requirements.

2. Existing conditions

This section outlines the existing traffic and transport conditions and behaviours in the study area. It also analyses other areas with similar characteristics with those proposed by development in West Appin, to provide an indication of the potential travel behaviour of future residents and employees. It describes the current transport capacity and performance of key elements of the existing road network, public transport networks and services, and the walking and cycling network.

2.1 Travel behaviour

Three existing datasets have been used to analyse weekday travel behaviour for the study area and surrounds:

- Raw Census Data (Australian Bureau of Statistics (ABS)).
- Journey to Work Data (Bureau of Transport Statistics (BTS), TfNSW).
- Household Travel Survey Data (BTS).

Key results of the above datasets are presented below. The existing travel behaviour of residents and employees in and surrounding the study area provides an indication of how the residents and employees of West Appin, Wollondilly, and surrounding areas are likely to travel in the future.

2.1.1 Number of trips and trip purposes

Table 2.1 provides a summary of HTS population, trip generation, and trip purpose data for Wollondilly LGA, Camden LGA, Campbelltown LGA, and Sydney GMA. For the purposes of this assessment, these categories have been consolidated to those presented in Table 2.1. The results indicate that trip purposes in the study area differ significantly during different times of the day. For example:

- Education/childcare related trips comprise approximately twice the proportion of total trips during AM peak periods than they do during PM peak periods.
- Social/recreation and other trips comprise approximately twice the proportion of total trips during PM peak periods than they do during AM peak periods.

Table 2.1 Population, trip generation, and trip purpose data (All modes, average weekday)

Area	Wollondilly LGA	Camden LGA	Campbelltown LGA	Sydney GMA
Population data				
Population	46,000	74,000	150,000	4,551,000
Households	16,000	25,000	51,000	1,689,000
Trip generation data				
Daily trips per person	3.6	3.7	3.5	3.7
Daily trips per household	10.6	11.3	10.3	9.9
Trip purpose data – % of total daily trips(1)				
Commute, work-related business	33%	32%	29%	30%
Education/childcare	17%	15%	14%	11%
Shopping, personal business	23%	24%	29%	27%
Social/recreation, other	28%	29%	28%	32%
Trip purpose data – % of total AM peak trips(1)				
Commute, work-related business	33%	40%	39%	43%
Education/childcare	43%	31%	36%	28%
Shopping, personal business	10%	17%	14%	15%
Social/recreation, other	13%	11%	11%	14%
Trip purpose data – % of total PM peak trips(1)				
Commute, work-related business	28%	29%	29%	31%
Education/childcare	18%	17%	18%	14%
Shopping, personal business	28%	24%	25%	25%
Social/recreation, other	26%	31%	28%	30%

Source: Household Travel Survey 2012/13 (BTS, September 2014)

(1) Trip purpose data calculated using 2011/12 HTS detailed trip data tables. Trips to serve passenger have been re-apportioned across the trip purposes presented.

2.1.2 Vehicle ownership and transport mode share

Table 2.2 provides a summary of vehicle ownership data provided by the 2012/13 HTS, and priority travel mode data provided by the 2011 Journey to Work (JTW) dataset.

Table 2.2 Vehicle ownership and transport mode share data (Average weekday)

Area	Wollondilly LGA	Camden LGA	Campbelltown LGA	Sydney GMA
Vehicle ownership				
Vehicles per household	2.3	2.1	1.7	1.6
Vehicles per person	0.78	0.70	0.58	0.59
Primary travel mode for commuting trips				
Vehicle driver	85%	83%	70%	67%
Vehicle passenger	5%	5%	6%	5%
Train	4%	7%	18%	14%
Walk (Only)	2%	1%	2%	4%
Other	1%	1%	1%	2%
Bus	1%	1%	1%	6%
Unknown	2%	1%	2%	2%
Primary travel mode for all daily trips(1)				
Vehicle driver	61%	60%	54%	48%
Vehicle passenger	25%	27%	26%	21%
Other modes	14%	13%	20%	31%

Source: Household Travel Survey 2012/13 (BTS, September 2014) and 2011 Journey to Work Data (BTS, 2013)

(1) Travel mode data for all daily trips calculated using 2011/12 HTS detailed trip data tables.

Vehicle ownership provides an indicator of the ability for residents to choose to travel modes other than public or active transport. Many new land release areas have a high level of vehicle ownership, providing households with a greater ability to choose to drive. Car ownership is influenced by the number of people per dwelling as well as the level of alternative transport options, affluence, job type and the cost and availability of parking. The average number of cars per household for Wollondilly LGA measured in the 2012/2013 HTS survey was 2.3, over 40% higher than the Sydney GMA average of 1.6.

Travel mode choice is dependent on a range of factors including:

- Availability of alternative transport options.
- Relative performance and cost of alternative options.
- Car ownership/availability.
- Need for predictable arrival time.
- Length of journey.
- Trip purpose.

The modal splits for commuting trips from Wollondilly LGA, Camden LGA, Campbelltown LGA, and Sydney GMA extracted from 2011 JTW data are summarised in Table 2.2. In addition, estimated vehicle driver and vehicle passenger mode split percentages for all daily trips have been calculated using 2011/12 HTS detailed trip data tables. This data indicates that non-commuting trips (for example education, shopping, and recreational trips) have a significantly higher proportion of trips made by vehicle passengers when compared to commuting trips, resulting in higher vehicle occupancy for non-commuting trip purposes.

2.1.3 Trip distribution

A summary of commuting trip distribution to and from Wollondilly LGA, Camden LGA, Campbelltown LGA provided by the 2011 Journey to Work (JTW) dataset is provided in Table 2.3. The results indicate:

- For all three LGAs analysed, the highest proportion of trips both start and end within the same LGA.
- For residents of Wollondilly LGA:
  - 33% commute to jobs within Wollondilly LGA.
  - 5% and 2% commute to the Southern Highlands and Wollongong respectively.
  - The remaining 60% commute to other areas, almost entirely to and from areas north of Wollondilly LGA.

Table 2.3 Commuting trip origins and destinations (All modes, average weekday)

Area	Wollondilly LGA	Camden LGA	Campbelltown LGA	Southern Highlands
Commuting trip destinations (Place of work for outbound trips)				
Wollondilly LGA	33%	3%	<1%	2%
Campbelltown LGA	14%	19%	36%	3%
Camden LGA	13%	28%	5%	1%
Southern Highlands	5%	<1%	<1%	73%
Wollongong	2%	<1%	<1%	1%
Other	33%	48%	56%	20%
Commuting trip origins (Place of residence for inbound trips)				
Wollondilly LGA	60%	14%	6%	5%
Campbelltown LGA	7%	18%	53%	1%
Camden LGA	8%	47%	11%	1%
Southern Highlands	4%	1%	<1%	83%
Wollongong	7%	1%	2%	1%
Other	14%	19%	27%	9%

Source: 2011 Journey to Work Data (BTS, 2013)

The commuting trip origins, which indicate the place of residence for inbound trips, show that 60% of trips to work in Wollondilly LGA originate in Wollondilly LGA. The difference in proportions for inbound and outbound trips indicates that there is a net surplus of workers in Wollondilly LGA, causing many to travel elsewhere for employment. As noted above the majority of these trips travel north to and from Camden LGA, Campbelltown LGA and Liverpool LGA.

2.2 Road network

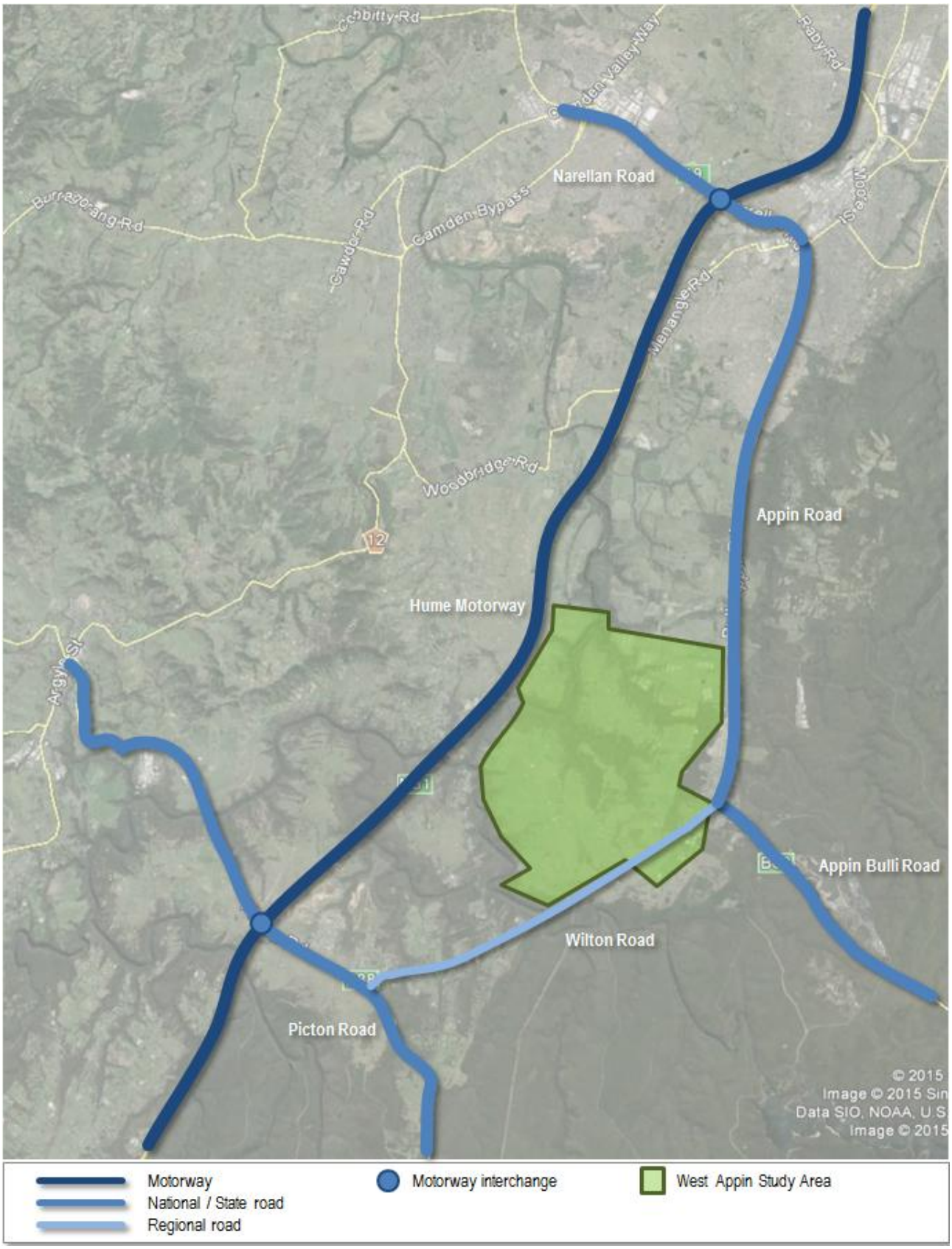
A summary of the details of key roads in and around the study area is provided in Table 2.4:

- Appin Road and the Hume Motorway provide the primary links to and from areas north of the study area.
- Appin Bulli Road provides the primary direct link to and from the east of the study area.
- The Hume Motorway and Wilton Road provide the primary links to and from the south of the study area.

Table 2.4 Existing key road network details

Route	Details
Hume Motorway (M31)	▪ Posted speed limit of 110 km/h in vicinity of study area. ▪ Part of the major interstate highway linking Sydney and Melbourne. ▪ Designated B-double route with maximum vehicle height of 4.6 m. ▪ Two traffic lanes per direction plus wide central median, paved shoulders, and grade-separated on-ramps, off-ramps, and road crossings in the vicinity of study area. ▪ Closest grade-separated interchanges to study area are located at: ‣ Narellan Road (approximately 14 km to the north) ‣ Picton Road (approximately 8 km to the south). ▪ Widens to three traffic lanes per direction north of Narellan Road. ▪ Widens to four traffic lanes per direction north of Raby Road.
Appin Road/ Appin Bulli Road (B69)	▪ Posted speed limit varies between 60 km/h, 80 km/h and 100 km/h in vicinity of study area. ▪ Part of the state road network connecting Campbelltown and Appin with the Southern (Princes) Motorway (M1). ▪ Designated B-double route with maximum vehicle height of 4.6 m. ▪ One traffic lane per direction (undivided), with overtaking lanes provided in some sections in the vicinity of study area.
Wilton Road	▪ Posted speed limits of: ‣ 100 km/h between Appin Village and Broughton Pass (Cataract River crossing). ‣ 80 km/h between Broughton Pass and Wilton Village. ▪ Regional route 610 from Picton Road (via Almond Street) at Wilton Village to Appin Village. ▪ Designated B-double route for vehicles up to 19 m between Picton Road and Douglas Park Drive. Other sections have a 12 tonne load limit and 15 m length limit. ▪ Generally provides one traffic lane per direction (undivided). ▪ Broughton Pass constitutes tight hairpin curves with a 15 km/h advisory speed limit on approach to the Cataract River crossing, and a single bridge over the Cataract River with a single-vehicle capacity at all times.
Narellan Road (A9/B69)	▪ Posted speed limit varies between 60 km/h and 80 km/h in vicinity of study area. ▪ Part of the national road network (A9) west of the Hume Motorway, and part of the state road network (B69) east of the Hume Motorway. ▪ Designated B-double route with maximum vehicle height of 4.6 m. ▪ Generally provides two traffic lanes per direction plus paved central median, with traffic signals and localised widening at intersections in the vicinity of the study area.
Picton Road (B88)	▪ Posted speed limit varies between 80 km/h and 100 km/h in vicinity of study area. ▪ Part of the state road network connecting Picton with the Southern (Princes) Motorway (M1). ▪ B-double route with maximum vehicle height of 4.6 m between Maldon and the M1. ▪ Generally provides one traffic lane per direction (undivided), with overtaking lanes provided in some sections in the vicinity of study area.

Figure 2.1 illustrates the locations and alignment of existing key roads in the study area.



Source: Parsons Brinckerhoff, adapted from Google Earth imagery (Google Earth, extracted March 2015)

Figure 2.1 Existing key roads in study area

2.3 Traffic volumes

Traffic data from several sources have been used to develop an understanding of traffic conditions on key roads in the study area including Roads and Maritime Services' (RMS) data and traffic data from previous studies and reports.

Vehicle classified intersection turn counts were undertaken during a weekday AM peak period (6.30–9.30) and PM peak period (15.30–18.30) at key locations around the network. The results of these surveys, with AM peak volumes for key locations presented in Table 2.5, have been used to calibrate the mesoscopic traffic model (refer to section 5 for details).

The Hume Motorway has been extensively upgraded to improve safety and travel efficiency since the 1970s. This has included 22 major bypasses and ultimately the completion of a continuous dual carriageway with a minimum of two lanes per direction in mid-2013. This continual improvement has resulted in a decrease in travel times (a saving totalling over three hours between Sydney and Melbourne).

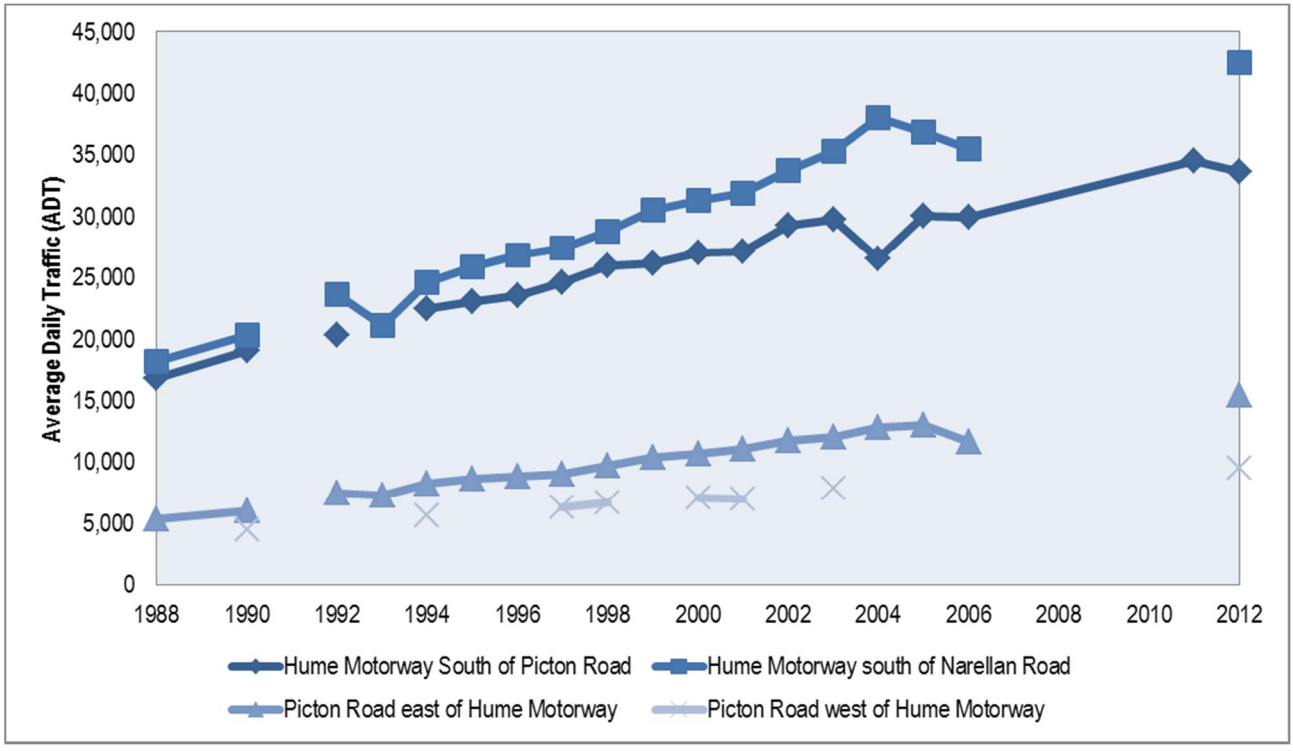
The ongoing upgrades of the Hume Motorway and the introduction in 2007 of higher mass limits for heavy goods vehicles have directly contributed to the historic traffic growth on the Hume Motorway, and indirectly to growth on Picton Road. Figure 2.2 indicates that:

- Traffic on the Hume Motorway increased by an average of around 4–5% between 1988 and 2012.
- Traffic on Picton Road increased by an average of between 5-6% between 1990 and 2012.

Table 2.5 Traffic volumes on key roads (Vehicles per hour, 2013 weekday)

Route/Location/Direction		AM peak			
		Light	Heavy	Total	% Heavy
Hume Motorway (M31)					
North of Narellan Road	NB	3,155	330	3,485	9%
	SB	1,530	360	1,890	19%
South of Narellan Road	NB	1,380	265	1,645	16%
	SB	985	295	1,280	23%
South of Picton Road	NB	840	170	1,010	17%
	SB	815	185	1,000	19%
Appin Road/Appin Bulli Road					
North of Appin Village	NB	755	35	790	4%
	SB	325	40	365	11%
East of Appin Village	WB	595	60	655	9%
	EB	310	60	370	16%
Wilton Road					
South of Appin Village	NB	100	5	105	5%
	SB	90	5	95	5%

Route/Location/Direction		AM peak			
		Light	Heavy	Total	% Heavy
Narellan Road					
East of Hume Motorway	WB	1,740	90	1,830	5%
	EB	2,160	105	2,265	5%
West of Hume Motorway	WB	1,555	150	1,705	9%
	EB	3,195	175	3,370	5%
Picton Road					
East of Hume Motorway	WB	725	140	865	16%
	EB	635	150	785	19%



Source: Permanent traffic count data (Roads and Maritime Services)

Figure 2.2 Historic traffic growth on the Hume Motorway and Picton Road

2.4 Network performance

2.4.1 Mid-block Level of Service

Mid-block Level of Service (LoS) indicators for key roads in the study have been calculated using surveyed traffic volumes presented in section 2.3 and lane capacities provided by the *Guide to Traffic Management Part 3: Traffic Studies and Analysis* (Austroads, 2013), summarised in Table 2.6.

This analysis requires the application of Passenger Car equivalent Unit (PCU) values for heavy vehicles. The use of PCUs is essentially a method to represent the equivalent number of cars that would create the same impact on the road network as a single heavy vehicle. RMS' *Traffic Modelling Guidelines* (RMS, 2013) provides PCU equivalents shown in Table 2.7.

Classified traffic counts supplied by RMS indicate an average of approximately 3.0 PCUs per heavy vehicle on both the Hume Motorway and Picton Road, with similar volumes of both rigid and articulated vehicles present on these routes. Based on this assumption, total traffic in PCUs, road configuration, and the resulting performance for key locations in the study area are presented in Table 2.8, which shows that during the busiest AM peak periods:

- Traffic volumes on the Hume Motorway are within capacity, resulting in LoS C or better.
- Traffic volumes on Appin Road/Appin Bulli Road are approaching capacity, resulting in LoS D during peak periods.
- Wilton Road is currently operating at LoS E due to the network constraints at and approaching Broughton Pass.
- Traffic volumes on Narellan Road exceed capacity in the eastbound direction west of the Hume Motorway where only two lanes are provided, resulting in LoS E.

Table 2.6 Austroads lane capacities (Passenger Car equivalent Units (PCUs))

Level of Service (LoS)	2-lane, 2-way roads (Combined, 2-way capacity)	Multi-lane arterial	Motorway
A	490	560	770
	▪ Condition of free flow in which individual drivers are virtually unaffected by others in the traffic stream. ▪ Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high. ▪ General level of comfort and convenience provided is excellent.		
B	780	880	1,210
	▪ Stable flow; drivers have reasonable freedom to select speed and manoeuvre within the traffic stream. ▪ General level of comfort and convenience is less than LoS A.		
C	1,190	1,280	1,740
	▪ Stable flow; most drivers restricted to some extent in freedom to select speed and manoeuvre. ▪ General level of comfort and convenience declines noticeably at this level.		
D	1,830	1,705	2,135
	▪ Close to the limit of stable flow and approaching unstable flow. ▪ Drivers severely restricted in freedom to select desired speed and manoeuvre. ▪ General level of comfort and convenience is poor; and small increases in traffic will generally cause operational problems.		
E	3,200	2,000	2,350
	▪ Traffic volumes at or close to capacity and virtually no freedom to select desired speed or manoeuvre. ▪ Flow is unstable and minor disturbances within the traffic stream will cause a traffic-jam.		
F	>3,200	>2,000	>2,350
	▪ In the zone of forced flow. ▪ Traffic volume exceeds capacity; flow break-down occurs and queuing and delays result.		

Source: Lane capacities provided by Guide to Traffic Management Part 3: Traffic Studies and Analysis (Austroads, 2013); LoS definitions provided by Guide to Traffic Generating Developments (Roads and Traffic Authority, 2002)

Table 2.7 PCU equivalents used for analysis

Vehicle type	PCU factor
Passenger car	1.0
Light Commercial Vehicle (LCV)	1.0
Rigid heavy vehicle/Bus	2.0
Articulated heavy vehicle	4.0

Source: Traffic Modelling Guidelines (RMS, 2013)

Table 2.8 Mid-block LoS on key roads (2013 weekday)

Route/Location/Direction		Configuration[1]		AM peak		
		Road type	Number of lanes	Total PCUs	PCU/ Lane	LoS
Hume Motorway (M31)						
North of Narellan Road	NB	Motorway	3	4,145	1,380	C
	SB		3	2,610	870	B
South of Narellan Road	NB	Motorway	2	2,175	1,090	B
	SB		2	1,870	935	B
South of Picton Road	NB	Motorway	2	1,350	675	A
	SB		2	1,370	685	A
Appin Road/Appin Bulli Road						
North of Appin Village	NB	2-lane, 2-way	2	1,305	655	D
	SB					
East of Appin Village	WB	2-lane, 2-way	2	1,265	635	D
	EB					
Wilton Road						
South of Appin Village	NB	2-lane, 2-way	2	220	110	E[2]
	SB					
Narellan Road						
East of Hume Motorway	WB	Multi-lane arterial	2	2,010	1,005	C
	EB		2	2,475	1,240	C
West of Hume Motorway	WB	Multi-lane arterial	3	2,005	670	B
	EB		2	3,720	1,860	E
Picton Road						
East of Hume Motorway	WB	2-lane, 2-way	2	2,230	1,115	E
	EB					

(1) Indicates road configuration at point of lowest capacity where configuration varies.

(2) LoS for Wilton Road has been determined by simulating Broughton Pass as a set of traffic signals with an all-red period equal to the clearance time for the 90 m long bridge.

2.5 Public transport

Existing public transport services in the area are limited, reflecting the small population currently living and working in the area, and the dispersed, low density nature of development.

2.5.1 Bus

Bus services in the vicinity of the study area are focussed around Campbelltown, Camden, and Macarthur (operated by Busabout), and Picton (operated by Picton Buslines). The following existing services shown in Figure 2.3 travel to, from, and through the study area:

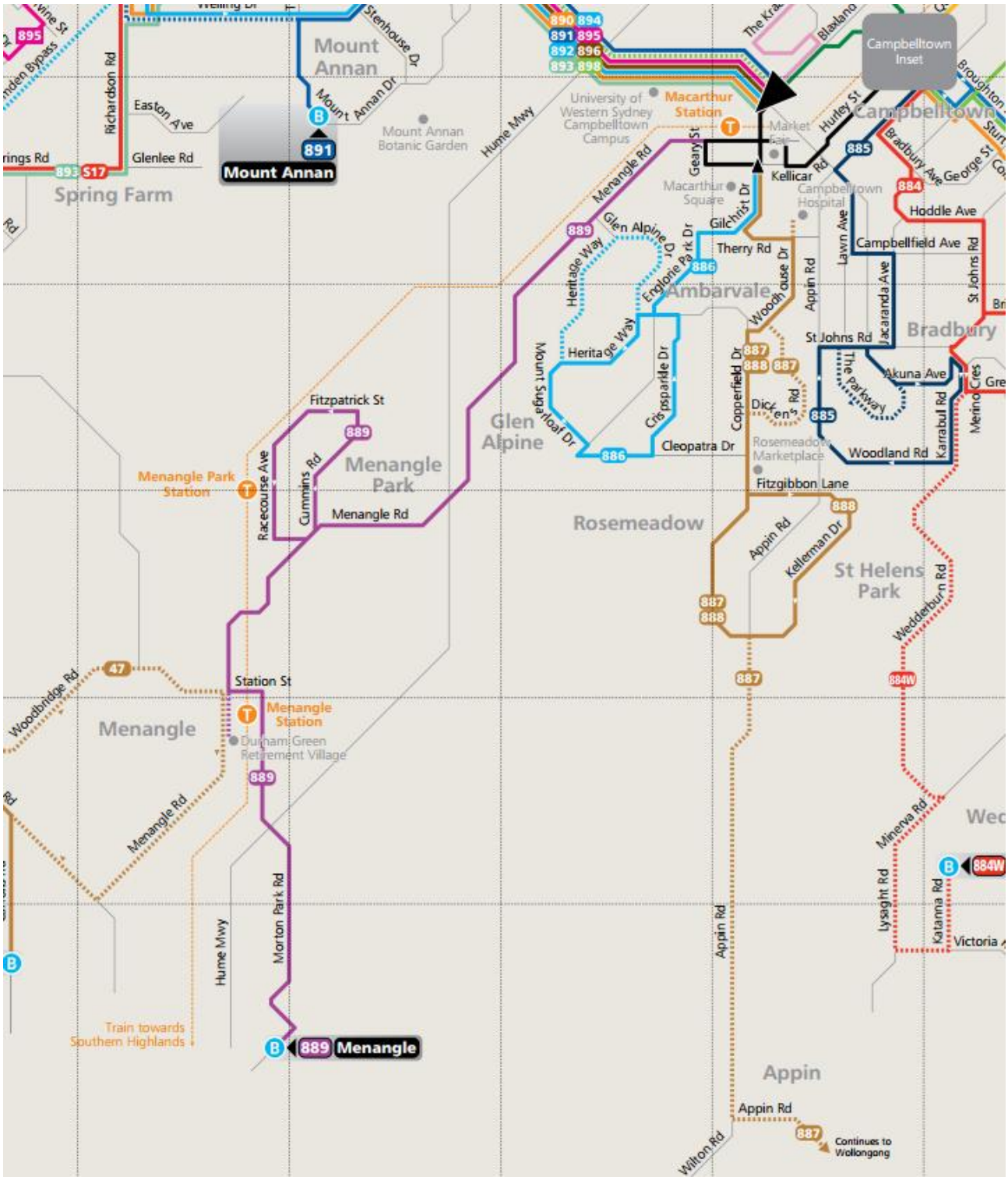
- Route 887: Campbelltown to Wollongong via Appin.
- Route 889: Campbelltown to Menangle (Moreton Park Road).

The operating hours and frequencies of bus services in the study area are summarised in Table 2.9, demonstrating the limited existing services provided.

Table 2.9 Bus service frequency and hours of operation (2015 weekday)

Route – Direction (Operating hours)	Weekday frequency (Buses/hr)		
	AM peak	Off-peak	PM peak
887 – To Wollongong (7.30 am–5.30 pm)	1	0.5	1
887 – To Campbelltown (6.30 am–7.15 pm)	1	0.5	1
889 – To Menangle (7.00 am–7.00 pm)	1	1 bus between 8.00 am and 4.30 pm	1
889 – To Campbelltown (6.00 am–6.00 pm)	1	1 bus between 8.00 am and 4.30 pm	1

Source: Busabout Bus Timetables (Busabout, effective 1 June 2014)



Source: Campbelltown and Camden bus network map (Busabout, accessed Feb 2015)

Figure 2.3 Existing bus service routes

2.5.2 Rail

There are no existing train stations within the study area, with Douglas Park and Menangle the closest stations located to the west on the Southern Highlands line. Macarthur and Campbelltown stations are located further away to the north of the study area. The operating hours and frequencies of train services to and from these stations are summarised in Table 2.10.

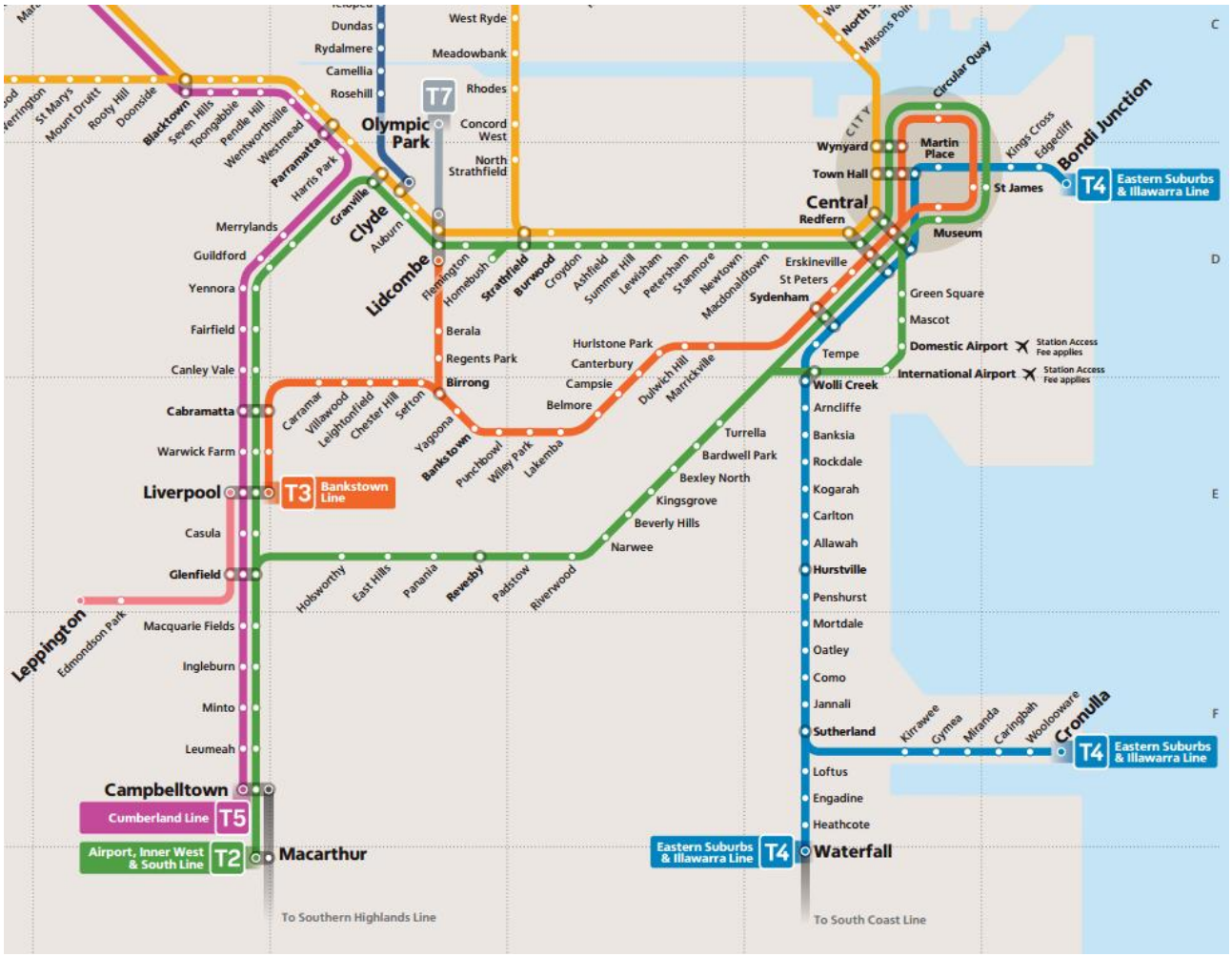
Table 2.10 Train service frequency and hours of operation (2015 weekday)

Station – Direction (Operating hours)	Weekday frequency (Trains/hr)		
	AM peak	Off-peak	PM peak
Douglas Park/Menangle – to Campbelltown (4.30 am–10.00 pm)	1	1	1
Douglas Park/Menangle – From Campbelltown (5.30 am–11.00 pm)	1	1	2
Macarthur/Campbelltown – To Sydney (4.00 am–12.00 am)	18	9	10
Macarthur/Campbelltown – From Sydney (5.00 am–1.30 am)	10	9	15

Source: Sydney Trains Timetables (Sydney Trains, accessed Feb 2015)

Douglas Park and Menangle stations are serviced by the Southern Highlands line, which provides limited inter-city services, with passengers required to change trains at Campbelltown from a diesel train to an electric-powered train. More frequent services are available at Macarthur and Campbelltown Stations, which are also serviced by the Inner West and South line and the Cumberland line, as shown in Figure 2.4. These stations also provide commuter car park facilities.

Table 2.11 summarises passenger entries and exits at stations close to the study area during a typical weekday. This dataset illustrates that the vast majority of train passengers in the vicinity of the study area use the Macarthur and Campbelltown stations, due to the higher frequency of services to and from these stations.



Source: Sydney Trains Network Map (Sydney Trains, accessed Feb 2015)

Figure 2.4 Sydney rail network map

Table 2.11 Train station passenger entries and exits (2013 weekday)

Time period	Douglas Park		Menangle		Macarthur		Campbelltown	
	Entries	Exits	Entries	Exits	Entries	Exits	Entries	Exits
2.00 am–6.00 am	10	0	0	0	50	20	110	50
6.00 am–9.30 am	40	0	10	0	1,030	420	3,180	890
9.30 am–3.00 pm	0	10	0	0	610	580	1,300	1,190
3.00 pm–6.30 pm	0	20	10	10	420	970	1,170	2,770
6.30 pm–2.00 am	0	20	0	0	190	310	300	1,150
TOTAL	**50**	**50**	**20**	**10**	**2,300**	**2,300**	**6,060**	**6,060**

Source: Rail station barrier counts (BTS, 2013)

2.6 Walking and cycling

Given the long distances between developments in the study area and limited facilities, walking and cycling trips comprise a low mode share and are typically restricted to short distances.

Within and surrounding the study area limited paved footpaths are provided on one side of major roads in developed areas (e.g. Appin Road within Appin). In other areas and on minor roads no paved footpaths are generally provided.

Although there is no formal cycling infrastructure in the study area, Wollondilly Shire Council recently adopted a Shared Cycleway Plan for the Shire. The principles applied in the development of these shared cycleway routes included:

- Connecting logical start and end points (e.g. schools to residential areas, towns to each other, etc.).
- Maximising/using off road routes wherever feasible.
- On road routes along major connecting roads may be considered in rural areas to reduce construction costs and increase useability.
- Target known future land release areas for off road routes.
- Link tourist and other places of interest to encourage visitors and residents into recreational cycling.

Cycleway and shared pathway routes within Appin Village are illustrated in Figure 2.5. In addition, the following routes would provide cycleways to and from Appin Village and the wider study area:

- Appin to Campbelltown via Appin Road.
- Appin to Wilton (and beyond) via Wilton Road.
- Appin to Douglas Park via Wilton Road and Douglas Park Drive.
- Appin to Baden Powell Drive via Appin Bulli Road.
- Douglas Park to Menangle via Moreton Park Road.

Source: Wollondilly Shire Council

Figure 2.5 Proposed shared cycle pathways for Appin

3. West Appin development

West Appin presents an opportunity to facilitate the creation of new housing and local employment, addressing significant housing supply shortages and affordability pressures in Sydney. The new town would provide housing choice through a variety of dwelling sizes and locations and accommodate new business, supported by the provision of appropriate physical and social infrastructure.

The area is strategically located directly east of the Hume Motorway, supplemented by a direct connection to Campbelltown and beyond provided by Appin Road. The site also adjoins the Southern Highlands rail line, located to the east of Douglas Park station. Although electrification to Douglas Park is not proposed, the development of West Appin would make this a more viable option. Any decision would be subject to agreement with the Commonwealth owned Australian Rail Track Corporation (ARTC) who lease the line from the NSW government.

West Appin is also located in the approximate area of the proposed M9 Outer Orbital Motorway alignment illustrated in the *NSW Long Term Transport Master Plan* (TfNSW, December 2012), and traversed by the preferred alignment for the proposed east coast high-speed rail line between Melbourne, Canberra and Sydney.

West Appin would deliver the next potential major centre along the Hume Motorway transport corridor south of Campbelltown-Macarthur. The proposed development would also benefit from consolidated land ownership of around 2,000 hectares in the control of recognised developers, with the resources and capability to expedite housing delivery, roll out enabling infrastructure, deliver social services and provide local employment.

3.1 Land owners

The three proponents, who are the majority landowners at West Appin, are:

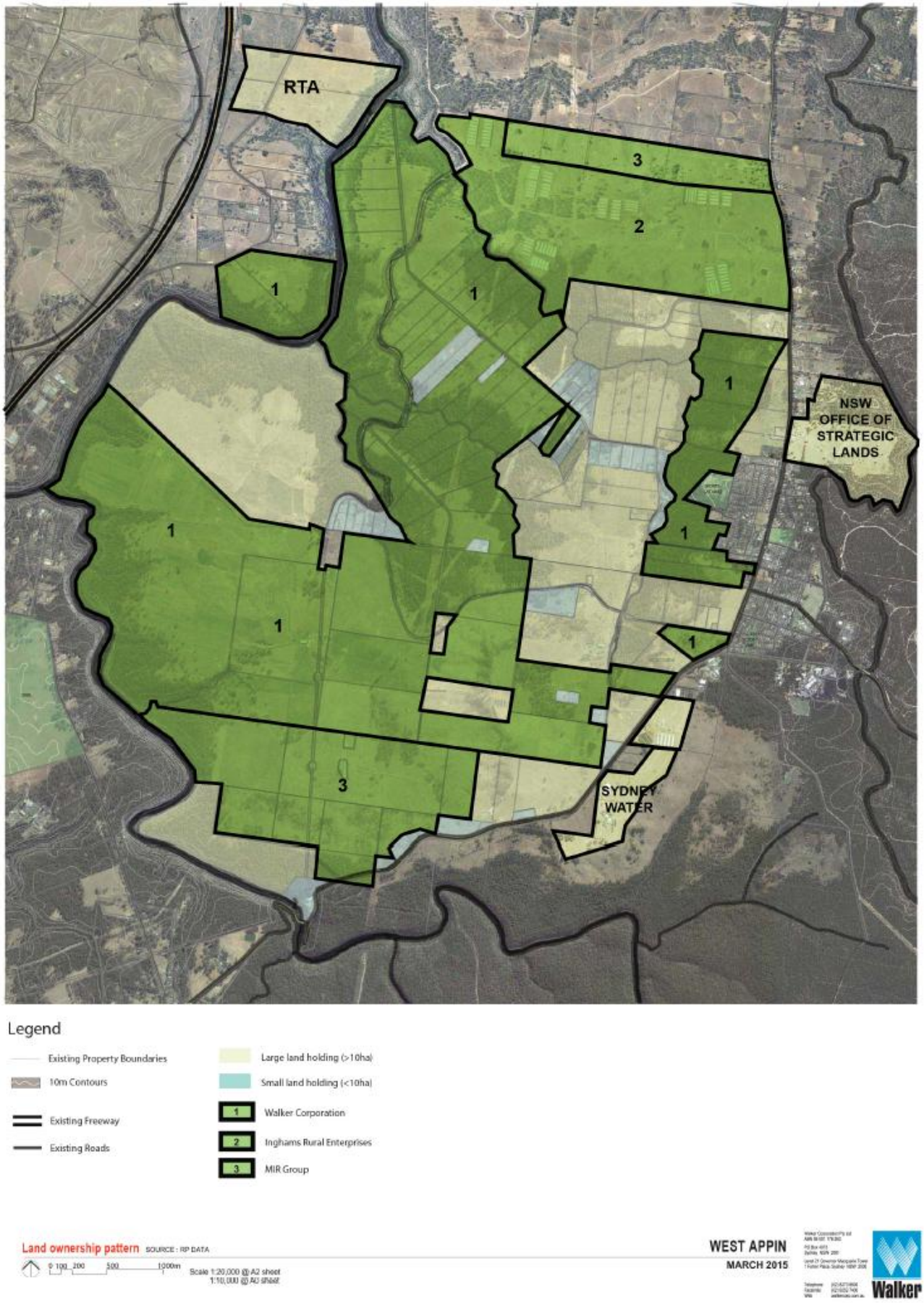
- Walker Corporation.
- Inghams.
- Mir Group.

The proposed development includes the proponents' land and other private landowners' land, the details of which are summarised in Table 3.1 and illustrated in Figure 3.1.

Table 3.1 West Appin land ownership summary

Landowner	Gross land area (hectares)
Walker Corporation	1,362
Inghams	301
Mir Group	253
Others	378
Total	**2,294**

Source: (Walker Corporation, 2015)



Source: (Walker Corporation, March 2015)

Figure 3.1 West Appin indicative proponent land ownership

3.2 Project description

The project would create a new town with around 15,500 new homes and over 15,500 jobs. Residential neighbourhoods would be created around green spaces providing a range of housing choice and facilitating healthy lifestyles options for all new residents.

A town centre of around 30–35 hectares would be established in the study area, complemented by surrounding employment areas. Neighbourhood centres would be created within residential neighbourhoods to provide local convenience retail and other services. Community facilities and physical infrastructure would be provided to promote the creation of a self-sustaining community. The proposed master plan will be further developed and informed by key planning principles and considerations. Specifically for traffic and transport, the key principles are summarised in Table 3.2.

Table 3.2 Traffic and transport planning key principles

Planning area	Key principles
Integrated land use planning	▪ Development of a combination of residential, employment, and commercial land uses to achieve high internal trip containment. ▪ Self-containment in services and employment to reduce trip numbers and length. ▪ Integrate land uses to limit trip generation and vehicle movements. ▪ Accommodate and promote work from home opportunities.
Public transport	▪ Provide for non-car travel modes, including early delivery of public transport infrastructure to establish and reinforce sustainable transport habits. ▪ Facilitate a bus network comprising: ‣ Local bus services to connect local residents within West Appin. ‣ District and regional routes to provide external connections to major external centres. ▪ Creation of higher density development and trip generators on bus routes. ▪ Establishment of a centralised and accessible public transport interchange. ▪ Establish opportunities for Kiss-and-Drop, Park-and-Ride/Park-and-Share. ▪ Establish bus priority measures. ▪ Ensure multi-modal integration with accessible bus routes and stops connected to the cycling and pedestrian network.
Road network/ private vehicles	▪ Providing strategic motorway and bus access to surrounding areas. ▪ Develop an internal road network to support connectivity and facilitate legible movement throughout the development. ▪ Implementation of appropriate parking management practices.
Walking and cycling	▪ Ensure a high level of connectivity within the development for non-vehicular movement.

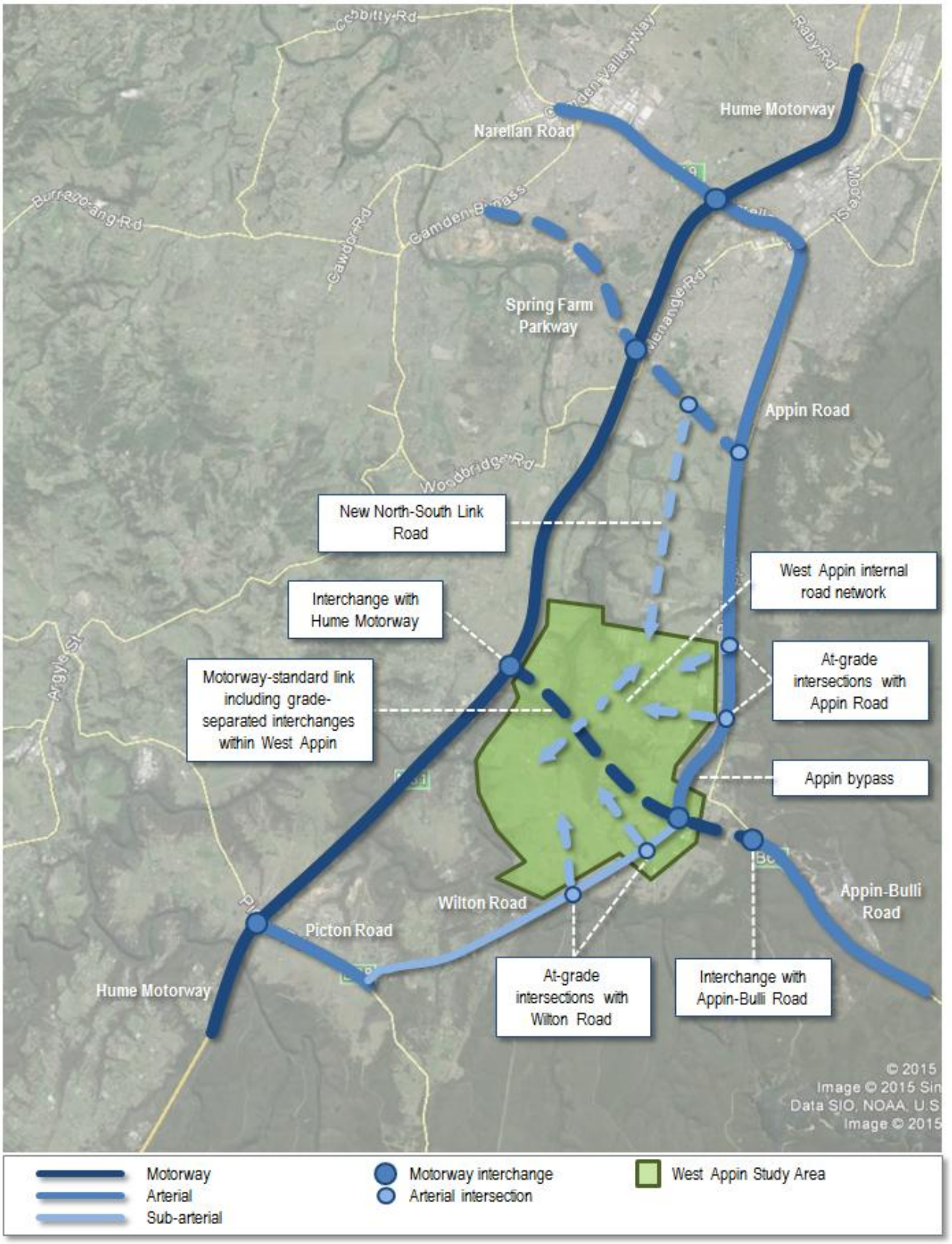
From a traffic access and management perspective the provisional master plan proposes the following fundamental features which have been informed by the preliminary traffic impact assessment presented in section 6.2:

- A town centre located in proximity of a new high-capacity, motorway-standard link between the Hume Motorway and Appin-Bulli Road, including the following interchanges:
  - A full grade-separated interchange with the Hume Motorway.
  - Grade-separated interchanges at appropriate locations within West Appin to facilitate efficient movement to, from, and within West Appin.
  - An eastbound left-in, left-out interchange with Appin-Bulli Road.
- A bypass of Appin to the current western and southern boundaries of the village.

- A new North-South Link Road between the proposed Spring Farm Parkway and West Appin.
- Two new at-grade intersections with Appin Road to facilitate traffic movements between West Appin and Campbelltown.
- Two new at-grade intersections with Wilton Road to facilitate access to and from southern residential and employment areas for internal and external traffic.
- An internal road network suitable for bus services and pedestrian/cycle links between major trip generating areas within West Appin.
- Neighbourhood centres and primary schools in 'villages' within the development to minimise the impacts of local trips.

An illustration of strategic connections to, from, and through West Appin is provided in Figure 3.2. The proposed internal road network would be further developed to separate and minimise the conflicts, and consequent impacts of these conflicts, between local and regional traffic on the road network surrounding the development. The West Appin team will continue to participate in discussions with relevant authorities to investigate further opportunities to minimise conflicts between local and regional traffic, while also providing an appropriate level of access between the road networks within and external to the development.

Opportunities to further refine and optimise the proposed road network would also be possible at the detailed design/development application stage, as more detailed land use plans are defined.



Source: Parsons Brinckerhoff, adapted from Google Earth imagery (Google Earth, extracted March 2015)

Figure 3.2 Proposed West Appin access strategy features

3.3 Development yield

3.3.1 Residential yield

The proposed development would contribute a supply of affordable housing land to the Sydney and Wollongong markets, critically required to support Sydney's economic and social growth. A summary of the forecast dwelling yield and resultant population at full development is provided in Table 3.3.

Table 3.3 West Appin residential yield (Full development)

Parameter	Description/assumptions	Yield
Designated residential land area	▪ Total ha (Gross). ▪ Excludes non-residential land uses and constrained land.	1,735 ha
Net residential land area	▪ Total ha (Net). ▪ Assumes 20% of designated area used for roads and services infrastructure and open spaces.	1,390 ha
Dwelling yield	▪ Total dwellings. ▪ Assumes average yield of 11 dwellings per ha of net residential area.	**15,500 dwellings**
Population	▪ Total population. ▪ Assumes 2.94 residents per dwelling.	**45,570 residents**

Source: (Walker Corporation, 2015)

3.3.2 Commercial and industrial yield

The proposed development would provide a variety of commercial and industrial areas, resulting in the anticipated creation of over 84,000 m^2 of commercial floor space and 15,500 jobs. A summary of employment areas and types, and resultant commercial area and employment yields is presented in Table 3.4.

Table 3.4 West Appin commercial space and employment yield (Full development)

Area/parameter	Description/assumptions	Yield
Town centre (B2 Zones – Local centres)		
Designated land area	▪ Total ha (Gross). ▪ Excludes constrained land.	33 ha
Net land area	▪ Total ha (Net). ▪ Assumes 20% of designated area used for roads and services infrastructure and open spaces.	26.4 ha
Commercial floor space	▪ Gross Floor Area (GFA, m^2). ▪ Assumes 1,740 m^2 GFA per ha of net land area.	**45,900 m^2**
Employees	▪ Assumes 1 employee per 12 m^2 of commercial floor space.	**3,910 employees**
Neighbourhood centres (B1 Zones)		
Designated land area	▪ Total ha (Gross). ▪ Excludes constrained land.	12.5 ha

Area/parameter	Description/assumptions	Yield
Net land area	■ Total ha (Net). ■ Assumes 20% of designated area used for roads and services infrastructure and open spaces.	10.0 ha
Commercial floor space	■ Gross Floor Area (GFA, m^2). ■ Assumes 3,825 m^2 GFA per ha of net land area.	**38,250 m^2**
Employees	■ Assumes 1 employee per 8 m^2 of commercial floor space.	**4,675 employees**
Light industrial areas (East of Nepean River) (IN2 Zones – Light Industrial)		
Designated land area	■ Total ha (Gross). ■ Excludes constrained land.	120 ha
Net land area	■ Total ha (Net). ■ Assumes 20% of designated area used for roads and services infrastructure and open spaces.	96 ha
Employees	■ Assumes 42 employees per ha of net land area.	**4,065 employees**
Light industrial areas (West of Nepean River) (IN2 Zones – Light Industrial)		
Designated land area	■ Total ha (Gross). ■ Excludes constrained land.	346 ha
Net land area	■ Total ha (Net). ■ Assumes 20% of designated area used for roads and services infrastructure and open spaces.	277 ha
Employees	■ Assumes 10 employees per ha of net land area.	**2,945 employees**
Total commercial floor space and employees (All Zones)		
Commercial floor space	■ Gross Floor Area (GFA, m^2).	**84,150 m^2**
Employees	■ Total employees.	**15,595 employees**

Source: (Walker Corporation, 2015)

3.4 Development staging

Land use development would be staged to align with the rollout of transport infrastructure and public transport operations for the development:

- During Stage 1, between 2017 and 2026, there would be no new connection to the Hume Motorway, and consequently development yield would focus around Appin Road and Wilton Road.
- Around 2026 a new interchange with the Hume Motorway would provide an additional access point to and from West Appin, in combination with a major road corridor through the development, facilitating the development of other areas of the site.

Commercial and industrial land would be developed at the same time as residential land to provide employment opportunities and commercial services for residents within West Appin throughout its development. This approach would maximise internal travel containment and minimise the impacts of trips generated by the development on external transport networks. While an approximately equal yield of dwellings and employees is planned at full development to achieve this, during interim stages it has been assumed that commercial floor space and employment yield development would lag residential development by approximately 5% and 10% respectively due to market conditions and other economic factors.

A summary of forecast development yield at the end of Stage 1 (2026) and at full development (around 2046) is provided in Table 3.5. These estimates have been developed by the proponents based on the anticipated rate of development for various sub-areas within the West Appin precinct. The realisation of these forecasts would be dependent on market demand and other economic factors.

Table 3.5 Preliminary staging plan

Period	Stage	Cumulative yield at end of stage (% of full development yield)		
		Dwellings	Commercial floor space (GFA)	Employees
2017–2026	Stage 1 development commences	4,550 (29%)	20,070 m^2 (24%)	3,020 (19%)
2026–2046	Remaining Stage 1 development continues; Stage 2 development commences	15,500 (100%)	84,150 m^2 (100%)	15,595 (100%)

Source: (Walker Corporation, 2015)

This preliminary assessment presents the modelling of impacts and resultant transport infrastructure requirements relevant to the full development of West Appin. Following the consideration and finalisation of this full development scenario, the modelling of interim impacts and infrastructure requirements will be undertaken to develop a staged transport infrastructure and servicing strategy. This will include the identification of triggers and staging requirements for 'ultimate' networks for relevant scenarios, as required by the terms of reference for the study.

4. Project context

This section summarises State and Local Government planning policies, controls, and forecasts relevant to the study area.

4.1 State planning context

Key State Government planning policies and schemes relevant to the study area include:

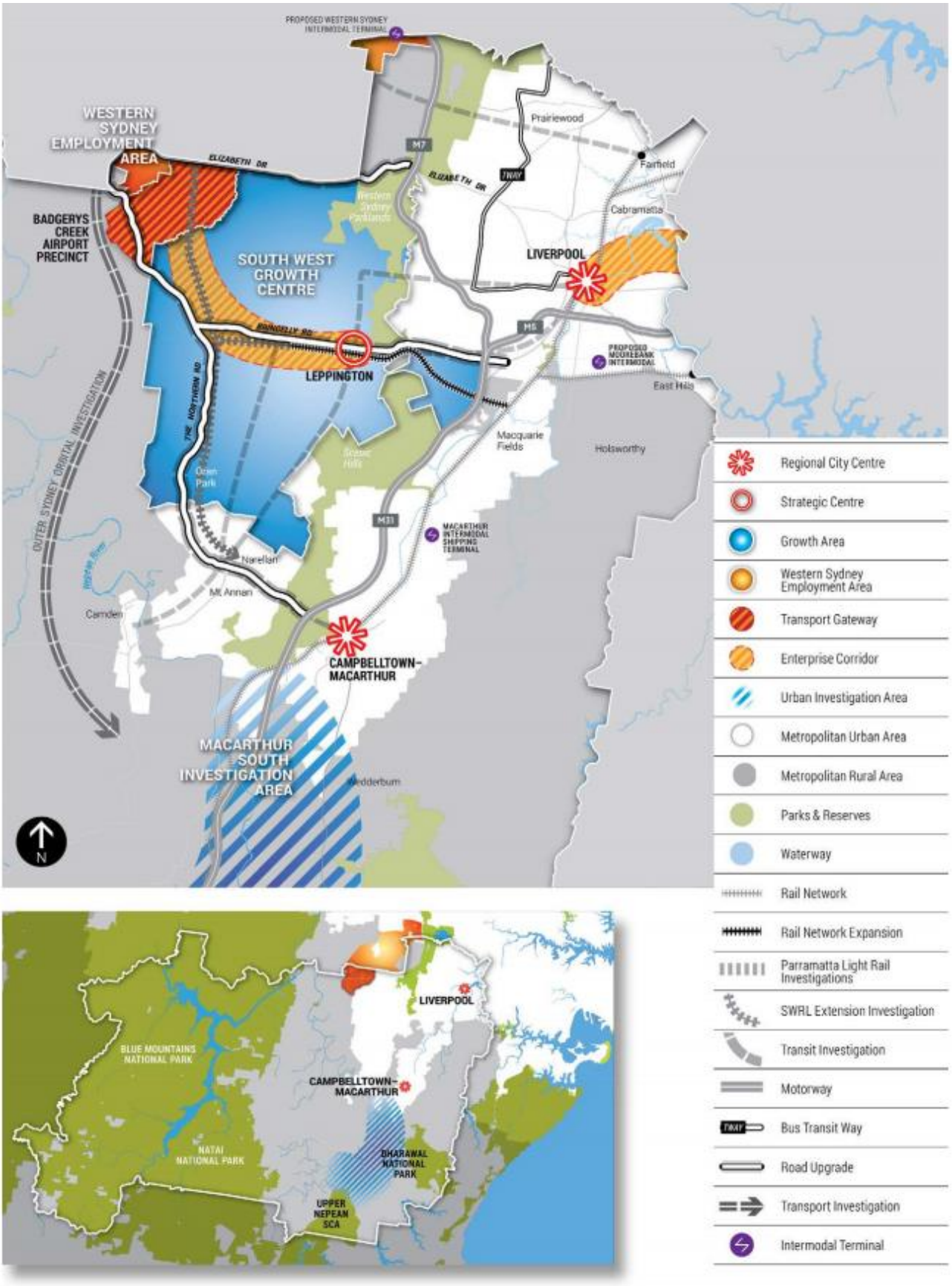
- A Plan for Growing Sydney (NSW DP&E, December 2014)
- Draft Metropolitan Strategy for Sydney to 2031 (NSW Government, March 2013)
- NSW Long Term Transport Master Plan (TfNSW, December 2012)
- NSW Freight and Ports Strategy (TfNSW, November 2013).

Key information relevant to the study area provided by these sources is summarised in the following sections.

4.1.1 A Plan for Growing Sydney

A Plan for Growing Sydney (The Plan) includes an action item to develop a framework for the identification of new growth centres. Within this item The Plan states that Government will 'identify potential locations for new greenfield development giving particular attention to investigating the potential for greenfield development south and south-west of Campbelltown MacArthur'.

The Plan also details priorities for the South West subregion, including the investigation of the suitability of the Macarthur South Investigation Area for a future Growth Centre. This investigation area, illustrated in Figure 4.1, includes the area proposed for the development of West Appin.

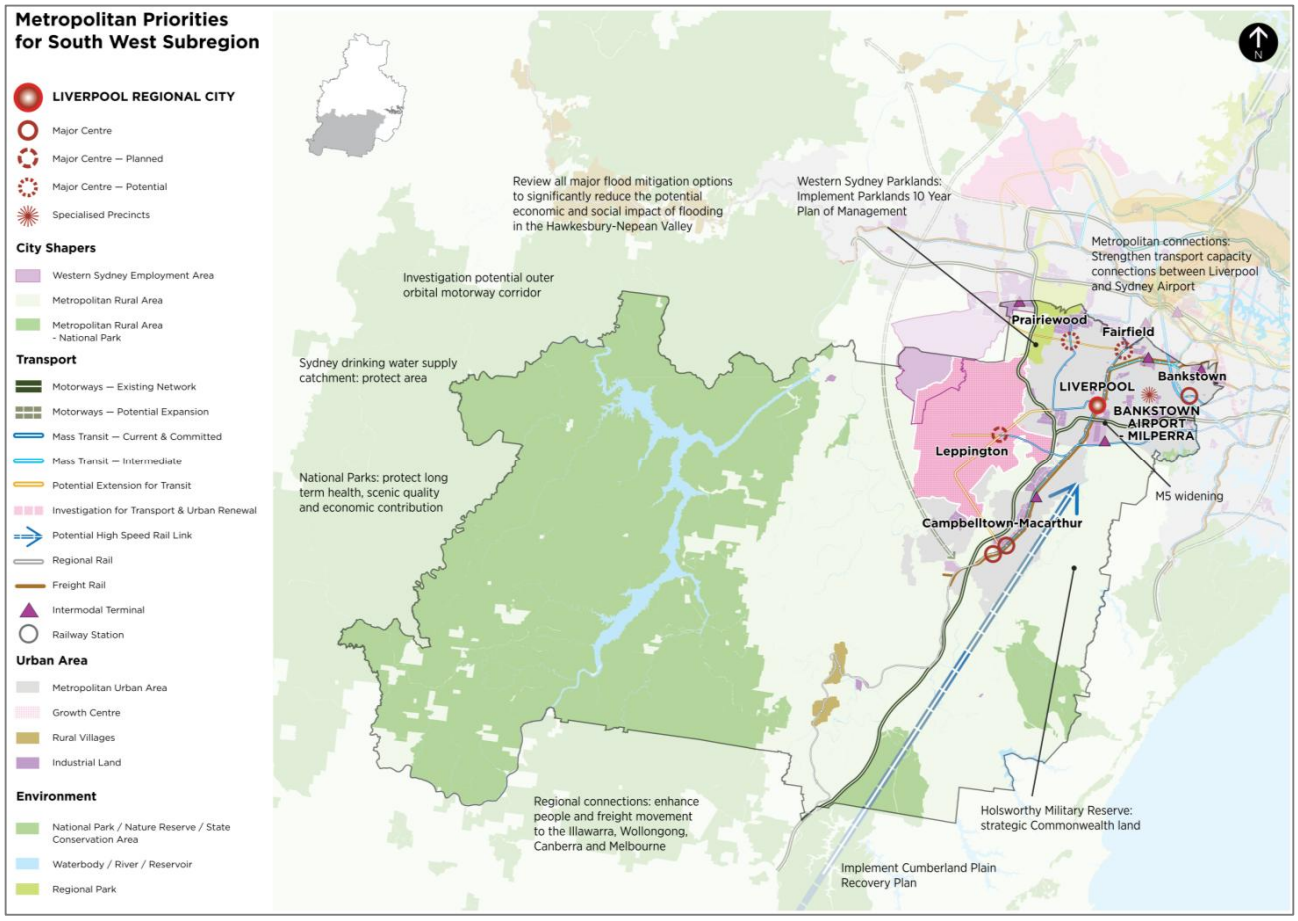


Source: A Plan for Growing Sydney (NSW DP&E, December 2014)

Figure 4.1 South West Subregion and Macarthur South Investigation Area

4.1.2 Draft Metropolitan Strategy for Sydney to 2031

The Draft Metropolitan Strategy for Sydney to 2031 (The Strategy) is a long-term land use, urban, and transport plan. The Strategy outlines total growth targets by subregion, with the distribution of that growth determined by Subregional Delivery Plans. West Appin is located within the area defined as the South West Subregion, shown in Figure 4.2. Population, employment, and housing targets in this area are shown in Table 4.1.



Source: Draft Metropolitan Strategy for Sydney to 2031 (NSW Government, 2013)

Figure 4.2 South West Subregion

Table 4.1 Targets for South West Subregion

Measure	Current	Total by 2021	Total by 2031
Housing	286,000	346,000 (+60,000)	427,000 (+141,000)
Population	829,000	1,048,000 (+219,000)	1,298,000 (+469,000)
Employment	298,000	362,000 (+64,000)	432,000 (+134,000)

Source: Draft Metropolitan Strategy for Sydney to 2031 (NSW Government, 2013)

The primary proposed housing growth area in the South West Subregion is the South West Growth Centre, where approximately half of all new dwellings planned for development are located. The proposed employment targets include significant increases in existing and planned centres, including Campbelltown–Macarthur (10,000 new jobs by 2031) and Leppington (13,000 new jobs by 2031). The development of West Appin would contribute significantly to both the population and employment targets identified in The Strategy.

Based on the criteria identified for major centres in The Strategy, West Appin would satisfy many of the key criteria defined for a major centre, including both dwelling and employment yields. It would also satisfy many of the transport criteria, summarised in Table 4.2.

Table 4.2 Defined Strategy transport criteria and features of West Appin

Strategy transport criteria	Features of West Appin
Transport catchment: subregional.	■ Proposed bus network would include regional bus routes to provide connections to major adjacent external centres. ■ Significant employment and commercial development would reinforce identity of West Appin as a major business and commercial centre.
Linked to the metropolitan rail network directly or very high volume trunk bus services.	■ Trunk bus services to and from Campbelltown-Macarthur area would provide indirect access to the existing metropolitan rail network.
Focal point as a destination and origin for subregional public transport services (typically bus).	■ Proposed bus network would comprise local bus services within West Appin and district and regional routes to provide connections to major adjacent external centres. ■ Development would include establishment of a centralised and accessible public transport interchange.
Focal point of subregional arterial and collector road network.	■ Direct road links to Hume Motorway, Picton Road, and potentially the proposed M9 Outer Orbital Motorway.
Freight access links with Sydney freight network.	■ Direct road links to Hume Motorway, Picton Road, and potentially the proposed M9 Outer Orbital Motorway.

Source: Parsons Brinckerhoff, adapted from Draft Metropolitan Strategy for Sydney to 2031 (NSW Government, 2013)

In addition, The Strategy makes reference to the priorities and planned transport improvements in the NSW Long Term Transport Master Plan (LTTMP – refer section 4.1.3). West Appin in the vicinity of some of the most significant proposed transport infrastructure in the LTTMP, including direct alignment with:

- The approximate area of the southern end of M9 Outer Sydney Orbital Motorway.
- The preferred alignment for the proposed east coast high-speed rail line between Melbourne, Canberra and Sydney.

The Strategy also builds upon the LTTMP strategies for Sydney's Metropolitan Rural Areas, including improved capacity and service quality on major commuting corridors into Sydney, illustrated in Figure 4.3. The Strategy includes the M9 Outer Sydney Orbital as a key element of this network, and identifies the Hume Motorway and a corridor between the Hume Motorway and Wollongong in the vicinity of Picton Road and Appin Road as major connections.

Source: Draft Metropolitan Strategy for Sydney to 2031 (NSW Government, March 2013)

Figure 4.3 Regional connections to Sydney

4.1.3 NSW Long Term Transport Master Plan

The *NSW Long Term Transport Master Plan* (LTTMP) provides a framework for addressing transport challenges over the next 20 years. The key features of the LTTMP are most relevant to the West Appin study area are summarised in Table 4.3.

Table 4.3 Features of LTTMP relevant to the study area

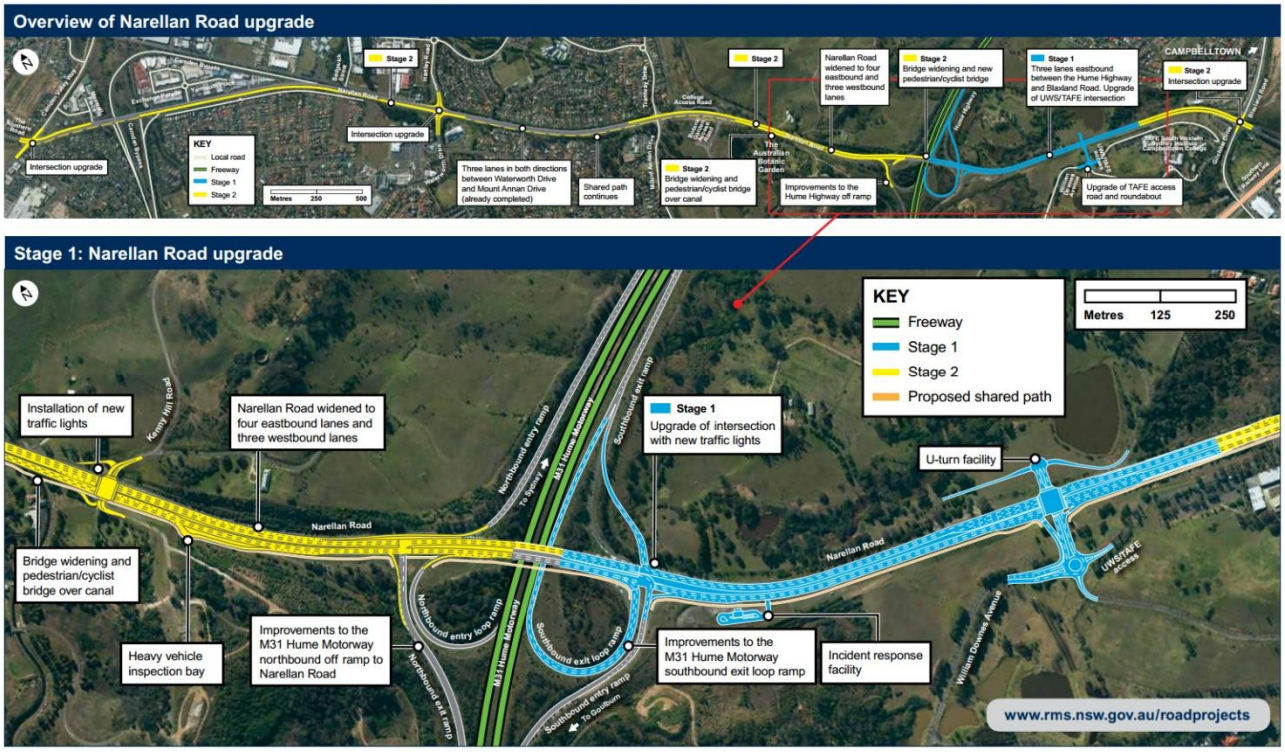
Feature	Details
M9 Outer Orbital	▪ Identified as a future transport corridor for preservation. ▪ Study area is in direct alignment with the illustrated southern end of this corridor, as shown in Figure 4.6.
East Coast high speed rail	▪ Corridor is identified for preservation in collaboration with the Federal Government. ▪ Current preferred alignment traverses the study area.
Georges River Parkway	▪ Identified as a future transport corridor that is already protected, as shown in Figure 4.6.
Hume Motorway	▪ Identified as a key part of the National Road Network. ▪ Identified as a corridor under pressure.
Picton Road	▪ Identified as a State Road. ▪ Safety upgrades underway to support the Port Kembla Expansion (refer section 4.1.4). ▪ Further capacity upgrades planned in the medium to long term; action item to seek to establish connections between the Illawarra Region and the South West Growth Centre with upgrade works to Picton Road.

Feature	Details
Appin Road	■ Identified as a State Road.
Wilton Road	■ Identified as a Regional Road.

Source: Parsons Brinckerhoff, adapted from Long Term Transport Master Plan (TfNSW, December 2012)

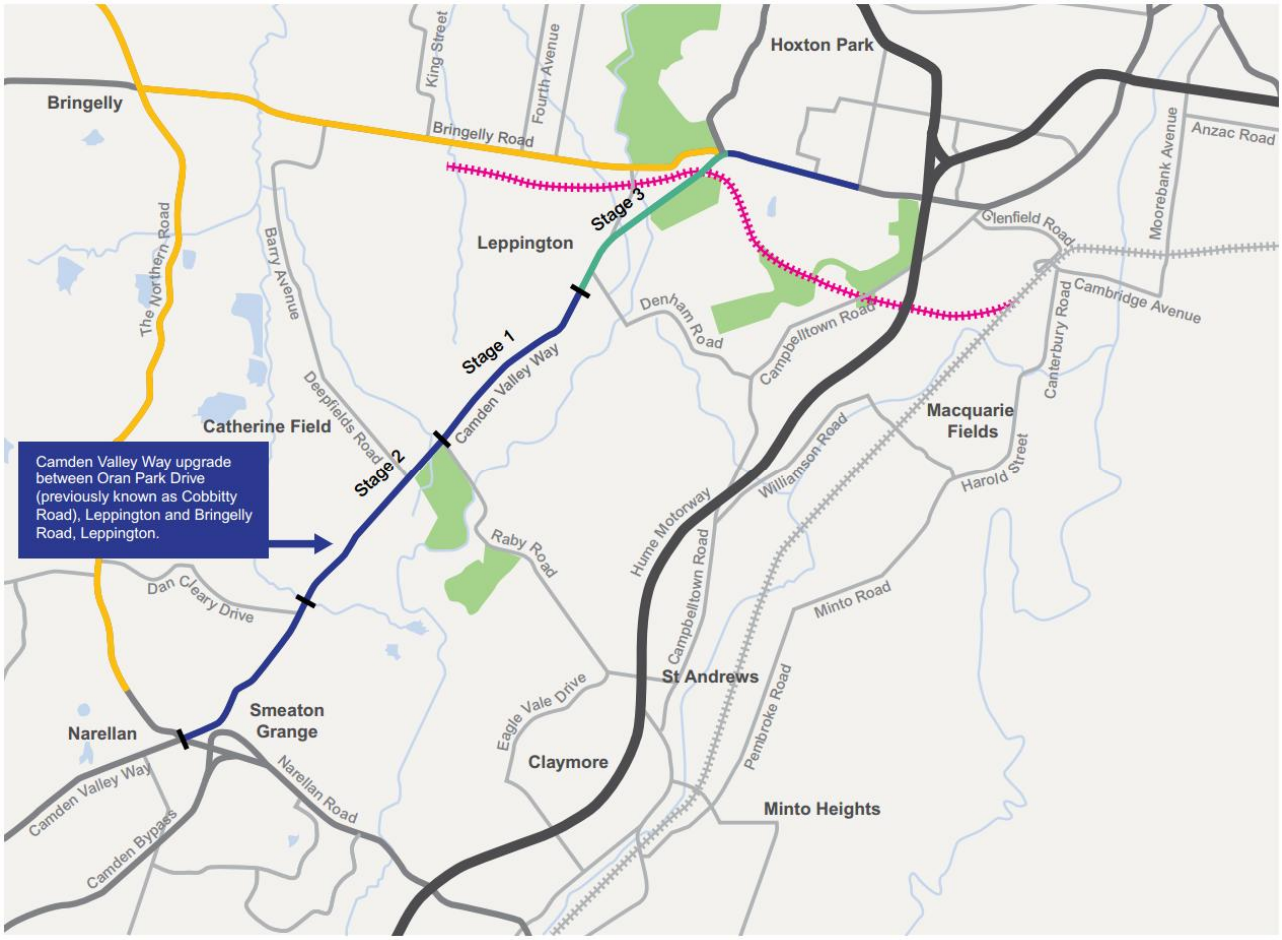
Construction of road projects included in the LTTMP and relevant to the study area includes:

- Narellan Road upgrade (Figure 4.4):
  - Construction of Stage 1 began in July 2014.
  - Stage 2 currently undergoing detailed design; construction scheduled to begin in early 2016.
- Camden Valley Way upgrade (Figure 4.5):
  - Stage 1 and Stage 2 completed in November 2014.
  - Stage 3 is currently under construction with work expected to finish in late 2015.
- M5 West widening:
  - Three lanes were opened to traffic in both directions in December 2014.
  - Minor landscaping, noise remediation, and other finishing works are scheduled to be completed in early 2015.



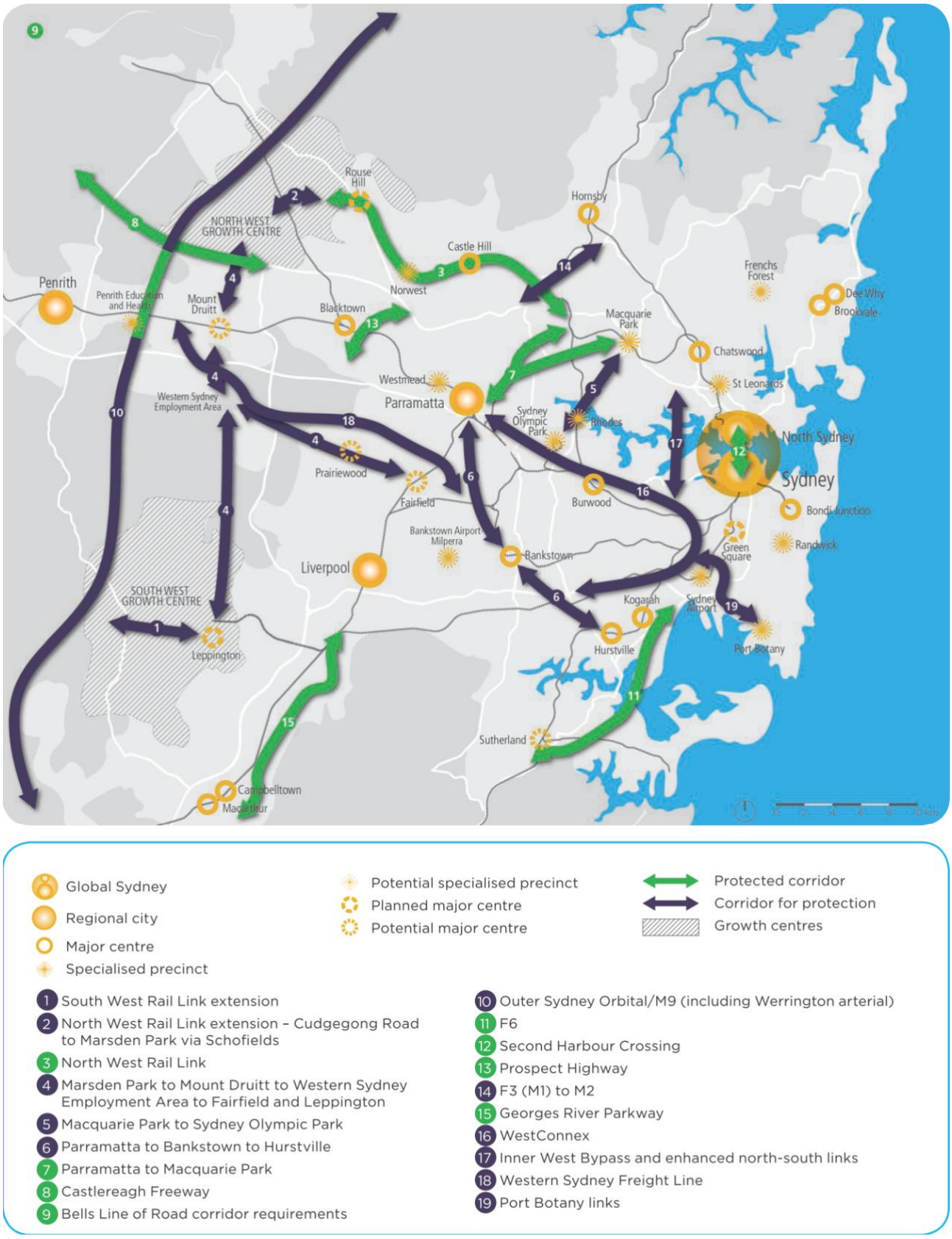
Source: Roads and Maritime Services website (RMS, extracted March 2015)

Figure 4.4 Overview of Narellan Road upgrade program



Source: Roads and Maritime Services website (RMS, extracted March 2015)

Figure 4.5 Overview of Camden Valley Way upgrade program



Source: *Long Term Transport Master Plan* (TfNSW, December 2012)

Figure 4.6 Protected corridors to support urban growth

4.1.4 NSW Freight and Ports Strategy

The Freight and Ports Strategy is the 20 year road map that will ensure freight is at the forefront of the NSW economy. Identified commitments on network infrastructure tasks across NSW are illustrated in Figure 4.5. Within the study area the benefits of these projects are likely to include improvements road safety and capacity and/or reduce road freight traffic demand.

Figure 16 Current commitments to date on network infrastructure tasks across NSW

Source: NSW Freight and Ports Strategy (Transport for NSW, November 2013)

Figure 4.7 Committed network infrastructure tasks across NSW

4.2 Local planning context

4.2.1 Other proposed developments surrounding the study area

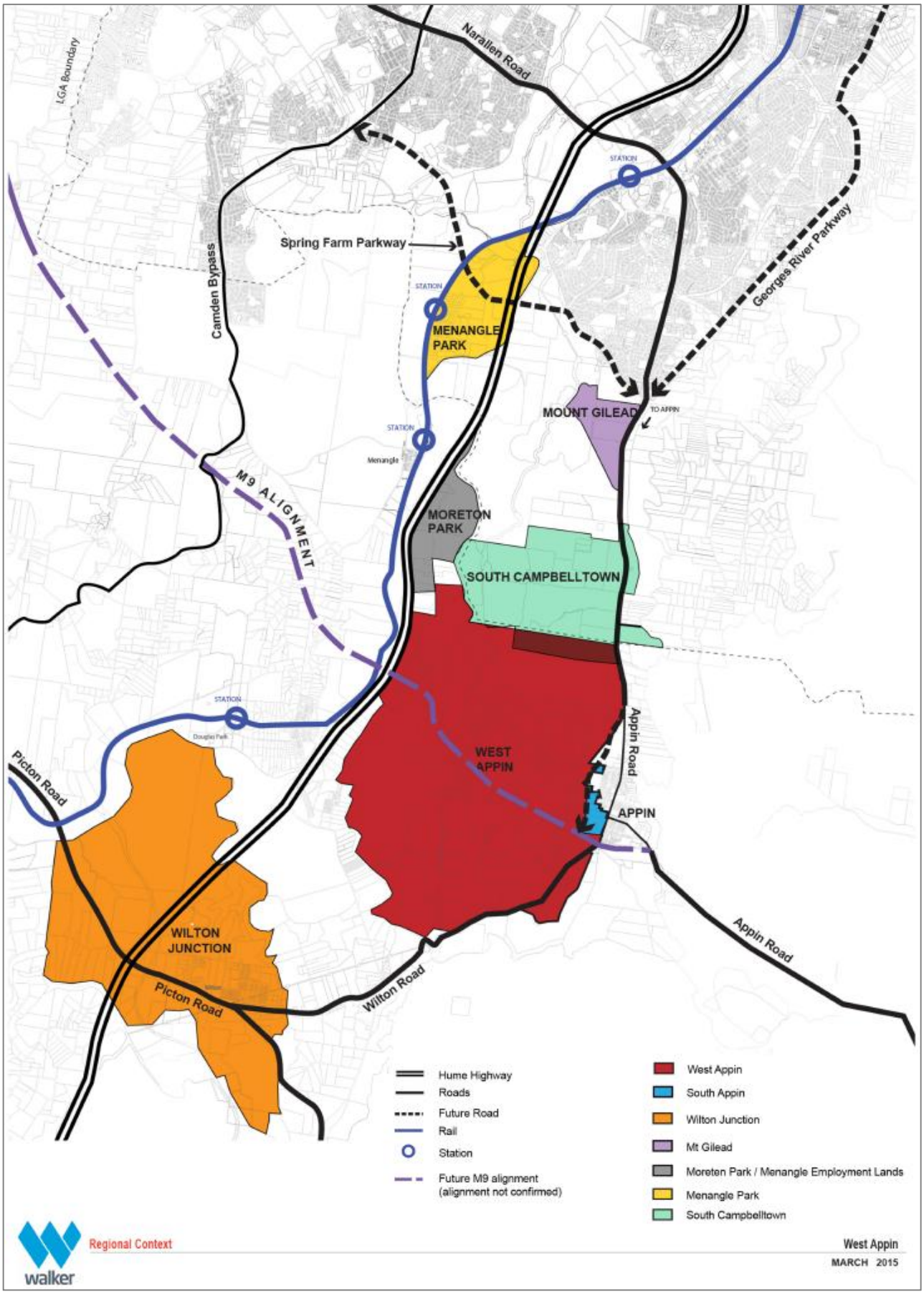
A number of other currently proposed developments are located in the vicinity of West Appin, as illustrated in Figure 4.8. Details of the estimated residential, employment, and commercial yield for each of these areas are summarised in Table 4.5. These estimates have been created using publically available information where possible and/or augmented with the industry knowledge of the proponent group.

Table 4.4 Population, employment, and commercial area forecasts for surrounding developments

Area/Population/Employment		2026	2036
West Appin			
Population		13,375	45,570
Employment	B1 Zones – Neighbourhood Centres	1,115	4,680
	B2 Zones – Local Centres	935	3,910
	IN2 Zones – Light Industrial	970	7,010
Commercial areas (GFA)	B1 Zones – Neighbourhood Centres	9,120 m^2	38,250 m^2
	B2 Zones – Local Centres	10,950 m^2	45,900 m^2
Menangle Park			
Population		4,410	9,990
Employment	B2 Zones – Local Centres	90	200
	IN1 Zones – General Industrial	90	200
Commercial areas (GFA)	B2 Zones – Local Centres	740 m^2	1,630 m^2
Mount Gilead			
Population		3,970	4,410
Employment	B1 Zones – Neighbourhood Centres	115	115
Commercial areas (GFA)	B1 Zones – Neighbourhood Centres	940 m^2	940 m^2
South Campbelltown			
Population		5,290	11,170
Employment	B1 Zones – Neighbourhood Centres	350	950
	B2 Zones – Local Centres	290	800
	IN2 Zones – Light Industrial	310	830
Commercial areas (GFA)	B1 Zones – Neighbourhood Centres	2,870 m^2	7,760 m^2
	B2 Zones – Local Centres	3,410 m^2	9,390 m^2

Area/Population/Employment		2026	2036
Menangle (Moreton Park and Station Street)			
Population		1,030	1,030
Employment	B1 Zones – Neighbourhood Centres	110	110
	IN2 Zones – Light Industrial	420	2,400
Commercial areas (GFA)	B1 Zones – Neighbourhood Centres	900 m^2	900 m^2
Wilton Junction			
Population		16,070	28,930
Employment	(Consistent with Wilton Junction TMAP assumptions)	4,230	8,560
Commercial areas (GFA)		30,000 m^2	57,300 m^2
Total – West Appin and other developments			
Population		44,145	101,100
Employment		9,025	29,765
Commercial areas (GFA)		58,930 m^2	162,070 m^2

Source: Proponent group (December 2014)



Source: Walker Corporation (March 2015)

Figure 4.8 Location of West Appin and surrounding developments

4.2.2 Wollondilly Shire planning controls

Wollondilly Shire Local Environment Plan 2011 (LEP) states an aim 'to encourage development that provides for an integrated transport and infrastructure system and adequate facilities and service provision for future growth'.

The Wollondilly Development Control Plan 2011 (DCP) includes the objective 'to encourage the integration of land use and transport, and provide for environments that are highly accessible and conducive to walking, cycling and the use of public transport'. Various volumes of the DCP contain transport planning objectives for residential, commercial, and industrial developments in Wollondilly Shire. Overarching transport and movement objectives in the DCP are:

a) Create a hierarchy and network of publicly accessible roads, shared pathways and other links.

b) Provide links to public transport and opportunities to use public transport.

c) Create public spaces which allow the safe and practical movement of pedestrians, cyclists and vehicles.

d) Achieve permeability and connectivity for movement other than by private motor vehicles.

The details of the proposed development at West Appin would be developed and refined during subsequent planning and design phases based on the objectives, principles, and controls defined by the LEP and DCP.

4.3 Government population and employment forecasts

State Government population and employment forecasts for the area are presented in Table 4.6. These forecasts were released by BTS in September 2014, and exclude the proposed development of West Appin and other proposed developments surrounding the study area. In summary, over the 25 years between 2011 and 2036:

- Wollondilly LGA's population is forecast to increase by 16,500 (37%) and employment by 4,600 (39%).
- The South West Subregion's population is forecast to increase by 465,300 (56%) and employment by 142,800 (50%).
- Sydney LGA's outside of the South West Subregion are forecast to experience a population increase of over 1.4 million (42%) and employment increase of over 700,000 (38%).
- The average for all areas is a population and employment increase of around 40%.

In the context of the State Government forecasts, West Appin would significantly increase future growth within Wollondilly LGA, providing dwellings for an additional 45,000 residents, and over 15,000 new jobs. In the context of the South West Subregion, West Appin would comprise approximately 10% of the population and employment growth forecast for this area.

Table 4.5 State Government population and employment forecasts

Area/Population/Employment	2011	2026	2036
Wollondilly LGA			
Population	44,100	53,400	60,600
Employment	11,800	14,400	16,400
Campbelltown LGA			
Population	149,800	187,500	214,100
Employment	50,500	62,400	70,900
Camden LGA			
Population	57,900	131,700	188,200
Employment	20,200	38,300	50,600
Liverpool LGA			
Population	186,300	273,500	325,500
Employment	67,500	95,300	113,600
Fairfield LGA			
Population	194,900	227,500	246,400
Employment	60,200	79,700	86,300
Bankstown LGA			
Population	188,700	228,300	252,200
Employment	70,900	80,300	86,100
South West Subregion (Wollondilly, Campbelltown, Camden, Liverpool, Fairfield, Bankstown)			
Population	821,700	1,101,900	1,287,000
Employment	281,100	370,500	423,900
Sydney LGAs (Non-South West Subregion)			
Population	3,396,800	4,267,100	4,834,200
Employment	1,875,600	2,311,200	2,589,000
Other Non-Sydney LGAs			
Population	1,274,500	1,461,000	1,563,900
Employment	521,100	629,300	707,700
Total			
Population	5,493,000	6,830,000	7,685,100
Employment	2,677,800	3,311,000	3,720,600

Source: NSW Government population and employment forecasts (BTS, September 2014)

5. Traffic modelling overview

As required by the terms of reference for the study, the traffic modelling methodology used to undertake the traffic impact assessment presented in Section 6 comprises a two-part approach:

- Strategic transport modelling undertaken by TfNSW (BTS) using the Sydney Strategic Transport Model (STM).
- The assignment and assessment of the transport network at a mesoscopic level undertaken by Parsons Brinckerhoff using AIMSUN modelling software.

The following sections provide a detailed description of the traffic modelling methodology adopted.

5.1 Scenarios

A variety of combinations of horizon years, land use, and transport network options have been assessed. The key scenarios which have been modelled and presented in Section 6 of this report are summarised in Table 5.1.

Table 5.1 Overview of key modelled scenarios

Land use/Transport network		Horizon year		
		Existing conditions	2026	2036
Land use: Base Case				
Transport networks:	**Base case**			
	Base case + M9 Outer Orbital (East & West)			
Land use: Base Case + West Appin				
Transport networks:	**Base case + Bus enhancements + M9 (East only)**			
	Base case + Bus enhancements + M9 (East & West)			

Key:
Modelled scenarios
Scenario not applicable

Details of the key land use assumptions for each scenario are presented in Table 5.2. All scenarios adopt the State Government population and employment forecasts for Sydney Greater Metropolitan Area (September 2014 release). For scenarios which adjust these 'Base Case' forecasts to represent West Appin, the following methodology has been applied:

- Population and employment forecasts for West Appin have been added to Base Case forecasts, increasing control totals for relevant areas within the South West Subregion.
- Areas within the South West Subregion which are not affected by West Appin maintain consistency with Base Case population and employment forecasts.
- Overall population and employment control totals for non-South West Subregion Sydney LGAs reduced to balance increase within South West Subregion, maintaining overall control total for Sydney LGAs. Population and employment distribution across non-South West Subregion LGAs is consistent with Base Case distribution.

Importantly, Table 5.2 shows that for modelling purposes it has been assumed that West Appin would be fully developed by 2036. This assumption has been applied to the modelling undertaken as required by the terms of reference for the study. However, as noted in section 3.4, the full development of West Appin is not expected to be completed until around 2046. Consequently, the modelling of 2036 conditions including West Appin effectively represents a worst-case scenario where the rate of development, traffic generated, and resulting impacts and infrastructure needs would be accelerated when compared to the currently anticipated rate of development.

Table 5.2 Key land use scenario details

<table>
<tr><th>Land use scenario</th><th>Existing conditions</th><th>2026</th><th>2036</th></tr>
<tr><td>Base Case</td><td>■ Existing population, employment, and commercial areas.</td><td colspan="2">■ State Government population and employment forecasts for Sydney Greater Metropolitan Area (September 2014 release).</td></tr>
<tr><td rowspan="3">Base Case + West Appin</td><td rowspan="3">■ Not applicable.</td><td colspan="2">Base Case forecasts adjusted by:</td></tr>
<tr><td>■ Increasing population in West Appin (Wollondilly LGA) by 13,375.
■ Increasing employment in West Appin by 3,020.</td><td>■ Increasing population in West Appin (Wollondilly LGA) by 45,570.
■ Increasing employment in West Appin by 15,595.</td></tr>
<tr><td colspan="2">■ Reducing population and employment in non-South West subregion LGAs within Sydney to maintain population and employment control totals.</td></tr>
</table>

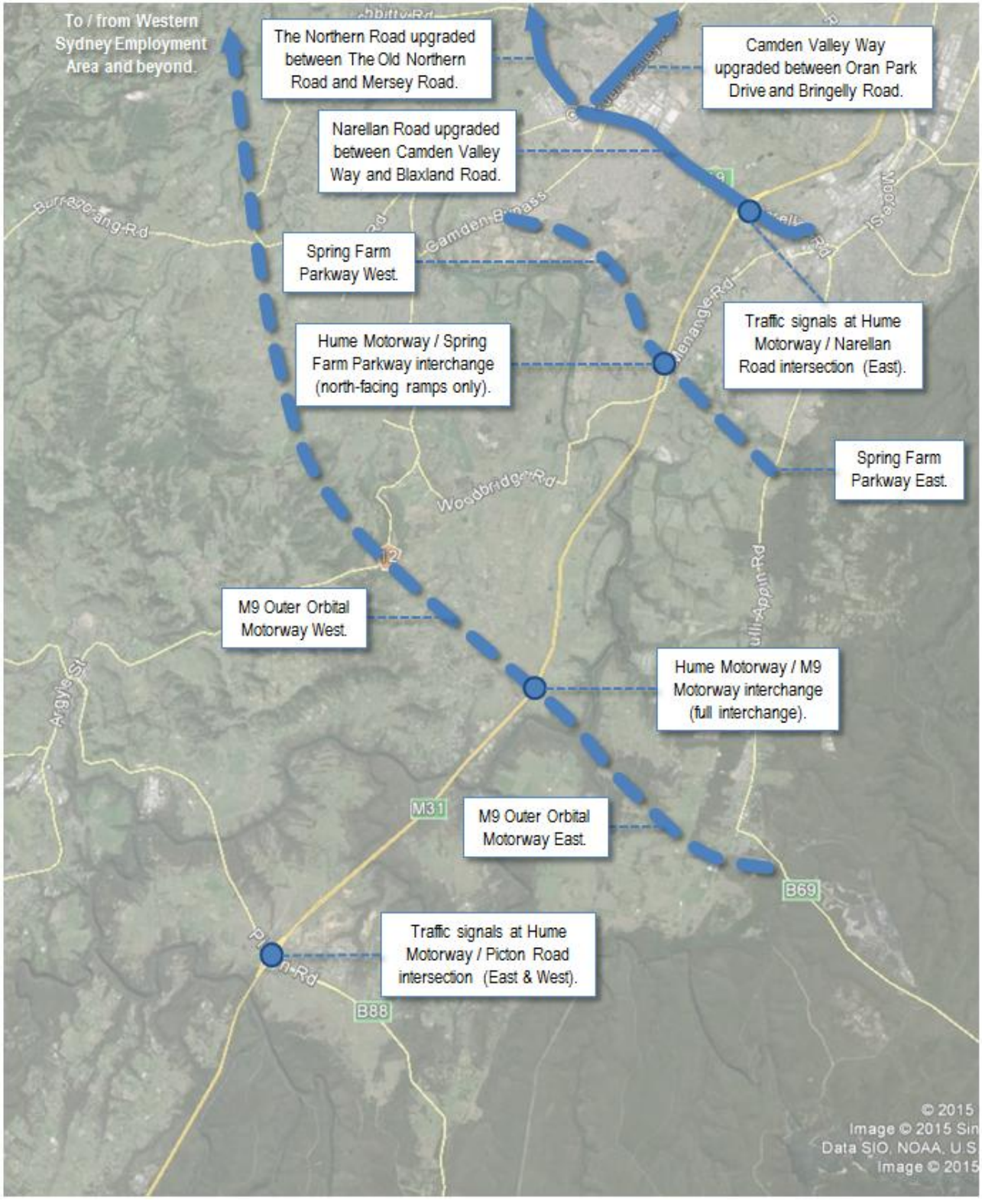
Details of the core transport network assumptions relevant to the study area for each scenario are presented in Table 5.3:

- Base Case assumptions are relevant to all scenarios in that Horizon Year.
- Other assumptions are only relevant to the scenarios indicated in Table 5.1.

Indicative locations of the road network assumptions are illustrated in Figure 5.1. In addition to the core network assumptions shown, the traffic impact assessment presented in Section 6 identifies additional upgrades and enhancements relevant to each scenario.

Table 5.3 Future transport network scenario details

Transport network scenario	2026	2036
Base Case	■ Existing road network enhanced by the construction of: ▸ Narellan Road upgrades: – Widening to 3 lanes in each direction (minimum). – Traffic signals at the Hume Motorway/ Narellan Road (East) interchange intersection. ▸ Camden Valley Way upgrades: – Widening allowing for up to three lanes in each direction. – Traffic signal installation at various locations. ▸ The Northern Road upgrades: – Widening allowing for up to three lanes in each direction. – Traffic signal installation at various locations. ▸ Hume Motorway/Picton Road interchange upgrade: – Traffic signals at the east and west intersections. ▸ Spring Farm Parkway: – North-facing ramps on Hume Motorway approximately 4.5 km south of Narellan Road interchange. – Arterial road west of Hume Motorway providing connection between new north-facing ramps and Camden bypass.	■ 2026 road network enhanced by the construction of: ▸ Spring Farm Parkway: – Arterial road east of Hume Motorway providing connection between new north-facing ramps and Appin Road.
Bus enhance-ments	■ Existing bus operations enhanced by additional services to, from, and through study area to provide public transport services to and from new developments: ▸ Additional/modified services between West Appin and Campbelltown–Macarthur area via Appin Road.	■ 2026 bus operations further enhanced by additional services to, from, and through study area to provide public transport services to and from new developments: ▸ New services between West Appin and Campbelltown-Macarthur area via Hume Motorway and M9 (East). ▸ New services between West Appin and Wilton via Wilton Road and Picton Road.
M9 Outer Orbital (East)	■ Base Case road network enhanced by the construction of: ▸ North-facing and south-facing ramps on Hume Motorway approximately 9 km north of Picton Road interchange. ▸ Motorway connection east of Hume Motorway between Hume Motorway interchange and Appin-Bulli Road.	
M9 Outer Orbital (West)	■ Not applicable.	■ M9 Outer Orbital (East) extended by the construction of a motorway connection west of Hume Motorway, to and from Western Sydney Employment Area and beyond.



Source: Parsons Brinckerhoff, adapted from Google Earth imagery (Google Earth, extracted March 2015)

Figure 5.1 Key road network enhancements

5.2 Modelling methodology overview

The traffic impact assessment presented in section 6 primarily uses the West Appin Mesoscopic Model (an AIMSUN-based mesoscopic model developed by Parsons Brinckerhoff for the purpose of this study) to simultaneously forecast traffic and assess impacts and performance. However, the development of this model required and incorporated key inputs from the following sources:

- Existing traffic survey/operational data.
- First-principles modelling: Various first-principles assumptions and calculations have been developed to provide inputs to the STM and West Appin Mesoscopic Model where appropriate.
- Sydney Strategic Transport Model (STM): Emme-based Strategic Transport Modelling tool owned and maintained by BTS.

The following sections provide a summary of the methodology used to develop the base year and future year AIMSUN models used to undertake the traffic impact assessment.

5.3 Base year model development

The AIMSUN model has been developed to simulate AM and PM peak traffic conditions in the area. A 2-hour model for both peak periods has been developed, with the following 2-hour peak periods identified through the analysis of traffic surveys undertaken in the study area:

- AM peak: 07.00–09.00
- PM peak: 15.45–17.45

The modelled road network and zone system defined in the base year models accurately represent key roads, intersections, and other access points in the study area. The modelled area, illustrated in Figure 5.2, is generally bounded by:

- Narellan Road to the north.
- Picton Road/Remembrance Drive to the south.
- M1 Princes Motorway to the east.
- Remembrance Drive/Old Hume Highway to the west.

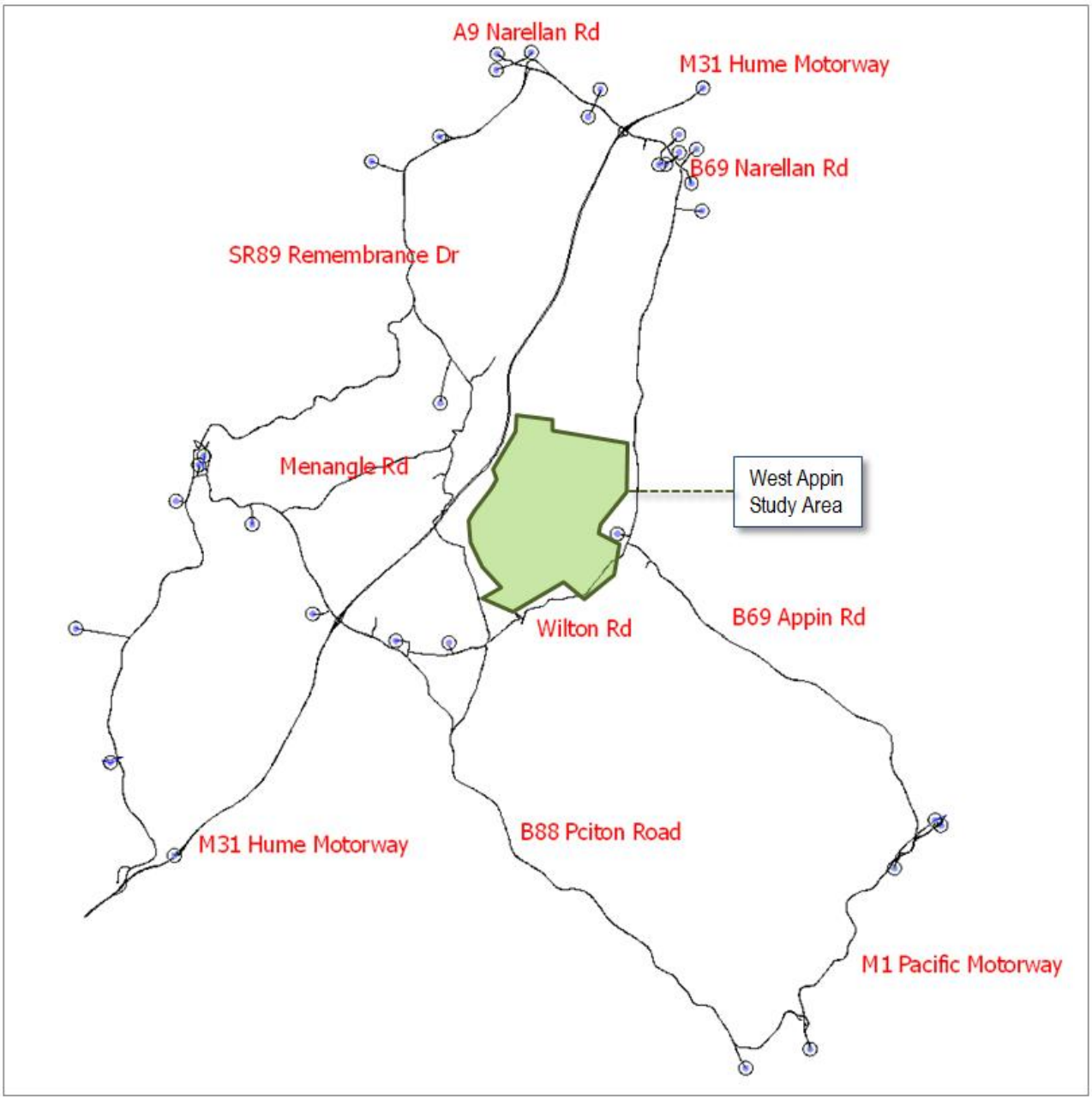


Figure 5.2 West Appin AIMSUN Model Base Year road network and zone system

In the absence of surveyed Origin-Destination data, the development of base year vehicle demand matrices for these AM and PM peak periods used a combination of the following sources:

- STM demand matrices provided by BTS.
- Classified intersection turning movement counts.
- Traffic signal SCATS counts.
- Mid-block movement counts.

During the model development process, estimation and adjustment functions in AIMSUN including furnessing have been used to refine the base year vehicle demand matrices. Following their development, the base year matrices have been assigned to the modelled road network using Dynamic User Equilibrium (DUE), as required by the Terms of Reference for the study.

5.4 Future year model development

The traffic modelling methodology for the various future horizon years and scenarios used to undertake the traffic impact assessment adopted a standard 4-stage modelling approach, which involves:

- Trip generation.
- Trip distribution.
- Mode choice.
- Trip assignment.

These modelling stages, and key modelling tools/inputs used for each stage, are summarised in the following sections. The STM modelling undertaken for the purpose of this assessment provides key outputs for each of the modelling stages, as summarised in Table 5.4. Further details of how the STM outputs have been incorporated in the overall modelling process are provided in subsequent sections where relevant. Detailed technical documentation for the STM is available on the BTS website[1].

[1] Refer to http://www.bts.nsw.gov.au/Publications/Technical-documentation/default.aspx.

Table 5.4 Key features of STM modelling undertaken

Modelling stage	Inputs/processes	Key outputs
Trip generation	▪ The STM estimates total trips (all modes) generated to, from, and within Sydney. ▪ STM trip generation is estimated using land use assumptions including: ‣ Population forecasts. ‣ Employment forecasts. ‣ Trip generation rates. ▪ As an example, West Appin is represented within Travel Zone (TZ) 1446 of the STM. When calculating the impacts of the development of West Appin, additional population and employment yields are added to TZ1446, and the STM calculates the additional trips generated by the development.	▪ Trip generation outputs from the STM have not been directly used for the purpose of this assessment. However, trip generation estimates are required to undertake subsequent stages of STM modelling, and are therefore a fundamental part of the modelling process.
Trip distribution	▪ Following the creation of trip generation forecasts, trips are then distributed between TZs within the STM based on key factors and parameters, including: ‣ Population demographics/socio-economics. ‣ Travel purpose. ‣ Travel time/distance.	▪ The output of this process is an estimate of the origins and destinations of all trips for all TZs in the STM. ▪ As an example, the trip distribution produced by the STM for TZ1446 provides an estimate of: ‣ The proportion of trips which would be internally contained within West Appin (intra-zonal trips). ‣ The proportion of trips which travel between West Appin and other areas (external/inter-zonal trips). ‣ The areas which external trips to/from West Appin are likely to be generated/attracted by.
Mode choice	▪ The STM estimates mode choice and trip distribution simultaneously. The estimates produced during the simultaneous trip distribution/mode choice process use transport network assumptions including: ‣ Transport availability (e.g. car ownership, road network connections, public transport services, etc.). ‣ Transport cost (e.g. car operating costs, parking costs, public transport fares, and travel and waiting times).	▪ The output of this process is an estimate of demand for different travel modes between origins and destinations for all TZs in the STM. ▪ As an example, the mode choice outputs produced by the STM for TZ1446 provides an estimate of: ‣ The proportion of trips which would use public transport to, from, and within West Appin. ‣ The proportion of trips which would be car drivers and car passengers. ‣ The areas which public transport trips to/from West Appin are likely to be generated/attracted by.
Trip assignment	▪ Following the preceding stages, road vehicle trips are assigned to the road network. This process allows vehicles to make route choices, and ultimately creates traffic forecasts, based on: ‣ The alignment, speed, and capacity of alternative routes. ‣ Traffic demand and resulting congestion and delays on alternative routes.	▪ The output of this process is the creation of traffic forecasts on all roads included in the STM. ▪ As an example, the trip assignment outputs produced by the STM in the study area provide an estimate of traffic demand on key roads (e.g. Hume Motorway, Narellan Road, Appin Road, M9 Motorway, etc.).

5.4.1 Trip generation

Increased trip end generation internal and external to the modelled study area have been developed from a combination of two key sources:

- External zones (e.g. Hume Motorway, Camden Valley Way, The Northern Road, M1 Princes Motorway): Road vehicle trip end growth has generally been calculated using the relative growth between horizon year and scenario outputs produced by the STM trip assignment process.
- Internal zones (excluding West Appin): Road vehicle trip end growth has generally been calculated using the relative growth between horizon year and scenario outputs produced by the STM trip generation, distribution, mode choice, and assignment processes.
- Internal zones (West Appin): Road vehicle generation for West Appin has been calculated using first-principles modelling.

The first principles modelling undertaken to develop trip end forecasts for West Appin uses the following key inputs for proposed land uses:

- Population, employment, and commercial area yield – summarised in Table 4.5 (section 4.2)).
- Trip generation rates (summarised in Table 5.5).
- Directional split assumptions (summarised in Table 5.6).

Summaries of resulting trip end forecasts for West Appin for 2026 AM and PM peak hours are provided in Table 5.7 and Table 5.8 respectively. 2036 AM and PM peak hour trip end forecasts are provided in Table 5.9 and Table 5.10 respectively.

Additional trip generation in the study area as a result of West Appin has been added to Base Case traffic generation forecasts for the area. As an example, referring to Table 5.9 and Table 5.10, in 2036 it is anticipated that West Appin would generate around 13,000 additional inbound and outbound trips in the study area during peak hours when compared to conditions without West Appin.

The forecasts presented in Table 5.9 and Table 5.10 represents peak hour traffic generation. The AIMSUN modelling undertaken covers a 2-hour peak period, representing conditions during the busiest hour of the day combined with a similarly highly trafficked preceding or following hour. Based on the analysis of traffic data for the study area, the following hours and factors are represented in the AIMSUN modelling:

- AM peak period:
  - 7.00–8.00 am: peak hour (100%).
  - 8.00–9.00 am: 2nd highest hour (89% of peak hour demand).
- PM peak period:
  - 3.45–4.45 pm: 2nd highest hour (98% of peak hour demand).
  - 4.45–5.45 pm: peak hour (100%).

Table 5.5 Trip generation rates

Land use	Parameter	Vehicle trips/ hour	Assumptions
AM peak			
Residential	Vehicle trips/ dwelling	0.78	▪ Low density residential dwelling rate (Regional areas)[1].
Employment	Vehicle trips/ employee	0.48	▪ 85% vehicle driver mode for commuting trips[2]. ▪ 56% of vehicle driver commuting trips occur in peak hour[3].
Retail/commercial: 0–10,000 m^2	Vehicle trips/ 100m^2 GFA	12.3	▪ Peak hour generation rates[1].
Retail/commercial: 10,000–20,000 m^2		7.6	
Retail/commercial: 20,000–30,000 m^2		5.9	
Retail/commercial: 40,000–70,000 m^2		4.4	
PM peak			
Residential	Vehicle trips/dwelling	0.84	▪ Low density residential dwelling rate (Regional areas)[1].
Employment	Vehicle trips/employee	0.41	▪ 85% vehicle driver mode for commuting trips[2]. ▪ 48% of vehicle driver commuting trips occur in peak hour[3].
Retail/commercial: 0–10,000m^2	Vehicle trips/ 100m^2 GFA	12.5	▪ Peak hour generation rates[1].
Retail/commercial: 10,000–20,000 m^2		6.2	
Retail/commercial: 20,000–30,000 m^2		5.6	
Retail/commercial: 40,000–70,000 m^2		4.4	

(1) Guide to Traffic Generating Developments: Updated traffic surveys (RMS, August 2013)
(2) Household Travel Survey 2012/13 (BTS, September 2014) and 2011 Journey to Work Data (BTS, 2013) – see Table 2.2
(3) Parsons Brinckerhoff, based on Guide to Traffic Generating Developments: Updated traffic surveys (RMS, August 2013)

Table 5.6 Directional split assumptions

Land use	Inbound trips (% total)	Outbound trips (% total)
AM peak		
Residential	30%	70%
Employment	85%	15%
Small retail (Neighbourhood centres)	50%	50%
Large retail (Town centres, mixed use, etc.)	60%	40%
PM peak		
Residential	70%	30%
Employment	15%	85%
Small retail (Neighbourhood centres)	50%	50%
Large retail (Town centres, mixed use, etc.)	50%	50%

Table 5.7 Trip end forecasts for West Appin (2026 Weekday, AM peak)

Area/Population/Employment		2026 yield	Trip generation rate (vehicles)	Vehicle trip generation/hour[1]		
				Total	Inbound	Out-bound
West Appin						
Residential	Dwellings	4,550	0.78/dwelling	3,550	1,065	2,485
Employment	Jobs	3,020	0.48/employee	1,450	1,235	215
Retail (Local centres)	GFA (m^2)	9,120 m^2	12.3/100 m^2	1,120	560	560
Retail (Town centre)	GFA (m^2)	10,950 m^2	12.3/100 m^2	1,345	805	540
Total		-	-		7,465	3,665

(1) Inbound/outbound trip ends calculated using directional splits shown in Table 5.5.

Table 5.8 Trip end forecasts for West Appin (2026 Weekday, PM peak)

Area/Population/Employment		2026 yield	Trip generation rate (vehicles)	Vehicle trip generation/hour[1]		
				Total	Inbound	Out-bound
West Appin						
Residential	Dwellings	4,550	0.84/dwelling	3,820	2,675	1,145
Employment	Jobs	3,020	0.41/employee	1,240	185	1,055
Retail (Local centres)	GFA (m^2)	9,120 m^2	12.5/100 m^2	1,140	570	570
Retail (Town centre)	GFA (m^2)	10,950 m^2	12.5/100 m^2	1,370	685	685
Total		-	-		7,570	4,115

(1) Inbound/outbound trip ends calculated using directional splits shown in Table 5.5.

Table 5.9 Trip end forecasts for West Appin (2036 Weekday, AM peak)

Area/Population/Employment		2036 yield	Trip generation rate (vehicles)	Vehicle trip generation/hour[1]		
				Total	Inbound	Out-bound
West Appin						
Residential	Dwellings	15,500	0.78/dwelling	12,085	3,625	8,460
Employment	Jobs	15,595	0.48/employee	7,465	6,345	1,120
Retail (Local centres)	GFA (m^2)	38,250 m^2	12.3/100 m^2	4,705	2,355	2,350
Retail (Town centre)	GFA (m^2)	45,900 m^2	4.4/100 m^2	2,020	1,210	810
Total		-	-	**26,275**	**13,535**	**12,740**

(1) Inbound/outbound trip ends calculated using directional splits shown in Table 5.5.

Table 5.10 Trip end forecasts for West Appin (2036 Weekday, PM peak)

Area/Population/Employment		2036 yield	Trip generation rate (vehicles)	Vehicle trip generation/hour[1]		
				Total	Inbound	Out-bound
West Appin						
Residential	Dwellings	15,500	0.84/dwelling	13,015	9,110	3,905
Employment	Jobs	15,595	0.41/employee	6,370	955	5,415
Retail (Local centres)	GFA (m^2)	38,250 m^2	12.5/100 m^2	4,780	2,390	2,390
Retail (Town centre)	GFA (m^2)	45,900 m^2	4.4/100 m^2	2,020	1,010	1,010
Total		-	-	**26,185**	**13,465**	**12,720**

(1) Inbound/outbound trip ends calculated using directional splits shown in Table 5.5.

5.4.2 Trip distribution

Trip distribution, including the level of internal containment within areas, and the origins and destinations of external trips, primarily use the following key outputs produced by the STM trip distribution process:

- Proportion of total trips generated which are internally contained (intra-zonal trips as a proportion of total trips).
- Relative proportions of external trips travelling to and from other areas.

A summary of modelled trip containment produced by the STM trip distribution process is provided in Table 5.11. The results of the Base Case STM modelling indicate internal trip containment of around 20% for West Appin (TZ1446) in 2036. This is consistent with the Guide to Traffic Generating Developments (RMS, 2002), which states that around 25% of trips are typically internally contained in predominantly residential areas.

Conversely, the corresponding results of the STM modelling including West Appin indicate an internal containment figure of around 70% at full development, which is considered to be unrealistically high. Consequently, a revised internal containment proportion of 50% has been applied when developing trip matrices for the AIMSUN modelling. Although the STM modelling estimates a higher proportion of trips would be internally-contained, the lower proportion has been adopted to assess the potential worst-case impacts on external road network links providing access to and from West Appin.

Table 5.11 STM modelled internal containment and revised internal containment assumptions

Area (STM Travel Zone)	AM peak hour (2036)			PM peak hour (2036)		
	STM outputs		Revised internal contain-ment	STM outputs		Revised internal contain-ment
	Total trips (Car driver)	Intra-zonal trips (% total)		Total trips (Car driver)	Intra-zonal trips (% total)	
Base Case						
West Appin (TZ1446)	1,110	215 (19%)	(No adjustment)	1,050	235 (22%)	(No adjustment)
Including new developments						
West Appin (TZ1446)	16,050	10,885 (68%)	**50%**	16,750	12,030 (72%)	**50%**

The process which has been used to develop future trip distribution models for the AIMSUN models has generally applied the following methodology:

1. Initial (prior) trip matrices have been constructed incorporating forecast trip ends (see section 5.4.1), and estimated STM trip distribution.
2. Final trip matrices have been refined (furnessed) to balance the prior trip matrices through:
    a) Factoring total origin and destination trip ends.
    b) Adjusting relevant initial Origin-Destination (O-D) trip forecasts to correspond with factored trip ends.

In addition to the above process, when forecasting trip distribution for West Appin an additional step has been applied due to the relatively high level of detail (internal zones and road network) included in the AIMSUN model within West Appin. Given the mix of residential, employment, and commercial yield proposed, and the high level of internal containment consequently expected, detailed internal trip distribution matrices have been developed for West Appin to appropriately represent traffic movements to, from, and within the development. This process has been applied to ensure that the identification of strategic infrastructure upgrades to the external road network have been developed in tandem with the development of an appropriate access strategy to, from, and within West Appin.

The detailed trip distribution forecasting methodology for West Appin incorporates the following stages:

1. Development of strategic, aggregated matrices representing all traffic movements generated by West Appin.
2. Development of disaggregated matrices based on the proposed yields and locations of land uses within West Appin.

The first stage of this process involves the application of trip purpose data to trip end forecasts to estimate movements between different land use types. As an example, the trip purpose data presented in Section 2.1.1 indicates that 33% of AM peak trips made in Wollondilly LGA are commuting trips (e.g. typically trips between residential and employment areas). These trip purpose proportions, internal containment factors shown in Table 5.11, and ultimately a furnessing process have been used to develop the aggregated trip matrices shown in Table 5.12 and Table 5.13.

Table 5.12 West Appin traffic generation and distribution summary (2036 weekday, AM Peak hour)

Trip generator	To	Residential		Employment		Retail		Total
From	Internal/ External	I	E	I	E	I	E	
Residential	I	1,450	1,470	1,730	1,740	1,030	1,040	**8,460**
	E	1,650	-	1,960	-	1,170	-	**4,780**
Employment	I	120	120	300	300	140	140	**1,120**
	E	130	-	340	-	160	-	**630**
Retail	I	130	130	950	960	500	500	**3,160**
	E	150	-	1,080	-	560	-	**1,790**
Total		**3,630**	**1,720**	**6,350**	**3,000**	**3,560**	**1,690**	**19,940**

Table 5.13 West Appin traffic generation and distribution summary (2036 weekday, PM Peak hour)

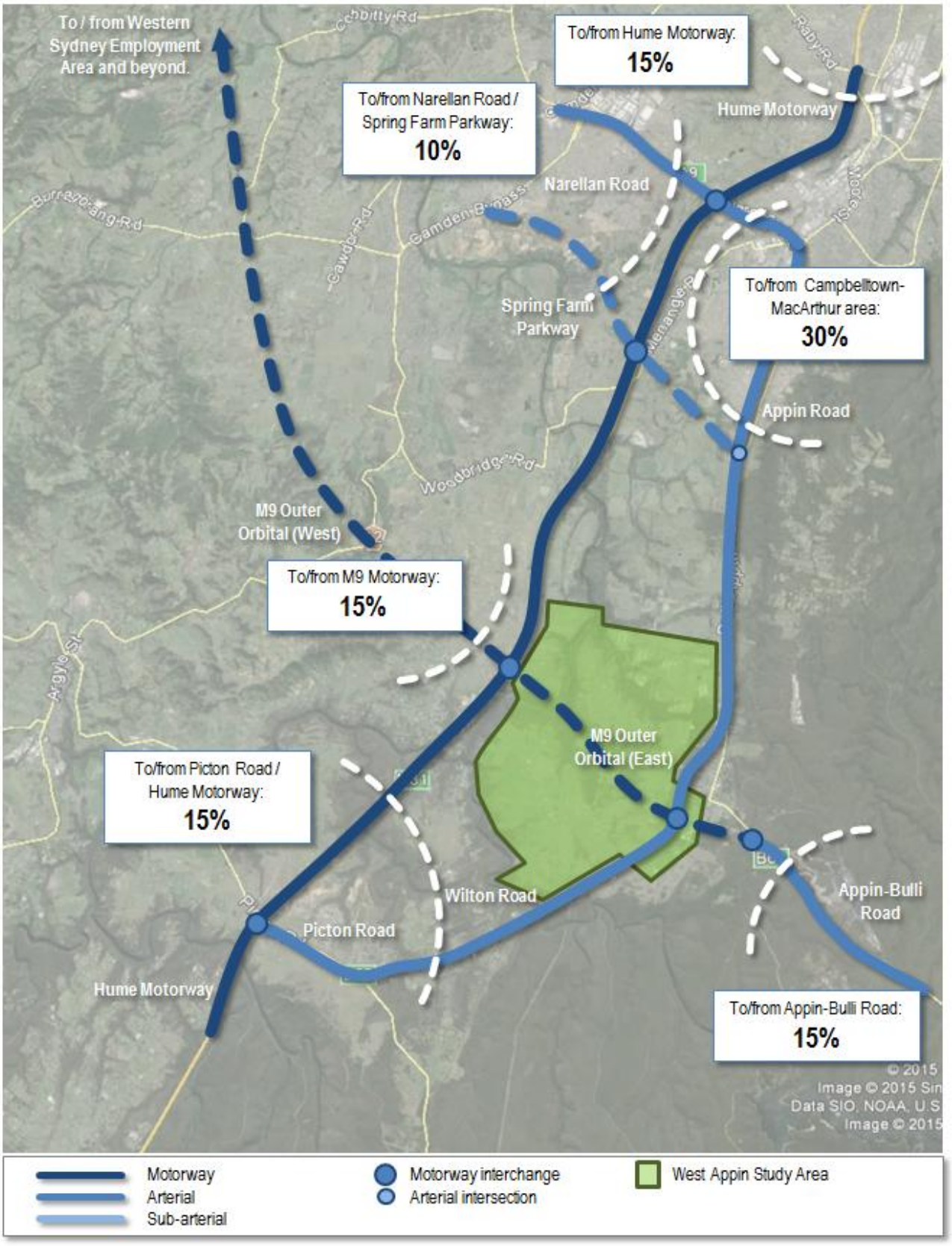
Trip generator	To	Residential		Employment		Retail		Total
From	Internal/ External	I	E	I	E	I	E	
Residential	I	1,590	1,480	120	110	420	190	**3,910**
	E	1,580	-	120	-	420	-	**2,110**
Employment	I	1,740	1,600	230	210	770	850	**5,420**
	E	1,860	-	240	-	830	-	**2,920**
Retail	I	1,140	1,050	120	110	470	510	**3,400**
	E	1,200	-	130	-	490	-	**1,840**
Total		**9,110**	**4,140**	**960**	**430**	**3,400**	**1,550**	**19,590**

Following the development of aggregated trip matrices, the second stage disaggregates these matrices to align with the proposed land use plan (i.e. land use types, yields, and locations) and corresponding AIMSUN model zoning system within West Appin. During the disaggregation process:

- O-D movements contained within Appin (i.e. internal to internal movements shown in Table 5.12 and Table 5.13) have been distributed using the relative gravity of O-D pairs.
- O-D movements travelling externally to and from West Appin (i.e. internal to external/external to internal movements) have been distributed, calibrated, and refined using outputs produced by the STM trip distribution and assignment processes.
- Matrix furnessing is again applied as a last step to re-balance the final AIMSUN matrices.

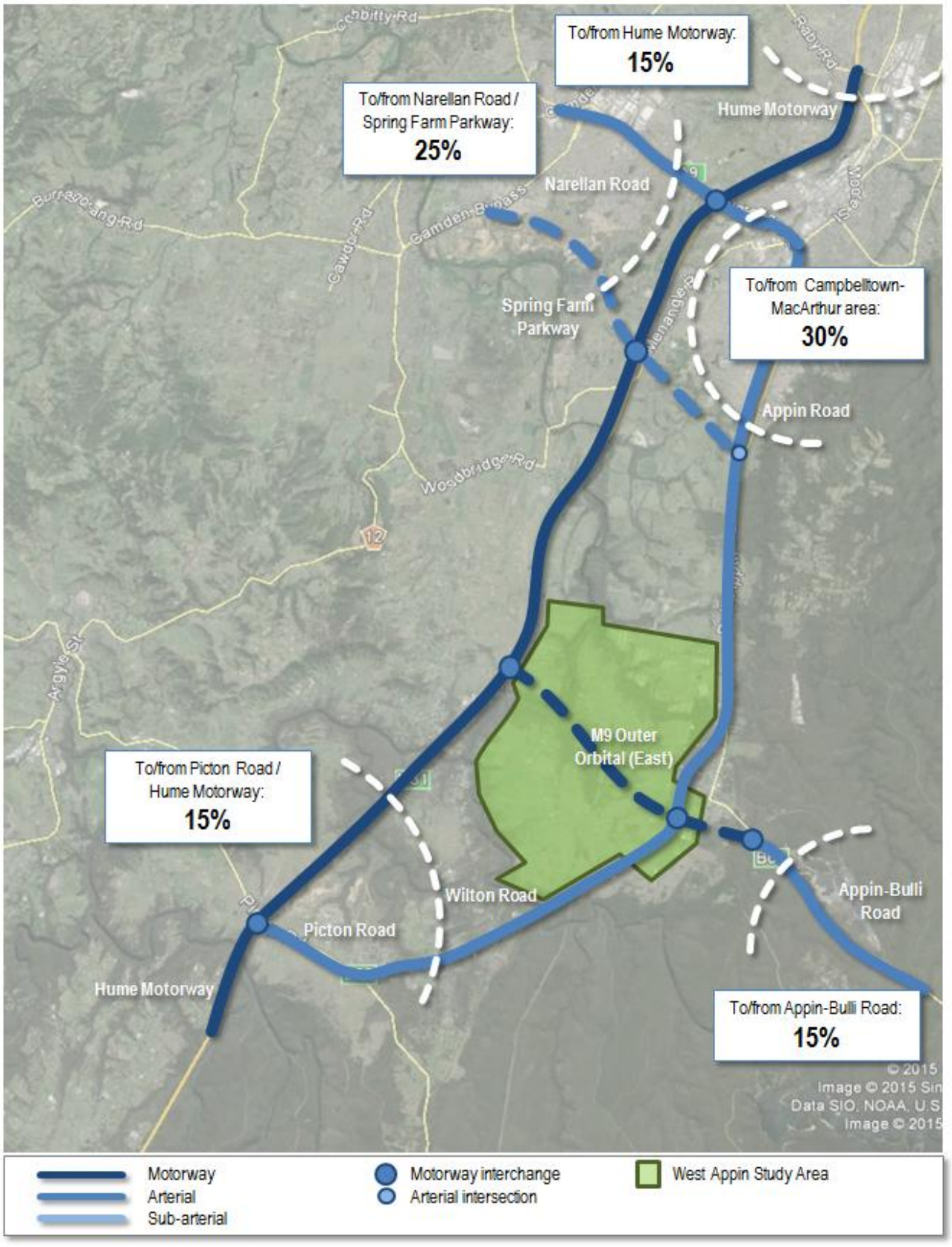
Overviews of forecast external trip distribution to and from West Appin at full development produced by this process are presented in Figure 5.3 and Figure 5.4, for scenarios with and without the M9 Motorway link west of the Hume Motorway respectively. The figures illustrate:

- The Campbelltown-MacArthur area is anticipated to generate and attract the greatest proportion (around 30%) of trips to and from West Appin.
- Areas to the west of the Hume Motorway are expected to generate and attract around 25% of trips to and from West Appin:
  - Without the construction of the M9 Motorway, these trips would travel to and from these areas via Narellan Road and Spring Farm Parkway only.
  - If the M9 Motorway were constructed, over half of the trips travelling to and from areas west of the Hume Motorway are forecast to transfer from Narellan Road and Spring Farm Parkway to the new motorway.



Source: Parsons Brinckerhoff, adapted from Google Earth imagery (Google Earth, extracted March 2015)

Figure 5.3 West Appin forecast trip distribution (2036 weekday, Peak hours, including M9 Motorway)



Source: Parsons Brinckerhoff, adapted from Google Earth imagery (Google Earth, extracted March 2015)

Figure 5.4 West Appin forecast trip distribution (2036 weekday, Peak hours, excluding M9 Motorway)

5.4.3 Mode choice

As noted in section 5.4, the STM estimates mode choice and trip distribution simultaneously using key road network and public transport assumptions as inputs, and producing public transport demand estimates as an output.

West Appin would be directly serviced by the following enhancements to public bus services, as described in section 5.1, and illustrated in Figure 5.5:

- New services and increased frequency of existing services between West Appin and the Campbelltown-Macarthur area via Appin Road and the Hume Motorway (following construction of a new interchange between the Hume Motorway and the M9 Motorway).
- Increased frequency of existing services between West Appin and Wollongong via Appin-Bulli Road.
- New services between West Appin and Wilton via Wilton Road and Picton Road.

These proposed enhancements to existing bus services in the area have been provided as inputs into the STM trip distribution and mode choice processes, with a summary of the results presented in Table 5.14, which illustrate that:

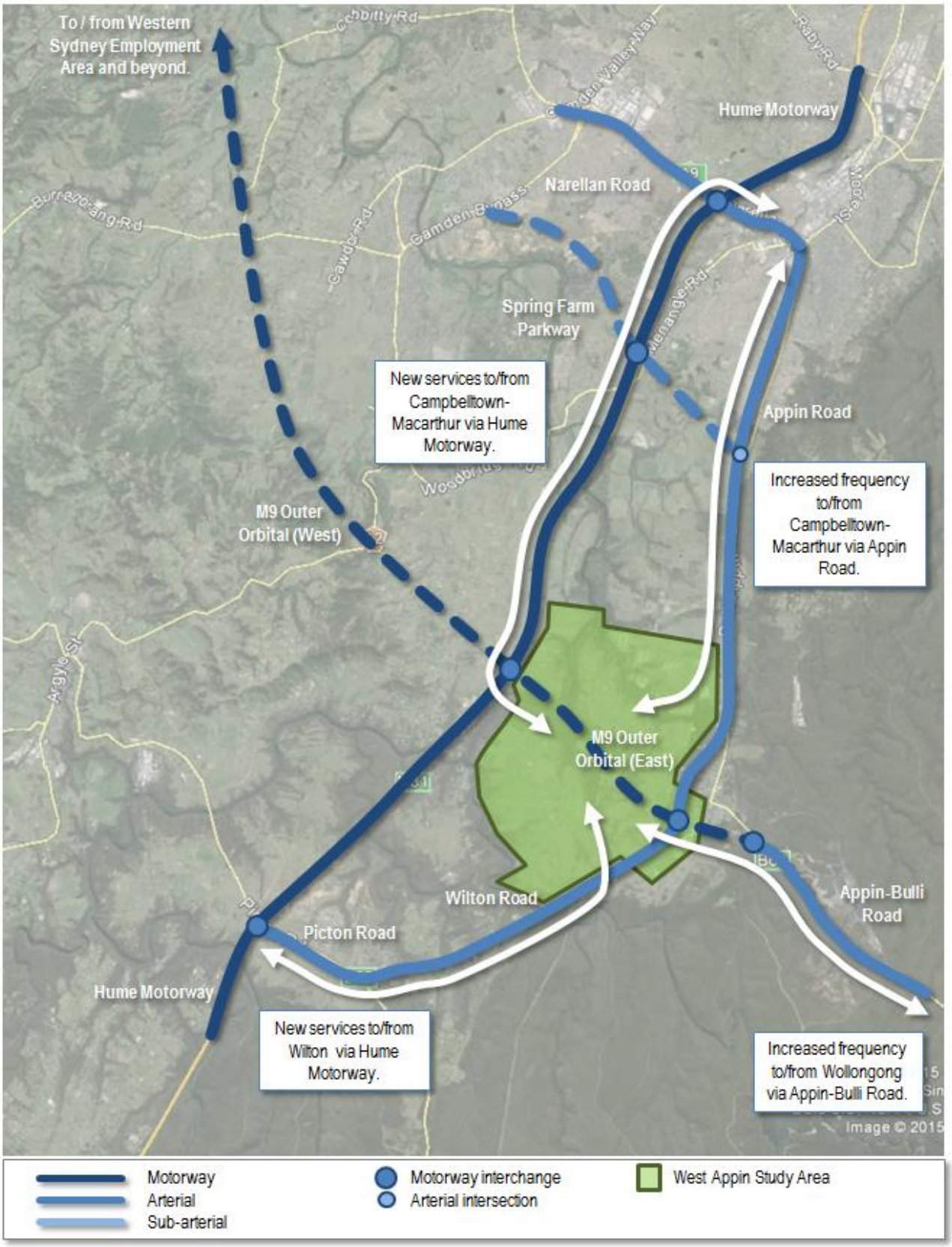
- Modelled existing conditions indicate a relatively low bus mode share of around 5–7% of all trips to and from the study area. This is consistent with surveyed existing conditions (see section 2.1.2).
- In the future bus mode shares are forecast to remain relatively constant both with and without the development of West Appin.
- The provision of new bus services and increased bus frequencies is estimated to increase bus mode share to up to 10% of total trips during peak periods.

Although the enhancement of bus networks to and from West Appin is estimated to increase bus patronage, bus mode share as a proportion of total trips is still expected to remain relatively low. The STM trip distribution and assignment process outputs, and consequently the AIMSUN model inputs, reflect these estimates.

In addition, the mode choice results produced by the STM have been used to validate the trip generation rates applied to generate the trip end forecasts presented in section 5.4.1. In areas of high public transport mode shares it can be appropriate to correspondingly reduce trip generation rates used to create private vehicle forecasts. However, the results produced by the STM suggest that West Appin will have a reliance on private vehicle transport consistent with similar areas, and consequently no reduction to vehicle generation rates is required.

Table 5.14 STM modelled bus patronage and mode share for West Appin (TZ1446)

Year/Scenario	AM peak hour			PM peak hour		
	STM outputs		Bus mode share (%)	STM outputs		Bus mode share (%)
	Total trips	Bus passenger trips		Total trips	Bus passenger trips	
2011 – Land use: Base Case						
Existing bus network	770	55	**7%**	710	35	**5%**
2026 – Land use: Base Case						
No enhancement to existing bus network	1,130	75	**7%**	1,050	45	**4%**
2036 – Land use: Base Case						
No enhancement to existing bus network	1,180	70	**6%**	1,090	45	**4%**
2026 – Land use: Base Case + West Appin						
No enhancement to existing bus network	5,360	400	**7%**	5,320	255	**5%**
New services and increased frequency		540	**10%**		350	**7%**
2036 – Land use: Base Case + West Appin						
No enhancement to existing bus network	17,710	1,200	**7%**	17,930	775	**4%**
New services and increased frequency		1,600	**9%**		1,030	**6%**



Source: Parsons Brinckerhoff, adapted from Google Earth imagery (Google Earth, extracted March 2015)

Figure 5.5 West Appin strategic bus network enhancements

5.4.4 Traffic assignment

The STM assignment process incorporates outputs from the preceding STM processes, with corresponding assignment outputs used to calculate road vehicle trip end growth for external zones in the AIMSUN model, as described in section 5.4.1.

The STM assignment process ultimately provides an estimate of strategic route choice for routes which are not entirely contained within the AIMSUN model boundaries. As an example, the STM assignment process provides an indication of estimated route choice for traffic on alternative routes such as Appin Bulli Road/ Picton Road to and from the east, or the Hume Motorway/M9 Motorway to and from the north of West Appin, which is outside of the capability of the AIMSUN model.

The STM assignment outputs and other relevant outputs from the STM modelling have been incorporated within the AIMSUN model where appropriate. For each scenario, the AIMSUN model is then used to assign road vehicle trips within the model limits of West Appin and the surrounding study area. In a similar way to the STM assignment process, but with additional detail relevant to the study area, the AIMSUN assignment process allows vehicles to make route choices, and ultimately creates traffic forecasts, based on:

- The alignment, speed, and capacity of alternative routes.
- Traffic demand and resulting congestion and delays on alternative routes.

The AIMSUN assignment process ultimately creates traffic forecasts for all roads included within the model. Generally the assignment process has been run multiple times for each scenario to refine road network requirements relevant to each scenario. The final, refined traffic forecasts for each scenario are presented in section 6, and have been used to determine strategic infrastructure needs.

6. Traffic impact assessment

The traffic impact assessment presented within this section considers the scenarios detailed in section 5.1, and applies the modelling methodology described in section 5.2, section 5.3, and section 5.4.

As noted in section 5.4.4 the AIMSUN assignment process has been run multiple times for each scenario to refine road network requirements relevant to each scenario. The final, refined traffic forecasts for each scenario are presented in relevant sections and have been used to determine strategic infrastructure needs.

This preliminary assessment considers and presents the impacts and proposed infrastructure requirements for the future 'Base Case' and 'Base Case plus West Appin' scenarios relevant to the full development of West Appin (2036). However, the following additional scenarios also require assessment to satisfy the terms of reference for the study:

- 'Base Case plus West Appin plus Other Developments' scenario.
- 2026 (interim) horizon year for all scenarios.

The additional scenario and interim year models are effectively iterations of, and therefore dependent on, the 'Base Case plus West Appin' full development scenario. Consequently the additional models will be assessed following the finalisation of the details of the 'Base Case plus West Appin', full development scenario presented within this preliminary assessment.

6.1 Base Case excluding West Appin and Other Developments

A summary of key assumptions and inputs relating to each Base Case scenario are presented in Table 6.1. The Base Case scenarios use State Government population and employment forecasts, and exclude the additional development yield proposed by West Appin.

Ultimately the two Base Case Scenarios are differentiated by the following features of the modelled road networks:

- Base Case Scenario 1: Includes currently planned upgrades to the existing road network only.
- Base Case Scenario 2: Includes currently planned upgrades to the existing road network plus the construction of the M9 Outer Orbital Motorway.

Table 6.1 Summary of Base Case scenario assumptions

Scenario/ Assumptions	2026	2036
Base Case Scenario 1		
Land use assumptions	■ State Government population and employment forecasts.	
Major road network upgrades	■ Upgrades to existing road network at: ▸ Narellan Road. ▸ Camden Valley Way. ▸ The Northern Road. ▸ Hume Motorway/Picton Road interchange. ▸ Spring Farm Parkway: – Construct interchange with Hume Motorway. – Construct arterial road to/from west of Hume Motorway.	■ Further upgrades to existing road network at: ▸ Spring Farm Parkway: Construct arterial road between Hume Motorway and Appin Road.
Bus service enhancements	■ No enhancements to existing bus services.	
M9 Outer Orbital Motorway	■ Not included.	
Base Case Scenario 2		
Land use assumptions	■ Consistent with Base Case Scenario 1.	
Major road network upgrades	■ Consistent with Base Case Scenario 1.	
Bus service enhancements	■ Consistent with Base Case Scenario 1.	
M9 Outer Orbital Motorway	■ Not applicable.	■ Construct interchange with Hume Motorway. ■ Construct motorway to/from west of Hume Motorway. ■ Construct motorway between Hume Motorway and Appin-Bulli Road.

6.1.1 Mid-block traffic forecasts and performance

Mid-block Level of Service (LoS) indicators for key roads in the study have been calculated using forecast traffic volumes based on the lane capacities summarised in Table 2.6 (section 2.4.1). Mid-block performance is governed by the type, number of lanes (capacity), and traffic volume on a particular section of road. The following process has been used to determine the road type and number of lanes required to achieve LoS D or better:

- AIMSUN mesoscopic modelling methodology:
  - Initial model runs have been undertaken based on the upgrades identified in Table 6.1 plus any additional anticipated road capacity upgrades required to accommodate forecast traffic demand.
  - Outputs of initial model runs are analysed and initial estimates of capacity upgrades refined to match capacity to forecast traffic demand.
  - Subsequent model runs are undertaken and further refined to ensure appropriate capacity has been provided, resulting in acceptable volume/capacity ratios and levels of delay.
- Mid-block LoS calculations:
  - Following the development and refinement of required capacity upgrades in AIMSUN, mid-block LoS calculations have been undertaken using final forecast traffic volumes and modelled road configurations.
  - Calculated mid-block LoS is used to verify the suitability of capacity upgrades developed during the AIMSUN modelling, ensuring that appropriate capacity has been provided.

Based on this approach, total traffic, proposed road configuration, and the resulting performance for key locations in the study area are presented in Table 6.2 and Table 6.3, which show that to achieve LoS D or better during 2036 peak periods further upgrades would be required at the following locations:

- Base Case Scenario 1:
  - Appin Road between Narellan Road and Appin Village.
  - Appin-Bulli Road between the M1 Motorway and Appin Village.
  - Wilton Road between Picton Road and Appin Village.
  - Picton Road east of the Hume Motorway.
- Base Case Scenario 2:
  - Appin-Bulli Road between the M1 Motorway and Appin Village.
  - Wilton Road between Picton Road and Appin Village.
  - Picton Road east of the Hume Motorway.

Overview diagrams of anticipated mid-block lane requirements required to achieve LoS D or better for Scenario 1 and Scenario 2 are shown in Figure 6.1 and Figure 6.2. The results indicate that the construction of the M9 Motorway in Scenario 2 would potentially mitigate the need to upgrade Appin Road between Narellan Road and Appin Village.

Table 6.2 Mid-block LoS on key roads (2036 weekday, Base Case Scenario 1)

Route/Location/ Direction		Configuration		AM peak			PM peak		
		Road type	Number of lanes	Total PCUs[1]	PCU/ Lane	LoS	Total PCUs[1]	PCU/ Lane	LoS
Hume Motorway (M31)									
North of Narellan Road	NB	Motorway	3	5,400	1,800	D	4,200	1,400	C
	SB		3	3,900	1,300	C	4,200	1,400	C
South of Narellan Road	NB	Motorway	2	3,700	1,850	D	2,800	1,400	C
	SB		2	2,800	1,400	C	3,800	1,900	D
South of Spring Farm Parkway	NB	Motorway	2	3,200	1,600	C	2,200	1,100	B
	SB		2	2,200	1,100	B	2,600	1,300	C
South of Picton Road	NB	Motorway	2	1,700	850	B	2,000	1,000	B
	SB		2	1,900	950	B	1,600	800	B
Appin Road/Appin Bulli Road									
North of Spring Farm Parkway	NB	Multi-lane arterial	2	1,700	850	B	500	250	A
	SB		2	400	200	A	900	450	A
South of Spring Farm Parkway	NB	Multi-lane arterial	2	2,000	1,000	C	1,000	500	A
	SB		2	800	400	A	1,300	650	B
East of Appin Village	WB	Multi-lane arterial	2	900	450	A	900	450	A
	EB		2	1,100	550	A	1,100	550	A
Wilton Road									
South of Appin Village	NB	Multi-lane arterial	2	100	A	200	100	A	200
	SB		2	100	A	200	100	A	200
Narellan Road									
East of Hume Motorway	WB	Multi-lane arterial	3	2,700	900	C	4,700	1,565	D
	EB		3	4,100	1,365	D	3,100	1,035	C
West of Hume Motorway	WB	Multi-lane arterial	3	2,800	935	C	4,500	1,500	D
	EB		3	5,100	1,700	D	3,200	1,065	C
Picton Road									
East of Hume Motorway	WB	Multi-lane arterial	2	1,500	750	B	900	450	A
	EB		2	900	450	A	1,100	550	A

Route/Location/ Direction		Configuration		AM peak			PM peak		
		Road type	Number of lanes	Total PCUs(1)	PCU/ Lane	LoS	Total PCUs(1)	PCU/ Lane	LoS
Spring Farm Parkway									
East of Hume Motorway	WB	Multi-lane arterial	2	600	300	A	800	400	A
	EB		2	600	300	A	800	400	A
West of Hume Motorway	WB	Multi-lane arterial	2	400	200	A	900	450	A
	EB		2	500	250	A	300	150	A
Key:									
Existing/planned configuration									
Upgrades required to existing/planned configuration e.g. Narellan Road currently being upgraded to three lanes per direction; no upgrades to 'planned' configuration required.									

(1) Assumes an average of three PCU per heavy vehicle.

Table 6.3 Mid-block LoS on key roads (2036 weekday, Base Case Scenario 2)

Route/Location/ Direction		Configuration		AM peak			PM peak		
		Road type	Number of lanes	Total PCUs(1)	PCU/ Lane	LoS	Total PCUs(1)	PCU/ Lane	LoS
Hume Motorway (M31)									
North of Narellan Road	NB	Motorway	3	5,000	1,665	C	3,100	1,035	B
	SB		3	3,300	1,100	B	3,700	1,235	C
South of Narellan Road	NB	Motorway	2	3,400	1,700	C	2,400	1,200	B
	SB		2	2,100	1,050	B	3,600	1,800	D
South of Spring Farm Parkway	NB	Motorway	2	3,100	1,550	C	2,100	1,050	B
	SB		2	1,800	900	B	2,600	1,300	C
South of Picton Road	NB	Motorway	2	3,000	1,500	C	2,400	1,200	B
	SB		2	2,100	1,050	B	2,500	1,250	C
Appin Road/Appin Bulli Road									
North of Spring Farm Parkway	NB	2-lane, 2-way	2	1,600	800	D	1,000	500	C
	SB								
South of Spring Farm Parkway	NB	2-lane, 2-way	2	1,500	750	D	1,000	500	C
	SB								
East of Appin Village	WB	Multi-lane arterial	2	1,100	550	A	1,000	500	A
	EB		2	1,300	650	B	1,500	750	B

Route/Location/ Direction		Configuration		AM peak			PM peak		
		Road type	Number of lanes	Total PCUs(1)	PCU/ Lane	LoS	Total PCUs(1)	PCU/ Lane	LoS
Wilton Road									
South of Appin Village	NB	Multi-lane arterial	2	100	50	A	100	50	A
	SB		2	100	50	A	200	100	A
Narellan Road									
East of Hume Motorway	WB	Multi-lane arterial	3	2,900	965	C	4,900	1,635	D
	EB		3	4,200	1,400	D	3,300	1,100	C
West of Hume Motorway	WB	Multi-lane arterial	3	2,600	865	B	4,200	1,400	D
	EB		3	5,000	1,665	D	3,200	1,065	C
Picton Road									
East of Hume Motorway	WB	Multi-lane arterial	2	1,100	550	A	700	350	A
	EB		2	700	350	A	700	350	A
Spring Farm Parkway									
East of Hume Motorway	WB	Multi-lane arterial	2	100	50	A	200	100	A
	EB		2	200	100	A	200	100	A
West of Hume Motorway	WB	Multi-lane arterial	2	200	100	A	800	400	A
	EB		2	400	200	A	100	50	A
M9 Outer Orbital Motorway									
East of Hume Motorway	WB	Motorway	2	1,200	600	A	1,000	500	A
	EB		2	900	450	A	1,300	650	A
West of Hume Motorway	WB	Motorway	2	900	450	A	1,000	500	A
	EB		2	1,100	550	A	900	450	A

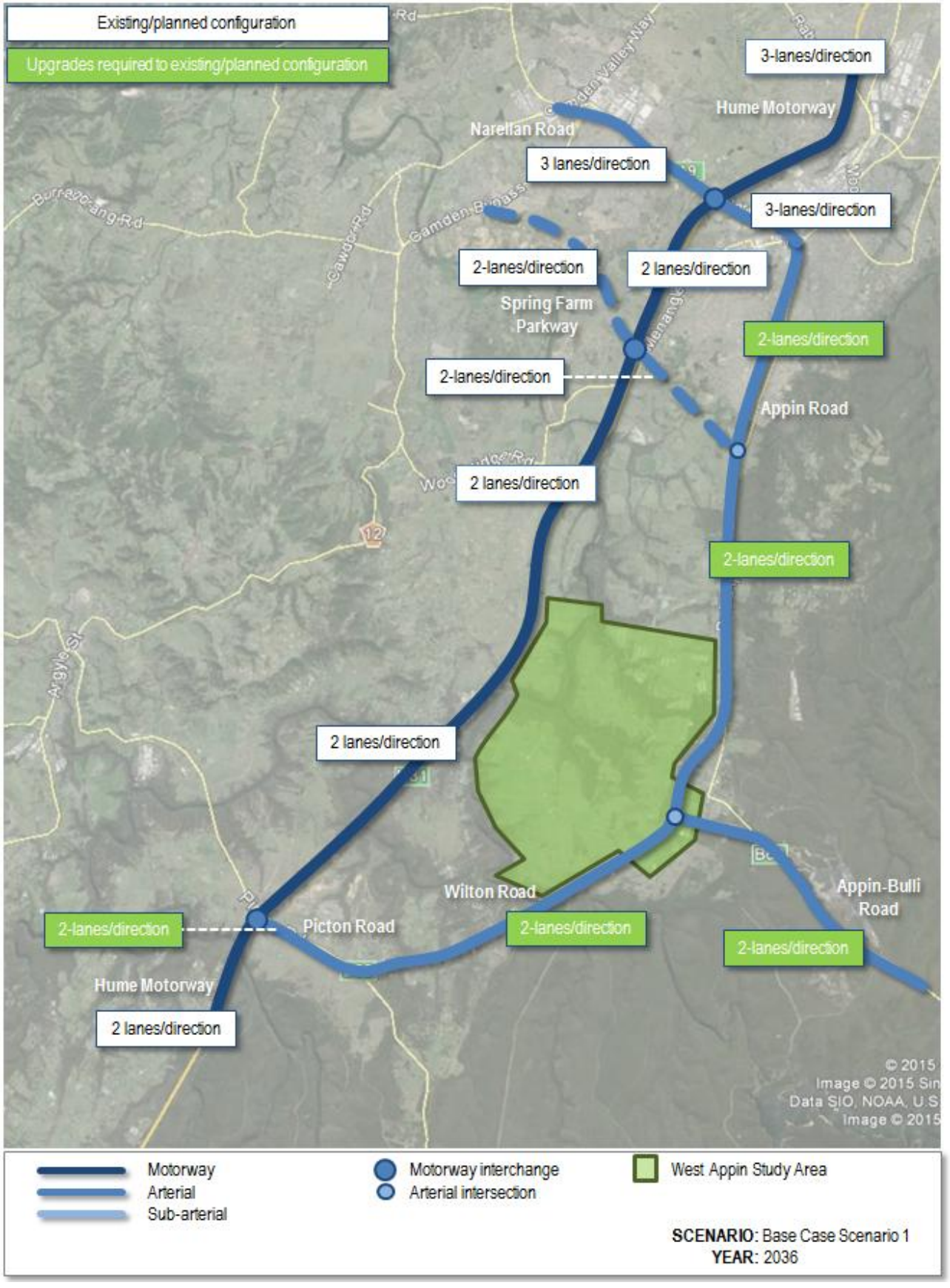
Key:

Existing/planned configuration

Upgrades required to existing/planned configuration

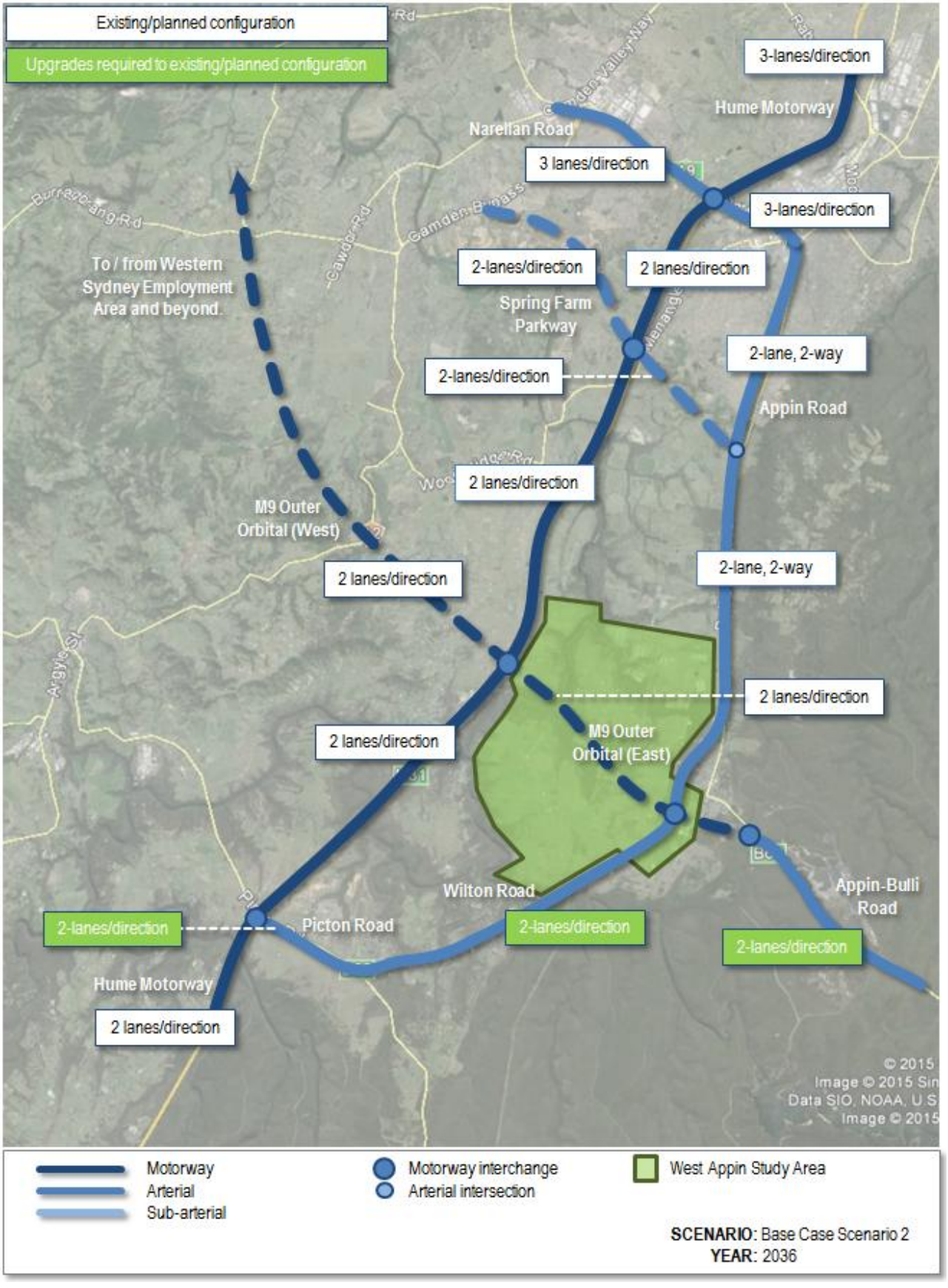
e.g. Narellan Road currently being upgraded to three lanes per direction; no upgrades to 'planned' configuration required.

(1) Assumes an average of three PCU per heavy vehicle.



Source: Parsons Brinckerhoff, adapted from Google Earth imagery (Google Earth, extracted March 2015)

Figure 6.1 Mid-block lane requirements overview (Base Case Scenario 1, 2036)



Source: Parsons Brinckerhoff, adapted from Google Earth imagery (Google Earth, extracted March 2015)

Figure 6.2 Mid-block lane requirements overview (Base Case Scenario 2, 2036)

6.1.2 Intersection and interchange requirements

In addition to the identification of mid-block lane requirements, AIMSUN modelling had also been used to identify strategic upgrades to interchanges and intersections within the modelled road network. These upgrades have been identified in this preliminary assessment through the development of configurations over a number of iterations:

- Initial models have been processed using Base Case transport assumptions only; the outputs of these models have been analysed to identify locations with unacceptable delays.
- Localised upgrades have been added to the models to rectify performance issues, based on the following hierarchy (e.g. intersection control upgrades have been investigated before increasing the number of lanes):
  - Upgrade intersection controls (e.g. provide signals at priority controlled-intersections; adjust existing signal timings to match future demand, etc.).
  - Provide additional approach/exit lanes.
  - Eliminate unresolved conflicts through grade-separation of movements.
- Models have then been processed iteratively through the above cycle until solutions have been reached which match capacity to demand.

The above process has considered intersection performance at a mesoscopic level, with solutions developed to ensure overall approach delays are not excessive. This preliminary assessment has not been used to develop or assess Level of Service (LoS) for detailed interchange or intersection layouts. LoS at a micro-level will be assessed following the finalisation of the fundamental details presented within this preliminary assessment.

Summaries of anticipated upgrade requirements by 2036 for Scenario 1 and Scenario 2 are presented in Table 6.4 and Table 6.5 respectively.

Table 6.4 Interchange and intersection requirements summary (Base Case Scenario 1, 2036)

Location	Upgrade requirements
Motorway interchanges	
Hume Motorway/ Narellan Road	▪ Upgrade existing interchange capacity; likely to require local widening and signals at both the east and west intersections.
Hume Motorway/ Spring Farm Parkway	▪ Construct Hume Motorway/Spring Farm Parkway interchange (north-facing ramps only).
Major intersections	
Narellan Road (General)	▪ Intersections on Narellan Road may require some upgrades (outside of existing scope of current upgrade works).
Appin Road/ Spring Farm Parkway	▪ Construct signalised intersection.

Table 6.5 Interchange and intersection requirements summary (Base Case Scenario 2, 2036)

Location	Upgrade requirements
Motorway interchanges	
Hume Motorway/ Narellan Road	■ Consistent with Base Case Scenario 1.
Hume Motorway/ Spring Farm Parkway	■ Consistent with Base Case Scenario 1.
Hume Motorway/ M9 Motorway	■ Construct Hume Motorway/M9 Motorway interchange (full, free-flow interchange).
M9 Motorway interchanges	■ Construct interchanges on the M9 (East) to provide access to and from Appin bypass / Wilton Road.
Major intersections	
Narellan Road (General)	■ Consistent with Base Case Scenario 1.
Appin Road/ Spring Farm Parkway	■ Consistent with Base Case Scenario 1.

6.2 Base Case plus West Appin

A summary of key assumptions and inputs relating to each scenario are presented in Table 6.6. Base Case population and employment forecasts have been adjusted by increasing population and employment in West Appin as indicated in Table 5.2 (section 5.1).

Ultimately the 2 scenarios are differentiated by the following features of the modelled road networks:

- West Appin Scenario 3: Includes currently planned upgrades to the existing road network consistent with the Base Case modelling, plus key upgrades required to provide access to, from, and within West Appin.
- West Appin Scenario 4: Consistent with West Appin Scenario 3, plus the construction of the M9 Outer Orbital Motorway to the west of the Hume Motorway.

For both scenarios a high-capacity motorway-standard road is included in the modelled road network traversing the proposed development, with strategic connections provided via interchanges with the Hume Motorway to the west and Appin Road/Wilton Road to the east:

- For Scenario 3 this connection would effectively form a standalone link road linking between the Hume Motorway and Appin-Bulli Road through West Appin.
- For Scenario 4 this link would complete a continuous M9 Motorway corridor linking between areas west of the Hume Motorway and Appin-Bulli Road through West Appin.

Table 6.6 Summary of Base Case plus West Appin scenario assumptions

Scenario/ Assumptions	2026	2036
West Appin Scenario 3		
Land use assumptions	■ State Government population and employment forecasts plus proposed population and employment increases within West Appin.	
Major road network upgrades	■ Upgrades to existing road network at: ▸ Narellan Road. ▸ Camden Valley Way. ▸ The Northern Road. ▸ Hume Motorway/Picton Road interchange. ▸ Spring Farm Parkway: – Construct interchange with Hume Motorway. – Construct arterial road to/from west of Hume Motorway.	■ Further upgrades to existing road network at: ▸ Spring Farm Parkway (arterial road between Hume Motorway and Appin Road). ▸ North-South Link Road, located between and parallel to Hume Motorway and Appin Road, linking West Appin and Spring Farm Parkway.
Bus service enhancements	■ Existing bus operations enhanced by additional services to, from, and through study area: ▸ Additional/modified services between West Appin and Campbelltown-Macarthur area via Appin Road.	■ 2026 bus operations further enhanced by additional services to, from, and through study area: ▸ New services between West Appin and Campbelltown–Macarthur area via Hume Motorway and M9 Motorway (East). ▸ New services between West Appin and Wilton area via Wilton Road and Picton Road.
M9 Outer Orbital Motorway	■ N/A.	■ Construct interchange with the Hume Motorway. ■ Construct link road between Hume Motorway and Appin-Bulli Road.
West Appin Scenario 4		
Land use assumptions	■ Consistent with West Appin Scenario 3.	
Major road network upgrades	■ Consistent with West Appin Scenario 3.	
Bus service enhancements	■ Consistent with West Appin Scenario 3.	
M9 Outer Orbital Motorway	■ Not applicable.	■ Construct interchange with Hume Motorway. ■ Construct motorway to/from west of Hume Motorway. ■ Construct motorway between Hume Motorway and Appin-Bulli Road.

6.2.1 Mid-block traffic forecasts and performance

Mid-block Level of Service (LoS) indicators for key roads in the study have been calculated using the methodology described in section 6.1.1 to determine the road type and number of lanes required to achieve LoS D or better.

Based on this approach, total traffic, proposed road configuration, and the resulting performance for key locations in the study area are presented in Table 6.7 and Table 6.8, which show that to achieve LoS D or better during peak periods further upgrades would be required at the following locations:

- West Appin Scenario 3/Scenario 4 (2036):
  - Hume Motorway between Narellan Road and M9 Motorway interchanges.
  - Appin Road between Narellan Road and Appin Village.
  - Appin-Bulli Road between the M1 Motorway and Appin Village.
  - Wilton Road between Picton Road and Appin Village.
  - Picton Road east of the Hume Motorway.
  - North-South Link Road between West Appin and Spring Farm Parkway (New road).

Overview diagrams of anticipated mid-block lane requirements required to achieve LoS D or better for Scenario 3 and Scenario 4 are shown in Figure 6.3 and Figure 6.4. The results indicate that the construction of the M9 Motorway west of the Hume Motorway in Scenario 4 is estimated to reduce upgrade requirements on Appin Road to from three lanes to two lanes in the northbound direction between Narellan Road and Spring Farm Parkway.

Table 6.7 Mid-block LoS on key roads (2036 weekday, West Appin Scenario 3)

Route/Location/ Direction		Configuration		AM peak			PM peak		
		Road type	Number of lanes	Total PCUs[(1)]	PCU/ Lane	LoS	Total PCUs[(1)]	PCU/ Lane	LoS
Hume Motorway (M31)									
North of Narellan Road	NB	Motorway	3	5,300	1,765	D	3,400	1,135	B
	SB		3	4,000	1,335	C	4,400	1,465	C
South of Narellan Road	NB	Motorway	3	4,700	1,565	C	4,100	1,365	C
	SB		3	4,200	1,400	C	5,200	1,735	C
South of Spring Farm Parkway	NB	Motorway	3	5,200	1,735	C	3,800	1,265	C
	SB		3	3,800	1,265	C	4,500	1,500	C
South of M9 Motorway	NB	Motorway	2	2,900	1,450	C	2,200	1,100	B
	SB		2	2,100	1,050	B	2,400	1,200	B
South of Picton Road	NB	Motorway	2	1,700	850	B	2,100	1,050	B
	SB		2	2,000	1,000	B	1,600	800	B

Route/Location/ Direction		Configuration		AM peak			PM peak		
		Road type	Number of lanes	Total PCUs[1]	PCU/ Lane	LoS	Total PCUs[1]	PCU/ Lane	LoS
Appin Road/Appin Bulli Road									
North of Spring Farm Parkway	NB	Multi-lane arterial	3	3,600	1,200	C	2,500	835	B
	SB		2	1,400	700	B	2,200	1,100	C
South of Spring Farm Parkway	NB	Multi-lane arterial	2	2,700	1,350	D	2,700	1,350	D
	SB		2	2,300	1,150	C	2,700	1,350	D
East of Appin Village	WB	Multi-lane arterial	2	1,700	850	B	1,600	800	B
	EB		2	1,900	950	C	1,800	900	C
Wilton Road									
South of Appin Village	NB	Multi-lane arterial	2	400	200	A	300	150	A
	SB		2	300	150	A	700	350	A
Narellan Road									
East of Hume Motorway	WB	Multi-lane arterial	3	3,000	1,000	C	4,800	1,600	D
	EB		3	3,200	1,065	C	2,300	765	B
West of Hume Motorway	WB	Multi-lane arterial	3	3,000	1,000	C	4,900	1,635	D
	EB		3	4,300	1,435	D	2,600	865	B
Picton Road									
East of Hume Motorway	WB	Multi-lane arterial	2	900	450	A	800	400	A
	EB		2	500	250	A	700	350	A
Spring Farm Parkway									
East of Hume Motorway	WB	Multi-lane arterial	2	700	350	A	1,400	700	B
	EB		2	2,500	1,250	C	1,700	850	B
West of Hume Motorway	WB	Multi-lane arterial	2	600	300	A	1,500	750	B
	EB		2	1,900	950	C	1,600	800	B
M9 Outer Orbital Motorway									
East of Hume Motorway	WB	Motorway	3	4,000	1,335	C	3,200	1,065	B
	EB		3	3,400	1,135	B	3,500	1,165	B
North-South Link Road									
South of Spring Farm Parkway	NB	Multi-lane arterial	2	1,600	800	B	700	350	A
	SB		2	700	350	A	600	300	A
Key:									
Existing/planned configuration									

Route/Location/ Direction	Configuration		AM peak			PM peak		
	Road type	Number of lanes	Total PCUs(1)	PCU/ Lane	LoS	Total PCUs(1)	PCU/ Lane	LoS
Upgrades required to existing/planned configuration e.g. Narellan Road currently being upgraded to three lanes per direction; no upgrades to 'planned' configuration required.								

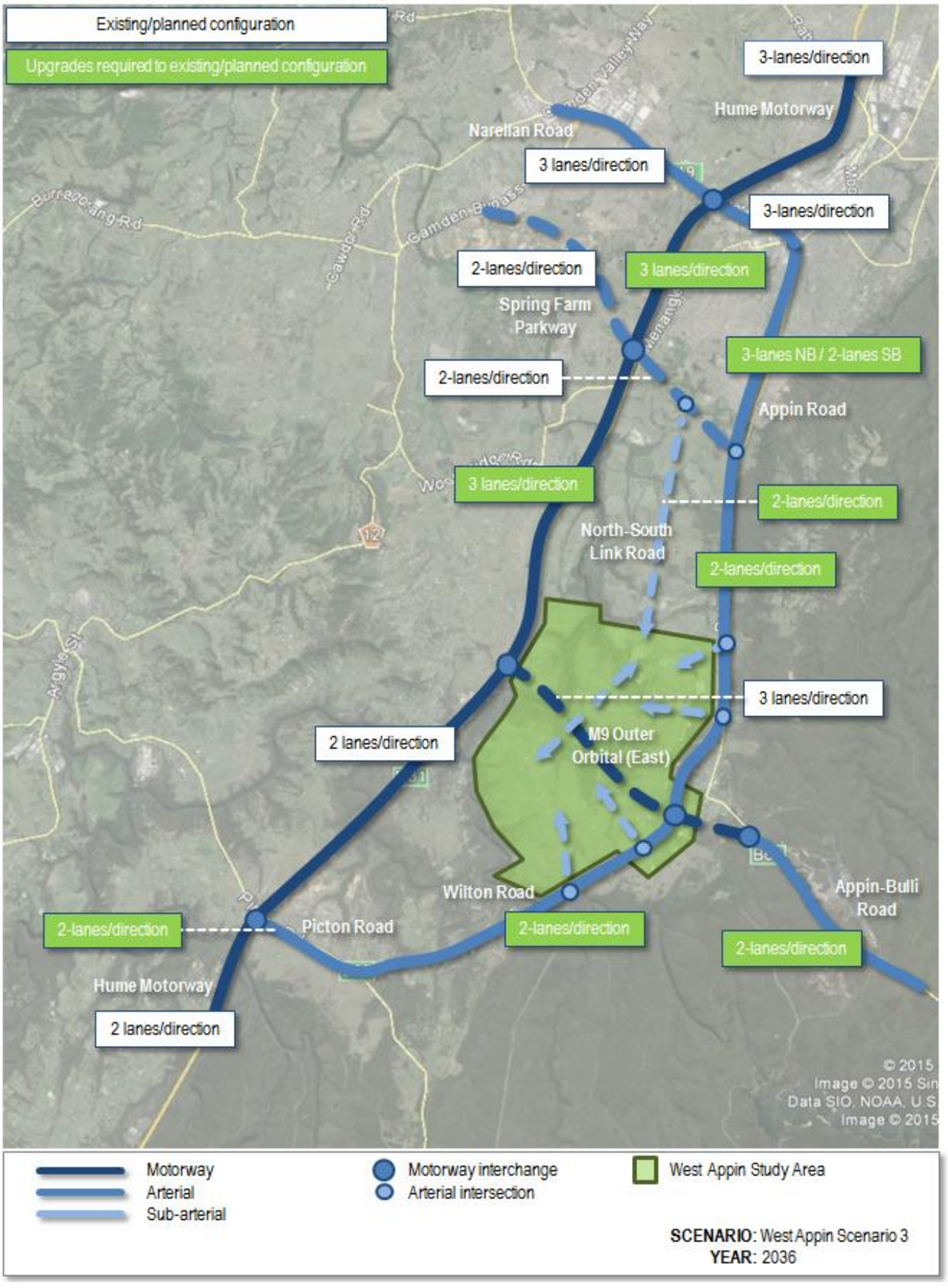
(1) Assumes an average of three PCU per heavy vehicle.

Table 6.8 Mid-block LoS on key roads (2036 weekday, West Appin Scenario 4)

Route/Location/ Direction		Configuration		AM peak			PM peak		
		Road type	Number of lanes	Total PCUs(1)	PCU/ Lane	LoS	Total PCUs(1)	PCU/ Lane	LoS
Hume Motorway (M31)									
North of Narellan Road	NB	Motorway	3	5,100	1,700	C	3,300	1,100	B
	SB		3	3,700	1,235	C	4,100	1,365	C
South of Narellan Road	NB	Motorway	3	4,500	1,500	C	3,900	1,300	C
	SB		3	3,900	1,300	C	4,400	1,465	C
South of Spring Farm Parkway	NB	Motorway	3	4,300	1,435	C	3,000	1,000	B
	SB		3	3,400	1,135	B	3,400	1,135	B
South of M9 Motorway	NB	Motorway	2	3,000	1,500	C	2,300	1,150	B
	SB		2	2,300	1,150	B	2,400	1,200	B
South of Picton Road	NB	Motorway	2	1,700	850	B	2,100	1,050	B
	SB		2	1,900	950	B	1,700	850	B
Appin Road/Appin Bulli Road									
North of Spring Farm Parkway	NB	Multi-lane arterial	2	2,700	1,350	D	1,900	950	C
	SB		2	1,500	750	B	2,100	1,050	C
South of Spring Farm Parkway	NB	Multi-lane arterial	2	2,300	1,150	C	1,800	900	C
	SB		2	1,700	850	B	2,700	1,350	D
East of Appin Village	WB	Multi-lane arterial	2	1,700	850	B	1,400	700	B
	EB		2	1,700	850	B	1,800	900	C
Wilton Road									
South of Appin Village	NB	Multi-lane arterial	2	300	150	A	400	200	A
	SB		2	300	150	A	500	250	A

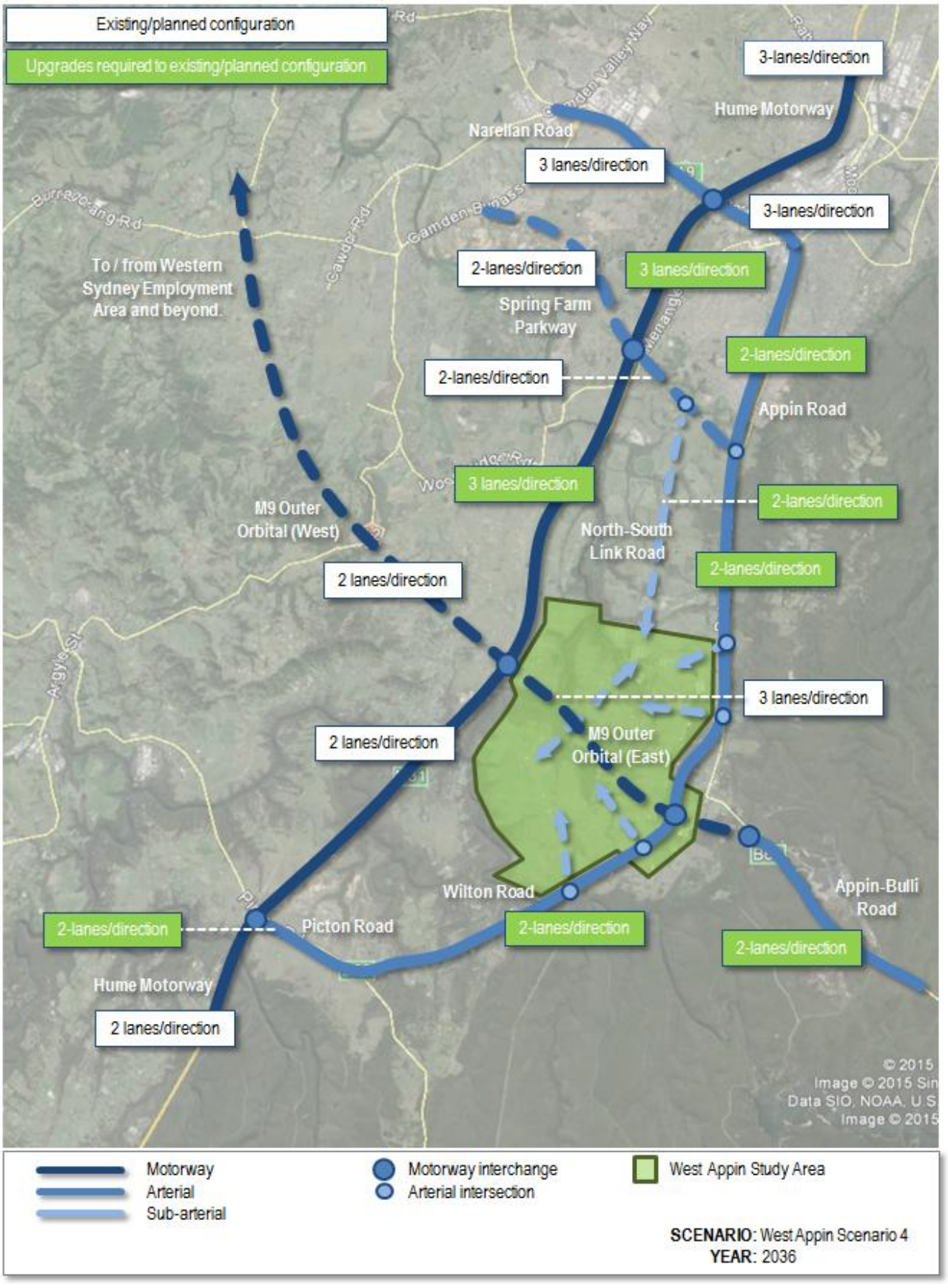
Route/Location/ Direction		Configuration		AM peak			PM peak		
		Road type	Number of lanes	Total PCUs(1)	PCU/ Lane	LoS	Total PCUs(1)	PCU/ Lane	LoS
Narellan Road									
East of Hume Motorway	WB	Multi-lane arterial	3	2,900	965	C	4,700	1,565	D
	EB		3	4,100	1,365	D	2,900	965	C
West of Hume Motorway	WB	Multi-lane arterial	3	2,500	835	B	4,600	1,535	D
	EB		3	4,600	1,535	D	2,500	835	B
Picton Road									
East of Hume Motorway	WB	Multi-lane arterial	2	900	450	A	800	400	A
	EB		2	600	300	A	800	400	A
Spring Farm Parkway									
East of Hume Motorway	WB	Multi-lane arterial	2	300	150	A	400	200	A
	EB		2	400	200	A	1,300	650	B
West of Hume Motorway	WB	Multi-lane arterial	2	300	150	A	500	250	A
	EB		2	300	150	A	800	400	A
M9 Outer Orbital Motorway									
East of Hume Motorway	WB	Motorway	3	4,700	1,565	C	4,300	1,435	C
	EB		3	4,400	1,465	C	3,900	1,300	C
West of Hume Motorway	WB	Motorway	2	1,600	800	B	1,700	850	B
	EB		2	1,800	900	B	1,500	750	A
North-South Link Road									
South of Spring Farm Parkway	NB	Multi-lane arterial	2	600	300	A	100	50	A
	SB		2	200	100	A	300	150	A
Key:									
Existing/planned configuration									
Upgrades required to existing/planned configuration e.g. Narellan Road currently being upgraded to three lanes per direction; no upgrades to 'planned' configuration required.									

(1) Assumes an average of three PCU per heavy vehicle.



Source: Parsons Brinckerhoff, adapted from Google Earth imagery (Google Earth, extracted March 2015)

Figure 6.3 Mid-block lane requirements overview (West Appin Scenario 3, 2036)



Source: Parsons Brinckerhoff, adapted from Google Earth imagery (Google Earth, extracted March 2015)

Figure 6.4 Mid-block lane requirements overview (West Appin Scenario 4, 2036)

6.2.2 Intersection and interchange requirements

In addition to the identification of mid-block lane requirements, AIMSUN modelling had also been used to identify strategic upgrades to interchanges and intersections within the modelled road network. These upgrades have been identified in this preliminary assessment through the development of configurations over a number of iterations, as described in section 6.1.2.

The preliminary modelling process has considered intersection performance at a mesoscopic level, with solutions developed to ensure overall approach delays are not excessive. LoS at a micro-level will be assessed following the finalisation of the fundamental details presented within this preliminary assessment.

Summaries of anticipated upgrade requirements by 2036 for Scenario 3 and Scenario 4 are presented in Table 6.9 and Table 6.10 respectively.

Table 6.9 Interchange and intersection requirements summary (West Appin Scenario 3, 2036)

Location	Upgrade requirements
Motorway interchanges	
Hume Motorway/ Narellan Road	▪ Upgrade existing interchange capacity; likely to require local widening and signals at both the east and west intersections.
Hume Motorway/ Spring Farm Parkway	▪ Construct Hume Motorway/Spring Farm Parkway interchange (north-facing ramps only).
Hume Motorway/ M9 Motorway	▪ Construct Hume Motorway/M9 Motorway (link road) 3-arm interchange (full, free-flow interchange).
M9 Motorway interchanges	▪ Construct interchanges on the M9 (East) to provide access to and from West Appin and Appin bypass / Wilton Road.
Major intersections	
Narellan Road (General)	▪ Most intersections on Narellan Road likely to require some upgrades (outside of existing scope of current upgrade works). ▪ Grade separation on Narellan Road west of the Hume Motorway.
Appin Road/ Spring Farm Parkway	▪ Construct signalised intersection.
Appin Road/West Appin access roads	▪ Construct 2x signalised intersections.
Wilton Road/West Appin access roads	▪ Construct 2x signalised intersections.
Spring Farm Parkway/ North-South Link Road	▪ Construct signalised intersection.

Table 6.10 Interchange and intersection requirements summary (West Appin Scenario 4, 2036)

Location	Upgrade requirements
Motorway interchanges	
Hume Motorway/ Narellan Road	■ Consistent with West Appin Scenario 3.
Hume Motorway/ Spring Farm Parkway	■ Consistent with West Appin Scenario 3.
Hume Motorway/ M9 Motorway	■ Construct Hume Motorway/M9 Motorway 4-arm interchange (full, free-flow interchange).
M9 Motorway interchanges	■ Consistent with West Appin Scenario 3.
Major intersections	
Narellan Road (General)	■ Most intersections on Narellan Road likely to require some upgrades (outside of existing scope of current upgrade works).
Appin Road/ Spring Farm Parkway	■ Consistent with West Appin Scenario 3.
Appin Road/West Appin access roads	■ Consistent with West Appin Scenario 3.
Wilton Road/West Appin access roads	■ Consistent with West Appin Scenario 3.
Spring Farm Parkway/ North-South Link Road	■ Consistent with West Appin Scenario 3.

7. Summary and next steps

7.1 Infrastructure requirements summary

Summaries of identified mid-block upgrades and interchange and intersection upgrades for each of the preliminary scenarios tested are presented in Table 7.1 and Table 7.2 respectively.

Table 7.1 Mid-block upgrade requirements summary (2036)

Road	Current configuration (At point of lowest capacity)	Mid-block upgrade requirements				Comments
		Base Case Scenario 1	Base Case Scenario 2	West Appin Scenario 3	West Appin Scenario 4	
Hume Motorway	Motorway: two lanes per direction (south of Narellan Road).	No upgrade.		Upgrade to three lanes per direction between Narellan Road and M9 Motorway interchanges.		
Appin Road	2-lane, 2-way.	Upgrade to arterial (two lanes per direction) between Narellan Road and Appin Village.	No upgrade.	Upgrade to arterial (two lanes per direction) between Narellan Road and Appin Village. Upgrade to three lanes northbound between Spring Farm Parkway and Narellan Road.	Upgrade to arterial (two lanes per direction) between Narellan Road and Appin Village.	Construction of M9 Motorway between Hume Motorway and Appin-Bulli Road expected to reduce upgrade requirements for equivalent scenarios.
Appin-Bulli Road	2-lane, 2-way.	Upgrade to arterial (two lanes per direction) between M1 Motorway and Appin Village.				
Wilton Road	2-lane, 2-way; single lane bridge at Broughton Pass.	Upgrade to arterial (two lanes per direction) between Picton Road and Appin Village.				Assumes that minimum upgrade to arterial standard would involve construction of two lanes per direction.
Narellan Road	Arterial: two lanes per direction.	Upgrade to three lanes per direction between Camden Valley Way and Appin Road.				Currently being upgraded to three lanes per direction as required.

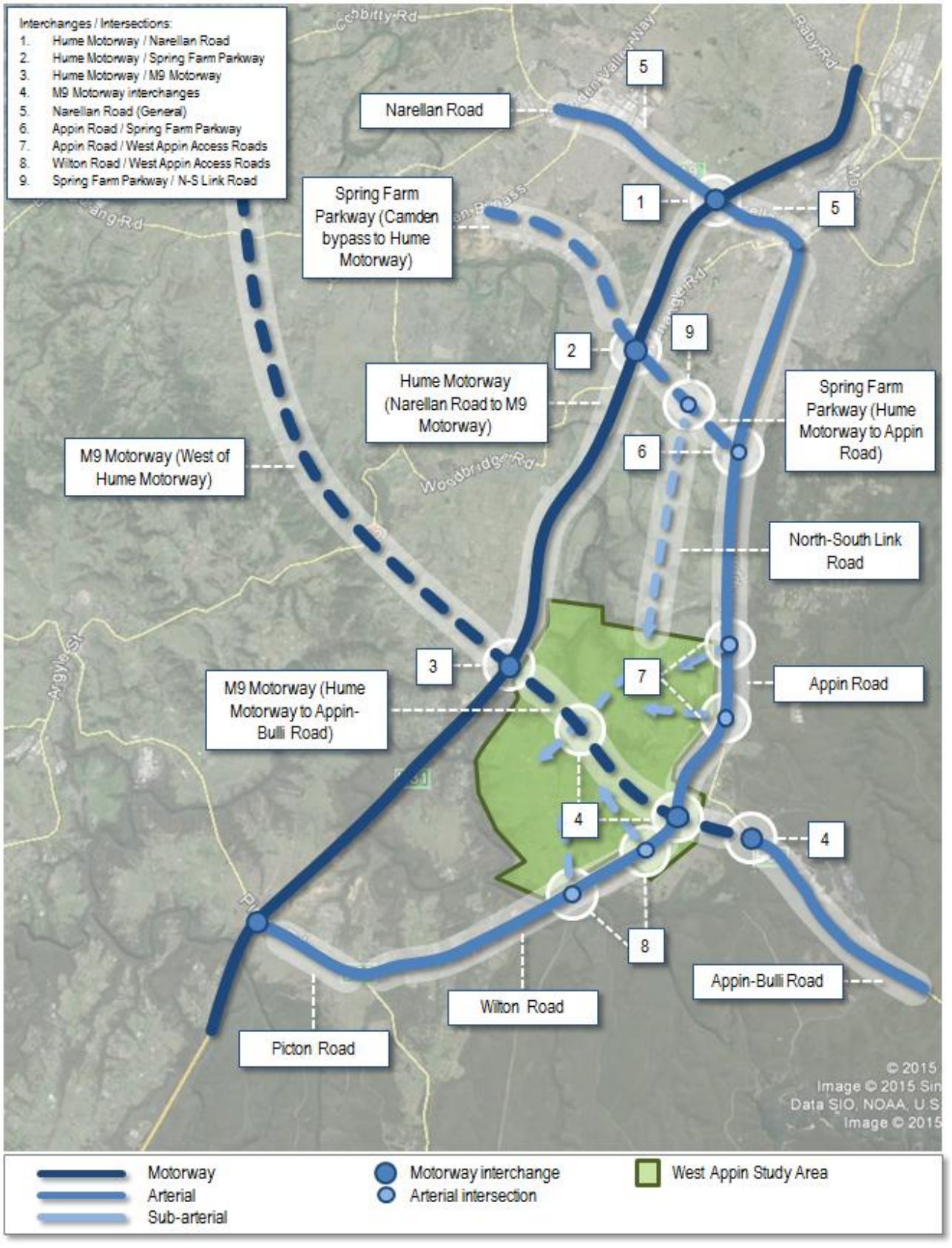
Road	Current configuration (At point of lowest capacity)	Mid-block upgrade requirements				Comments
		Base Case Scenario 1	Base Case Scenario 2	West Appin Scenario 3	West Appin Scenario 4	
Picton Road	2-lane, 2-way.	Upgrade to two lanes per direction between Hume Motorway and Wilton Road (Almond Street).				
Spring Farm Parkway	N/A	Construct arterial road (two lanes per direction) between Camden Bypass and Appin Road.				Assumes that minimum upgrade to arterial standard would involve construction of two lanes per direction.
M9 Motorway	N/A	N/A	Construct motorway (two lanes per direction) between Hume Motorway and Appin-Bulli Road. Construct motorway (two lanes per direction) west of Hume Motorway.	Construct motorway (three lanes per direction) between Hume Motorway and Appin-Bulli Road.	Construct motorway (three lanes per direction) between Hume Motorway and Appin-Bulli Road. Construct motorway (two lanes per direction) west of Hume Motorway.	
North-South Link Road	N/A	N/A		Construct arterial road (two lanes per direction) between Spring Farm Parkway and West Appin.		Assumes that minimum upgrade to arterial standard would involve construction of two lanes per direction.

Table 7.2 Interchange and intersection requirements summary (2036)

Location	Upgrade requirements				Comments
	Base Case Scenario 1	Base Case Scenario 2	West Appin Scenario 3	West Appin Scenario 4	
Motorway interchanges					
Hume Motorway/ Narellan Road	Upgrade existing interchange capacity; likely to require local widening and signals at both the east and west intersections.				East intersection will be signalised as part of current upgrade works on Narellan Road (see Figure 4.4).
Hume Motorway/ Spring Farm Parkway	Construct interchange (north-facing ramps only).				Construction of M9 Motorway west of Hume Motorway expected to reduce upgrade requirements on Spring Farm Parkway for equivalent scenarios.
Hume Motorway/ M9 Motorway	N/A	Construct Hume Motorway/M9 Motorway 4-arm interchange (full, free-flow interchange).	Construct Hume Motorway/M9 Motorway 3-arm interchange (full, free-flow interchange).	Construct Hume Motorway/M9 Motorway 4-arm interchange (full, free-flow interchange).	Interchange would generally require 2-lane on-ramps and off-ramps and corresponding auxiliary approach and exit lanes for major movements for Scenario 3 and Scenario 4.
M9 Motorway interchanges	N/A	Construct interchanges on the M9 (East) to provide access to and from Appin bypass/ Wilton Road.	Construct interchanges on the M9 (East) to provide access to and from Appin bypass/Wilton Road. Construct interchanges on the M9 (East) to provide access to and from West Appin.		Interchanges would generally require 2-lane on-ramps and off-ramps and corresponding auxiliary approach and exit lanes for major movements for Scenario 3 and Scenario 4.
Major intersections					
Narellan Road (General)	Some Intersections on Narellan Road may require future upgrades.		Most intersections on Narellan Road likely to require future upgrades. Grade-separation of intersections west of Hume Motorway.	Most intersections on Narellan Road likely to require future upgrades.	Upgrades identified are outside of scope of existing upgrade works. Construction of M9 Motorway west of Hume Motorway would reduce upgrade requirements on Narellan Road for equivalent scenarios.
Appin Road/ Spring Farm Parkway	Construct signalised intersection.				

Location	Upgrade requirements				Comments
	Base Case Scenario 1	Base Case Scenario 2	West Appin Scenario 3	West Appin Scenario 4	
Appin Road/West Appin Access Roads	N/A		Construct 2x signalised intersections.		
Wilton Road/West Appin Access Roads	N/A		Construct 2x signalised intersections.		
Spring Farm Parkway/ North-South Link Road	N/A		Construct signalised intersection.		

The locations of mid-block, interchange, and intersection upgrades described are illustrated in Figure 7.1.



Source: Parsons Brinckerhoff, adapted from Google Earth imagery (Google Earth, extracted March 2015)

Figure 7.1 Identified key upgrade requirement locations

Upgrade requirements for the Base Case scenarios (triggered by existing issues and/or background growth), and additional requirements triggered by the development of West Appin, are summarised in Table 7.1.

Table 7.3 Summary of upgrade requirements and triggers

Scenario	Upgrade requirements and triggers (2036)
Land use: Base Case	
Scenario 1 (Excludes M9)	■ **Mid-block upgrades:** ▸ **Hume Motorway:** No upgrade required. Existing capacity will accommodate future traffic growth. ▸ **Appin Road:** Requires upgrade to two lanes per direction to accommodate future traffic growth. ▸ **Appin-Bulli Road:** Requires upgrade to two lanes per direction to accommodate traffic growth. ▸ **Wilton Road:** Requires upgrade to remove existing single lane bridge and 15 km/h hairpin curves on approaches to Broughton Pass. Currently operating at LoS E during peak periods. Modelling has assumed minimum upgrade to arterial standard would involve construction of two lanes per direction, removing hairpin curves and bridge. ▸ **Narellan Road:** Currently being upgraded to three lanes per direction. No further upgrades required to accommodate future traffic growth. ▸ **Picton Road:** Requires upgrade to two lanes per direction to accommodate existing and future traffic volumes. Currently operating at LoS E during peak periods. ▸ **Spring Farm Parkway:** Construction planned by Government. Modelling has assumed minimum upgrade to arterial standard would involve construction of two lanes per direction. ■ **Interchange upgrades:** ▸ **Hume Motorway/Narellan Road:** Likely to require local widening and signals at both the east and west intersections to accommodate future traffic growth. East intersection (only) will be signalised as part of current upgrade works. ▸ **Hume Motorway/Spring Farm Parkway:** Construction of north-facing ramps planned by Government. ■ **Intersection upgrades:** ▸ **Narellan Road (General):** Modelling indicates some intersections on Narellan Road may require further upgrades outside of scope of existing upgrade works to accommodate future traffic growth. ▸ **Appin Road/Spring Farm Parkway:** Modelling assumes a signalised intersection would be constructed at this location to provide a connection to and from Spring Farm Parkway.
Scenario 2 (Includes M9 East & West)	This scenario is consistent with the requirements and triggers shown for Scenario 1, with differences noted below. ■ **Mid-block upgrades:** ▸ **Appin Road:** No upgrade required. Existing capacity will accommodate future traffic growth. Future traffic expected to transfer to M9 Motorway, reducing future traffic growth. ▸ **M9 Motorway:** Currently being investigated by Government. Modelling has assumed minimum upgrade to Motorway standard would involve construction of two lanes per direction between areas west of the Hume Motorway and Appin-Bulli Road. ■ **Interchange upgrades:** ▸ **Hume Motorway/M9 Motorway:** Modelling assumes a 4-arm interchange providing free-flow for all movements. ▸ **M9 Motorway interchanges:** Modelling assumes the provision of a 4-arm interchange providing free-flow for movements to and from the M9 Motorway at Appin Bypass, and the provision of a 3-arm interchange providing free-flow for eastbound movements to and from the M9 Motorway at Appin-Bulli Road.

Scenario	Upgrade requirements and triggers (2036)
Land use: Base Case + West Appin	
Scenario 3 **(Includes M9 East)**	This scenario is consistent with the requirements and triggers shown for Scenario 1, with differences noted below. ■ **Mid-block upgrades:** ▸ **Hume Motorway:** Requires the construction of an additional lane in each direction (three lanes total per direction), triggered by the additional traffic generated by West Appin. ▸ **Appin Road:** Requires the construction of an additional northbound lane north of Spring Farm Parkway (three lanes total northbound), triggered by the additional traffic generated by West Appin. ▸ **M9 Motorway (East):** Modelling indicates that three lanes per direction would be required between the Hume Motorway and Appin-Bulli Road. ▸ **North-South Link Road:** Construction proposed by proponents to reduce impacts of traffic generated by West Appin on the Hume Motorway and Appin Road. Modelling has assumed minimum upgrade to sub-arterial standard would involve construction of two lanes per direction. ■ **Interchange upgrades:** ▸ **Hume Motorway/M9 Motorway (East):** Modelling assumes a 3-arm interchange providing free-flow for all movements. ▸ **M9 Motorway interchanges:** Modelling assumes the provision of a 4-arm interchange providing free-flow for movements to and from the M9 Motorway at Appin Bypass, and the provision of a 3-arm interchange providing free-flow for eastbound movements to and from the M9 Motorway at Appin-Bulli Road. Additional 4-arm interchanges providing free-flow for movements to and from the M9 Motorway would provide access to and from West Appin. ■ **Intersection upgrades:** ▸ **Narellan Road (General):** Modelling indicates most intersections on Narellan Road are likely to require further upgrades outside of scope of existing upgrade works, and that grade-separation of intersections west of the Hume Motorway may be required to accommodate future traffic growth plus the additional traffic generated by West Appin. ▸ **Appin Road/West Appin Access Roads:** Modelling assumes two signalised intersections would be constructed to provide access to and from West Appin. ▸ **Wilton Road/West Appin Access Roads:** Modelling assumes two signalised intersections would be constructed to provide access to and from West Appin. ▸ **Spring Farm Parkway/North-South Link Road:** Modelling assumes a signalised intersection would be constructed at this location to provide a connection to and from Spring Farm Parkway.
Scenario 4 **(Includes M9 East & West)**	This scenario is consistent with the requirements and triggers shown for Scenario 3, with differences noted below. ■ **Mid-block upgrades:** ▸ **Appin Road:** Requires upgrades consistent with Base Case Scenario 1. Construction of additional northbound lane north of Spring Farm Parkway not required. Future traffic expected to transfer to M9 Motorway, reducing traffic growth on Appin Road. ▸ **M9 Motorway (West):** Currently being investigated by Government. Modelling has assumed minimum upgrade to Motorway standard would involve construction of two lanes per direction between areas west of the Hume Motorway and Hume Motorway interchange. ■ **Interchange upgrades:** ▸ **Hume Motorway/M9 Motorway:** Modelling assumes a 4-arm interchange providing free-flow for all movements. ▸ **Narellan Road (General):** Modelling indicates most intersections on Narellan Road are likely to require further upgrades outside of scope of existing upgrade works to accommodate future traffic growth. Future traffic anticipated to transfer to M9 Motorway west of Hume Motorway reducing future traffic growth and mitigating need for grade separation on Narellan Road west of Hume Motorway.

7.2 Next steps

This report provides a preliminary assessment of key traffic and transport-related issues raised in the *West Appin High Level Strategic Infrastructure Investigation Draft Terms of Reference* (DP&E, 2013). It investigates and addresses the most critical traffic and transport issues and fundamental features and requirements of the development.

The assessment presented in this report has been undertaken based on indicative draft plans for the proposed development of West Appin. These plans will be refined and finalised through further investigation and appropriate planning and approval processes. Specifically, further detailed traffic and transport assessments will jointly consider and inform the detailed integrated land use and transport planning process.

It is proposed that the ongoing traffic and transport assessment will continue to be developed, refined, and finalised in collaboration with Government. Following the confirmation of the fundamental features of the development and accompanying traffic and transport infrastructure, the final traffic and transport assessment will develop and include the additional level detail required to fully satisfy the draft terms of reference for the study.

This assessment considers and presents the impacts and proposed strategic infrastructure requirements for the future 'Base Case' and 'Base Case plus West Appin' scenarios relevant to the full development of West Appin (2036). However, the following additional scenarios also require assessment to satisfy the terms of reference for the study:

- 'Base Case plus West Appin plus Other Developments' scenario.
- 2026 (interim) horizon year for all scenarios.

The additional scenario and interim year models are effectively iterations of, and therefore dependent on, the 'Base Case plus West Appin' full development scenario. Consequently the additional models will be assessed following the finalisation of the details of the 'Base Case plus West Appin', full development scenario presented within this preliminary assessment.

Considering the above, the proposed steps required to finalise the traffic and transport assessment and satisfy the terms of reference are as follows:

1. Agree and finalise strategic infrastructure upgrade requirements for the 'Base Case' and 'Base Case plus West Appin' scenarios for 2036.
2. Complete the detailed modelling for the 'Base Case' and 'Base Case plus West Appin' scenarios:
    a) Finalise interchange and intersection concept plans and demonstrate acceptable performance.
    b) Finalise interim (2026) year modelling to identify infrastructure triggers and develop transport infrastructure staging strategy.
3. Complete the corresponding modelling for the 'Base Case plus West Appin plus Other Developments' scenario for 2026 and 2036 to identify additional infrastructure requirements.

Strategic Investigation of Social Infrastructure Requirements

West Appin

Client:
Walker Corporation, Mir Group, Ingham Rural Property Group

Date:
16 March 2015

Final Report

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Contents

1 Introduction

This report has been prepared for a landowner group comprising Walker Corporation, Mir Group and Ingham Rural Property Group, which is seeking to initiate a master planning process for land at West Appin. The West Appin site lies wholly within the Wollondilly local government area. The report presents the outcomes of a high level investigation into social infrastructure requirements for West Appin, based upon a potential yield of up to 15,500 dwellings.

This investigation has been undertaken at the request of the NSW Department of Planning and Environment (DPE), which is seeking to ensure that there are no threshold issues that would prevent the development of West Appin, prior to committing to a joint master planning process. DPE has issued Terms of Reference for the Strategic Infrastructure Investigation.

Elements of the Terms of Reference relevant to social infrastructure include:

1. Prepare a High Level Investigation and Business Case to determine, at a strategic level, the required infrastructure, servicing, staging and cost

2. Document the existing infrastructure services and condition at West Appin, including:

- Public and private schools
- Community health and hospital services
- Emergency services
- Recreational and sporting facilities

3. Detail the infrastructure required to service the development, including:

- Public and private schools
- Community health and hospital services
- Emergency services
- Recreational and sporting facilities

4. Provide details of area of influence of infrastructure associated with estimated housing production

5. Outline an infrastructure delivery strategy and related development thresholds which trigger delivery

6. Provide details of proposed funding for staging and cost of delivery of required infrastructure

7. Consult with Wollondilly Council and relevant public authorities and service providers.

2 Existing social infrastructure

2.1 Local social infrastructure

The West Appin Investigation Area is located in the eastern part of the Wollondilly Shire and extends to the Local Government Area (LGA) boundary with Campbelltown City Council to the north. It lies between the villages of Appin and Douglas Park and comprises land currently used for rural or rural residential purposes. Consistent with these uses, there is no social infrastructure currently within the precinct, apart from:

- The Macarthur Motorcycle Complex
- Delta Force Paintball
- Appin Greyhound Track

Social infrastructure within the existing **village of Appin** includes:

- Appin Public School – a small semi-rural school with around 217 students. The Department of Education and Communities (DEC) has advised that this school is currently at 100% utilisation
- Appin Community Hall – has some limited capacity for greater utilisation
- Appin Medical Centre – recently established practice with equivalent of one full time GP
- Bright Sparks Early Learning Centre, a 56 place long daycare centre
- Appin AIS sportsground (Gordon Lewis Oval, tennis and netball courts)
- Several local parks - Appin Park, Elizabeth Park and William Woods Reserve
- Wollongong Mountain Bike Club
- Appin Rural Fire Service
- Several churches.

Douglas Park is separated from the West Appin Precinct by the barriers of the Nepean River and the Hume Highway. Douglas Park has a similar range of facilities, including:

- Douglas Park Public School. The DEC has advised that this school is currently at full capacity.
- Douglas Park Community Centre – a well utilised facility
- Fidgety Frogs Early Learning Centre (long daycare centre with some vacancies)
- Douglas Park Sportsground and several local parks
- Douglas Park Rural Fire Service

2.2 District and regional social infrastructure

District level facilities and services accessible from the West Appin area are located in Campbelltown and its southern suburbs, and in Picton and Tahmoor, as outlined below.

Appin residents rely on district and regional level facilities in Campbelltown for:

- Major shopping and commercial services, including Macarthur Square and Campbelltown Mall
- Government high school – Appin is zoned within the catchment for Ambarvale High School. This school has a current utilisation rate of 68%, with enrolments projected to decrease. It occupies a large site, with potential for expansion. However, spare capacity may be taken up by proposed development at Gilead and Menangle Park, and so may not be available to absorb future demand from West Appin.
- Private schools – Broughton Anglican College, John Therry Catholic High School, Our Lady help of Christians Primary School are all located in the southern suburbs of Campbelltown.
- Tertiary education – Macarthur Institute of TAFE, University of Western Sydney Campbelltown campus
- Campbelltown Hospital, Rosemeadow Community Health Centre and medical specialty and allied health services
- District sport and recreation facilities, including Noorumba Reserve, Georges River Recreation Reserve, Rosemeadow Reserve and Mary Brookes Park playing fields
- Campbelltown Regional Arts Centre
- Most types of welfare and support services
- Cinemas and other leisure and entertainment facilities.

Residents of West Appin would also have access to a range of district level facilities located in Picton and Tahmoor which serve the Wollondilly Shire. Key facilities include:

- Picton High School, which is already over capacity and is the only high school within Wollondilly
- Private schools – Wollondilly Anglican College, a co-educational Kindergarten to Year 12 college at Tahmoor with 660 students and capacity to grow further, and St Anthony's Catholic Primary School at Picton, which is now at capacity
- Council civic and cultural facilities, including Wollondilly Shire Library, Wollondilly Shire Hall and Picton School of Arts. These facilities are too small and outmoded to meet current needs and Council has plans for their redevelopment. However proposed redevelopment has been based on current population forecasts and will not provide sufficient capacity for a Wollondilly population of 100,000+ people.
- Wollondilly Leisure Centre, a Council facility which provides a 50m outdoor swimming pool, 25m indoor pool gym and indoor sports court. This facility is heavily utilised and considered to be at capacity.
- District level sporting fields and Botanical Gardens in Picton
- Adult and community education at Tahmoor
- Wollondilly Community Health Centre at Tahmoor. Services include baby health clinics, counselling services, women's health services, mental health, speech pathology and dental services
- UnitingCare Burnside Family and Children's Services in Tahmoor Community Centre
- Emergency services – Picton Police Station, Picton Fire and Rescue, Picton SES, Picton ambulance base.

Appin residents also have access to a variety of facilities within Wollongong LGA, including:

- Wollongong TAFE and University of Wollongong

» Cinemas and other entertainment facilities.

2.3 Summing up

Consistent with its small population, there is very little social infrastructure in and around the Appin area currently. The limited range of facilities and services that do exist have been created to meet the needs of the existing local population (around 1,800 people) and have no excess capacity with which they might meet demand arising from future urban development. They do, however, provide a platform from which additional facilities and services might be developed in the future.

At present a limited range of district level facilities and services are available to residents of Wollondilly Shire and these are clustered in Picton and Tahmoor. Council facilities (library, leisure centre, meeting and activity spaces, sporting facilities) are already at capacity, and in need of augmentation to meet current needs. The West Appin area also has good access to a range of district and regional level facilities and services in Campbelltown. However, as the site is located in Wollondilly Shire, residents would be required to use Wollondilly-based services for those service types where catchment boundaries are applied (eg Council services, community health services).

With regard to the range of social infrastructure itemised in the Terms of Reference for this study:

- Public and private schools:
  - The local Appin Public School is already at capacity, although it occupies a 2.8 ha site and so has room for some expansion
  - Picton High School, the only high school within Wollondilly Shire, is already over capacity. However Ambarvale High School, currently zoned to take students from Appin, has some spare capacity
  - Wollondilly has two private schools – a Catholic primary school, which is at capacity, and the Wollondilly Anglican College at Tahmoor, which has scope for further expansion. Private schools within the southern suburbs of Campbelltown are accessible from Appin, although these are already close to capacity and will face increasing enrolments from proposed development at Gilead and Menangle Park.
- Community health and hospital services:
  - There is no hospital within Wollondilly and residents rely on public hospital services at Campbelltown, Camden and Bowral and private hospitals in Campbelltown and Bowral
  - The Wollondilly Community Health Centre in Tahmoor has no capacity to meet the needs of a growing population without additional resources for staffing and programs.
- Emergency services:
  - While there are bases for police, fire and rescue, ambulance and SES in Picton, these services are limited by staffing restrictions and distance from meeting the needs of an expanded urban area at Appin. Additional new or expanded services will be required.
- Recreational and sporting facilities: Council's Open Space, Recreation and Community Facilities Strategy has identified that:
  - Existing open space provision does not consistently meet demand in either quantity or quality. In particular, there is a need for a district level town park in Appin to match population thresholds.
  - Most outdoor sporting facilities in Wollondilly are at capacity. There is a need for future expansion and redevelopment of the Appin Sportsground to accommodate more field

training and sports. The sportsground at Douglas Park also requires reconfiguration to permit a greater range of sports. These changes would address only current needs.

- Council's indoor sporting facilities are already at capacity and will require expansion to meet the needs of a growing population.

In summary, with the possible exception of Ambarvale High School, there is currently no social infrastructure with capacity to meet demand generated by West Appin, and a range of new facilities and services will be required. Some of these future needs may be met by facilities and services that at this stage are proposed to be provided within Wilton Junction.

3 Social infrastructure requirements

This section identifies likely social infrastructure requirements for a future population of around 41,000 people at West Appin, based on a development scenario that envisages up to 15,500 new dwellings.

Should development of this scale proceed at West Appin, this has potential to take the population of Wollondilly Shire to around 140,000, when other current development opportunities are included.

This high level assessment has relied upon standards and thresholds and advice on planning approaches provided by agencies during detailed agency consultations for proposed development at Wilton Junction.

3.1 Approach to planning social infrastructure

In social infrastructure planning, facilities and services are commonly considered at three levels:

- Neighbourhood level services, facilities and open space, available within about five - ten minute walking or driving distance for most residents in order to meet their local everyday neighbourhood needs.
- District level services, facilities and open space, with more specialist features designed to meet the needs of a broader district catchment of around 20,000 – 50,000 people. These types of facilities and services are generally best located in larger activity centres that are well served by public transport, to maximise access for the whole catchment.
- Sub-regional and regional level services, comprising major facilities for a population of over around 100,000 people, and usually located in a major activity centre.

West Appin, with up to 41,000 people, will be large enough to warrant a range of district level facilities and services, in addition to comprising a number of neighbourhoods, each with their own local facilities and services. West Appin will also contribute significantly to Wollondilly's population exceeding 100,000 and thereby justifying provision of some higher order regional facilities and services.

3.2 Local government social infrastructure

As West Appin is located within Wollondilly Shire, the requirements and benchmarks of Wollondilly Council would apply in identifying requirements for local government social infrastructure.

3.2.1 Community facilities

Wollondilly Shire Council has recently adopted an Open Space, Recreation and Community Facilities Strategy (*Clouston Associates with Elton Consulting 2013*) which sets out Council's strategic framework for the planning and provision of its community facilities in response to forecast

population growth. It is understood that Wollondilly Council's Section 94 Contributions Plan is likely to be revised to reflect the adopted strategy.

This strategy proposes that:

- Community facilities be planned on the basis of a desired rate of provision of around 80 square metres per 1,000 people (to include both local and district community facilities)
- Libraries be planned according to the benchmarks contained in the NSW State Library publication *People Places: A Guide for Public Library Buildings in NSW.* These include:
  - 39 square metres of library floor space for every 1,000 people for populations between 20,000 and 35,000 people, plus 20% allowance for circulation and administrative space
  - 35 square metres of library floor space for every 1,000 people for populations between 35,001 and 65,000 people, plus 20% allowance for circulation and administrative space.

On this basis, a population at West Appin of around 41,000 people would generate a need for:

- **Around 3,280 sqm of floorspace for community facilities. The distribution of this will depend upon the geography of the development and hierarchy of centres, but is likely to comprise one large district level community hub (1280 sqm) and up to four local community centres (each of around 500 sqm)**
- **A district level library of around 1,722 sqm, co-located with the district community hub.**

While West Appin, by itself, will not be big enough to trigger a need for regional level civic and cultural facilities, it will contribute significantly towards the population of Wollondilly Shire reaching a level (100,000+ people) which justifies the provision of such facilities. West Appin may be required to contribute in proportion to its population size to new cultural facilities such as a performing / visual arts centre or civic auditorium.

3.2.2 Recreational and sporting facilities

The *Wollondilly Open Space, Recreation and Community Facilities Strategy* does not recommend that a standard rate of provision be adopted in the planning of open space in growth areas. Instead, it proposes that open space planning be based upon an analysis of needs of the future population, a contextual analysis of the site, assessment of opportunities in the locality and accessibility criteria.

While this is appropriate for detailed master planning processes, it does not provide guidance at this high level strategic planning phase.

The *Wollondilly Open Space, Recreation and Community Facilities Strategy* also suggests that open space be planned in line with the recommendations of the *NSW Recreation and Open Space Planning Guidelines for Local Government (2011).* These propose that, as a default position, an area equivalent to around 9% of the site area be allocated as local and district open space, with a rough 50:50 split between sporting and recreational uses.

Again, this is not a helpful approach at this high level strategic planning phase, when site details are not readily available.

For these reasons, this assessment has reverted to the approach adopted in precinct planning for the South West and North West Growth Centres, in which the *Growth Centres Development Code* (2006) proposes that open space be provided on the basis of 2.83 hectares per 1,000 people.

On this basis, a population of around 41,000 would generate **a need for around 116 hectares of public open space,** to be owned and managed by Wollondilly Council. Despite the

shortcomings of this benchmark, it provides a rough indication of the scale of open space likely to be required, in the absence of site specific details.

The *Wollondilly Open Space, Recreation and Community Facilities Strategy* does not contain a detailed planning strategy for sporting facilities. In our social infrastructure planning in the Growth Centre precincts, we have commonly adopted a minimum standard of one double playing field (around 5 ha) per 5,000 people. On this basis, a population of around 41,000 would generate a need for a minimum of around 8-9 double playing fields, with additional sites for tennis and netball complexes, and potentially also an indoor sports and aquatic centre.

All up, **around 55 ha of the proposed 116 ha of open space would be used for sporting facilities**. The balance would be used for recreational open space.

The *Wollondilly Open Space, Recreation and Community Facilities Strategy* and Council's *Development Contributions Plan* propose that sporting open space be provided for district catchments only, so as to cluster a number of sporting facilities to support sports competitions and training. The extent to which all of the identified sporting open space would be provided within West Appin, or would be required as contributions towards off-site facilities, would be a matter for detailed planning. The extent to which West Appin would also be required to provide indoor and aquatic facilities or any regional level sporting facilities will also depend upon the nature of sporting facilities provided in Wilton Junction. It will be important that sporting facilities complement, rather than duplicate, those provided elsewhere within Wollondilly.

3.3 State government social infrastructure

3.3.1 Public schools

The Department of Education and Communities (DEC) Advisory Notes for School Site Selection sets out the following criteria for the provision of schools in areas of new residential development:

- One public primary school per 2,000 to 2,500 new dwellings
- One public high school per 6,000 to 7,500 dwellings (ie catchment of three primary schools)
- Provision and timing of new schools takes account of a number of other factors, including:
  - Possible diversion of some students in new areas to existing schools
  - The impact of existing or proposed non-government schools
  - The type and speed to residential development
  - Possible need for additional sites to cater for temporary enrolment peaks
  - The nature of the population.

The DEC has advised that in practice in the growth areas it is starting to apply a higher threshold of one primary school for every 3,000 dwellings, on the basis that it is more economical to provide bigger, but fewer, primary schools. The threshold for a high school remains as outlined above.

On this basis, a yield of around 15,500 dwellings at West Appin would generate a need for:

- **Five new primary schools**
- **Two new high schools.**

3.3.2 Tertiary education

South Western Sydney Institute of TAFE has advised that it has no plans to build new TAFE facilities within Wollondilly Shire, even given the expected population growth.

Major changes to the TAFE funding model from 2015 will instead see greater competition for course delivery, increasing specialisation amongst TAFE campuses, greater flexibility in where courses are delivered (eg at workplaces) and changes to use of existing TAFE buildings and sites. The need to deliver courses within workplaces and demand for outreach classes may increase the need for rooms to be available within community facilities.

Given funding pressures on universities, it is unlikely that there will be any development of university campuses within Wollondilly.

Accordingly, development at **West Appin is unlikely to trigger any further development of tertiary education facilities.**

3.3.3 Community health and hospital services

In the light of the very substantial population growth forecasts for Wollondilly LGA over the next two decades, the South West Sydney Local Health District is still considering how the future health care needs of the local government area will be addressed. The Local Health District has adopted a model of Integrated Primary and Community Care (IPCC) for South Western Sydney. The catchment population for a Regional Integrated Primary Community Care Centre is around 75,000-100,000 people. The proposed growth across the Shire will create demand for **at least one such new centre** to be established within Wollondilly. This facility will co-locate community health, general practice and on-site specialist care, and provide a hub for multidisciplinary primary health care and potentially also day surgery and hospital outreach services.

Should there be only one regional IPCC centre established in Wollondilly, consultation undertaken to date with the Local Health District has indicated that this facility would potentially be located at Wilton Junction. This is considered to be a reasonably central location to serve the whole Wollondilly Shire. Such a facility would also address demand generated by West Appin. However, should approval be given for planning of West Appin to proceed, further consultation would need to be undertaken with the South West Sydney Local Health District to confirm the number of IPCC centres to be established in Wollondilly and their locations.

Wollondilly will continue to rely for in-patient services on Campbelltown, Camden, Bowral and Liverpool Hospitals into the future. Given difficulties in staffing health facilities in South West Sydney and the enormous cost of new hospitals, **Wollondilly will still not be large enough to justify a new hospital,** and no new hospital is envisaged for Wollondilly. Both Liverpool and Campbelltown Hospitals have plans for expansion to cope with forecast population growth in south west Sydney, although these forecasts have not included growth at West Appin. At present there are no plans for the expansion of Bowral Hospital.

Hospital expansion plans for South West Sydney will need to be reviewed in the light of the very substantial growth forecast for Wollondilly Shire, of which West Appin represents a significant component.

3.3.4 Welfare and support services

Welfare and support services are reliant on increases in funding through State and Commonwealth Government programs to meet the needs of growing populations. Resources are provided through budget allocation processes according to the resource allocation formulae of the various programs and government departments. As the population of Wollondilly continues to grow, there will be a

need for additional recurrent resources for staffing and programs to enable the establishment or expansion of welfare and support services to meet the needs of Wollondilly residents. There will be **no need for capital facilities**, as these types of services typically occupy leased commercial premises.

3.3.5 Emergency services

Emergency services are planned on the basis of response times and distance to travel, rather than population or dwelling thresholds.

As for health services, the State Government emergency services have been developing strategic plans in response to the urban growth forecast to occur in Wollondilly. Plans developed to date indicate that, on the basis that significant development will occur at Wilton Junction, including a new town centre, new facilities will be developed at Wilton Junction by NSW Police, Fire and Rescue, NSW Ambulance Service and the State Emergency Service. These services would cover the whole of the Wollondilly Shire, and hence would include the proposed West Appin development. Such facilities would be significantly closer to West Appin than the current bases in Picton, Camden and Campbelltown.

These agencies would need to review their strategic plans for Wollondilly if approval is given for West Appin to proceed. This may change the number and/or location of facilities proposed for Wilton Junction.

3.4 Private / non-government sector social infrastructure

Social infrastructure provided by the private and non-government sectors includes childcare, private schools, medical centres and allied health, places of worship, aged care facilities, commercial gym and fitness facilities, entertainment and leisure facilities. These types of facilities are not provided according to broad population thresholds, but instead are usually provided in response to the specific needs and characteristics of the incoming population and as commercial feasibility can be assessed. Sites for such facilities are usually acquired through the private market and generally do not need to be identified at the rezoning or master planning stage, as most types of these facilities can be provided in residential or mixed use zones.

Accordingly, this investigation has not identified requirements for facilities and services provided by the non-government and private sectors.

Nor has it identified requirements for shopping centres and associated commercial services. However, it is likely that a population of up to 41,000 would be large enough to support a large district level shopping centre and associated commercial services.

3.5 Summing up

Potential development at West Appin of the scale proposed is likely to generate a need for:

Local government social infrastructure, based upon current benchmarks of Wollondilly Shire Council to include:

- Around 3,280 sqm of floorspace for community facilities, likely to comprise one large district level community hub (1,280 sqm) and up to four local community centres (each of around 500 sqm)
- A district level library of around 1,722 sqm co-located with the district community hub

- Around 60 hectares of open space embellished for passive recreation (local and district parks)
- Around 55 hectares of open space to provide 8-9 double playing fields (each of 5 ha), with additional sites for tennis and netball complexes, and also an indoor sports and aquatic centre
- Contributions towards Shire wide cultural and civic facilities.

State Government social infrastructure:

- Up to five new primary schools
- Up to two new high schools
- Contributions towards a Regional Integrated Primary Community Care Centre, (at this stage likely to be located in Wilton Junction, but subject to further planning)
- Contributions towards new NSW Police, Fire and Rescue, NSW Ambulance Service and State Emergency Service bases / stations, (also at this stage proposed to be located in Wilton Junction but subject to further planning)
- Further expansion, yet to be determined, of hospital services at Liverpool / Campbelltown / Bowral Hospitals.
- Recurrent funding for additional staff and programs for community health, emergency services and welfare and support services.

4 Staging and cost of delivery

4.1 Staging

Schools need to be provided once there are around 200 children ready for enrolment and there is no capacity available in nearby schools.

Other than for schools, there are no critical thresholds that will trigger the need for social infrastructure delivery. Provision of social infrastructure needs to keep pace with population growth and be provided on an incremental basis as the population in West Appin grows. Beyond this, the staging of delivery will be influenced by the geographical spread of development and number of development fronts. A detailed staging and delivery plan would need to be developed in response to a master plan.

4.2 Costs of delivery

For State Government social infrastructure, costs would relate to:

- Provision of serviced sites, each of around 3 ha, for 5 primary schools
- Provision of serviced sites, each of around 6 ha, for 2 high schools
- Capital costs of construction of 5 primary and 2 high schools (noting that a primary school costs in the order of $15 million and a high school $30 million)
- Share of costs towards land and capital construction for a new Regional Integrated Primary Community Care Centre
- Share of costs towards land and capital construction for new Police Station, Fire and Rescue Station, Ambulance Station and SES base.

For local government social infrastructure, costs to be recouped through the development contribution system would include land and embellishments for recreational open space and sporting facilities, and land and capital construction for the district community hub and library, and up to four local neighbourhood community centres.

Initial cost estimates for the recommended local government social infrastructure are provided in the table below. These cost estimates are based on February 2012 quantity surveying work undertaken for similar community facilities, and the estimates used for calculating initial open space embellishment costs for Wilton Junction. They are provided to give an initial indication of costs and will require further testing, updating and confirmation through detailed quantity surveying.

The costs for built facilities were based on generic building templates and include estimated site areas, building sizes and specifications for each project. Costings include nominal allowances for furniture, fixtures and equipment based on Group 3 allowances. They do not include costs for daily operational items such as books, linens, toys, etc. The cost estimates are GST exclusive. Overall project costs include construction, standard contingencies, professional fees, Council fees and utilities provision.

It should be noted that no costs are included for cultural, aquatic or indoor sport and leisure facilities in West Appin, on the basis that such facilities are likely to be required on a broader district or LGA basis. West Appin will, at minimum, be required to contribute towards the provision of such facilities in the wider district, or, at maximum, provide these facilities within West Appin.

Table 1: Preliminary cost estimates for local government social infrastructure.

Facility	**Area required**	**Overall Project Rate ($/sqm)**	**Estimated overall project cost**
District multipurpose community hub	1,280sqm	$5,240	$6,707,200
District library	1,722 sqm	$5,630	$9,694,860
4 x local community centres	4 x 500 sqm	$5,109	$10,218,000
Sporting open space	55 ha	$107	$58,850,000
Recreational open space	61 ha	$65	$39,650,000
Total			**$125,120,060**

4.3 Conclusion

Based on the findings of this study, it is concluded that there are no threshold issues relating to social infrastructure that would prevent the development of West Appin. The development would be large enough to be reasonably self-sufficient in terms of local neighbourhood and district social infrastructure, and would be likely to generate sufficient funds to construct the facilities needed to create a balanced and sustainable community.

Summary of Agency Consultations

1. Department of Education and Communities

2 June 2014

Telephone discussion with Raphael Garcia, Statutory Planner

Phone 9561 8147

Discussion points:

- Current capacity and potential for augmentation of Appin Public School and Douglas Park Public School
- Which high school is zoned for the Appin district and its capacity to absorb future growth
- Capacity situation for Picton High School
- DEC benchmarks and guidelines for new schools in growth areas
- Application of the benchmarks to West Appin and the resultant numbers of primary and high schools likely to be required (5 and 2 respectively).

2. Wollondilly Shire Council

10 June 2014

Telephone discussion with Adam Gray, Manager, Facilities and Recreation

Phone 4677-8250

Discussion points:

- Progress in finalising Wollondilly Growth Management Strategy
- Background / context to DPE request for information and Terms of Reference for Strategic Infrastructure Investigation for West Appin
- Current Council social infrastructure in the Appin / Douglas Park areas
- Application of findings and recommendations of *Wollondilly Open Space, Recreation and Community Facilities Strategy 2013* to West Appin with regard to potential future requirements for community and recreation facilities and open space.

3. Emergency Services

Have relied on agency input to Wilton Junction Community Planning Study

4. South West Sydney Local Health District

Have relied on agency input to Wilton Junction Community Planning Study and findings and consultation outcomes for the Wollondilly Health Needs Assessment, currently being undertaken by Elton Consulting for the Wollondilly Health Alliance. Have relied in particular on input from David Lawrence, Manager, Planning, South West Sydney Local Health District, who is a member of the Wollondilly Health Alliance.

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