Joint Study on aviation capacity in the Sydney region

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Aviation capacity cost benefit economic assessment

C13

Aviation Capacity Cost Benefit Economic Assessment

Department of Infrastructure and Transport

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Contents

1. Introduction

1.1 Purpose of this document

The Australian and NSW Governments are currently working together on a Joint Study on aviation capacity for the Sydney region. The Joint Study is considering the short and long term aviation infrastructure and supporting surface transport requirements of the Sydney region, and identifying strategies and locations to meet future needs.

A Steering Committee, consisting of government officials and non-government members with expertise in infrastructure, transport, planning, aviation, economics, government, environment and tourism, is overseeing the Joint Study.

The Joint Study will facilitate the development of an Aviation Strategic Plan, which will inform future infrastructure planning and investment by government and industry, and enable the proper integration of future airport operations with surrounding state land use planning and surface transport networks.

Ernst & Young was commissioned by the Commonwealth Department of Infrastructure and Transport (the Department) to undertake a cost benefit analysis of aviation capacity expansion options to support the work of the Joint Study.

Specifically, a number of capacity expansion options were developed by the Joint Study team at various stages of its work and Ernst & Young was commissioned to analyse the relative costs and benefits of these options.

This report details the inputs and assumptions that underpin the economic analysis, describes the methodology used and sets out the results of the analysis.

This report is not designed to be read in isolation, but to be read as a supporting document for the main Joint Study report. Hence the report provides a factual description of the methodology used and results. It does not seek to provide a commentary on the results or an explanation of decisions taken by the Joint Study Steering Committee.

1.2 Context within Joint Steering Committee process

Ernst & Young was asked to undertake comparative analyses of aviation capacity expansion options to support different phases of the Joint Study:

- **Phase 2 (Identification of all reasonable locations for a greenfield airport in the Sydney region): A 'rapid' CBA of potential localities for new airports (Phase 1 of the economic analysis).** Following the identification of seven primary localities, this analysis was designed to provide a high level overview of the relative costs and benefits associated with each locality to inform a further filtering of options by the Steering Committee. The localities assessed, the methodology, inputs and results of the analysis are set out in chapter 4 of this report;

- **Phase 4 (Assessment of Individual sites within Phase 2 localities): A 'rapid' CBA of specific airport sites that had subsequently been identified within the broad localities previously identified (Phase 2 of the economic analysis).** This CBA was designed to inform the Steering Committee's identification of a list of preferred specific sites for further detailed study. This phase of the analysis reviewed the costs and benefits of 17 potential sites that could technically accommodate a Type 3 airport and

10 sites that could accommodate a Maximum Type 1 airport within the Sydney region. More information, including the list of sites assessed, is provided in chapter 6; and

- **Analysis of Brownfield options (Phase 3 of the economic analysis).** The detailed CBA of the Richmond RAAF site was designed to inform the Steering Committee on the range of costs and benefits that would be associated with the redevelopment of this airport to serve the general aviation requirements of the region. More information, including the list of sites assessed, is provided in chapter 8.

1.3 Cost benefit analysis

The economic analysis to compare possible aviation capacity expansion options for the Sydney region has been undertaken using a standard transport cost benefit analysis (CBA). A CBA is a systematic means of analysing the financial, economic, environmental and social costs and benefits associated with a project.

A CBA provides a decision-making framework that considers the net impacts of a project – positive and negative – on all stakeholders. Projects, and scenarios within projects, are ranked based on which provides the highest net benefit. It is important that both market impacts and non market impacts are captured within a CBA.

The analysis set out in this report has been conducted in accordance with the following specifications and guidelines:

- Australian Government Civil Aviation Safety Authority (CASA) Economic Guidelines, 2010;
- National Guidelines for Transport System Management in Australia, Australian Transport Council, 2007; and
- Infrastructure Australia's Outline of Infrastructure Australia's Prioritisation Methodology, 2008.

1.4 Options for analysis

Ernst & Young were asked to undertake comparative analyses of capacity expansion options at three phases of the economic analysis:

- Phase 1 (Phase 2 of the Steering Committee process) – a 'rapid' CBA of potential broad locations for new airports;
- Phase 2 (Phase 4 of the Steering Committee process) – a 'rapid' CBA of specific airport sites that had subsequently been identified within the broad locations identified in phase 1; and
- Phase 3 – a detailed CBA of Richmond RAAF.

It should be noted that Ernst & Young only analysed broad locations, new airport sites and other capacity expansion options as directed by the Department and the Steering Committee.

In each phase, the new aviation capacity options, including potentially one or more new airport(s), were assessed against a 'do-minimum' Base Case. The Base Case was defined as the maintenance of existing and planned supply of aviation services to the Sydney region. Specifically, the Base Case foresees the implementation of current airport masterplans, including the masterplan for Sydney's Kingsford Smith Airport (KSA).

Under the Base Case, KSA is assumed to continue to operate and develop in accordance with the existing Sydney Airport Corporation Limited (SACL) masterplan. This means that, under all capacity expansion options and stages of analysis, the planned investment in Sydney Airport, and any supporting infrastructure, will still be required.

The methodology and therefore the results of economic analysis was designed to be used on a relative comparison basis rather than an absolute BCR – that is, to help identify preferred sites for further work rather than present an economic case for the development of an airport over a do-minimum solution.

1.4.1 Types of airports

The following table provides a definition of each of the airport types analysed. These airport types were developed by the Department in conjunction with its technical advisors.

Table 1: Generic airport types

Airport Type	Definition
Maximum Type 1 Airport	*A full service international airport* – with runways up to 4,000m long and 60m wide and capable of carrying the largest passenger aircraft (A380). Such an airport will be expected to cater upward of 30 million passengers annually and have the capability to provide an additional parallel runway.
Type 2	*A land constrained international airport* – with a single runway up to 3,500m long and 45m wide. This type of airport will be capable of taking large wide body international jets, but not the A380 (which requires a 60m wide runway for a newly built airport). Such an airport would be expected to cater from 5 to 30 million passengers each year.
Type 3	*A limited service regular passenger transport (RPT) airport* – with a single runway up to 2,200m long and 45m wide. This type of airport will still be capable of handling wide body international jets (excluding the A380), but runway length will limit services to short-haul international destinations (e.g. Trans-Tasman). Such an airport will be expected to cater between 5 and 25 million passengers annually, predominantly on narrow body jet services.
Type 4	*A minimum service airport servicing general aviation (GA) and limited RPT*, serving 1 million passengers annually.

Source: The Department of Infrastructure

The development scenarios modelled in this analysis and the assumptions underlying them are explained in more detail later in this report.

1.5 Analysis inputs

At the direction of the Department, Ernst & Young drew upon a number of sources to develop the assumptions for the CBA. The following organisations were the main sources of information to support the economic analysis (primarily the first and second phase) produced in this report:

- Booz & Company[1], who undertook passenger and freight demand modeling under the constrained Base Case and unconstrained development scenarios (used throughout the analysis);

- Ernst & Young, Arup and Airbiz and Turner & Townsend [2], who undertook costings to develop a generic airport definition that was used within the first and second phase of the analysis (rapid analysis/CBA of locations and sites);

[1] Booz & Company (2011), *Updated demand forecasts for the Sydney region*

- Arup[3], who undertook an initial assessment of the supporting infrastructure construction and ongoing operating costs;

- Ernst & Young's Real Estate Advisory Team[4], who advised on land acquisition costs; and

- WorleyParsons/Airport Master Planning Consultants (AMPC)[5], who:

  - estimated the costs associated with the development of supporting infrastructure and the development of the land platform upon which a potential airport would be constructed;

  - estimated the construction costs of each of the airport types within the phase 3 detailed analysis; and

  - provided comprehensive data on the impact of options on a series of social, environmental and economic factors.

Sources for all assumptions within the analysis have been clearly stated throughout this report.

1.6 Key assumptions

A number of simplifying assumptions were made to undertake this analysis, including:

- There is no capacity or opportunity at other existing airports to meet the increase in demand for movements to and from Sydney (beyond the base case assumptions regarding KSA);

- The externality costs associated with additional aviation travel at the non-Sydney end of the trip (i.e. landside transport) were deemed outside the scope of this analysis;

- No residual value was applied to any of the asset values within the economic analysis due to the length of the analysis period;

- Any new airport or other additional capacity within the Sydney basin as analysed within phase 1 and 2 of the economic analysis will only service the demand for aviation services that cannot be provided by KSA;

- It is assumed that an individual's suppressed aviation demand in the constrained aviation base case does not transfer to other transport modes (eg: driving or catching a train);

- Demand forecasts provided by Booz & Company that were used within the first two phases of the economic analysis do not take into account the intrinsic nature of airport locations and the impact on demand for services that they provide;

- The internal project management and governance associated with the construction and operation of another airport within the Sydney basin is not included within this analysis;

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[2] Ernst & Young et al (2011), Provision of advice and analysis relating to investment in airport infrastructure with indicative generic airport costs (**Error! Reference source not found.**)- and supporting documentation (Appendix H)
[3] Arup (2011), Initial Assessment of Supporting Infrastructure for Airport Sites (Appendix F)
[4] Ernst & Young (2011), Land price assessment for a second airport in Sydney (Appendix I)
[5] WorleyParsons/AMPC (2011), Analysis of most suitable aviation sites

- Airline company profits, and hence revenue and costs realized from operating at a new airport were excluded from this analysis;

- This analysis excludes the cost of preparing the land over and above the creation of a platform (eg: environmental assessment, remediation etc.);

- The implication of additional "brownfield costs" that are inherent in the renewal of an operational airport has been excluded from this analysis (eg. working after airport operational hours, additional safety procedures etc.);

- Costs and benefits were developed throughout the Study's process, as best estimates of the values in current dollar terms. The real values of costs and benefits may vary between now and the time that an airport may be constructed and operational as a result of real inflation and other factors;

- The timing of all costs occurs in full calendar years, with each phase of the construction process being undertaken in the full year following the completion of the previous phase; and

- The inputs into this analysis have been developed to a confidence level that is suitable for the purposes of this stage of the analysis. Further analysis may be required to increase the confidence of inputs for the latter stages of the project (for example, the costings included within this report should not be used for budgeting purposes).

Other assumptions that have been made within specific phases of the project have been set out alongside the explanation of inputs.

Ernst & Young's approach to this analysis has been to adopt conservative assumptions in all cases where direct data cannot be sourced.

1.7 Limitations

The forecasts presented in this report were prepared using the information and assumptions acknowledged in this document, supported by the judgement and experience of those providing the assumptions. Some of the assumptions used to develop the forecasts may not be realised and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the forecast and the actual results, and these differences may be material.

Limitations on the accuracy of the results due to the variability in the inputs used, and the preliminary nature of the assessment, mean that the results should not be used for budgeting purposes or project cost forecasting.

Whilst every care has been taken in preparing this report, Ernst & Young, and those whose inputs have been used in the analysis, will not accept any responsibility or liability to any person or corporation seeking to rely on information, advice or opinion provided in this publication for any loss or damage, whatever nature suffered by such person or corporation.

1.8 Peer review process

The approach, methodology and results generated from this analysis have been subjected to an internal peer review process to confirm the validity of the approach and identify any areas for further consideration.

1.9 Disclaimer of use of report

This Report was prepared for the exclusive use of the Department of Infrastructure and Transport ("the Department"), for the purpose of the Department advising the Steering Committee on the Joint Study on Aviation Capacity in the Sydney Region and in their advice to Government pursuant to the agreement between Ernst & Young and the Department including the scope and limitations set out therein. The Report may be relied upon by the Department, however, Ernst & Young disclaims all liability to any person other than the Department for all costs, loss, damage and liability that the third party may suffer or incur arising from or relating to or in any way connected with the provision of the Report to a third party and any use they may make of the Report without Ernst & Young's prior written consent. The Department has agreed that the Department will not amend the Report without prior written approval from Ernst & Young. If third parties choose to rely on the Report in any way, they do so entirely at their own risk.

2. Background and project drivers

The need for additional aviation capacity in the Sydney region to supplement the existing KSA is an ongoing proposition that has been driven by concerns that demand for aviation capacity is likely to be larger than its supply in the future.

Planning for this additional capacity began in the 1970s when the Major Airport Needs of Sydney (MANS) intergovernmental group was established. In 1986, recommendations for a second Sydney airport at Wilton or Badgerys Creek were made to the Hawke Government, with the Government deciding upon Badgerys Creek. This airport did not eventuate as it was decided in 1989 to permit the construction of a third runway at KSA.

At the 1996 election, then Leader of the Opposition John Howard announced that, if elected, his government would explore the option of a second airport at Holsworthy. However, the Howard Government subsequently rejected this option in 1998 and confirmed Badgerys Creek as the preferred site a year later. A report given to the Government in 1999 recommended that:

- Regional air travel be shifted to Bankstown Airport;
- A new general aviation airport be built at Badgerys Creek;
- A fast train between Sydney and Canberra be established; and
- Investigation be undertaken into an extension of the fast train to Melbourne and Brisbane.

In December 2000, the Commonwealth Government decided not to build the second airport at Badgerys Creek and did not proceed with the first Very Fast Train project between Sydney and Canberra, while keeping regional airlines based at KSA and expanding Bankstown and Canberra airports.

To take forward this issue, the Commonwealth and NSW Governments are undertaking a Joint Study on aviation capacity for the Sydney region.

2.1 Context

The NSW Government has initiated a comprehensive review of its metropolitan land use strategy and its infrastructure plans for the Sydney region, with the aim of providing long term strategic planning for the provision of economic and social infrastructure for the region.

Aviation infrastructure is critical to economic development and employment in the Sydney region, and to maintaining Sydney's reputation and success as a competitive destination for business and investment.

In December 2009, the Commonwealth and NSW Governments agreed to undertake a Joint Study on aviation capacity for the Sydney region with a view to developing an Aviation Strategic Plan (the Strategic Plan) for the Sydney region. This will determine the region's long term aviation infrastructure requirements and inform the NSW government's planning and investment strategy for the region.

Both governments have also agreed to jointly consider the future planning, zoning and release of land at the Commonwealth-owned Badgerys Creek site to facilitate further economic development in South Western Sydney. Consideration will be given to how the site is best integrated with future employment locations, infrastructure needs and the overall NSW planning strategies for the region.

Both governments will continue to work with key stakeholders to develop better integrated transport solutions for KSA, including improved public transport links and road and rail connections. This work will be incorporated with strategic investment and transport planning being undertaken by the NSW Government for land transport corridors in the Sydney region.

2.2 Objectives and scope of the study

The Joint Study has two broad objectives:

- To assess the requirement for additional aviation capacity for the Sydney region; and
- To assess the future use of the Badgerys Creek site.

2.2.1 Additional aviation capacity for the Sydney region

The objectives of the Joint Study are to:

- Consider the immediate (10 year) aviation infrastructure requirements for the Sydney region and the capacity of the existing aviation infrastructure and the land transport network linkages to meet forecast demand;
- Determine the long-term (25+ years) aviation infrastructure requirements for the Sydney region and the capability of the existing aviation assets serving the region to meet the forecast market demand in passenger and air freight transport and general aviation sectors of the industry. This would include consideration of:
    - current airport capacity;
    - the implications of future long term (25 to 50+ year) demand forecasts for aviation services;
    - the planning of future economic infrastructure, including long term spatial and land use planning for employment in the region;
    - the location and nature of future urban growth in the Sydney region; and
    - key linkages between existing aviation infrastructure and other transport networks;
- Review existing investment strategies for the civil and Defence airport facilities in the region, including an assessment of their capacity to meet the Sydney region's future aviation requirements;
- Identify strategies and locations to meet the aviation infrastructure needs of the Sydney region, through examining:
    - current and future state land use and land transport planning strategies;

    - Sydney's future requirements for transport and economic infrastructure, including Sydney's future employment nodes;
    - existing and required transport infrastructure to support additional aviation capacity for the region;
    - the need for other supporting infrastructure (energy, communications, gas, water etc);
    - the availability and application of off-airport protection measures to ensure existing and future airport capacity is protected from inappropriate development which may limit its effective long-term operations and growth;
    - the interaction between airports in the region, including Sydney (Kingsford Smith) Airport;
    - economic investment and environmental opportunities and challenges associated with future land use; and
    - existing airport policy and legislative requirements; and
- Identify any other matters that will need to be considered, in delivering additional aviation capacity for the Sydney region.

2.2.2 Future use of the Badgerys Creek site

The Commonwealth and NSW Governments are developing a joint proposal for the future use of the Badgerys Creek site, by giving due consideration to:

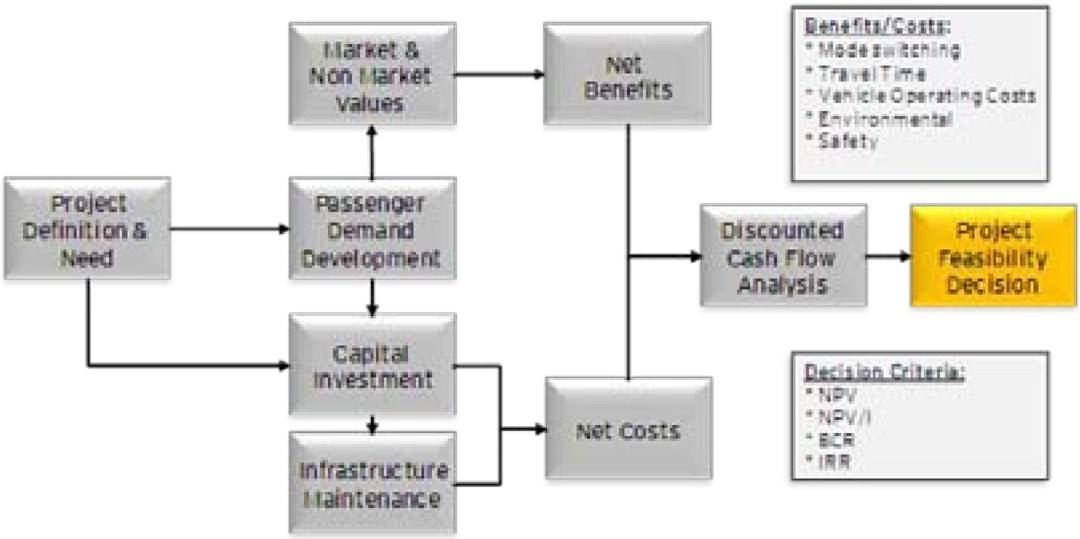
- Current state land use and land transport planning strategies;
- The demand for land at Badgerys Creek for future employment and economic development purposes (for example, strategic manufacturing investment and business park opportunities);
- Zoning requirements;
- Existing and required transport infrastructure to support future employment generating land;
- The need for other supporting infrastructure (energy, communications, gas, water etc); and
- The appropriate land release strategies which maximise long-term employment opportunities in South Western Sydney.

3. Methodology and approach

To support the work of the Joint Study in assessing the requirement for future aviation capacity in the Sydney region, the Commonwealth Department of Infrastructure and Transport commissioned Ernst & Young to undertake a comparative economic analysis of a series of aviation capacity options.

Ernst & Young's approach to the comparative quantitative and qualitative analysis of options to increase aviation capacity in the Sydney region is a cost benefit analysis (CBA). A CBA is a measure of the economic efficiency of a project or investment. It attempts to establish the best use of public funds based on improved social welfare. The methodology used in producing this analysis is shown in the figure below.

Figure 1: Approach to a transport cost-benefit study



The analysis was conducted using appropriate Commonwealth Government guidelines, including:

- Australian Government Civil Aviation Safety Authority (CASA) Economic Guidelines (2010);
- National Guidelines for Transport System Management in Australia, Australian Transport Council, 2007; and
- Infrastructure Australia's Outline of Infrastructure Australia's Prioritisation Methodology, 2008.

The following section of the report outlines the process involved in determining what should be included within the CBA, what was quantifiable and how these costs and benefits will be taken into account at each stage of the process.

3.1 Criteria for assessing sites

Prior to Ernst & Young's involvement in the project, the Department with the support of other consultants established 30 social, economic and environmental criteria to help determine the optimal location to provide an increase in aviation services to the Sydney basin.

At the start of the process, Ernst & Young undertook a literature review of economic evaluation guidelines as well as previous economic evaluations of similar aviation-related infrastructure that had been undertaken within Australia and internationally. Drawing on this research and analysis, Ernst & Young determined which criteria would be monetised in the CBA and which would be considered qualitatively at each phase of the CBA and how each of these criteria would be measured. The following table outlines the results of this process.

Table 2: Measurement of 30 criteria

Number &Ref	Criterion	Quantitative/ Qualitative	Approach to measurement	Rationale for not including criterion in monetised CBA
1	**Capacity created**	Quantitative and Qualitative (in Phase 2)	► Consumer surplus realised by Australian residents with the ability to fly (who otherwise would not have been able to fly) ► Tourism spend of non Australian residents who would have otherwise not accessed Australia; ► Value of freight that is able to transported to and from the Sydney region that would not have otherwise been moved ► Reduction in delays for passengers that would have flown in the Base Case ► Reduction in delays to aircraft operators (for movements that would have been flown in the Base Case); ► Reduction in the percentage of passengers that have to alter from their preferred flight time due to supply side constraints (i.e. those forced to 'peak spread') ► Capacity to expand from Type 3 to Type 1 airport (Phase 2 only)	
2	**Applicability to potential demand segments of new capacity**	Quantitative		
3	**Ease of connectivity between Sydney Airport and the airport site**	Not included		Not significant differentiator – all sites are located within two hours of Sydney Airport by road and/or rail
4	**Development costs**	Quantitative	► Land platform development costs	
5	**Accessibility (of the Sydney land transport network)**	Quantitative	► Change in land transport movements of both freight and passengers to access the airport that would have not otherwise occurred	
6	**Proximity of aviation capacity to NSW commercial growth centres**	Qualitative	► Existing employment land within 15 km of the site (both commercial and industrial) ► Potential employment land (including investigation areas) within 15km of the site (ha)	
7	**Commercial opportunities**	Qualitative	► Volume of employment at strategic growth centres within 30 mins of site, divided by access time from site	

Number &Ref	Criterion	Quantitative/ Qualitative	Approach to measurement	Rationale for not including criterion in monetised CBA
8	**Capacity;** **a) in relation to the centroid of population in Sydney (Ermington)** **b) In relation to the CBD of Sydney**	Quantitative	► Land transportation costs to access the airport	
9	**Airspace interactions**	Quantitative in Phase 2	► Phase 2 - ASA advice on the relative ability of each of the airport sites to be able to operate at their full capacity potential given the airspace interaction issues inherent in its location	
10	**Obstacle limitation surfaces**	Quantitative in Phase 2	► Number and range of assets that would interact with an airport on that specific site	
11	**Frequency of meteorologic al conditions affecting new and unlocked capacity**	Not included		► Not a significant differentiator between each of the localities or sites
12	**Potential impact on existing residents and other land users as a result of land acquisition**	Quantitative and Qualitative	► Land acquisition costs ► Population living in airport footprint ► Total number of zoned allotments within site area	
13	**Noise impact on Residents**	Quantitative and Qualitative	► Cost to provide noise abatement measures in line with Commonwealth Government guidelines to reduce the negative impact of airport and aircraft noise on residents within the vicinity of the new airport ► Total population within a 25 Australian Noise Exposure Forecast (ANEF) contour ► Sensitive land infrastructure likely to be affected by noise, including schools and other public facilities ► Number of N70 person events (noise events above 70 decibels) - Phase 2 only	
14	**Noise impacts on 'sensitive uses'**	Quantitative and Qualitative		
15	**Risk and consequence of aviation accidents at or around airports**	Not included		► Further site analysis required to understand relative risk ► Area of sensitive land use captured within other criteria (Number of zoned allotments)
16	**Greenhouse gas (GHG) emissions / ozone (Surface transport–related only)**	Quantitative	► Environmental impact of increased aircraft movements that would not have otherwise occurred	

Number &Ref	Criterion	Quantitative/ Qualitative	Approach to measurement	Rationale for not including criterion in monetised CBA
17	**Local air quality (pollution, particulate, odours)**	Not included		► Not significant differentiator – air quality not considered to vary significantly within NSW region (existing air quality rated at least 'Good' at all sites)
18	**Potential impact on quality of receiving waters**	Not included		► No significant differentiation – all sites located on or flow into water bodies
19	**Waterway and water supply catchment impact**	Not included		► Where sites are located within catchment boundary, it is not considered prohibitively expensive to mitigate potential impact
20	**National and State Parks**	Qualitative in Phase 1	► Proximity to World Heritage Areas ► Area of National and/or State Parks/Conservation areas affected	
21a	**Flora/Fauna Species in the locality**	Not included		► More specific site data used to assess impact on flora and fauna rather than locality data
21b	**Flora/Fauna Species within the representativ e Site**	Qualitative in Phase 1	► Total number of 'Protected', 'Vulnerable', 'Endangered' and 'Critically Endangered' flora and fauna species within footprint of airport	
22	**Indigenous cultural heritage and heritage items**	Qualitative in Phase 1	► Number of Indigenous cultural heritage items within site boundaries	
23	**Non-aboriginal heritage items**	Not included		► Indigenous heritage items have been prioritised for consideration
24	**State Significant Sites**	Not included		► No significant differentiation - no State Significant Sites within sites
25	**Flood risk at site**	Not included		► Not a significant differentiator – all sites are assumed to not be at significant risk of flooding on grounds of selection within seven sites
26	**Bushfire risk at site**	Not included		► No significant differentiation – all sites are entirely or partially Bushfire Prone Land
27	**Earthquake / other disaster**	Not included		► No significant differentiation – all sites have an acceleration coefficient between

Number &Ref	Criterion	Quantitative/ Qualitative	Approach to measurement	Rationale for not including criterion in monetised CBA
				0.08 and 0.10
28	Land remediation and contamination (i.e. leakages)	Not included		► Data required for analysis not undertaken at this stage
29	Presence of or potential for underground mining activity	Not included		► Not a significant differentiator – likely that government will be required to purchase titles at all sites
30	Unexploded ordnance risks	Not included		► All sites are assumed to meet threshold of UXO risk on grounds of selection within seven sites

Source: PwC and Ernst & Young analysis

A detailed explanation of how each of these impacts is valued in each stage of the economic analysis is presented within the relevant chapters of this report.

3.2 Process

As described in section 1.4, the CBA was undertaken within three distinct phases:

- Rapid CBA of broad localities;
- Rapid CBA of specific sites; and
- Detailed CBA.

Each of these analyses was undertaken in accordance with the relevant standards and procedures as outlined in existing economic evaluation guidelines.

Rapid CBA of localities

A rapid CBA is a cost-effective way of gauging whether an initiative is likely to pass a detailed appraisal, quantifying as many benefits and costs as necessary to establish whether an initiative is worth further investigation. It can also be used to facilitate comparison of multiple options, so that the 'most promising' can be prioritized for further analysis.

In essence, the methodology used for a rapid CBA is the same as for a more detailed CBA. However, the estimates for a rapid CBA are based on readily available information. Those benefits and costs that are small, standardised across all options, or difficult to estimate, may be omitted altogether.

The rapid CBA approach was undertaken at this phase of the Joint Study as a high level screening of a range of potential locations that could accommodate a new airport within the Sydney region. The purpose of this initial analysis was to assist in identifying preferred broad locations, which were then used to identify a list of site specific options for further analysis.

This phase of the study analysed seven potential localities. The inputs, methodology and results of this process are explained in more detail in chapter 4.

Rapid CBA of specific sites

Following the initial economic analysis, a further rapid CBA was undertaken on specific sites that were deemed to be able to accommodate specific types of airports (Maximum Type 1 and Type 3) within each of the localities taken forward from the first phase of the economic analysis. The inputs, methodology and results of this process are explained in more detail in chapter 6.

This phase of the study analysed 17 sites, all of which were capable of accommodating a Type 3 airport and 10 sites which were capable of accommodating a Maximum Type 1 airport.

Detailed CBA of Richmond site

The detailed CBA for phase 3 of the study was undertaken to determine which development option of the current Richmond RAAF airbase would present the greatest net benefit.

The detailed CBA focused on a wider range of scenarios than simply determining which site presents the best location to house an operational airport and included the following considerations:

3.3 Framework

As above, this economic analysis has been conducted in accordance with the specifications and guidelines including:

- Australian Government Civil Aviation Safety Authority (CASA) Economic Guidelines, 2010;
- National Guidelines for Transport System Management in Australia, Australian Transport Council, 2007; and
- Infrastructure Australia's Outline of Infrastructure Australia's Prioritisation Methodology, 2008.

3.3.1 Discount rate

The analysis has been conducted using a 7% real discount rate based on Commonwealth evaluation guidance (for example, by Infrastructure Australia).

3.3.2 Evaluation period

The analysis timeframe for the economic impact of the project is over a 50 year time horizon, from the commencement of the start of operations in the case of developing a new airport.

More specifically, the following assumptions have been used in the economic evaluation:

- Base analysis time period – start date 1 January 2011; and
- The operational time period for the new airport differs depending on the phase of the analysis:
  - Phases 1 and 2 have a static operational start date of 2035 for a type 1 and 2 airport and an optional start date of 2025 for a type 3 and 4 airport; and

- Phase 3 applies the same operational start dates as described above in the base case analysis. This analysis also identifies the effects of applying alternative operational start dates for the airport to determine which provides the greatest economic benefit.

Common start dates for each of the airport locations for the different airport types were applied within phases 1 and 2 of the economic analysis. This assumption was chosen based on technical analysis undertaken by Ernst & Young (with costings provided by Arup, Airbiz and Turner & Townsend) that determined that in order to maximise economic viability, these are probably the earliest that a greenfield airport of that size could be developed and commence operations in the Sydney basin.

Additional detail about the specific assumptions regarding the timing of construction of the alternative airport types are set out in relevant chapters within this report.

3.3.3 Perspective of analysis

The benefits associated with increasing Sydney's aviation capacity in the base case are viewed from a national perspective. The key difference between a national and state perspective in undertaking such an analysis is that, with a constrained aviation network in Sydney, it is likely that other major destinations within Australia (e.g. Melbourne and Brisbane) will benefit from a proportion of travel that would otherwise have been realised in Sydney. For example, rather than passengers travelling to Sydney, they may choose to travel to Melbourne, resulting in a lost benefit to NSW, but not to Australia as a whole.

The following benefits are affected when the perspective of the analysis is changed:

- Australian resident travel consumer surplus;
- International tourist spend;
- Consumer surplus of freight; and
- Passenger delays.

Conservative factors have been applied to key benefits to take into account the impact of diversion of demand to other states, which would reduce the net impact on the national economy. These assumptions are expressly stated within the relevant sections.

3.4 Data sources

A number of data sources were utilised in undertaking this analysis. At the direction of the Department, Ernst & Young drew upon a number of sources to develop the assumptions for the CBA. The following organisations were the main sources of information to support the economic analysis produced in this report:

- Booz & Company[6], who undertook passenger and freight demand modeling under the constrained Base Case and unconstrained development scenarios (used throughout the analysis);
- Ernst & Young, Arup, Airbiz and Turner & Townsend [7], who undertook costings[8] to develop a generic airport definition that was used within the first and second phases of the analysis (rapid of locations and sites);

[6] Booz & Company (2011), *Updated demand forecasts for the Sydney region*

- Arup[9] who undertook an initial assessment of the supporting infrastructure construction and ongoing operating costs;
- Ernst & Young's Real Estate Advisory Team[10], who advised on land acquisition costs; and
- WorleyParsons/AMPC[11], who:
  - estimated the costs associated with the development of supporting infrastructure and the development of the land platform upon which a potential airport would be developed; and
  - provided comprehensive data on the impact of options on a series of social, environmental and economic factors.

The data sources for each component within each phase of the analysis are set out in more detail within the relevant chapters of this report.[12]

3.5 Values and assumptions

All of the assumptions underlying the economic analysis can be found within this document. This report also provides direction as to where further information can be found that has been developed elsewhere within the wider Sydney Aviation Capacity project which forms the basis of the economic analysis. It does not repeat this data where it is being made available elsewhere within the Joint Study Documentation.

3.6 Base case

In each phase, the option to increase the aviation capacity of the Sydney basin was assessed against a 'do-minimum' Base Case. The Base Case was defined as the maintenance of existing and planned supply of aviation services to the Sydney region. Specifically, the Base Case foresees the implementation of current airport masterplans, including the masterplan for Sydney's Kingsford Smith Airport (KSA).

Under the Base Case, it is assumed that KSA continues to operate and develop in accordance with the existing Sydney Airport Corporation Limited (SACL) masterplan. This means that, under all capacity expansion options and stages of analysis, the planned investment in Sydney Airport, and any supporting infrastructure, will still be required.

Specifically within Phases 1 and 2 of the analysis it has been assumed that any new greenfield airport that would be developed within the Sydney basin would not attract aviation demand away from KSA. Therefore the analysis assumed that all aviation demand for a second airport would be realised by those persons and businesses that would not be able to be serviced by the current or (formally) planned aviation services within the Sydney basin.

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[7]Ernst & Young et al. (2011), Provision of advice and analysis relating to investment in airport infrastructure with indicative generic airport costs (**Error! Reference source not found.**)- and supporting documentation (Appendix H)
[8] Costings undertaken by Arup, Airbiz and Turner & Townsend
[9] Arup (2011), Initial Assessment of Supporting Infrastructure for Airport Sites (Appendix F)
[10] Ernst & Young (2011), Land price assessment for a second airport in Sydney (Appendix I)
[11] Worley Parsons (2011), Analysis of most suitable aviation sites

Within Phase 3 of the economic analysis, the detailed CBA of Richmond, the analysis considered both the assumption discussed above (no transfer of passengers). Even in the case of passengers transferring their demand for aviation services away from KSA it is assumed that this still would not result in a variation in KSA masterplan or any other government capital or operational expenditure.

It is accepted that this is a relatively simple base case and that reality may prove to be a more complex picture. However, for the purposes of this Study - in particular the comparison of multiple options - the fixed base case facilitates a relative analysis of options.

3.7 Outputs

Based on the outcomes of the costs and benefits identified above, the CBA was undertaken and reported through standard decision criteria. Using standard decision criteria allows for direct comparisons to be made across a range of scenarios against the Base Case.

The following decision criteria were used for each of the scenarios selected for analysis and compared to the Base Case:

- Net Present Value; and
- Benefit Cost Ratio (BCR).

The BCR can be used to rank options and is the most commonly presented economic evaluation result due to current practice within Infrastructure Australia. As discussed above, the results were aimed at supporting a comparison of capacity options rather than an absolute indication of costs versus benefits.

The results of the analyses undertaken for each phase of the study are provided in the following chapters.

4. Economic analysis of localities (Phase 1 of the economic analysis)

The first stage of the economic analysis was undertaken to assist the identification of preferred localities for new 'greenfield' aviation capacity. Once the preferred localities were identified, the Department's technical advisors identified specific sites within those locations for new facilities. To facilitate the identification of preferred localities, Ernst & Young was asked to undertake a comparative rapid CBA of the locality options.

The methodology for undertaking this rapid CBA was consistent with the framework and methodology used for subsequent phases of the study.

The following seven broad locations were analysed within Phase 1:

- Central Mangrove - Kulnura;
- Central Coast;
- Hawkesbury;
- Nepean;
- Burragorang;
- Cordeaux-Cataract; and
- Southern Highlands.

In each case, an illustrative site location within each broad location was identified by WorleyParsons/AMPC to determine the nature of costs associated with the development of an airport within the locality.

4.1 Demand assumptions

The underlying assumption for the requirement for a new airport within the Sydney region is that any new airport development will only service the demand for aviation services that could not be provided by KSA, including developments outlined in the KSA Masterplan. This is in line with the assumptions adopted by Booz & Company.

In reality, there is likely to be some movement of passengers and aircraft operations from KSA to any new airport. However, the level of movement will vary depending upon a number of factors including any new airport's location relative to the origin/destination of its core market and the take up of the new facility by major airlines. Due to the complexity of forecasting such variables, this potential movement has not been factored into the scope of this analysis.

4.1.1 Demand modelling

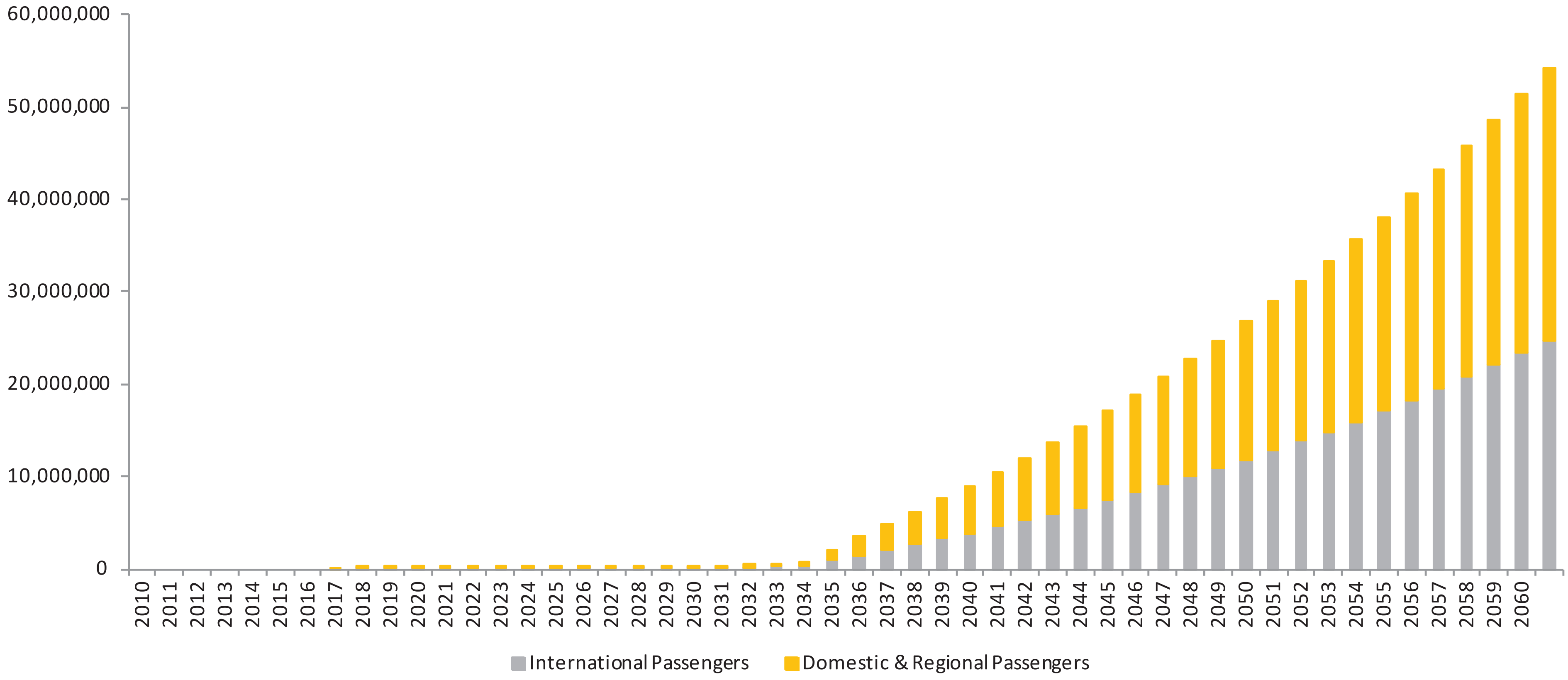
Booz & Company undertook modelling to forecast the demand for aviation services (passengers and freight) between 2010 and 2060.

Booz & Company provided two demand forecasts:

- Constrained demand for aviation services in Sydney assuming growth will be slowed when aircraft movements reach 80 movements per hour; and
- Unconstrained demand for aviation services in a market with a theoretically unlimited supply of these services and assuming unlimited movements per hour.

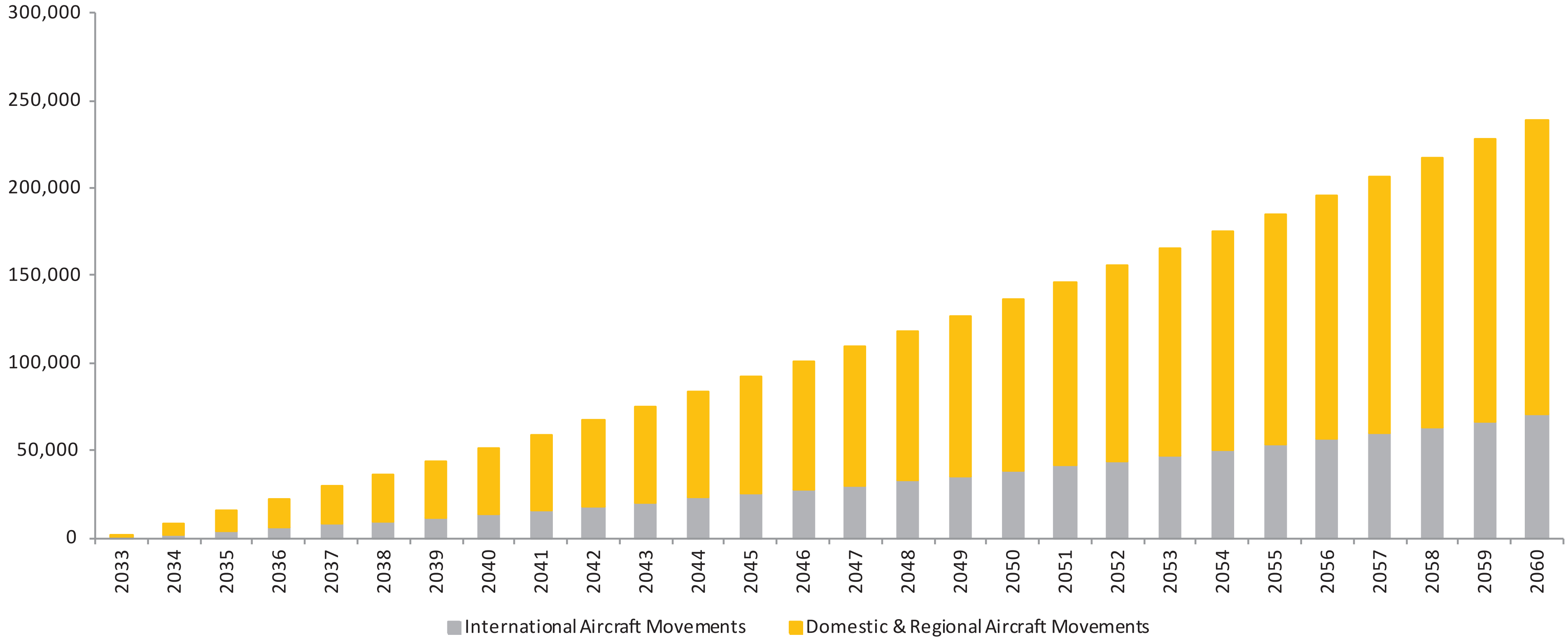
The figures below present the unmet demand forecasts between 2010 and 2060 within the Sydney region, for passengers, aircraft movements and freight.

Figure 2: Unmet demand for passenger movements



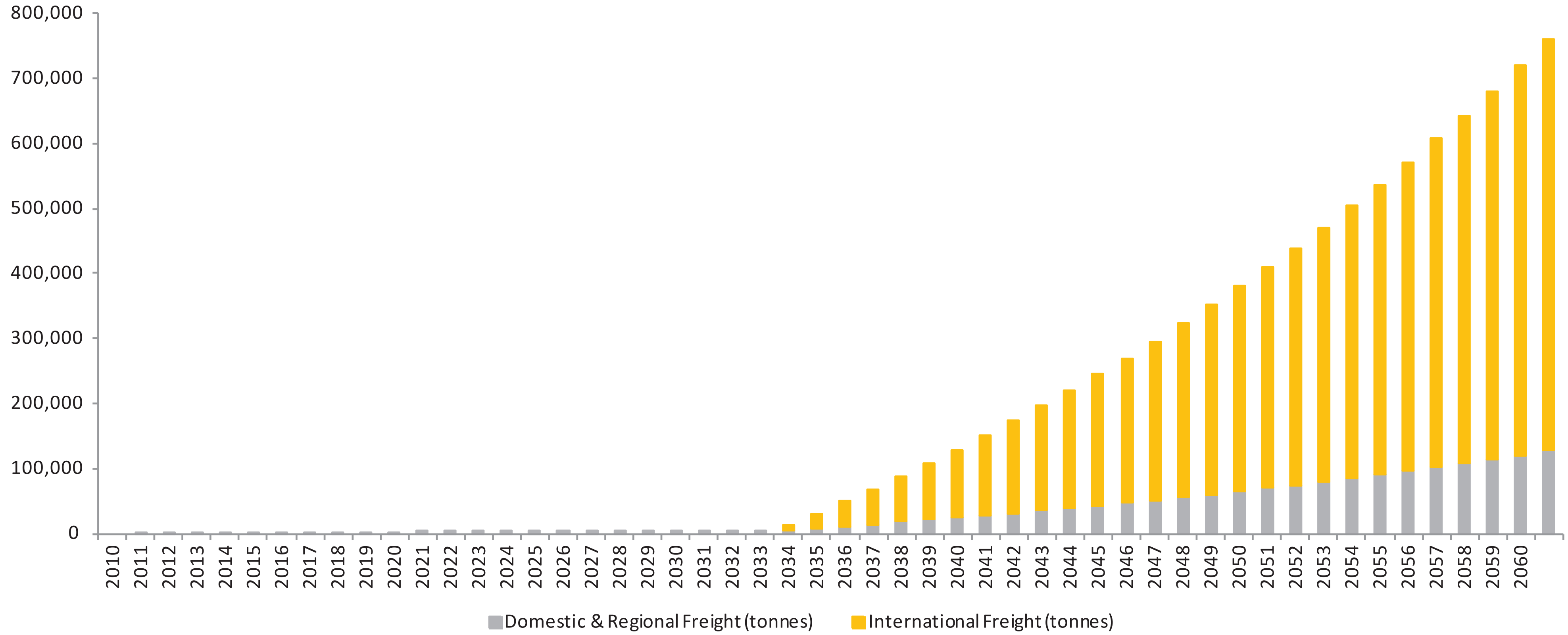
Source: Booz & Company

Figure 3: Unmet demand for aircraft movements



Source: Booz & Company

Figure 4: Unmet demand for freight tonnage



Source: Booz & Company

The figures demonstrate that the benefits associated with increasing Sydney's aviation capacity are realised by increasing the overall number of movements (passengers and freight) into and out of the region (additional movements that would otherwise not have been possible under the constrained Base Case (as modelled by Booz & Company)).

The profile of this additional demand is assumed to be the same within all of the development scenarios, regardless of size or location. Furthermore it is assumed that all of those persons that want to travel to particular airports in the Sydney region will do so if aggregate supply is sufficient to meet their demand.

This analysis assumed that a percentage of Australian residents would find alternative means of travelling regardless of the constrained aviation market (ie: the base case of not increase the supply of aviation services in the Sydney region). This value has been based on the travel elasticity information presented by the Bureau of Infrastructure, Transport and Regional Economics (BITRE).

The increase in the demand for aviation services in the development options when compared to the base case is a result of the provision of the ability to fly rather than a necessarily a reduction in the generalised cost of the trip.

For the purpose of this analysis, these passengers have been treated as induced or generated within this analysis and valued using the 'rule of a half'.

Each type of airport's ability to meet this demand is constrained by its intrinsic design features which are presented in the table below.

Table 3: Generic airport types as defined by the Joint Study

Airport Type	Definition
Maximum Type 1 Airport	*A full service international airport* – with runways up to 4,000m long and 60m wide and capable of carrying the largest passenger aircraft (A380). Such an airport will be expected to cater upward of 30 million passengers annually and have the capability to provide an additional parallel runway.
Type 2	*A land constrained international airport* – with a single runway up to 3,500m long and 45m wide. This type of airport will be capable of taking large wide body international jets, but not the A380 (which requires a 60m wide runway for a newly built airport). Such an airport would be expected to cater from 5 to 30 million passengers each year.
Type 3	*A limited service regular passenger transport (RPT) airport* – with a single runway up to 2,200m long and 45m wide. This type of airport will still be capable of handling wide body international jets (excluding the A380), but runway length will limit services to short-haul international destinations (e.g. Trans-Tasman). Such an airport will be expected to cater between 5 and 25 million passengers annually, predominantly on narrow body jet services.
Type 4	*A minimum service airport servicing general aviation (GA) and limited RPT*, serving 1 million passengers annually.

Source: The Department of Infrastructure

Therefore, as can be seen in the table above, a type 1 airport will be able to service approximately 30 million passengers per annum, whereas a type 4 airport will only be able to service 1 million passengers per annum.

Furthermore the Booz & Company demand analyses were prepared for the period 2010 to 2060. As the economic appraisal was prepared over a longer period, the unconstrained and constrained passenger and freight demand estimates realised in 2060 have been applied as the level for all years between 2061 and 2075 to 2085 (the end of the analysis period).

Given the impact of discounting on any analysis past 2060, this assumption has little impact on the outcomes of the analysis (applying a 7% discount rate on values that occur in a period post 15 to 25 years ahead has a very limited impact on present values).

4.1.2 Perspective of analysis

The benefits associated with increasing Sydney's aviation capacity in the base case are viewed from a national perspective. The key difference between a national and state perspective in undertaking such an analysis is that, with a constrained aviation network in Sydney, it is likely that other major destinations within Australia (e.g. Melbourne and Brisbane) will benefit from a proportion of travel that would otherwise have been realised in Sydney. For example, rather than passengers travelling to Sydney, they may choose to travel to Melbourne, resulting in a lost benefit to NSW, but not to Australia as a whole.

Alternatively, passengers that would have otherwise flown elsewhere overseas rather than come to Australia in the constrained aviation case have no impact on the base case of this assessment (ie: this travel outside of Australia would have no economic benefit to the national economy).

The following benefits are affected when the perspective of the analysis is changed:

- Australian resident travel consumer surplus;
- International tourist spend;
- Consumer surplus of freight; and
- Passenger delays.

Conservative factors have been applied to key benefits to take into account the impact of diversion of demand to other states, which would reduce the net impact on the national economy. These assumptions are expressly stated within the relevant sections.

4.2 Estimate of costs

The development of an airport in a greenfield location requires the following capital expenditure:

- Purchase of land;
- Development of a land platform so that it is able to accommodate an airport; and
- Construction of the airport infrastructure and supporting infrastructure.

To efficiently run and operate an airport, the site will need to be connected to a range of infrastructure networks and services (transport, water, power etc). Furthermore, the existing infrastructure networks and services may need to be upgraded if the additional demand from airport users and employees requires additional network capability/capacity (e.g. the power network may need upgrading to accommodate the increased demand for power from the airport).

The following specific upfront capital costs were analysed in Phase 1 of the study:

- Land acquisition;
- Comparative cost of earthworks to create a platform for the construction of the generic airport type; and
- Construction of associated infrastructure necessary to support the operations of an airport.

The following ongoing capital, maintenance and operating costs were analysed within this phase.

- Renewal of the airport and supporting infrastructure at the end of its useful economic life; and
- Operational and maintenance costs associated with the ongoing operation of the airport and supporting infrastructure.

Details on the data sources used to estimate the costs of these components are provided below.

4.2.1 Land acquisition

Some of the first costs to be realised in the development of an airport are those associated with the acquisition of land.

In this phase of the study, WorleyParsons/AMPC identified representative sites within the seven broad locations that were to be included within the analysis. WorleyParsons/AMPC also calculated the area of land that would have to be acquired to accommodate each type of airport.

The respective sizes for each airport type, as determined by WorleyParsons/AMPC, are set out in the following table.

Table 4: Hectares per airport type (Source: WorleyParsons/AMPC)[13]

Type of Airport	Assumed Hectares (Ha)
Type 1	1,012.6
Type 2	944.9
Type 3	723.3
Type 4	366

Source: WorleyParsons/AMPC

Cost estimates to acquire the land were developed from historical sales data within each of the localities by the Ernst & Young Real Estate Advisory team. The following table presents the assumed cost of purchasing the land per hectare for a representative airport site in each locality.

Table 5: Land value ($'000/hectare)

Location	Rate ($'000) per hectare
Central Mangrove - Kulnura	50
Central Coast	70
Hawkesbury	140
Nepean	65
Burragorang	215
Cordeaux-Cataract	40
Southern Highlands	50

Source: Ernst & Young Real Estate Advisory Services

As stated within Ernst & Young's Real Estate Advisory report[14] a factor of 25% has been applied on top of the values presented in the table above to take into account risk and contingency that would likely to be realised in the purchase of properties within these sites.

[13] Sourced from Matrix 2 of the Phase 2 greenfield assessment process
[14] Ernst & Young (2011), Land price assessment for a second airport in Sydney (Appendix I)

Further information regarding the methodology and process of calculating the cost of land acquisition within each of the localities are provided in the Ernst & Young Real Estate Advisory Services report.

The total land purchase costs were then calculated by multiplying assumed land sizes by the average rate per hectare for each specific site.

It was assumed that it would only take one year to purchase the land regardless of its size. The year in which the land is purchased is back-solved from the operational start date of 2025 (constant across all locations for a type 3 and 4 airport) and 2035 (constant across all locations for a type 1 and 2 airport) and the time required develop this land platform and generic airport on the site (which varies by airport type). The land platform development and airport construction timeframes were provided by Ernst & Young's Real Estate Advisory team. The table below sets out the year in which it has been assumed that land is purchased by airport type.

Table 6: **Year that land is purchased**

Type of Airport	Operational start date	Year cost incurred
Maximum Type 1	2035	2025
Type 2	2035	2027
Type 3	2025	2019
Type 4	2025	2019

Source: Ernst & Young - Real Estate assumption

4.2.2 Comparative cost of earthworks to create a platform for the construction of the generic airport type

The cost associated with the reconfiguration of the land in its natural formation to a state that it is able to represent a platform that conforms to the basic geometric requirements to enable the construction of a generic airport is also taken into account within this analysis.

Cost estimates to develop this platform were provided by WorleyParsons/AMPC, which determined the cost estimates based on a number of factors, including slope and rock composition of land within each of the airport locations analysed.

The following table presents the estimated cost to develop this land platform for each of the airport types and locations analysed.

Table 7: Comparative cost of earthworks to create a platform for the construction of the generic airport type ($'million)

Location	Maximum Type 1	Type 2	Type 3	Type 4
Central Mangrove – Kulnura	636	593	452	228
Central Coast	534	498	413	209
Hawkesbury	939	876	680	344
Nepean	203	190	135	68
Burragorang	430	401	298	151
Cordeaux-Cataract	293	273	212	107
Southern Highlands	452	422	314	159

Source: WorleyParsons/AMPC

A 50% factor has been applied to the values presented in the table above to take into account the additional cost associated with Contingency and Project Management & Design.

Time period

The time it takes to develop a land platform depends on the area and topography of the land. The estimated time to develop a land platform for each airport type is provided in the table below.

Table 8: Time to develop this land platform area

Airport type	Years	Start date	End date
Maximum Type 1	4	2026	2029
Type 2	3	2028	2030
Type 3	2	2020	2021
Type 4	2	2020	2021

Source: Arup

The profile of investment spending to develop this land platform throughout the construction period is set out in the table below.

Table 9: Land platform development – 'S curve'

Type of Airport	Year 1	Year 2	Year 3	Year 4
Maximum type 1	15%	25%	40%	20%
Type 2	25%	40%	35%	
Type 3	50%	50%		
Type 4	50%	50%		

Source: Arup and Ernst & Young assumptions.

4.2.3 Construction of the generic airport type

The cost to construct a generic airport, regardless of location, for each type of airport was provided by Airbiz, with assistance from Arup and Turner & Townsend.[15] A benchmarking approach was used to derive the indicative unit rates for construction.

The components of capital expenditure for a generic airport used for the purpose of this analysis included the following key items:

- Paved surfaces including the apron areas, the runways, and taxiways;
- Airfield lighting and landing aids;
- Passenger terminal buildings;
- Car parks; and
- Other facilities (such as air traffic control facilities).

Airbiz undertook a benchmarking study of airports (predominantly in Australia and New Zealand) to provide the inputs to a capital expenditure model for the airport infrastructure. Relationships between airport type, annual aircraft and passenger movements and the following primary airport infrastructure elements were used to derive the expenditure estimates.

[15] Ernst & Young et al (2011), Provision of advice and analysis relating to investment in airport infrastructure with indicative generic airport costs (**Error! Reference source not found.**)- and supporting documentation (Appendix H)

Table 10: Key capex cost drivers

Element	Capital expenditure drivers
Runways	Length, design aircraft determining width (and strength)
Taxiways	Length, design aircraft determining width (and strength)
Aprons	Number of stands and design aircraft determining area (and strength)
Passenger terminal buildings	Floor area calculation and unit rates reflecting building type finish
Car parks	Number of car spaces, multi-level or at grade

Source: Ernst & Young, Arup, Airbiz and Turner & Townsend

The airport capital expenditure model used an area calculation based on the benchmarking outcomes multiplied by unit rates to give the relative costs for the different types of airports, including relativity between the airport infrastructure elements listed above.

Cost

The cost to construct the airport, by airport type, is provided in the table below.

Table 11: Capital cost – generic airport types ($'000s)

Cost category	Maximum Type 1	Type 2	Type 3	Type 4
Runways/Taxiways	551,040	167,265	83,985	46,143
Apron Surfaces	274,067	199,397	130,581	22,530
Car Parking	201,600	249,000	48,000	2,400
Landing Aids/Lighting	84,148	36,381	21,093	5,278
Terminal – International	1,811,588	819,421	0	0
Terminal – Domestic	583,190	833,129	852,222	67,308
Other CAPEX	27,479	20,648	13,211	3,171
Contingency	1,059,934	697,572	344,727	44,049
Project Management & Design	706,622	465,048	229,818	29,366
Subtotal	**$5,299,669**	**$3,487,861**	**$1,723,637**	**$220,244**

Source: Ernst & Young, Arup, Airbiz and Turner & Townsend

Note that the difference between the construction cost values presented in the table above, with the values presented in the Ernst & Young, Arup, Airbiz and Turner & Townsend report is that they are based on different PAX throughput within the range of the airport definition (driven by the airport definitions provided by the Department).

Time period

It is assumed that the airport infrastructure is developed in the years that occur directly before the operational start date of 2025 (for a type 3 and 4 airport) and 2035 (for a type 1 and 2 airport).

The time to construct the airport for each of the airport types is provided in the following table.

Table 12: Construction of the airport – timing

Airport type	Development timetable (yrs)	Start date	End date
Maximum type 1	5	2030	2034
Type 2	4	2031	2034
Type 3	3	2022	2024
Type 4	3	2022	2024

Source: Ernst & Young, Arup, Airbiz and Turner & Townsend

The distribution of the total investment used to construct the airport over the construction period can be seen in the table below.

Table 13: Construction of generic airport types – 'S curve'

Period start	-5 year	-4 year	-3 year	-2 year	-1 year
Maximum type1	2%	15.5%	37%	37%	8.5%
Type 2		2.5%	17%	40%	40.5%
Type 3			15%	40%	45%
Type 4			4%	36%	60%

Source: Ernst & Young, Arup and Airbiz and Turner & Townsend

4.2.4 Construction of associated infrastructure necessary to support the operations of an airport

A range of other infrastructure will have to be constructed and connected to the existing infrastructure networks to support an operational airport. The associated infrastructure that has been incorporated within the analysis includes:

- Road;
- Rail;
- Water;
- Wastewater;
- Power;
- Communications;
- Gas; and
- Fuel.

Cost

The development of capital cost estimates for each of these assets to support the airport types in each of the locations was undertaken by Arup.[16] Arup developed costs to develop the infrastructure required to support an airport development at each of the analysed sites under the following development scenarios

- Type 2 airport;
- Type 4 airport;

[16] Arup (2011), Initial Assessment of Supporting Infrastructure for Airport Sites (Appendix F)

- Cost to upgrade the supporting infrastructure sufficient to support a type 2 airport to that sufficient to support a type 1 airport.

The methodology for determining the cost and the rationale behind cost differentials of sites can be found in the Arup technical report. However, a number of assumptions underpin Arup's analysis, including:

- A rail service to support an airport will only be developed in the case of a Maximum Type 1 airport;
- In the case of a Maximum Type 1 airport, there will be four tranches of capital expenditure, over five year increments to reflect the progressively increased utilisation of this asset; and
- The supporting infrastructure for all other airport types should be developed prior to the commencement of the airport's operations.

The following tables outline the supporting infrastructure costs associated with each of the airport types by location.

Maximum Type 1 airport

Table 14: Supporting infrastructure cost – Maximum Type 1airport (above type 2 cost estimate), year 0 of operation ($'000)

Infrastructure Asset	Central Mangrove - Kulnura	Central Coast	Hawkesbury	Nepean	Burragorang	Cordeaux-Cataract	Southern Highlands
Road	460,000	50,000	2,180,000	440,000	694,000	540,000	140,000
Rail	-	-	-	-	-	-	-
Water	64,800	17,000	20,000	19,000	11,000	11,300	15,500
Wastewater	4,000	9,480	9,980	11,180	6,380	1,000	11,780
Power	99,500	57,000	40,000	94,500	34,100	52,000	30,000
Communications	15,420	9,690	11,340	13,530	23,250	16,200	23,880
Gas	14,442	9,500	13,000	16,000	25,800	10,500	80,000
Fuel	526,900	250,500	210,750	181,350	260,250	231,000	376,500
Risk (30%)	1,549,519	120,951	745,521	232,668	316,434	258,600	203,298
Management (20%)	1,033,012	80,634	497,014	155,112	210,956	172,400	135,532
Total	3,767,593	604,755	3,727,605	1,163,340	1,582,170	1,293,000	1,016,490

Source: Arup

Table 15: Supporting infrastructure cost – Maximum Type 1airport, year 5 of operation ($'000)

Infrastructure Asset	Central Mangrove - Kulnura	Central Coast	Hawkesbury	Nepean	Burragorang	Cordeaux-Cataract	Southern Highlands
Road	1,440,000	1,120,000	860,000	220,000	1,060,000	552,000	1,872,000
Rail	-	-	-	-	-	-	-
Water	60,300	24,300	24,300	32,300	12,300	19,900	21,300
Wastewater	10,000	9,890	10,450	7,300	6,400	7,300	7,980
Power	-	-	-	-	-	-	-
Communications	-	-	-	-	-	-	-
Gas	-	-	-	-	-	-	-
Fuel	-	-	77,800	62,500	108,250	122,500	192,250
Risk (30%)	453,090	346,257	291,765	96,630	356,085	210,510	628,059
Management (20%)	302,060	230,838	194,510	64,420	237,390	140,340	418,706
Total	2,265,450	1,731,285	1,458,825	483,150	1,780,425	1,052,550	3,140,295

Source: Arup

Table 16: Supporting infrastructure cost – Maximum Type 1airport, year 10 of operation ($'000)

Infrastructure Asset	Central Mangrove - Kulnura	Central Coast	Hawkesbury	Nepean	Burragorang	Cordeaux-Cataract	Southern Highlands
Road	1,530,000	420,000	-	220,000	-	440,000	800,000
Rail	-	-	-	-	-	-	-
Water	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Wastewater	-	6,000	6,000	6,000	6,000	6,000	6,000
Power	-	-	57,000	50,000	50,000	20,000	40,000
Communications	-	-	-	-	-	-	-
Gas	-	-	-	-	-	-	-
Fuel	-	127,000	-	-	-	-	-
Risk (30%)	460,500	167,400	20,400	84,300	18,300	141,300	255,300
Management (20%)	307,000	111,600	13,600	56,200	12,200	94,200	170,200
Total	2,302,500	837,000	102,000	421,500	91,500	706,500	1,276,500

Source: Arup

Table 17: Supporting infrastructure cost – Maximum Type 1airport, year 15 of operation ($'000)

Infrastructure Asset	Central Mangrove - Kulnura	Central Coast	Hawkesbury	Nepean	Burragorang	Cordeaux-Cataract	Southern Highlands
Road	-	50,000	860,000	-	460,000	120,000	1,180,000
Rail	811,000	409,000	580,000	280,000	781,000	460,000	328,000
Water	-	-	-	-	-	-	-
Wastewater	-	-	-	-	-	-	-
Power	-	-	-	-	-	-	-
Communications	300	300	300	300	300	300	300
Gas	-	-	-	-	-	-	-
Fuel	-	124,200	78,280	64,000	106,700	120,000	185,100
Risk (30%)	243,390	175,050	455,574	103,290	404,400	210,090	508,020
Management (20%)	162,260	116,700	303,716	68,860	269,600	140,060	338,680
Total	1,216,950	875,250	2,277,870	516,450	2,022,000	1,050,450	2,540,100

Source: Arup

Airport type 2

Table 18: Supporting infrastructure cost – Airport type 2 ($'000)

Infrastructure Asset	Central Mangrove - Kulnura	Central Coast	Hawkesbury	Nepean	Burragorang	Cordeaux-Cataract	Southern Highlands
Road	460,000	50,000	2,180,000	440,000	694,000	540,000	140,000
Rail	-	-	-	-	-	-	-
Water	29,500	11,500	14,500	15,500	5,500	9,300	14,500
Wastewater	4,000	8,776	9,276	10,476	5,676	1,000	10,876
Power	99,500	30,000	28,000	94,500	34,100	52,000	30,000
Communications	15,420	9,690	11,340	13,530	23,250	16,200	23,880
Gas	14,442	9,110	11,310	13,920	22,446	9,980	73,550
Fuel	254,250	250,500	210,750	181,350	260,250	231,000	408,000
Risk (30%)	263,134	110,873	739,553	230,783	313,567	257,844	210,242
Management (20%)	175,422	73,915	493,035	153,855	209,044	171,896	140,161
Total	1,315,668	554,364	3,697,764	1,153,914	1,567,833	1,289,220	1,051,209

Source: Arup

Airport type 3

Table 19: Supporting infrastructure cost – Airport type 3 ($'000)

Infrastructure Asset	Central Mangrove - Kulnura	Central Coast	Hawkesbury	Nepean	Burragorang	Cordeaux-Cataract	Southern Highlands
Road	232,233	25,243	1,100,583	222,136	350,369	272,621	70,680
Rail	-	-	-	-	-	-	-
Water	14,893	5,806	7,320	7,825	2,777	4,695	7,320
Wastewater	2,019	4,431	4,683	5,289	2,866	505	5,491
Power	50,233	15,146	14,136	47,709	17,216	26,252	15,146
Communications	7,785	4,892	5,725	6,831	11,738	8,179	12,056
Gas	7,291	4,599	5,710	7,028	11,332	5,038	37,132
Fuel	128,359	126,466	106,398	91,555	131,388	116,621	205,981
Risk (30%)	132,844	55,975	373,366	116,512	158,305	130,174	106,141
Management (20%)	88,563	37,316	248,911	77,674	105,537	86,782	70,761
Total	664,221	279,873	1,866,832	582,559	791,527	650,868	530,707

Source: Arup

Airport type 4

Table 20: Supporting infrastructure cost – Airport type 4 ($'000)

Infrastructure Asset	Central Mangrove - Kulnura	Central Coast	Hawkesbury	Nepean	Burragorang	Cordeaux-Cataract	Southern Highlands
Road	-	-	-	-	262,000	80,000	-
Rail	-	-	-	-	-	-	-
Water	27,650	9,650	12,650	13,650	3,650	7,450	12,650
Wastewater	4,000	7,364	7,801	9,351	4,651	875	9,701
Power	63,250	16,250	1,000	20,500	13,000	12,000	3,750
Communications	6,750	3,960	3,210	4,740	8,550	8,100	4,560
Gas	100	100	100	100	100	100	100
Fuel	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Risk (30%)	30,825	11,497	7,728	14,802	87,885	32,858	9,528
Management (20%)	20,550	7,665	5,152	9,868	58,590	21,905	6,352
Total	154,125	57,485	38,642	74,012	439,427	164,288	47,642

Source: Arup

A more detailed explanation regarding the assumptions used by Arup to develop these costings can be found in the Arup technical report.

Time period

It is assumed that the airport's supporting infrastructure is developed in the years that occur directly before the operational start date of the airport.

It is assumed that it will take four years to undertake each of the developments of the supporting infrastructure. Note that in the case of a Maximum type 1 airport development, there are four tranches of development (as noted in section 4.2.4), which each take four years to complete.

The 'S curve' for supporting infrastructure is presented in the table below. This is used to calculate how the investment costs are distributed over the construction period and reflects the years required to develop the supporting infrastructure for each airport type.

Table 21: Construction of supporting Infrastructure – 'S curve' (original site)

Airport type/Year	Year -4	Year -3	Year -2	Year -1
All airport types	16.0%	34.4%	34.2%	15.4%

Source: Arup

4.2.5 Ongoing capital and operating costs associated with the airport

The ongoing capital and operational costs associated with the development of an airport include the:

- Renewal of the airport's assets; and
- Operation and maintenance of the airport's assets.

4.2.5.1 *Renewal of airport asset*

At the end of an asset's useful economic life, a level of capital expenditure (CAPEX) is required to renew the asset to a sufficient operational standard for it to continue to operate.

Capital expenditure cost assumptions for the renewal of airport infrastructure at the end of its useful life have been provided by Arup.

Timing

It is assumed that the capital renewal expenditure is completed in the years preceding the end of the asset's useful life.

To determine when the airport infrastructure assets require renewal, the useful life of airport infrastructure assets was taken into account.

Table 22: Economic useful life – Airport infrastructure

Asset type	Useful economic life (yrs)
Runways, taxiways and aprons	20
Terminal, building and services	40
Roads and Car Parks	9
Vehicles, plant and equipment	10

Source: Arup

The time to renew each of the infrastructure components has been based on the component's assumed size, which is in turn based on the airport development type. The following table presents the assumed renewal capital expenditure period for each of the asset types.

Table 23: Renewal capital expenditure timetable

Asset type	CAPEX spend time period (yrs)			
	Maximum Type 1	Type 2	Type 3	Type 4
Runways, taxiways and aprons	2	2	1	1
Terminal, building and services	2	2	1	1
Roads and Car Parks	2	2	1	1
Vehicles, plant and equipment	1	1	1	1

Source: Arup/Ernst & Young assumption

Cost and timing ('S curve')

The table below presents the 'S curve' for the renewal capital expenditure based on its relative spend time period.

Table 24: Renewal CAPEX spend S curve

CAPEX spend time period (yrs)	Year -2	Year – 1
1		100%
2	40%	60%

Source: Arup/Ernst & Young assumption

4.2.5.2 *Operational and maintenance cost of asset*

Airport operating expenditure assumptions have been provided by Airbiz. Operating costs have been estimated based on benchmarking which shares some of the key characteristics of each of the four generic airport types. For further detail, refer to section 8 of the Ernst & Young financial analysis Assumptions Book.[17]

The following table presents the operation and maintenance costs for each type of airport development. The figures are expressed in terms of dollars per passenger (pax) and, in the case of a type 4 airport, in terms of dollars per movement.

Table 25: Operating Costs

Type of costs	Units	Maximum Type 1	Type 2	Type 3	Type 4
Operating Costs per pax	**$/pax**	$6	$6	$8	$5
Operating Costs per movement	**$/movement**				$6

Source: Ernst & Young, Arup, Airbiz and Turner & Townsend

4.2.6 Ongoing capital and operating costs associated with the airport's supporting infrastructure

The ongoing capital and operational costs associated with the infrastructure supporting an operational airport include the:

- ► Renewal of the supporting infrastructure assets; and
- ► Operational and maintenance cost of the supporting infrastructure assets.

4.2.6.1 *Renewal of asset*

The cost to renew each of the supporting infrastructure assets has been taken into account within this analysis by assuming that the assets are redeveloped at the end of their useful life as detailed above.

Costs

The capital cost incurred to renew the asset at the end of its useful life for the infrastructure supporting an operational airport is the same cost that was realised within the initial development of the assets (as provided in section 4.2.4).

[17] Ernst & Young et al (2011), Provision of advice and analysis relating to investment in airport infrastructure with indicative generic airport costs supporting documentation (Appendix H)

Timing

The assumed replacement years for the various categories of supporting infrastructure are provided in the table below. Construction is assumed to take four years for each of the asset types and to begin immediately prior to the replacement date.

Table 26: Economic useful life – Supporting Infrastructure

Type	Useful economic life
Road	40
Rail	60
Water	50
Wastewater	70
Power	35
Communications	35
Gas	25
Fuel	50

Source: Arup

The distribution of capital expenditure to renew each of the supporting infrastructure assets can be seen in the table below.

Table 27: Supporting Infrastructure – renewal – 'S curve'

Year	Year -4	Year -3	Year -2	Year -1
All airport types	16.0%	34.4%	34.2%	15.4%

Source: Arup

4.2.6.2 *Operating and maintenance cost of assets*

Operating and maintenance (O&M) expenditure assumptions have been provided by Arup.[18] The O&M costs for the supporting infrastructure commence in 2025 (for a type 3 and 4 airport) and 2035 (for a type 1 and 2 airport).

A summary of the O&M costs for supporting infrastructure is provided in the table below.

Table 28: Average periodic maintenance cost based on airport type and location ($'000s p/a)

Airport type/Location ($'000)	Central Mangrove - Kulnura	Central Coast	Hawkesbury	Nepean	Burragorang	Cordeaux-Cataract	Southern Highlands
Maximum Type 1	54,586	27,662	39,470	20,554	46,313	33,533	42,811
Type 2	8,296	4,955	6,588	7,019	10,217	10,300	7,602
Type 3	4,188	2,502	3,326	3,543	5,158	5,200	3,838
Type 4	842	946	1,068	1,021	2,923	643	1,034

Source: Arup

The analysis of the operations and maintenance costs for a type 2, 3 and 4 airport was presented by Arup on an average per annum basis. Because of the nature of the staged development of supporting infrastructure for a maximum type 1 airport, the operation and maintenance costs of such an asset will vary over its life. The operations and maintenance cost value for a maximum type airport presented in the table above is the average cost realised over the 50 year economic analysis period.

[18] Ernst & Young et al (2011), Provision of advice and analysis relating to investment in airport infrastructure with indicative generic airport costs (**Error! Reference source not found.**)- and supporting documentation (Appendix H)

A more detailed summary of the components and methodology for these O&M costs can be found in the Arup supporting document.

4.3 Benefits

The following benefits were considered within this phase of the analysis, including:

- Value of aviation movements:
  - consumer surplus realised by Australian residents who will be able to fly if new capacity is added, that wouldn't have been able to fly otherwise;
  - tourism spend of non-Australian residents who would have otherwise not visited Australia; and
  - value of freight that is able to be transported to and from Sydney that would not have otherwise been transported;
- Reduction in aviation movement costs:
  - the reduction in delay of passengers that would have flown under the no development (Base Case) scenario;
  - the reduction in delays to aircraft operators; and
  - the reduction in the percentage of passengers that have to alter their preferred flight times due to supply constraints.

This should not be seen as a comprehensive list of impacts. For example, ticket prices will be expected to change (relative to the Base Case) if new capacity becomes available, potentially increasing welfare through lower prices. However, the pricing behaviour of airlines in a competitive market over the period is extremely difficult to forecast and has not been included for the purposes of this analysis.

Each of these components, the data source and results are explained in more detail below.

4.3.1 Value of passenger movements

The greatest benefit to the wider community from increasing the supply of aviation services to the Sydney basin stems from allowing additional movements to and from Sydney, NSW and Australia. These movements will be undertaken by:

- Australian residents;
- International leisure and business travellers; and
- Businesses moving freight.

The additional number of passenger and freight movements given the specific development scenario is defined by:

- The additional number of movements under the unconstrained market analysis undertaken by Booz & Company;
- The capacity of the airport type; and

► The utilisation of the new airport given its location and type.

The benefits accruing to each of these aviation users, realised through the benefit of being able to fly, are discussed in more detail below.

4.3.1.1 *Consumer surplus of Australian residents' travel*

Consumer surplus is a popular method used to measure the economic benefits that accrue to consumers from a specific market environment. It is defined as the difference between the willingness to pay for the good/service and price paid.

The inputs into this benefit calculation include:

- Percentage of passenger movements that are by Australian residents;
- The number of travellers that would have found alternative means of travel into and around Australia;
- Consumer surplus percentage; and
- Average cost of airfare.

This analysis has assumed that 55% and 90% of all international and domestic aviation movements respectively are undertaken by Australian residents.

Forty six percent of the average fare was attributed to consumer surplus within this analysis. This value was provided by BITRE[19] as part of their in-depth analysis of the elasticity of air travel within Australia.[20]

The consumer surplus of realising the ability fly was only applied within this analysis to those that were not able to fly in the constrained Base Case and now able to do so due to capacity increases (difference between demand under the constrained and unconstrained cases). The rule of half was applied in the estimation of this benefit.[21]

The consumer surplus captured through the ticket price is only one of the ways in which changes in welfare to passengers has been captured in the appraisal as a result of increases in aviation capacity. In addition, the impact on consumer welfare has been captured in the development case through reductions in passenger delays including wait times, reductions in peak spreading and changes in land transport costs (as discussed in the remainder of this section). These addition impacts capture the full (calculable) range of user welfare costs and benefits (i.e. the generalised costs and benefits of using additional aviation capacity).

Average cost of airfare

The weighted average airfare cost for both business and leisure travel along international and domestic routes to & from Sydney was determined by taking the average airfare spot price weighted by the number of passenger movements to each location in 2010, as defined within BITRE's[22] analysis of the aviation network.

This analysis was undertaken on the 15th April 2011 corresponding to the criteria below for the different flight classes.

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[19] BITRE internal briefing note, 2011

[20] This value was compared to similar analysis undertaken in Germany and Canada, as well as the relevant aviation-related economic guidelines to ensure its robustness.

[21] The 50% consumer surplus component refers to the slope of the demand curve – in effect resulting in application of the 'rule of a half'

[22] Monthly Airport Traffic Data for top twenty airports, BITRE, 2010

Table 29: Flight cost criteria

Passenger type	International	Domestic
Business	1 week's notice, business class	1 week's notice, economy class
Leisure	4 weeks' notice, economy class	3 weeks' notice, economy class

Source: Ernst & Young assumption[23]

This analysis found the average airfare prices for both international and domestic travel movements to be:

Table 30: Average flight costs (one way)

Passenger type	International	Domestic
Business	$3,800	$300
Leisure	$1,000	$250

Source: Ernst & Young analysis

Elasticity and Induced Demand

The demand analysis provided by Booz & Company presented the level of aviation demand that cannot be serviced by the current and planned supply of services in the Sydney region.

This analysis assumed that the with regards to the increase in additional Australian residents that travel as a result of increasing the supply of aviation services within the Sydney Basin to take into account the percentage of passengers would have found alternative means of travelling regardless of their mode or underlying reason for travel would still find a means of travelling. This value has been based on the travel elasticity information presented by the Bureau of Infrastructure, Transport and Regional Economics (BITRE).

The increase in the demand for aviation services in the development options when compared to the base case is a result of the provision of the ability to fly as a result of an increase in the capacity of services rather than a necessarily a reduction in the generalised cost of the trip.

For the purpose of this analysis, these passengers have been treated as induced or generated within this analysis and valued using the "rule of a half".

4.3.1.2 *Tourism spend of non-Australian residents that would have otherwise not visited Australia*

The state and national economies will benefit from increasing the Sydney basin's aviation capacity as a result of additional tourists visiting Australia and their spending while on holiday/or on business.

The assumptions and values utilised in the calculation of this benefit include:

- ► The number of passenger movements by tourists; and
- ► The profit realised by Australian businesses as a result of the average amount spent by tourists.

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[23] Therefore the costs for flights included within the analysis for business class domestic and international flights leaving on the 27th of April 2011, domestic leisure flights departing on the 11th of June, and international leisure flights departing on the 18th of June 2011.

This analysis has assumed that 45% and 10% of international and domestic aviation movements respectively are undertaken by non-Australian residents.[24]

The average spend per day by tourists in Australia has been sourced from Tourism Australia[25], the values of which can be seen in the table below.

Table 31: Average spend by tourists

Passenger type	Days	Spend	Days	Spend
International	23.1	$90	25	$94
Domestic	3.4	$157	3.4	$157

Source: Tourism Australia

To present the net benefit of increased tourism spend of non Australian residents that would not have otherwise visited Australia given the current supply of aviation services only the profit of this expenditure was taken into account. It is assumed that 25%[26] of tourism expenditure is realised as profit within the Australian economy.

4.3.1.3 *Value of freight that is able to be transported to and from Sydney*

Another economic benefit of increasing the supply of aviation services to the Sydney basin results from the increase in freight movements into and out of Sydney and Australia. These freight movements could include a mix of:

- The imports and exports of final goods;
- Imports of a relevant input into the supply chain; or
- The import/export of personal effects.

The economic benefit associated with increased freight movements into and out of Sydney and Australia has been determined based on its consumer surplus. The value assumptions used to calculate this benefit include:

- The average value of freight;
- Freight that would have not entered Australia as a result of a constrained Sydney aviation network; and
- Consumer surplus percentage.

The average value of freight ($8,000/tonne) was calculated based on KSA data of the value of freight movements in 2010. It was assumed that only 25%[27] of freight would find alternative means of entering Sydney/Australia in the case of constrained supply of aviation freight services.

A value of 50% consumer surplus (assuming that all users of freight are consumers – eg: consumers and producers) was used to calculate the net benefit of increasing freight transportation in and out of the Sydney Basin, as outlined within the CASA Economic Guidelines. The 50% consumer surplus component refers to the slope of the demand curve – in effect resulting in application of the ‘rule of a half’ to the generated freight demand. As the appraisal captures the incremental value in use of the additional freight, the benefits only recognise the net benefit.

[24]The inverse of the percentage of passengers who are Australian residents as presented in section 4.3.1.3
[25] International visitors in Australia, Department of Resources, Energy and Tourism, December 2010
[26] Ernst & Young assumption based on IBISworld analysis
[27] Ernst & Young assumption

4.3.2 Reduction in the real cost of flying

The other benefits that result from increasing aviation services to the Sydney basin are realised by those passengers and aircraft that would have travelled regardless of capacity constraints, through a decrease in delays and peak spreading.

4.3.2.1 *Reduction in passenger delays*

As the aviation network increases in capacity, and thus lowers the total network utilisation rate, it is assumed that the proportion of aircraft and thus passenger delays will decrease. This benefit varies significantly depending on the increase in overall capacity resulting from developing a greenfield airport and the time it takes for demand of aviation services to reach this new level of supply.

This section outlines the method for calculating the reduction in the average delay time per aircraft movement and the monetary values associated with this reduction.

Average delay time methodology

The base assumption for this calculation is that 20% of planes are currently delayed by an assumed average delay of 45 minutes[28]. This assumption is based on current BITRE market information.[29]

The relative amount of benefit that will be realised by existing aviation passengers from a reduction in delays is calculated based on the relative utilisation of the aviation network's capacity over the analysis period. This is based on the theory that the greater the utilisation in a network, the greater the constraints and the probability that delays will occur. Further, this analysis assumes that this benefit is only realised by Australian residents, who make up 90% of domestic movements and 55% of international movements.

This analysis assumes that only 40% of all aircraft delays occurred as a result of a constrained airport network and that this will be improved by increasing capacity.

The analysis also assumes that a delay to any one plane will have a flow on effect on other airline and airport operators within Australia. It is assumed that a domestic delay will have a 50% flow-on effect elsewhere on the Australian aviation network, while an international delay will have a 10% impact elsewhere. In other words it is assumed that a domestic flight that is delayed will realise a delay on its next flight that is half of the time realised in the original flight. Subsequent to this second flight the network returns to schedule.[30]

Further information regarding the number of passengers under the constrained scenario (those who will fly in any case), and information regarding the increase in network capacity as a result of different airport types can be found in Booz & Company (2011), *Updated demand forecasts for the Sydney region report*.

Economic value of time

The value of time assumptions were developed in accordance with the CASA Economic Guidelines, as set out in the table below.

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[28] Noting that a definition of a delay under BITRE definition is a plane that is more than 15 minutes behind schedule

[29] Airline On Time Performance Monthly report, BITRE, September 2011

[30] As an example, under this approach a half an hour delay on a flight would be assumed to result in the subsequent flight (of the same aircraft) being delayed by 15 minutes, then the flights resume normal scheduling.

Table 32: Value of time (2011$ per hour)

Component of trip	Business	Leisure
In-air	58.38	46.16
Waiting - on ground	19.79	5.24

Source: CASA Economic Guidelines

It is assumed that a factor is applied to the value of time to take into account the impact of the disruption of delay. The value used within this assumption is 2, and only applied to delays that are experienced while waiting on the ground. This assumption is in line with public transport economic analysis frameworks.

Within the base case and project cases the value of time is kept constant in real terms over the analysis period.

4.3.2.2 *Reduction in aircraft delays*

Reducing the network delay time associated with aviation services will also benefit the airline companies.

The calculation of the reduction in delay times that would have otherwise occurred without the increase in capacity is the same as that calculated to measure the benefit of reducing passenger delays.

Other inputs necessary to determine the benefit of reducing aircraft delays include:

- Where the delays occur (on the ground or in the air); and
- The cost of delays.

Delay occurrence

Based on information received from Air Services Australia it is assumed that 90% of delays occur on the ground while the remaining 10% occur in the air.

The cost of delays

The delay cost refers to the average cost per minute of a delayed commercial aircraft. The cost of delays in the air traffic management system as outlined within the CASA guidelines is based on most recent report by EUROCONTROL, which contained a detailed assessment of the delay costs for 12 specific aircraft types and also derives an estimate of the average delay cost per minute in Europe in actual monetary terms. The values of delay costs per minute, converted to Australian dollars, is summarised in the following table:

Table 33: Delay costs per minute per aircraft (2011$)

Cost component	Ground	Airborne	Ground	Airborne
Fuel costs	$1.9	$28.0	$1.9	$28.0
Maintenance costs	$1.9	$1.9	$1.9	$1.9
Crew costs	$16.8	$16.8	$20.5	$20.5
Ground and passenger handling				
Airport charges				
Aircraft ownership costs				
Passenger compensation	$26.1	$26.1	$48.4	$48.4
Direct cost to an airline	**$46.7**	**$72.8**	**$72.7**	**$98.8**

Source: CASA (2010), Standard Economic Values Guidelines, section 2.2

4.3.2.3 *Reduction in peak spreading*

Peak spreading refers to the time that passengers have to divert from their preferred departure time because of capacity constraints. A benefit associated with increasing the capacity of the aviation network is that there will be a reduction in the number of passengers having to divert from their preferred departure times.

Like the calculation of the reduction in delays, this benefit is only realised by Australian residents. As such, the percentage of Australian residents relative to the total passenger movements is the same within this calculation as that outlined in section 4.3.1.1.

The method for calculating peak spreading is the same as that to calculate the change in passenger and aircraft delays – in so far as it measures the total number of passengers that have to change their preferred flight times by the change in the relative utilisation of the aviation network capacity over the analysis period.

Booz & Company conducted a benchmarking study in 2011 of 35 global airports within the range of 250,000 and 50 million annual passenger movements in order to determine the estimated peak spreading ratios. This analysis found that 0.25% of passengers within Sydney currently have to change their preferred flight times due to capacity constraints.

It was assumed that the next available flight time that a person could fly on was assumed to be half an hour for domestic travellers and 3 hours for international travellers.

The value of time assumption was developed in accordance with the CASA Economic Guidelines, taking into account the average value of time of an aviation traveller taking into account the weighted average value between air time and on ground waiting time, which is presented in

Table 32. These value of time used for both business and leisure travellers can be seen in the table below.

Table 34: Average value of time (2011$ per hour)

Passenger type	Value
Business	40.06
Leisure	13.67

Source: CASA Economic Guidelines

The core analysis assumes that there is no real increase in the value of time.

4.4 Externality impacts

Increasing aviation services capacity within the Sydney network will have a net negative impact on the wider economy and society, including:

- Additional congestion/delays on the land transport network, realised by:
    - additional passenger vehicle movements; and
    - additional freight vehicle movements.
- The environmental impact of additional flights; and
- Noise impacts on local areas.

These are important impacts and the inputs and value assumptions associated with each of these components are discussed in more detail below.

4.4.1 Land transport network

Increasing the additional number of flights within Sydney will result in an increased number of passenger and freight vehicle movements on the local land transport network.

This impact, which will be realised by both the travellers themselves and the wider community, will include:

- Value of time;
- Vehicle operating costs;
- Accident costs; and
- Environmental costs.

These impacts are valued in accordance with NSW and Australian Transport Council economic evaluation guidelines. Factors relevant to the calculation of the values of these impacts include:

- The origin/destination of these journeys;
- The distance between the origin and destination to and from the airport location; and
- The average speed of vehicles.

Each of these inputs is discussed in more detail below.

The origin/destination of these journeys

The origin/destination of passenger and freight journeys associated with a new airport will determine the total aggregate land transport impacts of each of the development options.

It is assumed that the current make up of the users of any new airport (with the exception of a type 4 airport) will mirror that of KSA. It is assumed that a type 4 airport will only service the non-commercial aviation needs of the local community.

The origin and destination of users of an alternative airport in the Sydney basin was sourced from Booz & Company. Their analysis of the final origins and destinations of airline passenger trips (e.g. home, place of employment etc) to and from the Sydney region provides an understanding of the impact of location on demand at Sydney (Kingsford-Smith) Airport and other airports within the Sydney region. The National Visitors Survey 2005-2009 (NVS) and the International Visitors Survey 2005-2008 (IVS) provide information on the air trip profiles of passengers travelling to and from Sydney.

The current origin/destination of KSA freight has been calculated by Ernst & Young based on Transport NSW's trip matrix data. The results of this analysis can be seen in the table below.

Table 35: Breakdown of users origin/destination

Region	Passengers	Freight
North Sydney	14%	8%
South Sydney	NA	20%
Metro Sydney	49%	59%
Inner Western Sydney	NA	4%
South West Sydney	10%	2%
Western Sydney	13%	4%
North Western Sydney	11%	0%
Central and Northern Coast	3%	1%
Western Regional NSW	1%	0%

Source: Booz & Company, Transport NSW

Note: The values in the table above are rounded to the nearest 1%

Since there will be different levels of population and economic/employment growth in different regions over the analysis period, these origin/destinations are likely to change over time. Ernst & Young have used an analysis of the NSW Government's strategic growth plans to produce a simplified analysis of how the percentages in the table above may change over time. The annual growth rates used are set out in the table below.

Table 36: Residential/commercial growth of regions (per annum)

Region	Passengers	Freight
North Sydney	1%	1%
South Sydney	N/A	2%
Metro Sydney	3%	2%
Inner Western Sydney	N/A	2%
South West Sydney	1%	1%
Western Sydney	2%	1%
North Western Sydney	2%	2%
Central and Northern Coast	1%	2%
Wollongong and South NSW	1%	1%
Western Regional NSW	1%	1%

Source: NSW Government's strategic growth plan

The distance between the origin and destination to/from the airport location

Road distances were determined based on the actual distance between each proposed site and main locations within each Sydney region, based on the current road network. These distances are shown in table below.

Table 37: Road distances between O/D and each airport sites (km)

Region	Location	Central Mangrove - Kulnura	Central Coast	Hawkesbury	Nepean	Burragorang	Cordeaux-Cataract	Southern Highlands
North Sydney	Chatswood	75.4	65.9	52.6	68.2	93.1	96.2	149
South Sydney	Earlwood	93.8	65	75.3	49.7	65.9	69	121
Metro Sydney	Town Hall	86.7	77.3	61.6	60.6	83.2	86.4	139
Inner Western Sydney	Strathfield	85.4	76	57.2	50.6	68.1	71.2	124
South West Sydney	Cabramatta	95.1	85.6	47.2	24.9	53.6	56.7	109
Western Sydney	Woodcroft	91.6	82.1	27	35.7	71.5	74.6	127
North Western Sydney	Cherrybrook	71.7	62.3	34.1	57.9	93.7	96.8	149
Central and Northern Coast	Newcastle	103	84.7	179	194	230	233	286
Wollongong and South NSW	Wollongong	192	182	124	83.9	62.8	29	73.3
Western Regional NSW	Bathurst	251	242	149	161	190	229	284

Source: Ernst & Young analysis

The average speed of vehicles

As the travel distance increases, it is assumed that average vehicle speeds will increase. This is because airports located further away from urban areas are surrounded by less traffic and roads with higher speed limits. These figures are represented in the table below.

Table 38: Speed distance relationship

Distance (km)		Average vehicle speed (km/h)			
From	To	Car	Public Transport	Heavy vehicle	Light vehicle
0	50	40	25	35	35
51	100	50	40	45	45
101	250	60	50	50	50
251	9,999	90	75	80	80

Source: Ernst & Young assumption

The weighted average time it takes to travel between each of the origin/destination points to/from the airport has been calculated based on the average speed and the number of kilometres to the airport location.

Assumptions regarding the values associated with each of the components of land transport impacts are discussed below.

4.4.1.1 *Passenger travel*

Assumptions surrounding the transportation of passengers to and from the airport focus on the valuation of travel time, the negative externalities involved and the number of accidents it is likely to produce.

Land transport trips per passenger movements

The following table presents the assumed land transport trips by type relative to the number of total airplane passenger movements.[31]

Table 39: Passenger movement breakdown

Number of trips per airline passenger movement	Passenger movements
Private transport	0.75
Public transport (bus)	0.025
Public transport (train)	0.02

Source: Ernst & Young assumption

Vehicle breakdown

The type of transportation used to travel to and from the airport is assumed to correspond to the below table. The percentages will depend primarily on the location of the airport. This assumption is based on the existing breakdown of passengers mode of travel to KSA, SACL and the NSW Department of Transport's target and those of other airports within Australia and internationally.

Table 40: Vehicle use breakdown

Vehicle breakdown %	Metro airport	Rural airport
Private transport	80%	90%
Public transport	20%	10%

Source: Ernst & Young analysis

Public transport split

As stated in section 4.2.4 it is assumed that rail services to support an airport will only be developed for a Maximum Type 1 airport. For airport types 2, 3 and 4, all persons that travel by public transport will use bus services.

In the case of a maximum airport development, a rail network to support the airport will be operational 15 years after the commencement of airport operations. After the rail system is operational, it is assumed that of all those that travel by public transport 75% of which will chose to use this service.[32]

Value of time of travel time

This analysis uses Austroad's (2008) value of time for land transport users that are arriving from or departing to an airport, as summarised in the table below:

[31] Taxi trips are included within the private transport category
[32] It is assumed that an operational rail line will not induce public transport use

Table 41: Standard value of time for land transport users (2011 dollar terms)

Mode of transport	Private	Business
Private transport	$12.64	$40.43

Source: Austroads (2008), Update of RUC Unit Values, section, Table 2.8

Vehicle operating cost ('VOC') - Private vehicles

The vehicle operating cost includes costs such as running costs, depreciation, maintenance costs, tyres and brakes. Assumptions regarding the vehicle operating cost are summarised in the table below.

Table 42: Vehicle operating cost (cents/vehicle kilometre, 2011 dollar terms)

Speed (km/h)	Car/Taxi
20	56.83
30	40.11
40	32.34
50	28.23
60	26.01
70	25.17

Source: Austroads (2008), Guide to Project Evaluation Part 4: Project Evaluation Data, Section 6 (Stop/start model (Local / Arterial))

Vehicle operating cost ('VOC') - Public vehicles

The following table outlines the assumed cost to operate bus and rail services per kilometres travelled.

Table 43: Public vehicle operating cost ($/vehicle kilometre, 2011 dollar terms)

Form of transport	$ per kilometre
Train services	$35.9
Bus services	$37

Source: RailCorp Economic Evaluation Guidelines

Environmental and other externalities

The environmental and other externality costs associated with running the vehicle are summarised in the table below.

Table 44: Environmental and other externalities (cents/vehicle kilometre, 2011 dollar terms)

Component of externality cost	Passenger vehicle	Light vehicles	Heavy vehicles	Bus	Rail
Noise	0.90	29.80	3.89	4.67	2.25
Air pollution	2.79	175.88	23.30	30.68	4.38
Water pollution	0.42	26.22	3.50	0.00	0.00
Greenhouse	2.20	54.44	5.18	15.97	0.70
Nature and landscape	0.05	19.44	0.38	0.00	0.00
Urban separation	0.65	28.52	2.60	2.75	0.00

Source: Austroads (2008), Guide to Project Evaluation Part 4: Project Evaluation Data, Table 6.1 and RailCorp economic evaluation guidelines

Accidents

The estimated social costs of a road crash have been provided by a BITRE report and are expressed in terms of cents over the vehicle kilometres, as summarised in the following table.

Table 45: Estimated social cost of road crash (cents/vehicle kilometre, 2011 dollar terms)

Cost of accidents	Cars	Motorcycles	All vehicles	Rail
Social cost (cents/vkt)	9.2	22.4	9.0	0.05

Source: BITRE (2006), Cost of road crashes in Australia, Table 7.6

4.4.1.2 *Freight travel*

Assumptions for the transportation of freight to and from the airport focus on the valuation of travel time, the negative externalities involved and the number of accidents it is likely to produce.

Movement of location of freight

Over and above the general economic growth within the region, an airport will create a shift in economic activity towards the region. It is assumed that a percentage of those businesses requiring the freight services of an airport will relocate to the region where it is located.

To take this impact into account it has been assumed that, depending on the type of airport developed, a proportion of those businesses that use freight services at the new airport set up their business operations in the wider region of the airport.

The following table outlines the percentage of total freight that will utilise the services of the new airport that will move to the region, based on the type of airport developed.

Table 46: Estimated percentage of freight that will move to region

Airport type	Percentage of freight that will move to region
Maximum type 1	50%
Type 2	40%
Type 3	20%
Type 4	0%

Source: Ernst & Young assumption

This analysis assumes that if a greenfield airport had not been constructed that these companies, and thus their demand for aviation services, would have been realised in the Sydney Metro and South Sydney regions as they are the closest locations to current aviation services. Furthermore this analysis assumes that it will take 7 years, regardless of the type of airport developed to reach this full transfer of demand profile.

Value of time

This analysis uses Australian Transport Council (2006) and Austroads (2008) value of time for users of freight transport. They are used to quantify the negative externalities involved with saved time and delayed time and are summarised in the table below.

Table 47: Standard value of time of freight transport users (2011 dollar terms)

Mode of transport	Light vehicles	Heavy vehicles
Private	$24.77	$25.58

Source: Austroads (2008), Guide to Project Evaluation Part 4: Project Evaluation Data

Vehicle operating cost

The vehicle operating cost includes costs such as running costs, depreciation, maintenance costs, tyres and brakes. It is summarised in the table below.

Table 48: Vehicle operating cost (cents/vehicle kilometre, 2011 dollar terms)

	Stop/start model (Local / Arterial)	Freeway model
Speed	Bus/Truck	Bus/Truck
20	316.11	
30	223.62	
40	180.65	
50	157.53	
60	144.35	
70		136.55

Source: Austroads (2008), Guide to Project Evaluation Part 4: Project Evaluation Data, Section 6

Environmental and other externalities

The environmental and other externality costs associated with running the vehicle are summarised in the table below:

Table 49: Environmental and other externalities (cents/vehicle kilometre, 2011 dollar terms)

Component of externality cost	Light vehicle	Heavy vehicle
Noise	2.97	29.72
Air pollution	27.14	129.22
Water pollution	2.58	19.38
Greenhouse	5.17	54.28
Nature and landscape	2.97	19.38
Urban separation	2.58	28.43

Source: Austroads (2008), Guide to Project Evaluation Part 4: Project Evaluation Data, Table 6.1

Accidents

The social cost of road accidents is set out in the following table.

Table 50: Estimated social cost of road crash (cents/vehicle kilometre, 2011 dollar terms)

Accident costs	Rigid Trucks	Articulated trucks	All vehicles
Social cost (cents/vkt)	5.3	4.4	9.0

Source: BITRE (2006), Cost of road crashes in Australia, Table 7.6

4.4.2 Environmental impact of additional flights

Increasing aviation capacity in the Sydney basin will increase the number of flights that would have otherwise occurred. These additional aircraft movements will have associated net adverse environmental effects, which will be borne by the wider community.

These negative environmental effects are taken into account in the analysis by calculating the weighted average distance of domestic and international flights and the environmental cost of fuel burn.

The weighted average distance of flights was calculated based on the number of flights by destination (using BITRE information) and Ernst & Young's calculation of the actual distances between each of the seven locations and Sydney. The results of this analysis provided the average distance of domestic and international flights, which can be seen in the table below.

Table 51: Average distance of flights (km)

Type of travel	Distance (KM)
International	7,100
Domestic	950

Source: Ernst & Young analysis

The rate of fuel burn per passenger kilometre was taken from a previous BITRE report[33], which estimated that 1.9 megajoules of fuel was burned per passenger km flown.

The aeronautical economic guidelines provided an estimate of both the environmental impact (as measured by the level of emissions) and its associated cost values. These are set out in the table below.

Table 52: Environmental impact

Emission	Grammes per megajoule of fuel burnt	Cost ($ per tonne)
CO2	67.8	61.7
NoX	0.002	0.0075

Source: CASA Economic Guidelines

4.4.3 Noise impacts

A further negative impact associated with the development of airports is the increase in noise levels that is borne by the local community.

While noise impacts are often monetised in transport CBAs, the value of this impact has not been incorporated within this analysis. This is in line with the Department's formal guidance on the valuation of noise impacts for aviation projects – guidance which is based on international best practice. The principle underpinning this best practice is that an individual's perception of noise in the aviation context can vary a great deal. This reflects that the most important consideration is often the change in noise levels and/or the frequency and timing of noise events, rather than absolute or aggregate noise levels.

Therefore, the issue of noise is considered through the non-monetised analysis. However, Ernst & Young's approach does quantify the direct cost likely to be borne by governments in retrofitting houses and community facilities that are likely to be adversely affected by noise within the vicinity of any new airport (costs that are determined by specific regulations).

Houses and community facilities within a 20 ANEF (Australian Noise Exposure Forecast) contour will have to be retrofitted with noise abatement measures (double glazing windows etc). Since the methodology allows for this monetisation of mitigation costs as well as a non-monetised assessment, there may be a small theoretical 'double count' of noise impacts – to the extent to which the mitigation activity negates the perceived value of the noise impacts. However, we do not believe this to be material and it again ensures that the CBA is conservative.

The number of houses and community facilities within the 20 ANEF contour ranges for each of the proposed airport sites has been calculated by WorleyParsons/AMPC and is presented in the table below.

[33] Fuel Efficiency of Ships and Aircraft, BITRE, 2005

Table 53: Number of persons affected by airport noise

Infrastructure asset	ANEF 20			
	Maximum Type 1	Type 2	Type 3	Type 4
Central Mangrove - Kulnura	738	113	138	51
Central Coast	10,390	443	1,624	238
Hawkesbury	5,251	773	884	382
Nepean	11,564	293	389	260
Burragorang	3,387	828	1,036	898
Cordeaux-Cataract	1,648	91	135	51
Southern Highlands	712	57	70	42

Source: WorleyParsons/AMPC

The above estimates assume that the number of houses within the 20 ANEF contour ranges grow in line with the region's forecast population growth. This is likely to be conservative in CBA terms as the presence of new aviation facilities is likely to have a dampening effect on the demand for housing in noise affected areas.

The average cost to retrofit existing houses has been estimated at $20,000[34] per house, based on the average historical cost (in present dollar terms) incurred by the NSW Government in applying a similar program subsequent to the development of the third runway at KSA. It has been assumed that there are 2.1 persons per household[35].

4.5 Qualitative analysis

To complement the CBA, a number of qualitative factors were analysed to understand how each location compared on a range of non-monetisable economic, social and environmental considerations. These indicators were categorised into four categories (Strategic economic considerations, Social and cultural considerations, Environmental considerations and Noise). As set out in Section 2.1, the remainder of the 30 criteria were not included in the qualitative analysis as they were either monetised in the CBA, did not demonstrate significant differentiation between localities or insufficient data was available to measure localities against them.

Drawing on data provided by WorleyParsons/AMPC, the criteria and indicators analysed on a qualitative basis in this stage of the analysis are set out in the following table.

[34] This value is inclusive of risk and contingency
[35] In line with ABS estimates of persons per household

Table 54: Phase 1 - Qualitative criteria and indicators

Category	Criterion	Indicators
Strategic economic considerations	6. Proximity of aviation capacity to NSW commercial growth centres	► Existing employment land within 15 km of the site (both commercial and industrial) ► Potential employment land (including investigation areas) within 15km of the site (ha)
	7. Commercial opportunities near to or on-site	► Volume of employment at strategic growth centres within 30 mins of site, divided by access time from site
Social and cultural considerations	12. Potential impact on existing residents and other land users as a result of land acquisition	► Population living in airport footprint ► Total number of zoned allotments within site area
	22. Indigenous cultural heritage items	► Number of Indigenous cultural heritage items within site boundaries
Environmental considerations	20. National and State Parks	► Proximity to World Heritage Areas ► Area of National and/or State Parks/Conservation areas affected
	21B: Flora/fauna species within the representative site	► Total number of 'Protected', 'Vulnerable', 'Endangered' and 'Critically Endangered' flora and fauna species within footprint of airport
Noise	13. Noise impacts on residents	► Total population within 25 ANEF contour
	14. Noise impacts on 'sensitive' uses	► Sensitive land infrastructure likely to be affected by noise, including schools and other public facilities

Source: Ernst & Young analysis

To enable the localities and sites to be compared on a consistent basis, a scoring methodology was applied. Each indicator underpinning the four key categories was assigned a score on a 7 point scale (between -3 and +3) on the basis of their relative performance. A score of -3 indicates a highly negative impact, a score of 0 indicates a neutral impact and a score of +3 indicates a highly positive impact.

Based on a set of weightings for each indicator, scores for indicators within each category were aggregated to generate a total score for each locality or site under each category. The results of this analysis are summarised in Section 5.2 and the detailed scoring thresholds, scores and weightings are set out in Appendix D.

5. Locality analysis outcomes

5.1 Central outcomes

The quantitative analysis was undertaken on all seven localities for each of the potential airport types.

The BCRs over a 50 year period, based on an operational start date of 2025 for a type 3 and 4 airport and 2035 for a maximum and type 2 airport (as described in section 3.3.2) for each of these locations, based on airport type, are presented in the table below. The five highest BCR values for each of the airport types are highlighted in yellow.[36]

Table 55: Quantitative assessment results – BCR, 50 year analysis, 7% discount rate

Airport type/locality	Central Mangrove - Kulnura	Central Coast	Hawkesbury	Nepean	Burragorang	Cordeaux-Cataract	Southern Highlands
Maximum Type 1	1.37	2.25	1.67	2.82	1.80	2.00	0.81
Type 2	1.23	1.64	1.30	1.92	1.28	1.33	0.35
Type 3	0.68	0.95	0.74	1.22	0.72	0.76	0.02
Type 4	-0.09	0.05	0.23	0.38	0.00	0.18	-0.50

Source: Ernst & Young analysis
Note: BCRs should be used for the comparison of sites, and not to consider the relative difference between benefits and costs

As seen in the table above, regardless of the type of airport that was developed this analysis consistently found that the following five locations provided the greatest benefits when compared to the costs to construct and operate an airport:

- Central Coast;
- Hawkesbury;
- Nepean;
- Burragorang; and
- Cordeaux-Cataract.

This analysis also found that, taking into regards the limitations of the analysis, that the larger airport types presented the greatest BCRs.

[36] The yellow highlighting illustrates that, regardless of the airport type, the same 5 localities perform consistently most strongly from a BCR perspective.

5.2 Qualitative outcomes

The results of the Phase 1 qualitative analysis are set out in the table below. Each score represents an aggregated score for a range of indicators for each locality. Detailed thresholds, scores and weightings are set out in Appendix D.

Table 56: Phase 1 Qualitative assessment results

Category/locality	Central Mangrove - Kulnura	Central Coast	Hawkesbury	Nepean	Burragorang	Cordeaux-Cataract	Southern Highlands
Strategic economic considerations	+1.6	+2.0	+2.2	+2.8	+1.8	+1.0	+1.2
Social and cultural considerations	-0.7	-0.7	-1.2	-0.7	-1.7	-0.5	-0.7
Environmental considerations	-0.7	-1.5	-0.8	-0.8	-0.8	-1.3	-0.4
Noise	-2.0	-2.0	-1.0	-0.5	-1.0	-0.5	-1.0

Source: Ernst & Young analysis

Note: The BCR does not move in a logical direction with an increase in discount rates due to the impact of negative benefits, most notably land transport impacts.

The yellow highlighting indicates the five localities that perform most strongly in each category.

5.3 Sensitivity tests

A series of sensitivity assessments were modelled on the central (quantified) Cost Benefit Analysis that was detailed in the previous section of the report. These sensitivities have been conducted on the major risk factors and potential benefit streams that have been identified through the assessment process, in addition to the standard economic sensitivities prescribed by the Infrastructure Australia guidelines on economic appraisal.

The sensitivities which have been analysed include:

- Variations in the project discount rates;
- Variations in capital costs;
- Variations in all costs;
- Variations in benefits; and
- Value of time sensitivity.

5.3.1 Discount rates sensitivity

Discount rate sensitivities were undertaken to investigate the range of potential outcomes which could occur as a result of different future values of cash flows. The discount rate sensitivity analyses were run at 4% and 10% in line with the Infrastructure Australia Guidelines for economic appraisal.

The outputs of the discount rate sensitivity analyses are shown in the table below.

Table 57: Discount rate sensitivities – BCR, 50 year analysis, 7% discount rate

Airport type/location	Central Mangrove - Kulnura	Central Coast	Hawkesbury	Nepean	Burragorang	Cordeaux-Cataract	Southern Highlands
4% discount rate							
1	2.10	3.33	2.66	4.16	2.72	2.99	1.27
2	1.33	1.78	1.50	2.06	1.40	1.41	0.27
3	0.57	0.93	0.88	1.29	0.66	0.63	-0.53
4	-0.17	0.05	0.35	0.51	-0.02	0.23	-0.80
10% discount rate							
1	0.90	1.50	1.06	1.88	1.18	1.33	0.52
2	1.04	1.39	1.03	1.63	1.07	1.15	0.38
3	0.64	0.83	0.58	1.03	0.66	0.73	0.30
4	-0.04	0.05	0.16	0.28	0.01	0.14	-0.31

Source: Ernst & Young analysis

Note: BCRs should be used for the comparison of sites, and not to consider the relative difference between benefits and costs

5.3.2 Capital expenditure sensitivity

Capital expenditure sensitivities were undertaken to investigate the range of potential outcomes which could occur as a result of different investment profiles. The capital expenditure sensitivity analyses were run at plus and minus 20%.

The results of the 20% increase and decrease in capital expenditure sensitivity analysis are shown in the table below.

Table 58: Change in capital expenditure sensitivity – BCR, 50 year analysis, 7% discount rate

Airport type/location	Central Mangrove - Kulnura	Central Coast	Hawkesbury	Nepean	Burragorang	Cordeaux-Cataract	Southern Highlands
20% increase in capital costs							
1	1.19	1.97	1.44	2.47	1.56	1.75	0.70
2	1.10	1.48	1.16	1.74	1.15	1.20	0.32
3	0.59	0.83	0.64	1.08	0.63	0.67	0.02
4	-0.07	0.04	0.20	0.33	0.00	0.16	-0.43
20% decrease in capital costs							
1	1.63	2.64	2.00	3.30	2.12	2.35	0.95
2	1.38	1.83	1.49	2.14	1.44	1.48	0.40
3	0.79	1.10	0.88	1.40	0.84	0.87	0.03
4	-0.11	0.06	0.28	0.45	0.00	0.22	-0.60

Source: Ernst & Young analysis

Note: BCRs should be used for the comparison of sites, and not to consider the relative difference between benefits and costs

5.3.3 Cost expenditure sensitivity

Total cost expenditure sensitivities were undertaken to investigate the range of potential outcomes which could occur as a result of different investment profiles. Total cost expenditure sensitivity analyses were run at plus and minus 20%.

The results of the 20% increase and decrease in total cost sensitivity analysis are shown in the table below.

Table 59: Change in total cost sensitivity – BCR, 50 year analysis, 7% discount rate

Airport type/location	Central Mangrove - Kulnura	Central Coast	Hawkesbury	Nepean	Burragorang	Cordeaux-Cataract	Southern Highlands
20% increase in total costs							
1	1.14	1.88	1.40	2.35	1.50	1.67	0.67
2	1.02	1.37	1.08	1.60	1.07	1.11	0.29
3	0.56	0.79	0.62	1.01	0.60	0.63	0.02
4	-0.07	0.04	0.19	0.32	0.00	0.15	-0.42
20% decrease in total costs							
1	1.72	2.82	2.09	3.53	2.25	2.50	1.01
2	1.53	2.05	1.63	2.40	1.60	1.66	0.44
3	0.85	1.18	0.93	1.52	0.90	0.95	0.03
4	-0.11	0.06	0.29	0.48	0.00	0.23	-0.63

Source: Ernst & Young analysis

Note: BCRs should be used for the comparison of sites, and not to consider the relative difference between benefits and costs

5.3.4 Benefits sensitivity

Benefits realisation sensitivities were undertaken to investigate the range of potential outcomes which could occur as a result of different investment profiles. The benefit sensitivity analyses were run at plus and minus 20%.

The results of the 20% increase and decrease in benefit sensitivity analysis are shown in the table below.

Table 60: Change in benefits sensitivity – BCR, 50 year analysis, 7% discount rate

Airport type/location	Central Mangrove - Kulnura	Central Coast	Hawkesbury	Nepean	Burragorang	Cordeaux-Cataract	Southern Highlands
20% increase in benefits							
1	1.65	2.70	2.01	3.38	2.16	2.40	0.97
2	1.47	1.97	1.56	2.30	1.54	1.59	0.42
3	0.81	1.13	0.89	1.46	0.86	0.91	0.03
4	-0.11	0.06	0.28	0.46	0.00	0.22	-0.60
20% decrease in benefits							
1	1.10	1.80	1.34	2.26	1.44	1.60	0.65
2	0.98	1.31	1.04	1.53	1.02	1.06	0.28
3	0.54	0.76	0.59	0.97	0.58	0.61	0.02
4	-0.07	0.04	0.18	0.31	0.00	0.15	-0.40

Source: Ernst & Young analysis

Note: BCRs should be used for the comparison of sites, and not to consider the relative difference between benefits and costs

5.3.5 Value of time sensitivity

Value of time sensitivities were undertaken to investigate the range of potential outcomes which could occur as a result of changes in real wages of local residents. The value of time sensitivity increases the real value of time by 1% per annum in accordance with Infrastructure Australia guidelines.

The results of increasing the real value of time sensitivity analysis are shown in the table below.

Table 61: Value of time sensitivity – BCR, 50 year analysis, 7% discount rate

Airport type/location	Central Mangrove - Kulnura	Central Coast	Hawkesbury	Nepean	Burragorang	Cordeaux-Cataract	Southern Highlands
1	2.58	4.03	2.84	4.76	3.28	3.70	2.20
2	2.36	2.95	2.20	3.24	2.39	2.53	1.51
3	1.05	1.38	1.04	1.70	1.09	1.16	0.38
4	0.05	0.22	0.37	0.63	0.11	0.38	-0.33

Source: Ernst & Young analysis

Note: BCRs should be used for the comparison of sites, and not to consider the relative difference between benefits and costs

6. Economic analysis of aviation sites (Phase 2 of the economic analysis)

The Steering Committee decided to advance five of the seven localities analysed in Phase 2 of the Steering Committee process (phase 1 of the economic analysis) to the next phase of the study.

Following Phase 2 of the Steering Committee process, the Department commissioned WorleyParsons and AMPC to identify all possible sites in each locality that could feasibly accommodate a Maximum Type 1 or Type 3 airport (see section 1.4.1 for airport type definitions), with guidance from the Steering Committee.

The WorleyParsons/AMPC analysis found that there were 17 locations, all of which were capable of accommodating a type 3 airport and 10 of which were capable of accommodating a Maximum Type 1 airport. A list of these sites is set out in the table below.

Table 62: Aviation sites assessed in Phase 2

Location	Site	Airport type	
		Maximum Type 1	Type 3
Central Coast	Wallarah	✓	✓
Central Coast	Peats Ridge		✓
Central Coast	Somersby	✓	✓
Hawkesbury	Wilberforce	✓	✓
Hawkesbury	Castlereagh		✓
Nepean	Luddenham	✓	✓
Nepean	Kemps Creek		✓
Nepean	Badgerys Creek	✓	✓
Nepean	Bringelly	✓	✓
Nepean	Greendale	✓	✓
Burragorang	Silverdale		✓
Burragorang	The Oaks		✓
Burragorang	Mowbray Park	✓	✓
Cordeaux-Cataract	Southend		✓
Cordeaux-Cataract	Wilton	✓	✓
Cordeaux-Cataract	Wallandoola	✓	✓
Cordeaux-Cataract	Dendrobium		✓

Source: WorleyParsons/AMPC

A quantitative and qualitative analysis was undertaken by Ernst & Young within this phase to examine the economic, social and environmental costs and benefits of the identified site options.

This section of the report outlines the methodology and results of both the quantitative and qualitative analyses within this fourth phase of the Joint Study (Assessment of sites).

All costs and benefits within this phase have been assumed to occur in the same time periods as was assumed in the analysis conducted for the first phase of the study.

6.1 Quantitative analysis

6.1.1 Underlying assumptions

The underlying assumptions, including the demand for aviation services over the analysis period, are the same as those used for the first phase of the economic analysis (rapid CBA of locations).

6.1.2 Costs

6.1.2.1 *Land acquisition*

To incorporate the land acquisition cost associated with developing an operational airport within this phase of the study, the same values ($ per hectare) were applied as on a locality basis, and therefore the assumptions within this phase of the analysis correspond with those that are presented in section 4.2.1. However, in this phase, these values were applied to the specific land footprint size for each option provided by WorleyParsons/AMPC and can be seen in the table below.

Table 63: Size of airport footprint (ha)

Location	Site	Airport type	
		Maximum Type 1	Type 3
Central Coast	Wallarah	1,676	723
Central Coast	Peats Ridge		723
Central Coast	Somersby	1,465	763
Hawkesbury	Wilberforce	2,187	705
Hawkesbury	Castlereagh		1,148
Nepean	Luddenham	1,679	703
Nepean	Kemps Creek		713
Nepean	Badgerys Creek	1,669	686
Nepean	Bringelly	1,676	723
Nepean	Greendale	1,368	688
Burragorang	Silverdale		709
Burragorang	The Oaks		702
Burragorang	Mowbray Park	1,676	723
Cordeaux-Cataract	Southend		704
Cordeaux-Cataract	Wilton	1,783	678
Cordeaux-Cataract	Wallandoola	1,833	728
Cordeaux-Cataract	Dendrobium		723

Source: WorleyParsons/AMPC

6.1.2.2 *Comparative cost of earthworks to create the airport platform*

The cost associated with improving the land, to develop a platform at each site from its current state to accommodate a fully operational airport has been provided by WorleyParsons/AMPC.

The cost associated with the development of this land platform for each of the sites, depending upon the type of airport being constructed (Maximum Type 1 or type 3) is shown in the table below.

Table 64: Comparative cost of earthworks to create the airport platform

Location	Site	Airport type ($m)	
		Maximum Type 1	Type 3
Central Coast	Wallarah	282	184
Central Coast	Peats Ridge		413
Central Coast	Somersby	531	431
Hawkesbury	Wilberforce	343	196
Hawkesbury	Castlereagh		134
Nepean	Luddenham	284	126
Nepean	Kemps Creek		96
Nepean	Badgerys Creek	356	161
Nepean	Bringelly	407	310
Nepean	Greendale	304	226
Burragorang	Silverdale		463
Burragorang	The Oaks		489
Burragorang	Mowbray Park	680	372
Cordeaux-Cataract	Southend		504
Cordeaux-Cataract	Wilton	805	346
Cordeaux-Cataract	Wallandoola	564	345
Cordeaux-Cataract	Dendrobium		253

Source: WorleyParsons/AMPC

A 50% factor has been applied to the values presented in the table above to take into account the additional cost associated with Contingency and Project Management & Design.

6.1.2.3 *Construction of the generic airport type*

The assumptions and values for the capital costs associated with the construction of a generic airport are the same within this phase of the study as adopted for the first phase of the economic analysis and presented in section 4.2.3.

6.1.2.4 *Construction of infrastructure necessary to support the operations of an airport*

The development of capital cost estimates for both road and rail assets to support the airport types in each of the locations was undertaken by WorleyParsons/AMPC. The methodology for determining the cost and the rationale behind cost differentials of sites can be found in the WorleyParsons/AMPC technical report.

As WorleyParsons/AMPC did not provide any estimates of the cost associated with the construction of the other (non-transport) supporting infrastructure, this was estimated using the Arup analysis undertaken on a locations basis, taking into account the variability in distance between the airport sites and the nearest connection to the existing infrastructure corridor.

Furthermore this analysis has adopted Arup's assumption with regards to the percentage of the total cost of construction of this supporting infrastructure is associated with risk, contingency, project management and general costs.

The following tables outline the supporting infrastructure costs associated with each of the airport types by location.

Maximum airport type

Table 65: Supporting infrastructure cost – Maximum Type 1 airport ($'m)

Location	Site	Supporting infrastructure component				
		Road	Rail	Utilities	Preliminaries and contingency	Total
Burragorang	Mowbray Park	397	930	420	873	2,619
Central Coast	Somersby	82	2,190	650	1,461	4,382
Central Coast	Wallarah	108	740	650	749	2,246
Cordeaux-Cataract	Wallandoola	456	1,630	692	1,389	4,167
Cordeaux-Cataract	Wilton	456	1,100	623	1,089	3,268
Hawkesbury	Wilberforce	214	1,320	564	1,049	3,147
Nepean	Badgerys creek	192	1,130	774	1,048	3,143
Nepean	Bringelly	270	1,130	915	1,157	3,471
Nepean	Greendale	369	1,130	1,267	1,383	4,148
Nepean	Luddenham	346	1,130	563	1,019	3,058

Source: WorleyParsons/AMPC & Arup

Note: (1) Fuel is included within the cost of utilities within the above table.

(2) Preliminaries and contingency take into account a 50% risk allowance.

Type 3 airport

Table 66: Supporting infrastructure cost – type 3 airport ($'m)

Location	Site	Supporting infrastructure component				
		Road	Rail	Utilities	Preliminaries and contingency	Total
Burragorang	Mowbray Park	397	0	113	255	765
Burragorang	Silverdale	426	0	532	479	1,437
Burragorang	The Oaks	324	0	177	250	751
Central Coast	Peats Ridge	258	0	484	371	1,112
Central Coast	Somersby	82	0	161	121	364
Central Coast	Wallarah	73	0	16	45	134
Cordeaux-Cataract	Dendrobium	367	0	72	219	658
Cordeaux-Cataract	Southend	450	0	90	270	809
Cordeaux-Cataract	Wallandoola	456	0	179	317	952
Cordeaux-Cataract	Wilton	456	0	161	308	925
Hawkesbury	Castlereagh	214	0	104	159	476
Hawkesbury	Wilberforce	214	0	144	179	536
Nepean	Badgerys Creek	192	0	229	210	630
Nepean	Bringelly	270	0	270	270	809
Nepean	Greendale	369	0	374	371	1,114
Nepean	Luddenham	346	0	166	256	768
Nepean	Kemps Creek	126	0	125	125	375

Source: WorleyParsons/AMPC & Arup

Note: (1) Fuel is included within the cost of utilities within the above table.

(2) Preliminaries and contingency take into account a 50% risk allowance.

6.1.2.5 *Ongoing capital and operating costs associated with the Airport*

The assumptions and methodology that were used within the first phase of the study and presented in section 4.2.5 were also incorporated within this phase.

6.1.2.6 *Ongoing capital and operating costs associated with the Airport's supporting infrastructure*

The assumptions and methodology that were used within the first phase of study and presented in section 4.2.6 were also incorporated within this phase.

Each of the locality cost estimates for supporting infrastructure have been amended for each of the specific sites analysed within this phase of the study to take into account the differences in distance to the local surface access network. In other words, the values that were used in the first phase were pro-rated based on the distance to the main road highway or rail line network from the airport location.

6.1.3 Benefits

6.1.3.1 *Consumer surplus realised by Australian residents with the ability to fly*

The consumer surplus realised by Australian residents that have the ability to fly that otherwise would have been constrained has been incorporated in the study using the same methodology as that which was used in the first phase of the analysis and set out in section 4.3.1.1.

6.1.3.2 *Tourism spend of non-Australian residents that would have otherwise not accessed Australia*

The additional tourism spend of non-Australian residents whilst holidaying in Australia that would have otherwise not have occurred with the current supply of aviation services is the same within this phase of the study as was used within the first phase and presented in section 4.3.1.2.

6.1.3.3 *Value of freight that is able to be transported to/from Sydney*

The consumer surplus of the movement of freight into and out of Australia that wouldn't have been able to be transported under the current constrained aviation market is the same within this phase of the study as was used within the first phase and presented in section 4.3.1.3.

6.1.3.4 *The reduction in delay of passengers that would have flown under the no development scenario*

The reduction in delays realised by Australian residents than would have otherwise occurred under the Base Case is the same within this phase of the study as in the first phase of the analysis presented in section 4.3.2.1.

6.1.3.5 *The reduction in delays to aircraft operators*

The reduction in delays realised by aircraft operators than would have otherwise occurred under the Base Case is the same within this phase of the study as was used in the first phase of the analysis and presented in section 4.3.2.2.

6.1.3.6 *The reduction in the percentage of passengers that have to alter from their preferred flight times due to supply constraints*

The reduction in the percentage of passengers that have to alter from their preferred flight times due to supply constraints is the same within this phase of the study as was used within the first phase of the analysis and presented in section 4.3.2.3.

6.1.4 Externality impacts

6.1.4.1 *Land transport impacts*

The cost associated with increased passenger and freight landside transport movements was calculated using the same methodology and values as was used in the first phase of the economic analysis and presented in section 4.4.1.

Any change in the relative distances between the generic site used within the first phase of the analysis and the specific coordinates of the site within this phase of the analysis was accordingly taken into account in this phase.

6.1.4.2 *The cost to provide noise abatement measures*

This phase of the analysis looked at two impacts of noise on local residents:

1. The cost to mitigate noise of local residents that will require their properties retrofitted to mitigate noise levels

2. The cost to purchase properties that the Government is legally required because of noise levels.

The cost of these two noise abatement measures is discussed below.

Retrofitting houses

The methodology to calculate the cost of retrofitting houses within the local community that would be adversely affected by the noise levels created from an operational civil aviation airport is the same within this phase of the study as was used in the first phase of the analysis and presented in section 4.4.3.

Within this phase of the assessment WorleyParsons/AMPC recalculated the specific number of persons living within the ANEF 20 contour of an airport, which can be seen in the table below.

Table 67: Persons residing within 20 ANEF contour

Location	Site	Airport type	
		Maximum Type 1	Type 3
Burragorang	Mowbray Park	5,918	474
Burragorang	Silverdale		146
Burragorang	The Oaks		991
Central Coast	Peats Ridge		225
Central Coast	Somersby	4,176	533
Central Coast	Wallarah	10,700	3,877
Cordeaux-Cataract	Dendrobium		53
Cordeaux-Cataract	Southend		39
Cordeaux-Cataract	Wallandoola	1,277	144
Cordeaux-Cataract	Wilton	291	88
Hawkesbury	Castlereagh		3,433
Hawkesbury	Wilberforce	10,264	786
Nepean	Badgerys Creek	3,203	837
Nepean	Bringelly	3,986	599
Nepean	Greendale	1,922	443
Nepean	Kemps Creek		1,370
Nepean	Luddenham	3,293	377

Source: WorleyParsons/AMPC

Note: The net number of persons that reside within 20 ANEF contour of an operational airport within each of the analysed locations after accounting for those persons that reside within a 40 ANEF contour.

Purchasing property

The Commonwealth Government is legally required to purchase properties within an ANEF 40 contour of an operational airport. The methodology for calculating the cost of acquiring these properties is the same as that presented in section 4.4.3, including land valuation, timing and the number of persons per household. Furthermore it was assumed that the average size of an urban house/block of land was 0.05 hectares and a rural house/block of land was 0.07 hectares. It was also assumed that the cost of the house (building only) within an urban environment was $400,000 and $300,000 within a rural setting.

The number of persons that currently reside within 40 ANEF contour of each of the proposed sites can be seen in the table below.

Table 68: Persons residing within 40 ANEF contour

Location	Site	Airport type	
		Maximum Type 1	Type 3
Burragorang	Mowbray Park	297	10
Burragorang	Silverdale		
Burragorang	The Oaks		70
Central Coast	Peats Ridge		10
Central Coast	Somersby	47	20
Central Coast	Wallarah	383	320
Cordeaux-Cataract	Dendrobium		
Cordeaux-Cataract	Southend		
Cordeaux-Cataract	Wallandoola	26	10
Cordeaux-Cataract	Wilton	11	
Hawkesbury	Castlereagh		40
Hawkesbury	Wilberforce	112	20
Nepean	Badgerys Creek	98	40
Nepean	Bringelly	50	20
Nepean	Greendale	31	10
Nepean	Kemps Creek		40
Nepean	Luddenham	45	20

Source: WorleyParsons/AMPC

6.1.4.3 *The environmental impact of increased aircraft*

The assumptions and overall cost associated with the environmental impact of increasing the number of aircraft movements are the same as those for the first phase of the study and presented in section 4.4.2.

6.2 Qualitative analysis

As for Phase 1 of the economic analysis, a number of qualitative factors were analysed to understand how each site compared on a range of non-monetised social and environmental considerations.

In phase 2, a qualitative analysis was also undertaken for both a Maximum Type 1 and Type 3 airport in each site to support the CBA for both airport types.

In addition, a number of changes were made to the indicators included for this stage of analysis, reflecting the availability of data at the site level.

a) Environmental considerations were excluded from this stage of analysis as site-specific data was not available on these indicators.

b) The criterion regarding Indigenous cultural heritage items was excluded from this stage of analysis as none of the remaining sites contained Indigenous cultural heritage items.

c) The criterion regarding the impact of noise on sensitive land use was further broken down by type of land use as more detailed information was available at the site level.

d) An additional noise indicator was included to reflect the average number of N70 person events (number of noise events above 70dB(A)) as this data was available at the site level; and

e) An additional indicator was included within 'Strategic economic considerations' for the Type 3 airport analysis to reflect the fact that some Type 3 sites are capable of being expanded to accommodate a Maximum Type 1 airport whereas others are not.

The criteria and indicators assessed in this stage of analysis are set out in the table below.

Table 69: Phase 2 Qualitative criteria and indicators

Category	Criterion	Indicators
Strategic economic considerations	1. Capacity created	► Capacity to be expanded from a Type 1 airport site to a Maximum Type 1 airport site (only incorporated into Type 3 analysis)
	6. Proximity of aviation capacity to NSW commercial growth centres	► Existing employment land within 15 km of the site (both commercial and industrial) ► Potential employment land (including investigation areas) within 15km of the site (ha)
	7. Commercial opportunities near to or on-site	► Volume of employment at strategic growth centres within 30 mins of site, divided by access time from site
Social and cultural considerations	12. Potential impact on existing residents and other land users as a result of land acquisition	► Population living in airport footprint ► Total number of zoned allotments within site area
Noise	13. Noise impacts on residents	► Total population within 25 ANEF contour
	14. Noise impacts on 'sensitive' uses	► Sensitive land infrastructure likely to be affected by noise, broken down by Schools, Businesses and Other ► Average number of N70 person events (noise events above 70dB(A))

Source: WorleyParsons/AMPC and Ernst & Young analysis

As for Phase 1, each indicator underpinning the three key categories (Strategic economic considerations, Social and cultural considerations and Noise) was assigned a score on a 7 point scale (between -3 and +3). A score of -3 indicates a highly negative impact, a score of 0 indicates a neutral impact and a score of +3 indicates a highly positive impact.

Based on a set of weightings for each indicator, scores for indicators within each category were aggregated to generate a total score for each site under each category. The results of this analysis are summarised in section 7.2.3 and the detailed scoring thresholds, scores and weightings are set out in Appendix D.

7. Site specific results and outcomes

This chapter presents the results and outcomes of the analysis undertaken for Phase 2 of the economic analysis (phase 4 of the Joint Study). The results are presented for the Maximum type 1 and type 3 airport types.

The analysis on potential airport sites has been undertaken using a number of layered scenarios. These results and the scenarios were presented to the Department and the Steering Committee to aid their decision making. In presenting these results, Ernst & Young sought to present a balanced picture of the impacts of different options for consideration by the Steering Committee.

The first set of results presented was the ‘unconstrained’ assessment. These results were based on an unconstrained quantitative and qualitative assessment of the options, where it is assumed that all sites can provide the same passenger access and capacity with no operating, planning or engineering restrictions.

This unconstrained assessment was then supplemented by various ‘scenarios’, in which the first results were varied to allow for:

- Asset interaction costs;
- Airborne operational cost implications; and
- Noise mitigation costs.

7.1 Maximum Type 1 airport sites analysis

The Maximum airport type analysis was undertaken on 10 identified sites within the five broad localities.

7.1.1 Quantitative analysis

7.1.1.1 Unconstrained analysis

The first stage of analysis has been undertaken on an unconstrained scenario. The unconstrained analysis has been undertaken assuming all sites can provide the same passenger access and capacity with no operating, planning or engineering restrictions.

The results of the unconstrained analysis are shown in the table below.

Table 70: Quantified outcomes (PV $'billions) – ranked by locality

Locality	Site	Benefits	Costs	Net Present Value
Burragorang	Mowbray Park	5.7	3.0	2.7
Central Coast	Somersby	6.6	3.3	3.3
Central Coast	Wallarah	4.1	2.6	1.5
Cordeaux-Cataract	Wallandoola	6.0	3.2	2.8
Cordeaux-Cataract	Wilton	6.0	3.1	3.0
Hawkesbury	Wilberforce	7.6	3.0	4.7
Nepean	Badgerys creek	7.7	2.9	4.8
Nepean	Bringelly	7.9	3.0	4.9
Nepean	Greendale	7.4	3.1	4.3
Nepean	Luddenham	7.7	2.8	4.9

Source: Ernst & Young analysis

Note: (1) Differences can be attributable to rounding

(2) BCRs should be used for the comparison of sites, and not to consider the relative difference between benefits and costs

The BCRs for each of the locations, ranked by those that possess the greatest economic benefit can be seen in the table below.

Table 71: Quantitative analysis – unconstrained scenario – ranked by BCR

Locality	Site	BCR	Rank
Nepean	Luddenham	2.7	1
Nepean	Badgerys creek	2.7	2
Nepean	Bringelly	2.6	3
Hawkesbury	Wilberforce	2.6	4
Nepean	Greendale	2.4	5
Central Coast	Somersby	2.0	6
Cordeaux-Cataract	Wilton	2.0	7
Burragorang	Mowbray Park	1.9	8
Cordeaux-Cataract	Wallandoola	1.9	9
Central Coast	Wallarah	1.6	10

Source: Ernst & Young analysis

The spread of BCR outcomes of the unconstrained analysis are illustrated in the table below. The table provides a perspective on which localities provide the best outcomes on a site by site basis. The Nepean region tends to provide the highest BCRs across a range of sites.

Table 72: Quantitative outcomes by locality

Central Coast	BCR	Hawkesbury	BCR	Nepean	BCR	Burragorang	BCR	Cordeaux-Cataract	BCR
				Luddenham	**2.73**				
				Badgerys Creek	**2.67**				
				Bringelly	**2.64**				
		Wilberforce	**2.57**						
				Greendale	**2.38**				
Somersby	**2.00**								
								Wilton	**1.96**
						Mowbray Park	**1.90**		
								Wallandoola	**1.86**
Wallarah	**1.56**								

Source: Ernst & Young analysis

Note: (1) Differences can be attributable to rounding

(2) BCRs should be used for the comparison of sites, and not to consider the relative difference between benefits and costs

7.1.2 Constrained analysis

A number of scenario analyses were undertaken to determine the potential range of impacts a number of factors would have on the unconstrained results presented above, including:

1. Implications of airport interactions with other assets;
2. Operational implications of the proposed sites due to existing aviation network patterns, based on advice from Air Services Australia; and
3. The likely subjective quantitative noise implication of developing an airport in that specific location.

Each of these scenarios is outlined and results presented below.

7.1.2.1 Asset interaction costs

In this scenario, a value/cost has been attributed to the sites based on their interaction with other assets within the Sydney basin. Specifically, where the Department's technical advisor advised that operational airspace interactions with the new facility would either limit or stop aviation operations at an existing airfield in the Sydney basin, a cost was included in the CBA to reflect the economic cost of the reduced operations. The cost was estimated by the Department's technical advisor and included consideration of the impacts of new facilities upon:

- Richmond RAAF base;
- Holsworthy Base;
- Orchard Hills;
- Bankstown Airport;
- Camden Aerodrome;
- Wilton Aerodrome; and
- Oaks Aerodrome.

The interaction with existing assets in the Sydney region and the sites being analysed as part of the aviation capacity study, results of which are presented in the table below.

Table 73: Asset interaction by site

Location	Site	Richmond Air Base	Orchard Hills	Bankstown	Camden Aerodrome	Wilton Aerodrome	Williamtown	Power stations	Oaks Aerodrome	Holsworthy
Burragorang	Mowbray Park	N	N	N	N	Y	N	N	Y	N
Central Coast	Somersby	N	N	N	N	N	N	Y	N	N
Central Coast	Wallarah	N	N	N	N	N	N	N	N	N
Cordeaux-Cataract	Wilton	N	N	N	Y	Y	N	N	N	N
Cordeaux-Cataract	Wallandoola	N	N	N	Y	Y	N	N	N	N
Hawkesbury	Wilberforce	Y	Y	N	N	N	N	N	N	N
Nepean	Luddenham	N	Y	Y	Y	N	N	N	N	N
Nepean	Badgerys Creek	N	Y	Y	Y	N	N	N	N	N
Nepean	Bringelly	N	Y	Y	Y	Y	N	N	N	N
Nepean	Greendale	N	Y	Y	Y	N	N	N	N	N

Source: WorleyParsons/AMPC

The cost of removing or mitigating the asset interaction outcomes are shown in the table below. These figures are high level estimates of the costs, provided by the Department's technical advisor, and do not include any analysis of compensation required.

Table 74: Cost of removing or mitigating asset interaction ($'000)

Asset	Cost ($'000)
Richmond Air Base	1,000,000
Orchard Hills	500,000
Bankstown	150,000
Camden Aerodrome	100,000
Wilton Aerodrome	25,000
Williamtown	1,000,000
Power stations	1,000,000
Oaks Aerodrome	25,000
Holsworthy	1,000,000

Source: WorleyParsons/AMPC

The outcomes of the asset interaction analysis are illustrated in the table below.

Table 75: Asset interact outcomes

Central Coast	BCR	Hawkesbury	BCR	Nepean	BCR	Burragorang	BCR	Cordeaux-Cataract	BCR
				Luddenham	2.53				
				Badgerys Creek	2.47				
				Bringelly	2.45				
		Wilberforce	2.23						
				Greendale	2.22				
								Wilton	1.94
						Mowbray Park	1.89		
								Wallandoola	1.84
Somersby	1.84								
Wallarah	1.56								

Source: Ernst & Young analysis

Note: BCRs should be used for the comparison of sites, and not to consider the relative difference between benefits and costs

7.1.2.2 Operational limitations

In this scenario, the additional airline operating costs have been estimated for the individual sites based on potential air space operating constraints. Airspace operating constraints may result in additional flight time required to navigate competing aviation flows.

The value per additional hour, based on the existing mix of vehicle types, is $3,400 based on the CASA economic evaluation guidelines, 2007.

Average additional flight time was estimated for each site based on guidance from Air Services Australia. The additional flight times are presented in the table below.

Table 76: Additional flight time

Site	Additional Time (min)
Badgerys creek	20
Bringelly	20
Greendale	20
Luddenham	20
Mowbray Park	0
Somersby	40
Wallandoola	20
Wallarah	0
Wilberforce	30
Wilton	0

Source: WorleyParsons/AMPC and Ernst & Young estimates

The outcomes of the operational limitation analysis are presented in the table below.

Table 77: Operation limitation outcomes

Central Coast	BCR	Hawkesbury	BCR	Nepean	BCR	Burragorang	BCR	Cordeaux-Cataract	BCR
				Luddenham	2.62				
				Badgerys Creek	2.55				
				Bringelly	2.53				
		Wilberforce	2.41						
				Greendale	2.28				
								Wilton	1.96
						Mowbray Park	1.90		
Somersby	1.80								
								Wallandoola	1.76
Wallarah	1.56								

Source: Ernst & Young analysis

Note: BCRs should be used for the comparison of sites, and not to consider the relative difference between benefits and costs

7.1.2.3 Noise event costs

Under this scenario, the cost of N70 noise events has been valued. The potential N70 noise events were identified by WorleyParsons/AMPC as part of their site assessment. The outcomes of the valuation are shown in the table below and were presented to the Joint Steering Committee because noise is an important policy issue in the aviation arena. However, it is noted by both Ernst & Young and the Department that the Department's formal position is not to seek to put an economic value on noise for aviation matters, in line with international best practice, because of the complexities in ascribing an economic value of noise caused by aviation.

Table 78: Noise event analysis

Central Coast	BCR	Hawkesbury	BCR	Nepean	BCR	Burragorang	BCR	Cordeaux-Cataract	BCR
				Luddenham	2.72				
				Badgerys Creek	2.65				
				Bringelly	2.63				
		Wilberforce	2.55						
				Greendale	2.38				
Somersby	2.00								
								Wilton	1.96
						Mowbray Park	1.89		
								Wallandoola	1.86
Wallarah	1.52								

Source: Ernst & Young analysis

Note: BCRs should be used for the comparison of sites, and not to consider the relative difference between benefits and costs

7.1.3 Qualitative analysis

A qualitative analysis was also undertaken on each of the sites for both a Maximum Type 1 and a Type 3 airport drawing on WorleyParsons/AMPC site analysis. Detailed scoring thresholds, scores and weighting are presented in Appendix D.

The outcomes of the Maximum Type 1 airport qualitative analysis are presented in the table below.

Table 79: Phase 2 Qualitative assessment results (Maximum Type 1 airport) – ranked by locality

Locality	Site	Strategic economic considerations	Social & cultural	Noise
Central Coast	Wallarah	+2.0	+0.95	-0.9
Central Coast	Somersby	+2.0	-1	-0.8
Hawkesbury	Wilberforce	+2.2	-2.3	-1.5
Nepean	Luddenham	+2.8	-1	-1.3
Nepean	Badgerys Creek	+2.4	-1.3	-1.1
Nepean	Bringelly	+2.4	-1	-1.3
Nepean	Greendale	+2.8	-0.65	-0.5
Burragorang	Mowbray Park	+1.8	-0.65	-0.7
Cordeaux-Cataract	Wilton	+1.4	-0.65	0
Cordeaux-Cataract	Wallandoola	+1.4	-0.65	-0.3

Source: Ernst & Young analysis

7.1.4 Summary outcomes

The summary outcomes for the quantified cost benefit analysis, plus the five qualitative categories, are presented in the table below. In this table, the sites are ranked by BCR at a 7% discount rate.

Table 80: Summary outcomes – ranked by BCR

Location	Site	BCR	Strategic economic consideration	Social & cultural	Noise
Nepean	Luddenham	2.7	2.8	-1	-1.3
Nepean	Badgerys creek	2.7	2.4	-1.3	-1.1
Nepean	Bringelly	2.6	2.4	-1	-1.3
Hawkesbury	Wilberforce	2.6	2.2	-2.3	-1.5
Nepean	Greendale	2.4	2.8	-0.65	-0.5
Central Coast	Somersby	2.0	2	-1	-0.8
Cordeaux-Cataract	Wilton	2.0	1.4	-0.65	0
Burragorang	Mowbray Park	1.9	1.8	-0.65	-0.7
Cordeaux-Cataract	Wallandoola	1.9	1.4	-0.65	-0.3
Central Coast	Wallarah	1.6	2	0.95	-0.9

Source: Ernst & Young analysis

The table below identifies the site results as above, but groups the findings by location so that a comparison of the different sites at each location can be more easily made.

Table 81: Summary outcomes – ranked by locality

Location	Site	BCR	Strategic economic consideration	Social & cultural	Noise
Burragorang	Mowbray Park	1.9	1.8	-0.65	-0.7
Central Coast	Somersby	2.0	2	-1	-0.8
Central Coast	Wallarah	1.6	2	0.95	-0.9
Cordeaux-Cataract	Wilton	2.0	1.4	-0.65	0
Cordeaux-Cataract	Wallandoola	1.9	1.4	-0.65	-0.3
Hawkesbury	Wilberforce	2.6	2.2	-2.3	-1.5
Nepean	Luddenham	2.7	2.8	-1	-1.3
Nepean	Badgerys creek	2.7	2.4	-1.3	-1.1
Nepean	Bringelly	2.6	2.4	-1	-1.3
Nepean	Greendale	2.4	2.8	-0.65	-0.5

Source: Ernst & Young analysis

7.2 Type 3 airports

The type 3 airport analysis was undertaken on 17 identified sites within the five localities.

7.2.1 Quantitative analysis

7.2.1.1 Unconstrained analysis

The first stage of analysis has been undertaken on an unconstrained scenario. This scenario assumes that all sites can provide the same passenger access and capacity with no operating, planning or engineering restrictions.

The results of the unconstrained analysis are shown in the tables below.

Table 82: Quantified outcomes ($'billions) – ranked by locality

Location	Site	Benefits	Costs	Net Present Value
Burragorang	Mowbray Park	1.2	1.9	-0.7
Burragorang	Silverdale	1.9	2.3	-0.4
Burragorang	The Oaks	1.4	2.0	-0.6
Central Coast	Peats Ridge	1.4	2.1	-0.7
Central Coast	Somersby	1.6	1.7	-0.1
Central Coast	Wallarah	0.7	1.5	-0.8
Cordeaux-Cataract	Dendrobium	1.1	1.7	-0.6
Cordeaux-Cataract	Southend	1.9	2.0	-0.1
Cordeaux-Cataract	Wallandoola	1.3	1.9	-0.6
Cordeaux-Cataract	Wilton	1.3	1.9	-0.6
Hawkesbury	Castlereagh	1.8	1.6	0.2
Hawkesbury	Wilberforce	2.0	1.7	0.3
Nepean	Badgerys creek	2.0	1.7	0.3
Nepean	Bringelly	2.1	1.9	0.2
Nepean	Greendale	1.9	1.9	-0.1
Nepean	Kemps Creek	2.1	1.5	0.7
Nepean	Luddenham	2.0	1.7	0.3

Source: Ernst & Young analysis

Note: (1) Differences can be attributable to rounding

(2) BCRs should be used for the comparison of sites, and not to consider the relative difference between benefits and costs

The locations ranked by BCR value can be seen in the table below.

Table 83: Quantitative analysis of site locations – ranked by BCR

Location	Site	BCR	Rank
Nepean	Kemps Creek	1.4	1
Nepean	Badgerys creek	1.2	2
Hawkesbury	Wilberforce	1.2	3
Nepean	Luddenham	1.2	4
Nepean	Bringelly	1.1	5
Hawkesbury	Castlereagh	1.1	6
Cordeaux-Cataract	Southend	1.0	7
Nepean	Greendale	1.0	8
Central Coast	Somersby	0.9	9
Burragorang	Silverdale	0.8	10
Burragorang	The Oaks	0.7	11
Cordeaux-Cataract	Wilton	0.7	12
Cordeaux-Cataract	Wallandoola	0.7	13
Cordeaux-Cataract	Dendrobium	0.7	14
Central Coast	Peats Ridge	0.7	15
Burragorang	Mowbray Park	0.6	16
Central Coast	Wallarah	0.5	17

Source: Ernst & Young analysis

The outcomes of the analysis, split by locality, are illustrated in the table below.

Table 84: Outcomes by locality

Central Coast	BCR	Hawkesbury	BCR	Nepean	BCR	Burragorang	BCR	Cordeaux-Cataract	BCR
Somersby	0.93	Wilberforce	1.20	Kemps Creek	1.44	Silverdale	0.83	Southend	0.97
Peats Ridge	0.66	Castlereagh	1.09	Badgerys Creek	1.20	The Oaks	0.70	Wilton	0.70
Wallarah	0.46			Luddenham	1.18	Mowbray Park	0.63	Wallandoola	0.68
				Bringelly	1.11			Dendrobium	0.66
				Greendale	0.96				

Source: Ernst & Young analysis

Note: (1) Differences can be attributable to rounding

(2) BCRs should be used for the comparison of sites, and not to consider the relative difference between benefits and costs

7.2.2 Constrained analysis

A number of additional scenarios were analysed to determine the potential range of impacts a number of factors would have on the unconstrained results presented above, including:

1. Due to the interactions with other assets;
2. Operational implications of the proposed sites due to existing aviation network patterns, based on advice from Air Services Australia; and
3. The likely subjective quantitative noise implication of developing an airport in that specific location.

Each of these scenarios are outlined and results presented below.

7.2.2.1 Asset interaction costs

In this scenario, a value/cost has been attributed to the sites based on their interaction with other assets within the Sydney basin, including:

- Richmond RAAF;
- Holsworthy Base;
- Orchard Hills;
- Bankstown Airport;
- Camden Aerodrome;
- Wilton Aerodrome; and
- Oaks Aerodrome.

The interaction with existing assets in the Sydney region and the sites being analysed as part of the aviation capacity study are shown in Table 85.

Table 85: Asset interaction by site

Location	Site	Richmond Air Base	Orchard Hills	Bankstown	Camden Aerodrome	Wilton Aerodrome	Williamtown	Power stations	Oaks Aerodrome	Holsworthy
Burragorang	Silverdale	N	N	Y	Y	Y	N	N	Y	N
Burragorang	The Oaks	N	N	N	Y	Y	N	N	Y	N
Burragorang	Mowbray Park	N	N	N	N	Y	N	N	Y	N
Central Coast	Somersby	N	N	N	N	N	N	N	N	N
Central Coast	Peats Ridge	N	N	N	N	N	N	N	N	N
Central Coast	Wallarah	N	N	N	N	N	N	N	N	N
Cordeaux-Cataract	Southend	N	N	N	Y	Y	N	N	N	N
Cordeaux-Cataract	Wilton	N	N	N	Y	Y	N	N	N	N
Cordeaux-Cataract	Wallandoola	N	N	N	Y	Y	N	N	N	N
Cordeaux-Cataract	Dendrobium	N	N	N	N	Y	N	N	N	N
Hawkesbury	Wilberforce	Y	Y	N	N	N	N	N	N	N
Hawkesbury	Castlereagh	Y	Y	N	N	N	N	N	N	N
Nepean	Kemps Creek	N	N	Y	Y	N	N	N	N	N
Nepean	Catherine Field	N	N	Y	Y	Y	N	N	N	N
Nepean	Bringelly	N	Y	Y	Y	Y	N	N	N	N
Nepean	Badgerys Creek	N	Y	Y	Y	N	N	N	N	N
Nepean	Luddenham	N	Y	Y	Y	N	N	N	N	N

Source: Air Services Australia

The cost implications of asset interaction are the same as presented in the Maximum Type 1 airport analysis.

The outcomes of the asset interaction analysis are shown in the table below.

Table 86: Asset interaction outcomes

Central Coast	BCR	Hawkesbury	BCR	Nepean	BCR	Burragorang	BCR	Cordeaux-Cataract	BCR
				Kemps Creek	1.31				
				Badgerys Creek	0.95				
				Luddenham	0.94				
								Southend	0.93
Somersby	0.93								
				Bringelly	0.89				
		Wilberforce	0.78						
				Greendale	0.78				
						Silverdale	0.77		
		Castlereagh	0.71						
						The Oaks	0.67		
								Wilton	0.67
Peats Ridge	0.66								
								Dendrobium	0.66
								Wallandoola	0.65
						Mowbray Park	0.62		
Wallarah	0.46								

Source: Ernst & Young analysis

Note: BCRs should be used for the comparison of sites, and not to consider the relative difference between benefits and costs

7.2.2.2 Operational limitations

In this scenario, the additional airline operating costs have been estimated for the individual sites based on potential air space operating constraints. Airspace operating constraints may result in additional flight time required to navigate competing aviation flows.

The value per additional hour, based on the existing mix of vehicle types, is $3,400 based on the CASA economic evaluation guidelines, 2007.

Average additional flight time was estimated for each site based on guidance from Air Services Australia

The average additional flight time was estimated for each site based on guidance from Air Services Australia. The additional flight times are presented in the table below.

Table 87: Additional estimated flight time

Site	Additional Time (min)
Badgerys Creek	20
Bringelly	20
Castlereagh	20
Dendrobium	20
Greendale	20
Luddenham	20
Mowbray Park	20
Peats Ridge	30
Silverdale	20
Somersby	20
Southend	20
The Oaks	20
Wallandoola	20
Wallarah	20
Wilberforce	20
Wilton	20
Kemps Creek	20

Source: WorleyParsons/AMPC and Ernst & Young estimates

Table 88: Operational limitation outcomes

Central Coast	BCR	Hawkesbury	BCR	Nepean	BCR	Burragorang	BCR	Cordeaux-Cataract	BCR
				Kemps Creek	1.29				
				Badgerys Creek	1.07				
		Wilberforce	1.07						
				Luddenham	1.05				
				Bringelly	0.99				
		Castlereagh	0.96						
								Southend	0.85
				Greendale	0.84				
Somersby	0.80								
						Silverdale	0.73		
						The Oaks	0.59		
								Wilton	0.58
								Wallandoola	0.56
								Dendrobium	0.53
						Mowbray Park	0.52		
Peats Ridge	0.50								
Wallarah	0.30								

Source: Ernst & Young analysis

Note: BCRs should be used for the comparison of sites, and not to consider the relative difference between benefits and costs

7.2.2.3 Noise event costs

Under this scenario, the cost of N70 noise events has been valued. The potential N70 noise events were identified by WorleyParsons/AMPC as part of their site assessment. The outcomes of the valuation are presented in the table below.

Table 89: Noise event outcomes

Central Coast	BCR	Hawkesbury	BCR	Nepean	BCR	Burragorang	BCR	Cordeaux-Cataract	BCR
				Kemps Creek	1.44				
				Badgerys Creek	1.20				
		Wilberforce	1.20						
				Luddenham	1.18				
				Bringelly	1.11				
		Castlereagh	1.09						
								Southend	0.97
				Greendale	0.96				
Somersby	0.93								
						Silverdale	0.83		
						The Oaks	0.70		
								Wilton	0.70
								Wallandoola	0.68
								Dendrobium	0.66
Peats Ridge	0.66								
						Mowbray Park	0.63		
Wallarah	0.46								

Source: Ernst & Young analysis

Note: BCRs should be used for the comparison of sites, and not to consider the relative difference between benefits and costs

The noise impact has a limited effect on the outcomes of the analysis based on existing valuation methodologies.

7.2.3 Qualitative analysis

A qualitative analysis was also undertaken on each of the sites for a Type 3 airport drawing on WorleyParsons/AMPC site analysis. Detailed scoring thresholds, scores and weighting are presented in Appendix D.

The same characteristics were assessed for Type 3 airport sites as for the Maximum airport type analysis, with one addition. Within ‘Strategic economic considerations’, an additional indicator was considered – the ability to expand from a Type 3 airport site to a Maximum Type 1 airport site.

The outcomes of the Type 3 airport qualitative analysis are presented in the table below.

Table 90: Phase 2 Qualitative assessment results (Type 3 airport)

Locality	Site	Strategic economic considerations	Social & cultural	Noise
Burragorang	Mowbray Park	+2	-0.65	-0.6
Burragorang	Silverdale	+1.25	0	-0.3
Burragorang	The Oaks	+1.25	-1.3	-0.6
Central Coast	Peats Ridge	+1.5	-1	-0.6
Central Coast	Somersby	+2.25	-1	-0.9
Central Coast	Wallarah	+2.25	-2.3	-1.5
Cordeaux-Cataract	Dendrobium	+1	-0.65	-0.3
Cordeaux-Cataract	Southend	+1	-0.65	-0.3
Cordeaux-Cataract	Wallandoola	+1.75	-0.65	-0.3
Cordeaux-Cataract	Wilton	+1.75	-0.65	-0.3
Hawkesbury	Castlereagh	+1.5	-2.3	-2
Hawkesbury	Wilberforce	+1.5	-0.65	-1
Nepean	Badgerys Creek	+2.75	-0.65	-0.8
Nepean	Bringelly	+2.75	-1	-0.8
Nepean	Greendale	+2.75	-0.65	-0.8
Nepean	Kemps Creek	+2	-2.3	-1.5
Nepean	Luddenham	+2.75	-0.65	-1

Source: Ernst & Young analysis

7.2.4 Summary outcomes

The summary outcomes, ranked by those sites that possessed the highest BCRs are presented in the table below.

Table 91: Summary outcomes ranked by BCR

Location	Site	BCR	Strategic economic considerations	Social & cultural	Noise
Nepean	Kemps Creek	1.4	2	-2.3	-1.5
Nepean	Badgerys Creek	1.2	2.75	-0.65	-0.8
Hawkesbury	Wilberforce	1.2	1.5	-0.65	-1
Nepean	Luddenham	1.2	2.75	-0.65	-1
Nepean	Bringelly	1.1	2.75	-1	-0.8
Hawkesbury	Castlereagh	1.1	1.5	-2.3	-2
Cordeaux-Cataract	Southend	1.0	1	-0.65	-0.3
Nepean	Greendale	1.0	2.75	-0.65	-0.8
Central Coast	Somersby	0.9	2.25	-1	-0.9
Burragorang	Silverdale	0.8	1.25	0	-0.3
Burragorang	The Oaks	0.7	1.25	-1.3	-0.6
Cordeaux-Cataract	Wilton	0.7	1.75	-0.65	-0.3
Cordeaux-Cataract	Wallandoola	0.7	1.75	-0.65	-0.3
Cordeaux-Cataract	Dendrobium	0.7	1	-0.65	-0.3
Central Coast	Peats Ridge	0.7	1.5	-1	-0.6
Burragorang	Mowbray Park	0.6	2	-0.65	-0.6
Central Coast	Wallarah	0.5	2.25	-2.3	-1.5

Source: Ernst & Young analysis

The table below identifies the site outcomes based on their locations and ranked by BCR.

Table 92: Summary outcomes – Location based

Location	Site	BCR	Strategic economic considerations	Social & cultural	Noise
Burragorang	Silverdale	0.8	1.25	0	-0.3
Burragorang	The Oaks	0.7	1.25	-1.3	-0.6
Burragorang	Mowbray Park	0.6	2	-0.65	-0.6
Central Coast	Somersby	0.9	2.25	-1	-0.9
Central Coast	Peats Ridge	0.7	1.5	-1	-0.6
Central Coast	Wallarah	0.5	2.25	-2.3	-1.5
Cordeaux-Cataract	Southend	1.0	1	-0.65	-0.3
Cordeaux-Cataract	Wilton	0.7	1.75	-0.65	-0.3
Cordeaux-Cataract	Wallandoola	0.7	1.75	-0.65	-0.3
Cordeaux-Cataract	Dendrobium	0.7	1	-0.65	-0.3
Hawkesbury	Wilberforce	1.2	1.5	-0.65	-1
Hawkesbury	Castlereagh	1.1	1.5	-2.3	-2
Nepean	Kemps Creek	1.4	2	-2.3	-1.5
Nepean	Badgerys creek	1.2	2.75	-0.65	-0.8
Nepean	Luddenham	1.2	2.75	-0.65	-1
Nepean	Bringelly	1.1	2.75	-1	-0.8
Nepean	Greendale	1.0	2.75	-0.65	-0.8

Source: Ernst & Young analysis

8. Detailed CBA analysis (Phase 3 of economic analysis)

The Department directed Ernst & Young to undertake a detailed economic analysis of the proposal to develop the Richmond RAAF site so that it is fit for general aviation movements.

The analysis of the development of the Richmond RAAF "brownfield" site was undertaken to compliment the analysis undertaken in the previous phase of the study which analysed the development of an airport on a greenfield site.

The following sections of the report outline the methodology used in undertaking and the results of the analysis.

This analysis identified the net economic benefit associated with changing the Richmond RAAF site to be able to service general aviation demand by:

- Redeveloping the current East West runway alignment (scenario A and minimum scenario A[37]) into a 2,600 metre runway airport; and
- Developing a North South alignment 4,000 metre runway airport[38].

The options analysed for the redevelopment of the current East West runway alignment are Options A and C within WorleyParsons/AMPC, Civil RPT Aviation Operations – RAAF Base Richmond (November 2010) report.

The development of a 4,000 metre one-runway airport would be on a North south alignment incorporating the current East West aligned airbase and some surrounding areas. Two scenarios for the development of a North South Richmond airport were analysed:

- Once off development - the development of a maximum North South airport (as presented in the previous phases of the analysis); and
- Phased development - developing an airport on to a type 3 specification, which would be redeveloped to its maximum capacity at a later point in time. Results of this analysis can be seen in section 8.2.3.

8.1 Methodology

The methodology used to undertake this phase of the CBA is the same that was used within previous phases of the analysis. The main difference between a detailed and RAPID CBA is the greater level of confidence and specificity in the inputs into and thus the results of a detailed CBA.

This section of the report outlines the inputs into the analysis for this specific phase of the project.

[37] WorleyParsons/AMPC (2011), Civil RPT aviation operations: RAAF Base Richmond (east west)
[38] WorleyParsons/AMPC (2011), North south runway civil RPT aviation operations: RAAF Base Richmond

8.1.1 Demand analysis

Two distinct demand analyses were developed by Booz & Company, and were used within this phase of the analysis:

- The generic airport demand analysis; and
- Richmond site specific demand profile.

Both of these demand forecasts were used within this phase of the analysis to improve the robustness of the analysis by providing the Department with a range of BCR results that would potentially be realised if an airport was developed on the Richmond site given different levels of demand.

The generic airport demand analysis, the values and the underlying assumptions of its use are the same that was used in phase 1 and 2 of the economic analysis.

The Richmond site specific demand analysis was developed by Booz & Company to analyse the specific demand that could be attributable to an airport in that specific location. This demand forecast is discussed in more detail below.

8.1.1.1 *Richmond site specific aviation demand analysis*

Booz & Company were commissioned by the Department to undertake a demand analysis of the potential demand in aviation services at a Richmond Airport service depending on the type of services provided (East West or North South airport). [39] This analysis also looked at the specific origins and destinations of passengers within the Sydney basin that would use the airport.

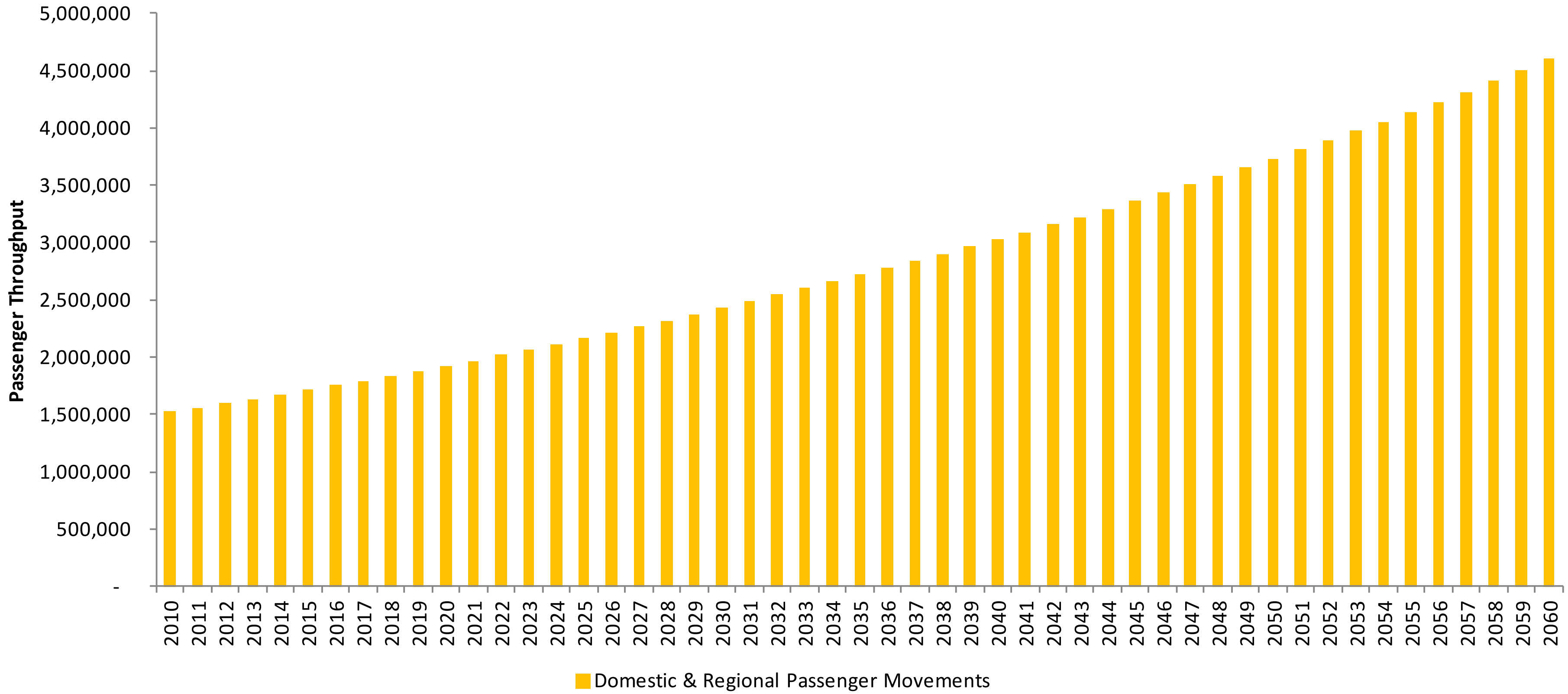
Unlike previous phases of the economic analysis, this demand analysis assumes that there would be a level of movement transfer from KSA, such that the demand at a Richmond civil aviation airport would be greater than the level of unmet demand for aviation services within the Sydney basin – therefore there is a level of switching between KSA and Richmond civil aviation services. In this event, given that these persons would have flown in any case regardless of the development of a second airport within the Sydney Basin then the only benefit they realise is the reduction in landside transport costs (as a result of residing closer to the airport).

Furthermore it is assumed that the capacity at the date of operational commencement of the airport will be that which is presented within Booz & Company analysis within that specific year.

The results of these Booz & Company Richmond specific passenger demand forecasts for both an East West and North South airport are presented graphically below.

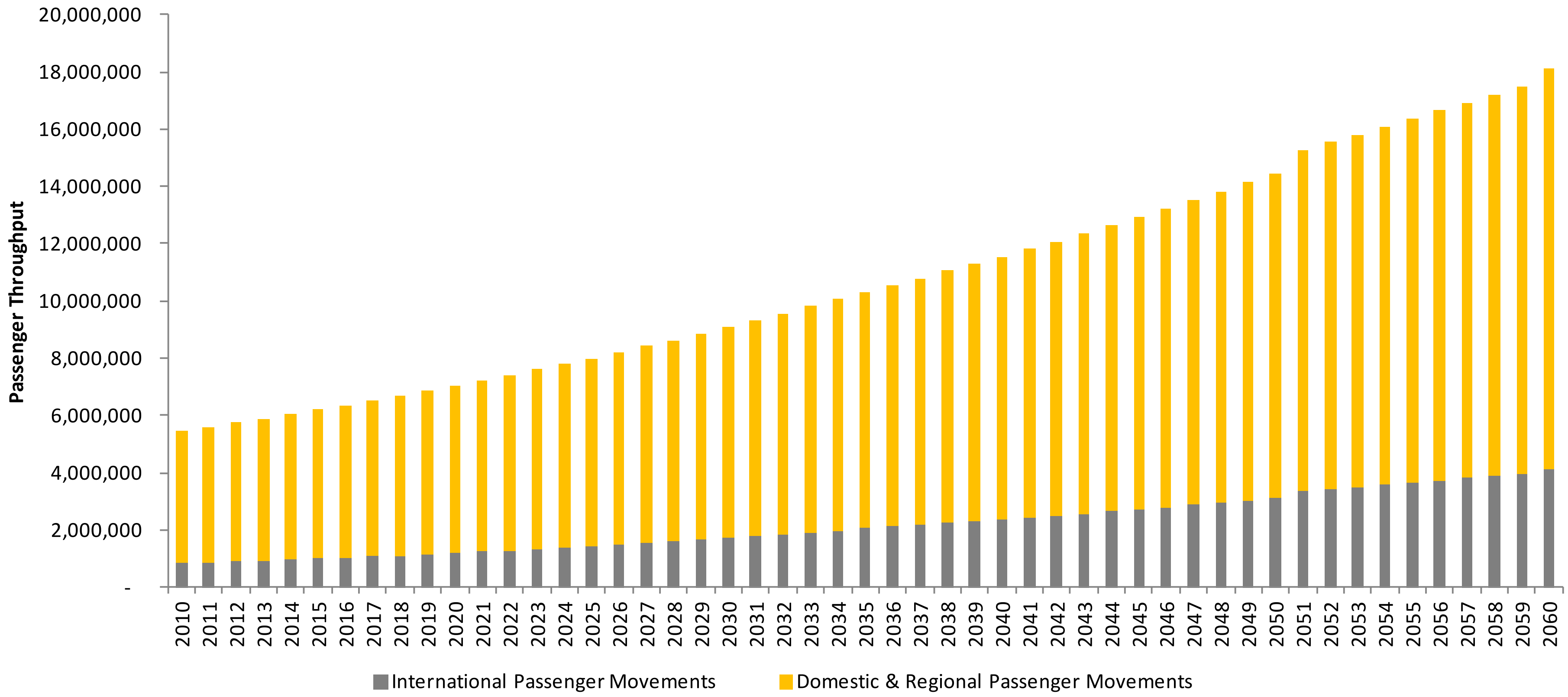
[39] Booz & Company (2011), Nature and extent of unmet demand that could be accommodated

Figure 5: Richmond site specific demand forecasts (PAX) – East West 2,600 metre airport development



Source: Booz & Company

Figure 6: Richmond site specific demand forecasts (PAX) – North South 4000 metre runway airport development



Source: Booz & Company

As can be seen in the graphs above, according to the Booz & Company analysis, if the Richmond airport was able to commence operations today (in a hypothetical case), then approximately 1.5 million persons, if an East West 2,600 metre runway airport was constructed, would demand its services. As KSA can currently meet all the aviation demand needs of Sydney then these passengers that choose to fly from Richmond would effectively be diverting their demand from KSA.

8.1.2 Base date

This analysis assumes that in a base case an East West airport would begin operations at Richmond in 2025 whilst a North South airport would begin operations in 2035.

8.1.3 Costs

8.1.3.1 *Land acquisition*

Ernst & Young's Real Estate Advisory team undertook a detailed evaluation[40] of the value of the land of the current Richmond airbase, and the proposed site in which a maximum North South airport could be constructed.

While the Commonwealth Government would not have to purchase the current RAAF site if it were to develop a general aviation facility on it (rather it would be a transfer of funds between Departments), this is however included within the analysis as the opportunity cost of using the land.

The following table presents the results from their analysis.

Table 93: Land acquisition cost ($'000)

Type of Airport	Value ($'000)
North South 4,000 metre	370,000
East West 2,600 metre	210,000

Source: Ernst & Young Real Estate Advisory

As stated with Ernst & Young's Real Estate Advisory report a factor of 25% has been applied on top of the values presented in the table above to take into account risk and contingency that would likely to be realised in the purchase of properties within these sites.

A detailed explanation of the methodology, information sources and results of the analysis can be seen within this report.

8.1.3.2 *Comparative cost of earthworks to create the airport platform*

The value applied to the cost associated with levelling the site from its current formation to accommodate a fully operational airport was sourced from the WorleyParsons/AMPC analysis.

It was assumed that the land area that currently holds the RAAF base would not require any land platform development, and therefore this cost was not associated with an East West airport.

The following table presents the assumed cost for remediating/excavating the land to accommodate a fully functional airport on the Richmond site.

[40] Ernst & Young (2011), Advice on potential property acquisition costs for three scenarios around the Richmond RAAF Air Base (Appendix J)

Table 94: Comparative cost of earthworks to create the airport platform ($'m)

Type of Airport	Value ($m)
North South 4,000 metre	343
East West 2,600 metre	0

Source: WorleyParsons/AMPC

8.1.3.3 *Construction of the Airport*

Specific costs associated with the development of each of the airport types analysed were provided by WorleyParsons/AMPC.[41] These values can be seen in the table below.

Table 95: Richmond airport CAPEX ($'000)

Airport component	North South 4000 metre runway	East West 2,600 metre runway	
		Scenario A	Minimum scenario A
Runways/Taxiways	799,033	61,612	12,262
Apron Surfaces	544,866	21,185	6,541
Car Parking	184,675	11,400	3,805
Landing Aids/Lighting	94,880	33,000	3,000
Terminal – International	1,640,600	-	-
Terminal – Domestic	761,767	50,500	14,687
Other CAPEX	624,873	82,293	36,389
Contingency	1,180,595	77,997	23,005
Project Management & Design	2,148,682	119,596	30,674
Total	7,979,971	457,583	130,363

Source: WorleyParsons/AMPC and Ernst & Young profit assumption

Note: (1) Contingency and Project Management components as presented in this table also include an allowance for these additional costs associated with earthworks

(2) Differences between the cost value used within the Economic evaluation and that presented within the WorleyParsons/AMPC report is the exclusion of profit as it is a wealth transfer

With regard to the upgraded North South airport development option, a split of assets assumed to be constructed in the original phase of development compared to those assets constructed at a later stage when the airport is upgraded, were suggested by WorleyParsons/AMPC for use in the economic analysis in collaboration with Ernst and Young. This can be seen in the table below.

Table 96: Components and timing of upgraded airport specific CAPEX ($'000)

Airport component	Upgraded 4000 metre North South runway development	
	Original development	Upgraded development
Runways/Taxiways	799,033	-
Apron Surfaces	544,866	-
Car Parking	11,400	173,275
Landing Aids/Lighting		94,880
Terminal – International		1,640,600
Terminal – Domestic	50,500	711,267
Other CAPEX	82,293	542,580
Contingency	377,757	802,837
Project Management & Design	687,518	1,461,164
Total	2,553,368	5,426,603

Source: WorleyParsons/AMPC and Ernst & Young assumptions

Note: Costs in the table above do not include additional brownfield costs associated with phasing development."

The rationale for the construction of these assets in the original development of the airport (land acquisition, formation and full length runway development) is that there is an extraordinary brownfield cost associated with upgrading these assets subsequent to the

[41] WorleyParsons/AMPC (2011), North south runway civil RPT aviation operations: RAAF Base Richmond

operational commencement of an airport (eg; construction after airport operational hours). This additional brownfield cost has a number of economic impacts, both the direct, increased cost of the actual upgrade, and indirect, financial impact on the operations of the airport throughout the process.

8.1.3.4 *Construction of the Supporting infrastructure*

The construction costs associated with the development of the supporting infrastructure necessary to operate an airport at Richmond were developed by WorleyParsons/AMPC[42 and 43] and can be seen in the table below.

Table 97: Richmond airport supporting infrastructure costs ($'000)

Supporting infrastructure component	Upgraded 4000 metre North South runway development	
	Original development	Upgraded development
Road	443,750	887,500
Rail		308,600
Water	13,317	17,873
Wastewater	5,582	10,421
Power	12,064	19,083
Communications	240	320
Gas	43,050	57,400
Fuel	112,950	151,300
Contingency	129,302	368,721
Project Management & Design	206,884	671,073
Total	967,139	2,492,292

Source: WorleyParsons/AMPC

For a North South 4000 metre airport development that is originally developed to type 3 airport specifications and subsequently redeveloped into a type 1 airport it is assumed that the supporting infrastructure required for that period of time can be developed and easily redeveloped. In other words the infrastructure to support the airport are built to support a type 3 airport originally and upgraded in line with the timing of the upgrading of the airport.

8.1.3.5 *Ongoing capital and operating costs associated with the Airport and supporting infrastructure*

The methodology and underlying assumptions to calculate the ongoing capital and operating costs of the airport and the supporting infrastructure were the same as that used within the second phase of the analysis and explained in section 4.2.5 and section 4.2.6.

8.1.4 Benefits

The following benefits are realised by the uptake in use of additional aviation services within the Sydney basin (eg: the benefit realised by someone that is now able to fly as a result of increasing aviation capacity). The benefit realised by those that choose to use the Richmond airport, when there is effective capacity at KSA is the reduction in landside transport generalised cost to access the airport, as outlined in section 8.1.4.8.

8.1.4.1 *Consumer surplus realised by Australian residents with the ability to fly*

The consumer surplus realised by Australian residents that have the ability to fly that otherwise would have been constrained has been incorporated in the study using the same methodology as that which was used in the first phase of the analysis and set out in section 4.3.1.1.

[42] WorleyParsons/AMPC (2011), North south runway civil RPT aviation operations: RAAF Base Richmond
[43] WorleyParsons/AMPC (2011), Civil RPT aviation operations: RAAF Base Richmond (east west)

8.1.4.2 *Tourism spend of non-Australian residents that would have otherwise not accessed Australia*

The additional tourism spend of non-Australian residents whilst holidaying in Australia that would have otherwise not have occurred with the current supply of aviation services is the same within this phase of the study as was used within the first phase and presented in section 4.3.1.2.

8.1.4.3 *Value of freight that is able to transported to/from Sydney*

The consumer surplus of the movement of freight into and out of Australia that wouldn't have been able to be transported under the current constrained aviation market is the same within this phase of the study as was used within the first phase and presented in section.

8.1.4.4 *The reduction in delay of passengers that would have flown under the no development scenario*

The reduction in delays realised by Australian residents than would have otherwise occurred under the Base Case is the same within this phase of the study as was used in the first phase of the analysis and presented in section 4.3.2.1.

8.1.4.5 *The reduction in delays to aircraft operators*

The reduction in delays realised by aircraft operators than would have otherwise occurred under the Base Case is the same within this phase of the study as was used in the first phase of the analysis and presented in section 4.3.2.2.

8.1.4.6 *The reduction in the percentage of passengers that have to alter from their preferred flight times due to supply constraints*

The reduction in the percentage of passengers that have to alter from their preferred flight times due to supply constraints is the same within this phase of the study as was used within the first phase of the analysis and presented in section 4.3.2.3.

8.1.4.7 *Land side transportation*

The assumptions and methodology applied under the base analysis (the dis-benefit associated with additional vehicle movements as a result of increasing the aviation capacity) is the same within this phase of the analysis as was used within the first and second phase.

Two alternative origin and destination assumptions were used within this phase of the analysis:

- ► Generic origin and destination forecasts (same as within section 4.4.1); and
- ► Richmond RAAF airbase specific origin and destination forecasts.

Both of these analyses were conducted by Booz & Company. As stated in section 4.4.1 the Booz & Company analysis of the final origins and destinations of airline passenger trips (e.g. home, place of employment etc) to and from the Sydney region provides an understanding of the impact of location on demand at Sydney (Kingsford-Smith) Airport and other airports within the Sydney region. The National Visitors Survey 2005-2009 (NVS) and the International Visitors Survey 2005-2008 (IVS) provide information on the air trip profiles of passengers travelling to and from Sydney. [44]

The Richmond RAAF airbase specific origin and destination forecasts were developed from the basis of the National Visitors Survey 2005-2009 (NVS) and the International Visitors Survey 2005-2008 (IVS) whilst taking into account the proximity of the Richmond site to

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[44] Booz & Company (2011), Nature and extent of unmet demand that could be accommodated

demand generators. The proximity of an airport to demand generators (i.e. population centres, and demand attractors such as tourism facilities and businesses), will impact the volume of traffic an airport can capture in two ways:

- Substitution - passenger volumes gained or lost to a competing airport; and
- Suppression/stimulation – As air travel is discretionary on many occasions, passenger's will avoid travelling if the generalised journey cost exceeds the passenger's willingness to pay or more passengers will travel if the generalised journey cost is below a passenger's willingness to pay.

More information regarding the calculation of the origin and destination of airport users can be found within the Booz & Company (2011), "Nature and extent of unmet demand that could be accommodated report".

The breakdown of the origin/destination of users for both the generic airport location and that specific for Richmond can be seen in the table below:

Table 98: Generic origin/destination of users

Region	Generic O/D breakdown	Richmond Specific O/D breakdown
North Sydney	14%	13%
Metro Sydney	49%	30%
South West Sydney	10%	7%
Western Sydney	13%	22%
North Western Sydney	11%	20%
Central and Northern Coast	3%	5%
Western Regional NSW	1%	2%

Source: Booz & Company

8.1.4.8 *Aviation transfer benefit*

As described in section 8.1.1.1, depending when the airport at Richmond is constructed, using the Booz & Company Richmond specific demand analysis may mean that an airport at Richmond will effectively take aviation demand from KSA (in the case when demand for Richmond is greater than the unmet demand on the network). Under this scenario the economic benefit to the user of these services at Richmond is only the reduced landside transportation costs relative to travelling to KSA.

As it is assumed that the demand for Richmond airport services above that which cannot be serviced by KSA is due to the relative cost of accessing the airport, it is assumed that those who use this (Richmond) airport whilst there is still capacity at KSA only do so because it is financially in their interest. Therefore the origin and destination of users of Richmond airport, at the time when services are still available at KSA, are assumed to be those that are effectively closer to Richmond than KSA (in reality, demand would also be affected by the flight destinations and airlines being offered at each airport). Furthermore, the relative weighting of each of these regions was based on their current aggregate demand for aviation services, as presented within the Sydney Airport 2006 Ground Travel Plan.

The table below presents the assumed origin and destination breakdown of users of a Richmond airport at the time when services are still available at KSA.

Table 99: Origin/destination of users that transfer away from KSA

Origin/Destination of users	% of total users
West Central	20%
North and North West	60%
The west	20%

Source: Ernst & Young assumption

The same value assumptions for the cost of land side transport were applied in this calculation as was applied in the dis-benefit of landside access transport in this and previous phases of the economic analysis and outlined in section 4.4.1.

8.1.5 Externality impacts

8.1.5.1 *The cost to provide noise abatement measures*

The methodology for calculating the cost to abate the additional noise created by an operational airport in each of the proposed locations is the same as that which was applied in phases 1 and 2 of the analysis.

The cost to provide noise abatement measures for households has been updated within this phase of the analysis to take into account the specific number of houses within an ANEF 20 contour, which was calculated by WorleyParsons/AMPC.[45]

The average cost associated with providing abatement measures to households is the same value which was assumed for the first and second phase of the analysis.

8.1.5.2 *The environmental impact of increased aircraft*

The assumptions and overall cost associated with the environmental impact of increasing the number of aircraft movements is the same as that for the first phase of the analysis.

8.2 Richmond RAAF detailed analysis results

This section presents the results of the detailed CBA analysis for an airport development at the currently occupied Richmond RAAF airbase.

The first set of results presented in this section "the core results" have been developed to provide decision makers with a comparison of the economic impact of developing an airport on Richmond RAAF relative to other sites analysed within this analysis. To be able to present this analysis on a consistent basis we have applied assumptions that are consistent with previous phases of the analysis, which include:

- The origin and destination of passengers based on the analysis undertaken in previous phases of the analysis, as presented in section 8.1.4.7;
- Forecasted demand for the airport based on Booz & Company generic estimates of unmet demand for aviation services within the Sydney Basin, as presented in section 4.1; and
- RAAF services remain at the current site and share use in the upgraded facilities.

This core assessment was then supplemented by various 'scenarios', in which the first results were varied to allow for:

- The origin and destination of passengers based on Booz & Company Richmond site specific analysis, as presented in section 8.1.4.7;

[45] WorleyParsons/AMPC (2011), Analysis of most suitable aviation sites

- Forecasted demand for aviation services at the Richmond airport based on Booz & company site specific demand analysis, as presented in section 0; and
- The phased development of an airport at the Richmond site.

The core assessment was kept consistent with the assumptions that underpinned the first two phases of the analysis to provide decision makers with a like-for-like comparison with alternative locations analysed. This core analysis was supplemented by more robust demand forecasts to analyse the likely range of benefits that would result from the development of a civil airport utilising the RAAF Richmond airbase.

8.2.1 Core results

As described above the core results within this phase of the analysis have been developed in line with assumptions that were used within previous phases of the analysis.

The results of the base case analysis are shown in the table below.

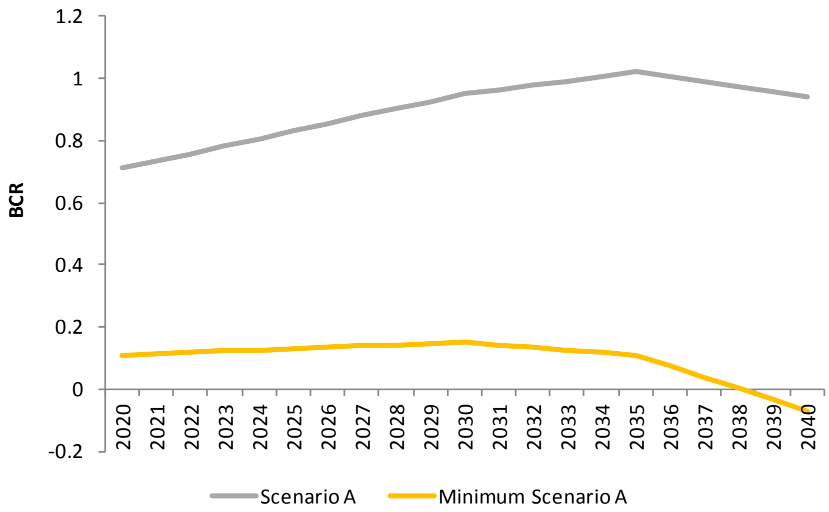
Table 100: Quantified outcomes ($'millions) – base case

Airport type	Benefits	Costs	Net Present Value	BCR
North South 4000m runway	6,333	3,380	2,952	1.9
East West – Scenario A	440	527	-87	0.8
East West - Minimum scenario A	30	240	-210	0.1

Source: Ernst & Young analysis

The following graphs graphically present how the BCR of the economic analysis changes if the operational start date is varied.

Figure 7: Richmond type 3 airport, base case assumptions



Source: Ernst & Young analysis

8.2.2 Alternative scenarios

This section presents the results of the alternative assumptions that were taken into account to supplement the base case assessment.

8.2.2.1 *Richmond specific demand and origin and destination analysis*

As shown in section 8.1.1.1, Booz & Company undertook a site specific demand analysis to determine the likely uptake of unmet aviation passenger demand within the Sydney basin that would use an airport at this location.

Furthermore, as shown in section 8.1.4.7, the Booz & Company site specific aviation demand assumptions were made with regards to the origin and destination of users of an airport at Richmond.

The CBA results using Booz & Company Richmond site specific origin and destination assumptions as well as their site specific aggregate total demand results are presented below.

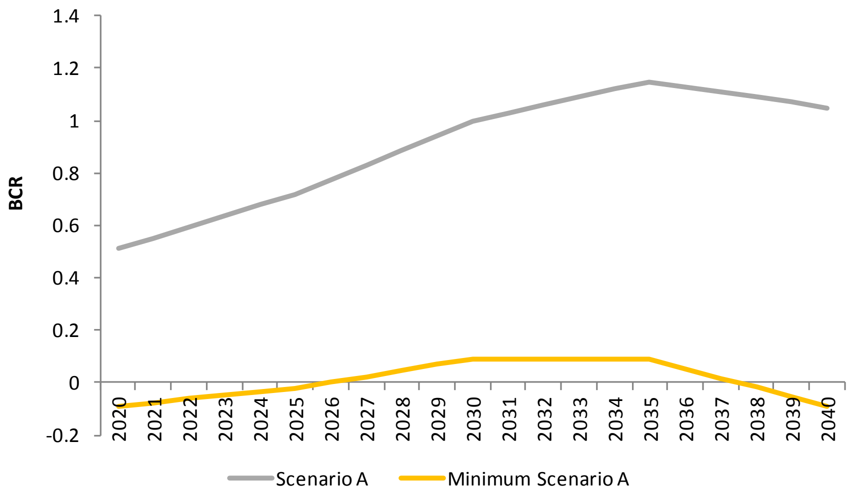
Table 101: Quantified outcomes ($'millions) – Booz & Company Richmond Specific demand and O/D forecasts

Airport type	Net Present Value	BCR
North South 4000m runway	1,683	1.5
East West – Scenario A	-165	0.7
East West - Minimum scenario A	-260	0.0

Source: Ernst & Young analysis

These results of the BCR analysis of the Richmond RAAF using the Booz & Company site specific demand and origin and destination forecasts with varying operational start dates for both of the East West airport options can be seen in the graph below.

Figure 8: Richmond type 3 airport, Richmond specific demand and O/D inputs



Source: Ernst & Young analysis

8.2.2.2 *Land valuation methodology*

As stated within section 8.1.3.1, Ernst & Young's Real Estate Advisory team undertook a detailed analysis of the likely value of the land associated with the footprint of an airport at the Richmond site. This value includes a real cost to government that would be required to purchase additional land, within the North South 4,000 metre runway option and the intrinsic opportunity cost valuation of the land that is currently owned by the Commonwealth Government and utilised by the Department of Defence.

If an assumption is made that the opportunity cost of using the existing site is not changed as a result of developing and accommodating general aviation services as it does not have a material effect on its current use, RAAF operations, then the change in associated land value can be removed. This analysis still includes the cost that would be associated with the cost to purchase properties outside of the land area that is currently owned by the Commonwealth Government.

The result of applying this assumption to the core analysis, general demand and origin and destination forecasts, can be seen in the table below.

Table 102: Core analysis excluding opportunity cost of land ($'millions)

Airport type	Net Present Value	BCR
North South 4000m runway	3,089	2.0
East West – Scenario A	38	1.1
East West - Minimum scenario A	-85	0.3

Source: Ernst & Young analysis

The result of applying this assumption to the Richmond specific forecasts can be seen in the table below.

Table 103: Richmond Specific analysis excluding opportunity cost of land ($'millions)

Airport type	Net Present Value	BCR
North South 4000m runway	1,820	1.6
East West – Scenario A	-40	0.9
East West - Minimum scenario A	-136	0.0

Source: Ernst & Young analysis

8.2.3 Alternative development scenarios

This analysis also analysed the potential impact of alternative development scenarios which include, staging the development of the airport and varying the date of commencing operations of the airport. Each of these alternative development scenarios are discussed and results presented in the following sections.

8.2.3.1 *Staged development scenario*

Staging the development of the airport in essence is the development of a type 3 airport with the capability of upgrading to a maximum airport development at a future point in time.

A number of assumptions have been made with regards to the timings of construction and development works, these assumptions are listed below:

- The land to accommodate a maximum airport is purchased and remediated in the original development of the airport

- The airport runway and taxiways are constructed to the maximum airport capacity in the original development of the airport
- Noise mitigation works, and other necessary airport construction works, to the airport itself and supporting infrastructure is undertaken on a needs basis.

These assumptions have been made for a number of reasons including:

- Advice from WorleyParsons/AMPC that this would represent best practice
- To mitigate against the significant operational constraints of upgrading core facilities at an airport site has
- To mitigate against the significant brownfield construction costs associated with the development within confined surroundings (ie: cost of working outside airport operational hours, security costs etc.)

The result of upgrading a North South 2,600 metre runway airport that is then developed into North South 4,000 metre runway airport at Richmond, maintaining the core assessment assumptions, maintaining the original airport operational commencement date at 2035 and varying the date that the upgraded airport begins operations can be seen in the table below.

Table 104: Quantified outcomes ($'millions) – staged development (base case)

Date of airport upgrade	Net Present Value	BCR
2040	2,681	1.9
2045	1,751	1.7
2050	896	1.5
2055	206	1.1
2060	-208	0.9

Source: Ernst & Young analysis

Results from applying the Booz & Company Richmond site specific aviation demand and origin and destination analysis to the upgraded airport scenario can be seen in the table below.

Table 105: Quantified outcomes ($'millions)– staged development (Richmond specific demand forecasts)

Date of airport upgrade	Net Present Value	BCR
2040	1,001	1.4
2045	627	1.3
2050	193	1.1
2055	-229	0.9
2060	-475	0.7

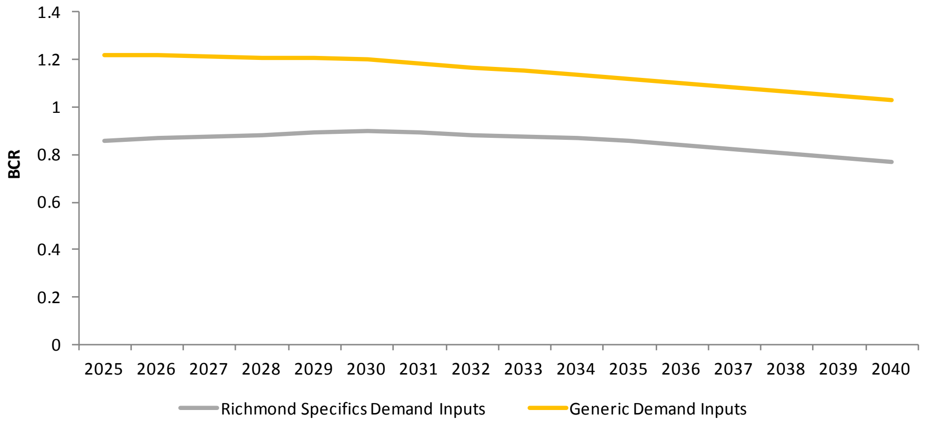
Source: Ernst & Young analysis

8.2.3.2 *Alternative operational commencement development scenarios*

This analysis also analysed the potential impact of varying the operational commencement of the airport and the potential impact that this would have on the CBA results.

The following graph presents the BCR result for the development of a North South 2,600 metre runway airport that is developed into North South 4,000 metre runway airport 10 years after its original operational commencement.

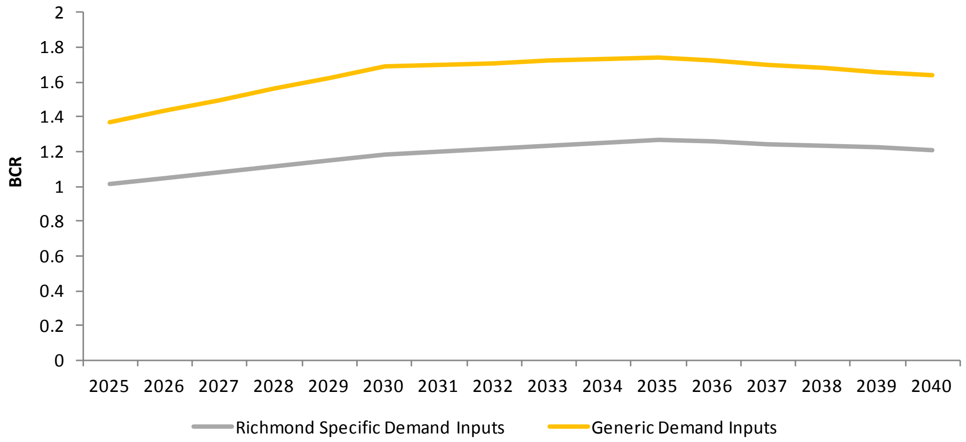
Figure 9: Richmond RAAF North South 4,000 metre runway airport with varying start date (assumed 10 years between upgrade)



Source: Ernst & Young analysis

The following graph presents the BCR result for the development of a North South 2,600 metre runway airport that is developed into North South 4,000 metre runway airport 20 years after its original operational commencement.

Figure 10: Richmond RAAF type 1 airport with varying start date (assumed 20 years between upgrade)



Source: Ernst & Young analysis

Appendix A Phase 1 Results

Table 106: Phase 1 undiscounted values – Type 1 costs (2011 million dollar terms)

	Locality	Kulnura	Somersby	Northern Hawkesbury	Luddenham	The Oaks	Wilton	Sutton Forest
Cost item								
Site specific land and earthworks costs	Land acquisition	63	89	177	82	272	51	63
	Earthworks for site preparation	954	800	1,408	305	645	440	678
	Sub total	1,017	889	1,585	387	917	490	741
Generic airport construction costs	Runways/taxiways	551	551	551	551	551	551	551
	Apron surfaces	274	274	274	274	274	274	274
	Car parking	202	202	202	202	202	202	202
	Landing aids/lighting	84	84	84	84	84	84	84
	Terminal - international	1,812	1,812	1,812	1,812	1,812	1,812	1,812
	Terminal - domestic	583	583	583	583	583	583	583
	Other capital costs	27	27	27	27	27	27	27
	Contingency	1,060	1,060	1,060	1,060	1,060	1,060	1,060
	Project management and design	707	707	707	707	707	707	707
	Sub total	5,300	5,300	5,300	5,300	5,300	5,300	5,300
Supporting infrastructure costs	Road	3,890	1,690	6,080	1,320	2,908	2,192	4,132
	Rail	811	409	580	280	781	460	328
	Utilities	408	199	247	373	223	218	241
	Fuel	810	771	602	519	784	725	1,315
	Contingency	2,970	921	2,253	748	1,409	1,078	1,805
	Project management and design	1,980	614	1,502	498	939	719	1,203
	Sub total	10,868	4,603	11,264	3,738	7,044	5,392	9,025
Ongoing costs								
Renewal	Airport	11,055	11,055	11,055	11,055	11,055	11,055	11,055
	Supporting infrastructure	4,795	2,394	3,407	1,719	4,084	2,882	3,634
	Sub total	15,850	13,449	14,462	12,774	15,139	13,937	14,689
Maintenance	Airport	11,542	11,542	11,542	11,542	11,542	11,542	11,542
	Supporting infrastructure	8,611	3,014	5,193	2,067	3,388	2,928	5,376
	Sub total	20,154	14,556	16,735	13,609	14,931	14,470	16,918
Total Costs		**53,188**	**38,797**	**49,346**	**35,809**	**43,330**	**39,589**	**46,672**

Table 107 - Phase 1 undiscounted values – Type 1 benefits (2011 million dollar terms)

	Locality	Kulnura	Somersby	Northern Hawkesbury	Luddenham	The Oaks	Wilton	Sutton Forest
Benefits								
Passenger Benefits	Consumer surplus	193,623	193,623	193,623	193,623	193,623	193,623	193,623
	Delay reduction	6,151	6,151	6,151	6,151	6,151	6,151	6,151
	Peak spreading	57	57	57	57	57	57	57
	Sub total	199,832	199,832	199,832	199,832	199,832	199,832	199,832
Wider economic benefits	Tourism benefits	86,705	86,705	86,705	86,705	86,705	86,705	86,705
	Freight benefits	36,392	36,392	36,392	36,392	36,392	36,392	36,392
	Sub total	123,097	123,097	123,097	123,097	123,097	123,097	123,097
Aircraft operations	Delay reduction	16,220	16,220	16,220	16,220	16,220	16,220	16,220
	Sub total	16,220	16,220	16,220	16,220	16,220	16,220	16,220
Road network impacts	Passenger land transport impacts	-74,101	-65,965	-51,059	-52,934	-72,635	-75,448	-115,464
	Freight land transport impacts	-74,549	-63,013	-51,731	-48,384	-65,615	-66,239	-106,869
	Sub total	-148,649	-128,979	-102,789	-101,318	-138,249	-141,687	-222,333
Environmental impacts	Noise abatement	-7	-99	-50	-110	-32	-16	-7
	Environmental dis-benefits - additional km	-20,888	-20,888	-20,888	-20,888	-20,888	-20,888	-20,888
	Sub total	-20,895	-20,987	-20,938	-20,999	-20,921	-20,904	-20,895
Total Benefits		**169,603**	**189,182**	**215,421**	**216,832**	**179,978**	**176,557**	**95,920**

Table 108: Phase 1 discounted values – Type 1 costs (2011 million dollar terms, 7% discount rate)

	Locality	Kulnura	Somersby	Northern Hawkesbury	Luddenham	The Oaks	Wilton	Sutton Forest
Cost item								
Site specific land and earthworks costs	Land acquisition	23	32	64	30	99	18	23
	Earthworks for site preparation	290	243	427	93	196	133	206
	Sub total	312	275	492	122	294	152	229
Generic airport construction costs	Runways/taxiways	122	122	122	122	122	122	122
	Apron surfaces	61	61	61	61	61	61	61
	Car parking	45	45	45	45	45	45	45
	Landing aids/lighting	19	19	19	19	19	19	19
	Terminal - international	400	400	400	400	400	400	400
	Terminal - domestic	129	129	129	129	129	129	129
	Other capital costs	6	6	6	6	6	6	6
	Contingency	234	234	234	234	234	234	234
	Project management and design	156	156	156	156	156	156	156
	Sub total	1,171	1,171	1,171	1,171	1,171	1,171	1,171
Supporting infrastructure costs	Road	651	252	1,103	237	470	362	589
	Rail	136	61	105	50	126	76	47
	Utilities	68	30	45	67	36	36	34
	Fuel	136	115	109	93	127	120	187
	Contingency	497	137	409	134	227	178	257
	Project management and design	331	91	273	89	152	119	171
	Sub total	1,818	686	2,044	670	1,137	891	1,286
Ongoing costs								
Renewal	Airport	300	300	300	300	300	300	300
	Supporting infrastructure	87	30	68	24	40	32	56
Maintenance	Airport	371	371	371	371	371	371	371
	Supporting infrastructure	149	78	110	64	129	98	119
	Sub total	908	779	849	759	841	801	846
Total Costs		**4,209**	**2,911**	**4,556**	**2,723**	**3,443**	**3,015**	**3,531**

Table 109: Phase 1 discounted values – Type 1 benefits and results (2011 million dollar terms, 7% discount rate)

	Locality	Kulnura	Somersby	Northern Hawkesbury	Luddenham	The Oaks	Wilton	Sutton Forest
Benefits								
Passenger Benefits	Consumer surplus	6,480	6,480	6,480	6,480	6,480	6,480	6,480
	Delay reduction	410	410	410	410	410	410	410
	Peak spreading	5	5	5	5	5	5	5
	Sub total	6,895	6,895	6,895	6,895	6,895	6,895	6,895
Wider economic benefits	Tourism benefits	2,982	2,982	2,982	2,982	2,982	2,982	2,982
	Freight benefits	1,512	1,512	1,512	1,512	1,512	1,512	1,512
	Sub total	4,494	4,494	4,494	4,494	4,494	4,494	4,494
Aircraft operations	Delay reduction	1,138	1,138	1,138	1,138	1,138	1,138	1,138
	Sub total	1,138	1,138	1,138	1,138	1,138	1,138	1,138
Road network impacts	Passenger land transport impacts	-2,933	-2,612	-2,013	-2,089	-2,881	-2,993	-4,490
	Freight land transport impacts	-3,095	-2,619	-2,159	-2,020	-2,736	-2,773	-4,462
	Sub total	-6,028	-5,230	-4,172	-4,109	-5,617	-5,766	-8,951
Environmental impacts	Noise abatement	-1	-20	-10	-22	-6	-3	-1
	Environmental dis-benefits - additional km	-715	-715	-715	-715	-715	-715	-715
	Sub total	-717	-735	-725	-737	-722	-718	-717
Total Benefits		**5,781**	**6,561**	**7,629**	**7,680**	**6,187**	**6,042**	**2,858**
Results	Net Present Value	1,572	3,650	3,073	4,957	2,744	3,026	-673
	BCR	1.37	2.25	1.67	2.82	1.80	2.00	0.81

Table 110: Phase 1 undiscounted values – Type 2 costs (2011 million dollar terms)

	Locality	Kulnura	Somersby	Northern Hawkesbury	Luddenham	The Oaks	Wilton	Sutton Forest
Cost item								
Site specific land and earthworks costs	Land acquisition	59	83	165	77	254	47	59
	Earthworks for site preparation	890	747	1,314	285	602	410	632
	Sub total	949	829	1,479	361	855	457	691
Generic airport construction costs	Runways/taxiways	167	167	167	167	167	167	167
	Apron surfaces	199	199	199	199	199	199	199
	Car parking	249	249	249	249	249	249	249
	Landing aids/lighting	36	36	36	36	36	36	36
	Terminal - international	819	819	819	819	819	819	819
	Terminal - domestic	833	833	833	833	833	833	833
	Other capital costs	21	21	21	21	21	21	21
	Contingency	698	698	698	698	698	698	698
	Project management and design	465	465	465	465	465	465	465
	Sub total	3,488	3,488	3,488	3,488	3,488	3,488	3,488
Supporting infrastructure costs	Road	460	50	2,180	440	694	540	140
	Rail	0	0	0	0	0	0	0
	Utilities	148	60	63	134	69	79	79
	Fuel	269	260	222	195	283	241	482
	Contingency	263	111	740	231	314	258	210
	Project management and design	175	74	493	154	209	172	140
	Sub total	1,316	554	3,698	1,154	1,568	1,289	1,051
Ongoing costs								
Renewal	Airport	26,618	26,618	26,618	26,618	26,618	26,618	26,618
	Supporting infrastructure	4,452	1,301	14,020	4,077	5,460	4,422	3,038
Maintenance	Airport	7,444	7,444	7,444	7,444	7,444	7,444	7,444
	Supporting infrastructure	2,091	1,268	1,660	1,769	2,575	2,596	1,916
	Sub total	40,604	36,630	49,741	39,907	42,096	41,079	39,015
Total Costs		**46,357**	**41,502**	**58,406**	**44,910**	**48,007**	**46,314**	**44,245**

Table 111: Phase 1 undiscounted values – Type 2 benefits (2011 million dollar terms)

	Locality	Kulnura	Somersby	Northern Hawkesbury	Luddenham	The Oaks	Wilton	Sutton Forest
Benefits								
Passenger Benefits	Consumer surplus	100,475	100,475	100,475	100,475	100,475	100,475	100,475
	Delay reduction	1,775	1,775	1,775	1,775	1,775	1,775	1,775
	Peak spreading	13	13	13	13	13	13	13
	Sub total	102,263	102,263	102,263	102,263	102,263	102,263	102,263
Wider economic benefits	Tourism benefits	34,839	34,839	34,839	34,839	34,839	34,839	34,839
	Freight benefits	21,242	21,242	21,242	21,242	21,242	21,242	21,242
	Sub total	56,081	56,081	56,081	56,081	56,081	56,081	56,081
Aircraft operations	Delay reduction	5,530	5,530	5,530	5,530	5,530	5,530	5,530
	Sub total	5,530	5,530	5,530	5,530	5,530	5,530	5,530
Road network impacts	Passenger land transport impacts	-54,118	-48,168	-38,818	-40,424	-53,065	-55,121	-85,022
	Freight land transport impacts	-43,213	-36,544	-31,035	-31,035	-38,651	-39,829	-63,571
	Sub total	-97,330	-84,712	-69,853	-71,458	-91,717	-94,950	-148,593
Environmental impacts	Noise abatement	-1	-4	-7	-7	-8	-1	-1
	Environmental dis-benefits - additional km	-9,419	-9,419	-9,419	-9,419	-9,419	-9,419	-9,419
	Sub total	-9,420	-9,423	-9,426	-9,426	-9,427	-9,420	-9,420
Total Benefits		**57,122**	**69,738**	**84,594**	**82,988**	**62,729**	**59,503**	**5,860**

Table 112: Phase 1 discounted values – Type 2 costs (2011 million dollar terms, 7% discount rate)

	Locality	Kulnura	Somersby	Northern Hawkesbury	Luddenham	The Oaks	Wilton	Sutton Forest
Cost item								
Site specific land and earthworks costs	Land acquisition	19	26	52	24	80	15	19
	Earthworks for site preparation	245	205	361	78	165	113	174
	Sub total	263	232	414	103	246	128	193
Generic airport construction costs	Runways/taxiways	35	35	35	35	35	35	35
	Apron surfaces	42	42	42	42	42	42	42
	Car parking	52	52	52	52	52	52	52
	Landing aids/lighting	8	8	8	8	8	8	8
	Terminal - international	171	171	171	171	171	171	171
	Terminal - domestic	174	174	174	174	174	174	174
	Other capital costs	4	4	4	4	4	4	4
	Contingency	146	146	146	146	146	146	146
	Project management and design	97	97	97	97	97	97	97
	Sub total	728	728	728	728	728	728	728
Supporting infrastructure costs	Road	101	11	477	96	152	118	31
	Rail	0	0	0	0	0	0	0
	Utilities	32	13	14	29	15	17	17
	Fuel	59	57	49	43	62	53	105
	Contingency	58	24	162	50	69	56	46
	Project management and design	38	16	108	34	46	38	31
	Sub total	288	121	809	252	343	282	230
Ongoing costs								
Renewal	Airport	616	616	616	616	616	616	616
	Supporting infrastructure	52	14	160	49	64	51	41
Maintenance	Airport	280	280	280	280	280	280	280
	Supporting infrastructure	84	51	67	71	104	105	77
	Sub total	1,033	962	1,124	1,016	1,064	1,052	1,014
Total Costs		**2,312**	**2,042**	**3,074**	**2,099**	**2,380**	**2,189**	**2,164**

Table 113: Phase 1 discounted values – Type 2 benefits and results (2011 million dollar terms, 7% discount rate)

	Locality	Kulnura	Somersby	Northern Hawkesbury	Luddenham	The Oaks	Wilton	Sutton Forest
Benefits								
Passenger Benefits	Consumer surplus	4,052	4,052	4,052	4,052	4,052	4,052	4,052
	Delay reduction	194	194	194	194	194	194	194
	Peak spreading	1	1	1	1	1	1	1
	Sub total	4,247	4,247	4,247	4,247	4,247	4,247	4,247
Wider economic benefits	Tourism benefits	1,581	1,581	1,581	1,581	1,581	1,581	1,581
	Freight benefits	831	831	831	831	831	831	831
	Sub total	2,413	2,413	2,413	2,413	2,413	2,413	2,413
Aircraft operations	Delay reduction	616	616	616	616	616	616	616
	Sub total	616	616	616	616	616	616	616
Road network impacts	Passenger land transport impacts	-2,343	-2,086	-1,647	-1,714	-2,302	-2,392	-3,605
	Freight land transport impacts	-1,691	-1,431	-1,218	-1,128	-1,518	-1,568	-2,498
	Sub total	-4,033	-3,517	-2,865	-2,843	-3,820	-3,959	-6,102
Environmental impacts	Noise abatement	-0	-1	-1	-1	-2	-0	-0
	Environmental dis-benefits - additional km	-408	-408	-408	-408	-408	-408	-408
	Sub total	-408	-409	-409	-408	-409	-408	-408
Total Benefits		**2,834**	**3,350**	**4,001**	**4,025**	**3,046**	**2,908**	**765**
Results	Net Present Value	522	1,308	927	1,926	666	719	-1,399
	BCR	1.23	1.64	1.30	1.92	1.28	1.33	0.35

Table 114: Phase 1 undiscounted values – Type 3 costs (2011 million dollar terms)

	Locality	Kulnura	Somersby	Northern Hawkesbury	Luddenham	The Oaks	Wilton	Sutton Forest
Cost item								
Site specific land and earthworks costs	Land acquisition	45	63	127	59	194	36	45
	Earthworks for site preparation	677	619	1,019	202	447	318	470
	Sub total	722	683	1,146	261	642	354	515
Generic airport construction costs	Runways/taxiways	84	84	84	84	84	84	84
	Apron surfaces	131	131	131	131	131	131	131
	Car parking	48	48	48	48	48	48	48
	Landing aids/lighting	21	21	21	21	21	21	21
	Terminal - international	0	0	0	0	0	0	0
	Terminal - domestic	852	852	852	852	852	852	852
	Other capital costs	13	13	13	13	13	13	13
	Contingency	345	345	345	345	345	345	345
	Project management and design	230	230	230	230	230	230	230
	Sub total	1,724	1,724	1,724	1,724	1,724	1,724	1,724
Supporting infrastructure costs	Road	232	25	1,101	222	350	273	71
	Rail	0	0	0	0	0	0	0
	Utilities	75	30	32	68	35	40	40
	Fuel	136	131	112	99	143	122	243
	Contingency	133	56	373	117	158	130	106
	Project management and design	89	37	249	78	106	87	71
	Sub total	664	280	1,867	583	792	651	531
Ongoing costs								
Renewal	Airport	6,754	6,754	6,754	6,754	6,754	6,754	6,754
	Supporting infrastructure	1,239	422	3,382	1,125	1,443	1,171	1,049
Maintenance	Airport	4,754	4,754	4,754	4,754	4,754	4,754	4,754
	Supporting infrastructure	905	549	718	765	1,114	1,123	829
	Sub total	13,653	12,479	15,609	13,398	14,065	13,802	13,386
Total Costs		**16,763**	**15,165**	**20,346**	**15,966**	**17,222**	**16,531**	**16,156**

Table 115: Phase 1 undiscounted values – Type 3 benefits (2011 million dollar terms)

	Locality	Kulnura	Somersby	Northern Hawkesbury	Luddenham	The Oaks	Wilton	Sutton Forest
Benefits								
Passenger Benefits	Consumer surplus	31,473	31,473	31,473	31,473	31,473	31,473	31,473
	Delay reduction	2,040	2,040	2,040	2,040	2,040	2,040	2,040
	Peak spreading	11	11	11	11	11	11	11
	Sub total	33,525	33,525	33,525	33,525	33,525	33,525	33,525
Wider economic benefits	Tourism benefits	3,172	3,172	3,172	3,172	3,172	3,172	3,172
	Freight benefits	10,305	10,305	10,305	10,305	10,305	10,305	10,305
	Sub total	13,477	13,477	13,477	13,477	13,477	13,477	13,477
Aircraft operations	Delay reduction	7,148	7,148	7,148	7,148	7,148	7,148	7,148
	Sub total	7,148	7,148	7,148	7,148	7,148	7,148	7,148
Road network impacts	Passenger land transport impacts	-27,669	-24,631	-19,641	-20,460	-27,159	-28,213	-43,037
	Freight land transport impacts	-20,882	-17,669	-15,293	-14,079	-18,865	-19,662	-31,231
	Sub total	-48,551	-42,300	-34,934	-34,539	-46,024	-47,874	-74,267
Environmental impacts	Noise abatement	-1	-15	-8	-4	-10	-1	-1
	Environmental dis-benefits - additional km	-1,845	-1,845	-1,845	-1,845	-1,845	-1,845	-1,845
	Sub total	-1,846	-1,860	-1,853	-1,848	-1,855	-1,846	-1,845
Total Benefits		3,753	9,990	17,363	17,763	6,271	4,430	-21,962

Table 116: Phase 1 discounted values – Type 3 costs (2011 million dollar terms, 7% discount rate)

	Locality	Kulnura	Somersby	Northern Hawkesbury	Luddenham	The Oaks	Wilton	Sutton Forest
Cost item								
Site specific land and earthworks costs	Land acquisition	25	34	69	32	106	20	25
	Earthworks for site preparation	333	305	501	99	220	156	231
	Sub total	358	339	570	131	326	176	256
Generic airport construction costs	Runways/taxiways	34	34	34	34	34	34	34
	Apron surfaces	53	53	53	53	53	53	53
	Car parking	20	20	20	20	20	20	20
	Landing aids/lighting	9	9	9	9	9	9	9
	Terminal - international	0	0	0	0	0	0	0
	Terminal - domestic	347	347	347	347	347	347	347
	Other capital costs	5	5	5	5	5	5	5
	Contingency	140	140	140	140	140	140	140
	Project management and design	94	94	94	94	94	94	94
	Sub total	702	702	702	702	702	702	702
Supporting infrastructure costs	Road	100	11	474	96	151	117	30
	Rail	0	0	0	0	0	0	0
	Utilities	32	13	14	29	15	17	17
	Fuel	58	56	48	42	61	52	105
	Contingency	57	24	161	50	68	56	46
	Project management and design	38	16	107	33	45	37	30
	Sub total	286	120	803	251	341	280	228
Ongoing costs								
Renewal	Airport	262	262	262	262	262	262	262
	Supporting infrastructure	27	8	74	25	32	25	25
Maintenance	Airport	230	230	230	230	230	230	230
	Supporting infrastructure	57	35	45	48	70	71	52
	Sub total	576	536	612	566	594	588	570
Total Costs		**1,922**	**1,697**	**2,687**	**1,649**	**1,962**	**1,746**	**1,756**

Table 117: Phase 1 discounted values – Type 3 benefits and results (2011 million dollar terms, 7% discount rate)

	Locality	Kulnura	Somersby	Northern Hawkesbury	Luddenham	The Oaks	Wilton	Sutton Forest
Benefits								
Passenger Benefits	Consumer surplus	1,524	1,524	1,524	1,524	1,524	1,524	1,524
	Delay reduction	360	360	360	360	360	360	360
	Peak spreading	2	2	2	2	2	2	2
	Sub total	1,886	1,886	1,886	1,886	1,886	1,886	1,886
Wider economic benefits	Tourism benefits	154	154	154	154	154	154	154
	Freight benefits	466	466	466	466	466	466	466
	Sub total	619	619	619	619	619	619	619
Aircraft operations	Delay reduction	1,309	1,309	1,309	1,309	1,309	1,309	1,309
	Sub total	1,309	1,309	1,309	1,309	1,309	1,309	1,309
Road network impacts	Passenger land transport impacts	-1,478	-1,317	-1,036	-1,078	-1,453	-1,510	-2,267
	Freight land transport impacts	-943	-799	-691	-637	-854	-890	-1,414
	Sub total	-2,422	-2,115	-1,727	-1,716	-2,307	-2,399	-3,681
Environmental impacts	Noise abatement	-1	-6	-3	-1	-4	-0	-0
	Environmental dis-benefits - additional km	-89	-89	-89	-89	-89	-89	-89
	Sub total	-90	-95	-93	-91	-93	-90	-90
Total Benefits		**1,303**	**1,604**	**1,994**	**2,008**	**1,414**	**1,325**	**44**
Results	Net Present Value	-619	-93	-692	359	-549	-421	-1,712
	BCR	0.68	0.95	0.74	1.22	0.72	0.76	0.02

Table 118: Phase 1 undiscounted values – Type 4 costs (2011 million dollar terms)

	Locality	Kulnura	Somersby	Northern Hawkesbury	Luddenham	The Oaks	Wilton	Sutton Forest
Cost item								
Site specific land and earthworks costs	Land acquisition	23	32	64	30	98	18	23
	Earthworks for site preparation	343	313	516	102	226	161	238
	Sub total	366	345	580	132	325	179	261
Generic airport construction costs	Runways/taxiways	46	46	46	46	46	46	46
	Apron surfaces	23	23	23	23	23	23	23
	Car parking	2	2	2	2	2	2	2
	Landing aids/lighting	5	5	5	5	5	5	5
	Terminal - international	0	0	0	0	0	0	0
	Terminal - domestic	67	67	67	67	67	67	67
	Other capital costs	3	3	3	3	3	3	3
	Contingency	44	44	44	44	44	44	44
	Project management and design	29	29	29	29	29	29	29
	Sub total	220	220	220	220	220	220	220
Supporting infrastructure costs	Road	0	0	0	0	262	80	0
	Rail	0	0	0	0	0	0	0
	Utilities	102	37	25	48	30	28	31
	Fuel	1	1	1	1	1	1	1
	Contingency	31	11	8	15	88	33	10
	Project management and design	21	8	5	10	59	22	6
	Sub total	154	57	39	74	439	164	48
Ongoing costs								
Renewal	Airport	733	733	733	733	733	733	733
	Supporting infrastructure	253	77	34	98	858	313	46
Maintenance	Airport	221	221	221	221	221	221	221
	Supporting infrastructure	77	86	97	93	266	58	94
	Sub total	1,284	1,117	1,085	1,145	2,078	1,326	1,094
Total Costs		**2,024**	**1,740**	**1,924**	**1,571**	**3,063**	**1,890**	**1,623**

Table 119: Phase 1 undiscounted values – Type 4 benefits (2011 million dollar terms)

	Locality	Kulnura	Somersby	Northern Hawkesbury	Luddenham	The Oaks	Wilton	Sutton Forest
Benefits								
Passenger Benefits	Consumer surplus	2,295	2,295	2,295	2,295	2,295	2,295	2,295
	Delay reduction	33	33	33	33	33	33	33
	Peak spreading	0	0	0	0	0	0	0
	Sub total	2,328	2,328	2,328	2,328	2,328	2,328	2,328
Wider economic benefits	Tourism benefits	231	231	231	231	231	231	231
	Freight benefits	1,318	1,318	1,318	1,318	1,318	1,318	1,318
	Sub total	1,549	1,549	1,549	1,549	1,549	1,549	1,549
Aircraft operations	Delay reduction	127	127	127	127	127	127	127
	Sub total	127	127	127	127	127	127	127
Road network impacts	Passenger land transport impacts	-1,767	-1,535	-797	-1,054	-1,547	-818	-1,806
	Freight land transport impacts	-2,665	-2,257	-1,969	-1,810	-2,422	-2,512	-4,020
	Sub total	-4,432	-3,792	-2,766	-2,864	-3,969	-3,331	-5,826
Environmental impacts	Noise abatement	-0	-2	-4	-2	-9	-0	-0
	Environmental dis-benefits - additional km	-134	-134	-134	-134	-134	-134	-134
	Sub total	-135	-137	-138	-137	-143	-135	-135
Total Benefits		**-564**	**75**	**1,099**	**1,002**	**-108**	**538**	**-1,957**

Table 120: Phase 1 discounted values – Type 4 costs (2011 million dollar terms, 7% discount rate)

	Locality	Kulnura	Somersby	Northern Hawkesbury	Luddenham	The Oaks	Wilton	Sutton Forest
Cost item								
Site specific land and earthworks costs	Land acquisition	12	17	35	16	54	10	12
	Earthworks for site preparation	169	154	254	50	111	79	117
	Sub total	181	172	288	66	165	89	129
Generic airport construction costs	Runways/taxiways	19	19	19	19	19	19	19
	Apron surfaces	9	9	9	9	9	9	9
	Car parking	1	1	1	1	1	1	1
	Landing aids/lighting	2	2	2	2	2	2	2
	Terminal - international	0	0	0	0	0	0	0
	Terminal - domestic	28	28	28	28	28	28	28
	Other capital costs	1	1	1	1	1	1	1
	Contingency	18	18	18	18	18	18	18
	Project management and design	12	12	12	12	12	12	12
	Sub total	91	91	91	91	91	91	91
Supporting infrastructure costs	Road	0	0	0	0	113	34	0
	Rail	0	0	0	0	0	0	0
	Utilities	44	16	11	21	13	12	13
	Fuel	0	0	0	0	0	0	0
	Contingency	13	5	3	6	38	14	4
	Project management and design	9	3	2	4	25	9	3
	Sub total	66	25	17	32	189	71	21
Ongoing costs								
Renewal	Airport	32	32	32	32	32	32	32
	Supporting infrastructure	7	2	1	3	20	7	1
Maintenance	Airport	17	17	17	17	17	17	17
	Supporting infrastructure	7	8	9	8	24	5	8
	Sub total	63	59	59	60	93	62	59
Total Costs		**401**	**346**	**455**	**249**	**537**	**312**	**300**

Table 121: Phase 1 discounted values – Type 4 benefits and results (2011 million dollar terms, 7% discount rate)

	Locality	Kulnura	Somersby	Northern Hawkesbury	Luddenham	The Oaks	Wilton	Sutton Forest
Benefits								
Passenger Benefits	Consumer surplus	182	182	182	182	182	182	182
	Delay reduction	8	8	8	8	8	8	8
	Peak spreading	0	0	0	0	0	0	0
	Sub total	190	190	190	190	190	190	190
Wider economic benefits	Tourism benefits	18	18	18	18	18	18	18
	Freight benefits	109	109	109	109	109	109	109
	Sub total	127	127	127	127	127	127	127
Aircraft operations	Delay reduction	31	31	31	31	31	31	31
	Sub total	31	31	31	31	31	31	31
Road network impacts	Passenger land transport impacts	-153	-133	-70	-92	-134	-73	-156
	Freight land transport impacts	-220	-186	-162	-149	-200	-207	-331
	Sub total	-373	-319	-232	-241	-334	-280	-488
Environmental impacts	Noise abatement	-0	-1	-1	-1	-3	-0	-0
	Environmental dis-benefits - additional km	-11	-11	-11	-11	-11	-11	-11
	Sub total	-11	-12	-12	-12	-14	-11	-11
Total Benefits		-35	18	105	95	1	58	-150
Results	Net Present Value	-437	-328	-350	-154	-537	-255	-450
	BCR	-0.09	0.05	0.23	0.38	0.00	0.18	-0.50

Appendix B Phase 2 Results

Table 122: Phase 2 undiscounted values – Type 1 costs (2011 million dollar terms)

	Locality	Nepean	Nepean	Nepean	Nepean	Cordeaux-Cataract	Cordeaux-Cataract	Burragorang	Hawkesbury	Central Coast	Central Coast
	Suitable site	Luddenham	Badgerys creek	Bringelly	Greendale	Wilton	Wallandoola	Mowbray Park	Wilberforce	Somersby	Wallarah
Cost item											
Site specific land and earthworks costs	Land acquisition	136	136	136	111	89	92	450	383	128	147
	Earthworks for site preparation	426	534	611	456	1,208	846	1,020	515	797	423
	Property purchase (ANEF 40)	9	19	10	6	2	4	45	22	7	56
	Sub total	571	688	756	573	1,298	941	1,516	919	932	625
Generic airport construction costs	Runways/taxiways	551	551	551	551	551	551	551	551	551	551
	Apron surfaces	274	274	274	274	274	274	274	274	274	274
	Car parking	202	202	202	202	202	202	202	202	202	202
	Landing aids/lighting	84	84	84	84	84	84	84	84	84	84
	Terminal - international	1,812	1,812	1,812	1,812	1,812	1,812	1,812	1,812	1,812	1,812
	Terminal - domestic	583	583	583	583	583	583	583	583	583	583
	Other capital costs	27	27	27	27	27	27	27	27	27	27
	Contingency	1,060	1,060	1,060	1,060	1,060	1,060	1,060	1,060	1,060	1,060
	Project management and design	707	707	707	707	707	707	707	707	707	707
	Sub total	5,300	5,300	5,300	5,300	5,300	5,300	5,300	5,300	5,300	5,300
Supporting infrastructure costs	Road	346	192	270	369	456	456	397	214	82	108
	Rail	1,130	1,130	1,130	1,130	1,100	1,630	930	1,320	2,190	740
	Utilities	239	329	389	538	139	154	99	184	139	139
	Fuel	324	445	526	729	484	538	321	380	511	511
	Contingency	612	629	694	830	654	833	524	629	876	449
	Project management and design	408	419	463	553	436	556	349	420	584	299
	Sub total	3,058	3,143	3,471	4,148	3,268	4,167	2,619	3,147	4,382	2,246
Other costs											
Renewal	Airport	10,678	10,678	10,678	10,678	10,678	10,678	10,678	10,678	10,678	10,678
	Supporting infrastructure	1,350	1,431	1,756	2,424	1,612	1,715	1,231	1,146	1,073	1,112
Maintenance	Airport	8,084	8,084	8,084	8,084	8,084	8,084	8,084	8,084	8,084	8,084
	Supporting infrastructure	1,922	2,022	2,134	2,389	1,918	2,647	1,564	2,122	3,254	1,379
	Sub total	22,034	22,215	22,652	23,576	22,293	23,125	21,558	22,031	23,090	21,254
Total Costs		**30,963**	**31,347**	**32,180**	**33,597**	**32,158**	**33,533**	**30,992**	**31,397**	**33,703**	**29,425**

Table 123: Phase 2 undiscounted values – Type 1 benefits (2011 million dollar terms)

	Locality	Nepean	Nepean	Nepean	Nepean	Cordeaux-Cataract	Cordeaux-Cataract	Burragorang	Hawkesbury	Central Coast	Central Coast
	Suitable site	Luddenham	Badgerys creek	Bringelly	Greendale	Wilton	Wallandoola	Mowbray Park	Wilberforce	Somersby	Wallarah
Benefits											
Passenger Benefits	Consumer surplus	193,623	193,623	193,623	193,623	193,623	193,623	193,623	193,623	193,623	193,623
	Delay reduction	6,151	6,151	6,151	6,151	6,151	6,151	6,151	6,151	6,151	6,151
	Peak spreading	57	57	57	57	57	57	57	57	57	57
	Sub total	199,832	199,832	199,832	199,832	199,832	199,832	199,832	199,832	199,832	199,832
Wider economic benefits	Tourism benefits	86,705	86,705	86,705	86,705	86,705	86,705	86,705	86,705	86,705	86,705
	Freight benefits	36,392	36,392	36,392	36,392	36,392	36,392	36,392	36,392	36,392	36,392
	Sub total	123,097	123,097	123,097	123,097	123,097	123,097	123,097	123,097	123,097	123,097
Aircraft operations	Delay reduction	16,220	16,220	16,220	16,220	16,220	16,220	16,220	16,220	16,220	16,220
	Sub total	16,220	16,220	16,220	16,220	16,220	16,220	16,220	16,220	16,220	16,220
Road network impacts	Passenger land transport impacts	-52,934	-53,242	-51,946	-57,929	-75,448	-76,246	-78,070	-51,059	-65,965	-88,539
	Freight land transport impacts	-48,384	-48,930	-45,219	-51,564	-66,239	-67,024	-71,879	-51,731	-63,013	-101,522
	Sub total	-101,318	-102,172	-97,165	-109,493	-141,687	-143,270	-149,950	-102,789	-128,979	-190,060
Environmental impacts	Noise abatement	-31	-30	-37	-18	-3	-12	-54	-97	-39	-98
	Environmental dis-benefits - additional km	-20,888	-20,888	-20,888	-20,888	-20,888	-20,888	-20,888	-20,888	-20,888	-20,888
	Sub total	-20,919	-20,918	-20,926	-20,906	-20,891	-20,900	-20,942	-20,985	-20,928	-20,987
Total Benefits		**216,911**	**216,058**	**221,058**	**208,749**	**176,570**	**174,978**	**168,257**	**215,374**	**189,242**	**128,101**

Table 124: Phase 2 discounted values – Type 1 costs (2011 million dollar terms, 7% discount rate)

	Locality	Nepean	Nepean	Nepean	Nepean	Cordeaux-Cataract	Cordeaux-Cataract	Burragorang	Hawkesbury	Central Coast	Central Coast
	Suitable site	Luddenham	Badgerys creek	Bringelly	Greendale	Wilton	Wallandoola	Mowbray Park	Wilberforce	Somersby	Wallarah
Capital (once off costs)											
Site specific land and earthworks costs	Land acquisition	49	49	49	40	32	33	163	139	46	53
	Property purchase (ANEF 40)	2	4	2	1	0	1	9	4	1	11
	Earthworks for site preparation	129	162	185	138	367	257	310	156	242	128
	Sub total	180	215	237	180	399	291	482	299	290	193
Generic airport construction costs	Runways/taxiways	122	122	122	122	122	122	122	122	122	122
	Apron surfaces	61	61	61	61	61	61	61	61	61	61
	Car parking	45	45	45	45	45	45	45	45	45	45
	Landing aids/lighting	19	19	19	19	19	19	19	19	19	19
	Terminal - international	400	400	400	400	400	400	400	400	400	400
	Terminal - domestic	129	129	129	129	129	129	129	129	129	129
	Other capital costs	6	6	6	6	6	6	6	6	6	6
	Contingency	234	234	234	234	234	234	234	234	234	234
	Project management and design	156	156	156	156	156	156	156	156	156	156
	Sub total	1,171	1,171	1,171	1,171	1,171	1,171	1,171	1,171	1,171	1,171
Supporting infrastructure costs	Road	76	42	59	81	100	100	87	47	18	24
	Rail	247	247	247	247	241	357	203	289	479	162
	Utilities	52	72	85	118	30	34	22	40	30	30
	Fuel	71	97	115	159	106	118	70	83	112	112
	Contingency	134	138	152	181	143	182	115	138	192	98
	Project management and design	89	92	101	121	95	122	76	92	128	66
	Sub total	669	688	760	907	715	912	573	688	959	491
Ongoing costs											
Renewal	Airport	300	300	300	300	300	300	300	300	300	300
	Supporting infrastructure	18	18	22	31	19	20	16	14	11	11
Maintenance	Airport	371	371	371	371	371	371	371	371	371	371
	Supporting infrastructure	105	110	116	130	104	144	85	115	177	75
	Sub total	793	799	810	832	795	835	772	800	859	757
Total Costs		**2,814**	**2,873**	**2,977**	**3,090**	**3,080**	**3,209**	**2,998**	**2,959**	**3,278**	**2,612**

Table 125Phase 2 discounted values – Type 1 benefits and results (2011 million dollar terms, 7% discount rate)

	Locality	Nepean	Nepean	Nepean	Nepean	Cordeaux-Cataract	Cordeaux-Cataract	Burragorang	Hawkesbury	Central Coast	Central Coast
	Suitable site	Luddenham	Badgerys creek	Bringelly	Greendale	Wilton	Wallandoola	Mowbray Park	Wilberforce	Somersby	Wallarah
Benefits											
Passenger Benefits	Consumer surplus	6,480	6,480	6,480	6,480	6,480	6,480	6,480	6,480	6,480	6,480
	Delay reduction	410	410	410	410	410	410	410	410	410	410
	Peak spreading	5	5	5	5	5	5	5	5	5	5
	Sub total	6,895	6,895	6,895	6,895	6,895	6,895	6,895	6,895	6,895	6,895
Wider economic benefits	Tourism benefits	2,982	2,982	2,982	2,982	2,982	2,982	2,982	2,982	2,982	2,982
	Freight benefits	1,512	1,512	1,512	1,512	1,512	1,512	1,512	1,512	1,512	1,512
	Sub total	4,494	4,494	4,494	4,494	4,494	4,494	4,494	4,494	4,494	4,494
Aircraft operations	Delay reduction	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138
	Sub total	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138
Road network impacts	Passenger land transport impacts	-2,089	-2,101	-2,050	-2,286	-2,993	-3,024	-3,096	-2,013	-2,612	-3,506
	Freight land transport impacts	-2,020	-2,043	-1,888	-2,153	-2,773	-2,806	-2,998	-2,159	-2,619	-4,219
	Sub total	-4,109	-4,144	-3,938	-4,439	-5,766	-5,831	-6,094	-4,172	-5,230	-7,724
Environmental impacts	Noise abatement	-7	-7	-8	-4	-1	-3	-12	-22	-9	-22
	Environmental dis-benefits - additional km	-715	-715	-715	-715	-715	-715	-715	-715	-715	-715
	Sub total	-722	-722	-724	-719	-716	-718	-727	-737	-724	-738
Total Benefits		**7,695**	**7,660**	**7,865**	**7,368**	**6,044**	**5,977**	**5,705**	**7,617**	**6,571**	**4,064**
Results	**NPV**	**4,881**	**4,788**	**4,888**	**4,278**	**2,964**	**2,769**	**2,707**	**4,658**	**3,293**	**1,452**
	BCR	**2.73**	**2.67**	**2.64**	**2.38**	**1.96**	**1.86**	**1.90**	**2.57**	**2.00**	**1.56**

Table 126: Phase 2 undiscounted values – Type 3 costs (2011 million dollar terms)

	Locality	Nepean	Nepean	Hawkesbury	Cordeaux-Cataract	Nepean	Nepean	Burragorang	Central Coast	Burragorang	Central Coast	Cordeaux-Cataract	Burragorang	Cordeaux-Cataract	Central Coast	Hawkesbury	Cordeaux-Cataract	Nepean
	Suitable site	Badgerys creek	Bringelly	Castlereagh	Dendrobium	Greendale	Luddenham	Mowbray Park	Peats Ridge	Silverdale	Somersby	Southend	The Oaks	Wallandoola	Wallarah	Wilberforce	Wilton	Kemps Creek
Cost item																		
Site specific land and earthworks costs	Land acquisition	56	59	201	36	56	57	194	63	58	67	35	189	36	63	123	34	58
	Earthworks for site preparation	242	465	201	380	339	189	558	620	695	647	756	734	518	276	294	519	144
	Property acquisition (40 ANEF)	8	4	8	0	2	4	2	1	0	3	0	11	1	47	4	0	8
	Sub total	305	528	410	416	397	250	754	684	752	716	791	933	555	386	421	553	210
Generic airport construction costs	Runways/taxiways	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84
	Apron surfaces	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131
	Car parking	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	Landing aids/lighting	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
	Terminal - international	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Terminal - domestic	852	852	852	852	852	852	852	852	852	852	852	852	852	852	852	852	852
	Other capital costs	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
	Contingency	345	345	345	345	345	345	345	345	345	345	345	345	345	345	345	345	345
	Project management and design	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230
	Sub total	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724
Supporting infrastructure costs	Road	192	270	214	367	369	346	397	258	426	82	450	324	456	73	214	456	126
	Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Utilities	93	110	23	18	152	68	22	91	104	30	22	35	44	3	32	40	51
	Fuel	136	160	81	54	222	99	91	393	428	131	68	143	135	13	112	122	74
	Contingency	126	162	95	132	223	154	153	222	287	73	162	150	190	27	107	185	75
	Project management and design	84	108	63	88	149	102	102	148	192	49	108	100	127	18	71	123	50
	Sub total	630	809	476	658	1,114	768	765	1,112	1,437	364	809	751	952	134	536	925	375
Other costs																		
Renewal	Airport	6,754	6,754	6,754	6,754	6,754	6,754	6,754	6,754	6,754	6,754	6,754	6,754	6,754	6,754	6,754	6,754	6,754
	Supporting infrastructure	600	774	457	648	1,064	746	752	1,018	1,374	333	333	333	333	333	333	333	381
Maintenance	Airport	4,754	4,754	4,754	4,754	4,754	4,754	4,754	4,754	4,754	4,754	4,754	4,754	4,754	4,754	4,754	4,754	4,754
	Supporting infrastructure	237	296	148	177	408	246	214	426	494	140	218	229	278	37	176	266	137
	Sub total	12,346	12,578	12,114	12,333	12,981	12,500	12,474	12,952	13,377	11,982	12,059	12,071	12,119	11,878	12,018	12,107	12,026
Total Costs		15,004	15,639	14,723	15,131	16,215	15,241	15,717	16,472	17,290	14,786	15,384	15,478	15,350	14,122	14,699	15,309	14,335

Table 127: Phase 2 undiscounted values – Type 3 benefits (2011 million dollar terms)

	Locality	Nepean	Nepean	Hawkesbury	Cordeaux-Cataract	Nepean	Nepean	Burragorang	Central Coast	Burragorang	Central Coast	Cordeaux-Cataract	Burragorang	Cordeaux-Cataract	Central Coast	Hawkesbury	Cordeaux-Cataract	Nepean
	Suitable site	Badgerys creek	Bringelly	Castlereagh	Dendrobium	Greendale	Luddenham	Mowbray Park	Peats Ridge	Silverdale	Somersby	Southend	The Oaks	Wallandoola	Wallarah	Wilberforce	Wilton	Kemps Creek
Benefits																		
Passenger Benefits	Consumer surplus	31,473	31,473	31,473	31,473	31,473	31,473	31,473	31,473	31,473	31,473	31,473	31,473	31,473	31,473	31,473	31,473	31,473
	Delay reduction	2,040	2,040	2,040	2,040	2,040	2,040	2,040	2,040	2,040	2,040	2,040	2,040	2,040	2,040	2,040	2,040	2,040
	Peak spreading	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	Sub total	33,525	33,525	33,525	33,525	33,525	33,525	33,525	33,525	33,525	33,525	33,525	33,525	33,525	33,525	33,525	33,525	33,525
Wider economic benefits	Tourism benefits	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172	3,172
	Freight benefits	10,305	10,305	10,305	10,305	10,305	10,305	10,305	10,305	10,305	10,305	10,305	10,305	10,305	10,305	10,305	10,305	10,305
	Sub total	13,477	13,477	13,477	13,477	13,477	13,477	13,477	13,477	13,477	13,477	13,477	13,477	13,477	13,477	13,477	13,477	13,477
Aircraft operations	Delay reduction	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148
	Sub total	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148	7,148
Road network impacts	Passenger land transport impacts	-20,579	-20,078	-21,831	-30,153	-22,390	-20,460	-29,192	-25,948	-21,976	-24,631	-22,425	-27,159	-28,511	-33,060	-19,641	-28,213	-19,078
	Freight land transport impacts	-14,238	-13,158	-17,215	-21,428	-15,005	-14,079	-20,666	-21,374	-14,891	-17,669	-13,842	-18,865	-19,894	-28,467	-15,293	-19,662	-12,702
	Sub total	-34,817	-33,236	-39,047	-51,581	-37,395	-34,539	-49,858	-47,322	-36,867	-42,300	-36,266	-46,024	-48,406	-61,527	-34,934	-47,874	-31,780
Environmental impacts	Noise abatement	-8	-6	-32	-1	-4	-3	-4	-2	-1	-5	-0	-9	-1	-34	-7	-1	-13
	Environmental dis-benefits - additional km	-1,845	-1,845	-1,845	-1,845	-1,845	-1,845	-1,845	-1,845	-1,845	-1,845	-1,845	-1,845	-1,845	-1,845	-1,845	-1,845	-1,845
	Sub total	-1,852	-1,850	-1,877	-1,845	-1,849	-1,848	-1,849	-1,847	-1,846	-1,850	-1,845	-1,854	-1,846	-1,879	-1,852	-1,846	-1,857
Total Benefits		17,481	19,064	13,227	724	14,907	17,763	2,443	4,981	15,437	10,000	16,039	6,273	3,899	-9,255	17,364	4,431	20,513

Table 128: Phase 2 discounted values - Type 3 costs (2011 million dollar terms, 7% discount rate)

	Locality	Nepean	Nepean	Hawkesbury	Cordeaux-Cataract	Nepean	Nepean	Burragorang	Central Coast	Burragorang	Central Coast	Cordeaux-Cataract	Burragorang	Cordeaux-Cataract	Central Coast	Hawkesbury	Cordeaux-Cataract	Nepean
	Suitable site	Badgerys creek	Bringelly	Castlereagh	Dendrobium	Greendale	Luddenham	Mowbray Park	Peats Ridge	Silverdale	Somersby	Southend	The Oaks	Wallandoola	Wallarah	Wilberforce	Wilton	Kemps Creek
Cost item																		
Site specific land and earthworks costs	Land acquisition	30	32	109	20	30	31	106	34	31	36	19	103	20	34	67	18	32
	Earthworks for site preparation	119	229	99	187	167	93	274	305	342	318	372	361	254	136	145	255	71
	Property acquisition (40 ANEF)	3	1	3	0	1	1	1	1	0	1	0	4	1	18	2	0	3
	Sub total	152	262	211	206	198	126	381	340	373	355	391	467	275	188	213	274	105
Generic airport construction costs	Runways/taxiways	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
	Apron surfaces	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
	Car parking	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
	Landing aids/lighting	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
	Terminal - international	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Terminal - domestic	347	347	347	347	347	347	347	347	347	347	347	347	347	347	347	347	347
	Other capital costs	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	Contingency	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140
	Project management and design	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94	94
	Sub total	702	702	702	702	702	702	702	702	702	702	702	702	702	702	702	702	702
Supporting infrastructure costs	Road	82	116	92	158	159	149	171	111	183	35	194	139	196	31	92	196	54
	Rail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Utilities	40	47	10	8	66	29	10	39	45	13	9	15	19	1	14	17	22
	Fuel	58	69	35	23	95	42	39	169	184	56	29	61	58	6	48	52	32
	Contingency	54	70	41	57	96	66	66	96	124	31	70	65	82	12	46	80	32
	Project management and design	36	46	27	38	64	44	44	64	82	21	46	43	55	8	31	53	22
	Sub total	271	348	205	283	479	330	329	479	618	157	348	323	410	58	231	398	162
Other costs																		
Renewal	Airport	262	262	262	262	262	262	262	262	262	262	262	262	262	262	262	262	262
	Supporting infrastructure	16	20	11	17	28	20	19	23	34	7	7	7	7	7	7	7	10
Maintenance	Airport	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230
	Supporting infrastructure	25	32	16	19	44	26	23	46	53	15	23	25	30	4	19	28	15
	Sub total	533	544	520	528	564	538	535	561	579	515	523	524	530	504	519	528	517
Total Costs		**1,658**	**1,857**	**1,637**	**1,719**	**1,943**	**1,696**	**1,947**	**2,081**	**2,272**	**1,729**	**1,964**	**2,017**	**1,916**	**1,451**	**1,664**	**1,902**	**1,485**

Table 129: Phase 2 discounted values – Type 3 benefits and results (2011 million dollar terms, 7% discount rate)

	Locality	Nepean	Nepean	Hawkesbury	Cordeaux-Cataract	Nepean	Nepean	Burragorang	Central Coast	Burragorang	Central Coast	Cordeaux-Cataract	Burragorang	Cordeaux-Cataract	Central Coast	Hawkesbury	Cordeaux-Cataract	Nepean
	Suitable site	Badgerys creek	Bringelly	Castlereagh	Dendrobium	Greendale	Luddenham	Mowbray Park	Peats Ridge	Silverdale	Somersby	Southend	The Oaks	Wallandoola	Wallarah	Wilberforce	Wilton	Kemps Creek
Benefits																		
Passenger Benefits	Consumer surplus	1,524	1,524	1,524	1,524	1,524	1,524	1,524	1,524	1,524	1,524	1,524	1,524	1,524	1,524	1,524	1,524	1,524
	Delay reduction	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360	360
	Peak spreading	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	Sub total	1,886	1,886	1,886	1,886	1,886	1,886	1,886	1,886	1,886	1,886	1,886	1,886	1,886	1,886	1,886	1,886	1,886
Wider economic benefits	Tourism benefits	154	154	154	154	154	154	154	154	154	154	154	154	154	154	154	154	154
	Freight benefits	466	466	466	466	466	466	466	466	466	466	466	466	466	466	466	466	466
	Sub total	619	619	619	619	619	619	619	619	619	619	619	619	619	619	619	619	619
Aircraft operations	Delay reduction	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309
	Sub total	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309	1,309
Road network impacts	Passenger land transport impacts	-1,085	-1,058	-1,151	-1,614	-1,180	-1,078	-1,562	-1,387	-1,158	-1,317	-1,200	-1,453	-1,526	-1,767	-1,036	-1,510	-1,005
	Freight land transport impacts	-645	-596	-778	-969	-679	-637	-935	-966	-674	-799	-626	-854	-900	-1,287	-691	-890	-575
	Sub total	-1,729	-1,654	-1,930	-2,583	-1,859	-1,716	-2,497	-2,353	-1,832	-2,115	-1,826	-2,307	-2,426	-3,054	-1,727	-2,399	-1,580
Environmental impacts	Noise abatement	-2	-1	-7	-0	-1	-1	-1	-0	-0	-1	-0	-2	-0	-8	-2	-0	-3
	Environmental dis-benefits - additional km	-89	-89	-89	-89	-89	-89	-89	-89	-89	-89	-89	-89	-89	-89	-89	-89	-89
	Sub total	-91	-91	-97	-89	-90	-90	-90	-90	-90	-90	-89	-91	-90	-97	-91	-90	-92
Total Benefits		**1,994**	**2,070**	**1,788**	**1,142**	**1,865**	**2,009**	**1,227**	**1,371**	**1,892**	**1,609**	**1,899**	**1,416**	**1,299**	**663**	**1,996**	**1,325**	**2,142**
Results	**NPV**	336	213	151	-578	-78	313	-720	-709	-379	-120	-65	-601	-617	-788	332	-576	656
	BCR	1.20	1.11	1.09	0.66	0.96	1.18	0.63	0.66	0.83	0.93	0.97	0.70	0.68	0.46	1.20	0.70	1.44

Appendix C Phase 3 Results

Table 130: Phase 3 undiscounted values – costs (2011 million dollar terms)

	Locality	North South 4000 metre runway	East West Scenario A	East West Minimum Scenario A
Cost item				
Site specific land and earthworks costs	Land acquisition	463	263	263
	Earthworks for site preparation	363	0	0
	Sub total	826	263	263
Generic airport construction costs	Runways/taxiways	799	62	12
	Apron surfaces	545	21	7
	Car parking	185	11	4
	Landing aids/lighting	95	33	3
	Terminal - international	1,641	0	0
	Terminal - domestic	762	51	15
	Other capital costs	625	82	36
	Contingency	1,181	78	23
	Project management and design	2,149	120	31
	Sub total	7,980	458	130
Supporting infrastructure costs	Road	888	0	0
	Rail	309	0	0
	Utilities	48	0	0
	Fuel	209	0	0
	Contingency	369	0	0
	Project management and design	671	0	0
	Sub total	2,492	0	0
Ongoing costs				
Renewal	Airport	16,493	1,495	456
	Supporting infrastructure	2,043	0	0
Maintenance	Airport	7,512	1,570	347
	Supporting infrastructure	1,368	0	0
	Sub total	27,417	3,065	803
Total Costs		**38,715**	**3,785**	**1,196**

Table 131: Phase 3 undiscounted values – benefits (2011 million dollar terms)

Locality		North South 4000 metre runway	East West Scenario A	East West Minimum Scenario A
Benefits				
Passenger Benefits	Consumer surplus	120,741	10,258	2,187
	Delay reduction	713	185	23
	Peak spreading	26	2	0
	Sub total	121,480	10,445	2,211
Wider economic benefits	Tourism benefits	50,920	1,048	231
	Freight benefits	72,321	8,939	5,405
	Sub total	123,241	9,987	5,636
Aircraft operations	Delay reduction	1,404	384	49
	Sub total	1,404	384	49
Road network impacts	Passenger land transport impacts	-33,396	-4,679	-1,022
	Freight land transport impacts	-25,860	-10,333	-6,491
	Sub total	-59,256	-15,012	-7,512
Environmental impacts	Noise abatement	-28	-9	-5
	Environmental dis-benefits - additional km	-12,616	-609	-135
	Sub total	-12,644	-618	-139
Total Benefits		174,225	5,186	244

Table 132: Phase 3 discounted values – costs (2011 million dollar terms, 7% discount rate)

	Locality	North South 4000 metre runway	East West Scenario A	East West Minimum Scenario A
Cost item				
Site specific land and earthworks costs	Land acquisition	137	125	125
	Earthworks for site preparation	93	0	0
	Sub total	230	125	125
Generic airport construction costs	Runways/taxiways	167	25	5
	Apron surfaces	114	9	3
	Car parking	39	5	2
	Landing aids/lighting	20	13	1
	Terminal - international	342	0	0
	Terminal - domestic	159	21	6
	Other capital costs	130	34	15
	Contingency	246	32	9
	Project management and design	448	49	12
	Sub total	1,665	186	53
Supporting infrastructure costs	Road	194	0	0
	Rail	68	0	0
	Utilities	10	0	0
	Fuel	46	0	0
	Contingency	81	0	0
	Project management and design	147	0	0
	Sub total	545	0	0
Ongoing costs				
Renewal	Airport	542	114	34
	Supporting infrastructure	30	0	0
Maintenance	Airport	293	102	28
	Supporting infrastructure	74	0	0
	Sub total	940	216	62
Total Costs		**3,380**	**527**	**240**

Table 133: Phase 3 discounted values – benefits (2011 million dollar terms, 7% discount rate)

	Locality	North South 4000 metre runway	East West Scenario A	East West Minimum Scenario A
Benefits				
Passenger Benefits	Consumer surplus	4,699	644	154
	Delay reduction	93	47	6
	Peak spreading	3	1	0
	Sub total	4,795	691	160
Wider economic benefits	Tourism benefits	2,128	68	18
	Freight benefits	2,523	433	320
	Sub total	4,652	501	338
Aircraft operations	Delay reduction	185	97	14
	Sub total	185	97	14
Road network impacts	Passenger land transport impacts	-1,232	-288	-76
	Freight land transport impacts	-1,541	-518	-393
	Sub total	-2,773	-807	-470
Environmental impacts	Noise abatement	-6	-3	-2
	Environmental dis-benefits - additional km	-520	-40	-11
	Sub total	-526	-43	-13
Total Benefits		**6,333**	**440**	**30**
Results	**NPV**	**2,952**	**-87**	**-210**
	BCR	**1.87**	**0.83**	**0.13**

Appendix D Qualitative analysis

Figure 11: Qualitative analysis – Scoring thresholds

	Indicator	-3	-2	-1	0	+1	+2	+3
Strategic growth alignment	► Capacity to expand from a Type 3 airport site to a Maximum Type 1 airport site**	N/A	N/A	N/A	No	N/A	N/A	Yes
	► Existing employment land within 15 km of the site (both commercial and industrial)	N/A	N/A	N/A	0	1 to 1,000	1,001 to 3,000	Greater than 3,000
	► Potential employment land (including investigation areas) within 15km of the site (ha)	N/A	N/A	N/A	0	1 to 15,000	15,001 to 30,000	Greater than 30,000
	► Volume of employment at strategic growth centres within 30 mins of site, divided by access time from site	N/A	N/A	N/A	0	1 to 1,000	1,001 to 2,000	Greater than 2,000
Social and cultural	► Population living in airport footprint for a maximum type airport (based on 2006 Census)	Greater than 500	251 to 500	1 to 250	0	N/A	N/A	N/A
	► Total number of zoned allotments within site area	Greater than 1,000	501 to 1,000	101 to 500	0 to 100	N/A	N/A	N/A
	► Number of Indigenous cultural heritage items within site boundaries for a maximum type airport *	Greater than 10	6 to 10	1 to 5	0	N/A	N/A	N/A
Environmental	► Proximity to World Heritage Areas *	Within WHA	N/A	On edge of WHA	Not close to WHA	N/A	N/A	N/A
	► Area of National and/or State Parks/Conservation areas affected by site under a maximum type airport *	Greater than 200 ha	101 to 200	1 to 100	0	N/A	N/A	N/A
	► Total number of 'Protected', 'Vulnerable', 'Endangered' and 'Critically Endangered' flora and fauna species within footprint of airport for a maximum type airport *	Greater than 200	51 to 200	11 to 50	0 to 10	N/A	N/A	N/A
Noise	► Total population within 25 ANEF contour	Greater than 5,000	1,001 to 5000	1 to 1000	0	N/A	N/A	N/A
	► Area of sensitive land use likely to be affected by noise greater than 25 ANEF Zones 2 and 5 or R1-R5 or SP 1& 3 (ha)	Greater than 1,000	501 to 1,000	101 to 500	0 to 100	N/A	N/A	N/A
	► Number of N70 person events (noise events above 70 decibels) **	Greater than 1,000,000	500,001 to 1,000,000	100,001 to 500,000	1 to 100,000	N/A	N/A	N/A

* Only included in Phase 1 analysis

** Only included in Phase 2 analysis

Figure 12: Phase 1 Qualitative analysis – Scores and weights

	Indicator	Central Mangrove-Kulnura	Central Coast	Hawkesbury	Nepean	Burragorang	Cordeaux-Cataract	Southern Highlands	Weighting
Strategic growth alignment	► Existing employment land within 15 km of the site (both commercial and industrial)	0	1,110	290	1,660	180	190	1170	20%
		0	+2	+1	+2	+1	+1	+2	
	► Potential employment land (including investigation areas) within 15km of the site (ha)	42350	32,960	44,350	30,330	35,590	16,710	22050	40%
		+3	+3	+3	+3	+3	+1	+2	
	► Volume of employment at strategic growth centres within 30 mins of site, divided by access time from site	420	480	1,440	3,050	170	170	0	40%
		+1	+1	+2	+3	+1	+1	0	
Social and cultural	► Population living in airport footprint for a maximum type airport (based on 2006 Census)	50	140	280	140	530	30	30	50%
		-1	-1	-2	-1	-3	-1	-1	
	► Total number of zoned allotments within site area	130	190	162	119	190	30	192	20%
		-1	-1	-1	-1	-1	0	-1	
	► Number of Indigenous cultural heritage items within site boundaries	0	4	0	3	0	3	0	30%
		0	-1	0	-1	0	-1	0	
Environmental	► Proximity to World Heritage Areas	0	0	Edge of BMs	Edge of BMs	Edge of BMs	0	0	40%
		0	0	-1	-1	-1	0	0	
	► Area of National and/or State Parks/Conservation areas affected by site under a maximum type airport	10	10	0	0	0	290	0	30%
		-1	-1	0	0	0	-3	0	
	► Total number of 'Protected', 'Vulnerable', 'Endangered' and 'Critically Endangered' flora and fauna species within footprint of airport for a maximum type airport	18	268	21	9	1	23	4	40%
		-1	-3	-2	-1	-2	-1	-1	
Noise	► Total population within 25 ANEF contour	270	5730	1890	590	1340	250	170	50%
		-1	-3	-2	-1	-2	-1	-1	
	► Area of sensitive land use likely to be affected by noise greater than 25 ANEF Zones 2 and 5 or R1-R5 or SP 1&3 (ha)	1130	150	40	20	10	0	140	50%
		-3	-1	0	0	0	0	-1	

Figure 13: Phase 2 Qualitative Analysis – Type 1 (Maximum)

	Indicator		Central Coast Wallarah	Central Coast Somersby	Hawkesbury Wilberforce	Nepean Luddenham	Nepean Badgerys Creek	Nepean Bringelly	Nepean Greendale	Burragorang Mowbray Park	Cordeaux -Cataract Wilton	Cordeaux - Cataract Wallandoola	Weighting
Strategic economic considerations	▸ Existing employment land within 15 km of the site (both commercial and industrial)		1,110	1,110	290	1,660	1,660	1,660	1,660	180	190	190	20%
			+2	+2	+1	+2	+2	+2	+2	+1	+1	+1	
	▸ Potential employment land (including investigation areas) within 15km of the site (ha)		32,960	32,960	44,350	30,330	30,330	30,330	30,330	35,590	16,710	16,710	40%
			+3	+3	+3	+3	+3	+3	+3	+3	+2	+2	
	▸ Volume of employment at strategic growth centres within 30 mins of site, divided by access time from site		480	480	1,440	3,050	3,050	3,050	3,050	170	170	170	40%
			+1	+1	+2	+3	+3	+3	+3	+1	+1	+1	
Social and cultural	▸ Population living in airport footprint for a maximum type airport (based on 2006 Census)		1,120	170	940	210	490	250	150	130	70	130	65%
			-3	-1	-3	-2	-2	-1	-1	-1	-1	-1	
	▸ Total number of zoned allotments within site area		500	190	380	140	40	180	70	100	40	10	35%
			-1	-1	-1	-1	0	-1	0	0	0	0	
Noise	▸ Total population within 25 ANEF contour		3,420	790	2,290	1,170	1,360	970	650	3,250	130	240	30%
			-2	-1	-2	-2	-2	-1	-1	-2	-1	-1	
	Area of sensitive land use likely to be affected by noise greater than 25 ANEF Zones 2 and 5 or R1-R5 or SP 1&3 (ha)	Schools	0	0	1	2	0	1	0	0	0	0	20%
			0	0	-1	-2	0	-1	0	0	0	0	
		Businesses	0	1	3	0	2	2	2	1	0	0	10%
			0	-1	-3	0	-2	-2	-2	-1	0	0	
		Other	0	1	1	0	0	0	0	0	0	0	10%
			0	-1	-1	0	0	0	0	0	0	0	
	▸ Number of N70 person events (noise events above 70 decibels)		2,534,20 0	670,600	2,020,800	1,545,200	1,668,000	1,284,600	499,200	799,400	81,500	324,800	30%
			-3	-2	-3	-3	-3	-3	-1	-2	0	-1	

Figure 14: Phase 2 Qualitative Analysis – Type 3

	Indicator		Central Coast Wallarah	Central Coast Peats Ridge	Central Coast Somersby	Hawkesbury Wilberforce	Hawkesbury Castlereagh (RAAF Relocated)	Nepean Luddenham	Nepean Kemps Creek	Nepean Badgerys Creek	Nepean Bringelly	Nepean Greendale	Weighting
Strategic economic considerations	► Capacity to expand from a Type 3 airport site to a Maximum Type 1 airport site		Yes	No	Yes	No	No	Yes	No	Yes	Yes	Yes	25%
			+3	0	+3	0	0	+3	0	+3	+3	+3	
	► Existing employment land within 15 km of the site (both commercial and industrial)		1,110	1,110	1,110	290	290	1,660	1,660	1,660	1,660	1,660	25%
			+2	+2	+2	+1	+1	+2	+2	+2	+2	+2	
	► Potential employment land (including investigation areas) within 15km of the site (ha)		32,960	32,960	32,960	44,350	44,350	30,330	30,330	30,330	30,330	30,330	25%
			+3	+3	+3	+3	+3	+3	+3	+3	+3	+3	
	► Volume of employment at strategic growth centres within 30 mins of site, divided by access time from site		480	480	480	1,440	1,440	3,050	3,050	3,050	3,050	3,050	25%
			+1	+1	+1	+2	+2	+3	+3	+3	+3	+3	
Social and cultural	► Population living in airport footprint for a maximum type airport (based on 2006 Census)		960	50	110	200	600	100	570	180	120	60	65%
			-3	-1	-1	-1	-3	-1	-3	-1	-1	-1	
	► Total number of zoned allotments within site area		200	110	140	100	180	80	200	10	150	40	35%
			-1	-1	-1	0	-1	0	-1	0	-1	0	
Noise	► Total population within 25 ANEF contour		1,880	90	160	280	510	160	610	380	210	130	30%
			-2	-1	-1	-1	-1	-1	-1	-1	-1	-1	
	Area of sensitive land use likely to be affected by noise greater than 25 ANEF Zones 2 and 5 or R1-R5 or SP 1&3 (ha)	Schools	0	0	0	1	3	2	1	0	1	0	20%
			0	0	0	-1	-3	-2	-1	0	-1	0	
		Businesses	0	2	1	2	0	0	3	2	0	1	10%
			0	-2	-1	-2	0	0	-3	-2	0	-1	
		Other	0	1	2	0	2	0	4	0	0	1	10%
			0	-1	-2	0	-2	0	-4	0	0	-1	
	► Number of N70 person events (noise events above 70 decibels)		1,048,700	45,500	236,600	172,800	1,085,400	206,300	330,300	200,700	179,200	104,800	30%
			-3	0	-1	-1	-3	-1	-1	-1	-1	-1	

Figure 15: Phase 2 Qualitative Analysis – Type 3 Continued

	Indicator		Burragorang Silverdale	Burragorang The Oaks	Burragorang Mowbray Park	Cordeaux -Cataract Southend	Cordeaux -Cataract Wilton	Cordeaux - Cataract Wallandoola	Cordeaux - Cataract Dendrobium	Weighting
Strategic growth alignment	▸ Capacity to expand from a Type 3 airport site to a Maximum Type 1 airport site		No	No	Yes	No	Yes	Yes	No	25%
			0	0	+3	0	+3	+3	0	
	▸ Existing employment land within 15 km of the site (both commercial and industrial)		180	180	180	190	190	190	190	25%
			+1	+1	+1	+1	+1	+1	+1	
	▸ Potential employment land (including investigation areas) within 15km of the site (ha)		35,590	35,590	35,590	16,710	16,710	16,710	16,710	25%
			+3	+3	+3	+2	+2	+2	+2	
	▸ Volume of employment at strategic growth centres within 30 mins of site, divided by access time from site		170	170	170	170	170	170	170	25%
			+1	+1	+1	+1	+1	+1	+1	
Social and cultural	▸ Population living in airport footprint for a maximum type airport (based on 2006 Census)		0	430	70	20	30	50	10	65%
			0	-2	-1	-1	-1	-1	-1	
	▸ Total number of zoned allotments within site area		40	70	40	10	10	5	5	35%
			0	0	0	0	0	0	0	
Noise	▸ Total population within 25 ANEF contour		30	500	140	20	40	70	10	30%
			-1	-1	-1	-1	-1	-1	-1	
	Area of sensitive land use likely to be affected by noise greater than 25 ANEF Zones 2 and 5 or R1-R5 or SP 1&3 (ha)	Schools	0	0	0	0	0	0	0	20%
			0	0	0	0	0	0	0	
		Businesses	0	0	0	0	0	0	0	10%
			0	0	0	0	0	0	0	
		Other	0	0	0	0	0	0	0	10%
			0	0	0	0	0	0	0	
	▸ Number of N70 person events (noise events above 70 decibels)		42,100	194,900	159,600	27,200	19,800	29,400	26,100	30%
			0	-1	-1	0	0	0	0	

Appendix E Reference List

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WorleyParsons/AMPC (2011), Analysis of most suitable aviation sites

Appendix F Initial assessment of supporting infrastructure for airport sites

Department of Infrastructure and Transport

Sydney Basin Airports Study

Initial Assessment of Supporting Infrastructure for Airport Sites

221188

Final | June 2011

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Input into Economic Modelling

Executive Summary

Arup has been engaged by Ernst & Young to investigate the supporting infrastructure for three airport development scenarios at seven specific locations within the Sydney Basin for the Department of Infrastructure and Transport (the "Department") as part of the project titled *Provision of analysis and advice on issues relating to investment in airport infrastructure (Agreement number:10003623).*

The purpose of the study is to:

- Identify at a high level the supporting infrastructure requirements for a variety of airport scenarios and sites.
- Develop high level comparative capital cost estimates for the likely supporting infrastructure for a variety of airport scenarios and sites.
- Develop high level comparative operating and maintenance cost estimates for supporting infrastructure for a variety of airport scenarios and sites.
- Develop high level comparative cost estimates for potential site levelling and preparation for a variety of airport scenarios and sites.
- Identify major differentiators between the sites with respect to the provision of supporting infrastructure and site levelling and preparation.

This study has proceeded with the fundamental assumption that the apparent latent capacity in the existing infrastructure networks (where identified) is available to this project. This has been investigated through qualitative assessment of publicly available data only. It is critical that this assessment is validated with the relevant government departments and could have a significant impact on the cost estimates presented.

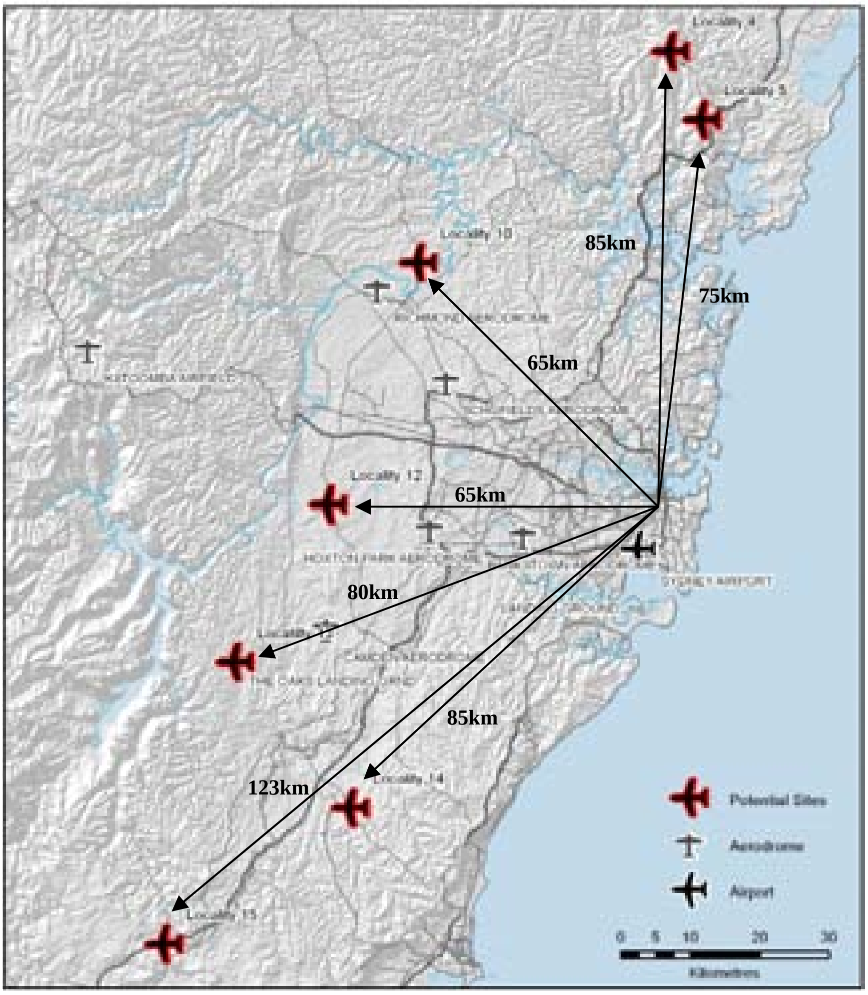
Scope of Study

Airport Localities

The study investigated a range of airport localities nominated by the Department, and focussed on the following seven nominated airport localities.

Locality	Geographic Locality descriptor	Principal Local Government Area
4	Kulnura	Gosford
5	Somersby	Gosford
10	Wilberforce	Hawkesbury
12	Luddenham	Liverpool
13	The Oaks	Wollondilly
14	Wilton	Wollondilly
15	Sutton Forest	Wingecarribee

Figure 1 – Airport localities



Airport Scenarios

At each locality the following three airport development scenarios were investigated:

Airport Development Scenario	Type 2	Type 4	Transition from Type 2 to Type 1 (Type 1 statistics below)
Category	Land Constrained full service international airports servicing all RPT segments	Minimum service airport servicing GA and limited RPT	Full Service International airport servicing all RPT segments
Indicative Land Use	400 Ha	120 Ha	Varies between 1,000 Ha and 1,800 Ha
Annual Passengers	5 million	0.5 million	32.6[1] million

Note 1: Based on passenger forecast at year 16 of transition profile (supplied by Ernst & Young)

Cost Estimates

For each combination of airport scenario and locality the following three indicative cost estimates have been developed for the potential supporting infrastructure. These estimates rely on industry cost information provided by Turner and Townsend. The cost estimates are not intended to be for budget purposes but are for high level comparison of options:

1. Capital expenditure
2. Operating and maintenance expenditure
3. Site levelling and preparation expenditure

Study Methodology

Infrastructure Design

The "supporting infrastructure" considered in this report comprises the infrastructure required for the operation of the airport which is outside of the airport boundary. This comprises the major elements of road, rail, water, wastewater, power, communication, gas and fuel services.

The individual infrastructure demands were generated through two methods:

a) Benchmarking against existing airports

b) Developed from airport annual passenger numbers or airport floor space

The infrastructure required to meet these demands was assessed (e.g. number of roads, pipe size, etc.). In addition the level of redundancy for each asset class and airport scenario was assessed based on standard industry guidelines. For each specific site the infrastructure connections from the airport to the existing networks were assessed at a high level using the information that is readily available in the public domain. Given the confidential nature of the work, it was not possible to liaise with the various infrastructure authorities to clarify the suitability of connections or future network capacity plans. With the information available these connections were assessed for notional feasibility and refined

Site Levelling and Preparation

An assessment was completed to estimate the likely cost to develop a clear and level site for each airport scenario at each locality. At each site the geology, the presence of acid sulfate soils, the number of buildings and coverage of vegetation was broadly assessed using what information was available. A preliminary earthworks model was completed to achieve a level site with a cut to fill balance with an excess of 10% cut. Topographic data used in this analysis was generally of low detail with 10m contour intervals.

Cost Estimates

Unit rates for the potential infrastructure were developed by utilising benchmarked recent similar projects and standard industry information. Utilising these, capital cost estimates were developed for each asset for each airport scenario at each site.

Operating and maintenance cost estimates were developed by using a corrective and preventative maintenance approach specific for each infrastructure asset over its design life.

The site levelling and preparation cost estimates were developed by applying industry construction unit rates to excavation (rock and soil), vegetation clearance, building demolition, treatment of acid sulfate soils and offsite disposal.

Findings

A major finding of the study is that surface transportation connections (road and rail) dominate the capital cost estimates. This in turn is strongly influenced by the existing transport infrastructure providing access to each site. The proportion of the cost estimates for surface transportation is 64% for Type 2, 43% for Type 4 and 70% for the transition from Type 2 to Type 1.

Capital cost estimates were included for a potential rail link for a Type 1 airport at each site for the purpose of identifying cost relativities. These are indicative based on a notional rail route only, without the development of route feasibility or transport analysis studies.

The operating and maintenance cost estimates are not expected to be a significant differentiator between the sites. The range between the highest and the lowest is less than the capital cost estimates.

The site levelling and preparation costs are a significant cost to the overall project. However they have been generated on a theoretical basis with minimal or no airport planning design work being completed to date. Further work is required to refine the airport site layout and design to improve the accuracy of these cost estimates.

Capital Expenditure

The following table summarises the supporting infrastructure cost estimates for each airport site and development scenario.

Table 1 - Summary of capital expenditure

Site	Type 2 Airport ($M)	Type 4 Airport ($M)	Transition from Type 2 to Type 1 ($M)[1]
Kulnura	1,300	160	7,500
Somersby	600	60	4,100
Wilberforce	3,700	40	7,600
Luddenham	1,200	80	2,600
The Oaks	1,600	270	5,500

Site	Type 2 Airport ($M)	Type 4 Airport ($M)	Transition from Type 2 to Type 1 ($M)[1]
Wilton	1,300	170	4,100
Sutton Forest	1,100	50	8,000

Note 1: These figures are the total capital expenditure over the 16 year transition period including the initial construction

Operational and Maintenance Expenditure

The operational and maintenance expenditure is made up of two components:

- Preventative maintenance – includes inspections, general repairs and is a consistent annual cost throughout the design life
- Corrective maintenance – includes replacement of parts, re-conditioning and occurs at intervals throughout the design life

Both categories are specific for each infrastructure asset. As such, it is not possible to present one summary cost estimate for the operating and maintenance costs. Refer to the individual locality summaries in this report or Appendix E for details.

Site Levelling and Preparation Expenditure

The following table summarises the total nominal site levelling and preparation cost estimate for each airport site and development scenario.

Table 2 – Summary of site levelling and preparation expenditure

Site	Type 2 Airport ($M)	Type 4 Airport ($M)	Transition from Type 2 to Type 1 ($M)[1]
Kulnura	900	230	9,500
Somersby	1,600	360	7,000
Wilberforce	1,200	300	3,100
Luddenham	600	30	4,700
The Oaks	2,200	410	5,500
Wilton	1,000	170	6,100

Site	Type 2 Airport ($M)	Type 4 Airport ($M)	Transition from Type 2 to Type 1 ($M)[1]
Sutton Forest	1,000	300	5,000

Note 1: These figures include the total nominal site preparation costs over the 16 year transition period including in the initial construction.

Key differentiators between sites

The following are some of the key differentiators between the sites:

- Kulnura has the highest volume of excavation and the highest (with Somersby) proportion of rock. Combined, these result in a relatively high site preparation cost estimate particularly for the Type 1 airport.
- Wilberforce has a relatively high proportion of rock but has the lowest volume of excavation required and therefore the lowest site preparation cost.
- The transition to Type 1 requires significant transport infrastructure at all localities. A key factor in the cost estimates is the proximity to major transport corridors. The localities that are furthest from the Sydney CBD require long rail connections and longer lengths of significant road upgrades. This results in Localities 4 and 15 having a comparatively high capital cost.
- Other sites lack existing high capacity transport corridors of note and will require new connections back to existing main roads. This results in high transport infrastructure costs for Localities 10 and 13, particularly for the transition scenario.
- Luddenham benefits from having multiple access routes to the site with existing transport corridors deemed to be feasible for upgrading. This is a key factor in its relatively low transport costs, particularly for the transition scenario.
- Somersby benefits from its proximity to the F3 and incurs a low transport cost for Type 2 and 4 airports. For the increased demand in the transition to Type 1, the F3 requires additional works and this benefit is reduced.

Limitations

No consultation with stakeholders has been permitted or undertaken throughout the development of this study. As a result assumptions and engineering judgement have been used where information on existing assets is not publicly available. It has not been possible to confirm with the appropriate authorities the impact that the airport development will have on their wider infrastructure network. Subsequently assumptions have been made in lieu of consultation and this will impact the accuracy and appropriateness of the cost estimates. Estimates are not intended to be for budget purpose but are intended to be for comparison of options and assessment of the scale of supporting infrastructure.

Next Steps

The following are steps that can be taken in order to advance the study and increase the accuracy and depth of the infrastructure concepts and the confidence of the cost estimates:

- Engage senior strategic personnel in the key state government authorities to discuss and refine the feasibility of the surface transportation connections proposed in this study. The key stakeholders would be the RTA, RailCorp and the NSW Department of Transport. The airport's infrastructure planning needs to be integrated into the Sydney Metropolitan Plan and the strategic plans for these organisations.
- Discuss the proposed works with the utility owners of each network (e.g. Transgrid, Integral Energy, Jemena, Shell, Caltex, Telstra, Sydney Water). This will allow a more accurate view on the condition of the existing assets at the time of the airport's development. It will also define if major augmentation works are required to the existing networks which is a key risk at the moment.
- Investigate in more detail the surface transportation routes nominated. Develop accurate connections into the existing network and assess the feasibility of the chosen corridors. This will increase the confidence of the cost estimates.
- Seek feedback from the Department on the site selection process and potentially refine the number of localities under consideration.
- Examine the remaining sites in further detail considering the following issues:
  - The expected interaction of the second Sydney airport with the existing Sydney KSA;
  - The airport layouts including site boundary, runway orientation, building location and envelopes; and
  - Investigate the subsequent development that will surround the establishment of an airport and include the infrastructure requirements of these areas in future planning.

1 Introduction

Arup has been engaged by Ernst & Young to investigate the supporting infrastructure for three airport development scenarios at seven specific locations within the Sydney Basin for the Department of Infrastructure and Transport (the “Department”) as part of the project titled *Provision of analysis and advice on issues relating to investment in airport infrastructure (Agreement number:10003623).*

The purpose of the study and this report is to:

- Identify at a high level the supporting infrastructure requirements for a variety of airport scenarios and sites.
- Develop high level comparative capital cost estimates for the likely supporting infrastructure for a variety of airport scenarios and sites.
- Develop high level comparative operating and maintenance cost estimates for supporting infrastructure for a variety of airport scenarios and sites.
- Develop high level comparative cost estimates for potential site levelling and preparation for a variety of airport scenarios and sites.
- Identify major differentiators between the sites with respect to the provision of supporting infrastructure and site levelling and preparation.

1.1 Context

During December 2010 Ernst & Young, Airbiz, Arup and Turner & Townsend developed the *Assumptions Book* for this project (Draft issued to the Department 16 December 2010). This report documented the assumptions and methodology used to estimate costs and revenues for the generic airport scenarios provided by the Department.

During January 2011 Arup and Turner & Townsend developed the *Supporting Infrastructure Capital Expenditure for Site Specific Scenarios* (Revision 3 issued to the Department 17 February 2011). This report documented the supporting infrastructure capital expenditure for four airport scenarios at the two specific locations of Richmond (brownfield site) and Wilton (greenfield site).

Throughout March and April 2011, investigation has focussed on a series of airport localities and development scenarios and this report has focused on those identified in Section 1.2.

1.2 Scope of Study

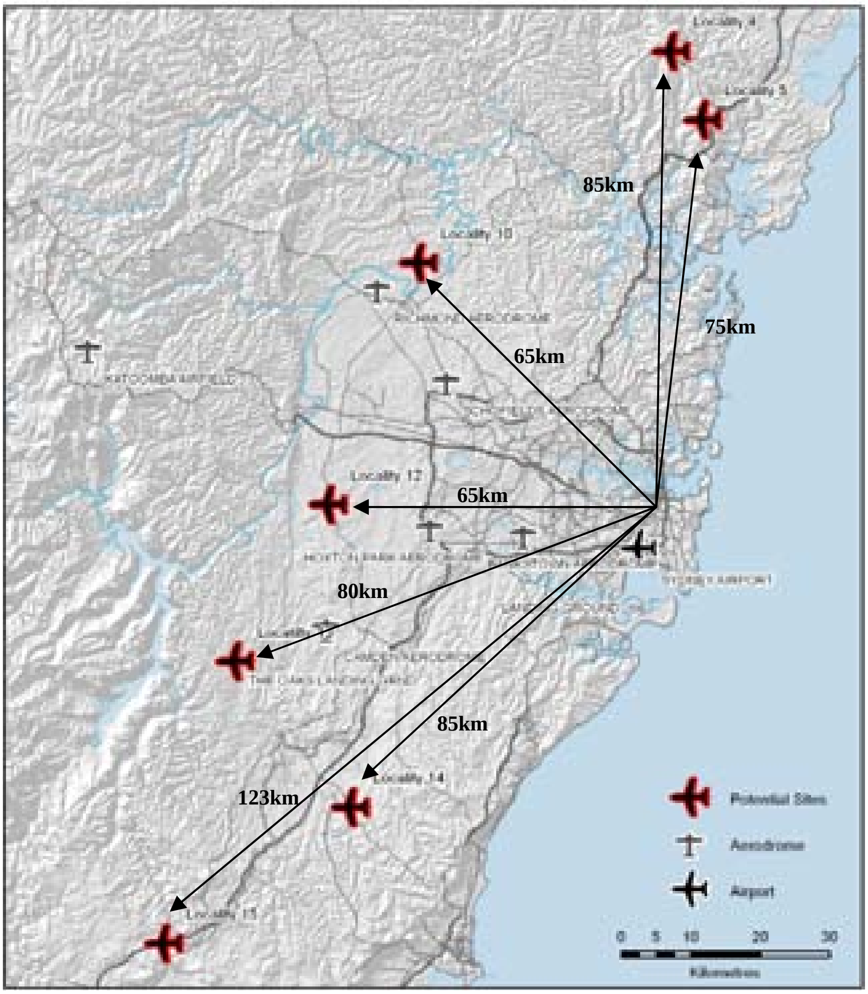
1.2.1 Airport Localities

The study investigated a range of airport localities nominated by the Department, and focussed on the following seven nominated airport localities.

Locality	Geographic Locality descriptor	Principal Local Government Area
4	Kulnura	Gosford

Locality	Geographic Locality descriptor	Principal Local Government Area
5	Somersby	Gosford
10	Wilberforce	Hawkesbury
12	Luddenham	Liverpool
13	The Oaks	Wollondilly
14	Wilton	Wollondilly
15	Sutton Forest	Wingecarribee

Figure 2 – Airport localities



The localities as nominated by the Department are in Appendix D.

1.2.2 Airport Scenarios

At each locality the following three airport development scenarios were investigated:

Airport Development Scenario	Type 2	Type 4	Transition from Type 2 to Type 1 (Type 1 statistics below)
Category	Land Constrained full service international airports servicing all RPT segments	Minimum service airport servicing GA and limited RPT	Full Service International airport servicing all RPT segments
Indicative Land Use	400 Ha	120 Ha	Varies between 1,000 Ha and 1,800 Ha
Annual Passengers	5 million	0.5 million	32.6[1] million

Note 1: Based on passenger forecast at year 16 of transition profile (supplied by Ernst & Young)

Refer to Appendix C and the "Comparative Assessment of Greenfields" prepared by Worley Parsons for further details of each airport development scenario.

1.2.3 Cost Estimates

For each combination of airport scenario and locality the following three indicative cost estimates have been developed for the potential supporting infrastructure. These estimates rely on industry cost information provided by Turner and Townsend. The cost estimates are not intended to be for budget purposes but are for high level comparison of options:

1. Capital expenditure
2. Operating and maintenance expenditure
3. Site levelling and preparation expenditure

1.2.4 Supporting Infrastructure

The "supporting infrastructure" is considered to be all the infrastructure required for the operation of the airport which is outside of the airport boundary. This includes the following infrastructure types:

- Road
- Rail
- Water
- Wastewater
- Power
- Communications
- Gas
- Fuel

1.3 Limitations

This report was prepared for the purpose of providing the Department with high level capital, operating and maintenance and site levelling and preparation cost estimates to compare at multiple airport locations.

No consultation with stakeholders has been permitted or undertaken throughout the development of this study. As a result assumptions and engineering judgement have been used where information on existing assets is not publicly available. It has not been possible to confirm with the appropriate authorities the impact that the airport development will have on their wider infrastructure network. Subsequently assumptions have been made in lieu of consultation and this will impact the accuracy and appropriateness of the cost estimates. Estimates are not intended to be for budget purpose but are intended to be for comparison of options and assessment of the scale of supporting infrastructure.

1.4 Disclaimer

Whilst every care has been taken in preparing this report, Arup and its sub consultants (including their collective directors, servants, and agents) will not accept any responsibility or liability to any person or corporation seeking to rely on information, advice or opinion provided in this publication for any loss or damage, whatever nature suffered by such person or corporation.

This report may not have considered issues relevant to any third parties. Any use such third parties may choose to make of our document is entirely at their own risk and we shall have no responsibility whatsoever in relation to any such use. This document should not be provided to any third parties without our prior approval and without them recognising in writing that we assume no responsibility or liability whatsoever to them in respect of the contents of our deliverables.

1.5 Methodology

The methodology for calculating the infrastructure demands utilised in this study is presented in detail in Appendix B. Refer to Appendix B for a full description of the methodology used and a summary of infrastructure demands for each airport development scenario.

1.6 Structure of Report

Section 1 - Introduction – Discusses the context of the study, limitations of the results and outlines the disclaimer of the content

Section 2 – Locality 4 - presents the supporting infrastructure for Kulnura

Section 3 – Locality 5 - presents the supporting infrastructure for Somersby

Section 4 – Locality 10 - presents the supporting infrastructure for Wilberforce

Section 5 – Locality 12 - presents the supporting infrastructure for Luddenham

Section 6 – Locality 13 - presents the supporting infrastructure for The Oaks

Section 7 – Locality 14 - presents the supporting infrastructure for Wilton

Section 8 – Locality 15 - presents the supporting infrastructure for Sutton Forest

Section 9 – Summary - summarises the capital expenditure, the assumptions and risks employed in the study

Appendix A – Figures – presents figures for each infrastructure type at each locality

Appendix B – Methodology

Appendix C – Airport characteristics for template airports

Appendix D – Airport Localities

Appendix E – Input to Economic Modelling

The cost estimate information is presented in several locations in the report. The following table is a summary of where to find the appropriate cost estimate by locality, airport scenario and type of cost estimate. The numbers refer to report sections and the letters to Appendices.

Table 3 - Summary of cost estimate locations in report

	Type 2 Airport			**Type 4 Airport**			**Transition from Type 2 to Type 1**		
Locality	**Cap**	**O&M**	**Site**	**Cap**	**O&M**	**Site**	**Cap**	**O&M**	**Site**
Kulnura	2.10	2.10	9.3	2.10	2.10	9.3	E	E	9.3
Somersby	3.10	3.10	9.3	3.10	3.10	9.3	E	E	9.3
Wilberforce	4.10	4.10	9.3	4.10	4.10	9.3	E	E	9.3
Luddenham	5.10	5.10	9.3	5.10	5.10	9.3	E	E	9.3
The Oaks	6.10	6.10	9.3	6.10	6.10	9.3	E	E	9.3
Wilton	7.10	7.10	9.3	7.10	7.10	9.3	E	E	9.3
Sutton Forest	8.10	8.10	9.3	8.10	8.10	9.3	E	E	9.3

2 Locality 4 – Kulnura

2.1 Introduction

Kulnura is located in the vicinity of Somersby, within the Gosford Council, approximately 85km north of Sydney. This site is located on a dissected montane plateau with some undulating rural land along long linear ridge lines. Adjacent water streams include tributaries of the Macdonald River and the Mangrove Creek and access is possible from Peats Ridge Road and George Downes Drive.

2.2 Site Issues

The proposed locality comprises the Brisbane Water National Park, the Jilliby State Conservation Area, the Palm Grove Nature Reserve and the Popran National Park. Locating an airport in this area would affect 775ha of State Forests.

In addition, “vulnerable” and “endangered” fauna and flora species are present in this area as well as aboriginal sites.

2.3 Surface Transport

2.3.1 Existing Infrastructure

2.3.1.1 Road

Road access to Kulnura is primarily via the F3 Sydney – Newcastle Freeway. Access to/from Sydney is via Peats Ridge Road from the F3 interchange at Calga. Access to/from Gosford and Newcastle is via the Peats Ridge / Central Mangrove interchange at Somersby.

Publicly available historical traffic data for these roads, accessible within the short timeframe for the analysis for this site are very dated, with no count data available after 2001.

Trend growth rates from these historical data to a future year of 2021 (assumed to be the earliest likely opening year for an airport allowing for planning and environmental investigations) indicate that the F3 Freeway will require widening from the current general four-lane two-way freeway standard between Kariong and Wyong to six-lane two-way freeway standard. This was assumed to occur for a base case with no airport.

Trend growth rates for Peats Ridge Road between Central Mangrove and the F3 Freeway at Somersby indicate that the current two-lane two-way standard with overtaking lanes will accommodate baseline traffic growth to 2021.

Trend growth rates for George Downes Drive between Central Mangrove and the airport site at Kulnura indicate that the current two-lane two-way standard will also accommodate baseline traffic growth to 2021.

There is only one recorded observation in public traffic data for Peats Ridge Road between Peats Ridge and Calga, this being from 1986, near to/adjacent a quarry site. It is unclear the extent to which traffic from the quarry influenced this observation or the level of traffic growth along this section Peats Ridge Road. An assumption of 2% linear growth per annum for this location from 1986 to 2021 would indicate that this section of Peats Ridge Road requires upgrading to four-lane two-way standard with no airport development. The surrounding area appears to be largely semi-rural with market gardens, so it is possible that vehicles servicing the market gardens could lead to future traffic volume increases. However the potential for growth in these vehicles is unlikely to be high unless significant redevelopment and/or increases in agricultural production occur. As such the available information was not considered sufficiently reliable or robust to assume widening of Peats Ridge Road between Peats Ridge and Calga for a do minimum case with no airport development.

Figure 4-3a shows the base case road upgrades assumed for Kulnura.

2.3.1.2 Rail

The nearest existing rail station is at Ourimbah, which is on the non-electrified Newcastle and Central Coast Line. The station can also be reached by the electrified North Shore and Western Line during peak hours. Ourimbah Railway Station is approximately 30 km by road from Kulnura.

2.3.1.3 Bus

Busways and Red Bus Services currently serve the Gosford and Wyong areas but do not extend as far west as Kulnura.

2.3.1.4 Taxi

Kulnura lies outside the Sydney Metropolitan Transport District and the Newcastle Transport District. Sydney and Newcastle taxis may drop off passengers at Kulnura but may not pick up passengers at Kulnura, and must return to a location within their own district without passengers. Kulnura lies within the Central Coast Region, and only Central Coast based taxis may pick up passengers from the site.

2.3.2 Type 2 Airport

2.3.2.1 Road

Analysis of airport generated traffic for development of an initial stage Type 2 airport at Kulnura indicates the following road network upgrades are required in addition to assumed baseline / do minimum upgrades:

- Upgrade Peats Ridge Road/George Downes Drive between F3 Freeway Calga interchange and airport to four-lanes divided with clearways;
- Undertake safety and passing / overtaking assessment of the eastern section of Peats Ridge Road between the airport site and the F3 Somersby interchange.

Figure 4-3b shows the road upgrades identified for an initial stage Type 2 airport at Kulnura.

2.3.2.2 Rail

Previous discussion in supporting reports has indicated there is no requirement for a rail link to a Type 2 airport in the initial stage of development.

2.3.2.3 Bus

Connecting bus services for a Type 2 airport at Kulnura should be provided to Gosford (to connect to rail services locally and to Sydney) and also potentially dedicated services to Sydney and Newcastle.

2.3.3 Type 4 Airport

2.3.3.1 Road

Analysis of airport generated traffic for the development of an initial stage Type 4 airport at Kulnura suggests that no road network upgrades would be required in addition to assumed baseline / do minimum upgrades.

2.3.3.2 Rail

Previous discussion in supporting reports has indicated there is no requirement for a rail link to a Type 4 airport in the initial stage of development.

2.3.3.3 Bus

Connecting bus services could be provided from a Type 4 airport at Kulnura to Gosford to connect to rail services locally and to Newcastle and Sydney.

2.3.4 Transition from Type 2 to Type 1 Airport

Transport upgrades for the transition from a Type 2 to a Type 1 airport were derived using trend analysis at five-year intervals from 2021 to 2036, from a starting point of the infrastructure that was identified for the initial stage Type 2 airport.

The passenger growth scenario for this transition was provided to Arup. These imply substantial growth in passenger numbers, starting at over 20% per annum in the early years of transition and tapering to 8% per annum by year 15 of transition. Forecasts of airport-related traffic generation for these increases in passenger numbers are described in the transport analysis methodology in Appendix B.

In several cases the trend extrapolation of baseline traffic on key access roads over a 25-year period to 2036 results in substantial traffic volumes, requiring significant infrastructure upgrades regardless of any airport development, and sometimes with substantial cost implications. The scope of the work however is such that baseline road upgrades could not be fully considered in the context of wider network performance or management and budgetary strategies. Computerised transport network modelling would provide improved outcomes for baseline traffic volume estimates balanced across wider network and land-use/demographic outcomes.

2.3.4.1 Road

Trend growth rates for the F3 Freeway to 2026, 2031 and 2036 with airport-related traffic indicate that extensive work will be required to provide capacity for transition from a Type 2 to a Type 1 airport at Kulnura. The suggested scale of widening of the F3 Freeway over a long distance implies significant expense.

Based on assumptions of passenger growth for the transition from a Type 2 to a Type 1 airport provided to Arup, baseline plus airport-related traffic estimates indicate the following road network upgrades by 2026 above the initial stage Type 2 airport works:

- Widen the F3 Freeway from Sydney to the Calga interchange from 6-lane freeway to 8-lane freeway;
- Widen Peats Ridge Road between the F3 Freeway Somersby interchange and George Downes Drive to 4-lanes undivided;
- Upgrade Peats Ridge Road between the F3 Freeway Calga interchange and George Downes Drive to a 4-lane motorway standard (however refer to the description in Section 2.3.1.1 regarding the paucity of traffic data and subsequent growth assumptions used for this section of road);
- Upgrade George Downes Drive between Peats Ridge Road and the airport site to 4-lane motorway standard.

By 2031, baseline plus airport traffic estimates indicate the following works requirements:

- Widen the F3 Freeway between Calga interchange and Wyong from 6-lane freeway to 8-lane freeway;
- Widen Peats Ridge Road from the F3 Freeway Calga interchange and George Downes Drive to 6-lane motorway standard (again refer to the description in Section 2.3.1.1 regarding assumptions for this section of road);
- Widen Yarramalong Road between the F3 Freeway and George Downes Drive from 2-lanes undivided to 4-lanes undivided.

No further upgrades are indicated to cater for projected baseline plus airport traffic volumes to 2036.

2.3.4.2 Rail

Previous working papers of this study have discussed that the provision of dedicated rail access is generally not justifiable for Type 2, 3 and 4 airports, and is more a question of transport policy goals for a Type 1 airport rather than a question of providing necessary capacity, until passenger numbers reach over approximately 45m per annum.

The discussion identified nonetheless that planning for a Type 1 airport at a greenfield site should include considerations for the provision of a rail link from the time of opening, to support transport sustainability and mobility goals and to enhance the service quality standard of the airport as measured in international rankings.

The provision of an airport link is requires substantial study outside the scope of this work. In the case of Kulnura, the provision of rail access might potentially have impacts on the ongoing requirements for upgrading of the F3 Freeway.

For the purposes of providing indicative capital costings only, a notional rail access link has been identified for Kulnura as it reaches Type 1 standard in 2036, via a new dual track rail service from the airport terminal station to Ourimbah Station. This should connect to the existing non-electrified Newcastle and Central Coast Line or the electrified North Shore and Western Line. No feasibility analysis has been undertaken for this notional line.

Figure 4-2/1-3 shows the road and rail upgrades indicated by the analysis for transition from a Type 2 to a Type 1 airport at Kulnura.

2.3.4.3 Bus

Connecting bus services for the transition period from Type 2 to Type 1 airport at Kulnura should be provided to Gosford (to connect to rail services locally and to Sydney) and also potentially dedicated services to Sydney and Newcastle.

As the airport reaches Type 1 status and/if a rail link is introduced, bus services to Sydney and Newcastle would require to be reviewed in the context of the new rail service.

2.4 Water

2.4.1 Existing Infrastructure

Kulnura is located in a region where the water supply is managed and supplied collaboratively between Gosford City Council and Wyong Shire Council through the Gosford/Wyong Councils’ Water Authority. The water supply on the Central Coast is the third largest urban water supply system in NSW and the Authority owns two water treatment plants which are connected via a transfer main. These treatment plants are located at Somersby in Gosford City and Mardi in Wyong Shire, respectively 25km and 35km from the proposed site.

2.4.2 Type 2 Airport

Proposed Infrastructure

It is proposed to provide a water supply to Kulnura from the existing Somersby water treatment plant, located 25km southeast from the proposed site, off Myoora Road. This new connection will be a 200mm diameter pipeline following George Downes Drive, Wisemans Ferry Road and Somersby Falls Road. A new pumping station (11L/s at 145m) at the treatment plant and on site storage (1ML capacity) at the airport will be provided for the airport’s water supply system. In addition, disinfection will likely to be required and a hypochlorite dosing system has been included in the proposed works (0.08kg/hr Cl equivalent hypo dosing unit).

Figure 4-4 in Appendix A shows the existing and proposed water supply network for Kulnura.

Issues to Consider

- Capacity of the existing Somersby water treatment plant is unconfirmed.

2.4.3 Type 4 Airport

Proposed Infrastructure

For a Type 4 airport, the water supply strategy will be similar to the strategy proposed for the Type 2 Airport and will be a connection to the existing Somersby water treatment plant. The proposed connection will be a 100mm diameter pipeline, a pumping station (11L/s at 135m) and storage tanks (0.5ML total capacity). A hypochlorite dosing system has also been included (0.008kg/hr Cl equivalent hypo dosing unit) as the disinfection system.

Refer to Figure 4-4 in Appendix A for a visual of the proposed works.

Issues to Consider

- Capacity of the existing Somersby water treatment plant is unconfirmed.

2.4.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The transition from a Type 2 airport to a Type 1 airport will occur over a 16 year period with the passenger capacity increasing from 5 million to 30 million. The water supply infrastructure required for this transition will be constructed in three stages:

- This initial water supply infrastructure will comprise a 200mm diameter pipeline, a new pumping station (11L/s at 145m) at the treatment plant, on site storage (11ML capacity) and a chlorination unit (0.25kg/hr Cl equivalent hypo dosing unit).
- It is then proposed to upgrade the works after 5 years by including larger pipes and providing additional storage capacity (11ML). Increasing the chlorination rate to 0.6kg/hr Cl equivalent hypo dosing unit will also be required.
- 10 years after the initial works, additional storage capacity will be required (11ML).

Figure 4-2/1-4 in Appendix A summarises the transition works for Kulnura.

Issues to Consider

- Capacity of the existing Somersby water treatment plant is unconfirmed.
- The growth of the surrounding area over the transition period will influence the timing and extent of water supply infrastructure upgrades.

2.5 Wastewater

2.5.1 Existing Infrastructure

Kulnura is located in a region where the wastewater supply is managed and supplied by the Gosford City Council. Gosford City Council operates two wastewater treatment plants located in Woy Woy and Kincumber, respectively 40km and 45km southeast of the proposed site. The Woy Woy plant is an "extended aeration activated-sludge" plant providing wastewater treatment for the Woy Woy Peninsula including Woy Woy Bay, Pearl Beach and Patonga. It serves around 40,000 customers and treats close to 10 million litres (ML) of flow on average each day. The Kincumber plant uses the same process and serves 140,000 customers in Gosford City including Gosford, Wyoming, Narara, Lisarow, and Kariong, treating up to 30 million litres (ML) on average each day[1].

There is also a wastewater treatment plant in Tuggerah, approximately 25 km by road from the proposed site which is managed by the Wyong Council.

2.5.2 Type 2 Airport

Kulnura is located within the Gosford City Council. Due to the distance to the nearest wastewater treatment facilities within this council, it is proposed to provide a new wastewater treatment plant on site. This will require the re-use of effluent in the airport vicinity and an allowance of $10 million was included in the cost estimate for the collection, treatment and disposal of the airport's wastewater.

Figure 4-4 in Appendix A shows the existing and proposed wastewater supply network for Kulnura.

Issues to Consider

- Footprint availability for a new wastewater treatment plant within the site boundary is unconfirmed.

2.5.3 Type 4 Airport

Proposed Infrastructure

For a Type 4 airport, the wastewater supply strategy will be similar to the strategy proposed for the Type 2 Airport. It is proposed to provide a new wastewater treatment plant on site.

Refer to Figure 4-4 in Appendix A for a visual of the proposed works.

Issues to Consider

- Footprint availability for a new wastewater treatment plant within the site boundary is unconfirmed.

[1] Gosford City Council

2.5.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The transition from a Type 2 airport to a Type 1 airport will occur over a 16 year period with the passenger capacity increasing from 5 million to 30 million. The wastewater supply infrastructure required for this transition will be constructed in two stages:

- This initial phase will need to provide a new wastewater treatment plant with four times the capacity of what was initially allowed for a Type 2 airport.
- It is then proposed to upgrade the works after 5 years increasing the capacity of this plant by 150%.

Figure 4-2/1-4 in Appendix A summarises the transition works for Kulnura.

Issues to Consider

- The growth of the surrounding area over the transition period will influence the timing and extent of wastewater supply infrastructure upgrades.

2.6 Power

2.6.1 General

This section describes the bulk supply of power to a Type 2 and Type 4 airport at Kulnura. The internal distribution of power around the airport itself is not discussed.

The existing infrastructure is assumed to be similarly affected by both types of airport developments. The runway at Kulnura is assumed to be orientated along the long axis of the site, i.e. south-east / north-west orientation.

The internal distribution of power is not described within this report for each site as the internal configuration will be similar for each airport type at any of the sites.

2.6.2 Existing Infrastructure

Kulnura has existing electricity services traversing and bordering the site. These are:

- The Transgrid Kemps Creek – Eraring 500kV transmission line, which is a north-east / south-west orientated overhead transmission line positioned in the north-west part of the site.
- Transgrid Sydney West – Eraring / Vales Point / Munmorah 330kV transmission lines, which are north-east / south-west orientated overhead transmission lines positioned to the south-east of the site.

- Ausgrid (previously known as Energy Australia) distribution high voltage and low voltage power lines for the provision of power to the properties within the area and further up George Downs Drive and other local roads.

All the existing electrical services within the proposed site will be affected by the proposed airport.

Any distribution high voltage and low voltage power lines that are required to be retained due to them servicing properties outside the site will need to be positioned in service easements outside of the site. Operational clearances may require lines to be placed underground for some sections, and this will be affected by the runway orientation yet to be determined. The relocation of these services is not expected to cause major disruptions and can be readily programmed with any works in the area.

The Transgrid Kemps Creek – Eraring 500kV transmission line will require relocation as this passes through the north-west part of the site. Two of the Transgrid Sydney West – Eraring / Vales Point / Munmorah 330kV transmission lines to the south-east of the site are anticipated as requiring relocation due to operational clearances.

The options for relocation are:

- direct bury on the same alignment
- install a cable tunnel on the same alignment
- divert above ground

The options of direct bury and a cable tunnel may have operational considerations that may rule them out, and these have not been considered further at this stage. Possible routes for each transmission line have been shown in Figure 4-5. As no discussions with Transgrid have been undertaken, these routes will need to be investigated further and any final route will be determined by Transgrid, with the final routes may result in longer sections of transmission lines to be relocated.

Should this site become the selected site for the airport, Transgrid will need to be advised as early as possible to allow the planning, design and procurement to avoid delay in the overall programme.

2.6.3 Type 2 Airport

Proposed Infrastructure

The site is located in the Central Coast area of Ausgrid's network. Supply to the site will be from Ausgrid's network.

All power lines have been assumed to be overhead wiring. The possibility of utilising existing easements is considered minimal and the cost for new easements needs to be considered.

Supply to the airport site will require a new substation to be established, with supply from Ausgrid.

Ausgrid have 33kV assets in the vicinity of the site, but based on current published details on available capacity on these assets, these will not have sufficient capacity to service the airport's 9MVA demand without augmentation of the existing 33kV lines.

Two bulk supplies could be obtained at 66kV from Ausgrid. Ausgrid's existing Sub-Transmission Substations (STS) in the vicinity of the site are Ourimbah STS and Gosford STS. These supplies and the electrical network supplying the airport will be fully rated to provide a redundant supply and configured to provide N-1 security. Each STS is located approximately 25km from the site...

It has been assumed that the existing STS's have the secure capacity to supply the initial demand of the airport at 66kV, based on the projected loads to 2016 as published by Ausgrid in their 2011 Electricity System. Augmentation works, such as the installation of additional circuit breakers and possibly new bus bars, is anticipated at each site.

It is anticipated that the airport will be a high voltage customer. Supply within the airport is anticipated to be reticulated at 11kV to distribution substations.

Issues to Consider

Relocation of Transgrid's assets in the vicinity of the airport will require considerable time to plan and implement. These assets are some of the main supplies to Sydney. In addition, the route for relocation noted on the sketches are arbitrary, and with further detailed analysis may require more significant re-routing then assumed. This will ne be fully understood until discussions with Transgrid can be undertaken, and further detailed planning and design has occurred.

The timeframe when supply would be required could result in other options that Ausgrid may have for supply to the site due to network planning considerations, and Ausgrid would need to be consulted to ascertain the most likely supply option. This includes the planned growth for the site, which may result in different options.

Route selection for the transmission lines can take considerable time to resolve. The use of existing easements, if available and suitable for use, is preferable to establishing new easements, especially if the area that is requiring to be traversed is already developed. This will require further investigation.

Transmission lines installation should be rated to provide the planned future demands for the site to minimise the need for costly augmentation works on the transmission lines. Ratings of other equipment should also be selected to deal with planned demand growth while considering the design life of the installed electrical assets.

2.6.4 Type 4 Airport

Proposed Infrastructure

Supply to the airport site, with a capacity of 1.7MVA, will likely be at low voltage, from a new Ausgrid substation connected to the nearest 11kV network. The 11kV network may require to be extended to the required site.

Issues to Consider

The relocation of Transgrid assets as discussed above is the main issue identified.

2.6.5 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

With supply to the site at 66kV, there will be sufficient capacity in the supply if the transmission lines are rated appropriately, as has been assumed. The design life of other electrical equipment assets, such as transformers and switchgear, is generally greater then 30 years, and the projected growth of the airport is anticipated to require the full anticipated demand after 10 years, within the assets lifetime. On this basis, it is assumed that any new equipment installed initially for the Type 2 Airport will be rated for the planned demand growth expected for a Type 1 airport, including the associated business park.

The maximum demand for a Type 1 airport, including the associated business park, is anticipated to be 64MVA. This size load is expected to exceed the secure capacity available from Ausgrid’s STS’s at Ourimbah and Gosford, requiring augmentation works to increase capacity of both.

The augmentation works anticipated include additional transformers and switchgear at each STS, and an increase in the rating of the 132kV network supplying the STS’s.

Issues to Consider

The planning and implementation required to upgrade any of Ausgrid’s network is to be factored in any development, and is considered to be considerable time.

Other augmentation works on Ausgrid’s network may be required as a consequence of any upgrades.

2.7 Communications

2.7.1 Existing Infrastructure

Telecommunications services are predominantly provided by Telstra. There are ADSL exchanges at Kulnura and Yarramalong. However, ADSL is considered not capable of sufficient bandwidth and services reliability for communications needs of airport and business operations.

2.7.2 Type 2 Airport

Proposed Infrastructure

Telecommunications services are necessary to support the airport operations, passengers and the community around. For business continuity reasons, resilient and alternative supplies are considered essential. As contrasted to a single point connection, diverse routes will enhance availability of telecommunications services. Fibre cable has much higher bandwidth capacity than copper cable or microwave transmission. Therefore, fibre cable is the preferred means of telecommunication backbone. Wyong exchange and Gosford exchange are nominated as telecommunications service sources on diverse routes for Kulnura. The road distances from Kulnura to Wyong and Gosford are 22.5km and 28.9km respectively. Their locations and the nominated fibre cable routes to the site are indicated in Figure 4-6a in Appendix A.

Issues to Consider

- Underground cable route along roads to airport is assumed.
- Use of diverse routes via different telecom carriers can enhance level of redundancy.

2.7.3 Type 4 Airport

Proposed Infrastructure

Telecommunications services are necessary to support the airport operations, passengers and the community around. The telecommunications demand on a Type 4 airport is significantly less than a Type 2 airport. The need for redundancy is also reduced and thus the airport no longer requires a secondary diverse source. The Wyong exchange has been nominated as the service source for this airport. The road distance from Kulnura to Wyong is 22.5km. The location and the nominated fibre cable route to the site is indicated in Figure 4-6b in Appendix A.

Issues to Consider

- Underground cable route along roads to airport is assumed.

2.7.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The proposed communications infrastructure of diverse fibre and copper cable routes for a Type 2 airport is capable of meeting the communications bandwidth demand of a Type 1 airport. During the transition to Type 1, the construction work will involve cable relocations to accommodate the new cable route within the airport site. The cost of 1km of communications cable infrastructure is estimated for that cable relocation.

Issues to Consider

- Underground cable infrastructure is assumed.

2.8 Gas

2.8.1 Existing Infrastructure

Kulnura is located in a region approximately 30km north-west of the Central Coast and Gosford regions.

A 450 mm diameter high pressure gas pipeline currently exists between Sydney and Newcastle.

It is assumed that there is no suitable gas infrastructure within the Kulnura region and therefore a new gas network is required to supply the Airport.

It is noted that discussions are needed with local gas suppliers to confirm the above assumptions.

2.8.2 Type 2 Airport

Proposed Infrastructure

It is proposed to connect to the existing Sydney/Newcastle gas pipeline as shown in Figure 4-7 in Appendix A. The anticipated route for the gas pipeline is expected to branch off the existing gas main, approximately 16.6 km from the site.

A Type 2 airport is expected to require a 125mm diameter, steel pipeline to supply a capacity of 30’000GJ of gas per annum.

Issues to Consider

- Information on specific locations of potential gas connection points is not currently available.
- Further investigation and discussions with suppliers are required to assess the use and extension for any existing gas infrastructure in the area of Kulnura.

2.8.3 Type 4 Airport

Proposed Infrastructure

The capacity needed for a type 4 airport has been identified as 3’000GJ per annum.

Due to the small gas demand and high cost of a pipeline, it is proposed that a weekly supply of gas can be scheduled and stored in two 3000 litre gas capacity storage tanks.

Further discussions with local gas suppliers are required to define the leasing condition for storage and supply contracts.

Issues to Consider

- Future increase in the demand for gas will require the provision of a reticulated supply. Utilisation of the existing Sydney/Newcastle high pressure main, as identified in a Type 2 airport scenario.
- The gas supply Authority may consider bearing the cost of the pipeline extension as it presents an opportunity to extend their infrastructure and develop a new revenue generating area to their network.

2.8.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

Over a 16 year period the potential passenger volumes at are expected to rise from 5 to 32 million passengers per annum. This will result in a proportional increase in gas demand from 30’000GJ to 177’000GJ per annum.

To accommodate this transition, an upfront infrastructure is proposed larger than that required for a Type 2 airport. It is proposed that 250mm diameter steel pipeline be used.

Issues to Consider

- Information on specific locations of potential gas connection points is not currently available.
- It is assumed that any necessary metering and control plant for the gas supply is owned by the supplier. Further investigation and discussion is required.

2.9 Fuel

2.9.1 Existing Infrastructure

Kulnura is located in a region approximately 30km north-west of the Central Coast and Gosford regions.

The Clyde and Kurnell refineries situated within the Sydney basin provide for aviation fuel supply; however the development and provision of a new reticulated pipeline is required to airport developments of any significant size.

An initial assessment of the existing fuel infrastructure in and around the Sydney region has identified an existing Sydney/Newcastle fuel pipeline. Utilisation of this pipeline is doubtful as it is not intended for aviation fuel purpose and its use will be subject to further investigation and discussion with suppliers to assess feasibility.

Newcastle currently has 3 fuel terminals associated with Caltex, BP, Shell and Mobil. (Petroleum import infrastructure in Australia’ main report ‘written for the Department of Resources, Energy and Tourism) As may be required, it is proposed that the existing facilities at the Port of Newcastle be developed to assist with fuel supply via shipping facilities and a reticulated pipeline network.

2.9.2 Type 2 Airport

Proposed Infrastructure

A Type 2 airport requires approximately 6ML of storage to provide for a minimum of 5 days to allow for the daily fuel consumption of 1.2ML

It is proposed that the Clyde refinery be utilised as the main source of fuel supply for the airport, with provision of a new pipeline and associated infrastructure. The proposed the pipeline will run for approximately 79km to the airport location.

To provide for supply resilience, there is a desire to have a second independent aviation fuel supply at the airport.

The Port of Newcastle presents a feasible option for the provision of a secondary fuel supply. A new pipeline is expected to extend approximately 89km to the proposed airport location.

The main and secondary pipeline each requires a 200mm steel pipe, with appropriate cathodic protection.

It is assumed that any necessary control station needed to assist with the aviation fuel distribution would be constructed as part of the airport facilities and infrastructure.

Issues to Consider

- There is no requirement for an intermediate pumping station currently identified, however further geographical studies need to be conducted to asses this in more detail.
- Further investigation is required to assess the feasibility of a new fuel pipeline routes.

2.9.3 Type 4 Airport

Proposed Infrastructure

Based on predicted air traffic movements for General Aviation (GA) and Regular Public Transport (RPT) the expected fuel capacity is estimated at approximately 100’000 litres per day.

It proposed that for the demand of a type 4 airport, the fuel supply will be a schedule of regular trucked deliveries and above ground storage tanks on site.

The storage facility will have the capacity to hold a minimum of 5 days storage in 0.5ML above ground storage tanks.
To further address resilience there is the flexibility to re-size the storage facility to meet growth in demand and to safe guard for redundancy.

Issues to Consider

- No identified issues at this stage however open discussions with suppliers may lead to re-evaluation of the current capital cost estimates.

2.9.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

Over a 16 year forecast the potential passenger growth from Type 2 to Type 1 l is expected to increase from 5 to 32 million passengers a year. In order to meet this demand, the aviation fuel capacity need for sufficient airport operations will increase from 1.2ML/day to 12ML/day respectively.

In order to accommodate this transition, (Type 2 to Type 1) it is suggested that the supporting infrastructure be constructed in two additional stages from that proposed for the Type 2 airport.

At 'year 0' the initial infrastructure will utilise the main and redundant 200mm diameter steel supply pipelines with 6ML above ground storage tanks to provide the minimum of 5 days storage.

At 'year 7' the fuel demand is expected to grow to 5ML/day. It is proposed to upgrade the infrastructure with an additional 200mm pipeline with an additional 20ML above ground storage tank will be installed giving a total capacity of 26ML for 5 days storage.

At 'year 14', the fuel demand is expected to grow to a capacity of 10-12ML/day. It is proposed to upgrade the infrastructure with a further and final 150mm pipeline and an additional 30ML above ground storage tank, giving a total capacity of 56ML.

At 'year 16' accommodating the operation and fuel demands for a Type 1 airport, the baseline infrastructure will consist;

- three fuel supply pipelines feeding from the primary source (2x200mm, 1x150mm)
- one fuel pipeline designed for redundancy (200mm) feeding from the secondary source; and
- 56 ML storage tanks.

Issues to Consider

- Further investigation is needed to assess the requirements of additional and intermediate pumping stations.
- Further investigation is required to assess the detailed feasibility of a new fuel pipeline reticulating out of the Port of Newcastle
- Further discussions with fuel suppliers are recommended to explore leasing opportunities and capital costs for Storage facilities.

2.10 Summary

2.10.1 Capital Expenditure

A summary of the capital expenditure for each infrastructure type for Kulnura is shown in Table 4 below.

Table 4 - Infrastructure Capital Expenditure for Kulnura

Infrastructure	**Infrastructure Capital Expenditure for Kulnura ($M)** **Type 2 Airport**	**Infrastructure Capital Expenditure for Kulnura ($M)** **Type 4 Airport**
Road	460	0
Rail	0	0
Water	30	28
Wastewater	4	4
Power	100	63
Communications	15	7
Gas	14	0
Fuel	254	1
Sub Total	877	103
Risk Contingency – 30%	263	31
Design and PM – 20%	175	21
Total	**1,316**	**154**

2.10.2 Operational and Maintenance Expenditure

A summary of the operational and maintenance expenditure for each infrastructure type for Kulnura is shown in the following tables.

Table 5 - Operational and Maintenance Expenditure for Kulnura (Type 2 Airport)

Asset	**Operational and Maintenance Costs ($000's)**	**Interval (year)**
Road		
Pavement - annual	1,468	1
Pavement (replace wearing course)	-	
Dual carriageway; divided (4 lanes)	14,950	10
Pavement (replace others)		
Dual carriageway; divided (4 lanes)	2,097	5
Water	-	

Asset	Operational and Maintenance Costs ($000's)	Interval (year)
Annual	8	1
Pipe	325	1
Pumping Station (repairs)	65	5
Pumping Station (replacement)	650	25
Storage Tank (repairs)	13	5
Storage Tank (painting)	39	15
Wastewater	-	
Annual	34	1
Treatment Plant	689	5
Power	-	
Annual	143	1
Transmission Line	3,250	9
Transformers 30MVA (33/11)	5,200	15
Switches (indoor)	10	18
Communications	-	
Annual	52	1
Cables and ducting	24	18
Gas	-	
Annual	139	1
Pipe	127	5
Valve Station	7	7
Cathodic Protection (repairs)	62	10
Cathodic Protection (replacement)	2,080	20
Fuel	-	
Annual	1,862	1
Pipe	1,108	5
Storage Tank (repairs)	20	5
Storage Tank (painting)	20	15
Cathodic Protection (repairs)	653	10
Cathodic Protection (replacement)	21,775	20

Table 6 - Operational and Maintenance Expenditure for Kulnura (Type 4 Airport)

Asset	Operational and Maintenance Costs ($M)	Interval (year)
Water	-	
Annual	7	1
Pipe	325	1
Pumping Station (repairs)	65	5
Pumping Station (replacement)	650	25
Storage Tank (repairs)	7	5
Storage Tank (painting)	20	15
Wastewater	-	
Annual	34	1
Treatment Plant	689	5
Power	-	
Annual	169	1
Transmission Line	65	9
Transformers 30MVA (33/11)	130	15
Communications	-	
Annual	52	1
Cables and ducting	11	18
Fuel	-	
Annual	1	1
Storage Tank (repairs)	20	5
Storage Tank (painting)	20	15

2.10.3 Transition Capital Expenditure

The capital expenditure for the transition from a Type 2 to a Type 1 airport is summarised in Appendix E.

2.10.4 Transition Operational and Maintenance Expenditure

The operational and maintenance costs are specific for each infrastructure asset. As such, it is not possible to present one summary cost estimate for the operating and maintenance costs. Refer to Appendix E for details.

2.10.5 Site Levelling and Preparation Expenditure

A summary of the site levelling and preparation expenditure for Kulnura is shown in the following table.

Table 7 - Summary of site levelling and preparation expenditure for Kulnura

Site	Type 2 Airport ($M)	Type 4 Airport ($M)	Transition from Type 2 to Type 1 ($M)[1]
Kulnura	900	230	9,500

Note 1: These figures include the total nominal site preparation costs over the 16 year transition period including in the initial construction.

3 Locality 5 – Somersby

3.1 Introduction

Somersby is located within the Gosford Council, approximately 75km north of Sydney. The proposed site is adjacent to the F3 freeway and access is also possible from Peats Ridge Road and Wisemans Ferry Road. The Mooney Mooney Creek and its tributaries are located southwest of the proposed site.

3.2 Site Issues

Somersby is surrounded by State Forests and may contain sensitive fauna and flora species as well as aboriginal sites.

3.3 Surface Transport

3.3.1 Existing Infrastructure

3.3.1.1 Road

Road access to Somersby is primarily via the F3 Sydney – Newcastle Freeway. Access to/from Sydney and Gosford is via Wisemans Ferry Road from the F3 interchange at Kariong. Access to/from Newcastle is via Peats Ridge Road from the F3 interchange at Somersby.

Publicly available historical traffic data for these roads, accessible within the short timeframe for the analysis for this site are very dated, with no count data available after 2001.

Trend growth rates from these historical data to a future year of 2021 (assumed to be the earliest likely opening year for an airport at allowing for planning and environmental investigations) indicate that the F3 Freeway will require widening from the current general four-lane two-way freeway standard between Kariong and Wyong to six-lane two-way freeway standard. These were assumed to occur for a base case with no airport.

Figure 5-3a shows the base case upgrades assumed for Somersby.

3.3.1.2 Rail

The nearest existing rail station is at Narara, which is on the non-electrified Newcastle and Central Coast Line. The station can also be reached by the electrified North Shore and Western Line during peak hours. Narara Railway Station is approximately 18 km by road from the Somersby site.

3.3.1.3 Bus

Busways and Red Bus Services currently serve the Gosford and Wyong areas but do not extend as far west as Somersby.

3.3.1.4 Taxi

Somersby lies only just outside the Sydney Metropolitan Transport District and outside the Newcastle Transport District. Sydney and Newcastle taxis may drop off passengers at Somersby but may not pick up passengers at Somersby, and must return to a location within their own district without passengers. Somersby lies within the Central Coast Region, and only Central Coast based taxis may pick up passengers from the site.

3.3.2 Type 2 Airport

3.3.2.1 Road

Analysis of trend growth rates to support the development of a Type 2 airport at Somersby indicate the following road network upgrades are required in addition to assumed baseline / do minimum upgrades:

- Upgrade Wisemans Ferry Road between F3 interchange at Kariong and the airport site to four-lane two-way standard.

Figure 5-3b shows the indicated road upgrades for a Type 2 airport at Somersby.

3.3.2.2 Rail

Previous discussion in supporting reports has indicated there is no requirement for a rail link to a Type 2 airport in the initial stage of development.

3.3.2.3 Bus

Connecting bus services for a Type 2 airport at Somersby should be provided to Gosford (to connect to rail services locally and to Sydney) and also potentially dedicated services to Sydney and Newcastle.

3.3.3 Type 4 Airport

3.3.3.1 Road

Analysis of airport generated traffic for the development of an initial stage Type 4 airport at Somersby suggests that no road network upgrades would be required in addition to assumed baseline / do minimum upgrades.

3.3.3.2 Rail

Previous discussion in supporting reports has indicated there is no requirement for a rail link to a Type 4 airport in the initial stage of development.

3.3.3.3 Bus

Connecting bus services could be provided from a Type 4 airport at Somersby to Gosford to connect to rail services locally and to Newcastle and Sydney.

3.3.4 Transition from Type 2 to Type 1 Airport

Transport upgrades for the transition from a Type 2 to a Type 1 airport were derived using trend analysis at five-year intervals from 2021 to 2036, from a starting point of the infrastructure that was identified for the initial stage Type 2 airport.

The passenger growth scenario for this transition was provided to Arup. These imply substantial growth in passenger numbers, starting at over 20% per annum in the early years of transition and tapering to 8% per annum by year 15 of transition. Forecasts of airport-related traffic generation for these increases in passenger numbers are described in the transport analysis methodology in Appendix B.

In several cases the trend extrapolation of baseline traffic on key access roads over a 25-year period to 2036 results in substantial traffic volumes, requiring significant infrastructure upgrades regardless of any airport development, and sometimes with substantial cost implications. The scope of the work however is such that baseline road upgrades could not be fully considered in the context of wider network performance or management and budgetary strategies. Computerised transport network modelling would provide improved outcomes for baseline traffic volume estimates balanced across wider network and land-use/demographic outcomes.

3.3.4.1 Road

Trend growth rates plus airport traffic for the F3 Freeway to 2026, 2031 and 2036 indicate that extensive work will be required to provide capacity for an upgrade from a Type 2 to a Type 1 airport at Somersby. The suggested scale of widening of the F3 Freeway over a long distance implies significant expense.

Based on assumptions of passenger growth for the transition from a Type 2 to a Type 1 airport provided to Arup, baseline plus airport-related traffic estimates indicate the following road network upgrades by 2026 above the initial stage Type 2 airport works:

- Widen the F3 Freeway between Sydney and Somersby interchange from 6-lane freeway to 8-lane freeway;
- Widen Wisemans Ferry Road between F3 Kariong interchange and airport site from 4-lanes undivided to 6-lanes;
- Widen Peats Ridge Road between F3 Somersby interchange and Wisemans Ferry Road from 2-lanes undivided to 4-lanes.

By 2031, baseline plus airport traffic estimates indicate the following works requirements:

- Widen the F3 Freeway between Somersby interchange and Wyong from 6-lane freeway to 8-lane freeway;

By 2036, baseline plus airport traffic estimates indicate the following works requirements:

- Widen Peats Ridge Road between F3 Somersby interchange and Wisemans Ferry Road from 4-lanes to 6-lanes.

Figure 5-2/1-3 shows the road upgrades identified for the transition scenario at Somersby.

3.3.4.2 Rail

Previous working papers of this study have discussed that the provision of dedicated rail access is generally not justifiable for Type 2, 3 and 4 airports, and is more a question of transport policy goals for a Type 1 airport rather than a question of providing necessary capacity, until passenger numbers reach over approximately 45m per annum.

The discussion identified nonetheless that planning for a Type 1 airport at a greenfield site should include considerations for the provision of a rail link from the time of opening, to support transport sustainability and mobility goals and to enhance the service quality standard of the airport as measured in international rankings.

The provision of an airport link is requires substantial study outside the scope of this work. In the case of Somersby, the provision of rail access might potentially have impacts on the ongoing requirements for upgrading of the F3 Freeway.

For the purposes of providing indicative capital costings only, a notional rail access link has been identified for Somersby as it reaches Type 1 standard in 2036, via a new dual track rail service from the airport terminal station to Narara Station. This should connect to the existing non-electrified Newcastle and Central Coast Line or the electrified North Shore and Western Line. No feasibility analysis has been undertaken for this notional line.

Figure 5-2/1-3 shows the notional rail link for Somersby.

3.3.4.3 Bus

Connecting bus services for the transition period from Type 2 to Type 1 airport at Somersby should be provided to Gosford (to connect to rail services locally and to Sydney) and also potentially dedicated services to Sydney and Newcastle.

As the airport reaches Type 1 status and/if a rail link is introduced, bus services to Sydney and Newcastle would require to be reviewed in the context of the new rail service.

3.4 Water

3.4.1 Existing Infrastructure

Somersbty is located in a region where the water supply is managed and supplied collaboratively between Gosford City Council and Wyong Shire Council through the Gosford/Wyong Councils' Water Authority. The water supply on the Central Coast is the third largest urban water supply system in NSW and the Authority owns two water treatment plants which are connected via a transfer main. These treatment plants are located at Somersby in Gosford City and Mardi in Wyong Shire, respectively 7km and 17km from the proposed site.

3.4.2 Type 2 Airport

Proposed Infrastructure

It is proposed to provide a water supply to Somersby from the existing Somersby water treatment plant, located 7km south from the proposed site, off Myoora Road. This new connection will be a 200mm diameter pipeline following George Downes Drive, Wisemans Ferry Road and Somersby Falls Road. A new pumping station (11L/s at 145m) at the treatment plant and on site storage (1ML capacity) at the airport will be provided for the airport's water supply system. In addition, disinfection will likely to be required and a hypochlorite dosing system has been included in the proposed works (0.08kg/hr Cl equivalent hypo dosing unit).

Figure 5-4 in Appendix A shows the existing and proposed water supply network for Somersby.

Issues to Consider

- Capacity of the existing Somersby water treatment plant is unconfirmed.

3.4.3 Type 4 Airport

Proposed Infrastructure

For a Type 4 airport, the water supply strategy will be similar to the strategy proposed for the Type 2 Airport and will be a connection to the existing Somersby water treatment plant. The proposed connection will comprise of a 100mm diameter pipeline, a pumping station (11L/s at 135m) and storage tanks (0.5ML total capacity). A hypochlorite dosing system has also been included (0.008kg/hr Cl equivalent hypo dosing unit) as the disinfection system.

Refer to Figure 5-4 in Appendix A for a visual of the proposed works.

Issues to Consider

- Capacity of the existing Somersby water treatment plant is unconfirmed.

3.4.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The transition from a Type 2 airport to a Type 1 airport will occur over a 16 year period with the passenger capacity increasing from 5 million to 30 million. The water supply infrastructure required for this transition will be constructed in three stages:

- This initial water supply infrastructure will comprise a 200mm diameter pipeline, a new pumping station (11L/s at 145m) at the treatment plant, on site storage (11ML capacity) and a chlorination unit (0.25kg/hr Cl equivalent hypo dosing unit).
- It is then proposed to upgrade the works after 5 years by including larger pipes and providing additional storage capacity (11ML). Increasing the chlorination rate to 0.6kg/hr Cl equivalent hypo dosing unit will also be required.
- 10 years after the initial works, additional storage capacity will be required (11ML).

Figure 5-2/1-4 in Appendix A summarises the transition works for Somersby.

Issues to Consider

- Capacity of the existing Somersby water treatment plant is unconfirmed.
- The growth of the surrounding area over the transition period will influence the timing and extent of water supply infrastructure upgrades.

3.5 Wastewater

3.5.1 Existing Infrastructure

Somersby is located in a region where the wastewater supply is managed and supplied by the Gosford City Council. Gosford City Council operates two wastewater treatment plants located in Woy Woy and Kincumber, respectively 16.5km and 20km southeast of the proposed site. The Woy Woy plant is an “extended aeration activated-sludge” plant providing wastewater treatment for the Woy Woy Peninsula including Woy Woy Bay, Pearl Beach and Patonga. It serves around 40,000 customers and treats close to 10 million litres (ML) of flow on average each day. The Kincumber plant uses the same process and serves 140,000 customers in Gosford City including Gosford, Wyoming, Narara, Lisarow, and Kariong, treating up to 30 million litres (ML) on average each day[2].

There is also a wastewater treatment plant in Tuggerah, approximately 25 km by road from the proposed site which is managed by the Wyong Council.

3.5.2 Type 2 Airport

Proposed Infrastructure

It is proposed to provide a wastewater supply to Somersby from the existing Woy Woy wastewater treatment plant, located 16.5km southeast from the proposed site. This new connection will be a rising main (16L/s) via a 150mm diameter pipeline along Peats Ridge Road, The F3 and Woy Woy Road. A new pumping station (16L/s at 32m) at the treatment plant and emergency on site storage at the airport will be provided for the airport's wastewater supply system.

Figure 5-4 in Appendix A shows the existing and proposed water supply network for Somersby.

Issues to Consider

- Spare capacity of existing Woy Woy wastewater treatment plant is unconfirmed.

3.5.3 Type 4 Airport

Proposed Infrastructure

For a Type 4 airport, the water supply strategy will be similar to the strategy proposed for the Type 2 Airport and will be a connection to the existing Woy Woy wastewater treatment plant. The proposed connection will be a rising main (2L/s) via a 100mm diameter pipeline, a pumping station (5L/s at 30m) and on site emergency storage.

Refer to Figure 5-4 in Appendix A for a visual of the proposed works.

Issues to Consider

- Spare capacity of existing Woy Woy wastewater treatment plant is unconfirmed.

3.5.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The transition from a Type 2 airport to a Type 1 airport will occur over a 16 year period with the passenger capacity increasing from 5 million to 30 million. The

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[2] Gosford City Council

water supply infrastructure required for this transition will be constructed in three stages:

- This initial wastewater supply infrastructure will comprise a rising main via a 150mm diameter pipeline, a new pumping station (50L/s at 50m) at the treatment plant, and emergency on site storage.
- It is then proposed to upgrade the works after 2 years by adding a 200mm diameter pipeline and a second pumping station (50L/s at 50m).
- 11 years after the initial works, it is proposed to modify the second pumping station to increase its capacity to 100L/s.

Figure 5-2/1-4 in Appendix A summarises the transition works for Somersby.

Issues to Consider

- Spare capacity of existing Woy Woy wastewater treatment plant is unconfirmed.
- The growth of the surrounding area over the transition period will influence the timing and extent of water supply infrastructure upgrades.

3.6 Power

3.6.1 General

This section describes the bulk supply of power to a Type 2 and Type 4 airport at this Somersby. The internal distribution of power around the airport itself is not discussed.

The existing infrastructure is assumed to be similarly affected by both types of airport developments. The runway at Somersby is assumed to be orientated along the long axis of the site, i.e. north / south orientation.

The internal distribution of power is not described within this report for each site as the internal configuration will be similar for each airport type at any of the sites.

3.6.2 Existing Infrastructure

Somersby has existing electricity services traversing and bordering the site. These are:

- An Ausgrid 132kV transmission line, from Gosford STS to Mt Colah STS. This line traverses the eastern boundary and south east corner of the site and will impact the operational clearances to the south of the site. This service will require to be relocated.
- Ausgrid’s Somersby ZS is located in the vicinity of the south eastern corner of the site, and may be affected by the final positioning of the site. This has been assumed as not to be currently affected by the site.

- An Ausgrid 66kV transmission line, from Gosford STS, that traverses across the centre of the site in an east / west orientation and will require to be relocated.
- Ausgrid distribution high voltage and low voltage power lines for the provision of power to the properties within the area and further up George Downs Drive and other local roads.

All the existing electrical services within the proposed site will be affected by the proposed airport.

Any distribution high voltage and low voltage power lines that are required to be retained due to them servicing properties outside the site will need to be positioned in service easements outside of the site. Operational clearances may require lines to be placed underground for some sections, and this will be affected by the runway orientation yet to be determined. The relocation of these services are not expected to cause major disruptions and can be readily programmed with any works in the area.

The options for relocation are:

- direct bury on the same alignment
- install a cable tunnel on the same alignment
- divert above ground

The options of direct bury and a cable tunnel may have operational considerations that may rule them out, and these have not been considered further at this stage. Possible routes for each transmission line have been shown in Figure 5-5. As no discussions with Ausgrid have been undertaken, these routes will need to be investigated further and any final route will be determined by Ausgrid, with the final routes may result in longer sections of transmission lines to be relocated.

Should this site become the selected site for the airport, Ausgrid will need to be advised as early as possible to allow the planning, design and procurement to avoid delay in the overall programme.

3.6.3 Type 2 Airport

Proposed Infrastructure

The site is located in the Central Coast area of Ausgrid's network. Supply to the site will be from Ausgrid's network.

All power lines have been assumed to be overhead wiring. The possibility of utilising existing easements is considered minimal and the cost for new easements needs to be considered.

Supply to the airport site will require a new substation to be established, with supply from Ausgrid.

Ausgrid have 33kV assets in the vicinity of the site, but it is assumed that these will not have sufficient capacity to service the airport's 9MVA demand. This is based on an assumption that the surrounding development in the area has taken its full capacity.

Two bulk supplies could be obtained at 66kV from Ausgrid. Ausgrid's existing Sub-Transmission Substations (STS) in the vicinity of the site are Ourimbah STS and Gosford STS. These supplies and the electrical network supplying the airport will be fully rated to provide a redundant supply and configured to provide N-1 security. Each STS is located approximately 10km from the site.

It has been assumed that the existing STS's have the secure capacity to supply the initial demand of the airport at 66kV, based on the projected loads to 2016 as published by Ausgrid in their 2011 Electricity System. Augmentation works, such as the installation of additional circuit breakers and possibly new bus bars, is anticipated at each site.

It is anticipated that the airport will be a high voltage customer. Supply within the airport is anticipated to be reticulated at 11kV to distribution substations.

Issues to Consider

Relocation of Ausgrid's assets, in particular the 132kV line, in the vicinity of the airport will require considerable time to plan and implement. The indicated relocations noted on the sketches are arbitrary, and with further detailed analysis may require more significant re-routing then assumed. Some assets, i.e. the 33kV line, noted to be relocated could be reconfigured instead of being relocated to account for changes need to supply the Airport, thus simplifying the works. This will ne be fully understood until discussions with Ausgrid can be undertaken, and further detailed planning and design has occurred.

The timeframe when supply would be required could result in other options that Ausgrid may have for supply to the site due to network planning considerations, and Ausgrid would need to be consulted to ascertain the most likely supply option. This includes the planned growth for the site, which may result in different options.

Route selection for new and relocated transmission and sub-transmission lines can take considerable time to resolve. The use of existing easements, if available and suitable for use, is preferable to establishing new easements, especially if the area that is requiring to be traversed is already developed. This will require further investigation.

Transmission lines installation should be rated to provide the planned future demands for the site to minimise the need for costly augmentation works on the transmission lines. Ratings of other equipment should also be selected to deal with planned demand growth while considering the design life of the installed electrical assets.

3.6.4 Type 4 Airport

Proposed Infrastructure

Supply to the airport site, with a capacity of 1.7MVA, will likely be at low voltage, from a new Ausgrid substation connected to the nearest 11kV network. The 11kV network may require to be extended to the required site.

Issues to Consider

The relocation of Ausgrid assets as discussed above is the main issue identified.

3.6.5 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

With supply to the site at 66kV, there will be sufficient capacity in the supply if the transmission lines are rated appropriately, as has been assumed. The design life of other electrical equipment assets, such as transformers and switchgear, is generally greater than 30 years, and the projected growth of the airport is anticipated to require the full anticipated demand after 10 years, within the assets lifetime. On this basis, it is assumed that any new equipment installed initially for the Type 2 Airport will be rated for the planned demand growth expected for a Type 1 airport, including the associated business park.

The maximum demand for a Type 1 airport, including the associated business park, is anticipated to be 64MVA. This size load is expected to exceed the secure capacity available from Ausgrid's STS's at Ourimbah and Gosford, requiring augmentation works to increase capacity of both.

The augmentation works anticipated include additional transformers and switchgear at each STS, and an increase in the rating of the 132kV network supplying the STS's.

Issues to Consider

The planning and implementation required to upgrade any of Ausgrid's network is to be factored in any development, and is considered to be considerable time.

Other augmentation works on Ausgrid's network may be required as a consequence of any upgrades.

3.7 Communications

3.7.1 Existing Infrastructure

Telecommunications services are predominantly provided by Telstra. There is an ADSL exchange at Somersby. However, ADSL is considered not capable of sufficient bandwidth and services reliability for communications needs of airport and business operations.

3.7.2 Type 2 Airport

Proposed Infrastructure

Telecommunications services are necessary to support the airport operations, passengers and the community around. For business continuity reasons, resilient and alternative supplies are considered essential. As contrasted to a single point connection, diverse routes will enhance availability of telecommunications services. Fibre cable has much higher bandwidth capacity than copper cable or microwave transmission. Therefore, fibre cable is the preferred means of telecommunication backbone. Wyong exchange and Gosford exchange are nominated as telecommunications service sources on diverse routes for Somersby. The road distances from Somersby to Wyong and Gosford are 19.1km and 13.2km respectively. Their locations and the nominated fibre cable routes to the site are indicated in Figure 5-6a in Appendix A.

Issues to Consider

- Underground cable route along roads to airport is assumed.
- Use of diverse routes via different telecom carriers can enhance level of redundancy.

3.7.3 Type 4 Airport

Proposed Infrastructure

Telecommunications services are necessary to support the airport operations, passengers and the community around. The telecommunications demand on a Type 4 airport is significantly less than a Type 2 airport. The need for redundancy is also reduced and thus the airport no longer requires a secondary diverse source. The Gosford exchange has been nominated as the service source for this airport. The road distance from Somersby to Gosford is 13.2 km. The location and the nominated fibre cable route to the site is indicated in Figure 5-6b in Appendix A.

Issues to Consider

- Underground cable route along roads to airport is assumed.

3.7.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The proposed communications infrastructure of diverse fibre and copper cable routes for a Type 2 airport is capable of meeting the communications bandwidth demand of a Type 1 airport. During the transition to Type 1, the construction work will involve cable relocations to accommodate the new cable route within the airport site. The cost of 1km of communications cable infrastructure is estimated for that cable relocation.

Issues to Consider

- Underground cable infrastructure is assumed.

3.8 Gas

3.8.1 Existing Infrastructure

Somersby is approximately 6km to the west of the Gosford region along the existing road infrastructure of Wiseman Ferry Road.
A 450 mm diameter high pressure gas pipeline currently exists between Sydney and Newcastle.
It is assumed that there is no suitable gas infrastructure and therefore a new gas network is required to supply the Airport.
It is noted that discussions are needed with local gas suppliers to confirm the above assumptions.

3.8.2 Type 2 Airport

Proposed Infrastructure

It is proposed to connect to the main Sydney/Newcastle gas pipeline as shown in figure 5.7 in Appendix A.

Due to the close proximity of the existing gas pipeline to the airport location, an allowance of 5km has been made for the gas connection to allow for a diverting branch to be considered at an appropriate location. At this time, no allowance has been made for any diversion costs of the existing gas pipeline as the location is insufficiently accurate and appears to run parallel to the runways. It is suggested the inclusion of an allowance in case there is a need for minor diversions or relocation and incorporate a budget of $2m

It is proposed that a 125mm diameter, steel pipeline be introduced to accommodate the supply capacity of 30’000GJ of gas per annum and a further 450mm diameter to accommodate for the high pressure pipeline diversion.

Issues to Consider

- Information on specific locations of potential gas connection points is not currently available.
- With reference to the existing township of Somersby, located approximately 2.5 km north of the proposed locations, further investigation and discussions with suppliers are recommended to assess the extension of any existing gas infrastructure.

3.8.3 Type 4 Airport

Proposed Infrastructure

The capacity needed for a type 4 airport has been identified as 3’000GJ per annum. Due to the small gas demand and high cost of a pipeline, it is proposed that a weekly supply of gas can be scheduled and stored in two 3000 litre gas capacity storage tanks. Further discussions with local gas suppliers are required to define the leasing condition for storage and supply contracts.

Issues to Consider

- Future increase in the demand for gas will require the provision of a reticulated supply, with utilisation of the existing Sydney/Newcastle high pressure main, as identified in a Type 2 airport scenario.
- The gas supply Authority may consider bearing the cost of the pipeline extension as it presents an opportunity to extend their infrastructure and develop a new revenue generating area to their network.

3.8.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

Over a 16 year period the potential passenger volumes at are expected to rise from 5 to 32 million passengers per annum. This will result in a proportional increase in gas demand from 30’000GJ to 177’000GJ per annum.

To accommodate this transition, an upfront infrastructure is proposed larger than that required for a Type 2 airport. It is proposed that 250mm diameter steel pipeline be used.

Issues to Consider

- Information on specific locations of potential gas connection points is not currently available.
- It is assumed that any necessary metering and control plant for the gas supply is owned by the supplier. Further investigation and discussion is required

3.9 Fuel

3.9.1 Existing Infrastructure

Somersby is located approximately 6km to the west of the Gosford region along the existing road infrastructure of Wiseman Ferry Road.

The Clyde and Kurnell refineries situated within the Sydney basin provide for aviation fuel supply; however the development and provision of a new reticulated pipeline is required to airport developments of any significant size.

An initial assessment of the existing fuel infrastructure in and around the Sydney region has identified an existing Sydney/Newcastle fuel pipeline. Utilisation of this pipeline is doubtful as it is not intended for aviation fuel purpose and its use will be subject to further investigation and discussion with suppliers to assess feasibility.

Newcastle currently has 3 fuel terminals associated with Caltex, BP, Shell and Mobil. (Petroleum import infrastructure in Australia’ main report ‘written for the Department of Resources, Energy and Tourism) As may be required, it is proposed that the existing facilities at the Port of Newcastle be developed to assist with fuel supply via shipping facilities and a reticulated pipeline network.

3.9.2 Type 2 Airport

3.9.3 Proposed Infrastructure

A Type 2 airport requires approximately 6ML of storage to provide for a minimum of 5 days to allow for the daily fuel consumption of 1.2ML

It is proposed that the Clyde refinery be utilised as the main source of fuel supply for the airport, with provision of a new pipeline and associated infrastructure. The proposed the pipeline will run for approximately 79km to the airport location.

To provide for supply resilience, there is a desire to have a second independent aviation fuel supply at the airport.

The Port of Newcastle presents a feasible option for the provision of a secondary fuel supply. A new pipeline is expected to extend approximately 87km to the proposed airport location.

The main and secondary pipeline each requires a 200mm steel pipe, with appropriate cathodic protection.

It is assumed that any necessary control station needed to assist with the aviation fuel distribution would be constructed as part of the airport facilities and infrastructure.

Issues to Consider

- There is no requirement for an intermediate pumping station currently identified, however further geographical studies need to be conducted to asses this in more detail.
- Further investigation is required to assess the feasibility of a new fuel pipeline routes.

3.9.4 Type 4 Airport

Proposed Infrastructure

Based on predicted air traffic movements for General Aviation (GA) and Regular Public Transport (RPT) the expected fuel capacity is estimated at approximately 100,000 litres per day. It proposed that for the demand of a type 4 airport, the fuel supply will be a schedule of regular trucked deliveries and above ground storage tanks on site.

The storage facility will have the capacity to hold a minimum of 5 days storage in 0.5ML above ground storage tanks. To further address resilience there is the flexibility to re-size the storage facility to meet growth in demand and to safe guard for redundancy.

Issues to Consider

- No identified issues at this stage however open discussions with suppliers may lead to re-evaluation of the current capital cost estimates.

3.9.5 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

Over a 16 year forecast the potential passenger growth from Type 2 to Type 1 l is expected to increase from 5 to 32 million passengers a year. In order to meet this demand, the aviation fuel capacity need for sufficient airport operations will increase from 1.2ML/day to 12ML/day respectively.

In order to accommodate this transition, (Type 2 to Type 1) it is suggested that the supporting infrastructure be constructed in two additional stages from that proposed for the Type 2 airport.

At 'year 0' the initial infrastructure will utilise the main and redundant 200mm diameter steel supply pipelines with 6ML above ground storage tanks to provide the minimum of 5 days storage.

At 'year 7' the fuel demand is expected to grow to 5ML/day. It is proposed to upgrade the infrastructure with an additional 200mm pipeline with an additional 20ML above ground storage tank will be installed giving a total capacity of 26ML for 5 days storage.

At 'year 14', the fuel demand is expected to grow to a capacity of 10-12ML/day. It is proposed to upgrade the infrastructure with a further and final 150mm pipeline and an additional 30ML above ground storage tank, giving a total capacity of 56ML.

At 'year 16' accommodating the operation and fuel demands for a Type 1 airport, the baseline infrastructure will consist;

- three fuel supply pipelines feeding from the primary source (2x200mm, 1x150mm)
- one fuel pipeline designed for redundancy (200mm) feeding from the secondary source; and
- 56 ML storage tanks.

Issues to Consider

- Further investigation is needed to assess the requirements of additional and intermediate pumping stations.
- Further investigation is required to assess the detailed feasibility of a new fuel pipeline reticulating out of the Port of Newcastle
- Further discussions with fuel suppliers are recommended to explore leasing opportunities and capital costs for Storage facilities.

3.10 Summary

3.10.1 Capital Expenditure

A summary of the capital expenditure for each infrastructure type for Somersby is shown in Table 8 below.

Table 8 - Infrastructure Capital Expenditure for Somersby

Infrastructure	**Infrastructure Capital Expenditure for Somersby ($M)** **Type 2 Airport**	**Infrastructure Capital Expenditure for Somersby ($M)** **Type 4 Airport**
Road	50	0
Rail	0	0
Water	12	10
Wastewater	9	7
Power	30	16
Communications	10	4
Gas	9	0
Fuel	251	1
Sub Total	370	38
Risk Contingency – 30%	111	11
Design and PM – 20%	74	8
Total	**554**	**57**

3.10.2 Operational and Maintenance Expenditure

A summary of the operational and maintenance expenditure for each infrastructure type for Somersby is shown in the following tables.

Table 9 - Operational and Maintenance Expenditure for Somersby (Type 2 Airport)

Asset	**Operational and Maintenance Costs ($’000)**	**Interval (year)**
Road	-	
Pavement - annual	160	1
Pavement (replace wearing course)	-	
Dual carriageway; undivided (4 lanes)	1,625	10
Pavement (replace others)		
Dual carriageway; undivided (4 lanes)	228	5
Water	-	

Asset	Operational and Maintenance Costs ($'000)	Interval (year)
Annual	8	1
Pipe	91	1
Pumping Station (repairs)	65	5
Pumping Station (replacement)	650	25
Storage Tank (repairs)	13	5
Storage Tank (painting)	39	15
Wastewater	-	
Annual	31	1
Pipe	215	1
Pumping Station (repairs)	13	5
Pumping Station (replacement)	3,900	15
Power	-	
Annual	140	1
Transmission Line	1,300	9
Transformers 30MVA (33/11)	5,200	15
Switches (indoor)	10	18
Communications	-	
Annual	52	1
Cables and ducting	15	18
Gas	-	
Annual	29	1
Pipe	39	5
Valve Station	7	7
Cathodic Protection (repairs)	12	10
Cathodic Protection (replacement)	390	20
Fuel	-	
Annual	1,834	1
Pipe	1,092	5
Storage Tank (repairs)	20	5
Storage Tank (painting)	20	15
Cathodic Protection (repairs)	644	10
Cathodic Protection	21,450	20

Asset	Operational and Maintenance Costs ($'000)	Interval (year)
(replacement)		

Table 10 - Operational and Maintenance Expenditure for Somersby (Type 4 Airport)

Asset	Operational and Maintenance Costs ($'000)	Interval (year)
Water	-	
Annual	7	1
Pipe	91	1
Pumping Station (repairs)	65	5
Pumping Station (replacement)	650	25
Storage Tank (repairs)	7	5
Storage Tank (painting)	20	15
Wastewater	-	
Annual	31	1
Pipe	215	1
Pumping Station (repairs)	26	5
Pumping Station (replacement)	3,900	15
Power	-	
Annual	169	1
Transmission Line	65	9
Transformers 30MVA (33/11)	130	15
Communications	-	
Annual	52	1
Cables and ducting	6	18
Gas	-	
Fuel	-	
Annual	1	1
Storage Tank (repairs)	20	5
Storage Tank (painting)	20	15

3.10.3 Transition Capital Expenditure

The capital expenditure for the transition from a Type 2 to a Type 1 airport is summarised in Appendix E.

3.10.4 Transition Operational and Maintenance Expenditure

The operational and maintenance costs are specific for each infrastructure asset. As such, it is not possible to present one summary cost estimate for the operating and maintenance costs. Refer to Appendix E for details.

3.10.5 Site Levelling and Preparation Expenditure

A summary of the site levelling and preparation expenditure for Somersby is shown in the following table.

Table 11 - Summary of site levelling and preparation expenditure for Somersby

Site	**Type 2 Airport ($M)**	**Type 4 Airport ($M)**	**Transition from Type 2 to Type 1 ($M)[1]**
Somersby	1,600	360	7,000

Note 1: These figures include the total nominal site preparation costs over the 16 year transition period including in the initial construction.

4 Locality 10 – Wilberforce

4.1 Introduction

Wilberforce is located within the Hawkesbury City Council, approximately 7km north of Wilberforce and 65km northwest of Sydney. This site is adjacent to two access roads: Putty Road to the west and Sackville Road to the west. In addition, the Hawkesbury River is present to the south and east of the proposed site.

4.2 Site Issues

The close proximity of the Hawkesbury River may require special attention to water quality. The Chain of Ponds Reserve also traverses the site which may contain sensitive fauna and flora species.

4.3 Surface Transport

4.3.1 Existing Infrastructure

4.3.1.1 Road

Road access to Wilberforce is primarily via Wilberforce Road, further connecting to Windsor Road, the M2 and M7 motorways. Access to/from Newcastle and Gosford is currently poor, with no direct road access to the airport site.

A key influence in road access for Wilberforce to/from Sydney is the North West Growth Centre, which is approximately 10,000 hectares comprising 16 Precincts and is planned to provide capacity for around 70,000 new dwellings for 200,000 people[3].

[3] http://www.gcc.nsw.gov.au/north+west-21.html, accessed 24 February 2011

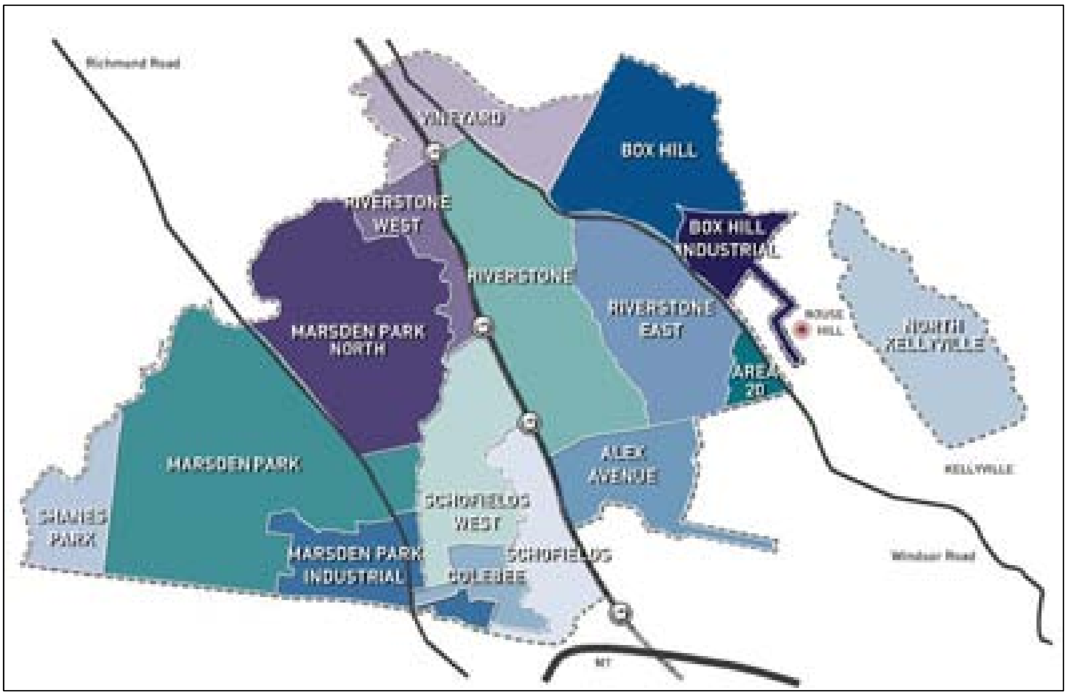

Figure 3 – North West Growth Centre

The development of the North West Growth Centre will have significant impacts on the road network providing access to Wilberforce. The NSW RTA is currently in the process of widening Schofields Road from a two-lane to four-lane standard with a wide central median for future widening to six lanes if required in the future. Road and intersection upgrades along Richmond Road are currently being undertaken to improve safety and better traffic flow. NSW RTA is also currently undertaking studies into the rehabilitation or refurbishment of Windsor Bridge. Based on currently available public information, no road widening proposals are known for Richmond Road and Windsor Road at present, however it is reasonable to consider that both of these roads will be upgraded to service and provide access for the North West Growth Centre.

The scope and timeframe for this analysis did not permit a detailed assessment of future traffic volumes on Richmond Road and Windsor Road with the effects of development in the North West Growth Centre. Historical growth rates do not fully account for the likely impacts of this development.

Publicly available historical traffic data for these roads, accessible within the short timeframe for the analysis are dated, with no count data after 2005 available for the Sydney region.

Trend growth rates from these historical data to a future year of 2021 (assumed to be the earliest likely opening year for an airport at allowing for planning and environmental investigations) indicate the following works are anticipated and were assumed to occur by 2021 regardless of development of an airport at Wilberforce:

- upgrading of Old Windsor Road from the Windsor Road intersection to the M2/M7 motorway to six-lane two-way standard; and
- widening of Windsor Road from Pitt Town Road to Old Windsor Road intersection to six lane two-way standard.

Figure 10-3a illustrates the assumed base case road upgrades for Wilberforce.

4.3.1.2 Rail

The nearest existing rail station is at Mulgrave, which is on the electrified Richmond Branch Line. Mulgrave Railway Station is approximately 12 km by road from Wilberforce.

4.3.1.3 Bus

CDC (Comfort Delgro Cabcharge) WestBus currently serves the Western Sydney regions including the Wilberforce area. This bus service provides a connection to Windsor.

4.3.1.4 Taxi

Wilberforce lies only just outside the Sydney Metropolitan Transport District, which is bounded by the Hawkesbury River. As such, Sydney taxis may drop off passengers at Wilberforce but may not pick up passengers at Wilberforce, and must return to a location within their own district without passengers.

4.3.2 Type 2 Airport

4.3.2.1 Road

Trend analyses of the upgrade requirements for Windsor Road that would be needed to provide sufficient capacity for baseline plus airport traffic for a Type 2 airport indicate that Windsor Road would require significant upgrades beyond its existing configuration, in many locations to motorway standard. This is in part caused by the impacts of additional traffic from the North West Growth Centre.

Windsor Road will be required to have an ongoing role in providing for access for the North West Growth Centre and other surrounding areas (Rouse Hill, Norwest). For this reason it is not considered practical or reasonable that Windsor Road will be upgraded beyond six-lane two-way divided carriageway standard, perhaps with grade separation at major junctions. A motorway standard road along the Windsor Road corridor is not considered feasible.

The trend analysis indicates that Windsor Road will not have sufficient capacity as a six-lane two-way road to provide for baseline (including North West Growth Centre) plus Type 2 airport-generated traffic, and a motorway standard link is indicated. As this is not considered practicable, the works adopted for Type 2 airport access are for airport traffic to be separated from local Windsor Road traffic through the construction of a new, dedicated access road to service an airport at Location 10.

Traffic estimates for a Type 2 airport at Wilberforce indicate the following upgrades in addition to assumed baseline / do minimum upgrades:

- Construction of a new, four-lane divided link road from Wilberforce Road east of Bridge Road to the vicinity of Old Windsor Road north of the M2/M7 interchange. This would be a purpose-built road to provide access to an airport at Location 10. Feasibility analysis of this new road has not been undertaken, and it is notionally included to provide estimates of capital costs;

- Widen Wilberforce Road from Bridge Street to the airport site from two-lanes undivided to four-lanes divided.

Figure 10-3b shows the road upgrades indicated for development of a Type 2 airport at Wilberforce.

4.3.2.2 Rail

Previous discussion in supporting reports has indicated there is no requirement for a rail link to a Type 2 airport in the initial stage of development.

4.3.2.3 Bus

At a minimum, connecting bus services should be provided to Clarendon or Mulgrave railway station to connect to CityRail services.

4.3.3 Type 4 Airport

4.3.3.1 Road

Analysis of trend growth rates indicates that to support the development of a Type 4 airport at Wilberforce, no road network upgrades would be required in addition to assumed baseline / do minimum upgrades.

4.3.3.2 Rail

Previous discussion in supporting reports has indicated there is no requirement for a rail link to a Type 4 airport in the initial stage of development.

4.3.3.3 Bus

Connecting bus services could be considered to Clarendon or Mulgrave railway station to connect to CityRail services.

4.3.4 Transition from Type 2 to Type 1 Airport

Transport upgrades for the transition from a Type 2 to a Type 1 airport were derived using trend analysis at five-year intervals from 2021 to 2036, from a starting point of the infrastructure that was identified for the initial stage Type 2 airport.

The passenger growth scenario for this transition was provided to Arup. These imply substantial growth in passenger numbers, starting at over 20% per annum in the early years of transition and tapering to 8% per annum by year 15 of transition. Forecasts of airport-related traffic generation for these increases in passenger numbers are described in the transport analysis methodology in Appendix B.

In several cases the trend extrapolation of baseline traffic on key access roads over a 25-year period to 2036 results in substantial traffic volumes, requiring significant infrastructure upgrades regardless of any airport development, and sometimes with substantial cost implications. The scope of the work however is such that baseline road upgrades could not be fully considered in the context of wider network performance or management and budgetary strategies. Computerised transport network modelling would provide improved outcomes for baseline traffic volume estimates balanced across wider network and land-use/demographic outcomes.

4.3.4.1 Road

As discussed in Section 4.3.2.1, Windsor Road is not considered appropriate as a key access road to an airport at Location 10, and it was adopted that a new link road would need to be provided connecting the airport to the Sydney motorway network.

Based on assumptions of passenger growth for the transition from a Type 2 to a Type 1 airport provided to Arup, baseline plus airport-related traffic estimates indicate the following road network upgrades by 2026 above the initial stage Type 2 airport works:

- Widen the new, dedicated airport link road from Wilberforce Road to M2 motorway near Old Windsor Road from four-lanes divided to six-lanes divided standard;
- Widen Wilberforce Road from Bridge Street to airport site from four-lanes divided to six-lanes divided.

No further works are indicated to be required until 2036 when the following are indicated to be needed:

- Widen the new, dedicated airport link road from Wilberforce Road to M2 motorway near Old Windsor Road from six-lanes divided to six-lane motorway standard;
- Upgrade Wilberforce Road from Bridge Street to airport site from six-lanes divided to six-lane motorway standard.

Figure 10-2/1-3 shows for road upgrades indicated for the transition scenario at Wilberforce.

4.3.4.2 Rail

Previous working papers of this study have discussed that the provision of dedicated rail access is generally not justifiable for Type 2, 3 and 4 airports, and is more a question of transport policy goals for a Type 1 airport rather than a question of providing necessary capacity, until passenger numbers reach over approximately 45m per annum.

The discussion identified nonetheless that planning for a Type 1 airport at a greenfield site should include considerations for the provision of a rail link from the time of opening, to support transport sustainability and mobility goals and to enhance the service quality standard of the airport as measured in international rankings.

The provision of an airport link is requires substantial study outside the scope of this work.

For the purposes of providing indicative capital costings only, a notional rail access link has been identified for Wilberforce as it reaches Type 1 standard in 2036, via a new dual track rail service from the airport terminal station to Mulgrave Station on the Richmond Branch line. No feasibility analysis has been undertaken for this notional line.

Figure 10-2/1-3 shows the notional rail link for Wilberforce.

4.3.4.3 Bus

With the construction of a rail station at the airport site, a study should be undertaken to ensure that bus and rail services are coordinated.

4.4 Water

4.4.1 Existing Infrastructure

There are existing water facilities located in the town of Wilberforce. The existing water network is connected to a water reservoir and a water treatment plant which is managed by Sydney Water. For this locality, it is proposed to connect to this existing plant, and since the capacity is unknown and considering the size of Wilberforce, an allowance has been included for upgrading this existing plant.

4.4.2 Type 2 Airport

Proposed Infrastructure

It is proposed to provide a water supply to this locality from the existing water treatment plant in Wilberforce, located 7km south from the proposed site. Upgrading this existing treatment plant is likely to be required. The new connection will be a 200mm diameter pipeline following George Putty Road. A new pumping station (11L/s at 145m) at the treatment plant and on site storage (1ML capacity) at the airport will be provided for the airport's water supply system. In addition, disinfection will likely to be required and a hypochlorite dosing system has been included in the proposed works (0.08kg/hr Cl equivalent hypo dosing unit).

Figure 10-4 in Appendix A shows the existing and proposed water supply network for Wilberforce.

Issues to Consider

- Capacity of the existing Wilberforce water treatment plant is unconfirmed.

4.4.3 Type 4 Airport

Proposed Infrastructure

For a Type 4 airport, the water supply strategy will be similar to the strategy proposed for the Type 2 Airport and will be a connection to the existing Wilberforce water treatment plant. Upgrading the existing treatment plant will also be required for a Type 4 airport. The proposed connection will be a 100mm diameter pipeline, including a pumping station (11L/s at 135m) and storage tanks (0.5ML total capacity). A hypochlorite dosing system has also been included (0.008kg/hr Cl equivalent hypo dosing unit) as the disinfection system.

Refer to Figure 10-4 in Appendix A for a visual of the proposed works.

Issues to Consider

- Capacity of the existing Wilberforce water treatment plant is unconfirmed.

4.4.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The transition from a Type 2 airport to a Type 1 airport will occur over a 16 year period with the passenger capacity increasing from 5 million to 30 million. The water supply infrastructure required for this transition will be constructed in three stages:

- This initial water supply infrastructure will comprise a 200mm diameter pipeline, a new pumping station (11L/s at 145m) at the treatment plant, on site storage (11ML capacity), a chlorination unit (0.25kg/hr Cl equivalent hypo dosing unit) and the upgrade of the existing Wilberforce water treatment plant.
- It is then proposed to upgrade the works after 5 years by including larger pipes and providing additional storage capacity (11ML). Increasing the chlorination rate to 0.6kg/hr Cl equivalent hypo dosing unit will also be required.
- 10 years after the initial works, additional storage capacity will be required (11ML).

Figure 10-2/1-4 in Appendix A summarises the transition works for Wilberforce.

Issues to Consider

- Capacity of the existing Wilberforce water treatment plant is unconfirmed.
- The growth of the surrounding area over the transition period will influence the timing and extent of water supply infrastructure upgrades.

4.5 Wastewater

4.5.1 Existing Infrastructure

There is not any wastewater treatment facility in close proximity of Wilberforce. However, there is an existing sewer reticulation network in the town of Wilberforce and as part of a priority sewerage program, some upgrades were scheduled to be completed by January 2011, including the following scheme for the area in the vicinity of Wilberforce:

- a network of small diameter pipelines within each town to transfer sewage from each property to a transfer pipeline
- a pumping station adjacent to Wilberforce to boost sewage flows from the town to Freemans Reach via a transfer pipeline
- a pumping station adjacent to Glossodia to boost sewage flows from the town to Freemans Reach via a transfer pipeline
- a pumping station adjacent to Freemans Reach to boost sewage flows from the towns via a transfer pipeline to the Richmond sewerage system for treatment at Richmond Sewage Treatment Plant, effluent reuse under existing arrangements and disposal of effluent to an unnamed tributary of Rickabys Creek.

The reticulated pressure sewerage was upgraded to service approximately 660 lots in Glossodia, 330 lots in Freemans Reach and 650 lots in Wilberforce.

In addition, there is an existing wastewater treatment plant in Richmond, 19km southwest of the proposed site, which is owned and operated by Sydney Water. This plant discharges 2.2ML per day[4] and the effluent is reused for irrigation at the University of Western Sydney Richmond Campus with the excess overflowing to the Rickabys Creek.

4.5.2 Type 2 Airport

Proposed Infrastructure

Although there is a possibility to connect to the upgraded network, considering the size of Wilberforce, additional upgrades may be required to support an airport demand. It is therefore proposed to provide a wastewater supply to Wilberforce from the existing Richmond wastewater treatment plant, located 19km southwest from the proposed site. This new connection will be a rising main (16L/s) via a 150mm diameter pipeline along Wilberforce Road and Richmond Road. A new pumping station (16L/s at 32m) at the treatment plant and emergency on site storage at the airport will be provided for the airport's wastewater supply system.

Figure 10-4 in Appendix A shows the existing and proposed wastewater supply network for Wilberforce.

[4] Sydney Water

Issues to Consider

- Spare capacity of existing Richmond wastewater treatment plant is unconfirmed.

4.5.3 Type 4 Airport

Proposed Infrastructure

For a Type 4 airport, the water supply strategy will be similar to the strategy proposed for the Type 2 Airport and will be a connection to the existing Richmond wastewater treatment plant. The proposed connection will comprise of a rising main (2L/s) via a 100mm diameter pipeline, a pumping station (5L/s at 30m) and on site emergency storage.

Refer to Figure 10-4 in Appendix A for a visual of the proposed works.

Issues to Consider

- Spare capacity of existing Richmond wastewater treatment plant is unconfirmed.

4.5.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The transition from a Type 2 airport to a Type 1 airport will occur over a 16 year period with the passenger capacity increasing from 5 million to 30 million. The water supply infrastructure required for this transition will be constructed in three stages:

- This initial wastewater supply infrastructure will comprise a rising main via a 150mm diameter pipeline, a new pumping station (50L/s at 50m) at the treatment plant, and emergency on site storage.
- It is then proposed to upgrade the works after 2 years by adding a 200mm diameter pipeline and a second pumping station (50L/s at 50m).
- 11 years after the initial works, it is proposed to modify the second pumping station to increase its capacity to 100L/s.

Figure 10-2/1-4 in Appendix A summarises the transition works for Wilberforce.

Issues to Consider

- Spare capacity of existing Richmond wastewater treatment plant is unconfirmed.
- The growth of the surrounding area over the transition period will influence the timing and extent of water supply infrastructure upgrades.

4.6 Power

4.6.1 General

This section describes the bulk supply of power to a Type 2 and Type 4 airport at Wilberforce. The internal distribution of power around the airport itself is not discussed.

The existing infrastructure is assumed to be similarly affected by both types of airport developments. The runway at Wilberforce is assumed to be orientated along the long axis of the site, i.e. east / west orientation.

The internal distribution of power is not described within this report for each site as the internal configuration will be similar for each airport type at any of the sites.

4.6.2 Existing Infrastructure

Wilberforce has existing electricity services in the vicinity of the site. These are:

- Endeavour Energy (previously known as Integral Energy) 33kV sub-transmission line adjacent to the south east corner of the site.
- Endeavour Energy distribution high voltage and low voltage power lines for the provision of power to the properties within the area.

All the existing electrical services within the proposed site will be affected by the proposed airport.

Any distribution high voltage and low voltage power lines that are required to be retained due to them servicing properties outside the site will need to be positioned in service easements outside of the site. The relocation of these services are not expected to cause major disruptions and can be readily programmed with any works in the area.

The Endeavour Energy 33kV line is located in an area that is not anticipated to have any operational clearance issues and will not require to be relocated.

4.6.3 Type 2 Airport

Proposed Infrastructure

All power lines have been assumed to be overhead wiring. The possibility of utilising existing easements is considered minimal and the cost for new easements needs to be considered.

Supply to the airport site will require a new substation to be established, with supply from Endeavour Energy. Endeavour Energy has 33kV networks to the south of the Site, but it is assumed that they do not have sufficient capacity to service the airport's 9MVA demand. This is based on an assumption that the surrounding development in the area has taken its full capacity.

Two bulk supplies could be obtained at 33kV from Endeavour Energy's Hawkesbury Transmission Substation, located near Windsor South. This substation contains 3 x120 MVA 132/33kVkV transformers.

These supplies and the electrical network supplying the airport will be fully rated to provide a redundant supply and configured to provide N-1 security.

It has been assumed that the existing TS have the secure capacity to supply the initial demand of the airport at 33kV. Augmentation works, such as the installation of additional circuit breakers and possibly new bus bars, is anticipated at each site.

It is anticipated that the airport will be a high voltage customer. Supply within the airport is anticipated to be reticulated at 11kV to distribution substations.

Issues to Consider

There are limited points of connection available at 33kV in the vicinity of Wilberforce. The proposed scheme provides for a dual supply to the airport with both originating from the same TS, with the redundancy relied on via connection to separate busses within the TS. Should an alternative point of supply for one of these supplies be required, an alternative point of supply, such as Penrith TS.

To allow for the future transition to a Type 1 airport, the transmission lines to the site are proposed to be rated at 132kV capable of delivering the required planned future demand, but operated at 33kV for the initial development until the demand requires upgrades. Equipment installed at the any substation on site requires to be rated for the future 132kV connection.

Route selection for new and relocated transmission and sub-transmission lines can take considerable time to resolve. The use of existing easements, if available and suitable for use, is preferable to establishing new easements, especially if the area that is requiring to be traversed is already developed. This will require further investigation.

4.6.4 Type 4 Airport

Proposed Infrastructure

Supply to the airport site, with a capacity of 1.7MVA, will likely be at low voltage, from a new Endeavour substation connected to the nearest 11kV network. The 11kV network may require to be extended to the required site.

Issues to Consider

No issues have been identified.

4.6.5 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

To supply a Type 1 airport development, the supply to the site will be required to be minimum 66kV. There are no 66kV assets within the vicinity of this site. Supply will be required to be upgraded to 132kV. As noted above, the existing transmission lines are proposed to be rated at 132kV. To obtain 132kV connections, these lines are proposed to be extended to Transgrid's Vineyard TS.

The augmentation works at the Vineyard TS is anticipated to include additional switchgear, and it is assumed that there will be adequate capacity available.

At the airport, a new 132/33kV substation will be installed. Supply to the existing 33/11kV substation is proposed to allow for reuse of the existing infrastructure. Additional 33/11kV substations or providing the intake substation to be 132/33/11kV for the additional developments will be required,

Issues to Consider

The planning and implementation required to upgrade any of Transgrid's network is to be factored in any development, and is considered to be considerable time.

Other augmentation works on Transgrid's network may be required as a consequence of any upgrades.

The increased demand on Transgrid's assets may require additional augmentation works, such as additional transformers, due to other developments that may occur prior to planning works occurring.

4.7 Communications

4.7.1 Existing Infrastructure

Telecommunications services are predominantly provided by Telstra. There are ADSL exchanges at Freemans Reach and Wilberforce. However, ADSL is considered not capable of sufficient bandwidth and services reliability for communications needs of airport and business operations.

4.7.2 Type 2 Airport

Proposed Infrastructure

Telecommunications services are necessary to support the airport operations, passengers and the community around. For business continuity reasons, resilient and alternative supplies are considered essential. As contrasted to a single point connection, diverse routes will enhance availability of telecommunications services. Fibre cable has much higher bandwidth capacity than copper cable or microwave transmission. Therefore, fibre cable is the preferred means of telecommunication backbone. Richmond exchange and Windsor exchange are nominated as telecommunications service sources on diverse routes for

Wilberforce. The road distances from Wilberforce to Richmond and Windsor are 27.1km and 10.7km respectively. Their locations and the nominated fibre cable routes to the site are indicated in Figure 10-6a in Appendix A.

Issues to Consider

- Underground cable route along roads to airport is assumed.
- Use of diverse routes via different telecom carriers can enhance level of redundancy.

4.7.3 Type 4 Airport

Proposed Infrastructure

Telecommunications services are necessary to support the airport operations, passengers and the community around. The telecommunications demand on a Type 4 airport is significantly less than a Type 2 airport. The need for redundancy is also reduced and thus the airport no longer requires a secondary diverse source. The Windsor exchange has been nominated as the service source for this airport. The road distance from Wilberforce to Windsor is 10.7km. The location and the nominated fibre cable route to the site is indicated in Figure 10-6b in Appendix A.

Issues to Consider

- Underground cable route along roads to airport is assumed.

4.7.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The proposed communications infrastructure of diverse fibre and copper cable routes for a Type 2 airport is capable of meeting the communications bandwidth demand of a Type 1 airport. During the transition to Type 1, the construction work will involve cable relocations to accommodate the new cable route within the airport site. The cost of 1km of communications cable infrastructure is estimated for that cable relocation.

Issues to Consider

- Underground cable infrastructure is assumed.

4.8 Gas

Wilberforce is situated just outside the Sydney basin, close to the Richmond RAAF air base.

A 450 mm diameter high pressure gas pipeline currently exists between Sydney and Newcastle.

Given the close vicinity of both the Richmond and Windsor regions, it has been assumed that a suitable medium pressure distribution supply point will be readily available, however it has not been confirmed as to whether an existing reticulated network can be utilised for the proposed airport location.

It is noted that discussions are needed with local gas suppliers to confirm the above assumptions.

4.8.1 Type 2 Airport

Proposed Infrastructure

It is proposed to connect to the existing Sydney/Newcastle gas pipeline as shown in Figure 10-7 in Appendix A. The nominated route for the gas pipeline is approximately 13 km to the proposed airport location

A Type 2 airport is expected to require a 125mm diameter, steel pipeline to supply a capacity of 30’000GJ of gas per annum.

Issues to Consider

- Information on specific locations of potential gas connection points is not currently available.
- Further investigation and discussions with suppliers are recommended to assess the use and extension for any existing gas infrastructure extending from Richmond and Windsor that can accommodate the required capacity needed for a type 2 airport

4.8.2 Type 4 Airport

Proposed Infrastructure

The capacity needed for a type 4 airport has been identified as 3’000GJ per annum.

Due to the small gas demand and high cost of a pipeline, it is proposed that a weekly supply of gas can be scheduled and stored in two 3000 litre gas capacity storage tanks.

Further discussions with local gas suppliers are required to define the leasing condition for storage and supply contracts.

Issues to Consider

- Future increase in the demand for gas will require the provision of a reticulated supply with utilisation of the existing Sydney/Newcastle high pressure main, as identified in a Type 2 airport scenario.

- The gas supply Authority may consider bearing the cost of the pipeline extension as it presents an opportunity to extend their infrastructure and develop a new revenue generating area to their network.

4.8.3 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

Over a 16 year period the potential passenger volumes at are expected to rise from 5 to 32 million passengers per annum. This will result in a proportional increase in gas demand from 30’000GJ to 177’000GJ per annum.

To accommodate this transition, an upfront infrastructure is proposed larger than that required for a Type 2 airport. It is proposed that 250mm diameter steel pipeline be used.

Issues to Consider

- Information on specific locations of potential gas connection points is not currently available.
- It is assumed that any necessary metering and control plant for the gas supply is owned by the supplier. Further investigation and discussion is required.

4.9 Fuel

4.9.1 Existing Infrastructure

Wilberforce is situated just outside the Sydney basin, close to the Richmond RAAF air base.

The Clyde and Kurnell refineries situated within the Sydney basin provide for aviation fuel supply; however the development and provision of a new reticulated pipeline is required to airport developments of any significant size.

As Richmond RAAF Base is in close proximity there is scope to utilise their current aviation fuel supply which is a system of supply and storage via road tankers. A total of approximately 10 tankers are currently used per week. These are the small road tankers and thus numbers could be reduced if B Doubles were introduced.

The existing supply arrangements would potentially be sufficient for a Type 2 airport until the passenger numbers grow, however given the numbers of tankers and associated terminal facilities available, assessed against for the number of tankers needed for the base case Type 2 airport, it is assumed that the fuel companies are likely to consider the investment would be better spent on a pipeline.

An initial assessment of the existing fuel infrastructure in and around the Sydney region has identified an existing Sydney/Newcastle fuel pipeline. Utilisation of this pipeline is doubtful as it is not intended for aviation fuel purpose and its use will be subject to further investigation and discussion with suppliers to assess feasibility.

Newcastle currently has 3 fuel terminals associated with Caltex, BP, Shell and Mobil. (Petroleum import infrastructure in Australia' main report 'written for the Department of Resources, Energy and Tourism) As may be required, it is proposed that the existing facilities at the Port of Newcastle be developed to assist with fuel supply via shipping facilities and a reticulated pipeline network.

4.9.2 Type 2 Airport

Proposed Infrastructure

A Type 2 airport requires approximately 6ML of storage to provide for a minimum of 5 days to allow for the daily fuel consumption of 1.2ML

It is proposed that the Clyde refinery be utilised as the main source of fuel supply for the airport, with provision of a new pipeline and associated infrastructure. The proposed the pipeline will run for approximately 45km to the airport location.

To provide for supply resilience, there is a desire to have a second independent aviation fuel supply at the airport. Due to the location of Wilberforce it is suggested that Kurnell Refinery in Sydney be utilised.

Provision of a new pipeline and its associated infrastructure is recommended out of Kurnell, extending west for approximately 20km then north toward Stanley Park for approximately 75km to the airport. Further investigation is required to confirm the preference for this route.

The main and secondary pipeline each requires a 200mm steel pipe, with appropriate cathodic protection.

It is assumed that any necessary control station needed to assist with the aviation fuel distribution would be constructed as part of the airport facilities and infrastructure.

Issues to Consider

- There is no requirement for an intermediate pumping station currently identified, however further geographical studies need to be conducted to asses this in more detail.

4.9.3 Type 4 Airport

Proposed Infrastructure

Based on predicted air traffic movements for General Aviation (GA) and Regular Public Transport (RPT) the expected fuel capacity is estimated at approximately 100'000 litres per day.

It proposed that for the demand of a type 4 airport, the fuel supply will be a schedule of regular trucked deliveries and above ground storage tanks on site.

The storage facility will have the capacity to hold a minimum of 5 days storage in 0.5ML above ground storage tanks.
To further address resilience there is the flexibility to re-size the storage facility to meet growth in demand and to safe guard for redundancy.

Issues to Consider

- No identified issues at this stage however discussions with suppliers may lead to re-evaluation of the current capital cost estimates.

4.9.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

Over a 16 year forecast the potential passenger growth from Type 2 to Type 1 l is expected to increase from 5 to 32 million passengers a year. In order to meet this demand, the aviation fuel capacity need for sufficient airport operations will increase from 1.2ML/day to 12ML/day respectively.

In order to accommodate this transition, (Type 2 to Type 1) it is suggested that the supporting infrastructure be constructed in two additional stages from that proposed for the Type 2 airport.

At 'year 0' the initial infrastructure will utilise the main and redundant 200mm diameter steel supply pipelines with 6ML above ground storage tanks to provide the minimum of 5 days storage.

At 'year 7' the fuel demand is expected to grow to 5ML/day. It is proposed to upgrade the infrastructure with an additional 200mm pipeline with an additional 20ML above ground storage tank will be installed giving a total capacity of 26ML for 5 days storage.

At 'year 14', the fuel demand is expected to grow to a capacity of 10-12ML/day. It is proposed to upgrade the infrastructure with a further and final 150mm pipeline and an additional 30ML above ground storage tank, giving a total capacity of 56ML.

At 'year 16' accommodating the operation and fuel demands for a Type 1 airport, the baseline infrastructure will consist;

- three fuel supply pipelines feeding from the primary source (2x200mm, 1x150mm)
- one fuel pipeline designed for redundancy (200mm) feeding from the secondary source; and
- 56 ML storage tanks.

Issues to Consider

- Further investigation is needed to assess the requirements of additional and intermediate pumping stations.

- Further discussions with fuel suppliers are recommended to explore leasing opportunities and capital costs for Storage facilities.

4.10 Summary

4.10.1 Capital Expenditure

A summary of the capital expenditure for each infrastructure type for Wilberforce is shown in Table 12 below.

Table 12 - Infrastructure Capital Expenditure for Wilberforce

Infrastructure	**Infrastructure Capital Expenditure for Wilberforce ($M)** **Type 2 Airport**	**Infrastructure Capital Expenditure for Wilberforce ($M)** **Type 4 Airport**
Road	2,180	0
Rail	0	0
Water	15	13
Wastewater	9	8
Power	28	1
Communications	11	3
Gas	11	0
Fuel	211	1
Sub Total	2,465	26
Risk Contingency – 30%	740	8
Design and PM – 20%	493	5
Total	**3,698**	**39**

4.10.2 Operational and Maintenance Expenditure

A summary of the operational and maintenance expenditure for each infrastructure type for Wilberforce is shown in the following tables.

Table 13 - Operational and Maintenance Expenditure for Wilberforce (Type 2 Airport)

Asset	**Operational and Maintenance Costs ($'000)**	**Interval (year)**
Road	-	
Pavement - annual	830	1
Pavement (replace wearing course)	-	
Dual carriageway; divided (4 lanes)	10,400	10
Pavement (replace others)		

Asset	Operational and Maintenance Costs ($'000)	Interval (year)
Dual carriageway; divided (4 lanes)	1,459	5
Water	-	
Annual	42	1
Pipe	91	1
Pumping Station (repairs)	65	5
Pumping Station (replacement)	650	25
Storage Tank (repairs)	13	5
Storage Tank (painting)	39	15
Treatment Plant	390	7
Wastewater	-	
Annual	31	1
Pipe	247	1
Pumping Station (repairs)	130	5
Pumping Station (replacement)	3,900	15
Power	-	
Annual	141	1
Transmission Line	1,950	9
Transformers 30MVA (33/11)	5,200	15
Switches (indoor)	10	18
Communications	-	
Annual	52	1
Cables and ducting	18	18
Gas	-	
Annual	113	1
Pipe	104	5
Valve Station	7	7
Cathodic Protection (repairs)	51	10
Cathodic Protection (replacement)	1,690	20
Fuel	-	
Annual	1,541	1
Pipe	920	5
Storage Tank (repairs)	20	5

Asset	Operational and Maintenance Costs ($'000)	Interval (year)
Storage Tank (painting)	20	15
Cathodic Protection (repairs)	540	10
Cathodic Protection (replacement)	18,005	20

Table 14 - Operational and Maintenance Expenditure for Wilberforce (Type 4 Airport)

Asset	Operational and Maintenance Costs ($'000)	Interval (year)
Water	-	
Annual	40	1
Pipe	91	1
Pumping Station (repairs)	65	5
Pumping Station (replacement)	650	25
Storage Tank (repairs)	7	5
Storage Tank (painting)	20	15
Treatment Plant	390	7
Wastewater	-	
Annual	31	1
Pipe	247	1
Pumping Station (repairs)	26	5
Pumping Station (replacement)	3,900	15
Power	-	
Annual	169	1
Transmission Line	65	9
Transformers 30MVA (33/11)	130	15
Communications	-	
Annual	52	1
Cables and ducting	5	18
Gas	-	
Fuel	-	
Annual	1	1

Asset	Operational and Maintenance Costs ($'000)	Interval (year)
Pipe	-	5
Storage Tank (repairs)	20	5
Storage Tank (painting)	20	15

4.10.3 Transition Capital Expenditure

The capital expenditure for the transition from a Type 2 to a Type 1 airport is summarised in Appendix E.

4.10.4 Transition Operational and Maintenance Expenditure

The operational and maintenance costs are specific for each infrastructure asset. As such, it is not possible to present one summary cost estimate for the operating and maintenance costs. Refer to Appendix E for details.

4.10.5 Site Levelling and Preparation Expenditure

A summary of the site levelling and preparation expenditure for Wilberforce is shown in the following table.

Table 15 - Summary of site levelling and preparation expenditure for Wilberforce

Site	Type 2 Airport ($M)	Type 4 Airport ($M)	Transition from Type 2 to Type 1 ($M)[1]
Wilberforce	1,200	300	3,100

Note 1: These figures include the total nominal site preparation costs over the 16 year transition period including in the initial construction.

5 Locality 12 – Luddenham

5.1 Introduction

Luddenham is located south west of Sydney, in the Liverpool City Council. The topography generally consists of broad river valley with open rural land and gently undulating terrain in the west and higher grounds to the east. The Nepean River, the Oakey, Badgerys and South Creeks are present within this locality and the existing access includes the M4 Western Motorway, the M7 Sydney Western Orbital, the Northern Road, Elizabeth Drive and Bringelly Road.

There are two airports close to Luddenham including the Wallacia and St Mary's private airfields in Camden.

5.2 Site Issues

Luddenham comprises national parks, conservation areas and World Heritage areas which are of significance in the evolution of Australia's diverse ecosystems and communities of plants.

In addition, "vulnerable" "endangered", and "critically endangered" fauna and flora species are present in this area as well as aboriginal sites.

5.3 Surface Transport

5.3.1 Existing Infrastructure

5.3.1.1 Road

Luddenham is well served by road access, with access via the M4 Western Motorway and then The Northern Road or via the M5 South Western Motorway and then the M7 Westlink toll road and Elizabeth Drive.

A key influence in the area of Luddenham is the South West Growth Centre, which is approximately 17,000 hectares comprising 18 Precincts and is planned to provide capacity for around 110,000 new dwellings for 300,000 people[5].

[5] http://www.gcc.nsw.gov.au/south+west-22.html, accessed 22 February 2011

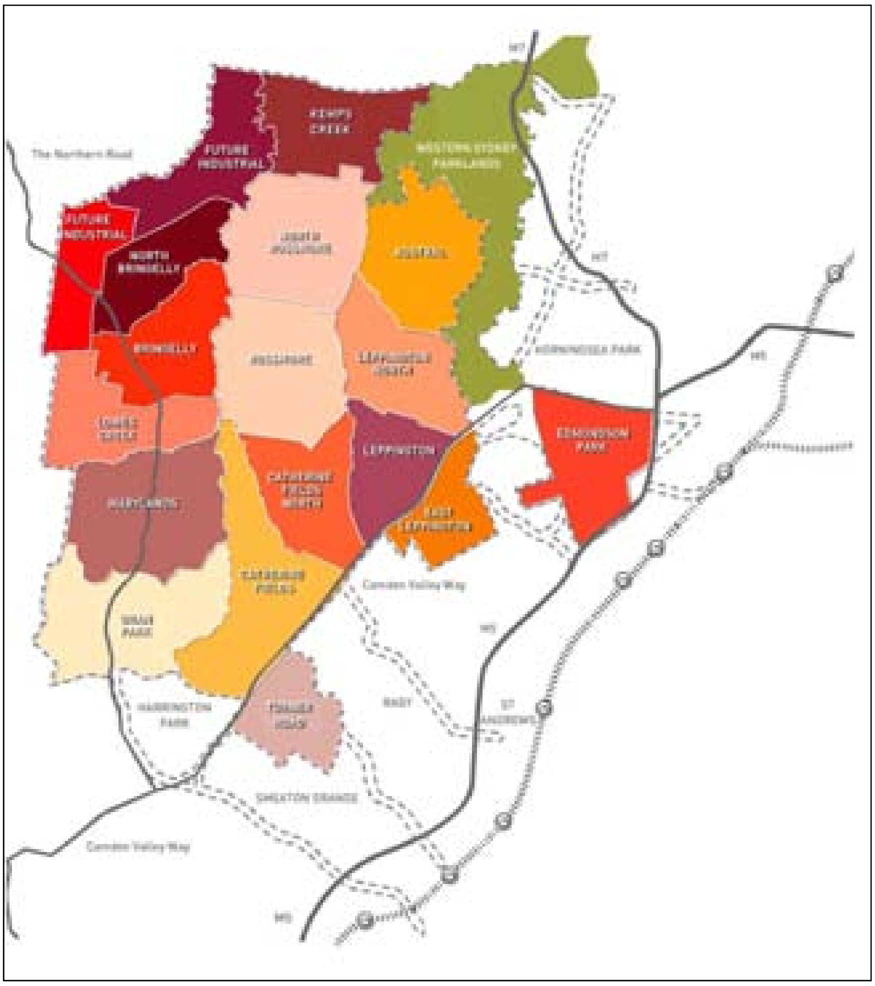

Figure 4 – South West Growth Centre

The development of the South West Growth Centre will have significant impacts on the road network surrounding Luddenham. The NSW RTA is currently in the process of commissioning work to investigate concept design for widening of The Northern Road from The Old Northern Road to Mersey Road to four-lane two-way standard, with provision for future additional widening to six-lane two-way standard, to accommodate expected growth in the South West Growth Centre.

In addition, the following works are anticipated and have been assumed to occur by 2021 regardless of development of an airport at Location 12:

- widening of Elizabeth Drive from M7 to The Northern Road to four-lane two-way, with provision for future widening to six-lane two-way;
- widening of The Northern Road from M4 to Elizabeth Drive to four-lane two-way, with provision for further widening to six-lane two-way.

The M4 Western Motorway is six-lane two-way standard on the approaches to The Northern Road, and does not require further upgrading as a result of development of an airport at Location 12.

The M5 South Western Motorway is four-lanes two-way on the eastern side of the M7. Traffic count data for the M5 in this location are not published and no assessment could be made on the requirement for future widening of the M5 east of the M7 with or without an airport at Luddenham.

Figure 12-3a illustrates the assumed base case road upgrades for Luddenham in 2021.

5.3.1.2 Rail

It is anticipated that by 2021 there may be a rail station in the Bringelly area; this being part of the planned expansion of the South West Rail link, which is soon to be constructed to Leppington.

5.3.1.3 Bus

CDC (Comfort Delgro Cabcharge) WestBus currently serves the Western Sydney regions including the Luddenham area.

5.3.1.4 Taxi

Luddenham is within the Sydney Metropolitan Transport District and as such passengers can be transported to and from the site by Sydney taxis.

5.3.2 Type 2 Airport

5.3.2.1 Road

Publicly available historical traffic data for The Northern Road and Elizabeth Drive, accessible within the timeframe for the analysis for this site are dated, with no count data available after 2005.

The timeframe for this analysis did not permit a detailed assessment of future traffic volumes on The Northern Road and Elizabeth Drive with the effects of development in the South West Growth Centre. Trend historical growth rates do not fully account for the likely impacts of this development.

On this basis, considering potential needs reasonably expected to serve the South West Growth Centre, the likelihood for road upgrades to provide capacity for initial stage development of a Type 2 airport at Location 12 are as follows:

- Widen The Northern Road from M4 Western Motorway to airport site from a baseline assumption of four-lane two-way to six-lane two-way standard;
- Widen Elizabeth Drive from M7 Westlink to The Northern Road / airport site from a baseline assumption of four-lane two-way to six-lane two-way standard.

Figure 12-3b shows these road upgrades for a Type 2 airport at Luddenham.

5.3.2.2 Rail

Previous discussion in supporting reports has indicated there is no requirement for a rail link to a Type 2 airport in the initial stage of development.

5.3.2.3 Bus

Until the extension of the South West Rail Link to Bringelly, at a minimum connecting bus services should be provided to Leppington to connect to the South West Rail Link.

5.3.3 Type 4 Airport

5.3.3.1 Road

As before, the timeframe for this analysis did not permit a detailed assessment of future traffic volumes on The Northern Road and Elizabeth Drive with the effects of development in the South West Growth Centre. Trend historical growth rates do not fully account for the likely impacts of this development.

On this basis, considering the likely anticipated upgrade works necessary to serve the South West Growth Centre, no additional road upgrades are indicated to be required to provide capacity for initial stage development of a Type 4 airport at Location 12.

5.3.3.2 Rail

Previous discussion in supporting reports has indicated there is no requirement for a rail link to a Type 4 airport in the initial stage of development.

5.3.3.3 Bus

Until the extension of the South West Rail Link to Bringelly, connecting bus services could be provided to Leppington to connect to the South West Rail Link.

5.3.4 Transition from Type 2 to Type 1 Airport

Transport upgrades for the transition from a Type 2 to a Type 1 airport were derived using trend analysis at five-year intervals from 2021 to 2036, from a starting point of the infrastructure that was identified for the initial stage Type 2 airport.

The passenger growth scenario for this transition was provided to Arup. These imply substantial growth in passenger numbers, starting at over 20% per annum in the early years of transition and tapering to 8% per annum by year 15 of transition. Forecasts of airport-related traffic generation for these increases in passenger numbers are described in the transport analysis methodology in Appendix B.

In several cases the trend extrapolation of baseline traffic on key access roads over a 25-year period to 2036 results in substantial traffic volumes, requiring significant infrastructure upgrades regardless of any airport development, and sometimes with substantial cost implications. The scope of the work however is such that baseline road upgrades could not be fully considered in the context of wider network performance or management and budgetary strategies. Computerised transport network modelling would provide improved outcomes for baseline traffic volume estimates balanced across wider network and land-use/demographic outcomes.

5.3.4.1 Road

To provide capacity for transition from a Type 2 to a Type 1 airport at Luddenham, it was assumed that Luddenham Road would be upgraded as an additional airport access route to The Northern Road and Elizabeth Drive.

Based on assumptions of passenger growth for the transition from a Type 2 to a Type 1 airport provided to Arup, baseline plus airport-related traffic estimates indicate the following road network upgrades by 2026 above the initial stage Type 2 airport works:

- Widen Luddenham Road between the Western Motorway and Elizabeth Drive from two-lanes undivided to four-lanes divided.

By 2031, baseline plus airport traffic estimates indicate the following works requirements:

- Widen Luddenham Road between the Western Motorway and Elizabeth Drive from four-lanes divided with clearways to six-lanes divided with clearways.

Widening Luddenham Road prevents the need to further upgrade The Northern Road by spreading traffic across the two routes.

Figure 12-2/1-3 shows the road upgrades indicated for the transition scenario at Luddenham.

5.3.4.2 Rail

Previous working papers of this study have discussed that the provision of dedicated rail access is generally not justifiable for Type 2, 3 and 4 airports, and is more a question of transport policy goals for a Type 1 airport rather than a question of providing necessary capacity, until passenger numbers reach over approximately 45m per annum.

The discussion identified nonetheless that planning for a Type 1 airport at a greenfield site should include considerations for the provision of a rail link from the time of opening, to support transport sustainability and mobility goals and to enhance the service quality standard of the airport as measured in international rankings.

The provision of an airport link is requires substantial study outside the scope of this work.

For the purposes of providing indicative capital costings only, a notional rail access link has been identified for Luddenham as it reaches Type 1 standard in 2036, via a new dual track rail service from the airport terminal station to Bringelly Station on the South West Rail Link extension line. No feasibility analysis has been undertaken for this notional line.

Figure 12-2/1-3 shows the notional rail link for Luddenham.

5.3.4.3 Bus

As the airport reaches Type 1 status and/if a rail link is introduced, bus services to Sydney would require to be reviewed in the context of the new rail service.

5.4 Water

5.4.1 Existing Infrastructure

Luddenham is surrounded by urban areas and several water filtration plants including Warragamba, Orchard Hill and Prospect, all of which are managed by Sydney Water. The closest plant to the proposed site is the Warragamba water filtration plant, located about 11km west of the proposed site. The existing water network includes two 150mm diameter water mains in Elizabeth Drive which draw water from the Cecil park reservoirs, 9km east of the proposed site.

5.4.2 Type 2 Airport

Proposed Infrastructure

It is proposed to provide a water supply to Luddenham from the existing water treatment plant in Warragamba, located 11km west of the proposed site. The new connection will be a 200mm diameter pipeline following Park Road, Silverdale Road and Famsworth Avenue. A new pumping station (11L/s at 145m) at the treatment plant and on site storage (1ML capacity) at the airport will be provided for the airport’s water supply system. In addition, disinfection will likely to be required and a hypochlorite dosing system has been included in the proposed works (0.08kg/hr Cl equivalent hypo dosing unit).

Figure 12-4 in Appendix A shows the existing and proposed water supply network for Luddenham.

Issues to Consider

- Capacity of the existing Warragamba water treatment plant is unconfirmed.

5.4.3 Type 4 Airport

Proposed Infrastructure

For a Type 4 airport, the water supply strategy will be similar to the strategy proposed for the Type 2 Airport and will be a connection to the existing Warragamba water treatment plant. The proposed connection will be a 100mm diameter pipeline, including a pumping station (11L/s at 135m) and storage tanks (0.5ML total capacity). A hypochlorite dosing system has also been included (0.008kg/hr Cl equivalent hypo dosing unit) as the disinfection system.

Refer to Figure 12-4 in Appendix A for a visual of the proposed works.

Issues to Consider

- Capacity of the existing Warragamba water treatment plant is unconfirmed.

5.4.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The transition from a Type 2 airport to a Type 1 airport will occur over a 16 year period with the passenger capacity increasing from 5 million to 30 million. The water supply infrastructure required for this transition will be constructed in three stages:

- This initial water supply infrastructure will comprise a 200mm diameter pipeline, a new pumping station (11L/s at 145m) at the treatment plant, on site storage (11ML capacity) and a chlorination unit (0.08kg/hr Cl equivalent hypo dosing unit).
- It is then proposed to upgrade the works after 5 years by including larger pipes and providing additional storage capacity (11ML). Increasing the chlorination rate to 0.6kg/hr Cl equivalent hypo dosing unit will also be required.
- 10 years after the initial works, additional storage capacity will be required (11ML).

Figure 12-2/1-4 in Appendix A summarises the transition works for Luddenham.

Issues to Consider

- Capacity of the existing Warragamba water treatment plant is unconfirmed.
- The growth of the surrounding area over the transition period will influence the timing and extent of water supply infrastructure upgrades.

5.5 Wastewater

5.5.1 Existing Infrastructure

The closest wastewater treatment plant to Luddenham is located in Wallacia, 5km west of the proposed site. This plant was commissioned in 2006 and is a tertiary treatment plant using additional nitrogen and phosphorus removal and disinfection. It discharges to an inland waterway (Warragamba River) and the flows from the old Warragamba sewer treatment plant were transferred to this new facility the year it was commissioned.

5.5.2 Type 2 Airport

Proposed Infrastructure

It is proposed to provide a wastewater supply to Luddenham from the existing Wallacia wastewater treatment plant, located 5km west from the proposed site. This new connection will be a rising main (16L/s) via a 150mm diameter pipeline along Park Road. A new pumping station (16L/s at 32m) at the treatment plant and emergency on site storage at the airport will be provided for the airport's wastewater supply system. In addition, potential upgrades may be required to this existing wastewater treatment plant to meet the airport demand.

Figure 12-4 in Appendix A shows the existing and proposed wastewater supply network for Luddenham.

Issues to Consider

- Spare capacity of existing Wallacia wastewater treatment plant is unconfirmed.

5.5.3 Type 4 Airport

Proposed Infrastructure

For a Type 4 airport, the water supply strategy will be similar to the strategy proposed for the Type 2 Airport and will be a connection to the existing Wallacia wastewater treatment plant. The proposed connection will comprise of a rising main (2L/s) via a 100mm diameter pipeline, a pumping station (5L/s at 30m) and on site emergency storage. Upgrade of the existing Wallacia wastewater treatment plant may also be required.

Refer to Figure 12-4 in Appendix A for a visual of the proposed works.

Issues to Consider

- Spare capacity of existing Wallacia wastewater treatment plant is unconfirmed.

5.5.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The transition from a Type 2 airport to a Type 1 airport will occur over a 16 year period with the passenger capacity increasing from 5 million to 30 million. The water supply infrastructure required for this transition will be constructed in three stages:

- This initial wastewater supply infrastructure will comprise a rising main via a 150mm diameter pipeline, a new pumping station (50L/s at 50m) at the treatment plant, and emergency on site storage. Upgrade of the existing

Wallacia wastewater treatment plant will also occur during the initial phase.

- It is then proposed to upgrade the works after 2 years by adding a 200mm diameter pipeline and a second pumping station (50L/s at 50m).
- 11 years after the initial works, it is proposed to modify the second pumping station to increase its capacity to 100L/s.

Figure 12-2/1-4 in Appendix A summarises the transition works for Luddenham.

Issues to Consider

- Spare capacity of existing Wallacia wastewater treatment plant is unconfirmed.
- The growth of the surrounding area over the transition period will influence the timing and extent of water supply infrastructure upgrades.

5.6 Power

5.6.1 General

This section describes the bulk supply of power to a Type 2 and Type 4 airport at Luddenham. The internal distribution of power around the airport itself is not discussed.

The existing infrastructure is assumed to be similarly affected by both types of airport developments. The runway at Luddenham is assumed to be orientated along the long axis of the site, i.e. north / south orientation.

The internal distribution of power is not described within this report for each site as the internal configuration will be similar for each airport type at any of the sites.

5.6.2 Existing Infrastructure

Luddenham has existing electricity services traversing and bordering the site. These are:

- Transgrid Sydney West – Bannaby 330kV transmission line, which is a north / south orientated overhead transmission line that traverses the eastern part of the site.
- Endeavour Energy 33kV sub-transmission lines that traverse the site from east / west and north / south.
- Endeavour Energy distribution high voltage and low voltage power lines for the provision of power to the properties within the area.

All the existing electrical services within the proposed site will be affected by the proposed airport.

Any distribution high voltage and low voltage power lines that are required to be retained due to them servicing properties outside the site will need to be positioned in service easements outside of the site. Operational clearances may require lines to be placed underground for some sections, and this will be affected by the runway orientation yet to be determined. The relocation of these services is not expected to cause major disruptions and can be readily programmed with any works in the area.

The Transgrid 330kV transmission line will require relocation as this passes through the eastern part of the site.

The options for relocation are:

- direct bury on the same alignment
- install a cable tunnel on the same alignment
- divert above ground

The options of direct bury and a cable tunnel may have operational considerations that may rule them out, and these have not been considered further at this stage. Possible routes for each transmission line have been shown in Figure 12-5. As no discussions with Transgrid or Endeavour Energy have been undertaken, these routes will need to be investigated further and any final route will be determined by the respective organisation. The final routes may result in longer sections of transmission lines to be relocated.

Should this site become the selected site for the airport, Transgrid will need to be advised as early as possible to allow the planning, design and procurement to avoid delay in the overall programme.

5.6.3 Type 2 Airport

Proposed Infrastructure

The site is located in the Northern area of Endeavour Energy’s network. Supply to the site will be from Endeavour Energy’s network.

All power lines have been assumed to be overhead wiring. Although there maybe the possibility of utilising existing easements, the cost for new easements or widening existing easements is to be considered.

Supply to the airport site will require a new substation to be established, with supply from Endeavour Energy.

Endeavour Energy has 33kV networks passing through the site, but it is assumed that these do not have sufficient capacity to service the airport’s 9MVA demand. This is based on an assumption that the surrounding development in the area has taken its full capacity.

There are a number of existing Endeavour Energy assets surrounding the site, but based on the current demand ratings as published in Endeavour Energy’s annual reports there is no readily available capacity.

The most plausible option, based on current demand estimates, is to establish a new 132/33kV STS in the area and obtaining bulk supplies as a 132kV ring from the Transgrid Regentville Bulk Supply Point and from the Transgrid Sydney West Bulk Supply Point, located near Eastern Creek, by either a new 132kV transmission line, or by connecting into the existing 132kV line that passes the site. Augmentation works could be required, including additional switchgear and busbars, more land take, and extension of the control room.

Supply to the airport would then be at 33kV to the new airport substation.

It is anticipated that the airport will be a high voltage customer. Supply within the airport will be reticulated at 11kV to distribution substations.

Issues to Consider

Due to the time frame when supply could be required, there could be other options that Endeavour Energy may have due to network planning considerations and Endeavour Energy would need to be consulted to ascertain the most likely supply option. Relocation of Transgrid's and Endeavour Energy's assets, in particular the 330kV line, in the vicinity of the airport will require considerable time to plan and implement. The indicated relocations noted on the sketches are arbitrary, and with further detailed analysis may require more significant re-routing then assumed. Some assets, i.e. the 33kV line, noted to be relocated could be reconfigured instead of being relocated to account for changes need to supply the Airport, thus simplifying the works. This will ne be fully understood until discussions with Transgrid and Endeavour Energy can be undertaken, and further detailed planning and design has occurred.

The timeframe when supply would be required could result in other options that Endeavour Energy may have for supply to the site due to network planning considerations, and Endeavour Energy would need to be consulted to ascertain the most likely supply option. This includes the planned growth for the site, which may result in different options.

Route selection for new and relocated transmission and sub-transmission lines can take considerable time to resolve. The use of existing easements, if available and suitable for use, is preferable to establishing new easements, especially if the area that is requiring to be traversed is already developed. This will require further investigation.

Transmission lines installation should be rated to provide the planned future demands for the site to minimise the need for costly augmentation works on the transmission lines. Ratings of other equipment should also be selected to deal with planned demand growth while considering the design life of the installed electrical assets.

5.6.4 Type 4 Airport

Proposed Infrastructure

Supply to the airport site, with a capacity of 1.7MVA, will likely be at low voltage, from a new Endeavour Energy substation connected to the nearest 11kV network. The 11kV network may require to be extended to the required site.

Issues to Consider

The relocation of Transgrid and Endeavour Energy assets as discussed above is the main issue identified.

5.6.5 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

To supply a Type 1 airport development, the supply to the site will be required to be minimum 66kV. There are no 66kV assets within the vicinity of this site. Supply will be required to be upgraded to 132kV, with connection from Endeavour Energy's 132kV network.

At the airport, a new 132/33kV substation will be installed. Supply to the existing 33/11kV substation is proposed to allow for reuse of the existing infrastructure. Additional 33/11kV substations or providing the intake substation to be 132/33/11kV for the additional developments will be required,

It is assumed that there is no augmentation works required for Transgrid's infrastructure, and that Endeavour Energy's infrastructure installed for supply to the original airport development has sufficient capacity.

Issues to Consider

The increased demand on Endeavour Energy's and Transgrid's assets may require additional augmentation works due to other developments that may occur prior to planning works occurring.

5.7 Communications

5.7.1 Existing Infrastructure

Telecommunications services are predominantly provided by Telstra. There are ADSL exchanges at Mulgoa and Luddenham. However, ADSL is considered not capable of sufficient bandwidth and services reliability for communications needs of airport and business operations.

5.7.2 Type 2 Airport

Proposed Infrastructure

Telecommunications services are necessary to support the airport operations, passengers and the community around. For business continuity reasons, resilient and alternative supplies are considered essential. As contrasted to a single point connection, diverse routes will enhance availability of telecommunications services. Fibre cable has much higher bandwidth capacity than copper cable or microwave transmission. Therefore, fibre cable is the preferred means of telecommunication backbone. Penrith exchange and Campbelltown exchange are nominated as telecommunications service sources on diverse routes for

Luddenham. The road distances from Luddenham to Penrith and Campbelltown are 15.8km and 29.3km respectively. Their locations and the nominated fibre cable routes to the site are indicated in Figure 12-6a in Appendix A.

Issues to Consider

- Underground cable route along roads to airport is assumed.
- Use of diverse routes via different telecom carriers can enhance level of redundancy.

5.7.3 Type 4 Airport

Proposed Infrastructure

Telecommunications services are necessary to support the airport operations, passengers and the community around. The telecommunications demand on a Type 4 airport is significantly less than a Type 2 airport. The need for redundancy is also reduced and thus the airport no longer requires a secondary diverse source. The Penrith exchange has been nominated as the service source for this airport. The road distance from Luddenham to Penrith is 15.8km. The location and the nominated fibre cable route to the site is indicated in Figure 12-6b in Appendix A.

Issues to Consider

- Underground cable route along roads to airport is assumed.

5.7.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The proposed communications infrastructure of diverse fibre and copper cable routes for a Type 2 airport is capable of meeting the communications bandwidth demand of a Type 1 airport. During the transition to Type 1, the construction work will involve cable relocations to accommodate the new cable route within the airport site. The cable cost of 1km of communications cable infrastructure is estimated for that cable relocation.

Issues to Consider

- Underground cable infrastructure is assumed.

5.8 Gas

5.8.1 Existing Infrastructure

Luddenham is located in the region of Badgerys Creek, approximately 25km west of Liverpool.

A 450 mm diameter high pressure gas pipeline currently exists between Sydney and Newcastle.

It is assumed that there is no suitable gas infrastructure and therefore a new gas network is required to supply the Airport. Given the relatively close vicinity of both the Hoxton and Penrith regions, it has been assumed that a suitable medium pressure distribution supply point will be readily available, however it has not been confirmed as to whether an existing reticulated network can be utilised for the proposed airport location. It is further suggested that discussions with local gas suppliers are needed to confirm the above assumptions.

5.8.2 Type 2 Airport

Proposed Infrastructure

It is proposed to connect to the existing Sydney/Newcastle gas pipeline as shown in Figure 12-7 in Appendix A. The connection is expected to branch off approximately 5km North of Hoxton Park Aerodrome for a distance of 16km to the proposed airport location of Badgerys Creek

A Type 2 airport is expected to require a 125mm diameter, steel pipeline to supply a capacity of 30’000GJ of gas per annum.

Issues to Consider

- Information on specific locations of potential gas connection points is not currently available.
- Further investigation and discussions with suppliers are recommended to assess the use and extension for any existing gas infrastructure extending from Hoxton and Penrith that can accommodate the required capacity needed for a type 2 airport

5.8.3 Type 4 Airport

Proposed Infrastructure

The capacity needed for a type 4 airport has been identified as 3’000GJ per annum.

Due to the small gas demand and high cost of a pipeline, it is proposed that a weekly supply of gas can be scheduled and stored in two 3000 litre gas capacity storage tanks.

Further discussions with local gas suppliers are required to define the leasing condition for storage and supply contracts.

Issues to Consider

- Future increase in the demand for gas will require the provision of a reticulated supply with utilisation of the existing Sydney/Newcastle high pressure main, as identified in a Type 2 airport scenario.

- The gas supply Authority may consider bearing the cost of the pipeline extension as it presents an opportunity to extend their infrastructure and develop a new revenue generating area to their network.

5.8.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

Over a 16 year period the potential passenger volumes at are expected to rise from 5 to 32 million passengers per annum. This will result in a proportional increase in gas demand from 30,000GJ to 177,000GJ per annum.

To accommodate this transition, an upfront infrastructure is proposed larger than that required for a Type 2 airport. It is proposed that 250mm diameter steel pipeline be used.

Issues to Consider

- Information on specific locations of potential gas connection points is not currently available.
- It is assumed that any necessary metering and control plant for the gas supply is owned by the supplier. Further investigation and discussion is required.

5.9 Fuel

5.9.1 Existing Infrastructure

Luddenham is located in the region of Badgerys Creek, approximately 25km west of Liverpool.

The Clyde and Kurnell refineries situated within the Sydney basin provide for aviation fuel supply; however the development and provision of a new reticulated pipeline is required to airport developments of any significant size.

An initial assessment of the existing fuel infrastructure in and around the Sydney region has identified an existing Sydney/Newcastle fuel pipeline. Utilisation of this pipeline is doubtful as it is not intended for aviation fuel purpose and its use will be subject to further investigation and discussion with suppliers to assess feasibility.

Newcastle currently has 3 fuel terminals associated with Caltex, BP, Shell and Mobil. (Petroleum import infrastructure in Australia' main report 'written for the Department of Resources, Energy and Tourism) As may be required, it is proposed that the existing facilities at the Port of Newcastle be developed to assist with fuel supply via shipping facilities and a reticulated pipeline network.

5.9.2 Type 2 Airport

Proposed Infrastructure

A Type 2 airport requires approximately 6ML of storage to provide for a minimum of 5 days to allow for the daily fuel consumption of 1.2ML

It is proposed that the Clyde refinery be utilised as the main source of fuel supply for the airport, with provision of a new pipeline and associated infrastructure. The pipeline will extend approximately 35km to the airport location.

To provide for supply resilience, there is a desire to have a second independent aviation fuel supply at the airport. Due to the location of Badgerys Creek, it is suggested that Kurnell Refinery in Sydney be utilised.

Provision of a new pipeline and its associated infrastructure will extend approximately 80km to the airport. Further investigation is required to confirm the preference for this route.

The main and secondary pipeline each requires a 200mm steel pipe, with appropriate cathodic protection.

It is assumed that any necessary control station needed to assist with the aviation fuel distribution would be constructed as part of the airport facilities and infrastructure.

Issues to Consider

- There is no requirement for an intermediate pumping station currently identified, however further geographical studies need to be conducted to asses this in more detail.

5.9.3 Type 4 Airport

Proposed Infrastructure

Based on predicted air traffic movements for General Aviation (GA) and Regular Public Transport (RPT) the expected fuel capacity is estimated at approximately 100’000 litres per day.

It proposed that for the demand of a type 4 airport, the fuel supply will be a schedule of regular trucked deliveries and above ground storage tanks on site.

The storage facility will have the capacity to hold a minimum of 5 days storage in 0.5ML above ground storage tanks.
To further address resilience there is the flexibility to re-size the storage facility to meet growth in demand and to safe guard for redundancy.

Issues to Consider

- No identified issues at this stage however open discussions with suppliers may lead to re-evaluation of the current capital cost estimates.

5.9.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

Over a 16 year forecast the potential passenger growth from Type 2 to Type 1 l is expected to increase from 5 to 32 million passengers a year. In order to meet this demand, the aviation fuel capacity need for sufficient airport operations will increase from 1.2ML/day to 12ML/day respectively.

In order to accommodate this transition, (Type 2 to Type 1) it is suggested that the supporting infrastructure be constructed in two additional stages from that proposed for the Type 2 airport.

At ‘year 0’ the initial infrastructure will utilise the main and redundant 200mm diameter steel supply pipelines with 6ML above ground storage tanks to provide the minimum of 5 days storage.

At ‘year 7’ the fuel demand is expected to grow to 5ML/day. It is proposed to upgrade the infrastructure with an additional 200mm pipeline with an additional 20ML above ground storage tank will be installed giving a total capacity of 26ML for 5 days storage.

At ‘year 14’, the fuel demand is expected to grow to a capacity of 10-12ML/day. It is proposed to upgrade the infrastructure with a further and final 150mm pipeline and an additional 30ML above ground storage tank, giving a total capacity of 56ML.

At ‘year 16’ accommodating the operation and fuel demands for a Type 1 airport, the baseline infrastructure will consist;

- three fuel supply pipelines feeding from the primary source (2x200mm, 1x150mm)
- one fuel pipeline designed for redundancy (200mm) feeding from the secondary source; and
- 56 ML storage tanks.

Issues to Consider

- Further investigation is needed to assess the requirements of additional and intermediate pumping stations.
- Further discussions with fuel suppliers are recommended to explore leasing opportunities and capital costs for Storage facilities.

5.10 Summary

5.10.1 Capital Expenditure

A summary of the capital expenditure for each infrastructure type for Luddenham is shown in Table 16 below.

Table 16 - Infrastructure Capital Expenditure for Luddenham

Infrastructure	Infrastructure Capital Expenditure for Luddenham ($M) Type 2 Airport	Infrastructure Capital Expenditure for Luddenham ($M) Type 4 Airport
Road	440	0
Rail	0	0
Water	16	14
Wastewater	10	9
Power	95	21
Communications	14	5
Gas	14	0
Fuel	181	1
Sub Total	769	49
Risk Contingency – 30%	231	15
Design and PM – 20%	154	10
Total	**1,154**	**74**

5.10.2 Operational and Maintenance Expenditure

A summary of the operational and maintenance expenditure for each infrastructure type for Luddenham is shown in the following tables.

Table 17 - Operational and Maintenance Expenditure for Luddenham (Type 2 Airport)

Asset	Operational and Maintenance Costs ($'000)	Interval (year)
Road	-	
Pavement - annual	1,277	1
Pavement (replace wearing course)	-	
Motorway; divided (6 lanes)	10,530	10
Pavement (replace others)		
Motorway; divided (6 lanes)	1,476	5
Water	-	
Annual	8	1
Pipe	143	1
Pumping Station (repairs)	65	5
Pumping Station (replacement)	650	25

Asset	Operational and Maintenance Costs ($'000)	Interval (year)
Storage Tank (repairs)	13	5
Storage Tank (painting)	39	15
Wastewater	-	
Annual	31	1
Pipe	65	1
Pumping Station (repairs)	130	5
Pumping Station (replacement)	3,900	15
Treatment Plant	689	5
Power	-	
Annual	231	1
Transmission Line	1,300	9
Transformers 30MVA (132/33)	5,200	15
Transformers 30MVA (33/11)	5,200	15
Switches (indoor)	10	18
Switches (outdoor)	65	2
Communications	-	
Annual	52	1
Cables and ducting	21	18
Gas	-	
Annual	138	1
Pipe	124	5
Valve Station	7	7
Cathodic Protection (repairs)	62	10
Cathodic Protection (replacement)	2,080	20
Fuel	-	
Annual	1,325	1
Pipe	792	5
Storage Tank (repairs)	20	5
Storage Tank (painting)	20	15
Cathodic Protection (repairs)	464	10
Cathodic Protection (replacement)	15,457	20

Table 18 - Operational and Maintenance Expenditure for Luddenham (Type 4 Airport)

Asset	**Operational and Maintenance Costs ($'000)**	**Interval (year)**
Water	-	
Annual	7	1
Pipe	143	1
Pumping Station (repairs)	65	5
Pumping Station (replacement)	650	25
Storage Tank (repairs)	7	5
Storage Tank (painting)	20	15
Wastewater	-	
Annual	65	1
Pipe	65	1
Pumping Station (repairs)	26	5
Pumping Station (replacement)	3,900	15
Treatment Plant	689	5
Power	-	
Annual	169	1
Transmission Line	65	9
Transformers 30MVA (33/11)	130	15
Annual	52	1
Cables and ducting	8	18
Fuel	-	
Annual	1	1
Storage Tank (repairs)	20	5
Storage Tank (painting)	20	15

5.10.3 Transition Capital Expenditure

The capital expenditure for the transition from a Type 2 to a Type 1 airport is summarised in Appendix E.

5.10.4 Transition Operational and Maintenance Expenditure

The operational and maintenance costs are specific for each infrastructure asset. As such, it is not possible to present one summary cost estimate for the operating and maintenance costs. Refer to Appendix E for details.

5.10.5 Site Levelling and Preparation Expenditure

A summary of the site levelling and preparation expenditure for Luddenham is shown in the following table.

Table 19 - Summary of site levelling and preparation expenditure for Luddenham

Site	Type 2 Airport ($M)	Type 4 Airport ($M)	Transition from Type 2 to Type 1 ($M)[1]
Luddenham	600	30	4,700

Note 1: These figures include the total nominal site preparation costs over the 16 year transition period including in the initial construction.

6 Locality 13 – The Oaks

6.1 Introduction

The Oaks is approximately 17,712ha and is located in the vicinity of Oakdale, in the Wollondilly Shire, about 80km southwest of Sydney. Main access to this proposed site is available from Burragorang Road, Montpellier Road and Silverdale Road. The general topography of the site consists of an undulating plateau with open rural land, and Monkey Creek, Back Creek and other local creeks traverse the site. The Oaks private airfield is also located near this proposed site.

6.2 Site Issues

Waterfall Creek is located within this proposed locality and flows into the Werri Berri Creek before reaching the Hawkesbury Nepean River. This water is part of the Sydney Drinking Water Catchment and water quality should be considered.

In addition, this proposed site is located at the edge of the Blue Mountains and comprises national parks, conservation areas and World Heritage areas which are of significance in the evolution of Australia's diverse ecosystems and communities of plants. "Vulnerable" and "endangered" fauna and flora species are present in this area.

6.3 Surface Transport

6.3.1 Existing Infrastructure

6.3.1.1 Road

The Oaks is served by road access primarily via the F5 Freeway (Hume Highway), Narellan Road, Camden Bypass and Burragorang Road. Camden Bypass can also be accessed via Camden Valley Way.

A key influence in the area of The Oaks is the South West Growth Centre as previously discussed for Location 12. This is approximately 17,000 hectares comprising of 18 Precincts and is planned to provide capacity for around 110,000 new dwellings for 300,000 people. Access to an airport at The Oaks via Camden Valley Way is undesirable as Camden Valley Way will be required to have an ongoing role in providing access for the South West Growth Centre and surrounds.

The South West Growth Centre will have significant impacts on the road network surrounding The Oaks. A set of road upgrades on key access roads through the region is currently planned to accommodate expected growth, regardless of whether an airport is developed at The Oaks. These upgrades include the widening of Camden Valley Way to a four-lane divided road between Narellan Road and Cobbity Road, planned to commence shortly. Additionally, the NSW RTA is currently in the process of widening the F5 Freeway to eight lanes between Brooks Road and Raby Road and six lanes between Raby Road and Narellan Road.

The timeframe for this analysis did not permit a detailed assessment of future traffic volumes with the effects of development in the South West Growth Centre. Trend historical growth rates do not fully account for the likely impacts of these developments. It should be noted that the planned widening of Camden Valley Way to a four-lane divided road is unlikely to cater for population growth and regardless of the development of an airport at The Oaks, widening to six-lanes will be required.

Figure 13-3a illustrates the assumed base case road upgrades for The Oaks in 2021.

6.3.1.2 Rail

The nearest existing rail station to The Oaks is at Menangle Park, which is on the non-electrified Southern Highlands Line. Menangle Park Railway Station is approximately 30 km by road from The Oaks.

6.3.1.3 Bus

The Oaks is currently served by a Busways Campbelltown route. This route provides access between Camden and the proposed airport site.

6.3.1.4 Taxi

The Oaks is outside the Sydney Metropolitan Transport District, which is bounded by the Nepean River. As such, Sydney taxis may drop off passengers at The Oaks but may not pick up passengers at The Oaks, and must return to a location within their own district without passengers.

6.3.2 Type 2 Airport

6.3.2.1 Road

Trend growth rates from the historical data to a future year of 2021 (assumed to be the earliest likely opening year for an airport allowing for planning and environmental investigations) with addition of airport-related traffic indicate that the following upgrades will be required with the development of a Type 2 airport at The Oaks:

- widen Narellan Road from Camden Valley Way to the F5 Freeway from four-lanes divided with clearways to eight-lane motorway standard. This is not considered to be a practical or feasible outcome and an alternative is discussed further below;
- widen Camden Bypass from Narellan Road to Macarthur Road from four - lanes divided to six-lanes divided;
- widen Camden Bypass from Macarthur Road to Burragorang Road from two-lanes undivided to six-lanes divided; and

- widen Burragorang Road between the airport site and Camden Bypass from two-lanes undivided to four-lanes undivided with clearways.

An alternative and preferable solution would be to build a new link road from the F5 Freeway, south of Narellan road, directly to Burragorang Road, west of Camden to provide dedicated access to the airport. This will involve significant cost due to the required length of the link. However it would negate the need to widen Narellan Road to motorway standard. It would also remove airport related traffic from the urban areas along Narellan Road and Camden Valley Way.

Figure 13-3b shows the road upgrades identified for a Type 2 airport at The Oaks. This figure includes the notional new airport access link road.

6.3.2.2 Rail

Previous discussion in supporting reports has indicated there is no requirement for a rail link to a Type 2 airport in the initial stage of development.

6.3.2.3 Bus

Connecting bus services for a Type 2 airport at The Oaks should be provided to Campbelltown town centre to connect to CityRail services.

6.3.3 Type 4 Airport

6.3.3.1 Road

Trend growth rates from the historical data to a future year of 2021 (assumed to be the earliest likely opening year for an airport allowing for planning and environmental investigations) with addition of airport-related traffic indicate that the following upgrades will be required for the development of a Type 4 airport at The Oaks:

- Widen Narellan Road from Camden Valley Way to the F5 Freeway from four-lanes divided with clearways to six-lane motorway;
- Widen Camden Bypass from Macarthur Road to Burragorang Road from two-lanes undivided to four-lanes divided with clearways.

As discussed previously, an alternative and preferable solution would be to build a new link road from the F5 Freeway, south of Narellan road, directly to Burragorang Road. This is likely to involve significant cost due to the required length of this link. However it would negate the need to widen Narellan Road to motorway standard. It would also remove airport related traffic from the urban areas along Narellan Road and Camden Valley Way.

Figure 13-3c shows the road upgrades identified for a Type 4 airport at The Oaks.

6.3.3.2 Rail

Previous discussion in supporting reports has indicated there is no requirement for a rail link to a Type 4 airport in the initial stage of development.

6.3.3.3 Bus

Connecting bus services for a Type 4 airport at The Oaks could be provided to Campbelltown town centre to connect to CityRail services.

6.3.4 Transition from Type 2 to Type 1 Airport

Transport upgrades for the transition from a Type 2 to a Type 1 airport were derived using trend analysis at five-year intervals from 2021 to 2036, from a starting point of the infrastructure that was identified for the initial stage Type 2 airport.

The passenger growth scenario for this transition was provided to Arup. These imply substantial growth in passenger numbers, starting at over 20% per annum in the early years of transition and tapering to 8% per annum by year 15 of transition. Forecasts of airport-related traffic generation for these increases in passenger numbers are described in the transport analysis methodology in Appendix B.

In several cases the trend extrapolation of baseline traffic on key access roads over a 25-year period to 2036 results in substantial traffic volumes, requiring significant infrastructure upgrades regardless of any airport development, and sometimes with substantial cost implications. The scope of the work however is such that baseline road upgrades could not be fully considered in the context of wider network performance or management and budgetary strategies. Computerised transport network modelling would provide improved outcomes for baseline traffic volume estimates balanced across wider network and land-use/demographic outcomes.

6.3.4.1 Road

Trend growth rates to 2026, 2031 and 2036 indicate that extensive work will be required to provide capacity for an upgrade from a Type 2 to a Type 1 airport at The Oaks. Of significant expense is the construction of a new link road from the F5 Freeway to Burragorang Road.

Based on assumptions of passenger growth for the transition from a Type 2 to a Type 1 airport provided to Arup, analysis of traffic estimates from trend growth rates plus airport-related traffic indicate the following road network upgrades are required for an airport at Location 13 by 2026:

- Construct new six-lane two-way link road from the F5 south of Narellan Road to Burragorang Road west of Camden;
- Widen Burragorang Road between new link road and airport site from four-lanes undivided with clearways to six-lanes divided.

By 2036 the following upgrades will be required:

- Upgrade the new link road from six-lane two-way arterial highway standard to six-lane motorway;
- Upgrade Burragorang Road between new link road and airport site from six-lanes divided with clearways to six-lane motorway standard.

Figure 13-2/1-3 shows the road upgrades indicated for a transition scenario at The Oaks.

6.3.4.2 Rail

Previous working papers of this study have discussed that the provision of dedicated rail access is generally not justifiable for Type 2, 3 and 4 airports, and is more a question of transport policy goals for a Type 1 airport rather than a question of providing necessary capacity, until passenger numbers reach over approximately 45m per annum.

The discussion identified nonetheless that planning for a Type 1 airport at a greenfield site should include considerations for the provision of a rail link from the time of opening, to support transport sustainability and mobility goals and to enhance the service quality standard of the airport as measured in international rankings.

The provision of an airport link is requires substantial study outside the scope of this work.

For the purposes of providing indicative capital costings only, a notional rail access link has been identified for The Oaks as it reaches Type 1 standard in 2036, via a new dual track rail service from the airport terminal station to Menangle Park Station on the Southern Highlands Line. No feasibility analysis has been undertaken for this notional line.

Figure 13-2/1-3 shows the notional rail link for The Oaks.

6.3.4.3 Bus

As the airport reaches Type 1 status and/if a rail link is introduced, bus services to Sydney would require to be reviewed in the context of the new rail service.

6.3.4.4 Taxi

As stated, The Oaks is within the Sydney Metropolitan Transport District and as such passengers can be transported to and from the site by Sydney taxis.

6.4 Water

6.4.1 Existing Infrastructure

The Oaks is located approximately 40km north of the Nepean Dam. Water from this dam is pumped to Sydney Water's Nepean Water Filtration Plant near Bargo which then serves the areas of Picton, Bargo, The Oaks and Oakdale. The capacity of the Nepean Water Filtration Plant is nominally 31ML per day based on full storage level in the Nepean Dam[6].

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[6] Sydney Water

There is an existing water reticulation servicing the towns of Oakdale and The Oaks, including a watermain along Burragorang Road which is 250mm in diameter west of Binalong Road and 200mm in diameter east of Binalong Road.

6.4.2 Type 2 Airport

Proposed Infrastructure

It is proposed to provide a water supply to The Oaks by providing a new connection to the existing watermain along Burragorang Road. This new connection will be a 200mm diameter pipeline. A new pumping station (11L/s at 145m) at the Nepean water filtration plant and on site storage (1ML capacity) at the airport will be provided for the airport's water supply system. In addition, disinfection will likely to be required and a hypochlorite dosing system has been included in the proposed works (0.08kg/hr Cl equivalent hypo dosing unit).

Figure 13-4 in Appendix A shows the existing and proposed water supply network for The Oaks.

Issues to Consider

- Capacity of the existing water network to the Nepean water filtration plant is unconfirmed.

6.4.3 Type 4 Airport

Proposed Infrastructure

For a Type 4 airport, the water supply strategy will be similar to the strategy proposed for the Type 2 Airport and will be a connection to the existing watermain on Burragorang Road. The proposed connection will be a 100mm diameter pipeline, including a pumping station (11L/s at 135m) and storage tanks (0.5ML total capacity). A hypochlorite dosing system has also been included (0.008kg/hr Cl equivalent hypo dosing unit) as the disinfection system.

Refer to Figure 13-4 in Appendix A for a visual of the proposed works.

Issues to Consider

- Capacity of the existing water network to the Nepean water filtration plant is unconfirmed.

6.4.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The transition from a Type 2 airport to a Type 1 airport will occur over a 16 year period with the passenger capacity increasing from 5 million to 30 million. The water supply infrastructure required for this transition will be constructed in three stages:

- This initial water supply infrastructure will comprise a 200mm diameter pipeline, a new pumping station (11L/s at 145m) at the water filtration plant, on site storage (11ML capacity) and a chlorination unit (0.08kg/hr Cl equivalent hypo dosing unit).
- It is then proposed to upgrade the works after 5 years by including larger pipes and providing additional storage capacity (11ML). Increasing the chlorination rate to 0.6kg/hr Cl equivalent hypo dosing unit will also be required.
- 10 years after the initial works, additional storage capacity will be required (11ML).

Figure 13-2/1-4 in Appendix A summarises the transition works for The Oaks.

Issues to Consider

- Capacity of the existing water network to the Nepean water filtration plant is unconfirmed.
- The growth of the surrounding area over the transition period will influence the timing and extent of water supply infrastructure upgrades.

6.5 Wastewater

6.5.1 Existing Infrastructure

There is an existing wastewater reticulation network servicing the towns of Oakdale and The Oaks, comprising of gravity and rising mains which tie to the 300mm diameter Oaks/Oakdale Transfer Main.

The closest wastewater treatment plant to The Oaks is located in West Camden, about 14km northeast of the proposed site. This plant is owned by Sydney Water and its capacity is approximately 10.8ML per day. There has been a proposal to increase the capacity to 22.9ML per day to provide sufficient capacity for the population predicted for the year 2021[7].

There is also a water recycling plant in West Camden which had an initial capacity of 10.7ML per day. This plant has been upgraded since and now discharges up to 23 ML per day[8]. It uses a tertiary process, including additional phosphorus removal and disinfection, and some of this discharge is reused at the Elizabeth Macarthur Agricultural Institute while the remainder flows via Matahill Creek to the Nepean River.

It is worth noting that there is also a smaller water recycling plant in Picton, about 20km south east of the proposed site. The Picton plant also uses a tertiary process and treats about 1.5ML per day[8]. The discharge is mainly used for agricultural irrigation.

[7] Section 115C of the Environmental Planning and Assessment Act 1979
[8] Sydney Water

6.5.2 Type 2 Airport

Proposed Infrastructure

It is proposed to provide a wastewater supply to The Oaks by connecting to the existing sewer reticulation network along Burragorang Road. This new connection will be a rising main (16L/s) via a 150mm diameter pipeline. A new pumping station (16L/s at 32m) at the treatment plant and emergency on site storage at the airport will be provided for the airport’s wastewater supply system.

Figure 13-4 in Appendix A shows the existing and proposed wastewater supply network for The Oaks.

Issues to Consider

- Capacity of the existing wastewater reticulation network is unconfirmed.

6.5.3 Type 4 Airport

Proposed Infrastructure

For a Type 4 airport, the water supply strategy will be similar to the strategy proposed for the Type 2 Airport and will be a connection to the existing wastewater reticulation network along Burragorang Road. The proposed connection will comprise a rising main (2L/s) via a 100mm diameter pipeline, a pumping station (5L/s at 30m) and on site emergency storage.

Refer to Figure 13-4 in Appendix A for a visual of the proposed works.

Issues to Consider

- Capacity of the existing wastewater reticulation network is unconfirmed.

6.5.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The transition from a Type 2 airport to a Type 1 airport will occur over a 16 year period with the passenger capacity increasing from 5 million to 30 million. The water supply infrastructure required for this transition will be constructed in three stages:

- This initial wastewater supply infrastructure will comprise a rising main via a 150mm diameter pipeline, a new pumping station (50L/s at 50m) at the treatment plant, and emergency on site storage.
- It is then proposed to upgrade the works after 2 years by adding a 200mm diameter pipeline and a second pumping station (50L/s at 50m).
- 11 years after the initial works, it is proposed to modify the second pumping station to increase its capacity to 100L/s.

Figure 13-2/1-4 in Appendix A summarises the transition works for The Oaks.

Issues to Consider

- Capacity of the existing wastewater reticulation network is unconfirmed.
- The growth of the surrounding area over the transition period will influence the timing and extent of water supply infrastructure upgrades.

6.6 Power

6.6.1 General

This section describes the bulk supply of power to a Type 2 and Type 4 airport at The Oaks. The internal distribution of power around the airport itself is not discussed.

The existing infrastructure is assumed to be similarly affected by both types of airport developments. The runway at The Oaks is assumed to be orientated along the long axis of the site, i.e. north / south orientation.

The internal distribution of power is not described within this report for each site as the internal configuration will be similar for each airport type at any of the sites.

6.6.2 Existing Infrastructure

The Oaks has existing electricity services traversing and bordering the site. These are:

- A north –south orientated Transgrid 330kV transmission line is located to the east of the site.
- Endeavour Energy 66kV and 33kV sub-transmission lines that traverse the site east / west.
- Endeavour Energy distribution high voltage and low voltage power lines for the provision of power to the properties within the area.

All the existing electrical services within the proposed site will be affected by the proposed airport.

Any distribution high voltage and low voltage power lines that are required to be retained due to them servicing properties outside the site will need to be positioned in service easements outside of the site. Operational clearances may require lines to be placed underground for some sections, and this will be affected by the runway orientation yet to be determined. The relocation of these services is not expected to cause major disruptions and can be readily programmed with any works in the area.

The Transgrid 330kV transmission line will not require relocation.

Endeavour Energy’s 33kV and 66kV lines that traverse the site will require to be relocated.

Possible routes for each transmission line have been shown in Figure 13-5. As no discussions with Endeavour Energy have been undertaken, these routes will need to be investigated further and any final route will be determined by the respective organisation, with the final routes may result in longer sections of transmission lines to be relocated.

6.6.3 Type 2 Airport

Proposed Infrastructure

The site is located in Endeavour Energy’s network, and supply will be from Endeavour Energy’s network.

All power lines have been assumed to be overhead wiring. Although there maybe the possibility of utilising existing easements, the cost for new easements or widening existing easements is to be considered.

Supply to the airport site will require a new substation to be established, with supply from Endeavour Energy.

Endeavour Energy has both 33kV and 66kV networks in the vicinity of the site. It is assumed that the 33kV network does not have sufficient capacity to service the airport’s 9MVA demand, and that the 66kV network is assumed that it does. On this basis, it is proposed to obtain supply to the site at 66kV.

Supply to the airport site will require a new 66kV / 11kV substation to be established, with dual supplies from diverse 66kV lines.

It has been assumed that the existing networks will have the capacity to supply this additional load.

Due to the timeframe when supply could be required, there could be other options available due to network planning considerations, and Endeavour Energy and Transgrid would need to be consulted to ascertain the most likely supply option.

It is anticipated that the airport will be a high voltage customer. Supply within the airport will be reticulated at 11kV to distribution substations.

Issues to Consider

Due to the time frame when supply could be required, there could be other options that Endeavour Energy may have due to network planning considerations and Endeavour Energy would need to be consulted to ascertain the most likely supply option. Relocation of Endeavour Energy’s assets in the vicinity of the airport will require time to plan and implement. The indicated relocations noted on the sketches are arbitrary, and with further detailed analysis may require more significant re-routing then assumed. Some assets, i.e. the 33kV line, noted to be relocated could be reconfigured instead of being relocated to account for changes need to supply the Airport, thus simplifying the works. This will ne be fully understood until discussions with Endeavour Energy can be undertaken, and further detailed planning and design has occurred.

The timeframe when supply would be required could result in other options that Endeavour Energy may have for supply to the site due to network planning considerations, and Endeavour Energy would need to be consulted to ascertain the most likely supply option. This includes the planned growth for the site, which may result in different options.

Route selection for new and relocated transmission and sub-transmission lines can take considerable time to resolve. The use of existing easements, if available and suitable for use, is preferable to establishing new easements, especially if the area that is requiring to be traversed is already developed. This will require further investigation.

Transmission lines installation should be rated to provide the planned future demands for the site to minimise the need for costly augmentation works on the transmission lines. Ratings of other equipment should also be selected to deal with planned demand growth while considering the design life of the installed electrical assets.

6.6.4 Type 4 Airport

Proposed Infrastructure

Supply to the airport site, with a capacity of 1.7MVA, will likely be at low voltage, from a new Endeavour Energy substation connected to the nearest 11kV network. The 11kV network may require to be extended to the required site.

Issues to Consider

The relocation of Endeavour Energy assets as discussed above is the main issue identified.

6.6.5 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

To supply a Type 1 airport development, the supply to the site will be required to be minimum 66kV. The proposed infrastructure for the Type 2 airport is at 66kV, but it is anticipated that these will be required to be upgraded as these lines already supply other loads apart from the airport, and will not have sufficient capacity.

The proposed infrastructure is to either upgrade the existing lines that supply the airport to 132kV or provide dedicated 66kV supplies from Endeavour Energy's TS. Possible 66kV connection points are located approximately 20km from the site. For redundancy, it is proposed to have the 66kV connection points at different locations.

It is assumed that the additional infrastructure will be to install a 132kV line to allow for future network expansion, but operate at 66kV.

At the airport, expansion of the existing 66/11kV substation will be required to allow for the increased loads.

It is assumed that there will be augmentation works required for Endeavour Energy's infrastructure upstream of the proposed connection points to provide the required capacity 's. Augmentation works, including additional breakers and other substation works, will be required at the proposed connection works.

Issues to Consider

The increased demand on Endeavour Energy's and Transgrid's assets may require additional augmentation works due to other developments that may occur prior to planning works occurring.

Due to the time frame when supply could be required, there could be other options that Endeavour Energy may have due to network planning considerations and Endeavour Energy would need to be consulted to ascertain the most likely supply option.

The timeframe when supply would be required could result in other options that Endeavour Energy may have for supply to the site due to network planning considerations, and Endeavour Energy would need to be consulted to ascertain the most likely supply option. This includes the planned growth for the site, which may result in different options.

Route selection for new and relocated transmission and sub-transmission lines can take considerable time to resolve. The use of existing easements, if available and suitable for use, is preferable to establishing new easements, especially if the area that is requiring to be traversed is already developed. This will require further investigation.

Transmission lines installation should be rated to provide the planned future demands for the site to minimise the need for costly augmentation works on the transmission lines. Ratings of other equipment should also be selected to deal with planned demand growth while considering the design life of the installed electrical assets.

6.7 Communications

6.7.1 Existing Infrastructure

Telecommunications services are predominantly provided by Telstra. There is an existing ADSL exchange at The Oaks. However, ADSL is considered not capable of sufficient bandwidth and services reliability for communications needs of airport and business operations.

6.7.2 Type 2 Airport

Proposed Infrastructure

Telecommunications services are necessary to support the airport operations, passengers and the community around. For business continuity reasons, resilient and alternative supplies are considered essential. As contrasted to a single point connection, diverse routes will enhance availability of telecommunications services. Fibre cable has much higher bandwidth capacity than copper cable or microwave transmission. Therefore, fibre cable is the preferred means of telecommunication backbone. Liverpool exchange and Campbelltown exchange are nominated as telecommunications service sources on diverse routes for The Oaks. The road distances from The Oaks to Liverpool and Campbelltown are 49km and 28.5km respectively. Their locations and the nominated fibre cable routes to the site are indicated in Figure 13-6a in Appendix A.

Issues to Consider

- Underground cable route along roads to airport is assumed.
- Use of diverse routes via different telecom carriers can enhance level of redundancy.

6.7.3 Type 4 Airport

Proposed Infrastructure

Telecommunications services are necessary to support the airport operations, passengers and the community around. The telecommunications demand on a Type 4 airport is significantly less than a Type 2 airport. The need for redundancy is also reduced and thus the airport no longer requires a secondary diverse source. The Campbelltown exchange has been nominated as the service source for this airport. The road distance from The Oaks to Campbelltown is 28.5km. The location and the nominated fibre cable route to the site is indicated in Figure 13-6b in Appendix A.

Issues to Consider

- Underground cable route along roads to airport is assumed.

6.7.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The proposed communications infrastructure of diverse fibre and copper cable routes for a Type 2 airport is capable of meeting the communications bandwidth demand of a Type 1 airport. During the transition to Type 1, the construction work will involve cable relocations to accommodate the new cable route within the airport site. The cost of 1km of communications cable infrastructure is estimated for that cable relocation.

Issues to Consider

- Underground cable infrastructure is assumed.

6.8 Gas

6.8.1 Existing Infrastructure

The Oaks is located in the region of Belimbla Park, approximately 30km West of Campbelltown, close to the Oaks airfield on Burragorang road.

A 450 mm diameter high pressure gas pipeline currently exists between Sydney and Newcastle.

It is assumed that there is no detailed existing gas infrastructure reticulating out to the Belimbla Park region and therefore a new gas network is recommended to supply the required capacity for a Type 1, 2 or 4 Airport. It is further suggested that discussions with local gas suppliers are needed to confirm the above assumptions.

6.8.2 Type 2 Airport

Proposed Infrastructure

It is proposed to connect to the existing Sydney/Newcastle gas pipeline as shown in Figure 13-7 in Appendix A. The nominated route is approximately 25km.

A Type 2 airport is expected to require a 125mm diameter, steel pipeline to supply a capacity of 30’000GJ of gas per annum.

Issues to Consider

- Information on specific locations of potential gas connection points is not currently available.
- Further investigation and discussions with suppliers are recommended to assess the use and extension for any existing gas infrastructure in the area of Belimbla Park and the required capacity needed to accommodate a type 2 airport

6.8.3 Type 4 Airport

Proposed Infrastructure

The capacity needed for a type 4 airport has been identified as 3’000GJ per annum.

Due to the small gas demand and high cost of a pipeline, it is proposed that a weekly supply of gas can be scheduled and stored in two 3000 litre gas capacity storage tanks.

Further discussions with local gas suppliers are required to define the leasing condition for storage and supply contracts.

Issues to Consider

- Future increase in the demand for gas will require the provision of a reticulated supply, with utilisation of the existing Sydney/Newcastle high pressure main, as identified in a Type 2 airport scenario.
- The gas supply Authority may consider bearing the cost of the pipeline extension as it presents an opportunity to extend their infrastructure and develop a new revenue generating area to their network.

6.8.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

Over a 16 year period the potential passenger volumes at are expected to rise from 5 to 32 million passengers per annum. This will result in a proportional increase in gas demand from 30’000GJ to 177’000GJ per annum.

To accommodate this transition, an upfront infrastructure is proposed larger than that required for a Type 2 airport. It is proposed that 250mm diameter steel pipeline be used.

Issues to Consider

- Information on specific locations of potential gas connection points is not currently available.
- It is assumed that any necessary metering and control plant for the gas supply is owned by the supplier. Further investigation and discussion is required.

6.9 Fuel

6.9.1 Existing Infrastructure

The Oaks is located in the region of Belimbla Park, approximately 30km West of Campbelltown, close to the Oaks airfield on Burragorang road.

The Clyde and Kurnell refineries situated within the Sydney basin provide for aviation fuel supply; however the development and provision of a new reticulated pipeline is required to airport developments of any significant size.

An initial assessment of the existing fuel infrastructure in and around the Sydney region has identified an existing Sydney/Newcastle fuel pipeline. Utilisation of this pipeline is doubtful as it is not intended for aviation fuel purpose and its use will be subject to further investigation and discussion with suppliers to assess feasibility.

Newcastle currently has 3 fuel terminals associated with Caltex, BP, Shell and Mobil. (Petroleum import infrastructure in Australia’ main report ‘written for the Department of Resources, Energy and Tourism) As may be required, it is proposed that the existing facilities at the Port of Newcastle be developed to assist with fuel supply via shipping facilities and a reticulated pipeline network.

6.9.2 Type 2 Airport

Proposed Infrastructure

It is proposed that the Clyde refinery be utilised as the main source of fuel supply for the airport, with provision of a new pipeline and associated infrastructure for approximately 65km to the airport location in Belimbla Park.

To provide for supply resilience, there is a desire to have a second independent aviation fuel supply at the airport. Due to the location of Belimbla Park, it is suggested that Kurnell Refinery in Sydney be utilised.

Provision of a new pipeline and its associated infrastructure is recommended out of Kurnell, extending approximately 80km to the airport. Further investigation is required to confirm the preference for this route.

The main and secondary pipeline each requires a 200mm steel pipe, with appropriate cathodic protection.

It is assumed that any necessary control station needed to assist with the aviation fuel distribution would be constructed as part of the airport facilities and infrastructure.

Issues to Consider

- There is no requirement for an intermediate pumping station currently identified, however further geographical studies need to be conducted to asses this in more detail.

6.9.3 Type 4 Airport

Proposed Infrastructure

Based on predicted air traffic movements for General Aviation (GA) and Regular Public Transport (RPT) the expected fuel capacity is estimated at approximately 100’000 litres per day.

It proposed that for the demand of a type 4 airport, the fuel supply will be a schedule of regular trucked deliveries and above ground storage tanks on site.

The storage facility will have the capacity to hold a minimum of 5 days storage in 0.5ML above ground storage tanks.
To further address resilience there is the flexibility to re-size the storage facility to meet growth in demand and to safe guard for redundancy.

Issues to Consider

- No identified issues at this stage however open discussions with suppliers may lead to re-evaluation of the current capital cost estimates.

6.9.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

Over a 16 year forecast the potential passenger growth from Type 2 to Type 1 l is expected to increase from 5 to 32 million passengers a year. In order to meet this demand, the aviation fuel capacity need for sufficient airport operations will increase from 1.2ML/day to 12ML/day respectively.

In order to accommodate this transition, (Type 2 to Type 1) it is suggested that the supporting infrastructure be constructed in two additional stages from that proposed for the Type 2 airport.

At 'year 0' the initial infrastructure will utilise the main and redundant 200mm diameter steel supply pipelines with 6ML above ground storage tanks to provide the minimum of 5 days storage.

At 'year 7' the fuel demand is expected to grow to 5ML/day. It is proposed to upgrade the infrastructure with an additional 200mm pipeline with an additional 20ML above ground storage tank will be installed giving a total capacity of 26ML for 5 days storage.

At 'year 14', the fuel demand is expected to grow to a capacity of 10-12ML/day. It is proposed to upgrade the infrastructure with a further and final 150mm pipeline and an additional 30ML above ground storage tank, giving a total capacity of 56ML.

At 'year 16' accommodating the operation and fuel demands for a Type 1 airport, the baseline infrastructure will consist;

- three fuel supply pipelines feeding from the primary source (2x200mm, 1x150mm)
- one fuel pipeline designed for redundancy (200mm) feeding from the secondary source; and
- 56 ML storage tanks.

Issues to Consider

- Further investigation is needed to assess the requirements of additional and intermediate pumping stations.
- Further investigation is required to assess the detailed feasibility of a new fuel pipeline reticulating out of the Port Kembla
- Further discussions with fuel suppliers are recommended to explore leasing opportunities and capital costs for Storage facilities.

6.10 Summary

A summary of the capital expenditure for each infrastructure type for The Oaks is shown in Table 20 below.

Table 20 - Infrastructure Capital Expenditure for The Oaks

Infrastructure	Infrastructure Capital Expenditure for The Oaks ($M) Type 2 Airport	Infrastructure Capital Expenditure for The Oaks ($M) Type 4 Airport
Road	694	150
Rail	0	0
Water	6	4
Wastewater	6	5

Power	34	13
Communications	23	9
Gas	22	0
Fuel	260	1
Sub Total	1,045	181
Risk Contingency – 30%	314	54
Design and PM – 20%	209	36
Total	**1,568**	**271**

6.10.1 Operational and Maintenance Expenditure

A summary of the operational and maintenance expenditure for each infrastructure type for The Oaks is shown in the following tables.

Table 21 - Operational and Maintenance Expenditure for The Oaks (Type 2 Airport)

Asset	Operational and Maintenance Costs ($'000)	Interval (year)
Road	-	
Pavement - annual	2,094	1
Pavement (replace wearing course)	-	
Dual carriageway; undivided (4 lanes)	10,075	10
Motorway; divided (6 lanes)	6,318	10
Motorway; divided (8 lanes)	8,619	10
Pavement (replace others)		
Dual carriageway; undivided (4 lanes)	2,826	5
Motorway; divided (6 lanes)	886	5
Motorway; divided (8 lanes)	1,208	5
Water	-	
Annual	8	1
Pipe	13	1
Pumping Station (repairs)	65	5
Pumping Station (replacement)	650	25
Storage Tank (repairs)	13	5

Asset	Operational and Maintenance Costs ($'000)	Interval (year)
Storage Tank (painting)	39	15
Wastewater	-	
Annual	31	1
Pipe	13	1
Pumping Station (repairs)	130	5
Pumping Station (replacement)	3,900	15
Power	-	
Annual	146	1
Transmission Line	390	9
Transformers 30MVA (66/11)	5,200	15
Switches (indoor)	6	18
Switches (outdoor)	39	2
Communications	-	
Annual	52	1
Cables and ducting	37	18
Gas	-	
Annual	221	1
Pipe	187	5
Valve Station	7	7
Cathodic Protection (repairs)	101	10
Cathodic Protection (replacement)	3,354	20
Fuel	-	
Annual	1,906	1
Pipe	1,134	5
Storage Tank (repairs)	20	5
Storage Tank (painting)	20	15
Cathodic Protection (repairs)	669	10
Cathodic Protection (replacement)	22,295	20

Table 22 - Operational and Maintenance Expenditure for The Oaks (Type 4 Airport)

Asset	Operational and Maintenance Costs ($'000)	Interval (year)
Road	-	
Pavement - annual	836	1
Pavement (replace wearing course)	-	
Dual carriageway; divided (4 lanes)	1,625	10
Motorway; divided (6 lanes)	2,633	10
Motorway; divided (8 lanes)	3,094	10
Dual carriageway; divided (4 lanes)	456	5
Motorway; divided (6 lanes)	1,230	5
Motorway; divided (8 lanes)	1,734	5
Water	-	
Annual	7	1
Pipe	13	1
Pumping Station (repairs)	65	5
Pumping Station (replacement)	650	25
Storage Tank (repairs)	7	5
Storage Tank (painting)	20	15
Wastewater	-	
Annual	31	1
Pipe	13	1
Pumping Station (repairs)	26	5
Pumping Station (replacement)	3,900	15
Power	-	
Annual	169	1
Transmission Line	65	9
Transformers 30MVA (33/11)	130	15
Communications	-	
Annual	52	1
Cables and ducting	14	18

Asset	**Operational and Maintenance Costs ($'000)**	**Interval (year)**
Fuel	-	
Annual	1	1
Storage Tank (repairs)	20	5
Storage Tank (painting)	20	15

6.10.2 Transition Capital Expenditure

The capital expenditure for the transition from a Type 2 to a Type 1 airport is summarised in Appendix E.

6.10.3 Transition Operational and Maintenance Expenditure

The operational and maintenance costs are specific for each infrastructure asset. As such, it is not possible to present one summary cost estimate for the operating and maintenance costs. Refer to Appendix E for details.

6.10.4 Site Levelling and Preparation Expenditure

A summary of the site levelling and preparation expenditure for The Oaks is shown in the following table.

Table 23 - Summary of site levelling and preparation expenditure for The Oaks

Site	**Type 2 Airport ($M)**	**Type 4 Airport ($M)**	**Transition from Type 2 to Type 1 ($M)[1]**
The Oaks	2,200	410	5,500

Note 1: These figures include the total nominal site preparation costs over the 16 year transition period including in the initial construction.

7 Locality 14 – Wilton

Wilton has previously been studied by Arup in January 2011 and the findings presented in *Supporting Infrastructure Capital Expenditure for Site Specific Scenarios* report. The following is a summary for this airport locality based on this previous report including additional information gathered since the submission of the report listed above.

7.1 Introduction

Wilton is located 85km southwest of Sydney, in the Shire of Wollondilly. Access is available from Picton Road (off the Hume Highway) and Macarthur Drive. In the *Supporting Infrastructure Capital Expenditure for Site Specific Scenarios* report, the site which was proposed in the 1985 Second Sydney Airport EIS was initially adopted. Since then, the Department has provided a site boundary and this report has progressed the study based on the site boundary provided by the Department.

7.2 Site Issues

1,295ha of the proposed site is in government ownership while the remaining 145ha are in the hand of three private companies[9]. Only a few residential dwellings exist on the proposed site and the rural classification mainly aims at protecting the agricultural potential of this rural area. This proposed site is currently used as a catchment for the Sydney drinking water supply system. It is worth noting that coal seams are also present at this site which should be considered if future mining activities were to occur.

The site covers an area of 1,440ha on the Woronora plateau at an average height of 310m above sea level between the Cordeaux River and Wallandoola Creek, situated west and east respectively. Ridges, plateau, slopes, gorges and streams are present within the site and the elevation varies from 245m to 333m above sea level. The proposed site slopes gently to the north, east and west and is also heavily vegetated and prone to bushfires. The undulating nature of the site would require extensive earthworks and will have a material cost impact on the project. It is recommended that further investigation of this issue be completed to assess the feasibility of the site.

Rainfall within the proposed site drains rapidly away as there are no developed floodplains. There are several creeks however which are subject to flash flooding during major storm events (Allens, Cascade and Wallandoola Creeks). Adequate control measures will be adopted based on the drainage strategy to be developed to avoid flooding to the proposed site.

It is worth noting that no records of major floods were found for this area and since the proposed site is elevated and naturally drains to the north, east and west, it is not anticipated that drainage would become a major issue.

Access to the site is from Picton Road, off the Hume Highway, which intersects with Macarthur Drive within the proposed site. The closest railway station is in the town of Douglas Park, located 12km north of the site. Upgrade of the existing

[9] 1985 EIS - Second Sydney Airport Site Selection Programme

road network will be required and new public transport networks will need to be developed.

The undisturbed nature of this site makes it prone to finding items of heritage significance.

7.3 Surface transport

7.3.1 Existing Infrastructure

7.3.1.1 Road

The Wilton site has good road access via the Wilton bypass realignment of Picton Road south from the F5 Freeway, completed in 1993. This road provides for high numbers of truck movements between the freeway, surrounding coalfields and Port Kembla in Wollongong. The Wilton bypass realignment was constructed as two-lane two-way concrete roadway with overtaking lanes from the F5 to south of Macarthur Road.

The NSW RTA is currently in the process of widening the F5 Freeway to eight lanes between Brooks Road and Raby Road and six lanes between Raby Road and Narellan Road.

Access to Wilton is also via Appin Road and Wilton Road from Campbelltown in southern Sydney.

As for other locations, it was assumed that in order to allow for environmental and planning investigations and airport construction that an airport would at the earliest be operational at Wilton by 2021. The surface transport assessment thus considered potential baseline future traffic flows in 2021 to determine additional requirements to serve the airport.

As the M7 was opened in December 2005, later than the time of the most recent publicly available traffic data, this had some impacts on traffic patterns and volumes on key roads providing access to the Wilton site, particularly the F5 Freeway. The outcomes of the analysis should therefore be considered in the context of the quality of available baseline traffic data.

7.3.1.2 Rail

The nearest existing railway station is at Douglas Park, which is on the Main Southern Line linking Sydney and Melbourne and carries freight services as well as interstate passenger trains. On the CityRail network the station is on the Southern Highlands Line and not being electrified, diesel trains transport passengers between Goulburn, Moss Vale and Campbelltown. At Campbelltown some passengers need to alight and transfer to an electric train for metropolitan stations, although some diesel services run express to Central Station.

The Maldon-Dombarton freight rail link, which was partially constructed in the 1980’s but not completed, passes to the west of the Wilton site. This line was initially planned as a single track, non-electrified freight line with passing loops. A study into the future viability of the Maldon-Dombarton rail link is currently being undertaken. The outcomes of the study were not available for consideration in the assessment of the Wilton site.

7.3.1.3 Bus

Wilton is currently served by a Picton Buslines route. This route provides access between Picton and the proposed airport site at Wilton. This service also provides a connection to Campbelltown Station.

7.3.1.4 Taxi

The Wilton site lies outside the Sydney Metropolitan Transport District, which is bounded by the Cataract River and the Wollongong Local Government Area boundary. Sydney taxis may drop off passengers at the Wilton site but may not pick up passengers at Wilton, and must return to a location within the Sydney Metropolitan District without passengers. The Wilton site lies within the Wollongong Transport District, and only Wollongong based taxis may pick up passengers from the site.

7.3.2 Type 2 Airport

7.3.2.1 Road

Trendline growth forecasts produced for key access roads did not indicate that upgrades would be required in the absence of an airport development at Wilton. Based on the available data, the current upgrades of the F5 and Picton Roads were estimated to cater for trend growth in baseline traffic to 2021.

Picton Road currently passes through the centre of this proposed locality. For an airport development to occur, Picton Road will require realignment around the perimeter of the site. Picton Road will continue to serve high numbers of truck movements accessing Port Kembla, and will require upgrading to four-lane two-way standard along it entire length to provide safe driving conditions and passing opportunities should an airport be developed at Wilton.

Figure 14-3b shows the road upgrades identified for a Type 2 airport at Wilton.

7.3.2.2 Rail

Previous discussion in supporting reports has indicated there is no requirement for a rail link to a Type 2 airport in the initial stage of development.

7.3.2.3 Bus

A Type 2 airport at Wilton will require dedicated bus services. Picton Road and the F5 are suitable corridors for bus operations (possibly similar to the Melbourne SkyBus), so long as Picton Road is widened to four-lane two-way standard to provide for safe passing opportunities. Additional connections could also be provided to Campbelltown to connect with the suburban rail network.

7.3.3 Type 4 Airport

7.3.3.1 Road

The current upgrades of the F5 and Picton Roads are estimated to cater for trend growth in baseline traffic to 2021.

For a Type 4 airport development to occur, Picton Road will need to be realigned around the perimeter of the site.

Figure 14-3c shows this realignment for the Type 4 airport at Wilton.

7.3.3.2 Rail

Previous discussion in supporting reports has indicated there is no requirement for a rail link to a Type 4 airport in the initial stage of development.

7.3.3.3 Bus

Bus connections could also be provided from a Type 4 airport at Wilton to Campbelltown to connect with the suburban rail network.

7.3.4 Type 2 to Type 1 Airport

Transport upgrades for the transition from a Type 2 to a Type 1 airport were derived using trend analysis at five-year intervals from 2021 to 2036, from a starting point of the infrastructure that was identified for the initial stage Type 2 airport.

The passenger growth scenario for this transition was provided to Arup. These imply substantial growth in passenger numbers, starting at over 20% per annum in the early years of transition and tapering to 8% per annum by year 15 of transition. Forecasts of airport-related traffic generation for these increases in passenger numbers are described in the transport analysis methodology in Appendix B.

In several cases the trend extrapolation of baseline traffic on key access roads over a 25-year period to 2036 results in substantial traffic volumes, requiring significant infrastructure upgrades regardless of any airport development, and sometimes with substantial cost implications. The scope of the work however is such that baseline road upgrades could not be fully considered in the context of wider network performance or management and budgetary strategies. Computerised transport network modelling would provide improved outcomes for baseline traffic volume estimates balanced across wider network and land-use/demographic outcomes.

7.3.4.1 Road

Trend growth rates for the F5 Freeway to 2026, 2031 and 2036 with addition of airport-related traffic indicate that extensive work will be required to provide capacity for transition from a Type 2 to a Type 1 airport at Wilton. The suggested scale of widening of the F5 over a long distance implies significant expense.

Based on assumptions of passenger growth for the transition from a Type 2 to a Type 1 airport provided to Arup, baseline plus airport-related traffic estimates indicate the following road network upgrades by 2026 above the initial stage Type 2 airport works:

- Widen the F5 Freeway between Raby Road and Narellan Road from six-lanes to eight-lanes;
- Widen the F5 Freeway between Narellan Road and Picton Road from four-lanes to six-lanes.

By 2031, baseline plus airport traffic estimates indicate the following works requirements:

- Widen the F5 Freeway between Narellan Road and Picton Road from six-lanes to eight-lanes.

By 2036, baseline plus airport traffic estimates indicate the following works requirements:

- Widen Picton Road between the F5 and the airport site from four-lanes divided to six-lanes divided.

Figure 14-2/1-3 shows the road upgrades identified for a transition scenario at Wilton.

7.3.4.2 Rail

Previous working papers of this study have discussed that the provision of dedicated rail access is generally not justifiable for Type 2, 3 and 4 airports, and is more a question of transport policy goals for a Type 1 airport rather than a question of providing necessary capacity, until passenger numbers reach over approximately 45m per annum.

The discussion identified nonetheless that planning for a Type 1 airport at a greenfield site should include considerations for the provision of a rail link from the time of opening, to support transport sustainability and mobility goals and to enhance the service quality standard of the airport as measured in international rankings.

The provision of an airport link is requires substantial study outside the scope of this work.

For the purposes of providing indicative capital costings only, a notional rail access link has been identified for Wilton as it reaches Type 1 standard in 2036, via a new dual track rail service from the airport terminal station to Douglas Park Station on the Southern Highlands Line. No feasibility analysis has been undertaken for this notional line.

Figure 14-2/1-3 shows the notional rail link for Wilton.

7.3.4.3 Bus

As the airport reaches Type 1 status and/if a rail link is introduced, bus services to Sydney would require to be reviewed in the context of the new rail service.

7.4 Water

7.4.1 Existing Infrastructure

The Macarthur water treatment plant is the closest water treatment facility to Wilton. This plant located in the town of Appin, about 4.8km northeast of the proposed site and comprises a pumping station and a water treatment plant using direct filtration. The average capacity for this plant is 90ML per day and the maximum capacity is 265ML per day[10]. Wilton is currently supplied via a DN300 reducing to DN200 water main from the Macarthur water treatment plant. There is no water infrastructure within or adjacent the proposed airport site.

7.4.2 Type 2 Airport

Proposed Infrastructure

It is proposed to provide a water supply to Wilton from the existing Macarthur water treatment plant, located 4.8km northeast from the proposed site. This new connection will be a 200mm diameter pipeline connecting at Macarthur Drive. A new pumping station (11L/s at 145m) at the treatment plant and on site storage (1ML capacity) at the airport will be provided for the airport's water supply system. In addition, disinfection will likely to be required and a hypochlorite dosing system has been included in the proposed works (0.08kg/hr Cl equivalent hypo dosing unit).

Figure 14-4 in Appendix A shows the existing and proposed water supply network for Wilton.

Issues to Consider

- Spare capacity of the existing Macarthur water treatment plant is unconfirmed.

7.4.3 Type 4 Airport

Proposed Infrastructure

For a Type 4 airport, the water supply strategy will be similar to the strategy proposed for the Type 2 Airport and will be a connection to the existing Macarthur water treatment plant. The proposed connection will be a 100mm diameter pipeline, a pumping station (11L/s at 135m) and storage tanks (0.5ML total capacity). A hypochlorite dosing system has also been included (0.008kg/hr Cl equivalent hypo dosing unit) as the disinfection system.

Refer to Figure 14-4 in Appendix A for a visual of the proposed works.

[10] United Utilities Australia

Issues to Consider

- Spare capacity of the existing Macarthur water treatment plant is unconfirmed.

7.4.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The transition from a Type 2 airport to a Type 1 airport will occur over a 16 year period with the passenger capacity increasing from 5 million to 30 million. The water supply infrastructure required for this transition will be constructed in three stages:

- This initial water supply infrastructure will comprise a 200mm diameter pipeline, a new pumping station (11L/s at 145m) at the treatment plant, on site storage (11ML capacity) and a chlorination unit (0.25kg/hr Cl equivalent hypo dosing unit).
- It is then proposed to upgrade the works after 5 years by including larger pipes and providing additional storage capacity (11ML). Increasing the chlorination rate to 0.6kg/hr Cl equivalent hypo dosing unit will also be required.
- 10 years after the initial works, additional storage capacity will be required (11ML).

Figure 14-2/1-4 in Appendix A summarises the transition works for Wilton.

Issues to Consider

- Spare capacity of the existing Macarthur water treatment plant is unconfirmed.
- The growth of the surrounding area over the transition period will influence the timing and extent of water supply infrastructure upgrades.

7.5 Wastewater

7.5.1 Existing Infrastructure

The nearest town to this proposed locality, Wilton, does not currently have a sewer network and facilities. Sydney Water is currently looking at providing a wastewater services at Wilton through their Priority Sewerage Program although a date has not been set. The closest wastewater treatment plant (tertiary treatment level) is located in Picton, approximately 20km northwest of the proposed site.

7.5.2 Type 2 Airport

Proposed Infrastructure

Although timeframes have not been set (for either the Wilton wastewater treatment plant or the second Sydney airport) it has been assumed that a wastewater facility with suitable capacity is available for use by the airport just south of Wilton. This is considered reasonable as the earliest estimate for the airport to be operational at Wilton is by 2021.

The assumed treatment plant site is approximately 100m in vertical elevation below the airport site. With some basic thought into the airports onsite wastewater system it should be possible to gravitate wastewater from the airport site to the assumed treatment plant. It is therefore proposed to provide a gravity main (133L/s) via a 150mm diameter pipeline along Picton Road.

A scheme to reuse water on the airport site has been considered but has not been costed.

Figure 14-4 in Appendix A shows the existing and proposed wastewater supply network for Wilton.

Issues to Consider

- Provision of a wastewater treatment plant at Wilton is unconfirmed.

7.5.3 Type 4 Airport

Proposed Infrastructure

For a Type 4 airport, the water supply strategy will be similar to the strategy proposed for the Type 2 Airport and will be a connection to the assumed wastewater treatment plant. The proposed connection will comprise of a gravity main (133L/s) via a 100mm diameter pipeline.

Refer to Figure 14-4 in Appendix A for a visual of the proposed works.

Issues to Consider

- Provision of a wastewater treatment plant at Wilton is unconfirmed.

7.5.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The transition from a Type 2 airport to a Type 1 airport will occur over a 16 year period with the passenger capacity increasing from 5 million to 30 million. The water supply infrastructure required for this transition will be constructed in three stages:

- This initial wastewater supply infrastructure will comprise a rising main via a 150mm diameter pipeline, a new pumping station (50L/s at 50m) at the treatment plant, and emergency on site storage. The proposed works for a Type 2 airport initially included a gravity main however when allowing for future growth, it was proposed to include a rising main to allow some redundancy.

- It is then proposed to upgrade the works after 2 years by adding a 200mm diameter pipeline and a pumping station (50L/s at 50m).
- 11 years after the initial works, it is proposed to modify the pumping station to increase its capacity to 100L/s.

Figure 14-2/1-4 in Appendix A summarises the transition works for Wilton.

Issues to Consider

- Provision of a wastewater treatment plant at Wilton is unconfirmed.
- The growth of the surrounding area over the transition period will influence the timing and extent of water supply infrastructure upgrades.

7.6 Power

This section describes the bulk supply of power to a Type 2 and Type 4 airport at Wilton. The internal distribution of power around the airport itself is not discussed.

The existing infrastructure is assumed to be similarly affected by both types of airport developments. The runway at Wilton is assumed to be orientated along the long axis of the site, i.e. east / west orientation.

The internal distribution of power is not described within this report for each site as the internal configuration will be similar for each airport type at any of the sites.

7.6.1 Existing Infrastructure

Wilton has existing electricity services traversing and bordering the site. These are:

- The Transgrid Kemps Creek – Avon 330kV transmission line crosses the eastern edge of the site in a north-south orientation and will require relocation.
- Endeavour Energy distribution high voltage and low voltage power lines for the provision of power to the properties within the area.

All the existing electrical services within the proposed site will be affected by the proposed airport.

Any distribution high voltage and low voltage power lines that are required to be retained due to them servicing properties outside the site will need to be positioned in service easements outside of the site. Operational clearances may require lines to be placed underground for some sections, and this will be affected by the runway orientation yet to be determined. The relocation of these services is not expected to cause major disruptions and can be readily programmed with any works in the area.

The Transgrid 330kV transmission line will require relocation as this passes through the eastern part of the site.

The options for relocation are:

- direct bury on the same alignment
- install a cable tunnel on the same alignment
- divert above ground

The options of direct bury and a cable tunnel may have operational considerations that may rule them out, and these have not been considered further at this stage. Possible routes for each transmission line have been shown in Figure 14-5. As no discussions with Transgrid or Endeavour Energy have been undertaken, these routes will need to be investigated further and any final route will be determined by the respective organisation. The final routes may result in longer sections of transmission lines to be relocated.

Should this site become the selected site for the airport, Transgrid will need to be advised as early as possible to allow the planning, design and procurement to avoid delay in the overall programme.

7.6.2 Type 2 Airport

Proposed Infrastructure

The site is located in the Macarthur area of Endeavour Energy’s network.

All power lines have been assumed to be overhead wiring. Although there maybe the possibility of utilising existing easements, the cost for new easements or widening existing easements is to be considered.

Supply to the airport site will require a new substation to be established, with supply from Endeavour Energy.

Endeavour Energy has both 33kVand 66kV networks to the north of the Wilton Site, although the 33kV network is limited. For purposes of this report, it is assumed that the 66kV network will have the capacity required.

Supply could be obtained at 66kV with 2 off 66kV supplies from Endeavour Energy’s 66kV Douglas Park Switch Station, located near Douglas Park. This could require additional 66kV switchgear, but a limiting factor could be capacity of the 66kV lines to this substation as there are a number of existing 66kV loads already connected. These supplies and the electrical network supplying the airport will be fully rated to provide a redundant supply and configured to provide N-1 security.

Due to the time frame when supply could be required, there could be other options that Endeavour Energy may have due to network planning considerations and Endeavour Energy would need to be consulted to ascertain the most likely supply option.

It is anticipated that the airport will be a high voltage customer. Supply within the airport is anticipated to be reticulated at 11kV to distribution substations.

Issues to Consider

Relocation of Transgrid's assets in the vicinity of the airport will require considerable time to plan and implement. In addition, the route for relocation noted on the sketches are arbitrary, and with further detailed analysis may require more significant re-routing then assumed. This will ne be fully understood until discussions with Transgrid can be undertaken, and further detailed planning and design has occurred.

Route selection for the transmission lines can take considerable time to resolve. The use of existing easements, if available and suitable for use, is preferable to establishing new easements, especially if the area that is requiring to be traversed is already developed. This will require further investigation.

Transmission lines installation should be rated to provide the planned future demands for the site to minimise the need for costly augmentation works on the transmission lines. Ratings of other equipment should also be selected to deal with planned demand growth while considering the design life of the installed electrical assets.

There are limited points of connection available in the vicinity of this locality. The proposed scheme provides for a dual supply to the airport with both originating from the same switch station, with the redundancy relied on via connection to separate busses within the switching station. Should an alternative point of supply for one of these supplies be required, an alternative point of supply will need to be found.

7.6.3 Type 4 Airport

Proposed Infrastructure

Supply to the airport site, with a capacity of 1.7MVA, will likely be at low voltage, from a new Endeavour substation connected to the nearest 11kV network. The 11kV network may require to be extended to the required site.

Issues to Consider

The relocation of Transgrid assets as discussed above is the main issue identified.

7.6.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

To supply a Type 1 airport development, the supply to the site will be required to be minimum 66kV. The proposed infrastructure for the Type 2 airport is at 66kV, but it is anticipated that these will be required to be upgraded as these lines already supply other loads apart from the airport, and will not have sufficient capacity.

The proposed infrastructure is to either upgrade the existing lines that supply the airport to 132kV or provide dedicated 66kV supplies from Endeavour Energy's TS. Possible 66kV connection points are located approximately 20km from the site. For redundancy, it is proposed to have the 66kV connection points at different locations.

It is assumed that the additional infrastructure will be to install a 132kV line to allow for future network expansion, but operate at 66kV.

At the airport, expansion of the existing 66/11kV substation will be required to allow for the increased loads.

It is assumed that there will be augmentation works required for Endeavour Energy's infrastructure upstream of the proposed connection points to provide the required capacity 's. Augmentation works, including additional breakers and other substation works, will be required at the proposed connection works.

Issues to Consider

The increased demand on Endeavour Energy's assets may require additional augmentation works due to other developments that may occur prior to planning works occurring.

Due to the time frame when supply could be required, there could be other options that Endeavour Energy may have due to network planning considerations and Endeavour Energy would need to be consulted to ascertain the most likely supply option.

The timeframe when supply would be required could result in other options that Endeavour Energy may have for supply to the site due to network planning considerations, and Endeavour Energy would need to be consulted to ascertain the most likely supply option. This includes the planned growth for the site, which may result in different options.

Route selection for new and relocated transmission and sub-transmission lines can take considerable time to resolve. The use of existing easements, if available and suitable for use, is preferable to establishing new easements, especially if the area that is requiring to be traversed is already developed. This will require further investigation.

Transmission lines installation should be rated to provide the planned future demands for the site to minimise the need for costly augmentation works on the transmission lines. Ratings of other equipment should also be selected to deal with planned demand growth while considering the design life of the installed electrical assets.

7.7 Communications

7.7.1 Existing Infrastructure

Telecommunications services are predominantly provided by Telstra. There is an existing ADSL exchange Wilton. However, ADSL is considered not capable of sufficient bandwidth and services reliability for communications needs of airport and business operations.

7.7.2 Type 2 Airport

Proposed Infrastructure

Telecommunications services are necessary to support the airport operations, passengers and the community around. For business continuity reasons, resilient and alternative supplies are considered essential. As contrasted to a single point connection, diverse routes will enhance availability of telecommunications services. Fibre cable has much higher bandwidth capacity than copper cable or microwave transmission. Therefore, fibre cable is the preferred means of telecommunication backbone. Campbelltown exchange and Wollongong exchange are nominated as telecommunications service sources on diverse routes for Wilton. The road distances from Wilton to Campbelltown and Wollongong are 27km and 27km respectively. Their locations and the nominated fibre cable routes to the site are indicated in Figure 14-6a in Appendix A.

Issues to Consider

- Underground cable route along roads to airport is assumed.
- Use of diverse routes via different telecom carriers can enhance level of redundancy.

7.7.3 Type 4 Airport

Proposed Infrastructure

Telecommunications services are necessary to support the airport operations, passengers and the community around. The telecommunications demand on a Type 4 airport is significantly less than a Type 2 airport. The need for redundancy is also reduced and thus the airport no longer requires a secondary diverse source. The Campbelltown exchange has been nominated as the service source for this airport. The road distance from Wilton to Campbelltown is 27km. The location and the nominated fibre cable route to the site is indicated in Figure 14-6b in Appendix A.

Issues to Consider

- Underground cable route along roads to airport is assumed.

7.7.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The proposed communications infrastructure of diverse fibre and copper cable routes for a Type 2 airport is capable of meeting the communications bandwidth demand of a Type 1 airport. During the transition to Type 1, the construction work will involve cable relocations to accommodate the new cable route within the airport site. The cost of 1km of communications cable infrastructure is estimated for that cable relocation. .

Issues to Consider

- Underground cable infrastructure is assumed.

7.8 Gas

7.8.1 Existing Infrastructure

Wilton is located in a region situated approximately 45km west of Port Kembla.

A450 mm diameter high pressure gas pipeline currently exists between Sydney and Newcastle and traverses the proposed site. This will require diversion around the airport site.

The Wilton Custody Transfer Station (CTS) is in close proximity to the proposed site and provides the potential opportunity to obtain a high flow connection which can be utilised. It has been assumed that a suitable medium pressure distribution supply point will be readily available; however this has not been confirmed and will require further discussions with the local gas suppliers to confirm the above assumption.

7.8.2 Type 2 Airport

Proposed Infrastructure

It is proposed to connect to the existing Sydney/Newcastle gas pipeline as shown in Figure 14-7 in Appendix A. In order to achieve this 5 km diversion of the main trunk line is recommended.

A Type 2 airport is expected to require a 125mm diameter, steel pipeline to supply a capacity of 30’000GJ of gas per annum. It is also recommended that 5km of 450mm diameter pipeline be considered for the trunk line diversion.

At this stage no requirement for on-site gas storage has been identified for Wilton.

Issues to Consider

- Information on specific locations of potential gas connection points is not currently available.
- Further investigation and discussions with local gas suppliers are recommended to establish the impact of a 5km diversion of the main high pressure trunk line.

7.8.3 Type 4 Airport

Proposed Infrastructure

The capacity needed for a type 4 airport has been identified as 3’000GJ per annum.

Due to the small gas demand and high cost of a pipeline, it is proposed that a weekly supply of gas can be scheduled and stored in two 3000 litre gas capacity storage tanks.

Further discussions with local gas suppliers are required to define the leasing condition for storage and supply contracts.

Issues to Consider

- Future increase in the demand for gas will require the provision of a reticulated supply, with utilisation of the existing Sydney/Newcastle high pressure main, as identified in a Type 2 airport scenario.
- The gas supply Authority may consider bearing the cost of the pipeline extension as it presents an opportunity to extend their infrastructure and develop a new revenue generating area to their network.

7.8.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

Over a 16 year period the potential passenger volumes at are expected to rise from 5 to 32 million passengers per annum. This will result in a proportional increase in gas demand from 30,000GJ to 177,000GJ per annum.

To accommodate this transition, an upfront infrastructure is proposed larger than that required for a Type 2 airport. It is proposed that 250mm diameter steel pipeline be used.

Issues to Consider

- Information on specific locations of potential gas connection points is not currently available.
- It is assumed that any necessary metering and control plant for the gas supply is owned by the supplier. Further investigation and discussion is required.

7.9 Fuel

7.9.1 Existing Infrastructure

Wilton is located in a region situated approximately 45km west of Port Kembla.

The Clyde and Kurnell refineries situated within the Sydney basin provide for aviation fuel supply; however the development and provision of a new reticulated pipeline is required to airport developments of any significant size.

An initial assessment of the existing fuel infrastructure in and around the Sydney region has identified an existing Sydney/Newcastle fuel pipeline. Utilisation of this pipeline is doubtful as it is not intended for aviation fuel purpose and its use will be subject to further investigation and discussion with suppliers to assess feasibility.

Newcastle currently has 3 fuel terminals associated with Caltex, BP, Shell and Mobil. (Petroleum import infrastructure in Australia' main report 'written for the Department of Resources, Energy and Tourism) As may be required, it is proposed that the existing facilities at the Port of Newcastle be developed to assist with fuel supply via shipping facilities and a reticulated pipeline network.

7.9.2 Type 2 Airport

Proposed Infrastructure

It is proposed that the Clyde refinery be utilised as the main source of fuel supply for the airport, with provision of a new pipeline and associated infrastructure. The pipeline will extend approximately 75km to the airport location in Wilton.

To provide for supply resilience, there is a desire to have a second independent aviation fuel supply at the airport. Due to the location of Wilton, it is suggested that Kurnell Refinery in Sydney be utilised.

Provision of a new pipeline and its associated infrastructure is recommended out of Kurnell, extending approximately 115km to the airport. Further investigation is required to confirm the preference for this route.

The main and secondary pipeline each requires a 200mm steel pipe, with appropriate cathodic protection.

It is assumed that any necessary control station needed to assist with the aviation fuel distribution would be constructed as part of the airport facilities and infrastructure.

Issues to Consider

- There is no requirement for an intermediate pumping station currently identified, however further geographical studies need to be conducted to asses this in more detail.

7.9.3 Type 4 Airport

Proposed Infrastructure

Based on predicted air traffic movements for General Aviation (GA) and Regular Public Transport (RPT) the expected fuel capacity is estimated at approximately 100,000 litres per day.

It proposed that for the demand of a type 4 airport, the fuel supply will be a schedule of regular trucked deliveries and above ground storage tanks on site.

The storage facility will have the capacity to hold a minimum of 5 days storage in 0.5ML above ground storage tanks.

To further address resilience there is the flexibility to re-size the storage facility to meet growth in demand and to safe guard for redundancy.

Issues to Consider

- No identified issues at this stage however open discussions with suppliers may lead to re-evaluation of the current capital cost estimates.

7.9.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

Over a 16 year forecast the potential passenger growth from Type 2 to Type 1 l is expected to increase from 5 to 32 million passengers a year. In order to meet this demand, the aviation fuel capacity need for sufficient airport operations will increase from 1.2ML/day to 12ML/day respectively.

In order to accommodate this transition, (Type 2 to Type 1) it is suggested that the supporting infrastructure be constructed in two additional stages from that proposed for the Type 2 airport.

At ‘year 0’ the initial infrastructure will utilise the main and redundant 200mm diameter steel supply pipelines with 6ML above ground storage tanks to provide the minimum of 5 days storage.

At ‘year 7’ the fuel demand is expected to grow to 5ML/day. It is proposed to upgrade the infrastructure with an additional 200mm pipeline with an additional 20ML above ground storage tank will be installed giving a total capacity of 26ML for 5 days storage.

At ‘year 14’, the fuel demand is expected to grow to a capacity of 10-12ML/day. It is proposed to upgrade the infrastructure with a further and final 150mm pipeline and an additional 30ML above ground storage tank, giving a total capacity of 56ML.

At ‘year 16’ accommodating the operation and fuel demands for a Type 1 airport, the baseline infrastructure will consist;

- three fuel supply pipelines feeding from the primary source (2x200mm, 1x150mm)
- one fuel pipeline designed for redundancy (200mm) feeding from the secondary source; and
- 56 ML storage tanks.

Issues to Consider

- Further investigation is needed to assess the requirements of additional and intermediate pumping stations.
- Further investigation is required to assess the detailed feasibility of a new fuel pipeline reticulating out of the Port Kembla

- Further discussions with fuel suppliers are recommended to explore leasing opportunities and capital costs for Storage facilities.

7.10 Summary

7.10.1 Capital Expenditure

A summary of the capital expenditure for each infrastructure type for Wilton is shown in Table 24 below.

Table 24 - Infrastructure Capital Expenditure for Wilton

Infrastructure	**Infrastructure Capital Expenditure for Wilton ($M)** **Type 2 Airport**	**Infrastructure Capital Expenditure for Wilton ($M)** **Type 4 Airport**
Road	540	80
Rail	0	0
Water	9	7
Wastewater	1	1
Power	52	12
Communications	16	8
Gas	10	0
Fuel	231	1
Sub Total	859	110
Risk Contingency – 30%	258	33
Design and PM – 20%	172	22
Total	**1,289**	**164**

7.10.2 Operational and Maintenance Expenditure

A summary of the operational and maintenance expenditure for each infrastructure type for Wilton is shown in the following tables.

Table 25 - Operational and Maintenance Expenditure for Wilton (Type 2 Airport)

Asset	**Operational and Maintenance Costs ($'000)**	**Interval (year)**
Road	-	
Pavement - annual	2,936	1
Pavement (replace wearing course)	-	
Dual carriageway; divided (4 lanes)	14,950	10
Motorway; divided (6 lanes)	12,110	10
Pavement (replace		

Asset	Operational and Maintenance Costs ($'000)	Interval (year)
others)		
Dual carriageway; divided (4 lanes)	2,097	5
Motorway; divided (6 lanes)	1,698	5
Water	-	
Annual	8	1
Pipe	65	1
Pumping Station (repairs)	65	5
Pumping Station (replacement)	650	25
Storage Tank (repairs)	13	5
Storage Tank (painting)	39	15
Wastewater	-	
Pipe	65	1
Power	-	
Annual	162	1
Transmission Line	813	9
Transformers 30MVA (66/11)	5,200	15
Switches (indoor)	6	18
Switches (outdoor)	39	2
Communications	-	
Annual	52	1
Cables and ducting	26	18
Gas	-	
Annual	37	1
Pipe	46	5
Valve Station	7	7
Cathodic Protection (repairs)	16	10
Cathodic Protection (replacement)	520	20
Fuel	-	
Annual	1,691	1
Pipe	1,008	5
Storage Tank (repairs)	20	5
Storage Tank (painting)	20	15
Cathodic Protection	593	10

Asset	Operational and Maintenance Costs ($'000)	Interval (year)
(repairs)		
Cathodic Protection (replacement)	19,760	20

Table 26 - Operational and Maintenance Expenditure for Wilton (Type 4 Airport)

Asset	Operational and Maintenance Costs ($'000)	Interval (year)
Water	-	
Annual	7	1
Pipe	62	1
Pumping Station (repairs)	65	5
Pumping Station (replacement)	650	25
Storage Tank (repairs)	7	5
Storage Tank (painting)	20	15
Wastewater	-	
Pipe	65	1
Power	-	
Annual	332	1
Transmission Line	130	9
Transformers 30MVA (33/11)	130	15
Communications	-	
Annual	52	1
Cables and ducting	13	18
Gas	-	
Fuel	-	
Annual	1	1
Storage Tank (repairs)	20	5
Storage Tank (painting)	20	15

7.10.3 Transition Capital Expenditure

The capital expenditure for the transition from a Type 2 to a Type 1 airport is summarised in Appendix E.

7.10.4 Transition Operational and Maintenance Expenditure

The operational and maintenance costs are specific for each infrastructure asset. As such, it is not possible to present one summary cost estimate for the operating and maintenance costs. Refer to Appendix E for details.

7.10.5 Site Levelling and Preparation Expenditure

A summary of the site levelling and preparation expenditure for Wilton is shown in the following table.

Table 27 - Summary of site levelling and preparation expenditure for Wilton

Site	Type 2 Airport ($M)	Type 4 Airport ($M)	Transition from Type 2 to Type 1 ($M)[1]
Wilton	1,000	170	6,100

Note 1: These figures include the total nominal site preparation costs over the 16 year transition period including in the initial construction.

8 Locality 15 – Sutton Forest

8.1 Introduction

Sutton Forest is located 123km southwest of Sydney, near the town of Moss Vale. It is accessible from the Hume Highway, the Illawarra Highway and Golden Vale Road.

8.2 Site Issues

There are not any major creeks or reserves traversing the proposed site. The proposed site is located on an existing golf course.

8.3 Surface Transport

8.3.1 Existing Infrastructure

8.3.1.1 Road

Sutton Forest is served by road access via the F5 Freeway (Hume Highway) and the Illawarra Highway. The proposed site is approximately an hour and a half by road from central Sydney.

The NSW RTA is currently in the process of widening the F5 Freeway to eight lanes between Brooks Road and Raby Road and six lanes between Raby Road and Narellan Road. No other planned upgrades for access roads to Sutton Forest were identified in public material. Between Narellan Road and the Illawarra Highway the F5 Freeway is four lanes.

Figure 15-3a shows the current works, assumed to be the base case for Sutton Forest in 2021.

The timeframe for this analysis did not permit a detailed assessment of future traffic volumes with the effects of Sydney's growth centres, including the South West Growth Centre, which may have impacts on traffic volumes using the F5 Freeway. The historical trend growth rates used do not fully account for the likely impacts of such developments.

8.3.1.2 Rail

The nearest existing rail station is at Moss Vale, which is on the non-electrified Southern Highlands Line.

8.3.1.3 Taxi

Sutton Forest lies outside the Sydney Metropolitan Transport District. Sydney taxis may drop off passengers at Sutton Forest but may not pick up passengers at the site, and must return to a location within the Sydney Metropolitan District without passengers. Sutton Forest lies within the Southern Highlands district, and only taxis based in this area may pick up passengers from the site.

8.3.2 Type 2 Airport

8.3.2.1 Road

Trend growth rates from the historical data to a future year of 2021 (assumed to be the earliest likely opening year for an airport allowing for planning and environmental investigations) plus airport-related traffic indicate that the Illawarra Highway will need to be widened from the F5 Freeway to the airport site from a two-lane undivided road to four-lane divided road.

Figure 15-3b shows this upgrade for a Type 2 airport at Sutton Forest.

8.3.2.2 Rail

Previous discussion in supporting reports has indicated there is no requirement for a rail link to a Type 2 airport in the initial stage of development.

8.3.2.3 Bus

Connecting bus services could be provided from an airport at Sutton Forest to connect to the Southern Highlands Rail Link at Moss Vale and/or Exeter.

8.3.3 Type 4 Airport

8.3.3.1 Road

Trend growth rates from the historical data to a future year of 2021 (assumed to be the earliest likely opening year for an airport allowing for planning and environmental investigations) plus airport-related traffic indicate that no work will be required to provide capacity for initial stage development of a Type 4 airport at Location 15.

8.3.3.2 Rail

Previous discussion in supporting reports has indicated there is no requirement for a rail link to a Type 4 airport in the initial stage of development.

8.3.3.3 Bus

Connecting bus services could be provided from an airport at Sutton Forest to connect to the Southern Highlands Rail Link at Moss Vale and/or Exeter.

8.3.4 Transition from Type 2 to Type 1 Airport

Transport upgrades for the transition from a Type 2 to a Type 1 airport were derived using trend analysis at five-year intervals from 2021 to 2036, from a starting point of the infrastructure that was identified for the initial stage Type 2 airport.

The passenger growth scenario for this transition was provided to Arup. These imply substantial growth in passenger numbers, starting at over 20% per annum in the early years of transition and tapering to 8% per annum by year 15 of transition. Forecasts of airport-related traffic generation for these increases in passenger numbers are described in the transport analysis methodology in Appendix B.

In several cases the trend extrapolation of baseline traffic on key access roads over a 25-year period to 2036 results in substantial traffic volumes, requiring significant infrastructure upgrades regardless of any airport development, and sometimes with substantial cost implications. The scope of the work however is such that baseline road upgrades could not be fully considered in the context of wider network performance or management and budgetary strategies. Computerised transport network modelling would provide improved outcomes for baseline traffic volume estimates balanced across wider network and land-use/demographic outcomes.

8.3.4.1 Road

Trend growth rates for the F5 Freeway to 2026, 2031 and 2036 with addition of airport-related traffic indicate that extensive work will be required to provide capacity for transition from a Type 2 to a Type 1 airport at Sutton Forest. Of significant expense is the required widening of the F5 Freeway over a long distance and the construction of a new link road to access the airport site.

Based on assumptions of passenger growth for the transition from a Type 2 to a Type 1 airport provided to Arup, baseline plus airport-related traffic estimates indicate the following road network upgrades by 2026 above the initial stage Type 2 airport works:

- Widen the F5 Freeway between Raby Road and Narellan Road from six-lanes to eight-lanes;
- Widen the F5 Freeway between Narellan Road and Illawarra Highway from four-lanes to six-lanes;
- Widen the Illawarra Highway between the F5 and the airport site from four-lanes divided to six-lanes divided.

By 2031, baseline plus airport traffic estimates indicate the following works requirements:

- Widen the F5 Freeway between Narellan Road and Picton Road from six-lanes to eight-lanes;
- Construct a new six-lane divided link road from the F5, north of the Illawarra Highway to connect to the airport site.

This new link road mitigates the need to upgrade the Illawarra Highway further.

By 2036, baseline plus airport traffic estimates indicate the following works requirements:

- Widen the F5 Freeway between Picton Road and Illawarra Highway from six lanes to 8-lanes.

Figure 15-2/1-3 shows the road upgrades indicated for the transition scenario at Sutton Forest.

8.3.4.2 Rail

Previous working papers of this study have discussed that the provision of dedicated rail access is generally not justifiable for Type 2, 3 and 4 airports, and is more a question of transport policy goals for a Type 1 airport rather than a question of providing necessary capacity, until passenger numbers reach over approximately 45m per annum.

The discussion identified nonetheless that planning for a Type 1 airport at a greenfield site should include considerations for the provision of a rail link from the time of opening, to support transport sustainability and mobility goals and to enhance the service quality standard of the airport as measured in international rankings.

The provision of an airport link is requires substantial study outside the scope of this work.

For the purposes of providing indicative capital costings only, a notional rail access link has been identified for Sutton Forest as it reaches Type 1 standard in 2036, via a new dual track rail service from the airport terminal station to Moss Vale Station on the Southern Line. No feasibility analysis has been undertaken for this notional line.

Figure 15-2/1-3 shows this notional rail line for Sutton Forest.

8.3.4.3 Bus

As the airport reaches Type 1 status and/if a rail link is introduced, bus services to Sydney would require to be reviewed in the context of the new rail service.

8.4 Water

8.4.1 Existing Infrastructure

Sutton Forest is located in a region where water supply is managed by the Wingecarribee Shire Council. The closest water treatment facility to Sutton Forest is located in Berrima, approximately 10km north of the proposed site. The Berrima water treatment plant currently has a capacity of 8ML per day[11]. In addition, there is an existing water reservoir in Moss Vale.

8.4.2 Type 2 Airport

Proposed Infrastructure

It is proposed to provide a water supply to Sutton Forest from the existing Berrima water treatment plant, located 10km north of the proposed site. This new connection will be a 200mm diameter pipeline along the Illawarra Highway and Berrima Road. A new pumping station (11L/s at 145m) at the treatment plant and on site storage (1ML capacity) at the airport will be provided for the airport's water supply system. In addition, disinfection will likely to be required and a

[11] Wingecarribee Shire Council

hypochlorite dosing system has been included in the proposed works (0.08kg/hr Cl equivalent hypo dosing unit).

Figure 15-4 in Appendix A shows the existing and proposed water supply network for Sutton Forest.

Issues to Consider

- Spare capacity of the existing Berrima water treatment plant is unconfirmed.

8.4.3 Type 4 Airport

Proposed Infrastructure

For a Type 4 airport, the water supply strategy will be similar to the strategy proposed for the Type 2 Airport and will be a connection to the existing Macarthur water treatment plant. The proposed connection will be a 100mm diameter pipeline, a pumping station (11L/s at 135m) and storage tanks (0.5ML total capacity). A hypochlorite dosing system has also been included (0.008kg/hr Cl equivalent hypo dosing unit) as the disinfection system.

Refer to Figure 15-4 in Appendix A for a visual of the proposed works.

Issues to Consider

- Spare capacity of the existing Berrima water treatment plant is unconfirmed.

8.4.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The transition from a Type 2 airport to a Type 1 airport will occur over a 16 year period with the passenger capacity increasing from 5 million to 30 million. The water supply infrastructure required for this transition will be constructed in three stages:

- This initial water supply infrastructure will comprise a 200mm diameter pipeline, a new pumping station (11L/s at 145m) at the treatment plant, on site storage (11ML capacity) and a chlorination unit (0.25kg/hr Cl equivalent hypo dosing unit).
- It is then proposed to upgrade the works after 5 years by including larger pipes and providing additional storage capacity (11ML). Increasing the chlorination rate to 0.6kg/hr Cl equivalent hypo dosing unit will also be required.
- 10 years after the initial works, additional storage capacity will be required (11ML).

Figure 15-2/1-4 in Appendix A summarises the transition works for Sutton Forest.

Issues to Consider

- Spare capacity of the existing Berrima water treatment plant is unconfirmed.
- The growth of the surrounding area over the transition period will influence the timing and extent of water supply infrastructure upgrades.

8.5 Wastewater

8.5.1 Existing Infrastructure

Sutton Forest is located in a region where wastewater supply is managed by the Wingecarribee Shire Council. The closest wastewater treatment facility to Sutton Forest is located in Moss Vale and has a capacity of 9,000EP[12].

8.5.2 Type 2 Airport

Proposed Infrastructure

It is proposed to provide a wastewater supply to Sutton Forest from the existing Moss Vale wastewater treatment plant, located 7km north of the proposed site. This new connection will be a rising main (16L/s) via a 150mm diameter pipeline along the Illawarra Highway and Berrima Road. A new pumping station (16L/s at 32m) at the treatment plant and emergency on site storage at the airport will be provided for the airport's wastewater supply system. In addition, potential upgrades may be required to this existing wastewater treatment plant to meet the airport demand.

Figure 15-4 in Appendix A shows the existing and proposed wastewater supply network for Sutton Forest.

Issues to Consider

- Spare capacity of existing Moss Vale wastewater treatment plant is unconfirmed.

8.5.3 Type 4 Airport

Proposed Infrastructure

For a Type 4 airport, the water supply strategy will be similar to the strategy proposed for the Type 2 Airport and will be a connection to the existing Moss Vale wastewater treatment plant. The proposed connection will comprise of a rising main (2L/s) via a 100mm diameter pipeline, a pumping station (5L/s at 30m) and on site emergency storage. Upgrade of the existing Moss Vale wastewater treatment plant may also be required.

Refer to Figure 15-4 in Appendix A for a visual of the proposed works.

[12] Wingecarribee Shire Council

Issues to Consider

- Spare capacity of existing Moss Vale wastewater treatment plant is unconfirmed.

8.5.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The transition from a Type 2 airport to a Type 1 airport will occur over a 16 year period with the passenger capacity increasing from 5 million to 30 million. The water supply infrastructure required for this transition will be constructed in three stages:

- This initial wastewater supply infrastructure will comprise a rising main via a 150mm diameter pipeline, a new pumping station (50L/s at 50m) at the treatment plant, and emergency on site storage. Upgrade of the existing Moss Vale wastewater treatment plant will also occur during the initial phase.
- It is then proposed to upgrade the works after 2 years by adding a 200mm diameter pipeline and a second pumping station (50L/s at 50m).
- 11 years after the initial works, it is proposed to modify the second pumping station to increase its capacity to 100L/s.

Figure 15-2/1-4 in Appendix A summarises the transition works for Sutton Forest.

Issues to Consider

- Spare capacity of existing Moss Vale wastewater treatment plant is unconfirmed.
- The growth of the surrounding area over the transition period will influence the timing and extent of water supply infrastructure upgrades.

8.6 Power

8.6.1 General

This section describes the bulk supply of power to a Type 2 and Type 4 airport at Sutton Forest. The internal distribution of power around the airport itself is not discussed.

The existing infrastructure is assumed to be similarly affected by both types of airport developments. The runway at Sutton Forest is assumed to be orientated along the long axis of the site, i.e. east / west orientation.

The internal distribution of power is not described within this report for each site as the internal configuration will be similar for each airport type at any of the sites.

8.6.2 Existing Infrastructure

Sutton Forest has existing electricity services traversing and bordering the site. These are:

- Transgrid Marulan - Dapto 330kV transmission line, which is an east / west orientated overhead transmission line that is located close to the southern boundary of the site.
- Transgrid Marulan – Avon 330kV transmission line, which is an east / west orientated overhead transmission line that is located close to the southern boundary of the site.
- Endeavour Energy 33kV sub-transmission line that traverse the site north / south and reticulates between Moss Vale / Sutton Forest / Exeter.
- Endeavour Energy distribution high voltage and low voltage power lines for the provision of power to the properties within the area.

All the existing electrical services within the proposed site will be affected by the proposed airport.

Any distribution high voltage and low voltage power lines that are required to be retained due to them servicing properties outside the site will need to be positioned in service easements outside of the site. Operational clearances may require lines to be placed underground for some sections, and this will be affected by the runway orientation yet to be determined. The relocation of these services is not expected to cause major disruptions and can be readily programmed with any works in the area.

The section of the Transgrid 330kV transmission lines to the east of the site may require relocation if operational clearances are unable to be maintained. This requires further details on the runway positioning, and the elevations of the transmission lines and the runway. It has currently been assumed that these operational clearances will be obtained without relocation of these lines.

The Endeavour Energy 33kV line between Moss Vale / Sutton Forest / Exeter will require to be relocated. Possible has been shown in Figure 15-5. As no discussions with Endeavour Energy have been undertaken, these routes will need to be investigated further and any final route will be determined by the respective organisation. The final routes may result in longer sections of transmission lines to be relocated.

Should this site become the selected site for the airport, Transgrid will need to be advised as early as possible to allow the planning, design and procurement to avoid delay in the overall programme.

8.6.3 Type 2 Airport

Proposed Infrastructure

The site is located in the Southern Highlands area of Endeavour Energy's network. Supply to the site will be from Endeavour Energy's network.

All power lines have been assumed to be overhead wiring. Although there maybe the possibility of utilising existing easements, the cost for new easements or widening existing easements is to be considered.

Supply to the airport site will require a new substation to be established, with supply from Endeavour Energy.

Endeavour Energy has 33kV networks passing through the site, but it is assumed that these do not have sufficient capacity to service the airport's 9MVA demand. This is based on an assumption that the surrounding development in the area has taken its full capacity.

Two bulk supplies could be obtained at 33kV from Endeavour Energy's existing Fairfax Lane Sub-Transmission Substation (STS) located along Illawarra Road near Moss Vale. These supplies and the electrical network supplying the airport will be fully rated to provide a redundant supply and configured to provide N-1 security.

It has been assumed that the existing STS will have the capacity to supply this additional load at 33kV. Augmentation works, such as the installation of additional circuit breakers and possibly new bus bars, is anticipated at each site.

It is anticipated that the airport will be a high voltage customer. Supply within the airport is anticipated to be reticulated at 11kV to distribution substations.

Issues to Consider

There are limited points of connection available at 33kV. The proposed scheme provides for a dual supply to the airport with both originating from the same TS, with the redundancy relied on via connection to separate busses within the TS. Should an alternative point of supply for one of these supplies be required, an alternative point of supply will require significant works, and may require connections from far areas such as Wollongong, or alternatively need to install 132kV substation and connection to existing 132kV lines passing the site.

Relocation of Transgrid's assets, if required, in the vicinity of the airport will require considerable time to plan and implement. In addition, the route for relocation will require detailed analysis. This will ne be fully understood until discussions with Transgrid can be undertaken, and further detailed planning and design has occurred.

Route selection for the transmission lines can take considerable time to resolve. The use of existing easements, if available and suitable for use, is preferable to establishing new easements, especially if the area that is requiring to be traversed is already developed. This will require further investigation.

Transmission lines installation should be rated to provide the planned future demands for the site to minimise the need for costly augmentation works on the transmission lines. Ratings of other equipment should also be selected to deal with planned demand growth while considering the design life of the installed electrical assets.

8.6.4 Type 4 Airport

Proposed Infrastructure

Supply to the airport site, with a capacity of 1.7MVA, will likely be at low voltage, from a new Endeavour Energy substation connected to the nearest 11kV network. The 11kV network may require to be extended to the required site.

Issues to Consider

The relocation of Transgrid assets as discussed above is the main issue identified.

8.6.5 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

To supply a Type 1 airport development, the supply to the site will be required to be minimum 66kV. There are no 66kV assets within the vicinity of this site. Supply will be required to be upgraded to 132kV, with connection from Endeavour Energy’s 132kV network.

At the airport, a new 132/33kV substation will be installed. Supply to the existing 33/11kV substation is proposed to allow for reuse of the existing infrastructure. Additional 33/11kV substations or providing the intake substation to be 132/33/11kV for the additional developments will be required,

Based on a 2007 study by Connell Wagner for Wingecarribee Shire Council on a planned major development, in the area, it was noted that there would be a requirement for augmentation works on the 132kV lines supplying Fairfax Lane TS due to insufficient capacity, and augmentation works at Transgrid‘s Marulan Bulk Supply Point. The required capacity for a Type 1 airport would result in these works requiring to be undertaken if not already in progress.

Issues to Consider

The timeframe when supply would be required could result in other options that Endeavour Energy and Transgrid may have for supply to the site due to network planning considerations, and Endeavour Energy would need to be consulted to ascertain the most likely supply option. This includes the planned growth for the site, which may result in different options.

Route selection for new and relocated transmission and sub-transmission lines can take considerable time to resolve. The use of existing easements, if available and suitable for use, is preferable to establishing new easements, especially if the area that is requiring to be traversed is already developed. This will require further investigation.

Transmission lines installation should be rated to provide the planned future demands for the site to minimise the need for costly augmentation works on the transmission lines. Ratings of other equipment should also be selected to deal with planned demand growth while considering the design life of the installed electrical assets.

8.7 Communications

8.7.1 Existing Infrastructure

Telecommunications services are predominantly provided by Telstra. There are ADSL exchanges (Moss Vale, Exeter) near Sutton Forest. However, ADSL is considered not capable of sufficient bandwidth and services reliability for communications needs of airport and business operations.

8.7.2 Type 2 Airport

Proposed Infrastructure

Telecommunications services are necessary to support the airport operations, passengers and the community around. For business continuity reasons, resilient and alternative supplies are considered essential. As contrasted to a single point connection, diverse routes will enhance availability of telecommunications services. Fibre cable has much higher bandwidth capacity than copper cable or microwave transmission. Therefore, fibre cable is the preferred means of telecommunication backbone. Goulburn exchange and Bowral exchange are nominated as telecommunications service sources on diverse routes for Sutton Forest. The road distances from Sutton Forest to Goulburn and Bowral are 64.4km and 15.2km respectively. Their locations and the nominated fibre cable routes to the site are indicated in Figure 15-6a in Appendix A.

Issues to Consider

- Underground cable route along roads to airport is assumed.
- Use of diverse routes via different telecom carriers can enhance level of redundancy.

8.7.3 Type 4 Airport

Proposed Infrastructure

Telecommunications services are necessary to support the airport operations, passengers and the community around. The telecommunications demand on a Type 4 airport is significantly less than a Type 2 airport. The need for redundancy is also reduced and thus the airport no longer requires a secondary diverse source. The Bowral exchange has been nominated as the service source for this airport. From exterior investigation, the exchange appears to be a major telecommunications node. The road distance from Sutton Forest to Bowral is 15.2km. The location and the nominated fibre cable route to the site is indicated in Figure 15-6b in Appendix A.

Issues to Consider

- Underground cable route along roads to airport is assumed.

8.7.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

The proposed communications infrastructure of diverse fibre and copper cable routes for a Type 2 airport is capable of meeting the communications bandwidth demand of a Type 1 airport. During the transition to Type 1, the construction work will involve cable relocations to accommodate the new cable route within the airport site. The cost of 1km of communications cable infrastructure is estimated for that cable relocation.

Issues to Consider

- Underground cable infrastructure is assumed.

8.8 Gas

8.8.1 Existing Infrastructure

Sutton Forest is located in a region situated approximately 6km west of the township Moss Vale.

A high pressure gas pipeline currently exists between Moomba, Wollongong, Sydney and Newcastle. It is assumed that there is no existing gas infrastructure reticulating out to the Moss Vale region and therefore a new gas network is required to supply the Airport.

It is noted that discussions are needed with local gas suppliers to confirm the above assumptions.

8.8.2 Type 2 Airport

Proposed Infrastructure

It is proposed that the connection for Sutton Forest originate from the Sydney/Newcastle gas pipeline as shown in Figure 15-7 in Appendix A, as opposed to the closer and more convenient gas line scaling Moomba to Sydney.

The significance of the Moomba – Sydney pipeline is such that it is probable that a direct supply will not be permitted from the main and an access arrangement would require establishment of a major custody transfer station and metering. There is insufficient information in the public domain to establish if there are alternative locations in closer proximity to the site 15, so initial proposals would require detailed discussions with APA and Jemena to establish the required configurations.

As a result of this the nominated route for the gas pipeline is expected to progress in a south westerly direction, branching from Custody Transfer Station (CTS) at Wilton, for approximately 65 km to Sutton Forest. It is proposed that a 125mm diameter, steel pipeline be introduced to accommodate the supply capacity of 30’000GJ of gas per annum.

Sutton Forest currently spans the main Moomba to Sydney gas pipeline and additionally, spans a high pressure ethane pipeline. Both of these significant mains have easement rights and therefore require diversion. An allowance of 5km run has been incorporated for these local diversions, with pipeline diameters of 450mm and 660mm respectively.

At this stage no requirement for on-site gas storage has been identified for Sutton Forest.

Issues to Consider

- Information on specific locations of potential gas connection points is not currently available at or before the CTS.
- Further investigation and discussions with suppliers are recommended to assess the use and extension for any existing gas infrastructure in the area of Sutton Forest and the required capacity needed to accommodate a type 2 airport
- Further Investigation and discussion is needed to evaluate the impact of a 5km diversion of the existing high pressure gas main and ethane pipeline.

8.8.3 Type 4 Airport

Proposed Infrastructure

The capacity needed for a type 4 airport has been identified as 3’000GJ per annum.

Due to the small gas demand and high cost of a pipeline, it is proposed that a weekly supply of gas can be scheduled and stored in two 3000 litre gas capacity storage tanks.

Further discussions with local gas suppliers are required to define the leasing condition for storage and supply contracts.

Issues to Consider

- Future increase in the demand for gas will require the provision of a reticulated supply, with utilisation of the existing Sydney/Newcastle high pressure main, as identified in a Type 2 airport scenario.
- The gas supply Authority may consider bearing the cost of the pipeline extension as it presents an opportunity to extend their infrastructure and develop a new revenue generating area to their network.

8.8.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

Over a 16 year period the potential passenger volumes at are expected to rise from 5 to 32 million passengers per annum. This will result in a proportional increase in gas demand from 30’000GJ to 177’000GJ per annum.

To accommodate this transition, an upfront infrastructure is proposed larger than that required for a Type 2 airport. It is proposed that 250mm diameter steel pipeline be used.

Issues to Consider

- Information on specific locations of potential gas connection points is not currently available.
- It is assumed that any necessary metering and control plant for the gas supply is owned by the supplier. Further investigation and discussion is required.

8.9 Fuel

8.9.1 Existing Infrastructure

Sutton Forest is located in a region situated approximately 6km west of the township Moss Vale.

The Clyde and Kurnell refineries situated within the Sydney basin provide for aviation fuel supply; however the development and provision of a new reticulated pipeline is required to airport developments of any significant size.

An initial assessment of the existing fuel infrastructure in and around the Sydney region has identified an existing Sydney/Newcastle fuel pipeline. Utilisation of this pipeline is doubtful as it is not intended for aviation fuel purpose and its use will be subject to further investigation and discussion with suppliers to assess feasibility.

Newcastle currently has 3 fuel terminals associated with Caltex, BP, Shell and Mobil. (Petroleum import infrastructure in Australia’ main report ‘written for the Department of Resources, Energy and Tourism) As may be required, it is proposed that the existing facilities at the Port of Newcastle be developed to assist with fuel supply via shipping facilities and a reticulated pipeline network.

8.9.2 Type 2 Airport

Proposed Infrastructure

It is proposed that the Clyde refinery be utilised as the main source of fuel supply for the airport, with provision of a new pipeline and associated infrastructure. The pipeline will extend approximately 121.5km to the airport location.

To provide for supply resilience, there is a desire to have a second independent aviation fuel supply at the airport. Due to the location of Sutton Forest, it is suggested that Kurnell Refinery in Sydney be utilised.

Provision of a new pipeline and its associated infrastructure is recommended out of Kurnell, extending approximately 128km to the airport.

The main and secondary pipeline each requires a 200mm steel pipe, with appropriate cathodic protection.

It is assumed that any necessary control station needed to assist with the aviation fuel distribution would be constructed as part of the airport facilities and infrastructure.

Issues to Consider

- Given the remote location of Sutton Forest there is possible scope for an intermediate pumping station located at a minimum interval of 100 km for both the main and redundant supply pipelines. Further investigation is required to asses this component.

8.9.3 Type 4 Airport

Proposed Infrastructure

Based on predicted air traffic movements for General Aviation (GA) and Regular Public Transport (RPT) the expected fuel capacity is estimated at approximately 100’000 litres per day.

It proposed that for the demand of a type 4 airport, the fuel supply will be a schedule of regular trucked deliveries and above ground storage tanks on site.

The storage facility will have the capacity to hold a minimum of 5 days storage in 0.5ML above ground storage tanks.
To further address resilience there is the flexibility to re-size the storage facility to meet growth in demand and to safe guard for redundancy.

Issues to Consider

- No identified issues at this stage however open discussions with suppliers may lead to re-evaluation of the current capital cost estimates.

8.9.4 Transition from Type 2 to Type 1 Airport

Proposed Infrastructure

Over a 16 year forecast the potential passenger growth from Type 2 to Type l is expected to increase from 5 to 32 million passengers a year. In order to meet this demand, the aviation fuel capacity need for sufficient airport operations will increase from 1.2ML/day to 12ML/day respectively.

In order to accommodate this transition, (Type 2 to Type 1) it is suggested that the supporting infrastructure be constructed in two additional stages from that proposed for the Type 2 airport.

At ‘year 0’ the initial infrastructure will utilise the main and redundant 200mm diameter steel supply pipelines with 6ML above ground storage tanks to provide the minimum of 5 days storage.

At ‘year 7’ the fuel demand is expected to grow to 5ML/day. It is proposed to upgrade the infrastructure with an additional 200mm pipeline with an additional 20ML above ground storage tank will be installed giving a total capacity of 26ML for 5 days storage.

At ‘year 14’, the fuel demand is expected to grow to a capacity of 10-12ML/day. It is proposed to upgrade the infrastructure with a further and final 150mm pipeline and an additional 30ML above ground storage tank, giving a total capacity of 56ML.

At ‘year 16’ accommodating the operation and fuel demands for a Type 1 airport, the baseline infrastructure will consist;

- three fuel supply pipelines feeding from the primary source (2x200mm, 1x150mm)
- one fuel pipeline designed for redundancy (200mm) feeding from the secondary source; and
- 56 ML storage tanks.

Issues to Consider

- Further investigation is needed to assess the requirements of additional and intermediate pumping stations.
- Further investigation is required to assess the detailed feasibility of a new fuel pipeline reticulating out of the Port Kembla.
- Further discussions with fuel suppliers are recommended to explore leasing opportunities and capital costs for Storage facilities.

8.10 Summary

8.10.1 Capital Expenditure

A summary of the capital expenditure for each infrastructure type for Sutton Forest is shown in Table 28 below.

Table 28 - Infrastructure Capital Expenditure for Sutton Forest

Infrastructure	Infrastructure Capital Expenditure for Sutton Forest ($M) Type 2 Airport	Infrastructure Capital Expenditure for Sutton Forest ($M) Type 4 Airport
Road	140	0
Rail	0	0

Infrastructure	Infrastructure Capital Expenditure for Sutton Forest ($M) Type 2 Airport	Infrastructure Capital Expenditure for Sutton Forest ($M) Type 4 Airport
Water	15	13
Wastewater	11	10
Power	30	4
Communications	24	5
Gas	74	0
Fuel	408	1
Sub Total	701	32
Risk Contingency – 30%	210	10
Design and PM – 20%	140	6
Total	**1,051**	**48**

8.10.2 Operational and Maintenance Expenditure

A summary of the operational and maintenance expenditure for each infrastructure type for Sutton Forest is shown in the following tables.

Table 29 - Operational and Maintenance Expenditure for Sutton Forest (Type 2 Airport)

Asset	Operational and Maintenance Costs ($'000)	Interval (year)
Road	-	
Pavement - annual	447	1
Pavement (replace wearing course)	-	
Dual carriageway; divided (4 lanes)	4,550	10
Pavement (replace others)		
Dual carriageway; divided (4 lanes)	638	5
Water	-	
Annual	8	1
Pipe	130	1
Pumping Station (repairs)	65	5
Pumping Station (replacement)	650	25
Storage Tank (repairs)	13	5
Storage Tank (painting)	39	15
Wastewater	-	

Asset	Operational and Maintenance Costs ($'000)	Interval (year)
Annual	65	1
Pipe	91	1
Pumping Station (repairs)	130	5
Pumping Station (replacement)	3,900	15
Treatment Plant	689	5
Power	-	
Annual	139	1
Transmission Line	650	9
Transformers 30MVA (33/11)	5,200	15
Switches (indoor)	10	18
Communications	-	
Annual	52	1
Cables and ducting	38	18
Gas	-	
Annual	553	1
Pipe	442	5
Valve Station	7	7
Cathodic Protection (repairs)	254	10
Cathodic Protection (replacement)	8,450	20
Fuel	-	
Annual	2,586	1
Pipe	1,534	5
Storage Tank (repairs)	20	5
Storage Tank (painting)	20	15
Cathodic Protection (repairs)	909	10
Cathodic Protection (replacement)	30,290	20

Table 30 - Operational and Maintenance Expenditure for Sutton Forest (Type 4 Airport)

Asset	Operational and Maintenance Costs ($'000)	Interval (year)
Water	-	
Annual	7	1
Pipe	130	1
Pumping Station (repairs)	65	5
Pumping Station (replacement)	650	25
Storage Tank (repairs)	7	5
Storage Tank (painting)	20	15
Wastewater	-	
Annual	65	1
Pipe	91	1
Pumping Station (repairs)	26	5
Pumping Station (replacement)	3,900	15
Treatment Plant	689	5
Power	-	
Annual	169	1
Transmission Line	65	9
Transformers 30MVA (33/11)	130	15
Communications	-	
Annual	52	1
Cables and ducting	7	18
Fuel	-	
Annual	1	1
Storage Tank (repairs)	20	5
Storage Tank (painting)	20	15

8.10.3 Transition Capital Expenditure

The capital expenditure for the transition from a Type 2 to a Type 1 airport is summarised in Appendix E.

8.10.4 Transition Operational and Maintenance Expenditure

The operational and maintenance costs are specific for each infrastructure asset. As such, it is not possible to present one summary cost estimate for the operating and maintenance costs. Refer to Appendix E for details.

8.10.5 Site Levelling and Preparation Expenditure

A summary of the site levelling and preparation expenditure for Sutton Forest is shown in the following table.

Table 31 - Summary of site levelling and preparation expenditure for Sutton Forest

Site	Type 2 Airport ($M)	Type 4 Airport ($M)	Transition from Type 2 to Type 1 ($M)[1]
Sutton Forest	1,000	300	5,000

Note 1: These figures include the total nominal site preparation costs over the 16 year transition period including in the initial construction.

9 Summary

9.1 Capital Expenditure

9.1.1 Disbursement profile

The construction duration of the supporting infrastructure for a major new airport is dependent upon many factors including the delivery mechanism, the actual site and the type of infrastructure required (new roads or modifications of existing). At this stage of the investigation there are too many unknowns to accurately determine construction durations for each airport site. As such we have estimated a total construction duration range based on the typical daily spend range on recent major infrastructure projects in Australia. This results in an estimate of construction duration of between 4 and 8 years.

We have provided in the table below a capital cost disbursement profile by year. Please note the following:

- The percentages are based on a standard S-Curve profile for typical construction projects.
- The profiles do not take into account separate start and finish dates for the construction of each infrastructure asset.

Table 32 - Capital Cost Disbursement Profile by Year

Year	1	2	3	4	5	6	7	8
4 year construction period	16.0%	34.4%	34.2%	15.4%	-	-	-	-
8 year construction period	4.5%	11.5%	16.1%	18.3%	18.3%	15.9%	11.2%	4.2%

9.1.2 Summary

The following table summarises the supporting infrastructure cost estimates for each airport site and development scenario.

Table 33 - Summary of capital expenditure

Site	**Type 2 Airport ($M)**	**Type 4 Airport ($M)**	**Transition from Type 2 to Type 1 ($M)**[1]
Kulnura	1,300	160	7,500
Somersby	600	60	4,100

Site	Type 2 Airport ($M)	Type 4 Airport ($M)	Transition from Type 2 to Type 1 ($M)[1]
Wilberforce	3,700	40	7,600
Luddenham	1,200	80	2,600
The Oaks	1,600	270	5,500
Wilton	1,300	170	4,100
Sutton Forest	1,100	50	8,000

Note 1: These figures are the total capital expenditure over the 16 year transition period including the initial construction

9.2 Operational and Maintenance Expenditure

The operational and maintenance expenditure is made up of two components:

- Preventative maintenance – includes inspections, general repairs and is a consistent annual cost throughout the design life
- Corrective maintenance – includes replacement of parts, re-conditioning and occurs at intervals throughout the design life

Both categories are specific for each infrastructure asset. As such, it is not possible to present one summary cost estimate for the operating and maintenance costs. Refer to the individual locality summaries in this report or Appendix E for details.

9.3 Site Levelling and Preparation Expenditure

The following table summarises the total nominal site levelling and preparation cost estimates for each airport site and development scenario.

Table 34 - Summary of site levelling and preparation expenditure

Site	Type 2 Airport ($M)	Type 4 Airport ($M)	Transition from Type 2 to Type 1 ($M)[1]
Kulnura	900	230	9,500
Somersby	1,600	360	7,000
Wilberforce	1,200	300	3,100

Site	Type 2 Airport ($M)	Type 4 Airport ($M)	Transition from Type 2 to Type 1 ($M)[1]
Luddenham	600	30	4,700
The Oaks	2,200	410	5,500
Wilton	1,000	170	6,100
Sutton Forest	1,000	300	5,000

Note 1: These figures include the total nominal site preparation costs over the 16 year transition period including in the initial construction.

9.4 Diversions

Many of the airport localities have significant existing infrastructure crossing the site. Where identified an estimation for the relocation of these assets has been made in the capital cost estimates. The following table highlights the diversions identified at each site.

Many of the assets are major trunk infrastructure items. The feasibility of diverting them has not been confirmed with the utility owners.

Table 35 - Summary of diversion works

Locality	Asset	Diversion works
Kulnura	Power	Relocation of Transgrid 330kV and 500 kV aerial feeders.
Somersby	Power	Relocation of Energy Australia 33kV and 132kV aerial feeder.
	Gas	Divert gas main - 450mm dia
Luddenham	Power	Relocation of Transgrid 330kV aerial feeder. Relocation of Energy Australia 33kV aerial feeder.
The Oaks	Power	Relocation of Energy Australia 33kV and 66kV aerial feeder.
Wilton	Power	Diversion of 330kV above ground transmission line.
	Gas	Divert gas main - 450mm dia
	Road	Realign 4 lane rural road, Picton Road, south of Macarthur Road, around airport site
Sutton Forest	Power	Relocation of Energy Australia 33kV aerial feeder.
	Gas	Divert gas main - 660mm dia Divert ethane pipeline main -200mm Divert major gas main - dia TBC

9.5 Assumptions Register

The following assumptions register captures the key points to note for this study.

Table 36 - Assumptions Register

Category	Assumption	Comment
Airport scenarios	Airport details are as defined by the "*airport characteristics for template airports*" provided by the Department dated 3 December 2010, refer to Appendix C.	
Airport sites	The Type 1 airport site boundaries used in the investigation are as defined in the document in Appendix D. For Type 2 and 4 airports, 120ha and 400ha generic site boundaries were developed and placed centrally over the defined Type 1 location.	No rationalising for the location of the sites has occurred.
Infrastructure base case	Each airport scenario has been assumed to be implemented in 2021. As such the future state of the existing infrastructure at each site was estimated for the year 2021 and then the airport demand added to this. This was done an approximation or by utilising known trend data.	To firm up these assumptions, discussions are required with the responsible authorities (e.g. RTA, RailCorp, Energy Australia, etc.)
Site levelling	To develop an earthworks volume for the site levelling cost estimate, a flat platform over the entire sites was developed balancing cut to fill with 10% additional cut.	This is a theoretic exercise for comparison only. The airports can be designed to reduce the volumes used in this report.
Operation of KSA	It is assumed that the existing Sydney KSA airport remains operational in conjunction with the second Sydney airport proposed in this report. Minimal attempt has been made to couple operations as the exact model is unknown.	
GST	GST is excluded from the cost estimates.	
Contingency	A risk contingency of 30% and a design and project management allowance of 20% is applied throughout.	
Cost Base	The base date of all costs is 1 January 2011 and no allowance has been made for escalation	
Exclusions from cost estimate	The cost estimates exclude land acquisition, site remediation of contamination, cost inflation or taxes. The cost estimates presented are not intended for budgeting, tendering or contract purposes.	
Utility Cost Estimates	The capital and operating and maintenance costs for all utilities have been included in the cost estimates. However, in some cases the utility suppliers may provide the capital infrastructure at no cost to the airport in return for supply agreements. In these instances, the utility suppliers would also pay the operating and maintenance costs.	Has the potential to reduce the cost estimates for the utilities.

Category	Assumption	Comment
Operation and maintenance cost estimates	The cost of using the infrastructure (e.g. cost of power, water rates, purchasing fuel etc.) have been excluded.	

9.6 Risks

Defining supporting infrastructure and preparing cost estimates at this stage of a project contains risk. Table 37 below summarises the key risks identified during this study. The “rating” is a high level assessment taking into account the likelihood and consequence of each risk.

Table 37 - Summary of Key Risks

Item	Description	Rating
Assumptions behind generic airport types	The supporting infrastructure has been developed based on the “airport characteristics for template airports” provided by the Department dated 3 December 2010. Further interpretation of these statistics has been required to develop the type and quantity of supporting infrastructure. There is a risk that these interpretations differ from the original intent of the Department and have a material impact on the cost estimates.	Medium
Undefined site boundaries for Type 2 and Type 4 airports	The airport precinct boundaries and geometry for Type 2 and Type 4 airports was not defined and has been assumed. There is a risk that the assumptions and cost estimates presented in this report could alter once these are defined.	Medium
No consultation with stakeholders	Due to confidentiality and timeframe of this assessment, it has not been possible to consult with the appropriate infrastructure stakeholders. There is a risk that the assumptions made in this report are incorrect and the wider infrastructure networks require significant upgrading. There is a potential to significantly increase the costs presented.	High
Timing of development	The exact timing of the airport’s commissioning is not defined but is assumed to be 10-20 years from the decision to proceed. The state of the existing infrastructure at this future point in time is not well defined. Assumptions made in this report may prove incorrect.	Roads – Medium Rail – High
Diversions	Where identified major existing infrastructure items have been nominated for diversions and included in the cost estimates. No detailed assessment of these has been undertaken. There is a risk that they are not	High

Item	Description	Rating
	feasible to divert or the cost of doing so is very high.	
Contamination	It is not known if the existing ground conditions at the site or the corridors for supporting infrastructure include any contamination. This could have a significant impact on the cost estimates.	Medium
Interaction with Sydney KSA	The relationship of the second Sydney airport with Sydney KSA has not been defined. There is a risk that once determined the assumptions behind the supporting infrastructure may change (e.g. fuel supply, transport mode choice). Enhance routes may be required between the two airport precincts.	Low
Routes for supporting infrastructure	The routes for the supporting infrastructure for each site have been nominated based on a high level desktop study only. There is a risk that they prove to be not feasible and subsequent routes that are developed are more expensive.	High
Urban design standard	Airports and their supporting infrastructure are subject to a policy decision as to the level of urban design employed (i.e. world class or basic). Assumptions made in this report may be incorrect and this will impact the costs estimates.	Medium
Multiplier effect of airports	Major developments such as airports have a multiplier effect on the extent and location of population, workforce and land uses. An airport might vastly increase the number of jobs or houses in surrounding these sites. This has not been considered to date. There is a risk that this may impact and change assumptions made in this study.	Medium
The use of existing infrastructure demand trends	The provision on the basis of existing infrastructure demand trends is the best tool available for forecasting, but may prove incorrect. An example might be the impact of road pricing or oil price shocks reducing car volumes in the peaks or green-building sustainability advances reducing the demand for electricity and gas. The infrastructure analysis is generally based on recent historical trends and case studies of existing airports and cities. There is a risk that the calculated demands and hence the cost estimates are inaccurate.	Medium

9.7 Next Steps

The following are steps that can be taken in order to advance the study and increase the accuracy and depth of the infrastructure concepts and the confidence of the cost estimates:

- Engage senior strategic personnel in the key state government authorities to discuss and refine the feasibility of the surface transportation connections proposed in this study. The key stakeholders would be the RTA, RailCorp and the NSW Department of Transport. The airport's infrastructure planning needs to be integrated into the Sydney Metropolitan Plan and the strategic plans for these organisations.
- Discuss the proposed works with the utility owners of each network (e.g. Transgrid, Integral Energy, Jemena, Shell, Caltex, Telstra, Sydney Water). This will allow a more accurate view on the condition of the existing assets at the time of the airport's development. It will also define if major augmentation works are required to the existing networks which is a key risk at the moment.
- Investigate in more detail the surface transportation routes nominated. Develop accurate connections into the existing network and assess the feasibility of the chosen corridors. This will increase the confidence of the cost estimates.
- Seek feedback from the Department on the site selection process and potentially refine the number of localities under consideration.
- Examine the remaining sites in further detail considering the following issues:
    - the expected interaction of the second Sydney airport with the existing Sydney KSA
    - the airport layouts including site boundary, runway orientation, building location and envelopes.
    - Investigate the subsequent development that will surround the establishment of an airport and include the infrastructure requirements of these areas in future planning.

Appendix A

Figures

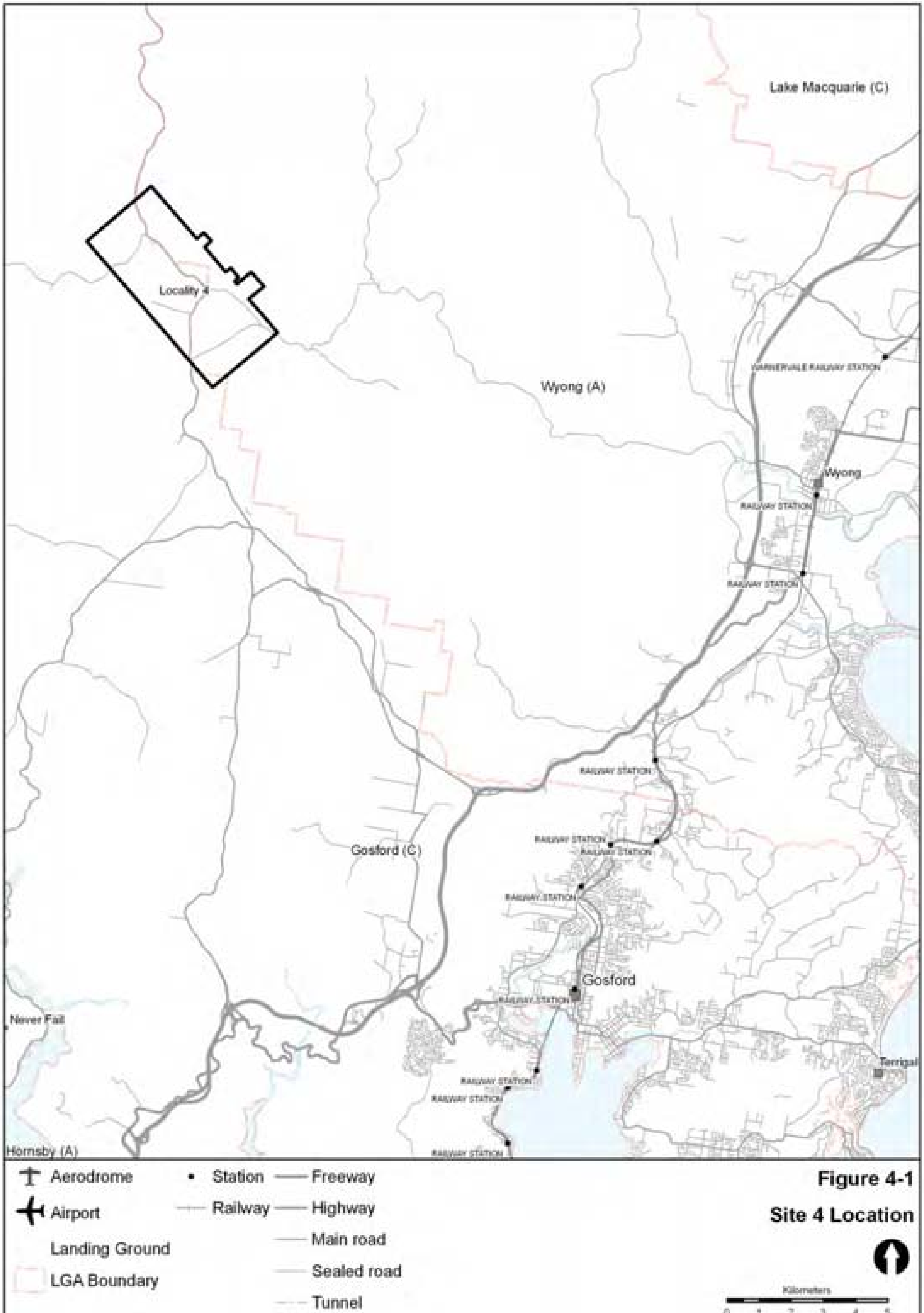


Figure 4-1

Site 4 Location

Legend

Type 1 Airport

Type 2 Airport

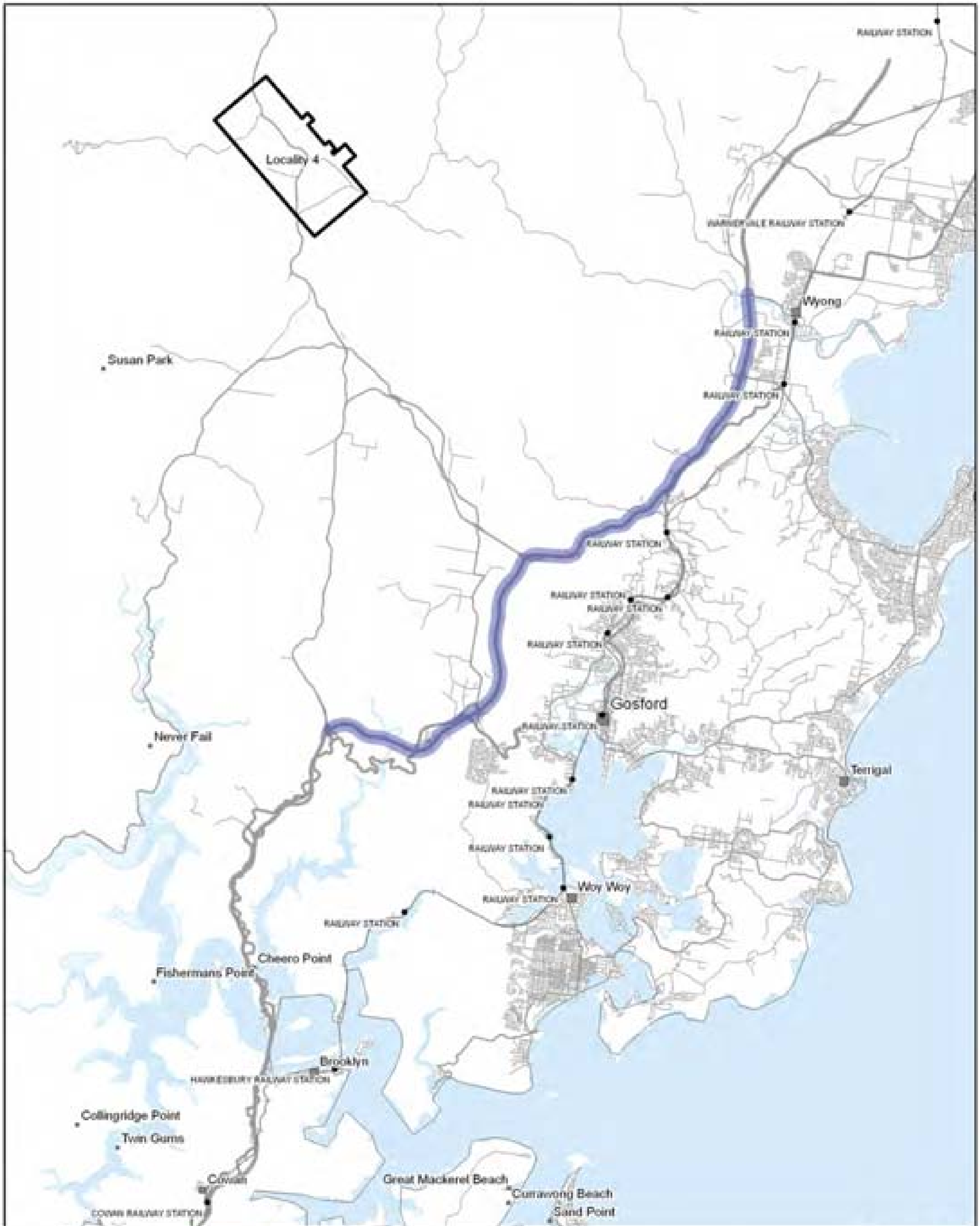
Type 4 Airport

Figure 4-2

Site 4 Aerial Plan

Kilometers

0 0.5 1 1.5 2



Proposed Site — Upgrade 4M to 6M

Figure 4-3a

Site 4 Roads - Base Case

Type 2 and 4 Airport

Kilometers 0 2 4 6 8 10

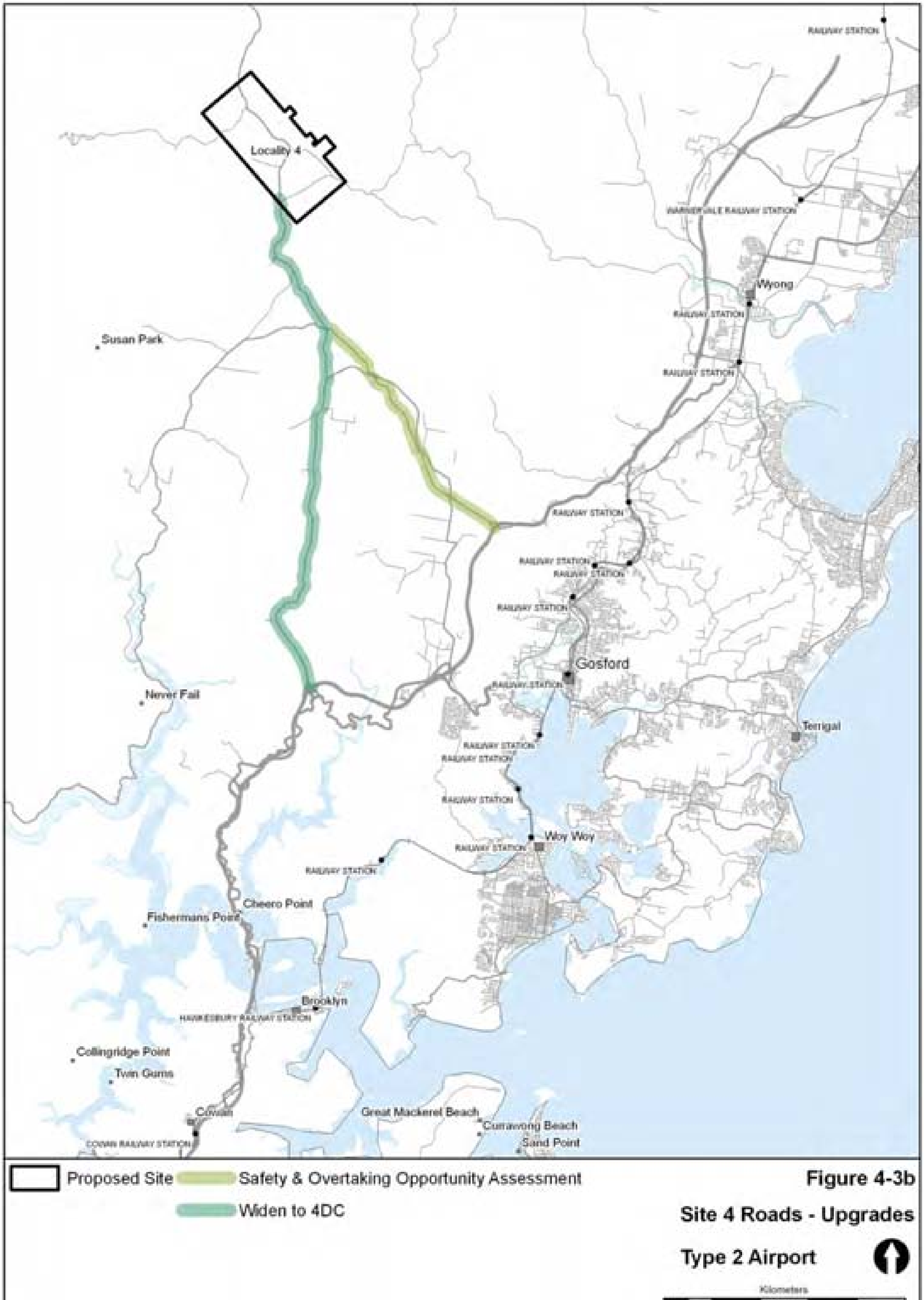


Figure 4-3b

Site 4 Roads - Upgrades

Type 2 Airport

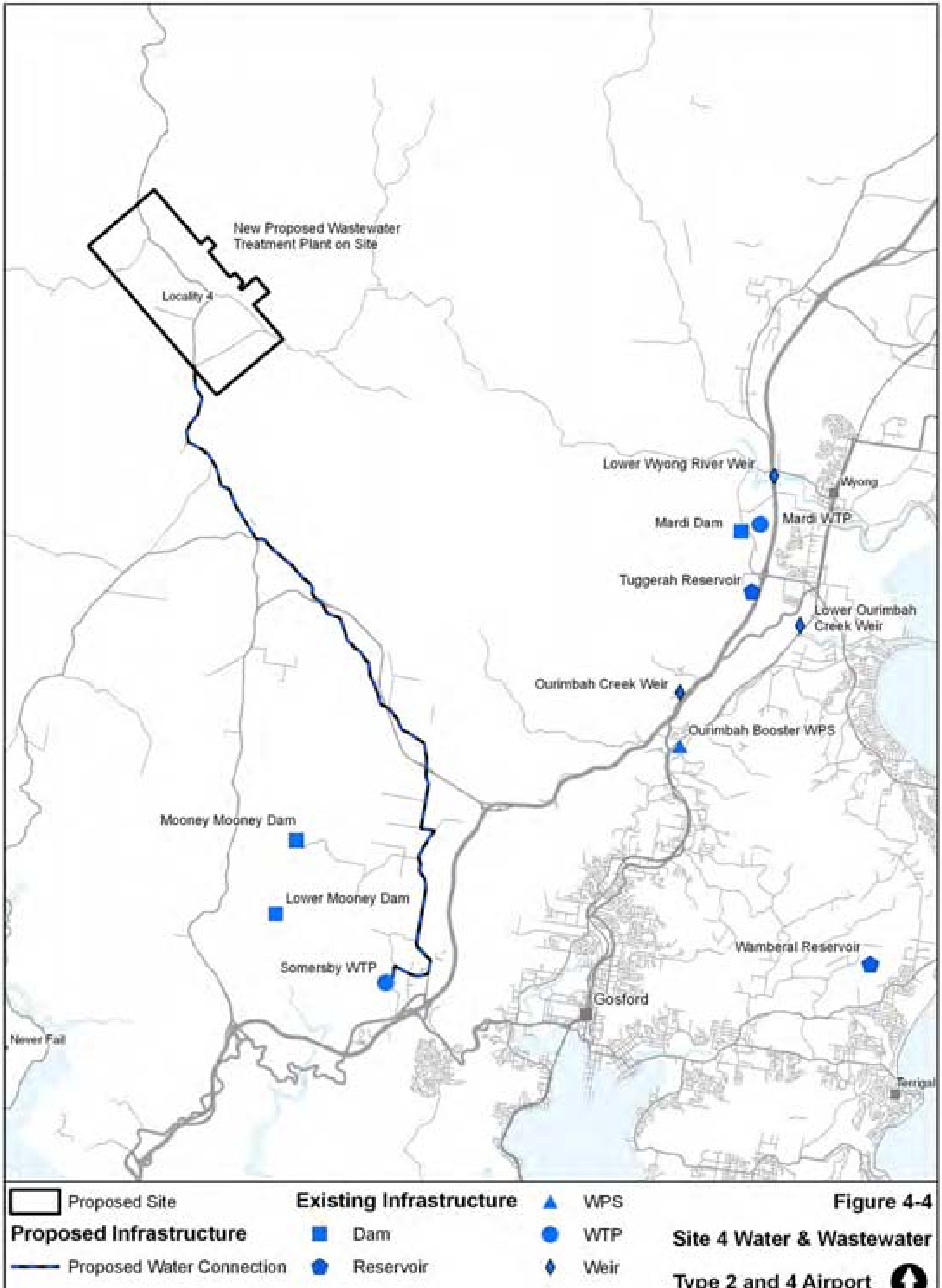
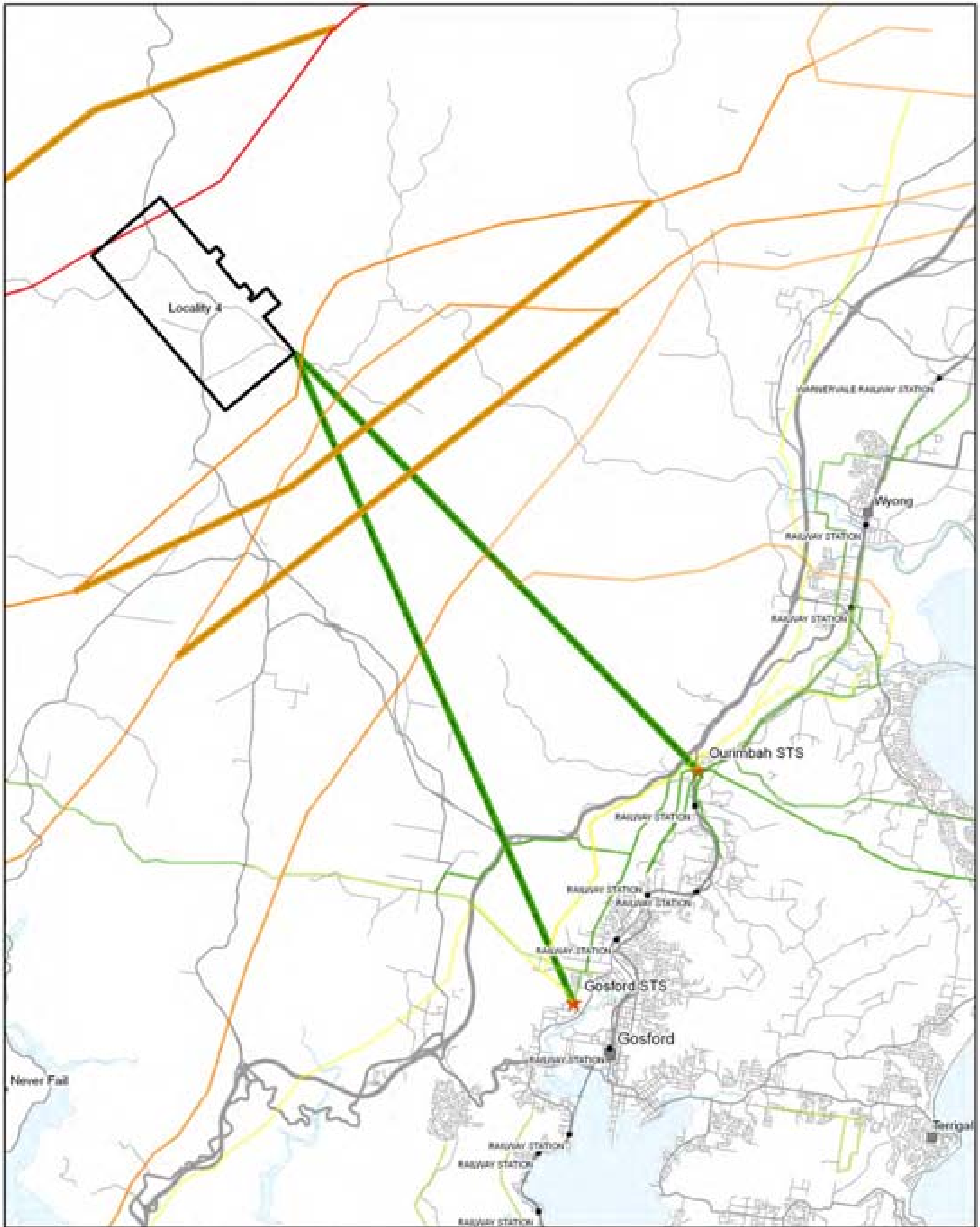


Figure 4-4

Site 4 Water & Wastewater

Type 2 and 4 Airport



Proposed Site

Existing Transmission

500kV
330kV
132kV
66kV
33kV

Proposed Transmission

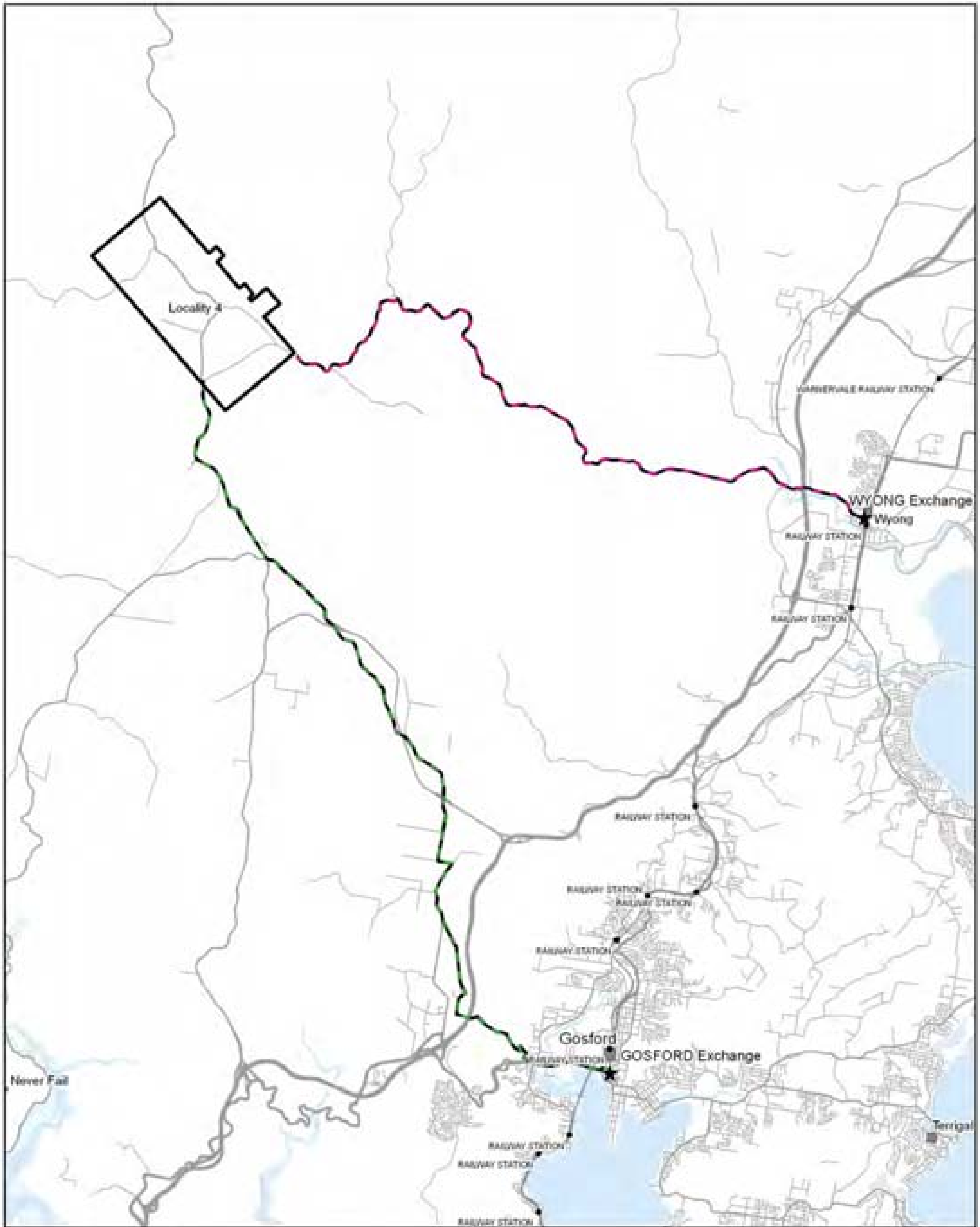
66kV
Diversion

Figure 4-5

Site 4 Power Supply

Type 2 and 4 Airport

Kilometers
0 1 2 3 4 5



Legend

Proposed Site ★ Exchange

Wyong Exchange

Gosford Exchange

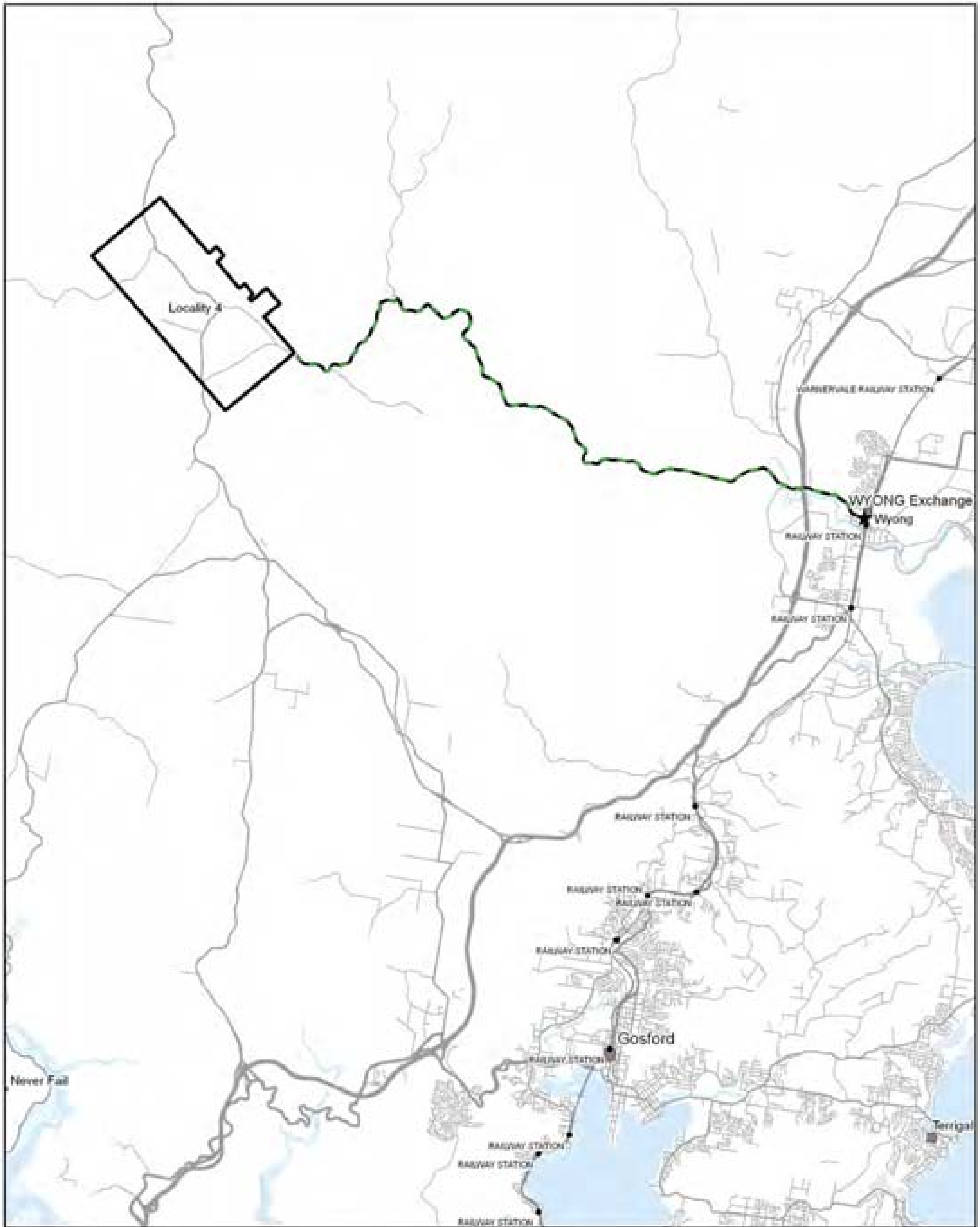
Figure 4-6a

Site 4 Communications

Type 2 Airport

Kilometers

0 1 2 3 4 5



Legend

Proposed Site ★ Exchange

Wyong Exchange

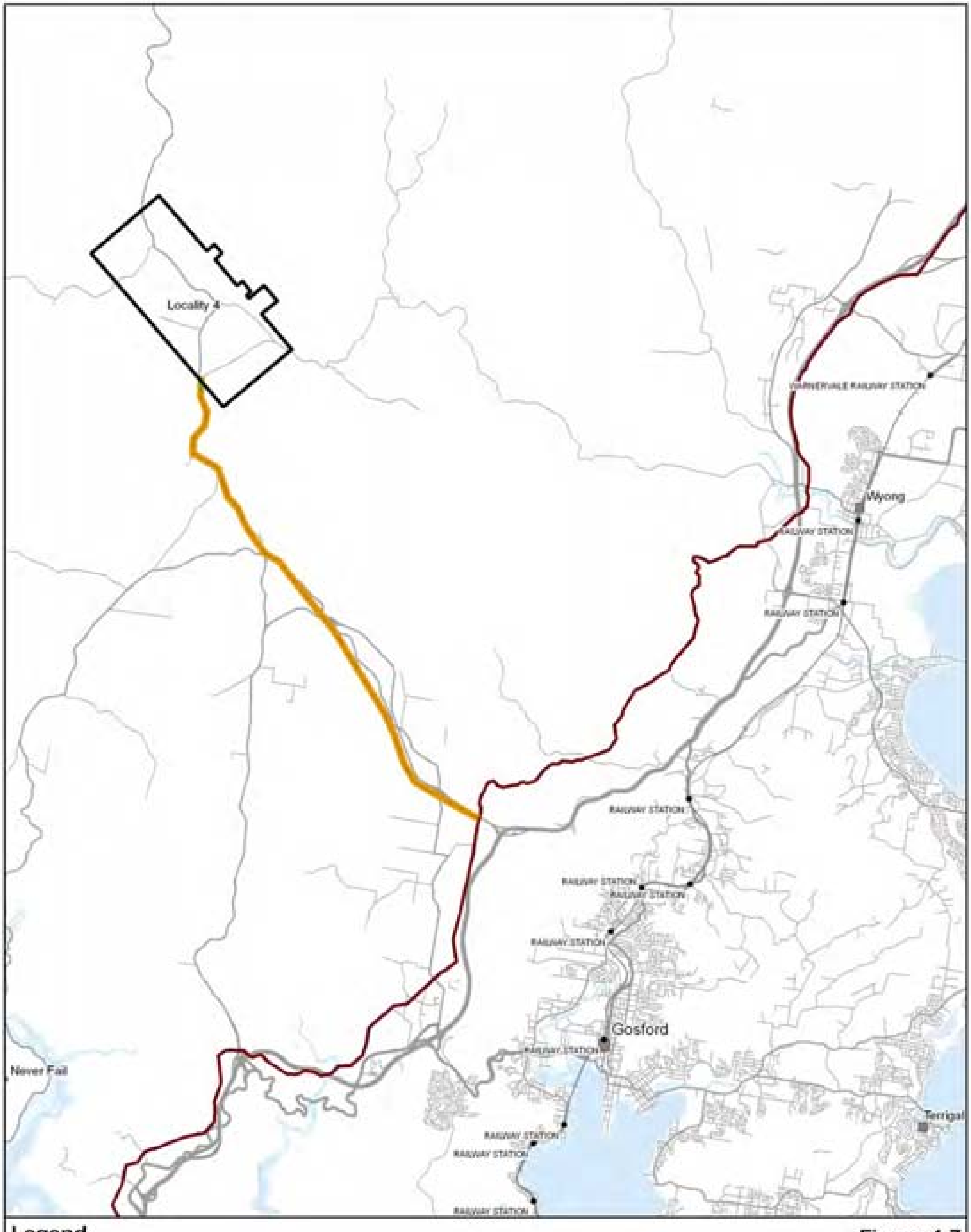
Figure 4-6b

Site 4 Communications

Type 4 Airport

Kilometers

0 1 2 3 4 5



Legend

Proposed Site — Proposed Pipeline

Exisiting Pipelines

Gas Pipeline

Kilometers

0 1 2 3 4 5

Figure 4-7

Site 4 Gas Supply

Legend

Proposed Site

Proposed Fuel Line

Second Independent Fuel Line - Redundancy

Figure 4-8

Site 4 Fuel Supply

Kilometers

0 5 10 15 20 25

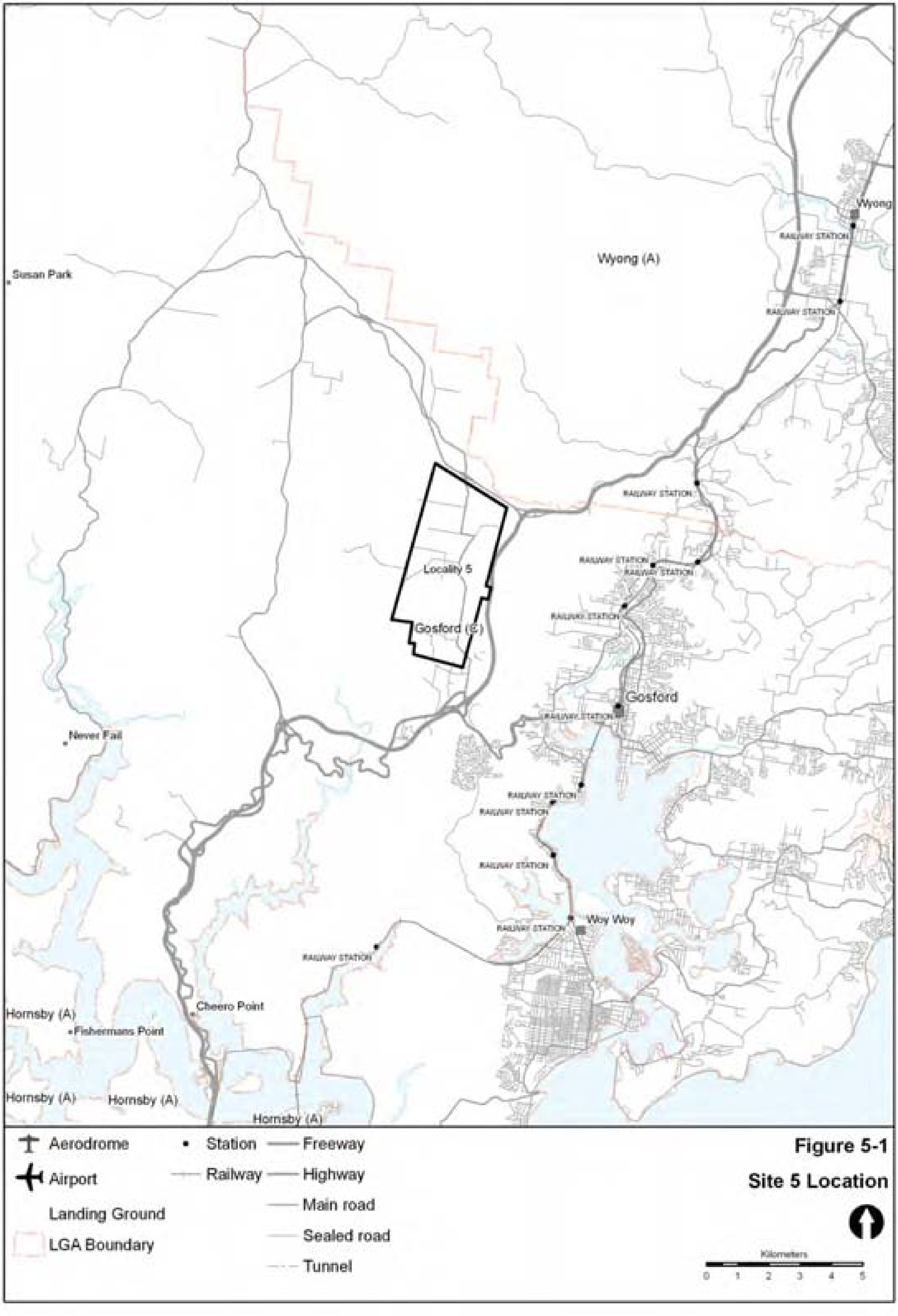


Figure 5-1

Site 5 Location

Legend

- Type 1 Airport
- Type 2 Airport
- Type 4 Airport

Figure 5-2

Site 5 Aerial Plan

Kilometers

0 0.5 1 1.5 2

Legend

Proposed Site

Figure 5a-2

Site 5 Alternate Location Aerial Plan

Kilometers

0 0.5 1 1.5 2

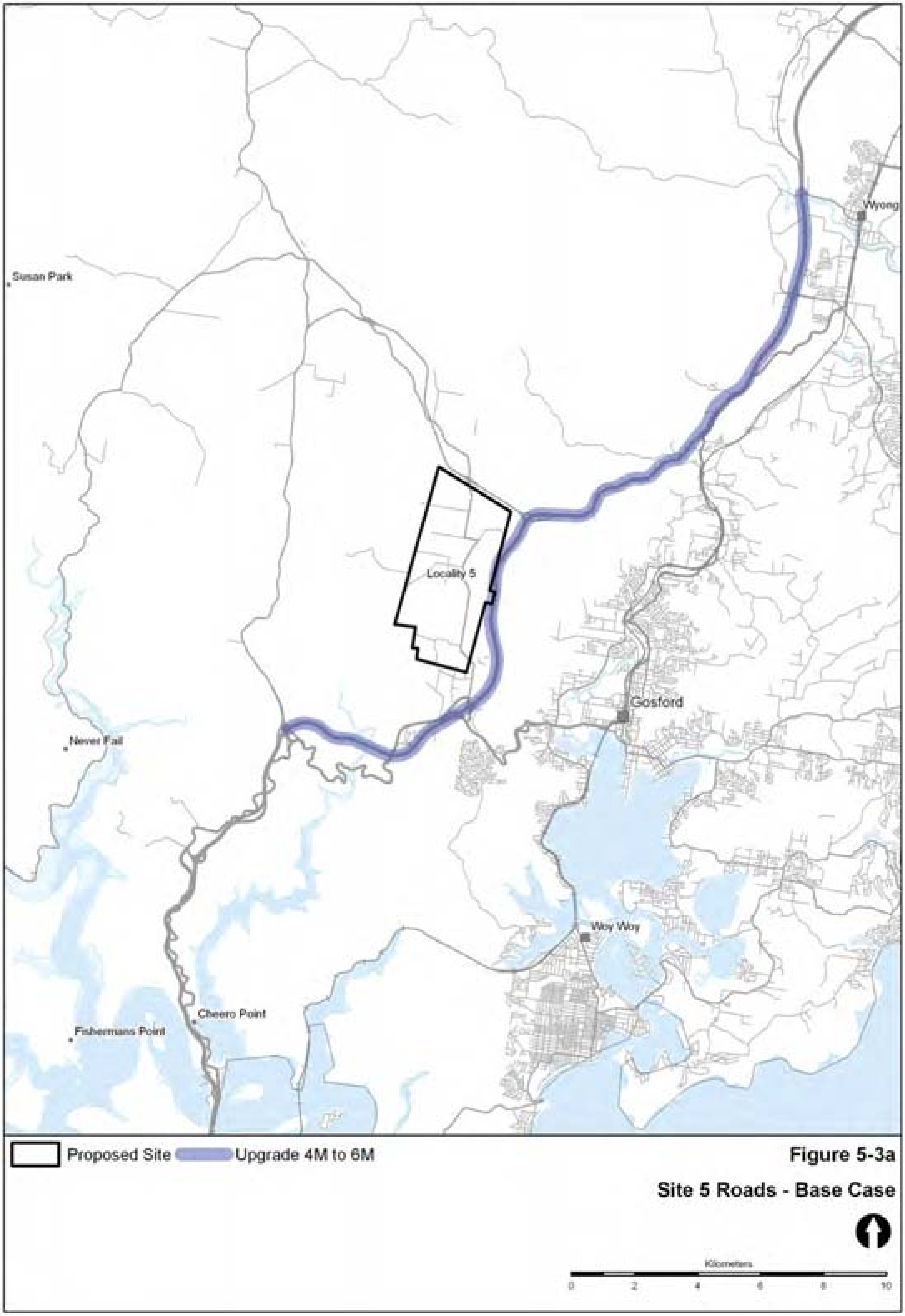
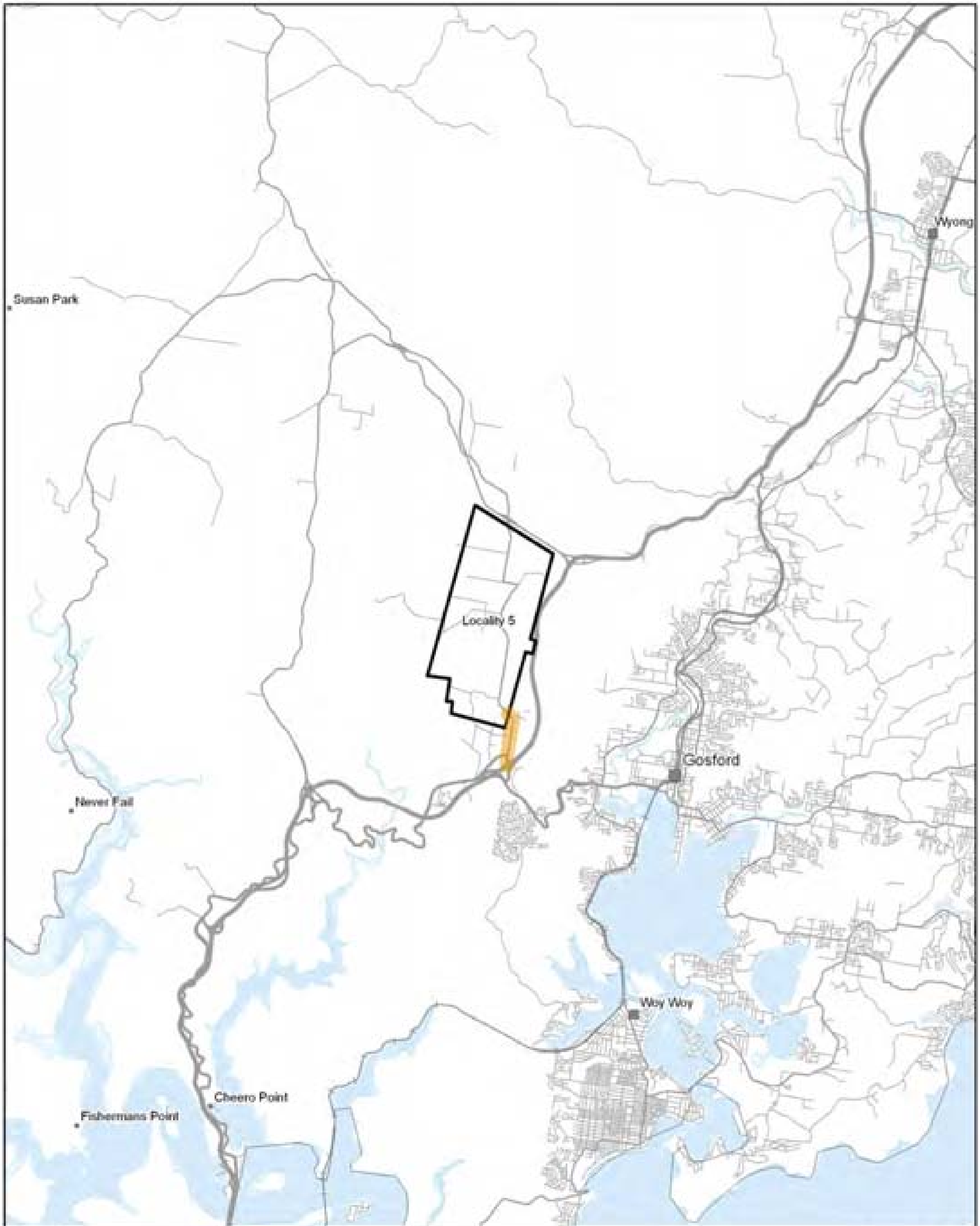


Figure 5-3a

Site 5 Roads - Base Case



Proposed Site Widen to 4U

Figure 5-3b

Site 5 Roads - Upgrades

Type 2 Airport

Kilometers
0 2 4 6 8 10

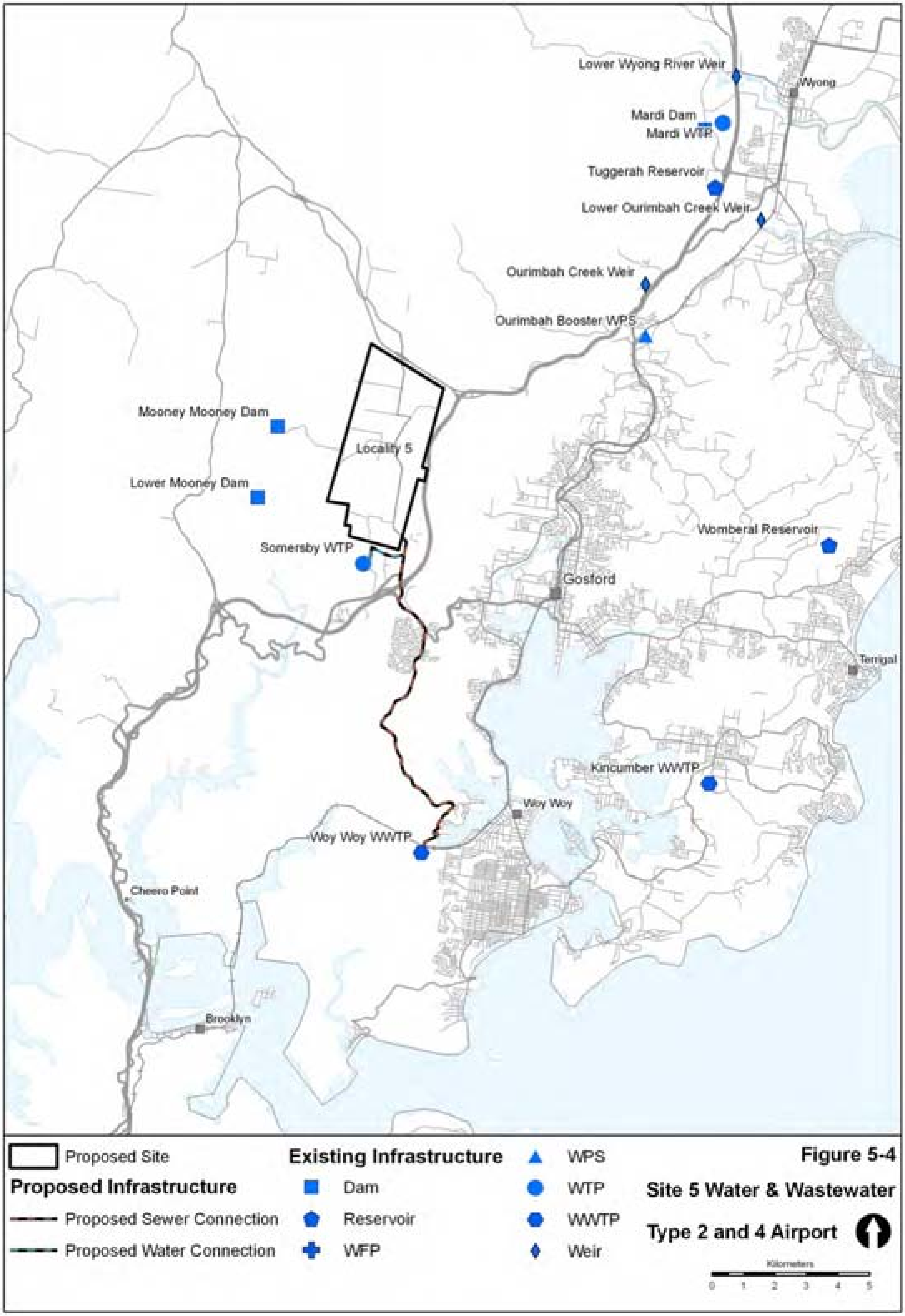


Figure 5-4
Site 5 Water & Wastewater
Type 2 and 4 Airport

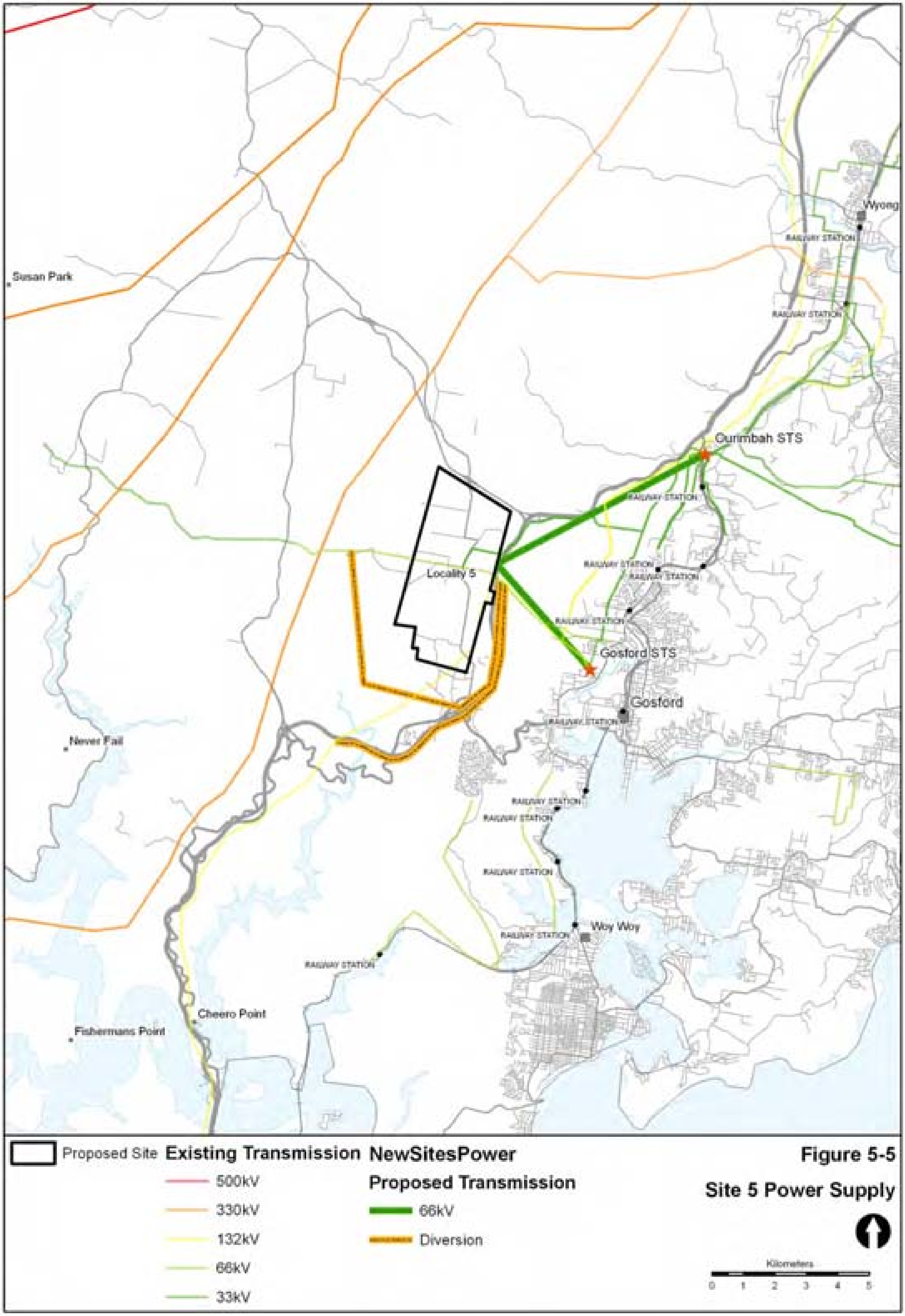
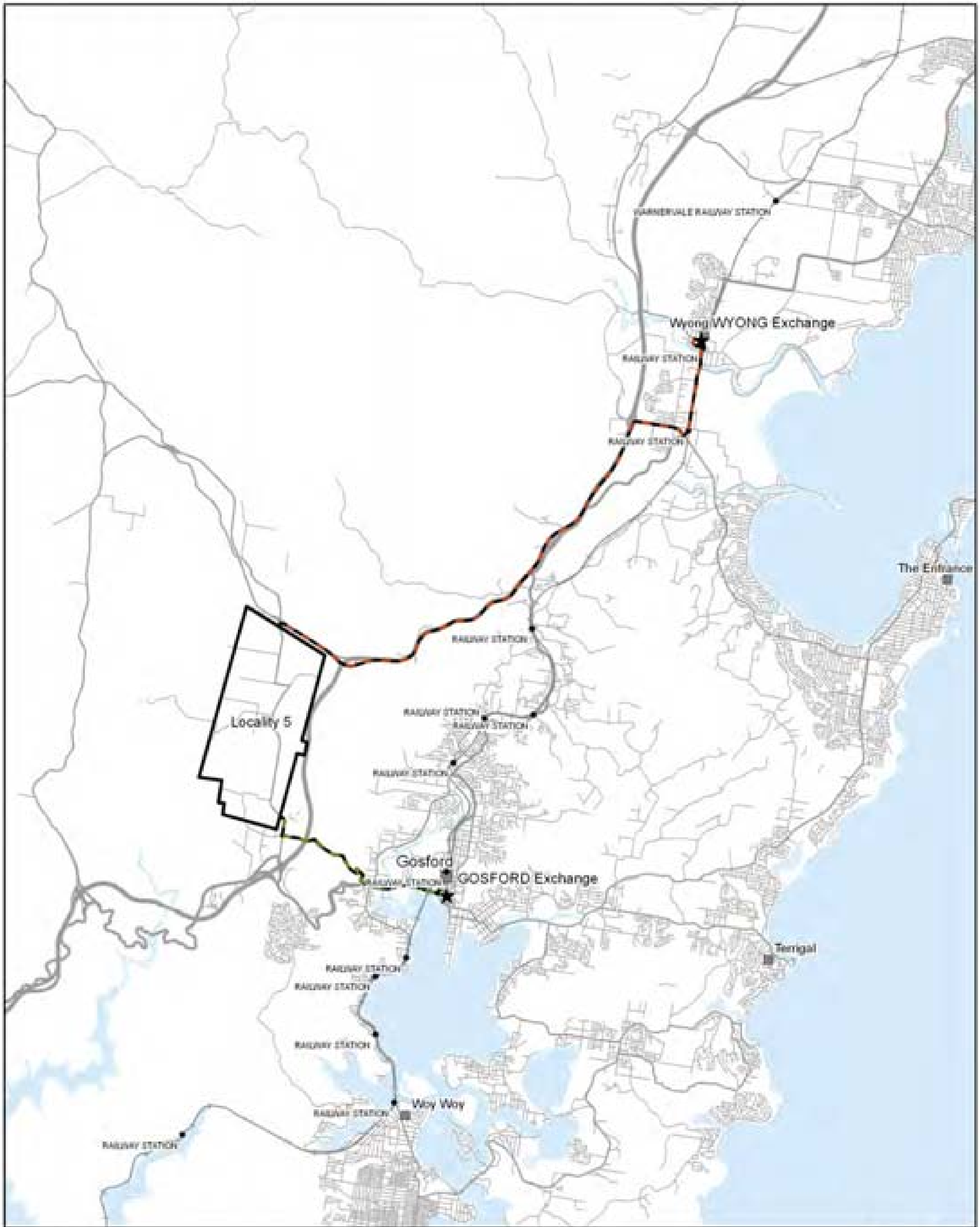


Figure 5-5

Site 5 Power Supply



Legend

Proposed Site ★ Exchange

Gosford Exchange

Wyong Exchange

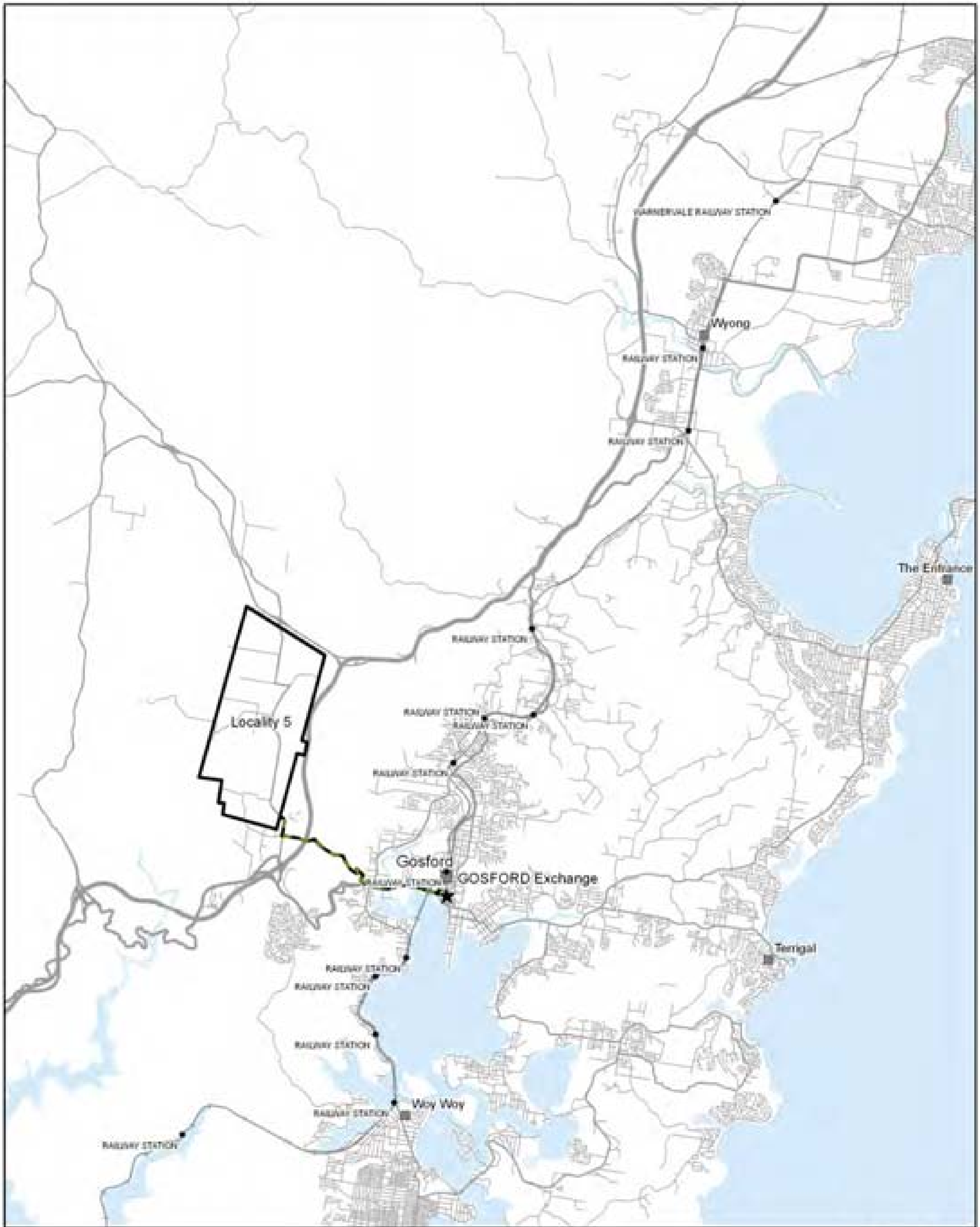
Figure 5-6a

Site 5 Communications

Type 2 Airport

Kilometers

0 1 2 3 4 5



Legend

Proposed Site ★ Exchange

Gosford Exchange

Figure 5-6b

Site 5 Communications

Type 4 Airport

Kilometers

0 1 2 3 4 5

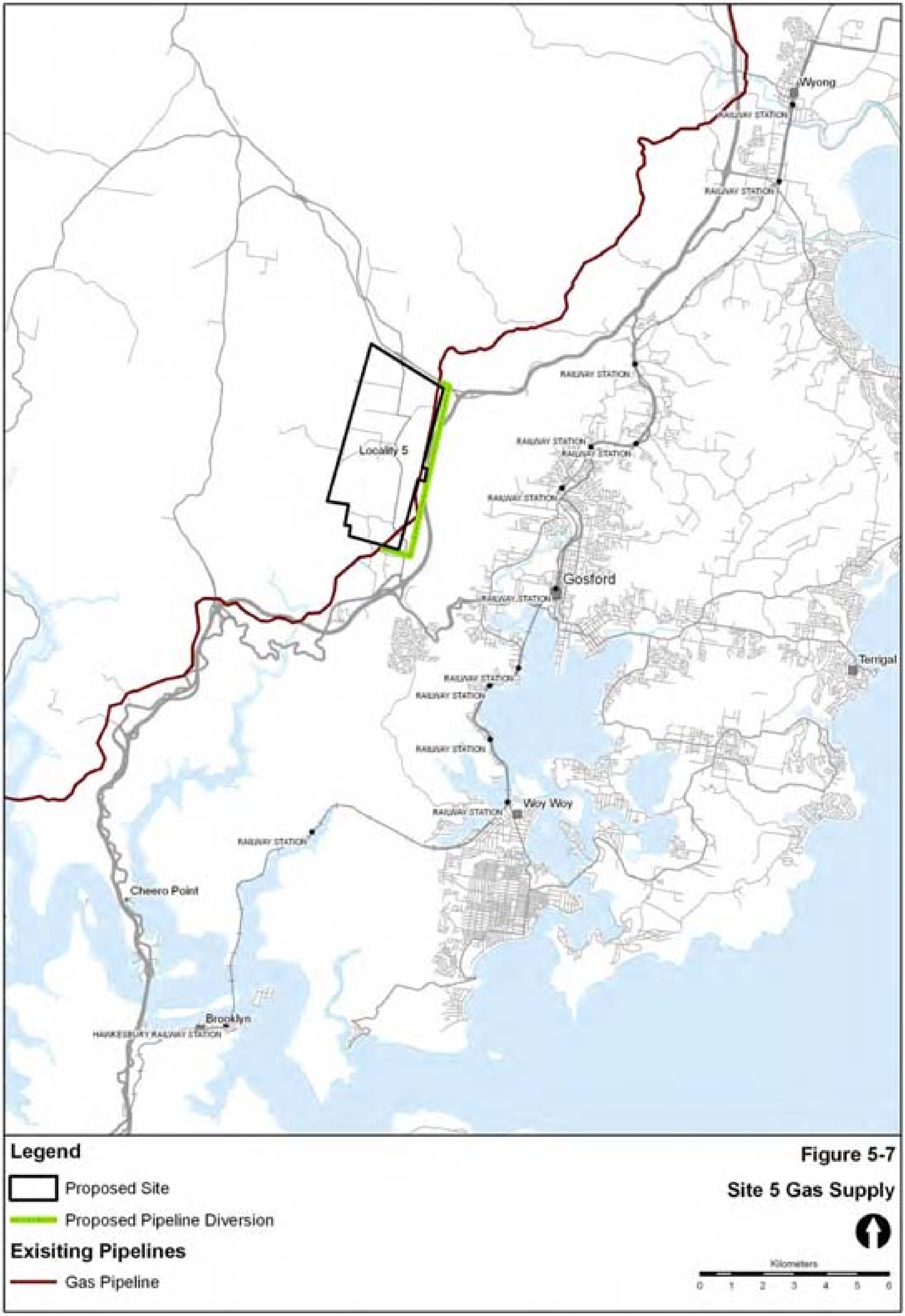


Figure 5-7

Site 5 Gas Supply

Figure 5-8

Site 5 Fuel Supply

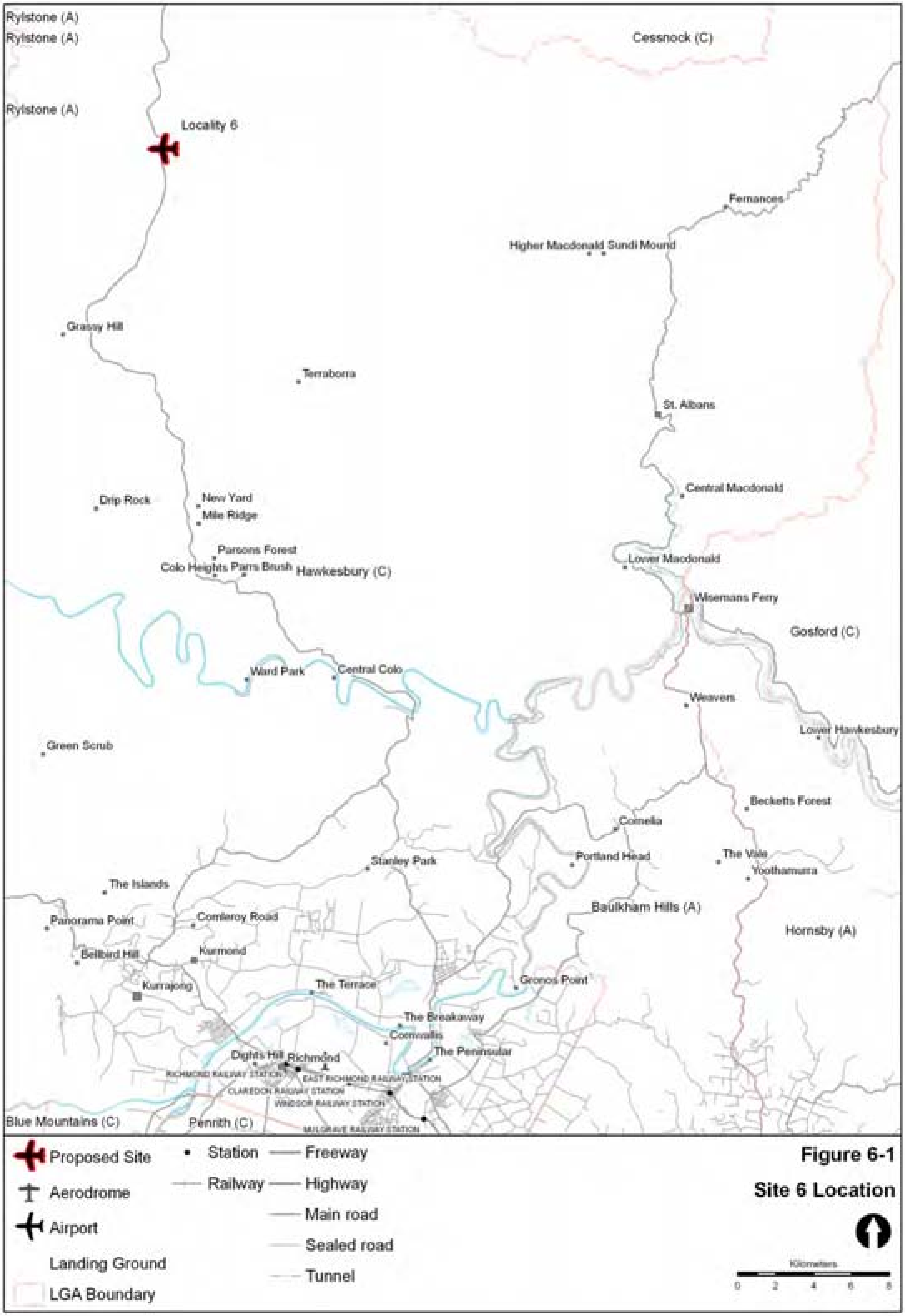


Figure 6-1

Site 6 Location

Legend

Proposed Site

Figure 6-2

Site 6 Aerial Plan

Kilometers

0 0.25 0.5 0.75 1

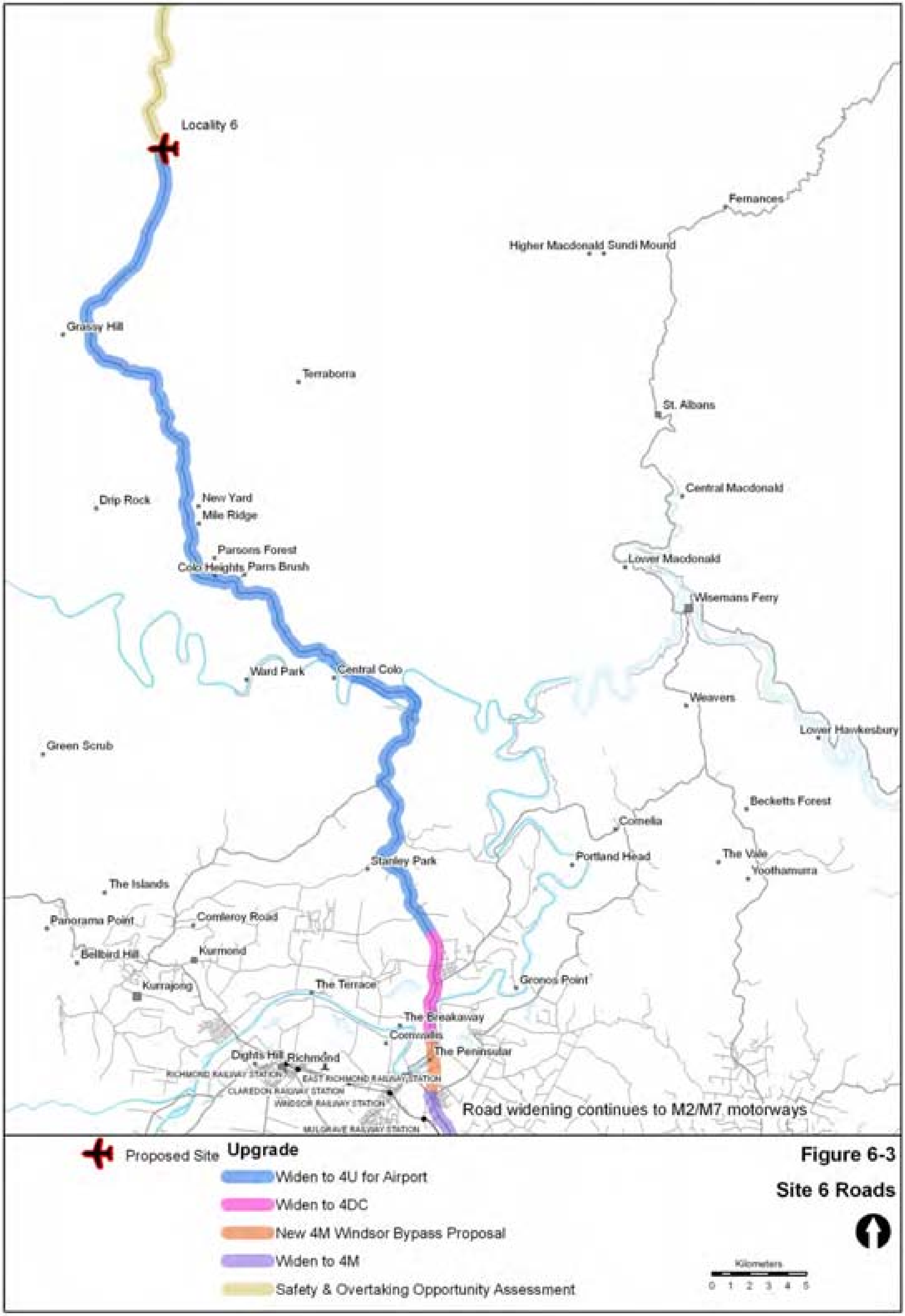
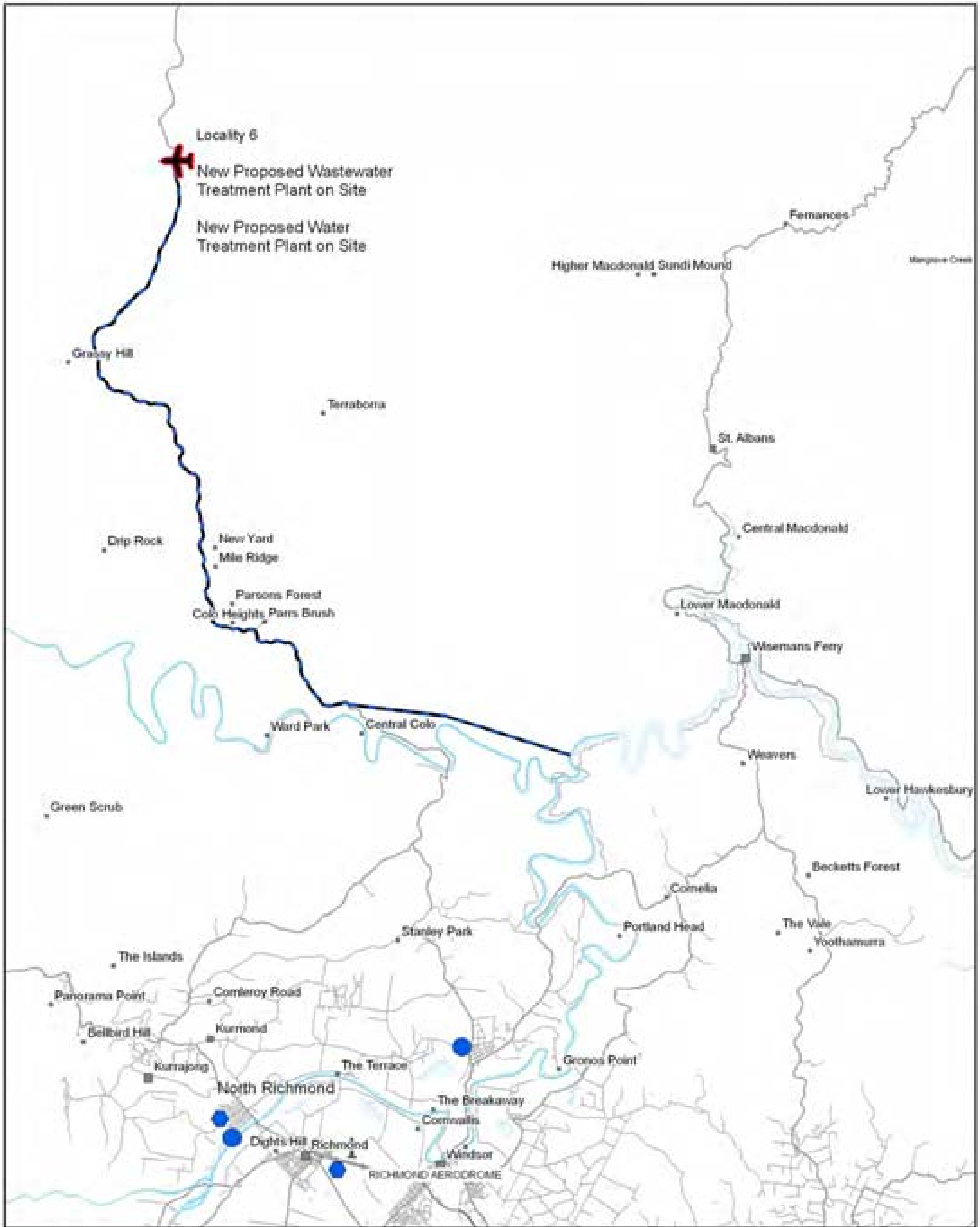


Figure 6-3

Site 6 Roads



Legend

Proposed Site

Proposed Water Connection

Existing Infrastructure

WTP

WWTP

Figure 6-4

Site 6 Water & Wastewater

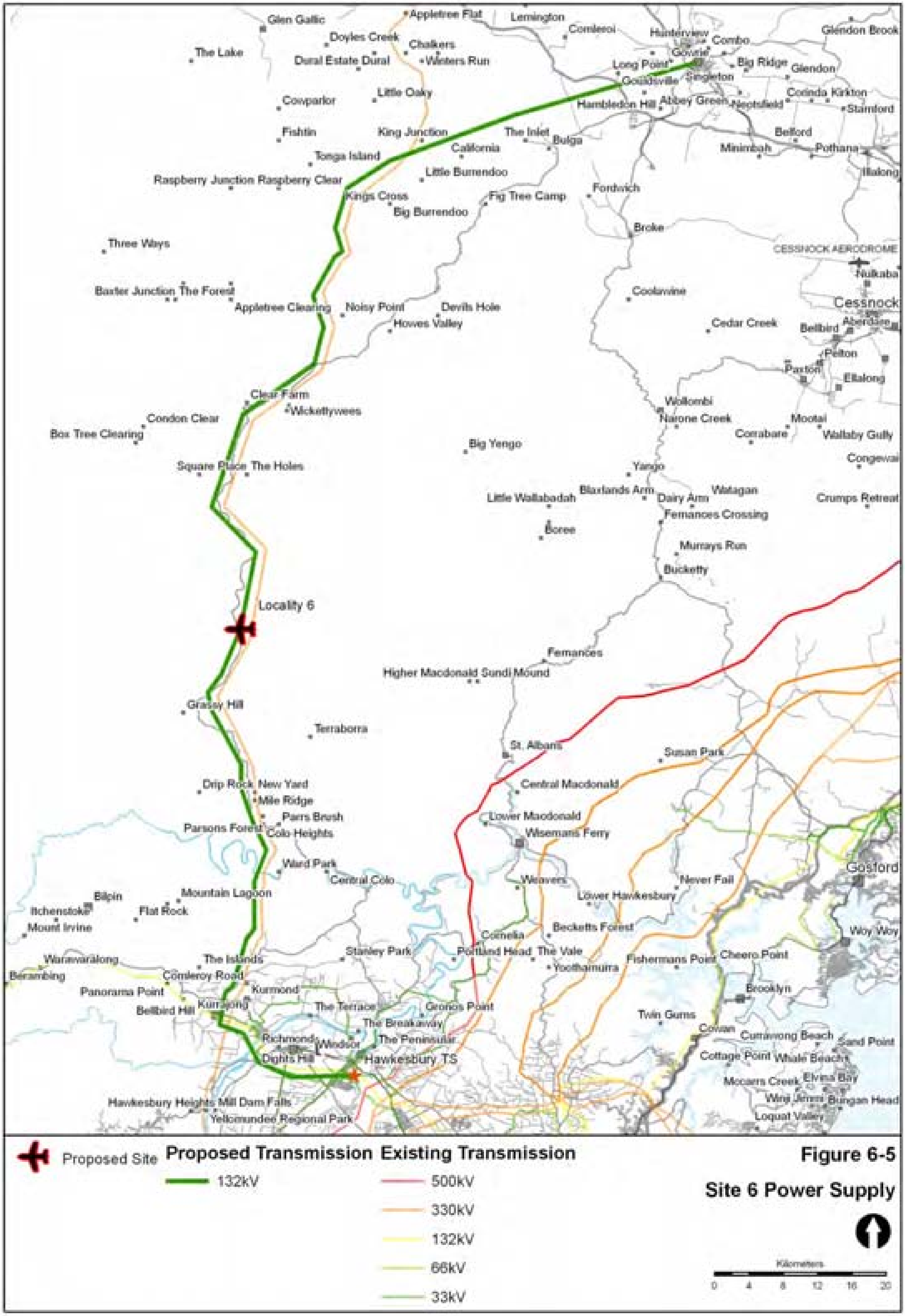
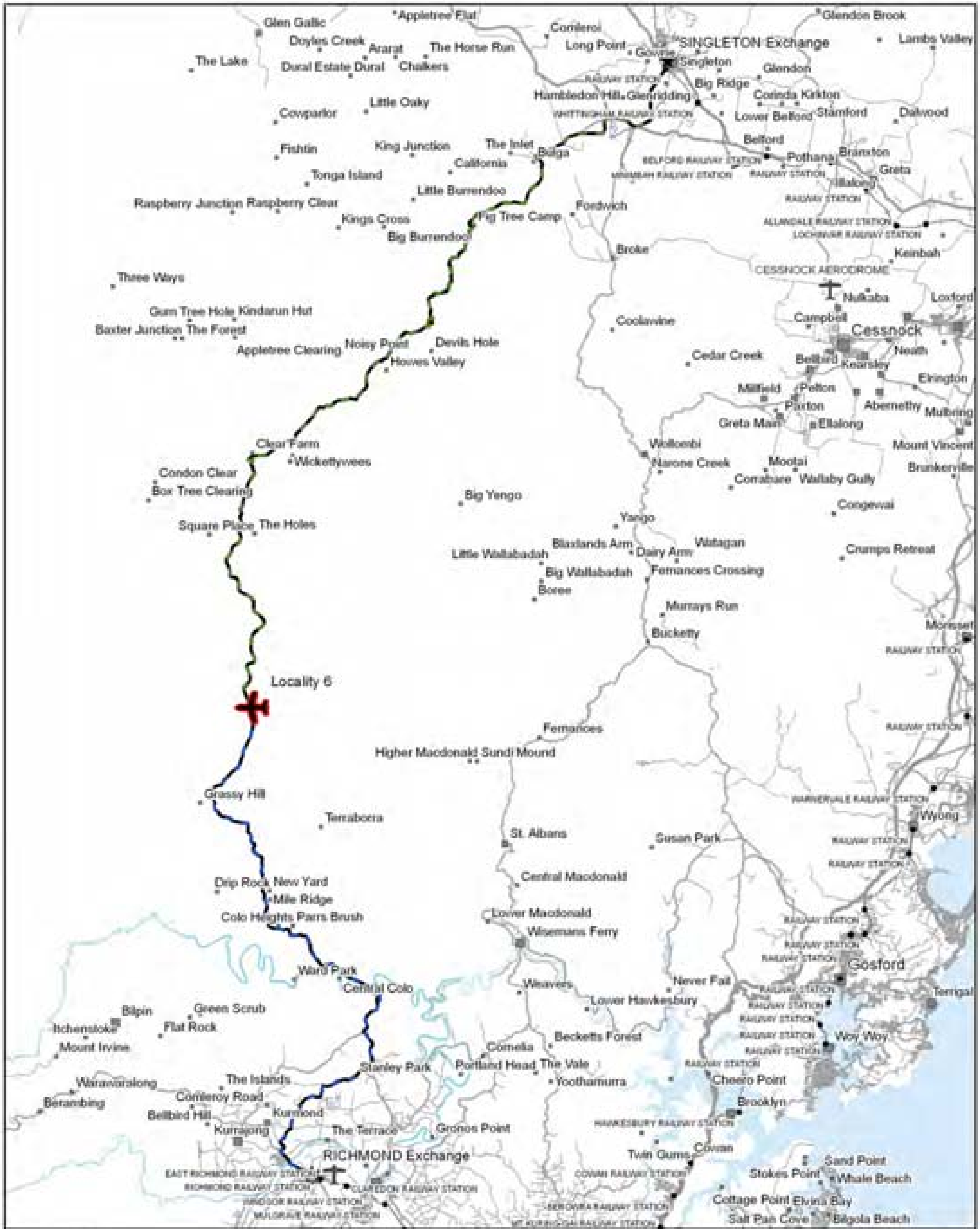


Figure 6-5

Site 6 Power Supply



Legend

Proposed Site

Exchange

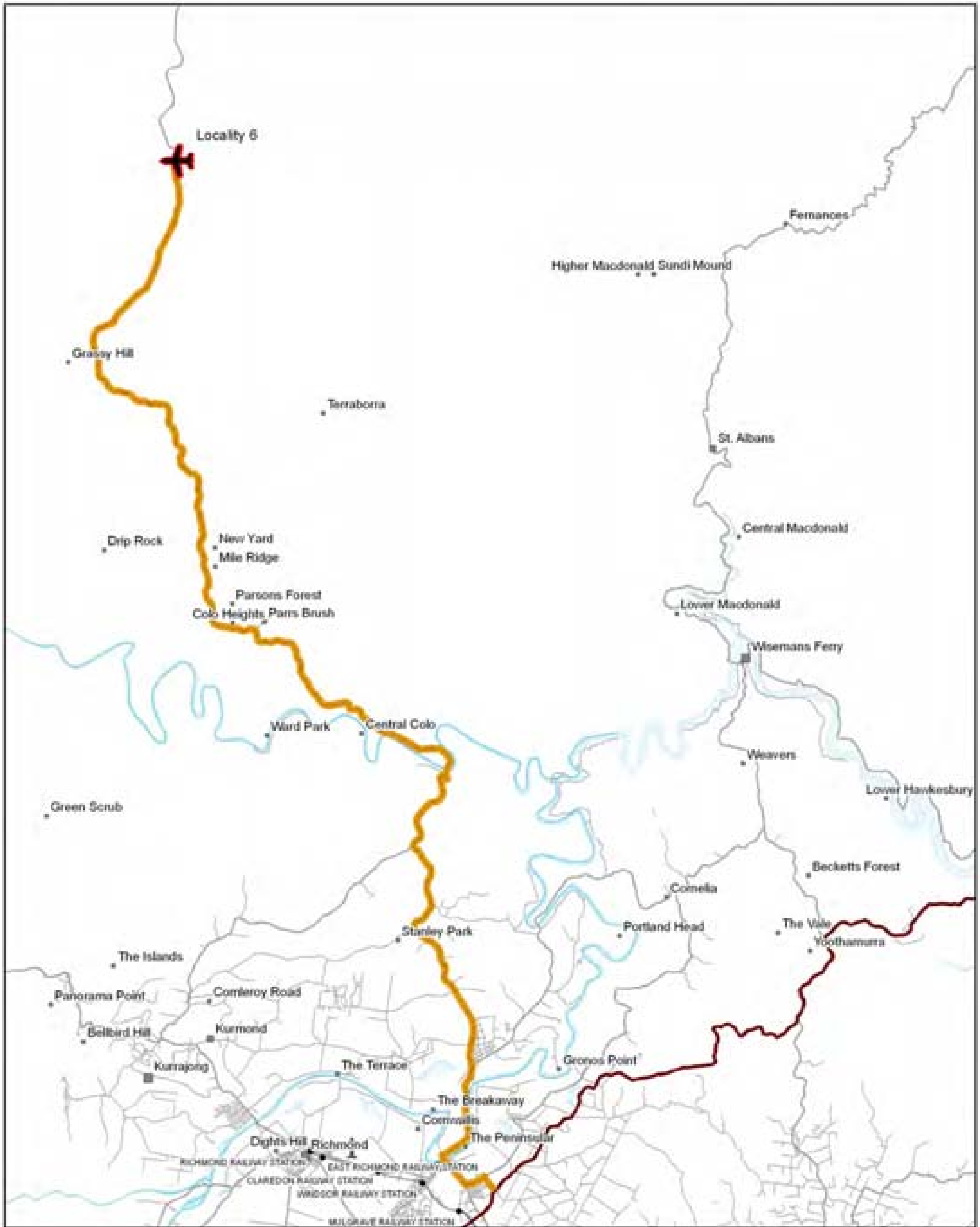
Richmond Exchange

Singleton Exchange

Kilometers 0 5 10 15 20

Figure 6-6

Site 6 Communications



Legend

Proposed Site

Proposed Pipeline (70.5km)

Exisiting Pipelines

Gas Pipeline

Figure 6-7

Site 6 Gas Supply

Legend

Proposed Site

Proposed Fuel Line

Second Independent Fuel Line - Redundancy

Kilometers

0 2 4 6 8 10

Figure 6-8

Site 6 Fuel Supply

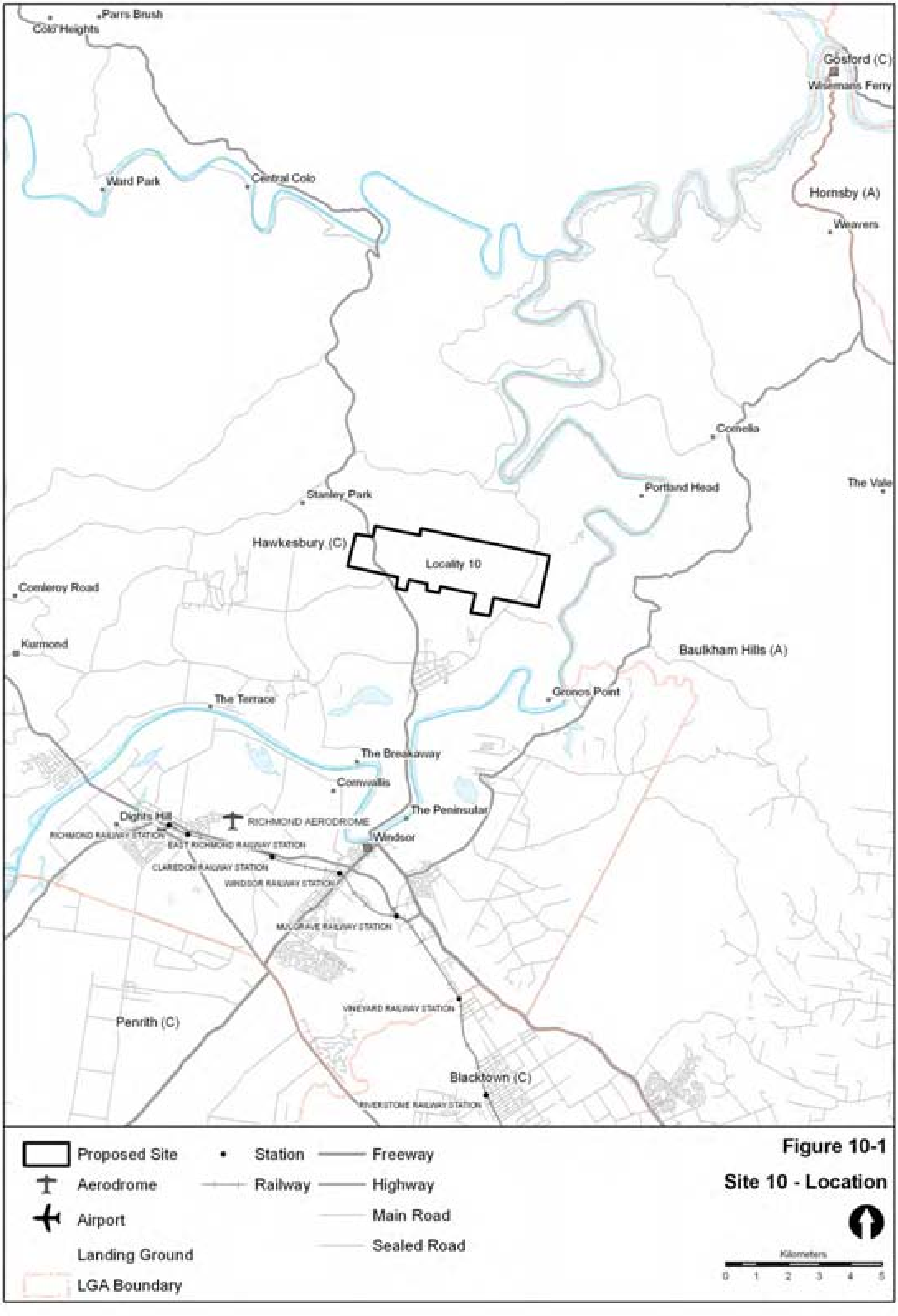


Figure 10-1

Site 10 - Location

Legend

Type 1 Airport

Type 2 Airport

Type 4 Airport

Figure 10-2

Site 10 Aerial Plan

Kilometers

0 0.5 1 1.5 2

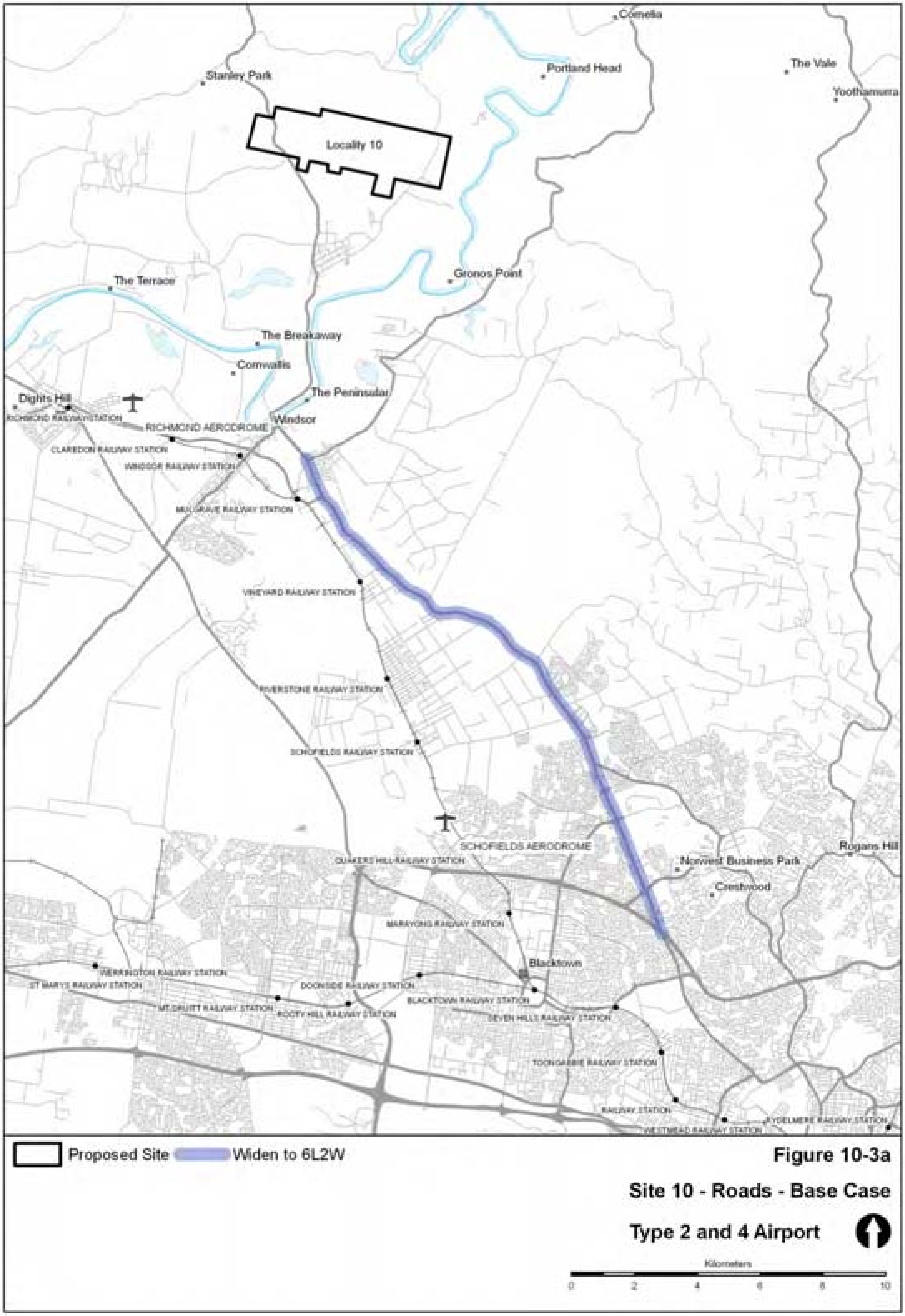
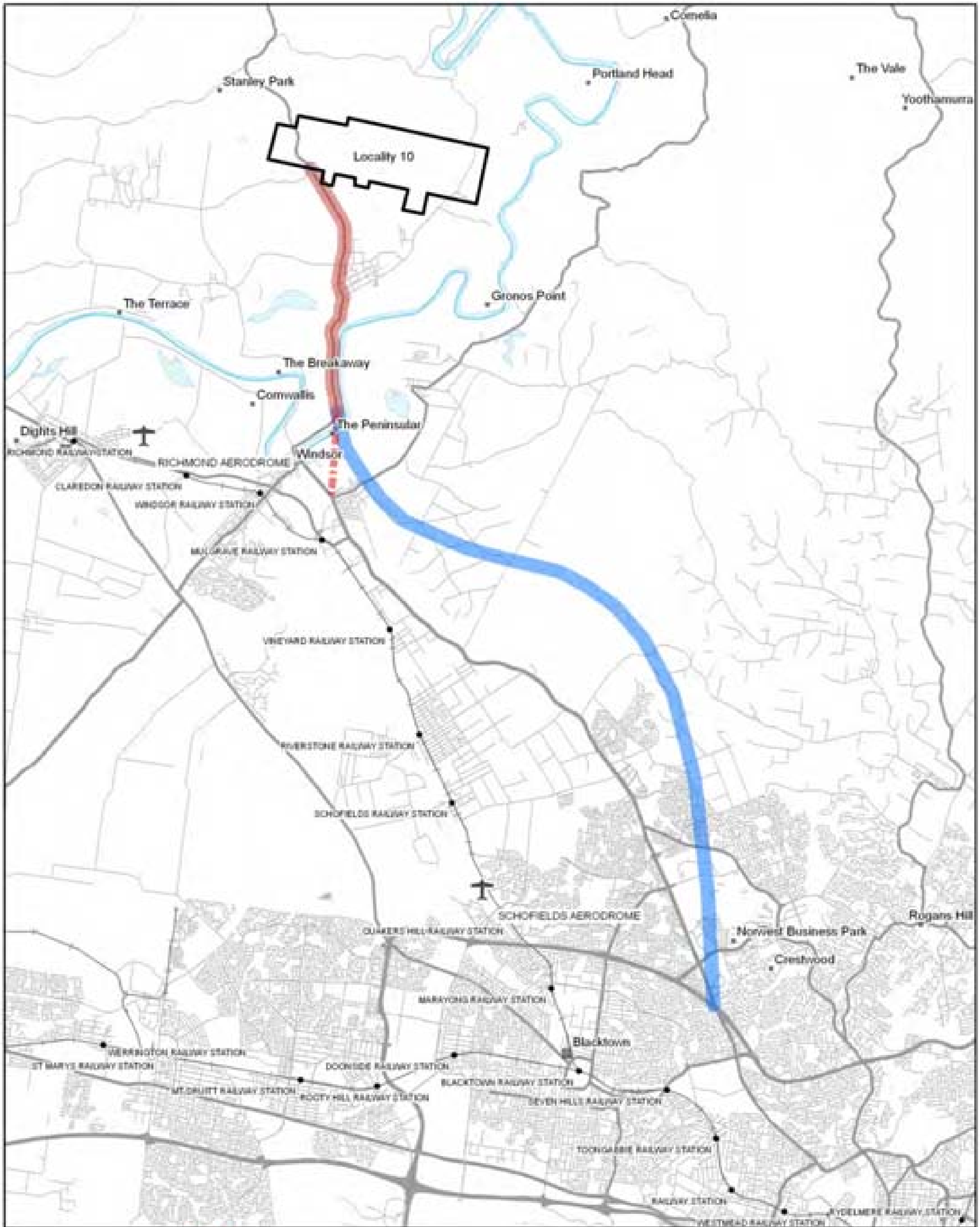


Figure 10-3a

Site 10 - Roads - Base Case

Type 2 and 4 Airport



Proposed Site
Proposed Windsor Bypass
Widen to 4DC
New Link Road: 4DC

Figure 10-3b

Site 10 - Roads - Upgrades

Type 2 Airport

Kilometers
0 2 4 6 8 10

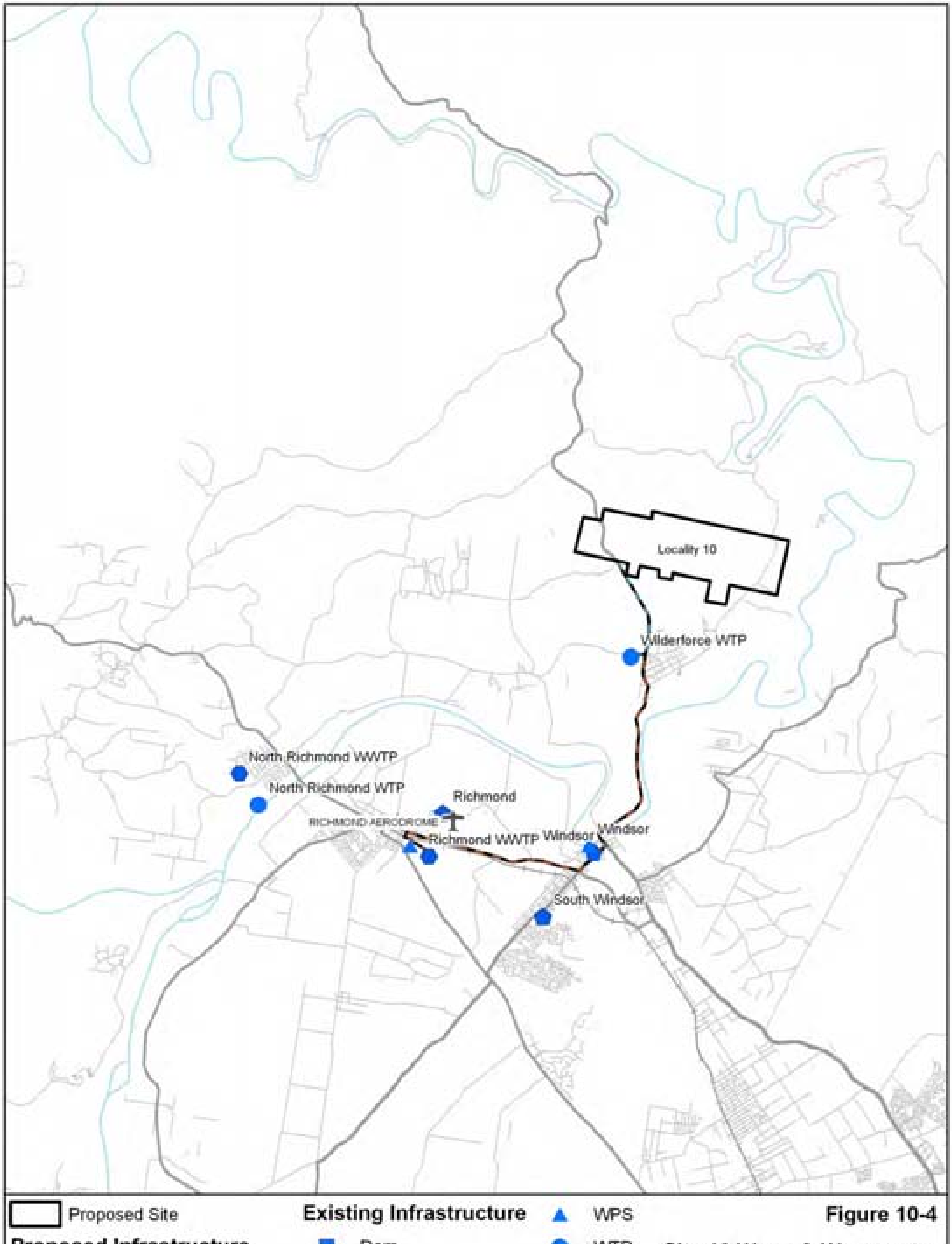
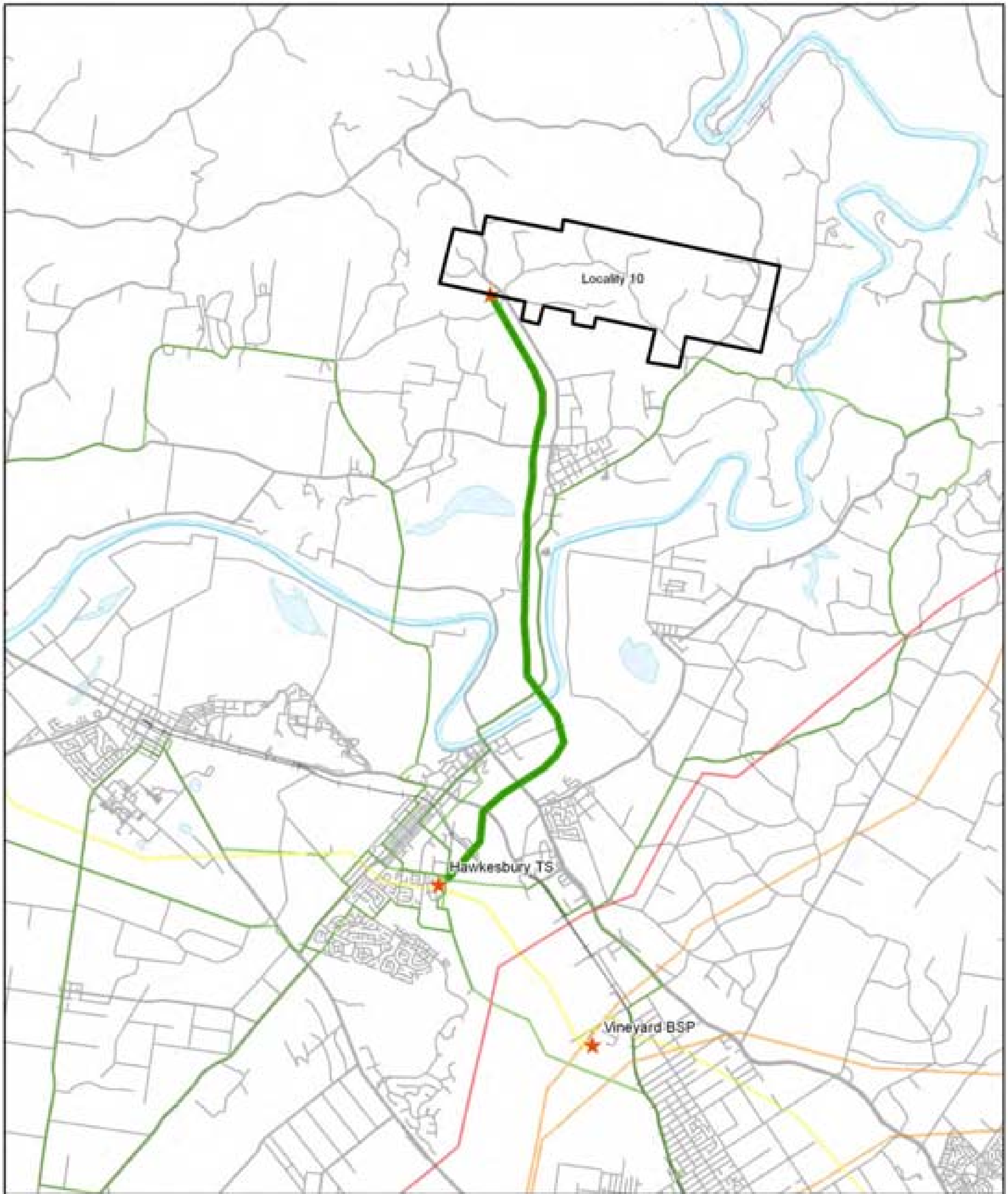


Figure 10-4

Site 10 Water & Wastewater

Type 2 and 4 Airport



Legend

Proposed Site **Exisitng Transmission** **Proposed Transmission**

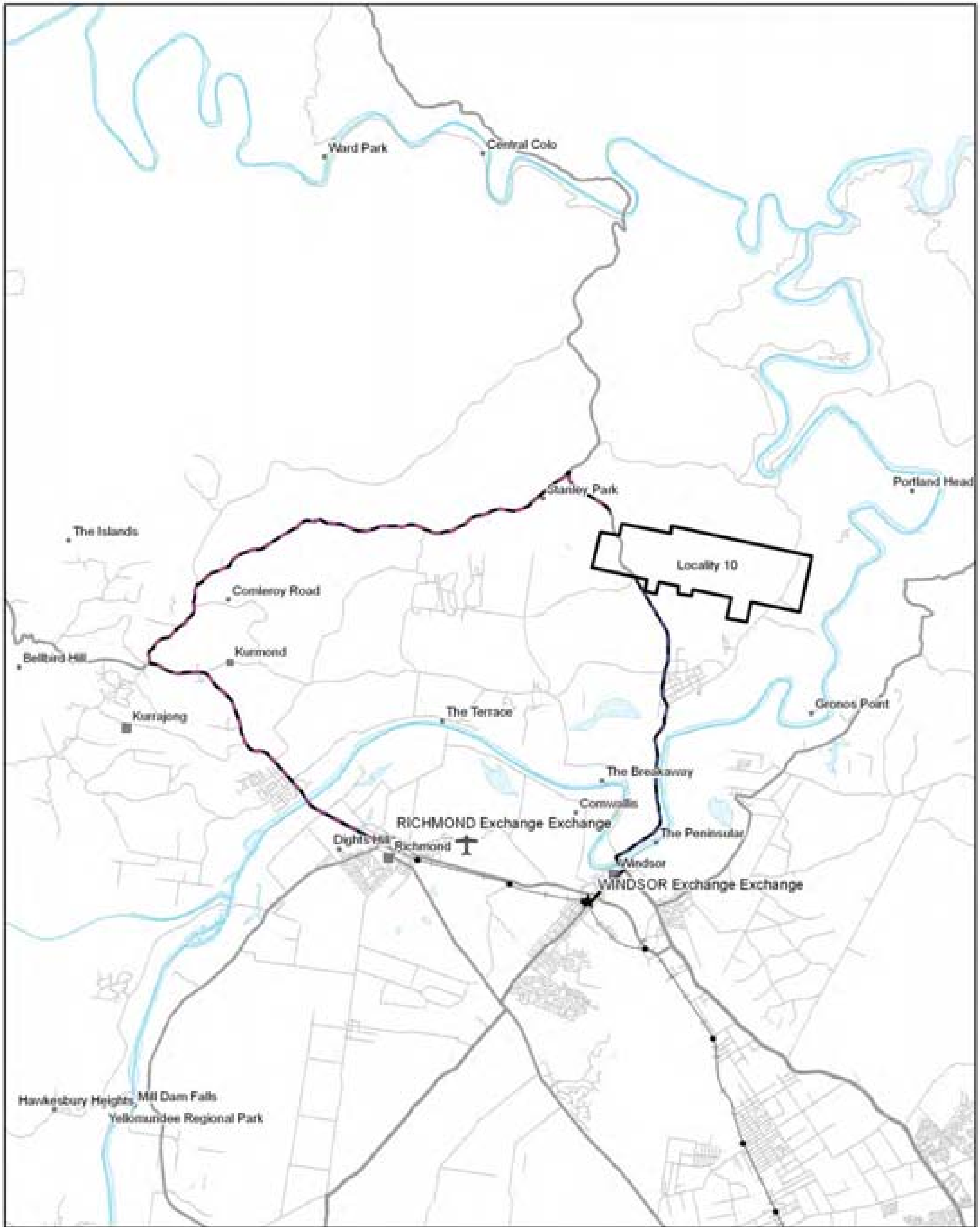
500kV
330kV
132kV
66kV
33kV

33kV

Figure 10-5
Site 10 Power

Type 2 and 4 Airport

Kilometers
0 1 2 3 4 5



Legend

Proposed Site

★ Exchange

Richmond Exchange

Windsor Exchange

Figure 10-6a

Site 10 - Communications

Type 2 Airport

Kilometers 0 1 2 3 4 5

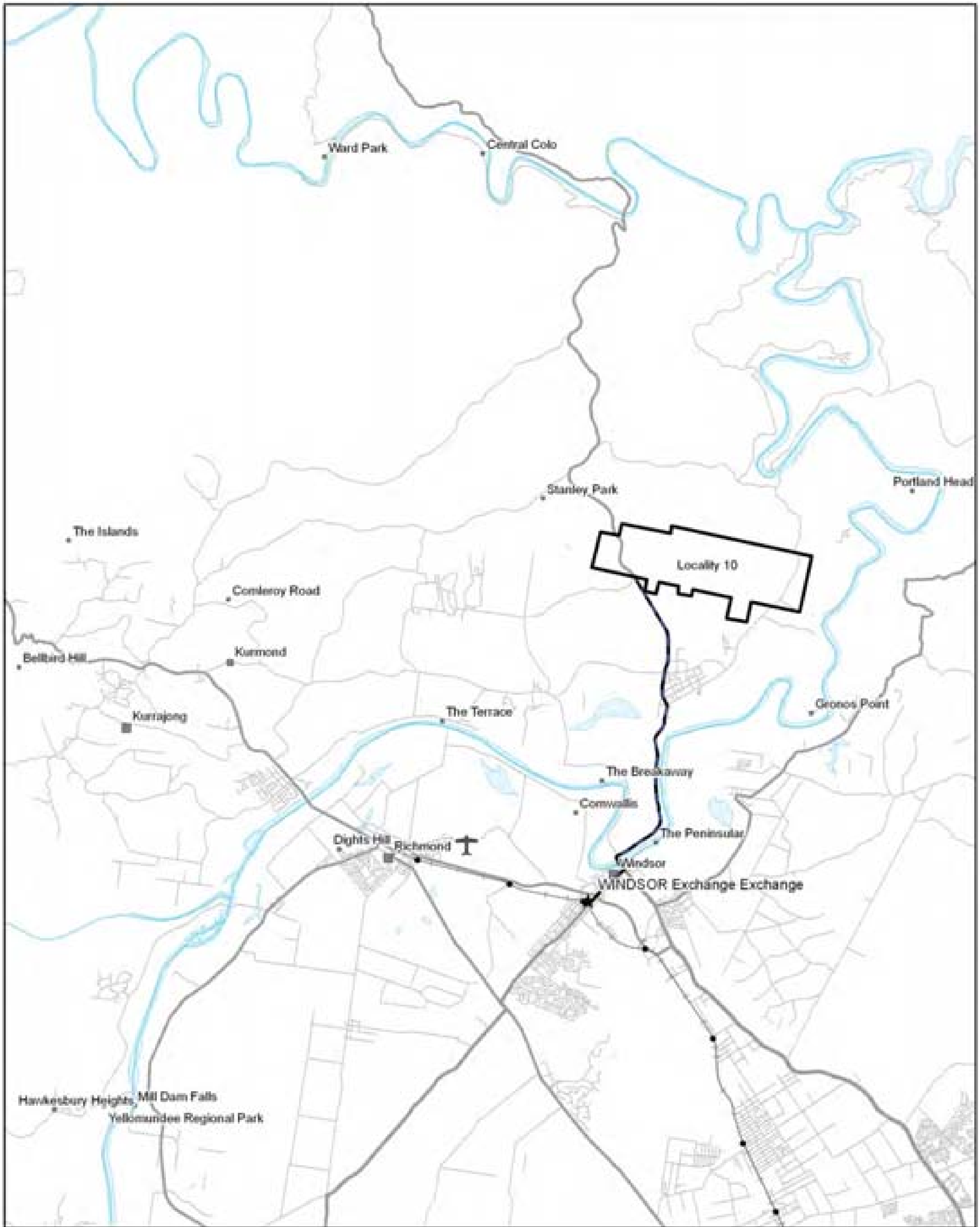


Figure 10-6b

Site 10 - Communications

Type 4 Airport

Legend

Proposed Site ★ Exchange

Windsor Exchange

Kilometers
0 1 2 3 4 5

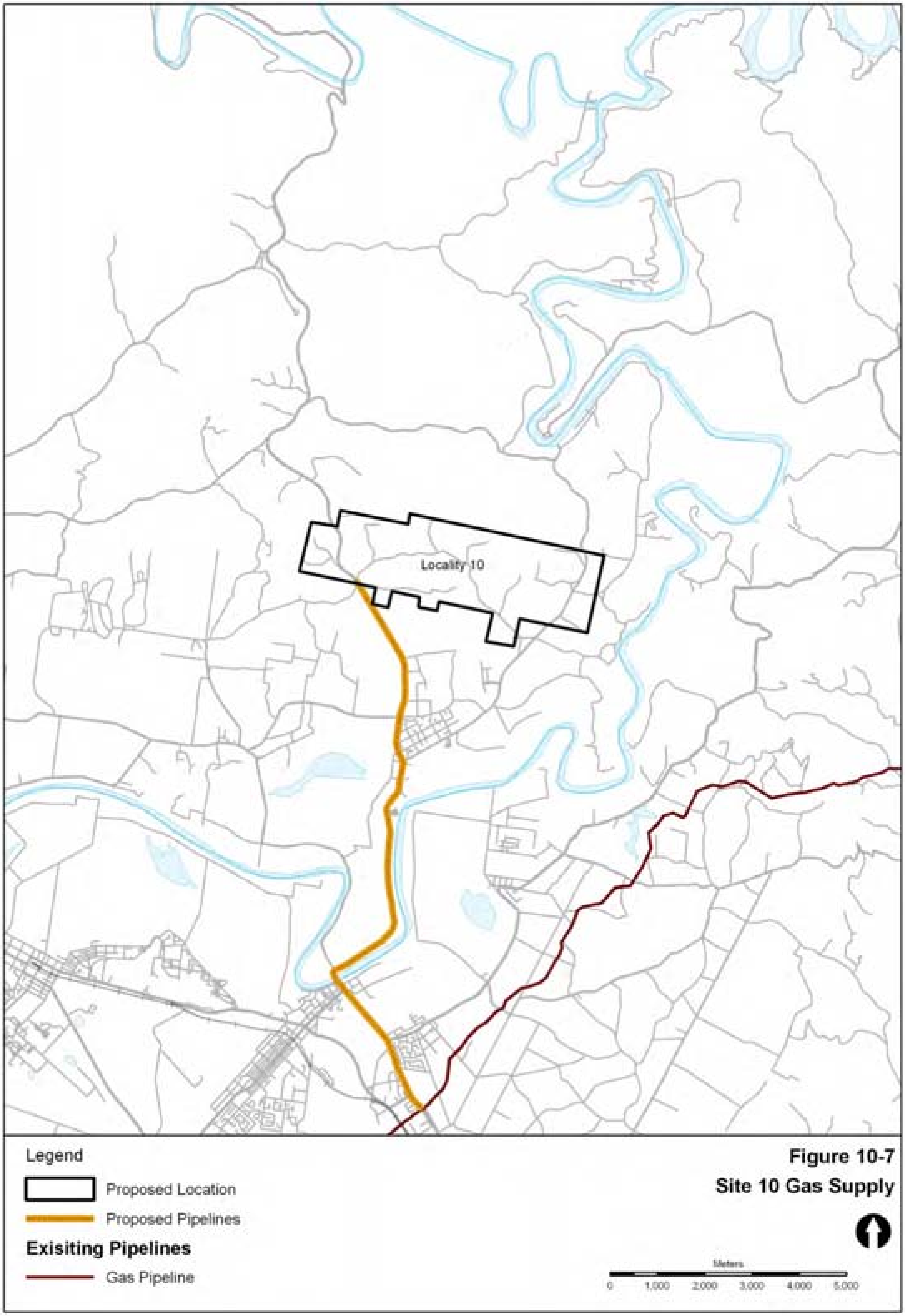


Figure 10-7

Site 10 Gas Supply

Figure 10-8

Site 10 Fuel Supply

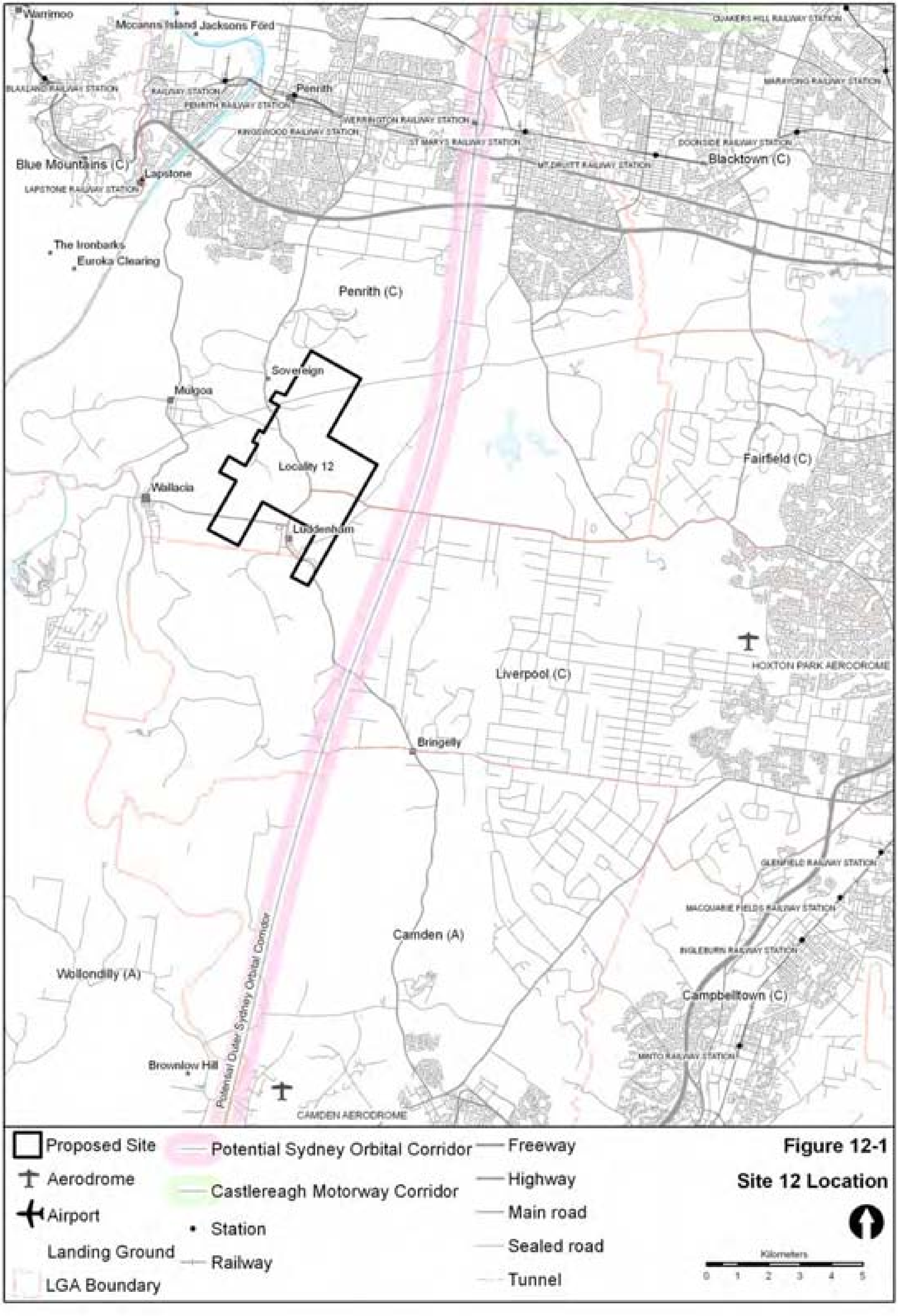


Figure 12-1

Site 12 Location

Legend

Type 1 Airport

Type 2 Airport

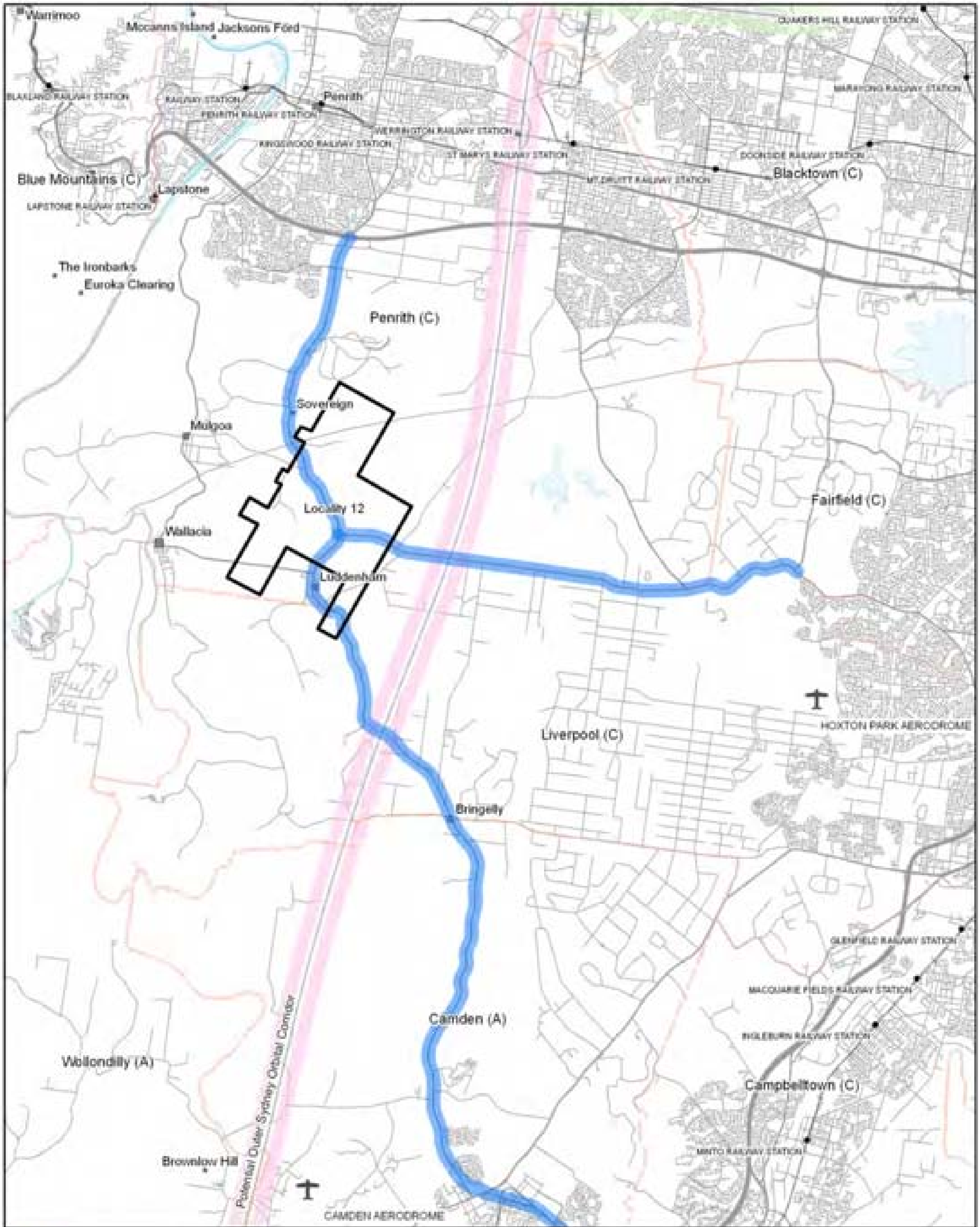
Type 4 Airport

Figure 12-2

Site 12 Aerial Plan

Kilometers

0 0.5 1 1.5 2



Base Case Upgrade from 2L2W to 4L2W

Potential Sydney Orbital Corridor

Castlereagh Motorway Corridor

Figure 12-3a

Site 12 Roads - Base Case

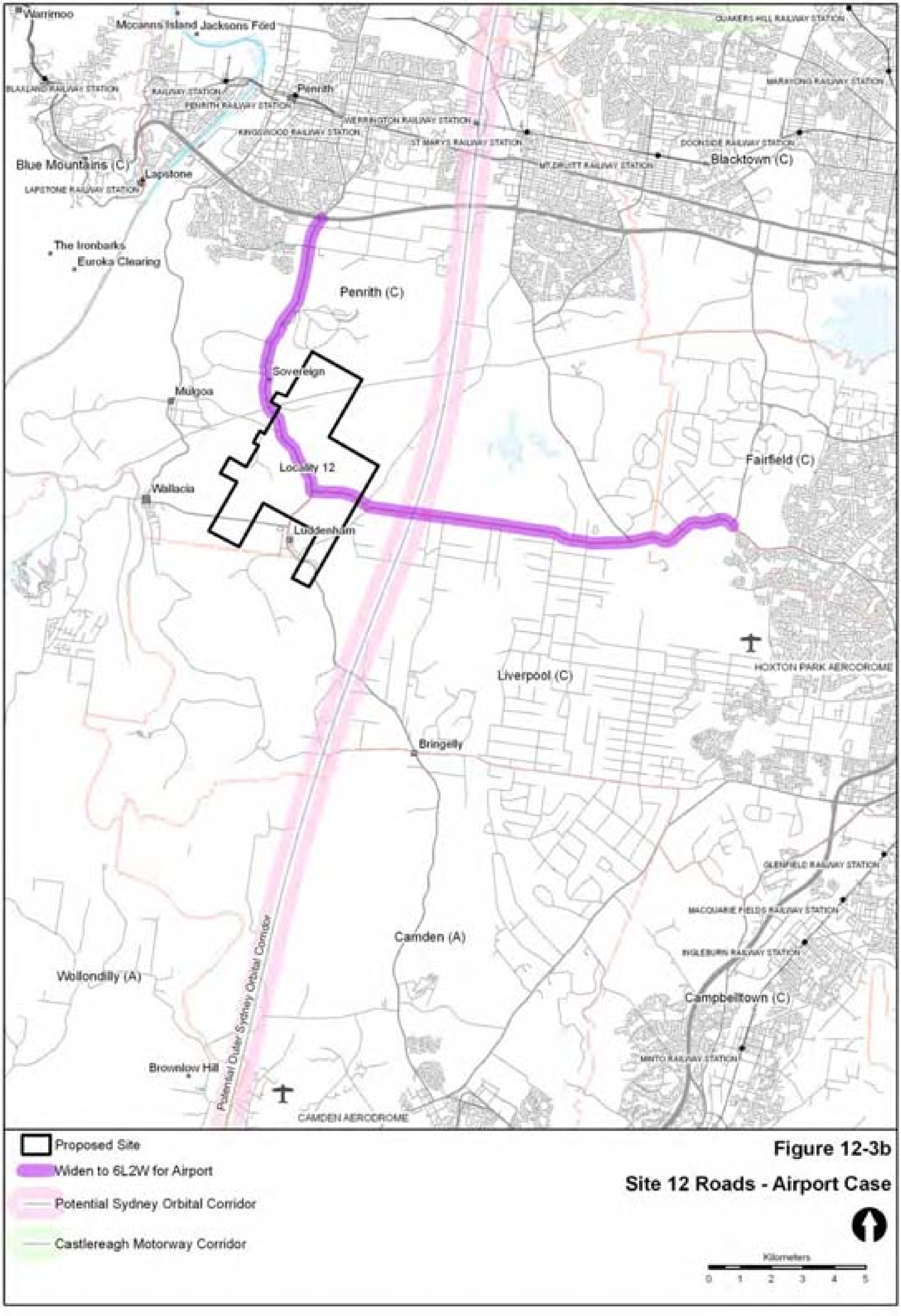
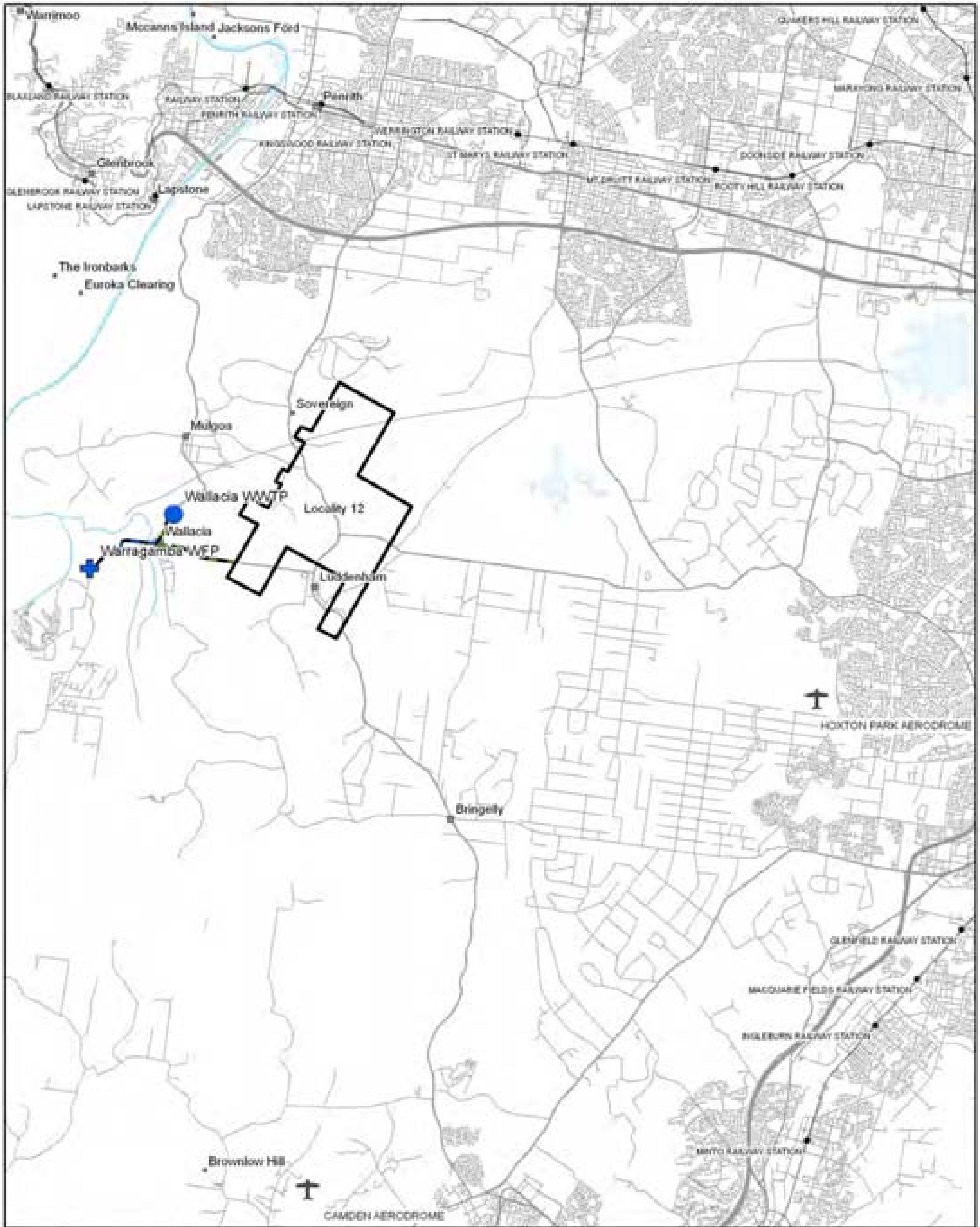


Figure 12-3b

Site 12 Roads - Airport Case



Proposed Site

Proposed Infrastructure

Proposed Sewer Connection

Proposed Water Connection

Existing Infrastructure

WFP

WWTP

Figure 12-4

Site 12 Water & Wastewater

Type 2 and 4 Airport

Kilometers

0 1 2 3 4 5

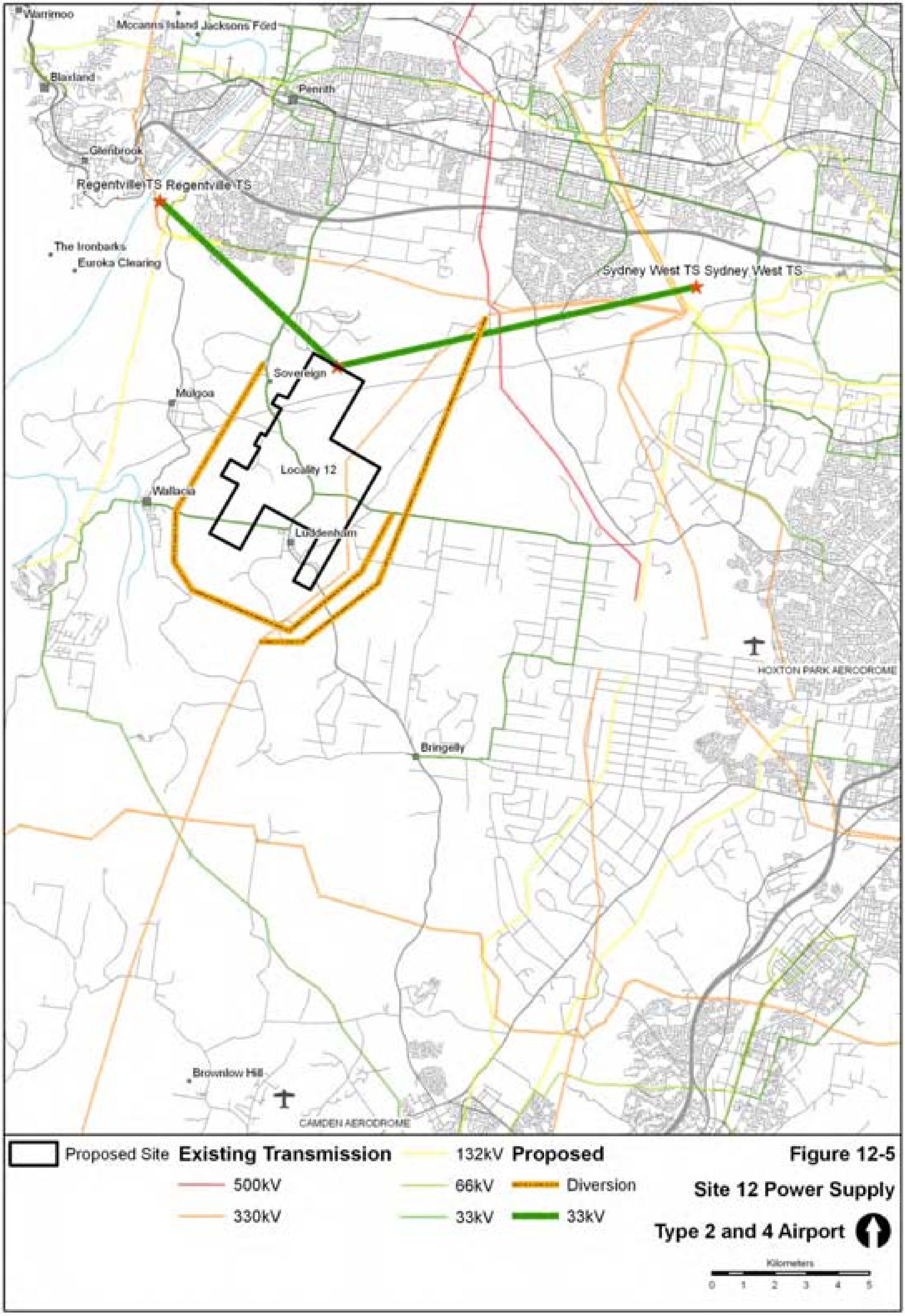
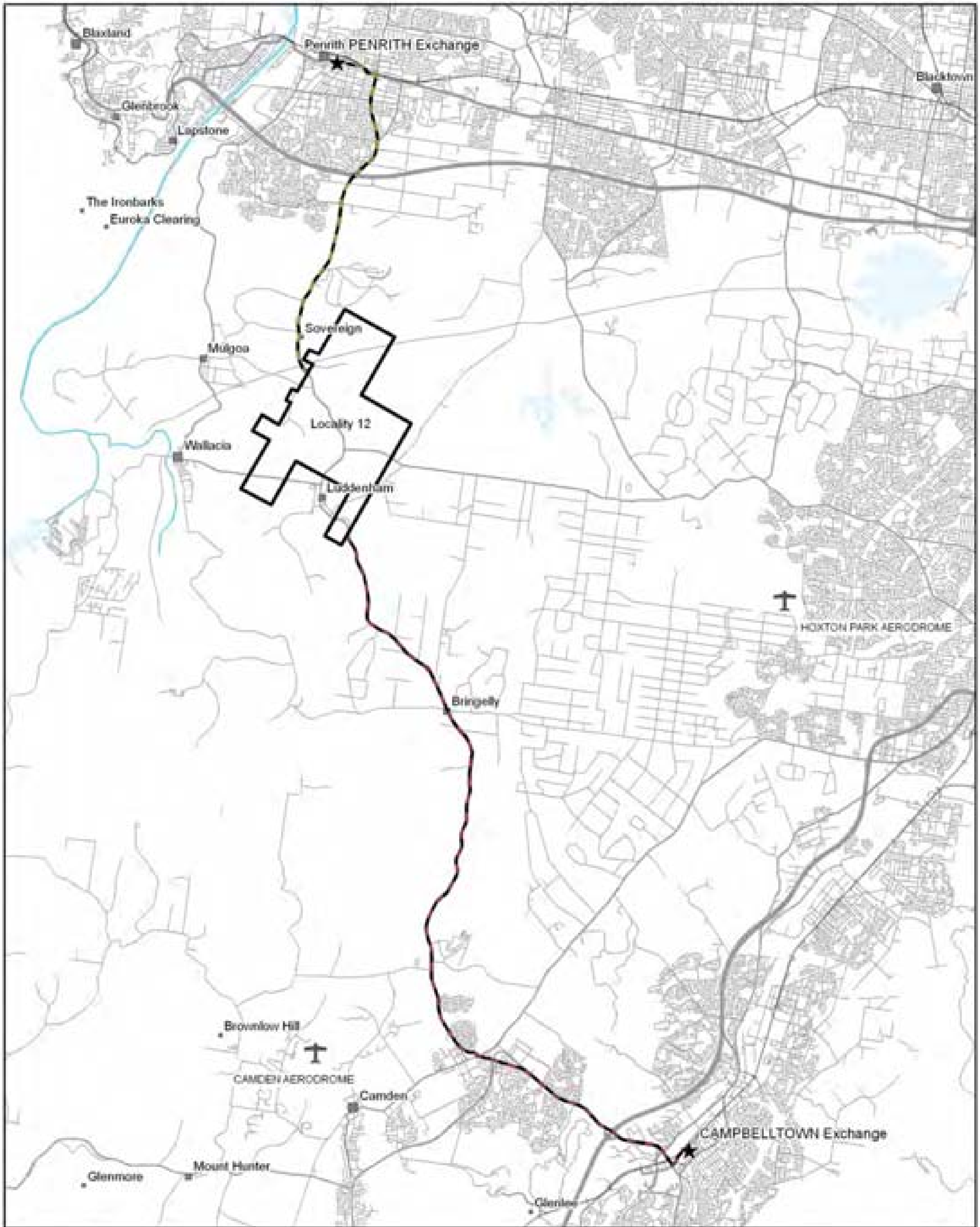


Figure 12-5

Site 12 Power Supply

Type 2 and 4 Airport



Legend

Proposed Site ★ Exchange

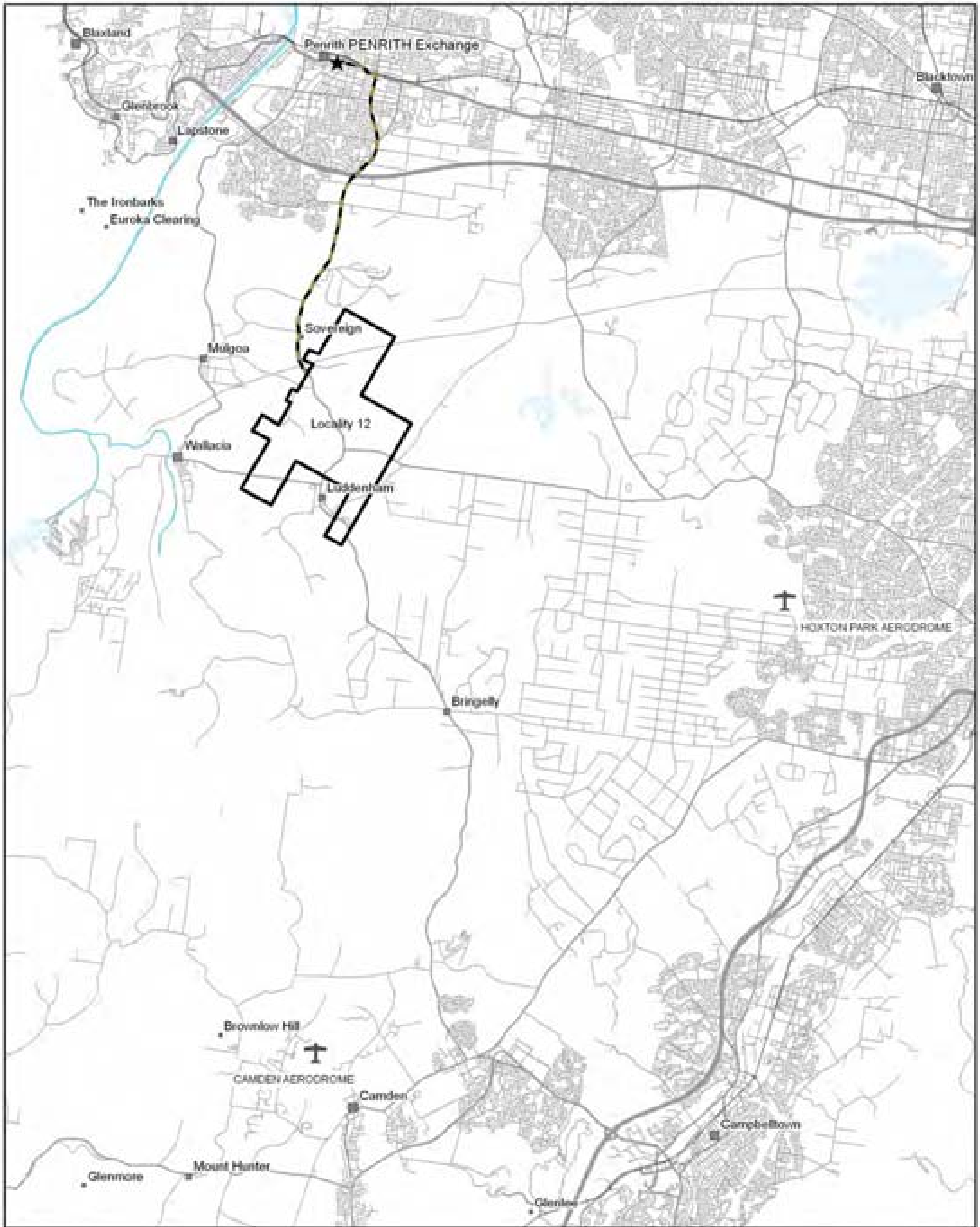
Campbelltown Exchange

Penrith Exchange

Figure 12-6a

Communications

Type 2 Airport



Legend

Proposed Site ★ Exchange

Penrith Exchange

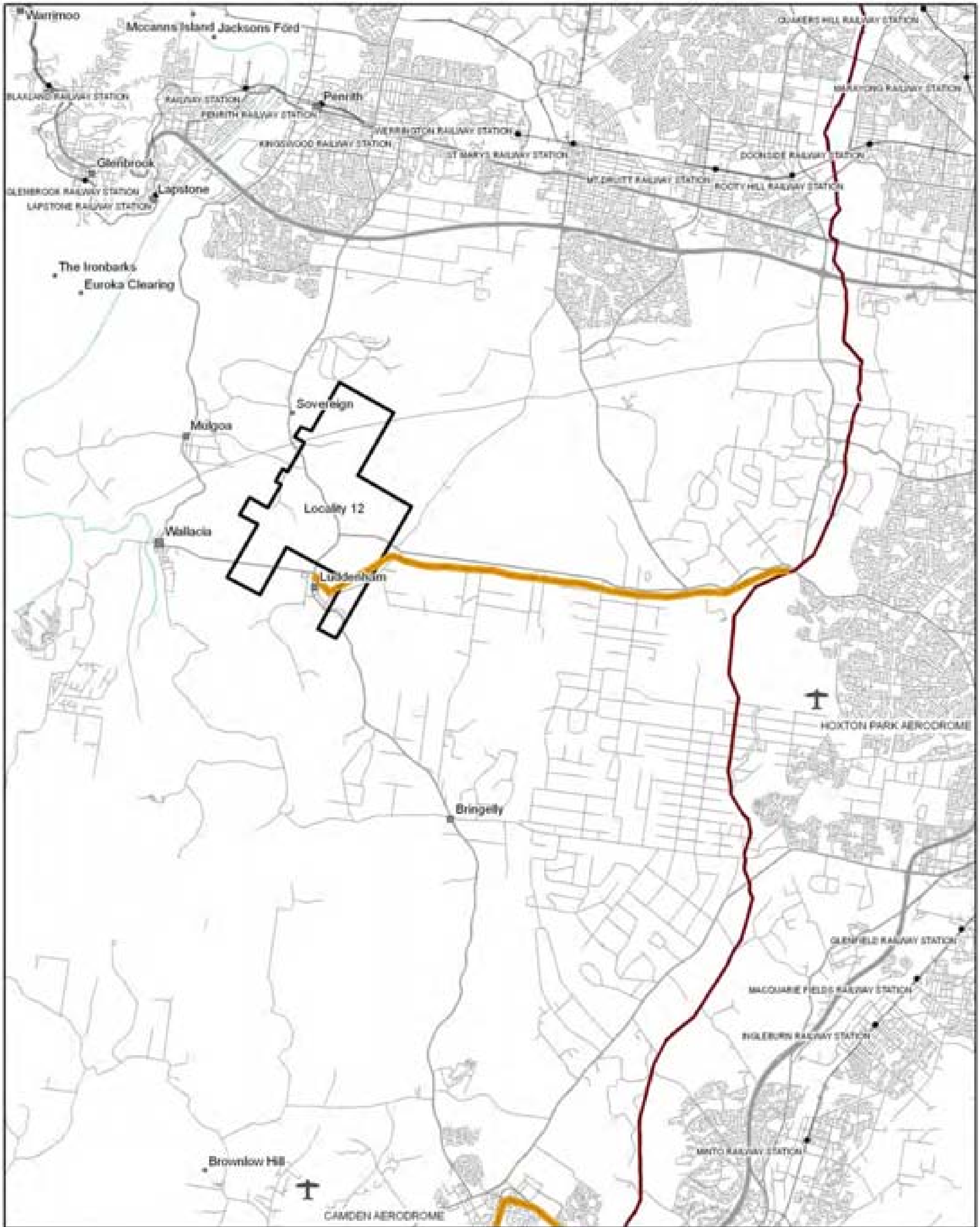
Figure 12-6b

Communications

Type 4 Airport

Kilometers

0 1 2 3 4 5



Legend

Proposed Gas Main (14.8km)

Exisitng Pipelines

Gas Pipeline

Figure 12-7

Site 12 Gas Supply

Kilometers

0 1 2 3 4 5

Figure 12-8

Site 12 Fuel Supply

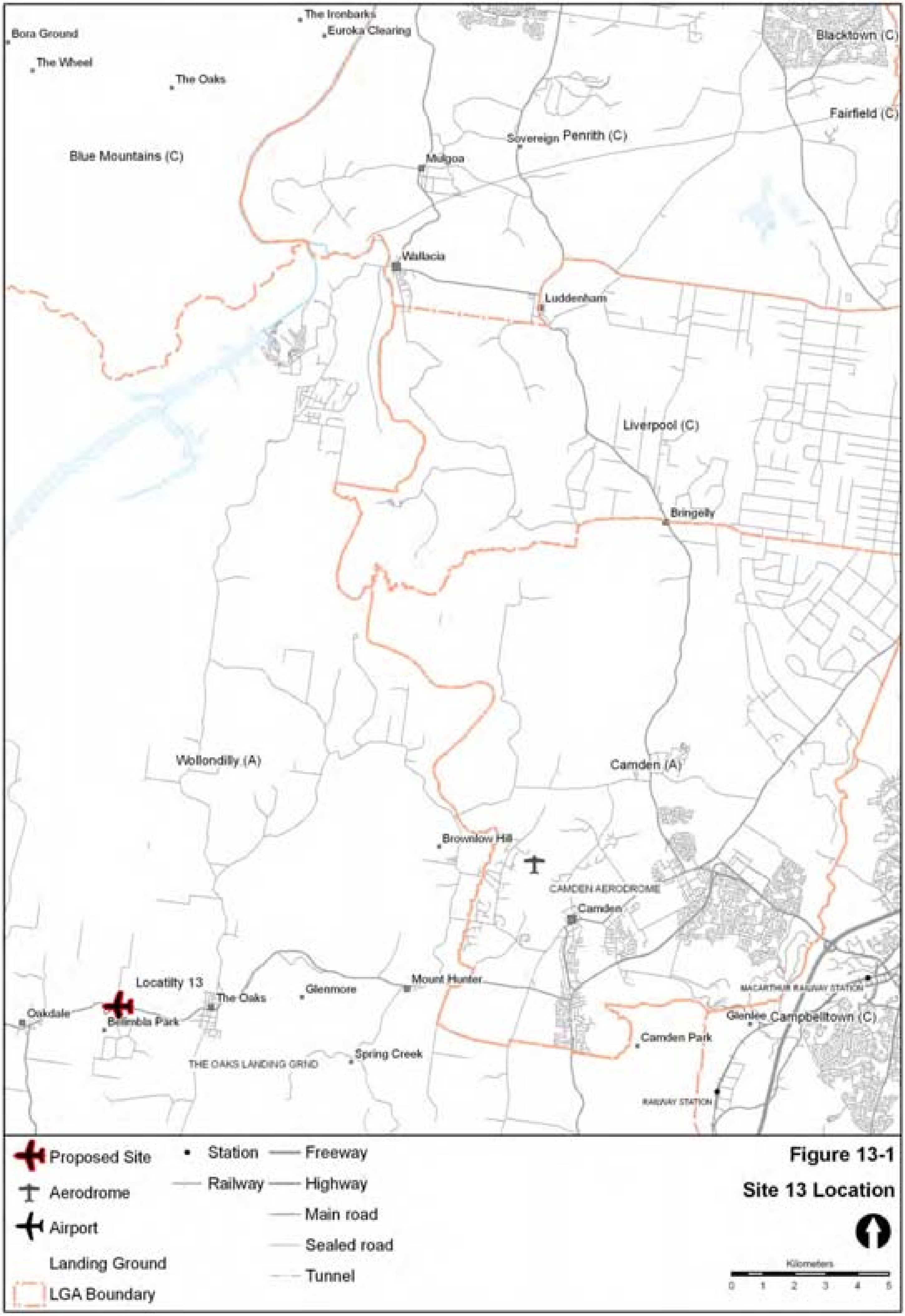


Figure 13-1

Site 13 Location

Legend

Type 1 Airport

Type 2 Airport

Type 4 Airport

Figure 13-2

Site 13 Aerial Plan

Kilometers

0 0.25 0.5 0.75 1

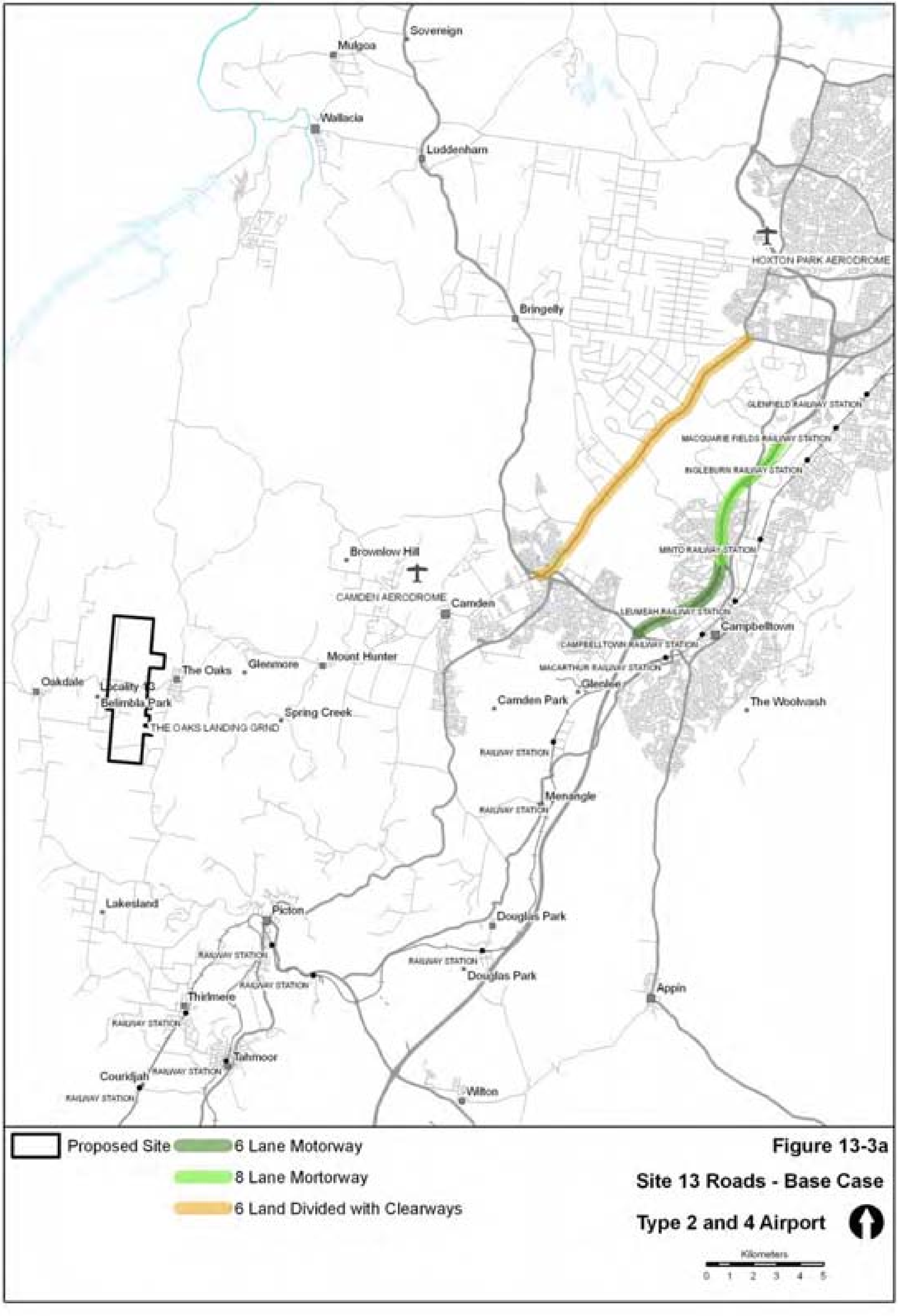


Figure 13-3a

Site 13 Roads - Base Case

Type 2 and 4 Airport

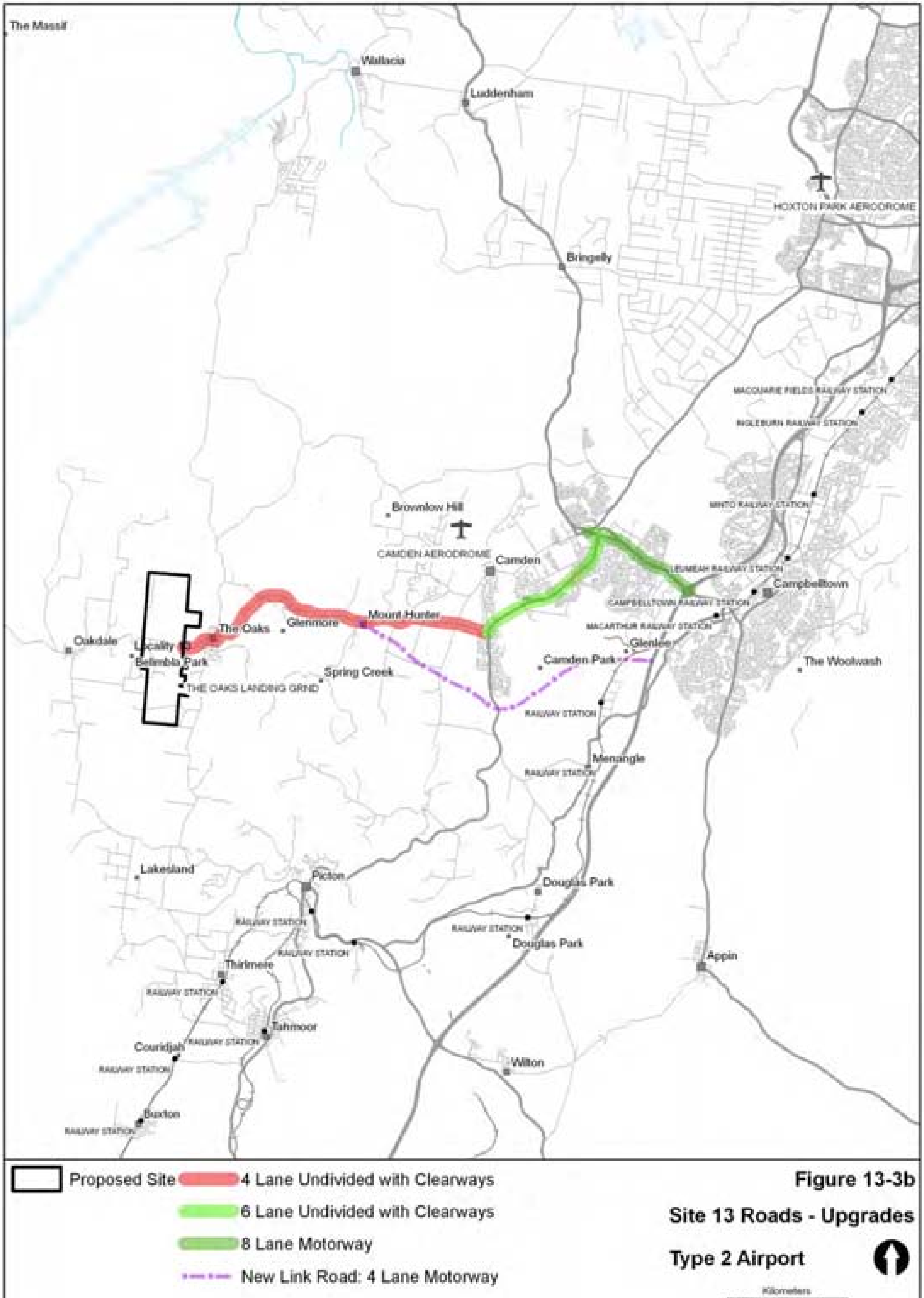
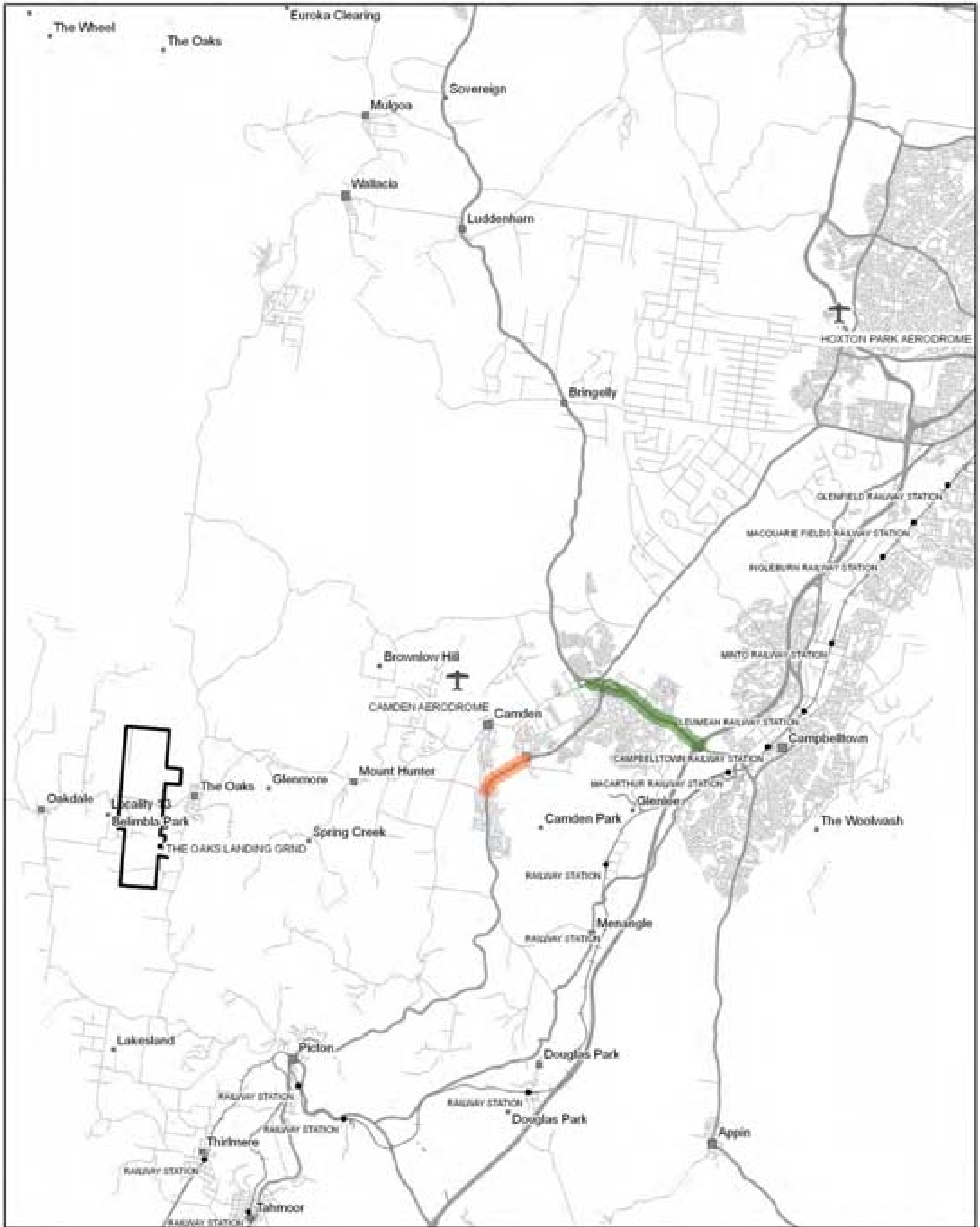


Figure 13-3b

Site 13 Roads - Upgrades

Type 2 Airport



Proposed Site

4 Lane Divided with Clearways

6 Lane Motorway

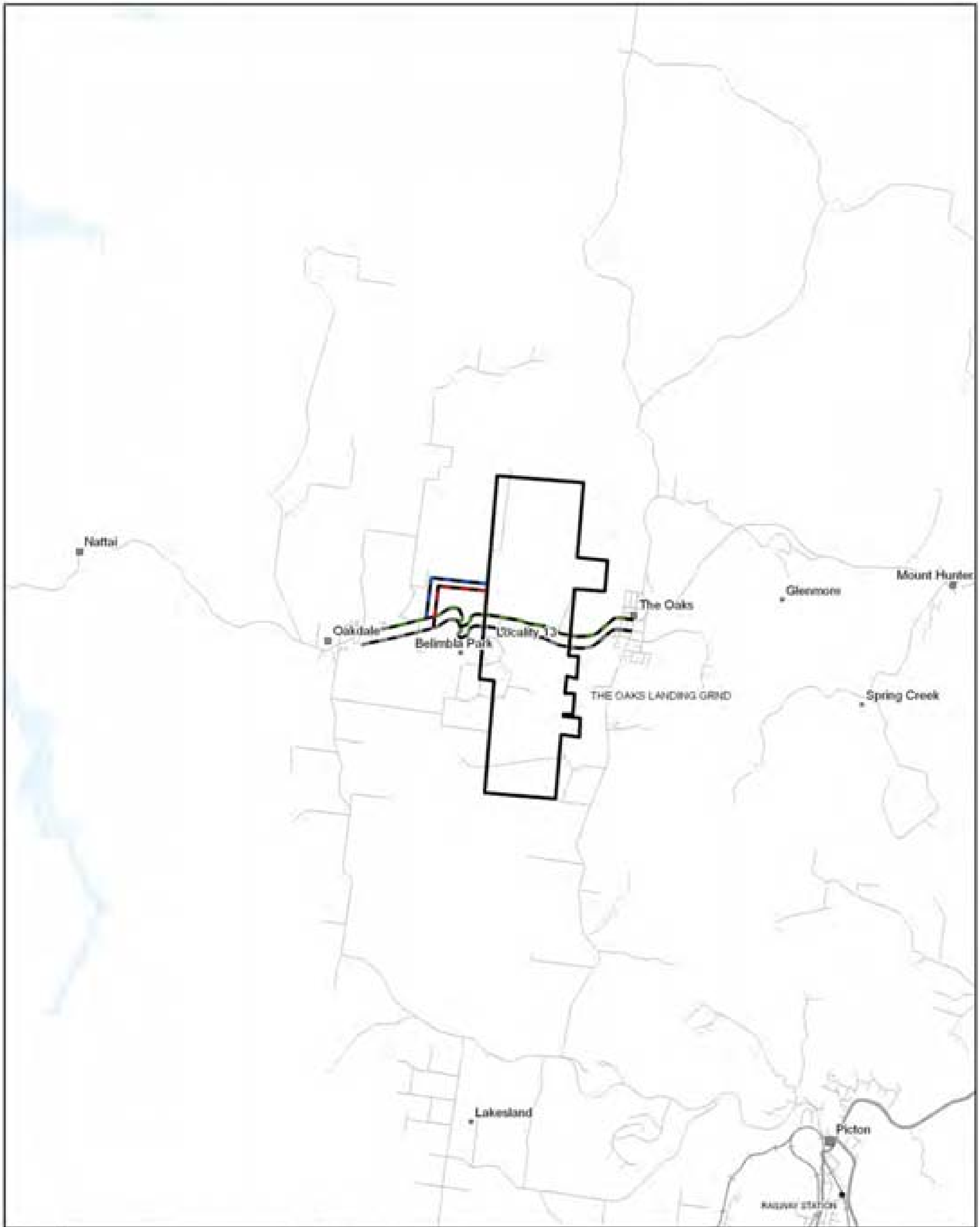
Figure 13-3c

Site 13 Roads - Upgrades

Type 4 Airport

Kilometers

0 1 2 3 4 5



Proposed Site

Proposed Infrastructure

Proposed Sewer Connection

Proposed Water Connection

Existing Infrastructure

WWTP

WFP

Existing Water Network

Existing Sewer Network

Figure 13-4

Site 13 Water & Wastewater

Type 2 and 4 Airport

Kilometers

0 1 2 3 4 5

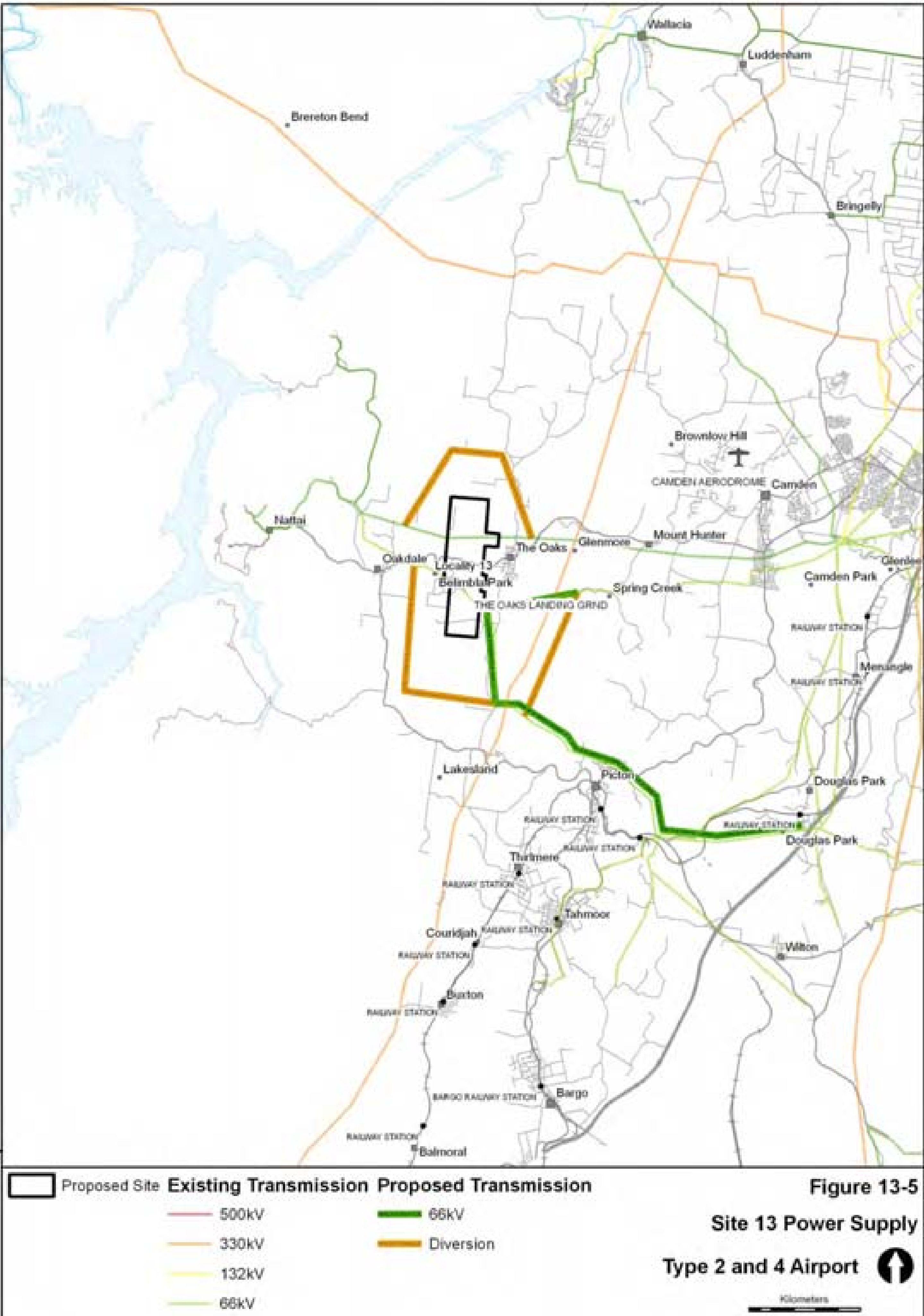
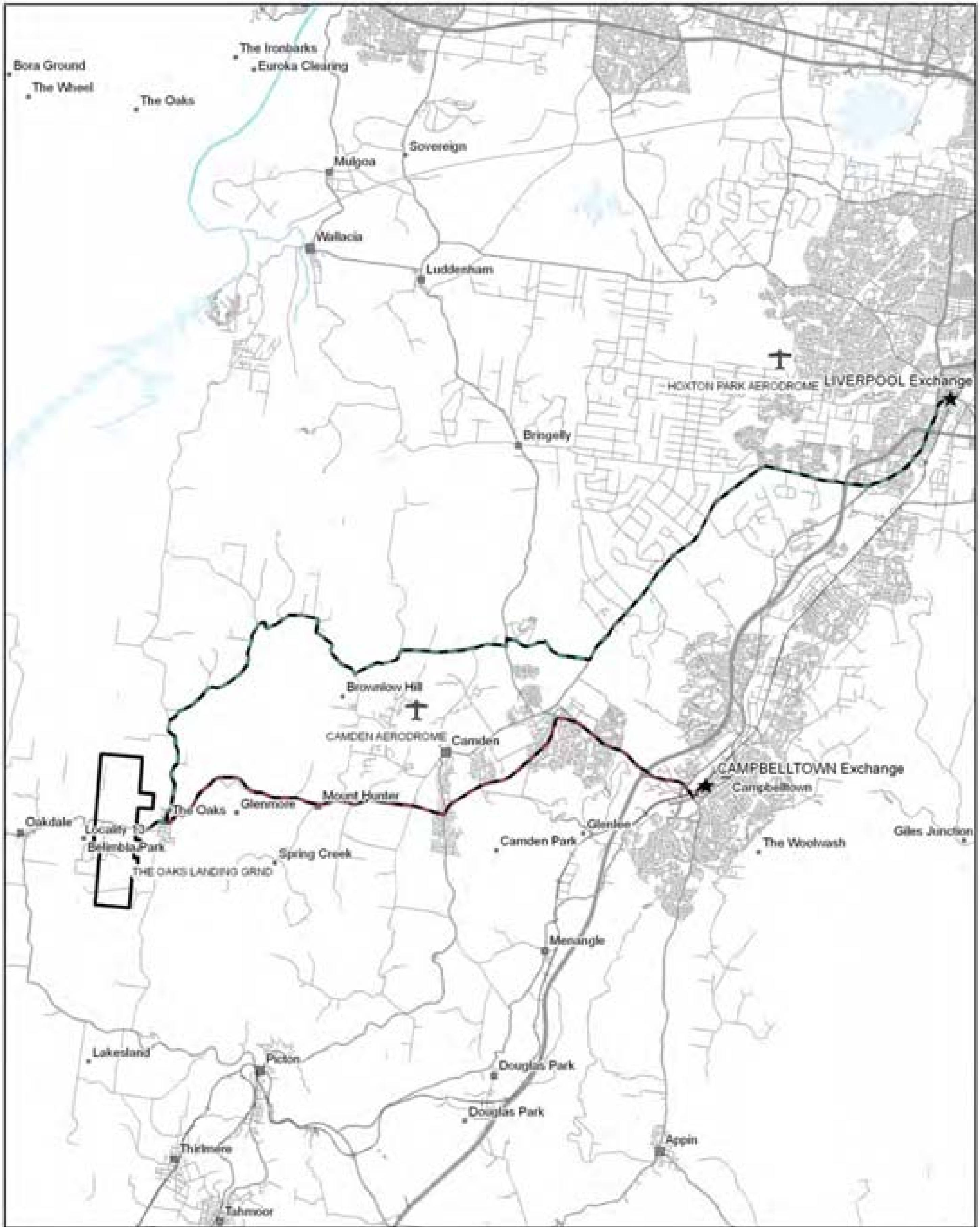


Figure 13-5

Site 13 Power Supply

Type 2 and 4 Airport



Legend

Proposed Site ★ Exchange

Campbelltown Exchange

Liverpool Exchange

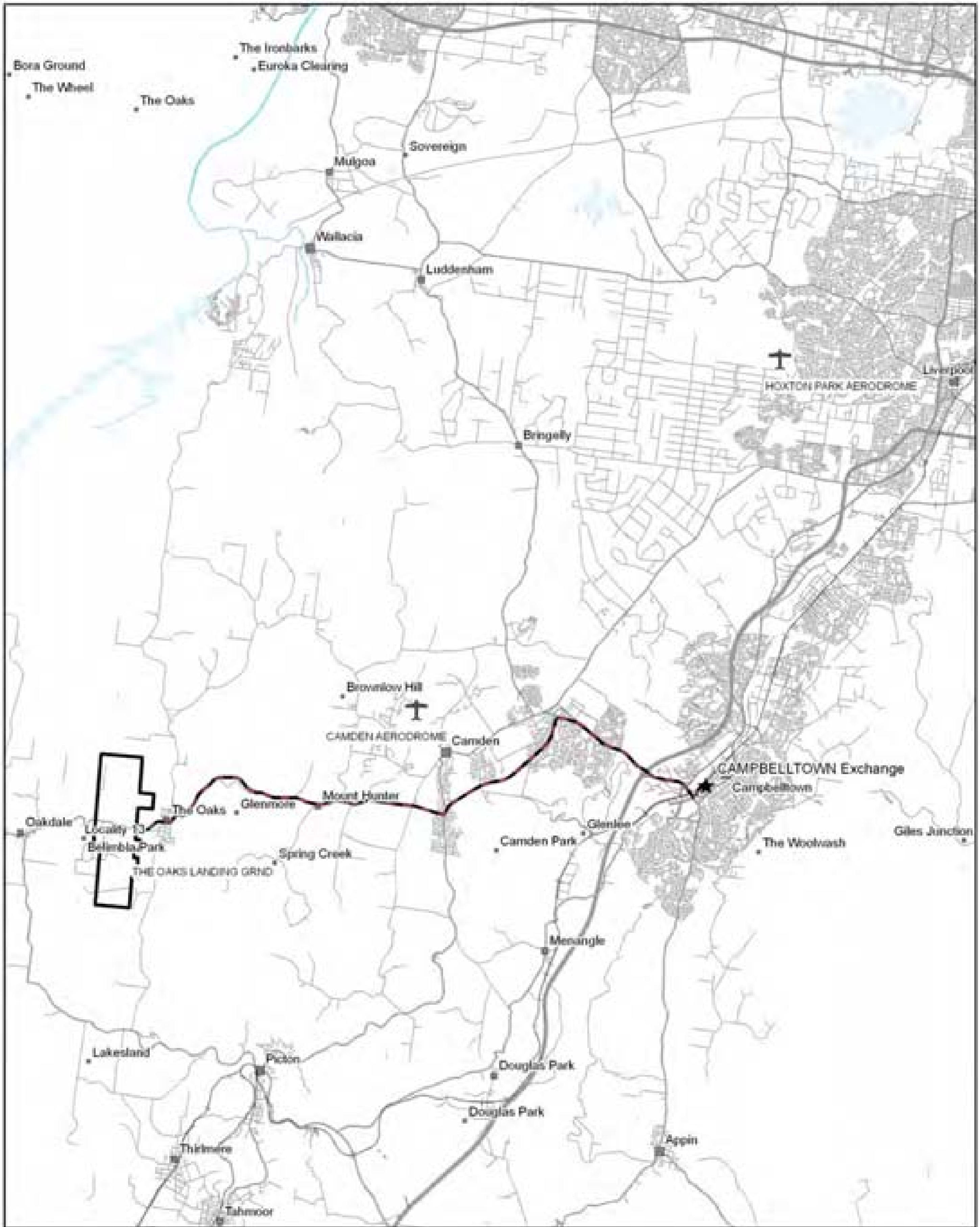
Figure 13-6a

Site 13 Communications

Type 2 Airport

Kilometers

0 2 4 6 8



Legend

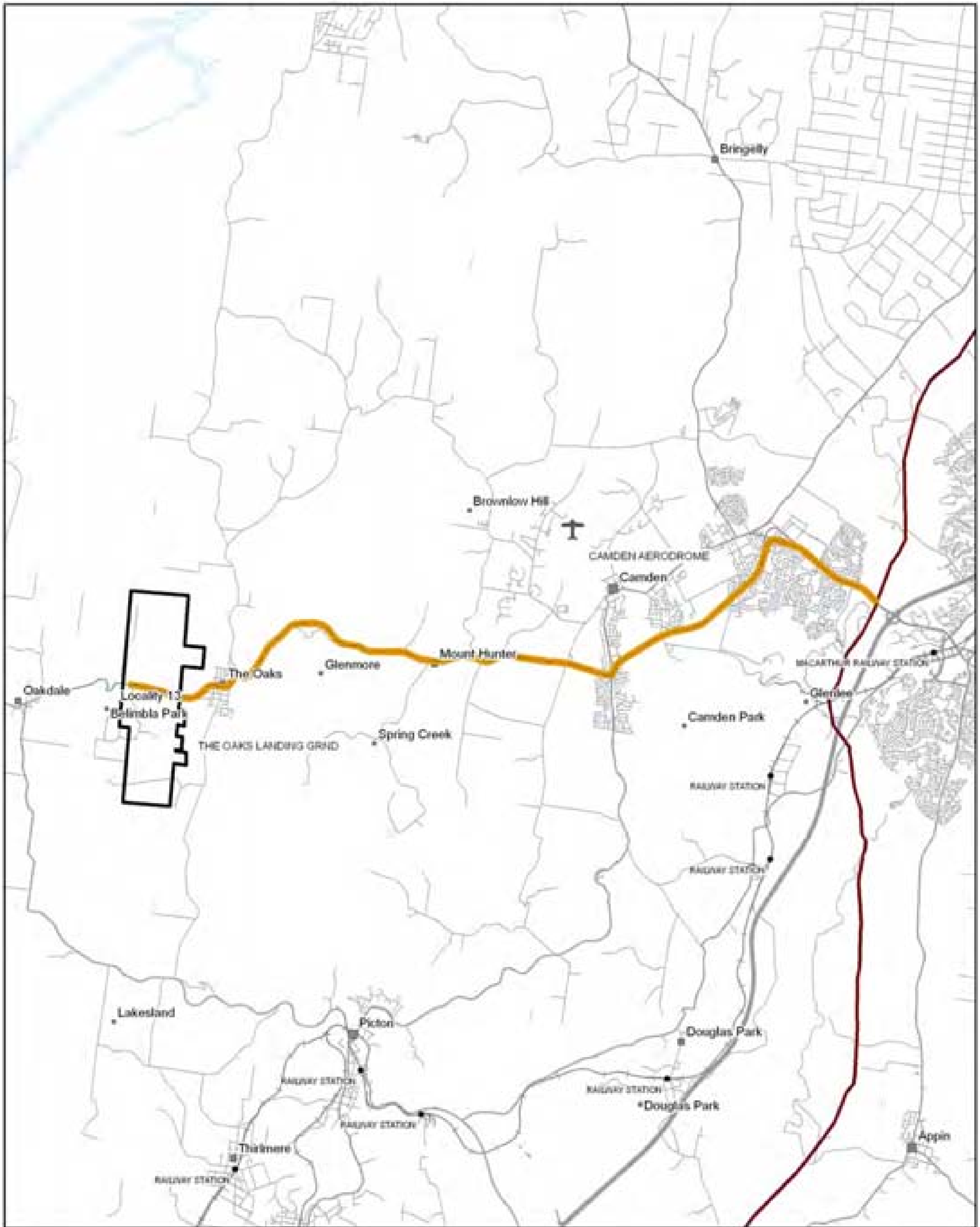
Proposed Site ★ Exchange

Campbelltown Exchange

Figure 13-6b

Site 13 Communications

Type 4 Airport



Legend

Proposed Site
Proposed Pipeline (25.8km)

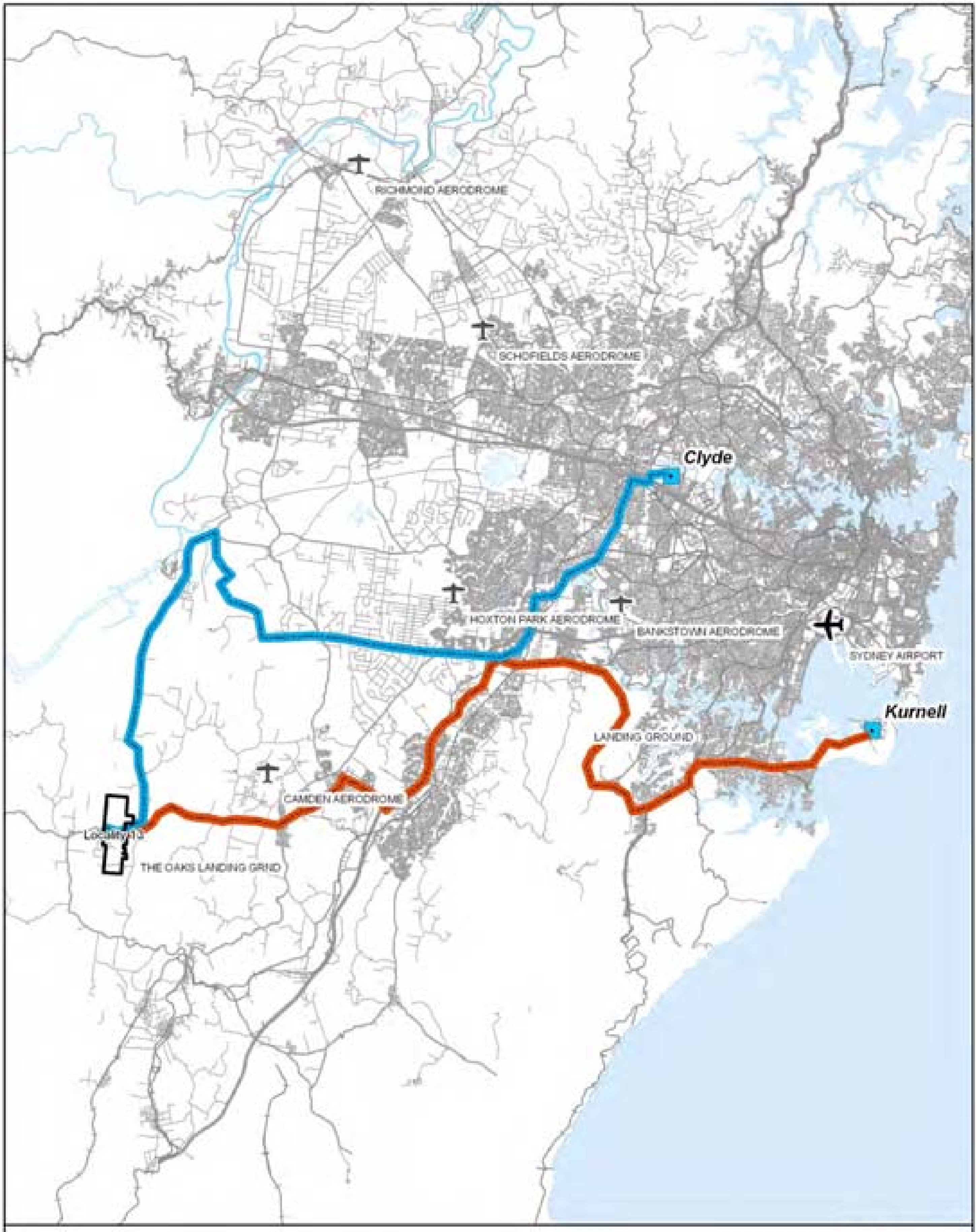
Exisiting Pipelines

Gas Pipeline

Kilometers
0 1 2 3 4 5

Figure 13-7

Site 13 Gas Supply



Legend

Proposed Site

Proposed Fuel Line

Secondary Independant Fuel Line - Redundancy

Kilometers

0 5 10 15 20 25

Figure 13-8

Site 13 Fuel Supply

Figure 14-1

Site 14 - Location

Legend

Type 1 Airport

Type 2 Airport

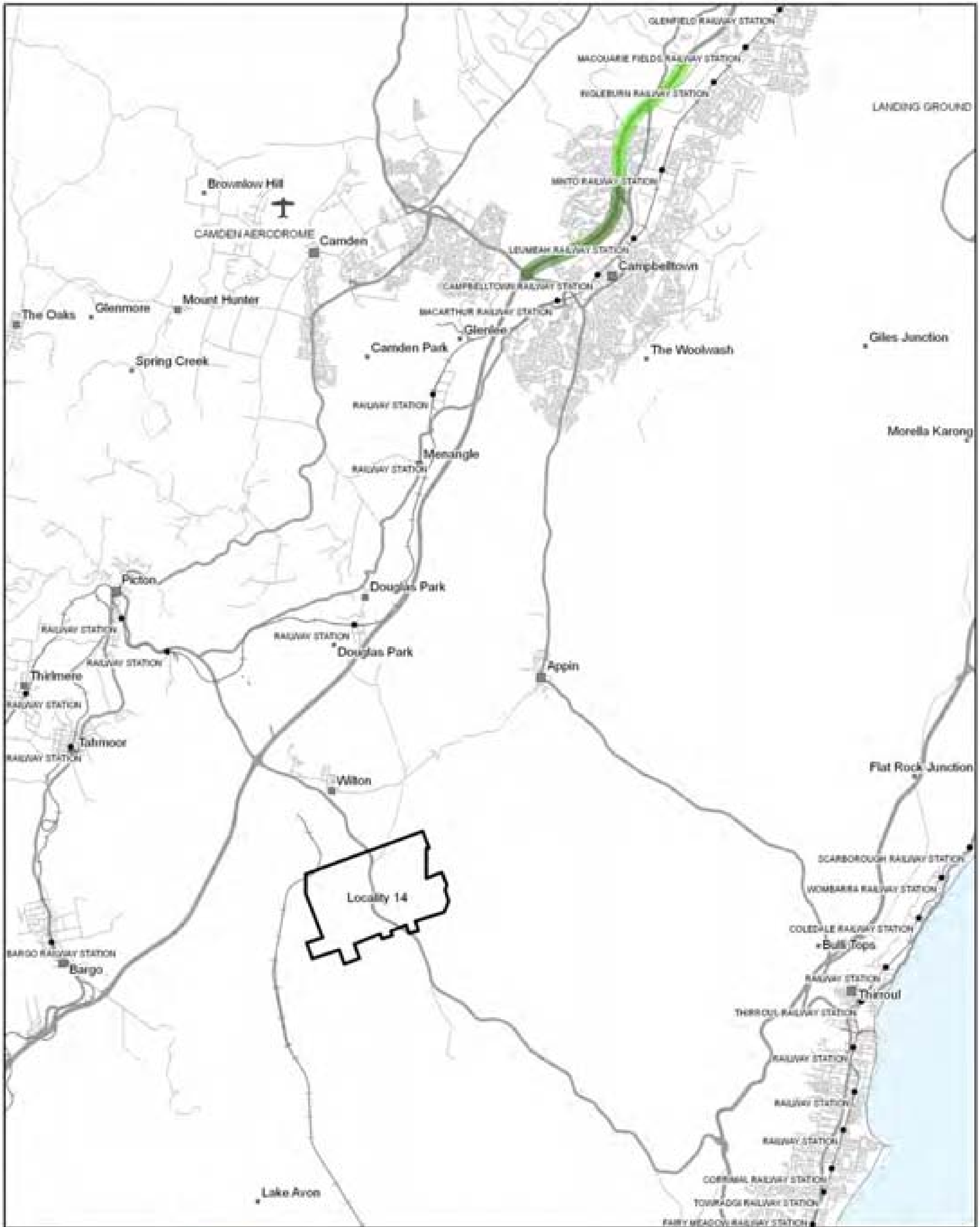
Type 4 Airport

Figure 14-2

Site 14 Aerial Plan

Kilometers

0 0.5 1 1.5 2



Proposed Site | 6 Lane Motorway | 8 Lane Motorway

Figure 14-3a

Site 14 Roads - Base Case

Type 2 and 4 Airport

Kilometers
0 2 4 6 8 10

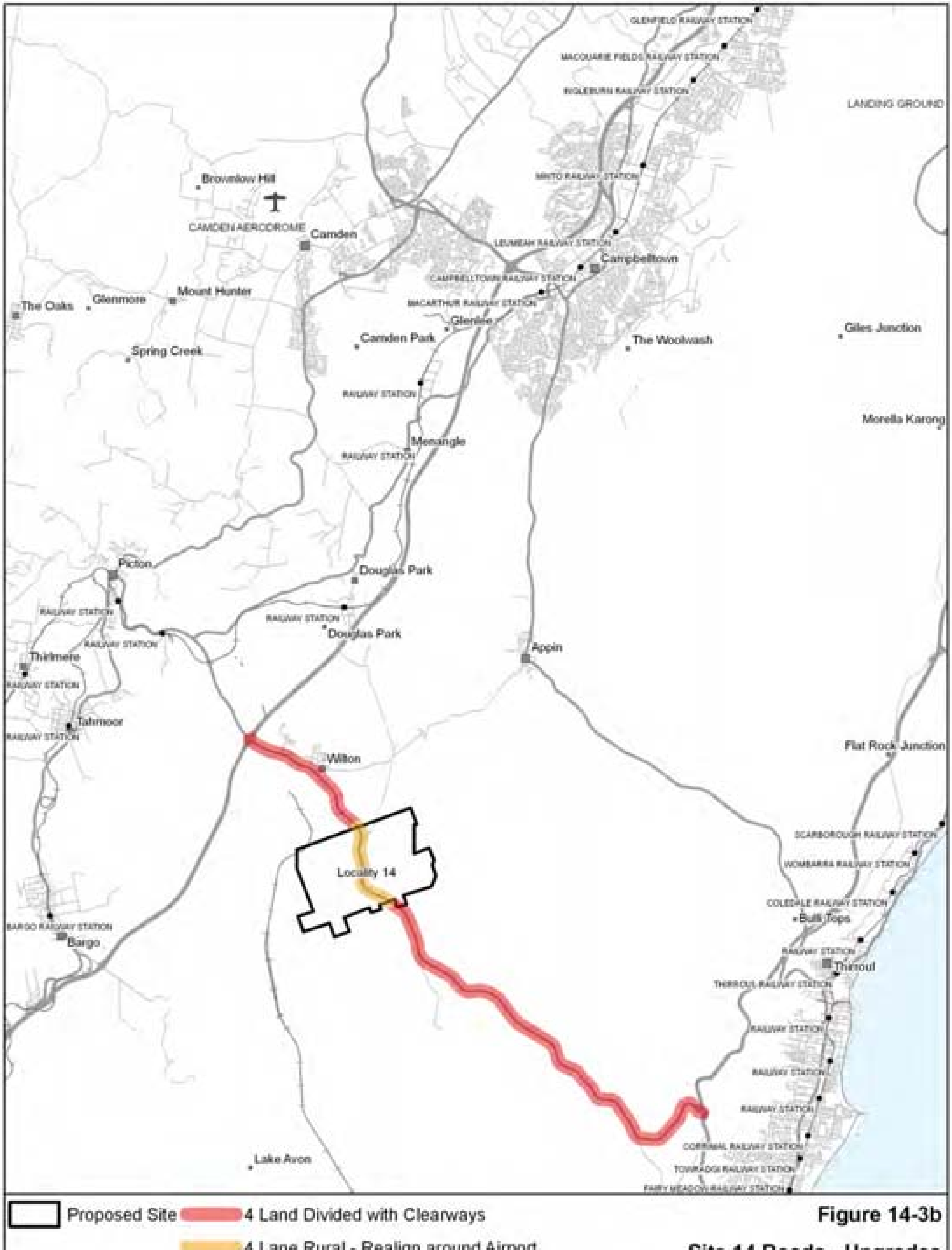
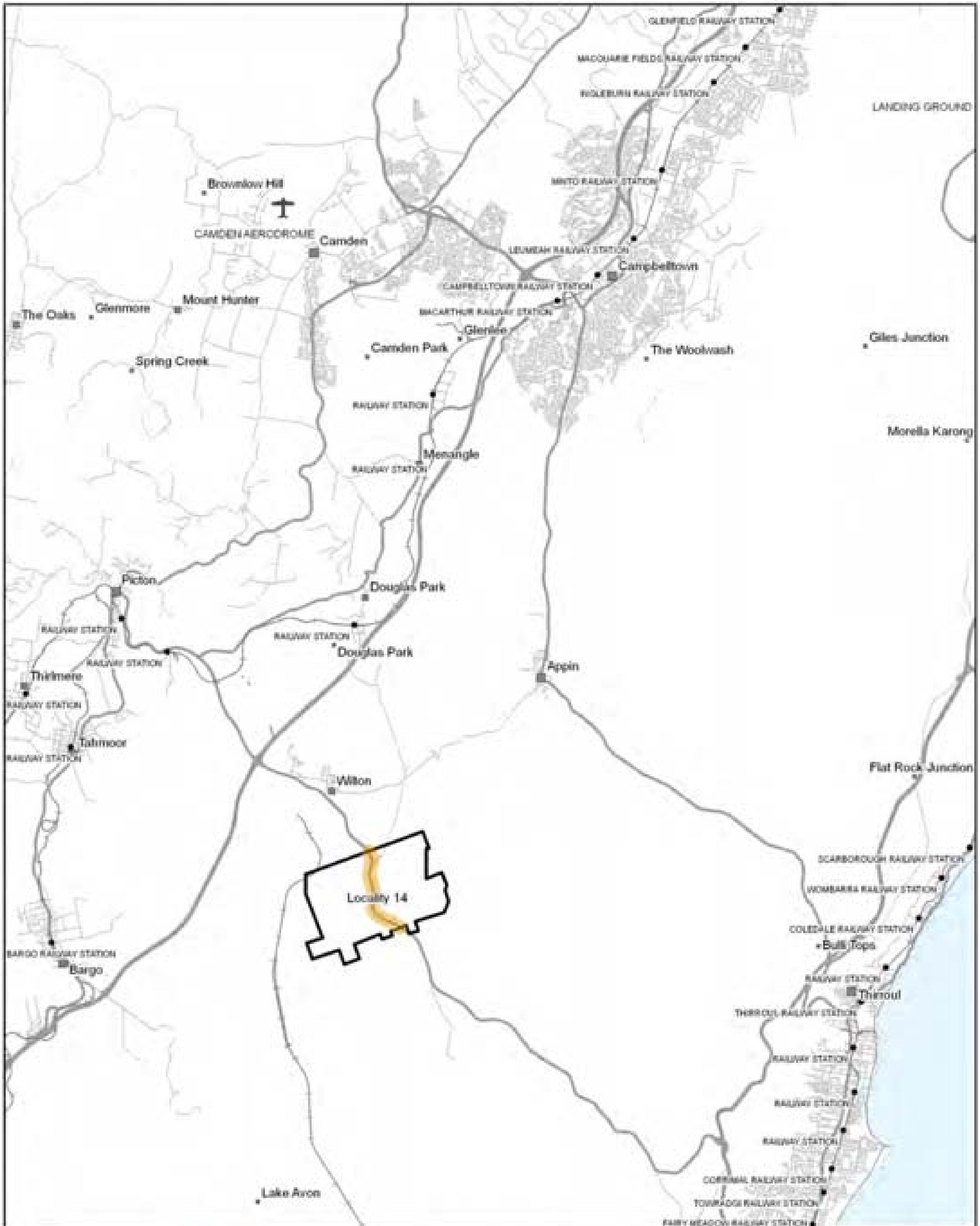


Figure 14-3b

Site 14 Roads - Upgrades

Type 2 Airport



Proposed Site 4 Lane Rural - Realign around Airport

Figure 14-3c

Site 14 Roads - Upgrades

Type 4 Airport

Kilometers

0 2 4 6 8 10

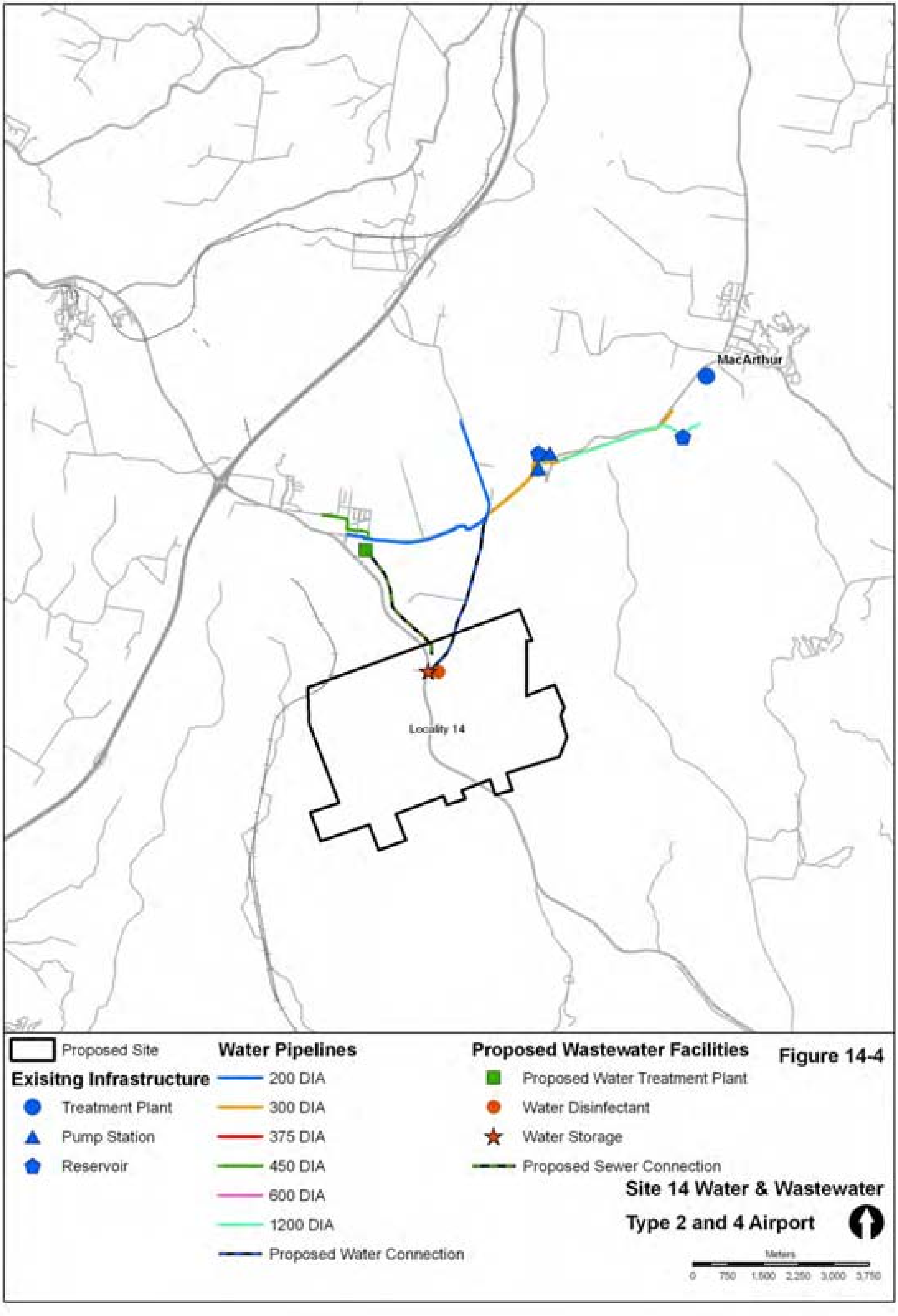


Figure 14-4

Site 14 Water & Wastewater

Type 2 and 4 Airport

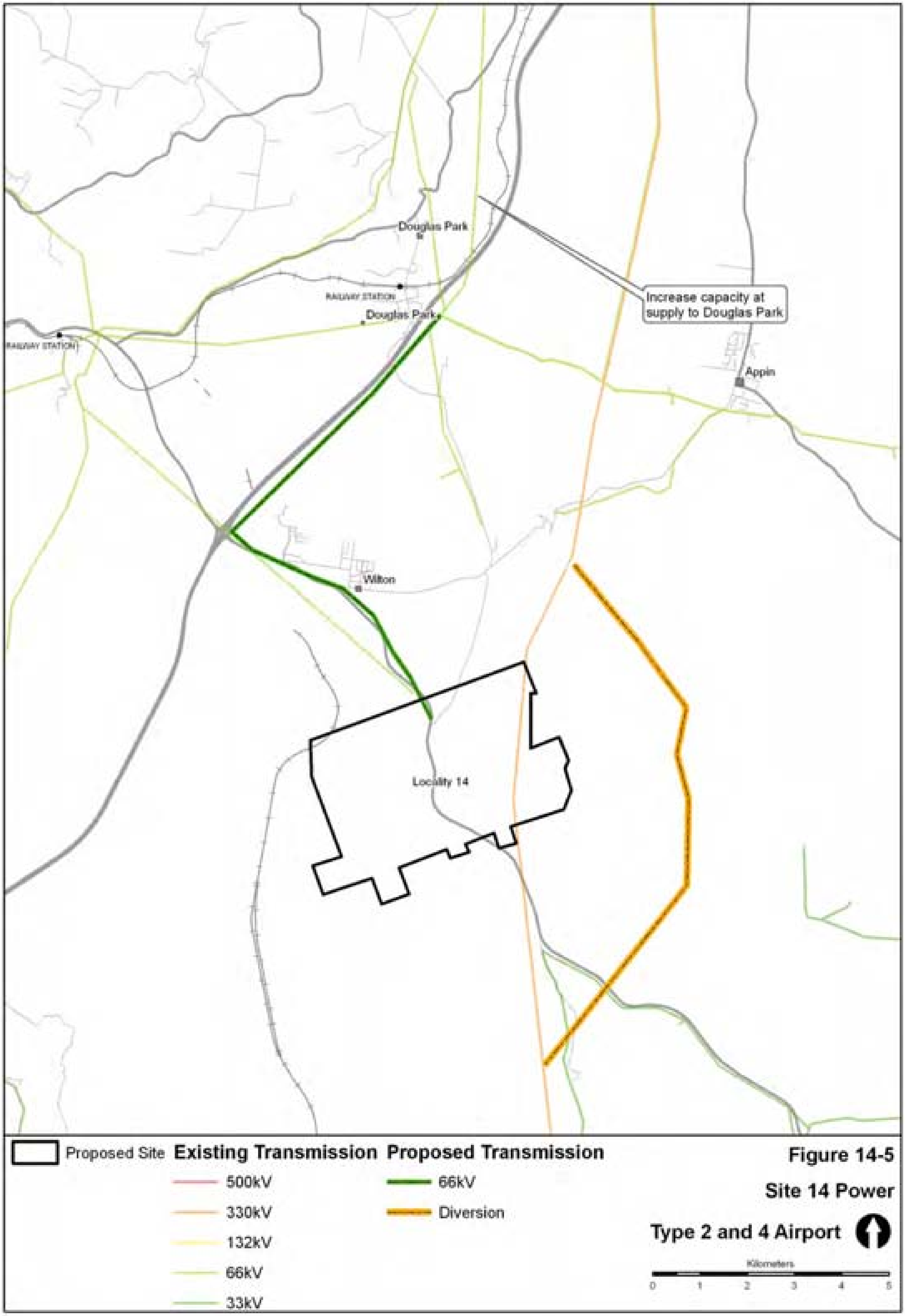


Figure 14-5
Site 14 Power
Type 2 and 4 Airport

Legend

Proposed Site
★ Exchange
Campbelltown Exchange
Wollongong Exchange

Figure 14-6a
Site 14 Communications

Type 2 Airport

Kilometers
0 2 4 6 8 10

Legend

Proposed Site

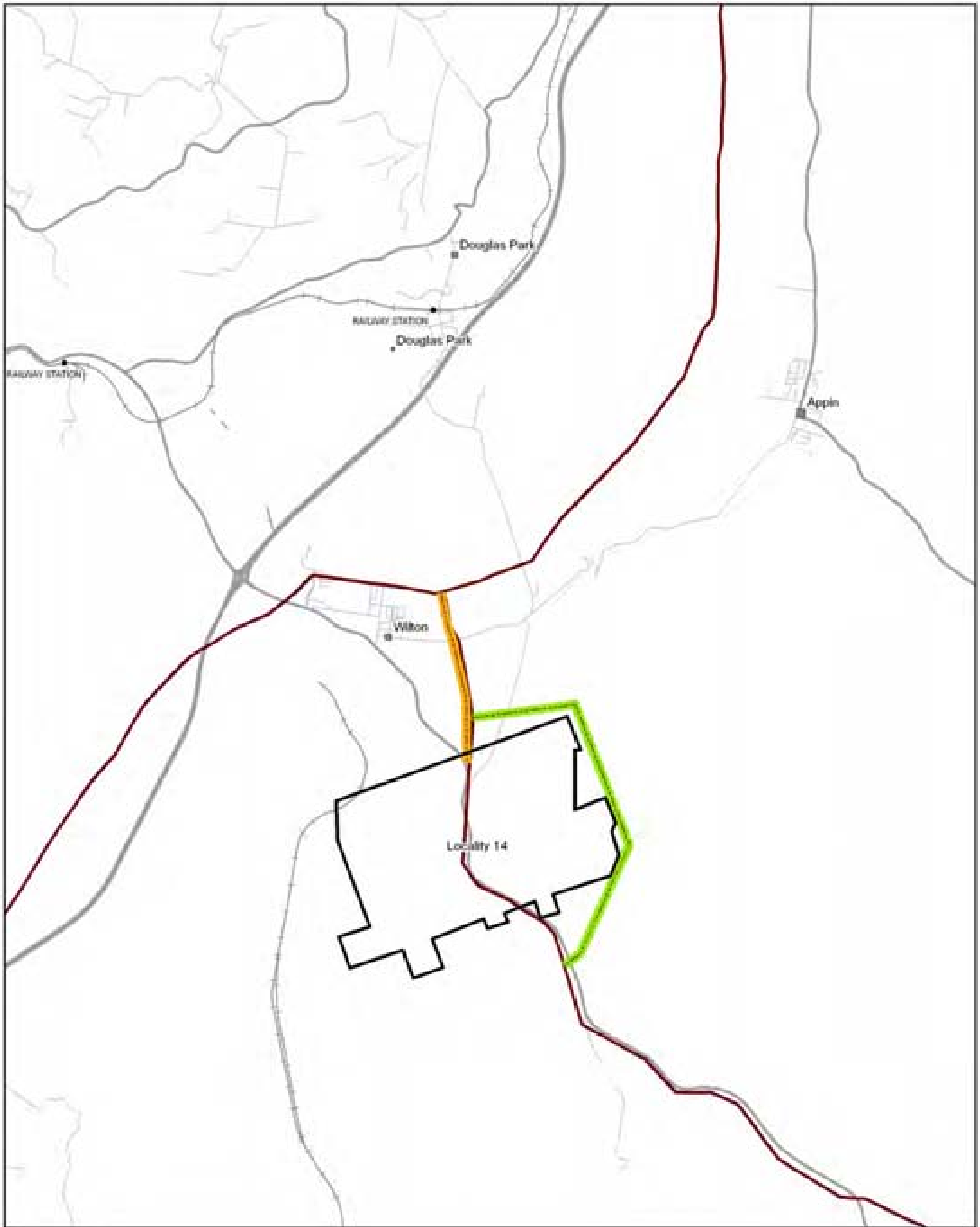
Exchange

Campbelltown Exchange

Figure 14-6b
Site 14 Communications

Type 4 Airport

Kilometers
0 2 4 6 8 10



Legend

Proposed Site
Proposed Pipeline
Proposed Diversion

Exisiting Pipelines

Gas Pipeline

Figure 14-7

Site 14 Gas Supply

Kilometers

0 1 2 3 4 5

Legend

Proposed Site

Proposed Fuel Line

Sea Terminals

Second Independant Fuel Line - Redundancy

Exisitng

Refineries

Proposed

Exisitng

Kilometers 0 5 10 15 20 25

Figure 14-8

Site 14 Fuel Supply

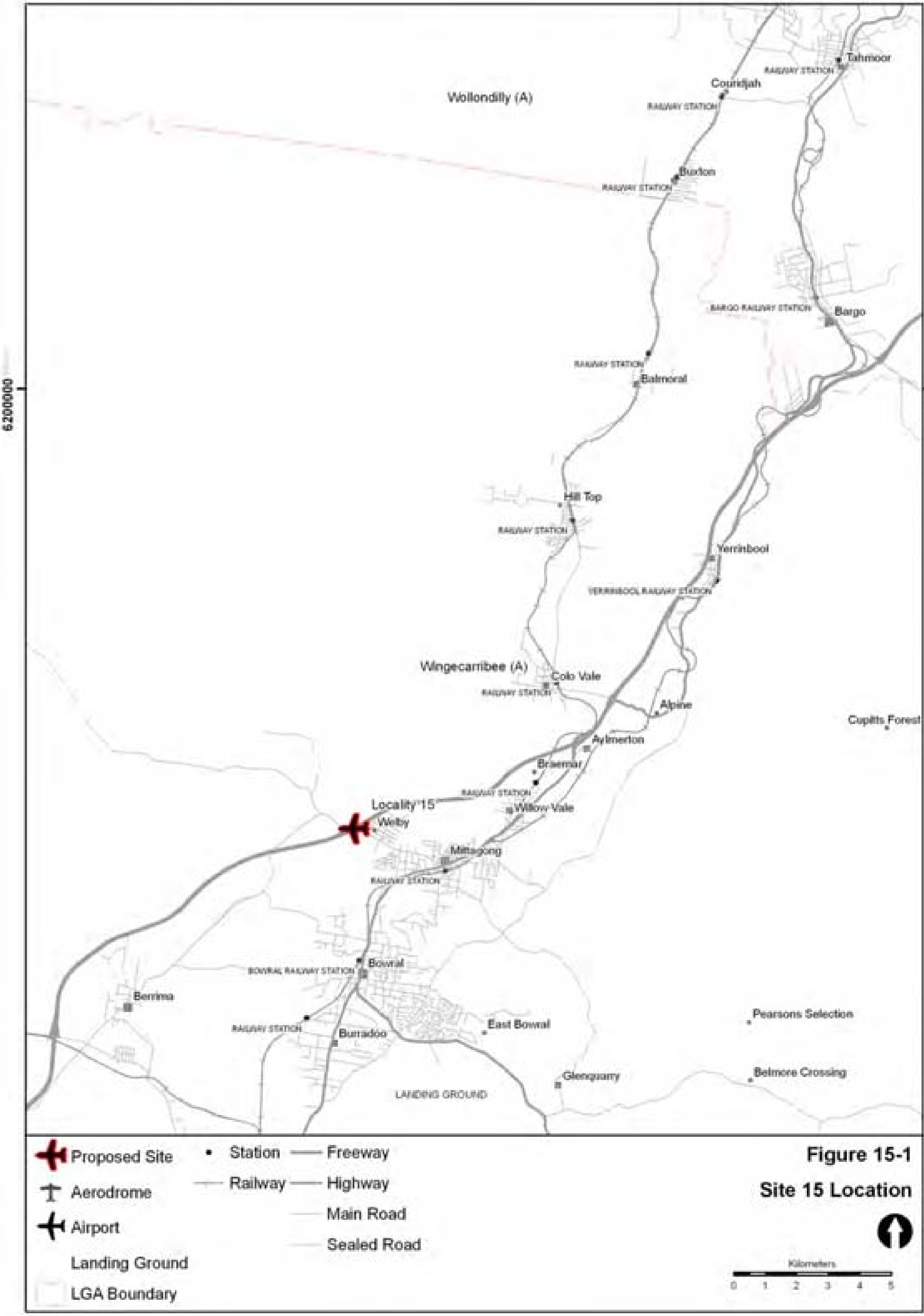


Figure 15-1

Site 15 Location

Legend

Type 1 Airport

Type 2 Airport

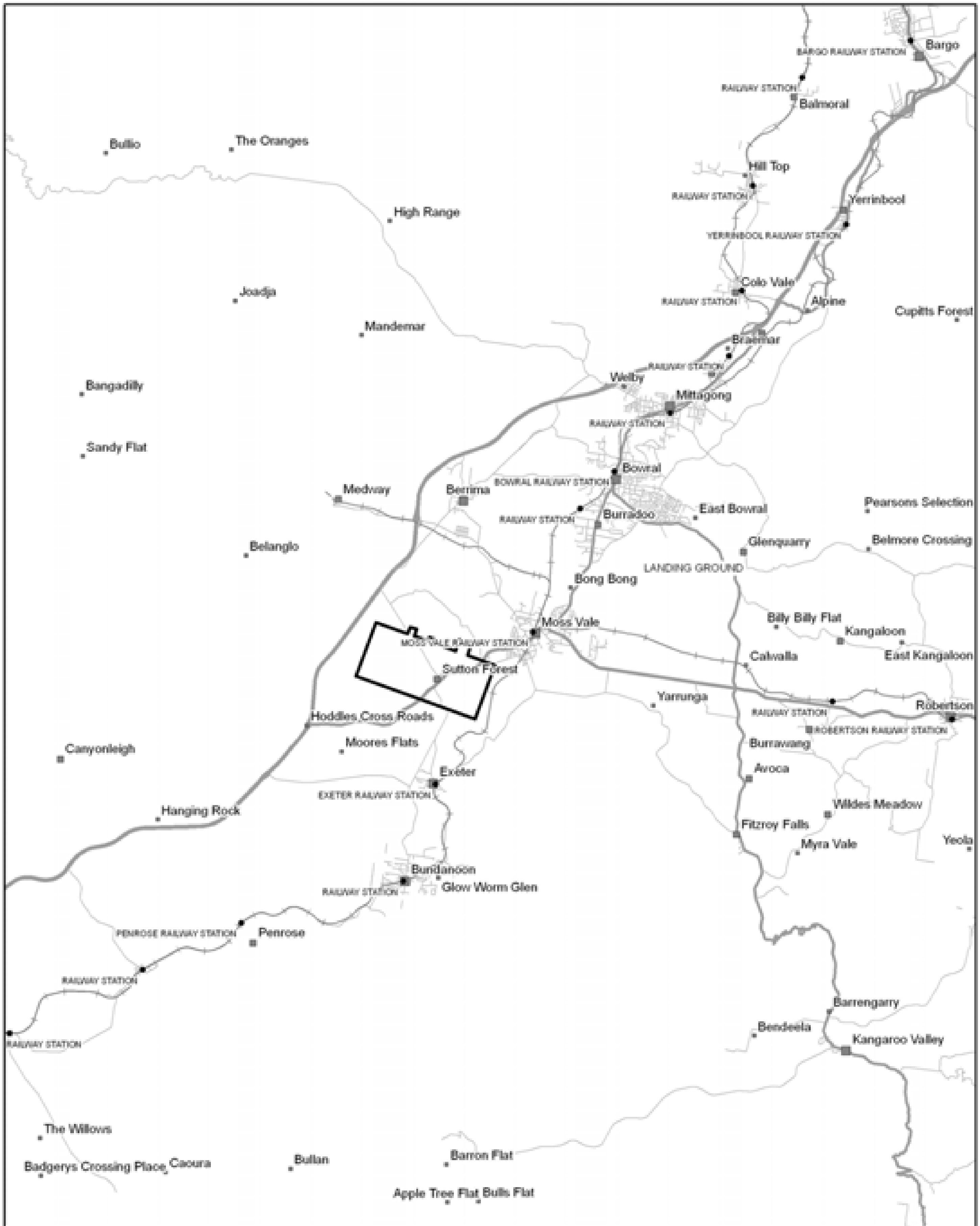
Type 4 Airport

Figure 15-2

Site 15 Aerial Plan

Kilometers

0 0.5 1 1.5 2



Proposed Site

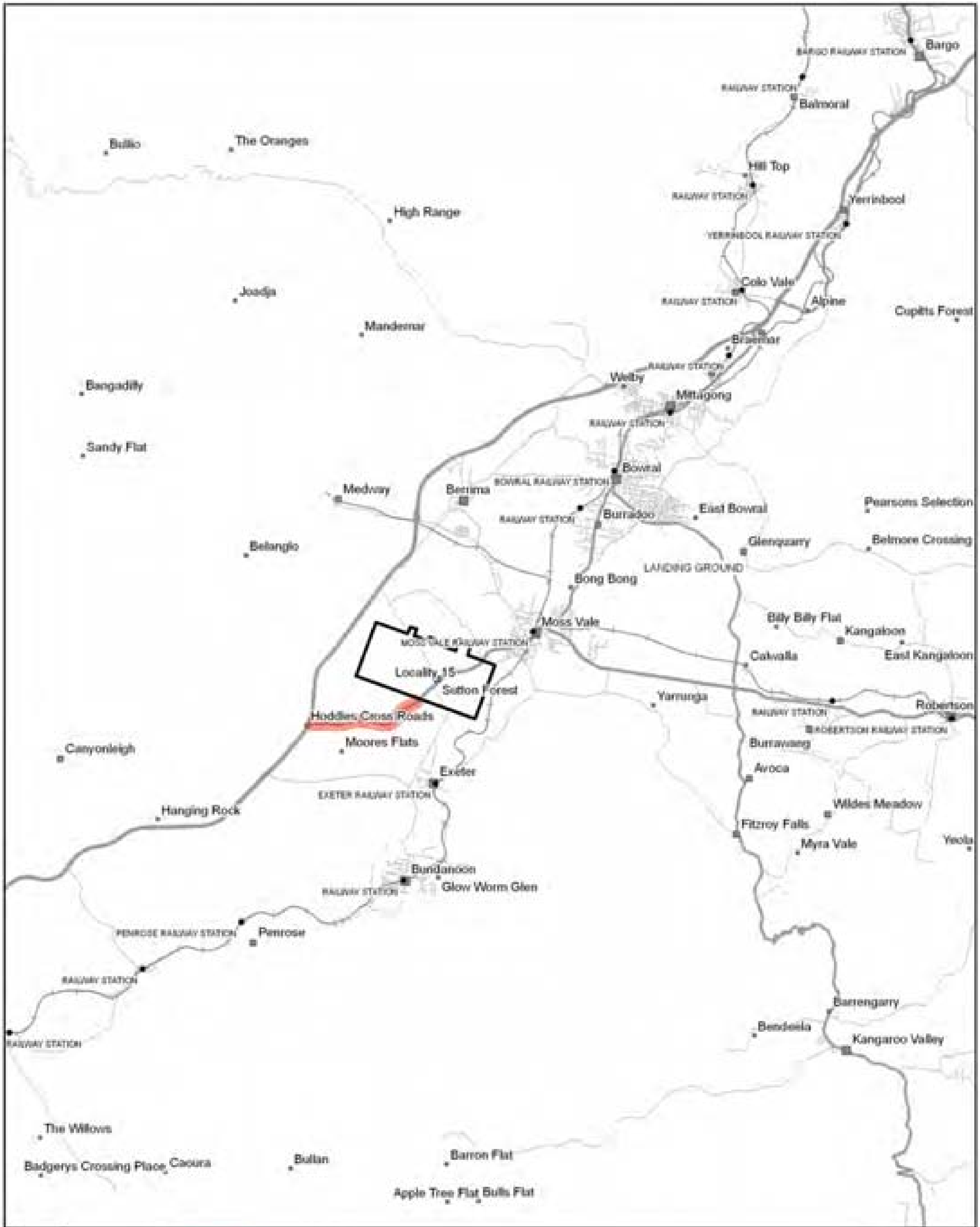
Figure 15-3

Site 15 Roads - Base Case

Type 2 and 4 Airport

Kilometers

0 2 4 6 8 10



Proposed Site 4 Lane Undivided

Figure 15-3b

Site 15 Roads - Upgrades

Type 2 Airport

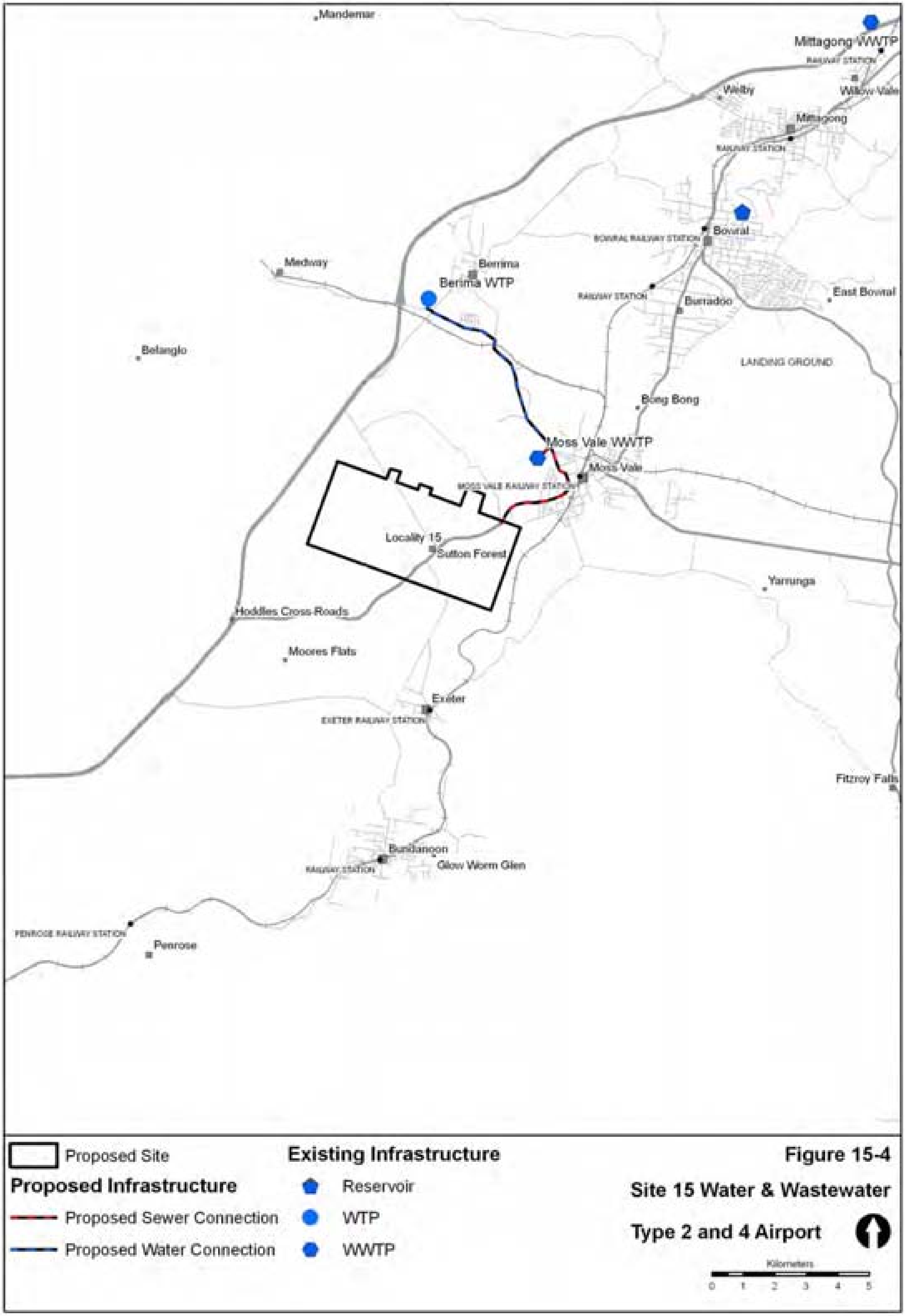


Figure 15-4

Site 15 Water & Wastewater

Type 2 and 4 Airport

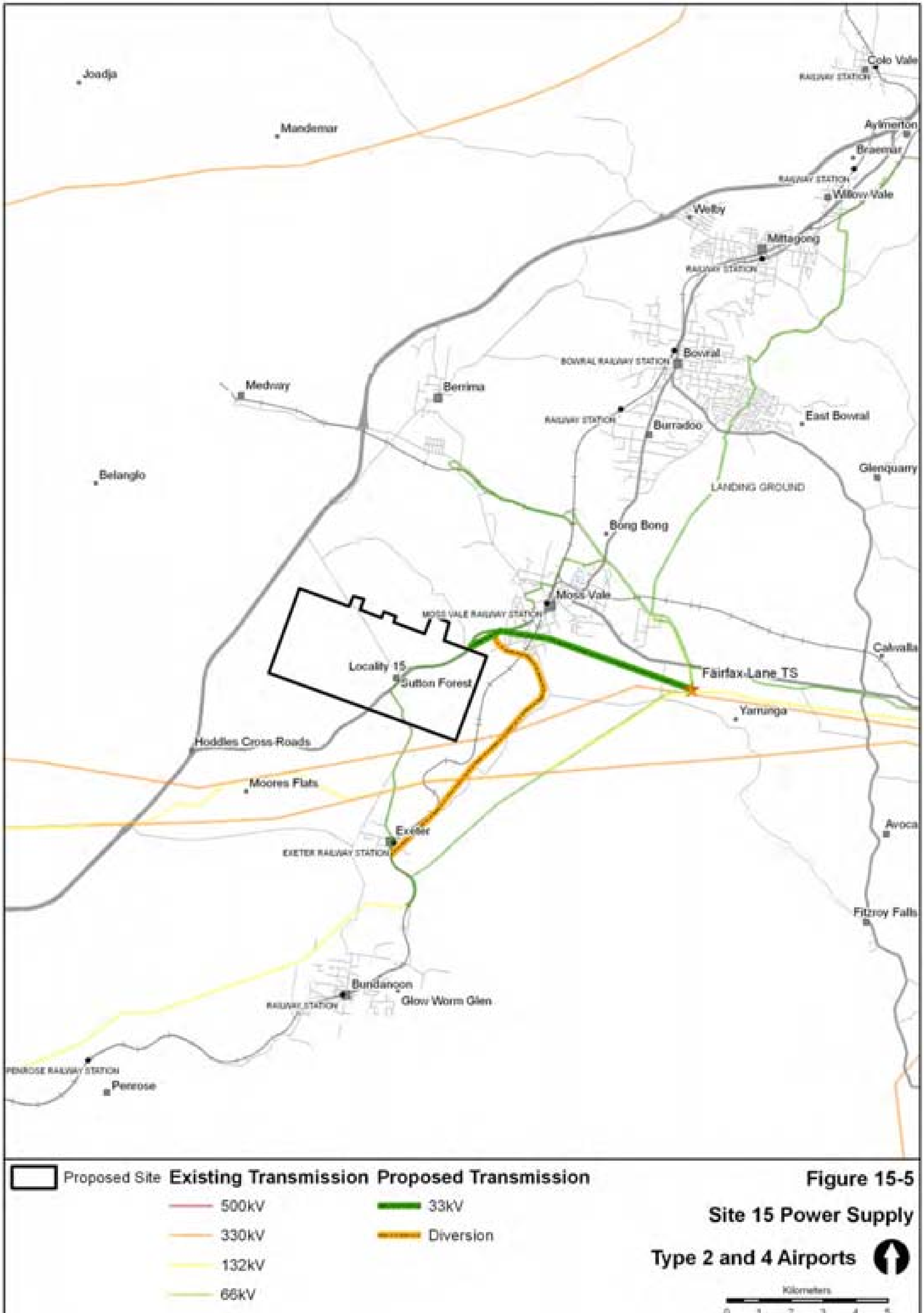
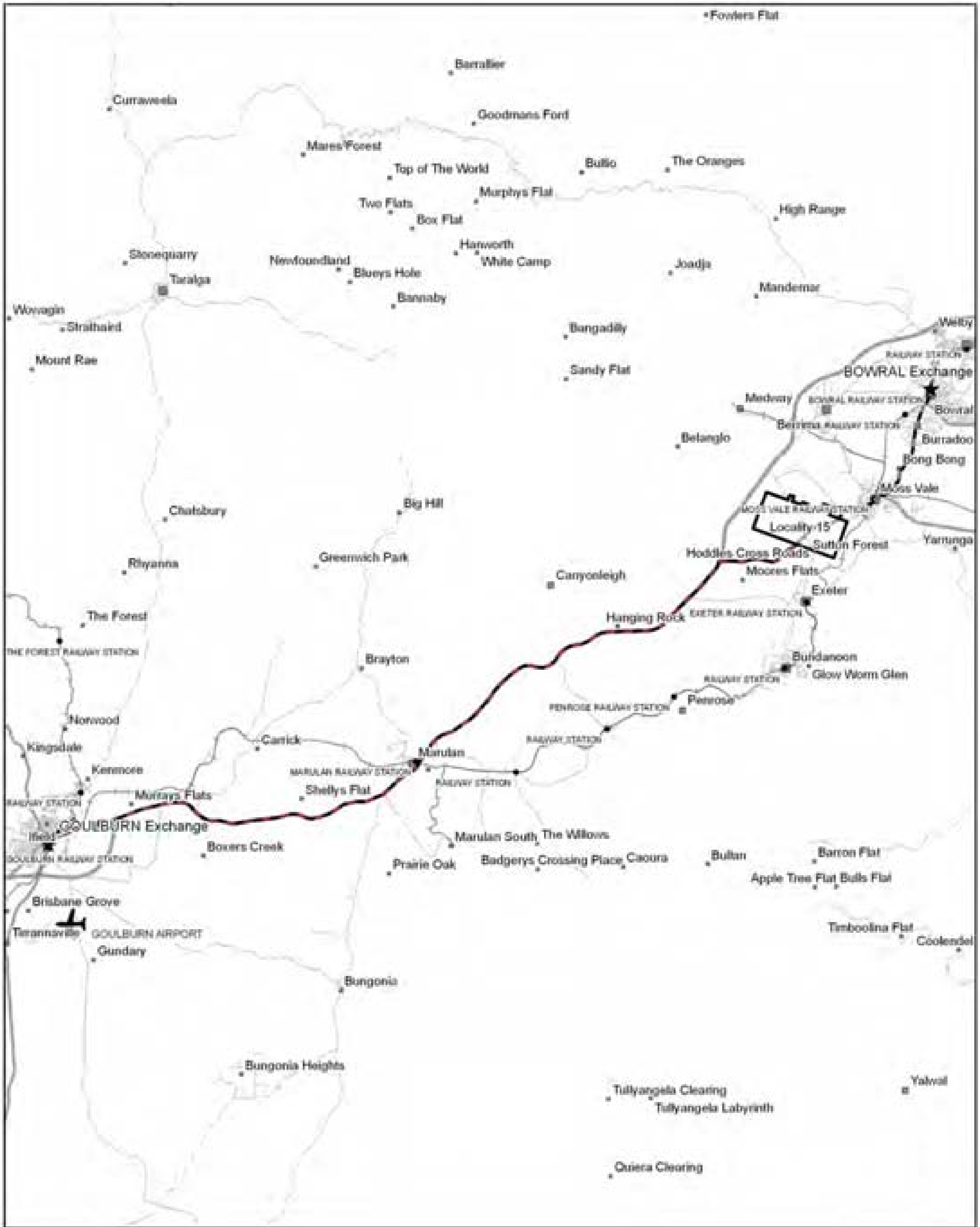


Figure 15-5

Site 15 Power Supply

Type 2 and 4 Airports



Legend

Proposed Site ★ Exchange

Bowral Exchange

Goulburn Exchange

Figure 15-6a

Site 15 Communications

Type 2 Airport

Kilometers

0 2 4 6 8

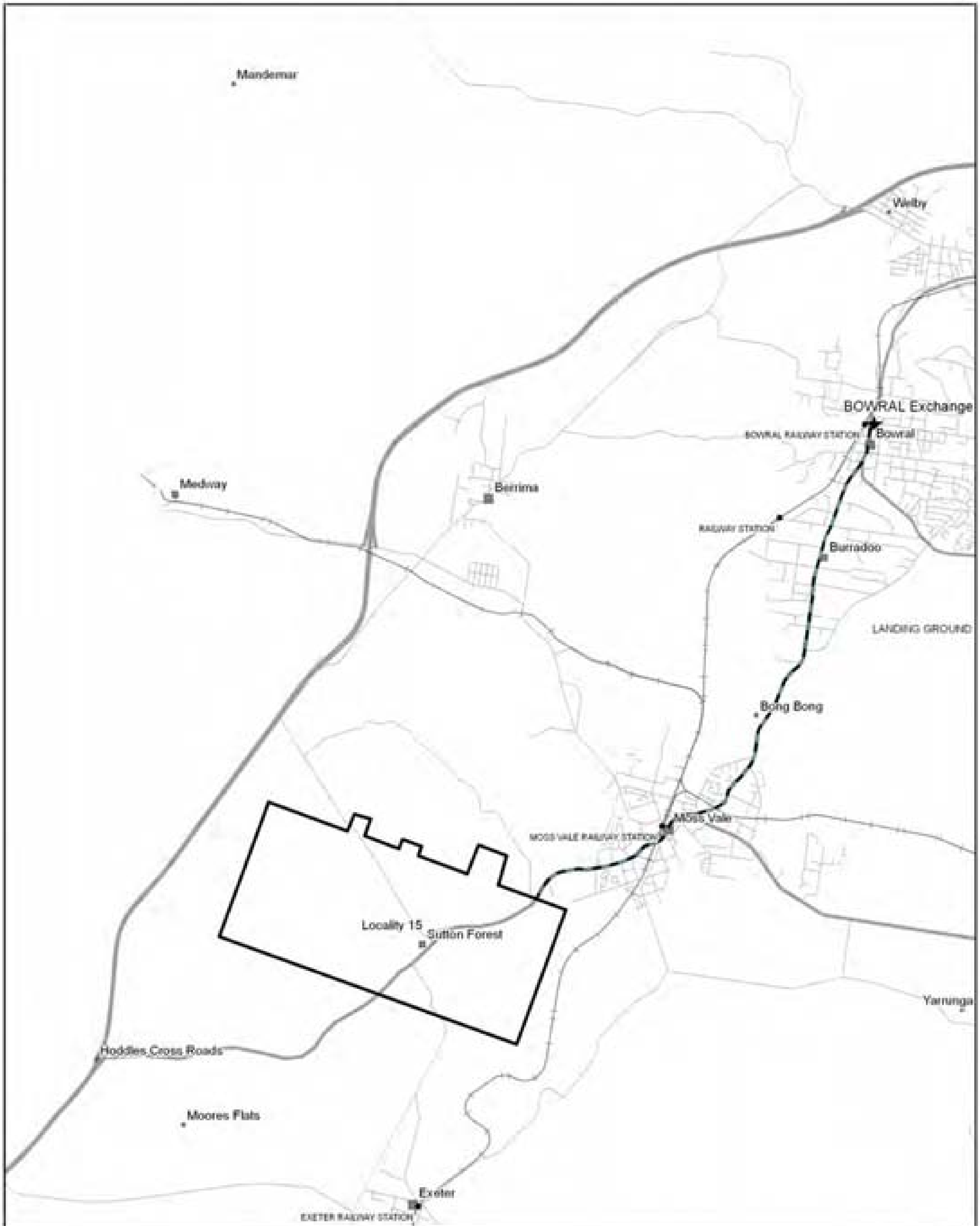


Figure 15-6b

Site 15 Communications

Type 4 Airport

Legend

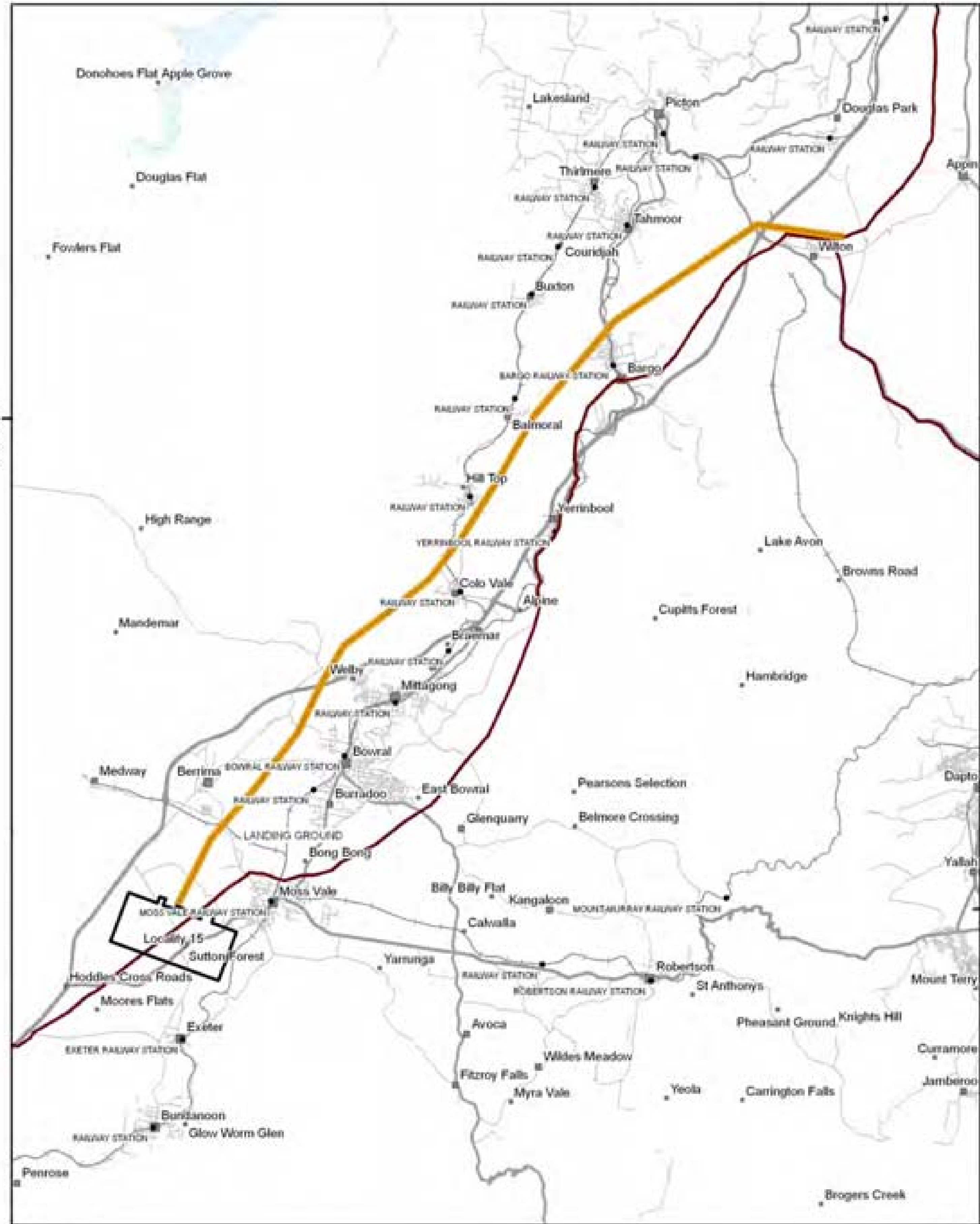
Proposed Site

Exchange

Bowral Exchange

Kilometers

0 1 2 3 4



Legend

Proposed Site

Proposed Pipelines

Exisiting Pipelines

Gas Pipeline

Figure 15-7

Site 15 Gas Supply

Type 2 and 4 Airport

Kilometers

0 2 4 6 8 10

Proposed Site

Sea Terminals

Exisiting

Proposed

Refineries

Exisitng

Proposed Fuel Line

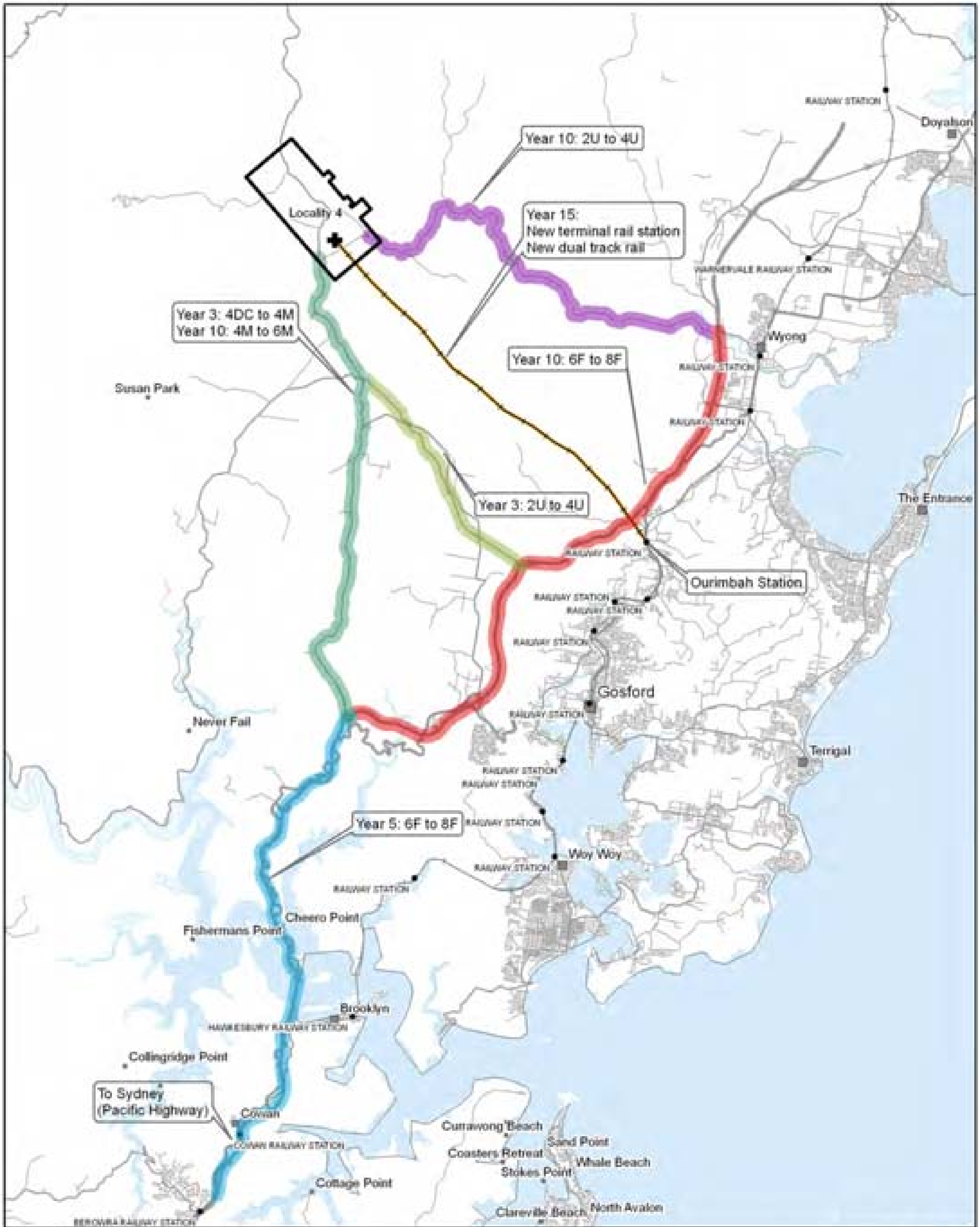
Second Independent Fuel Line - Redundancy

Kilometers
0 5 10 15 20

Figure 15-8a

Site 15 Fuel Supply

Type 2 Airport



Proposed Site

Figure 4-2/1-3

Site 4 Roads - Surface Transport - Upgrades

Type 2 to 1 Airport

Kilometers
0 2 4 6 8 10

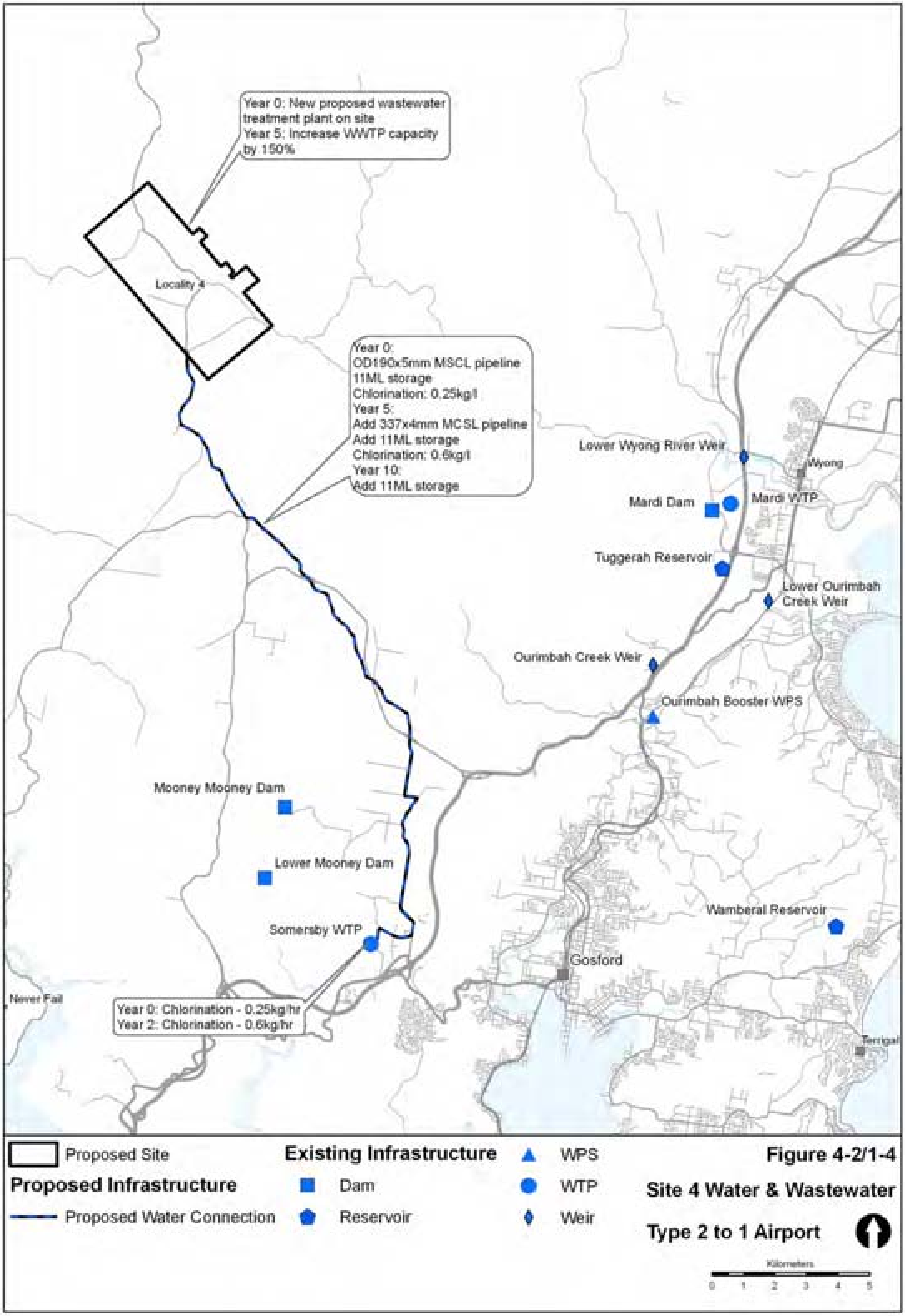


Figure 4-2/1-4

Site 4 Water & Wastewater

Type 2 to 1 Airport

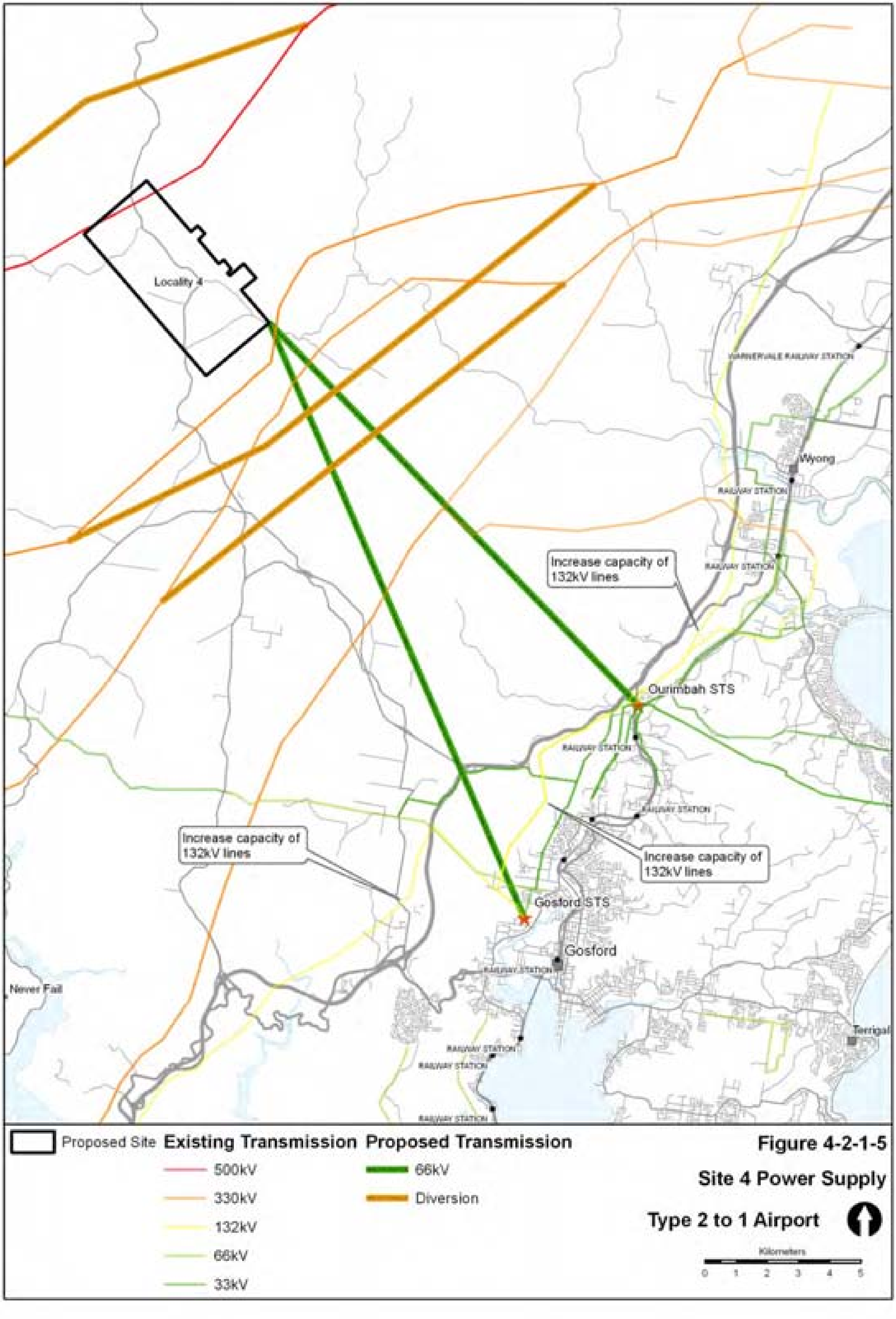
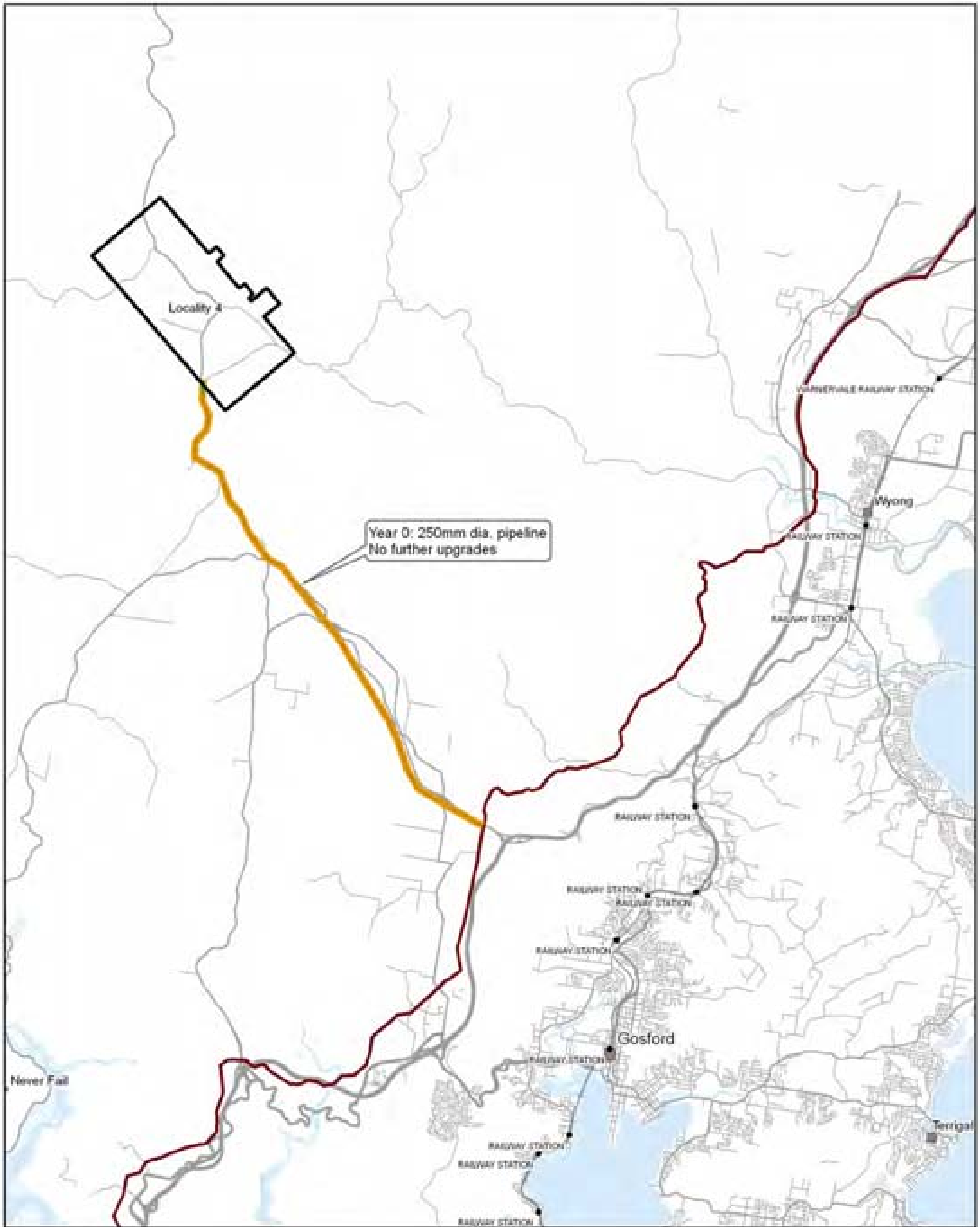


Figure 4-2-1-5

Site 4 Power Supply

Type 2 to 1 Airport



Legend

Proposed Site
Proposed Pipeline

Exisiting Pipelines

Gas Pipeline

Figure 4-2/1-7

Site 4 Gas Supply

Type 2 to 1 Airport

Kilometers
0 2 4 6 8 10

Legend

Proposed Site

Proposed Fuel Line

Second Independent Fuel Line - Redundancy

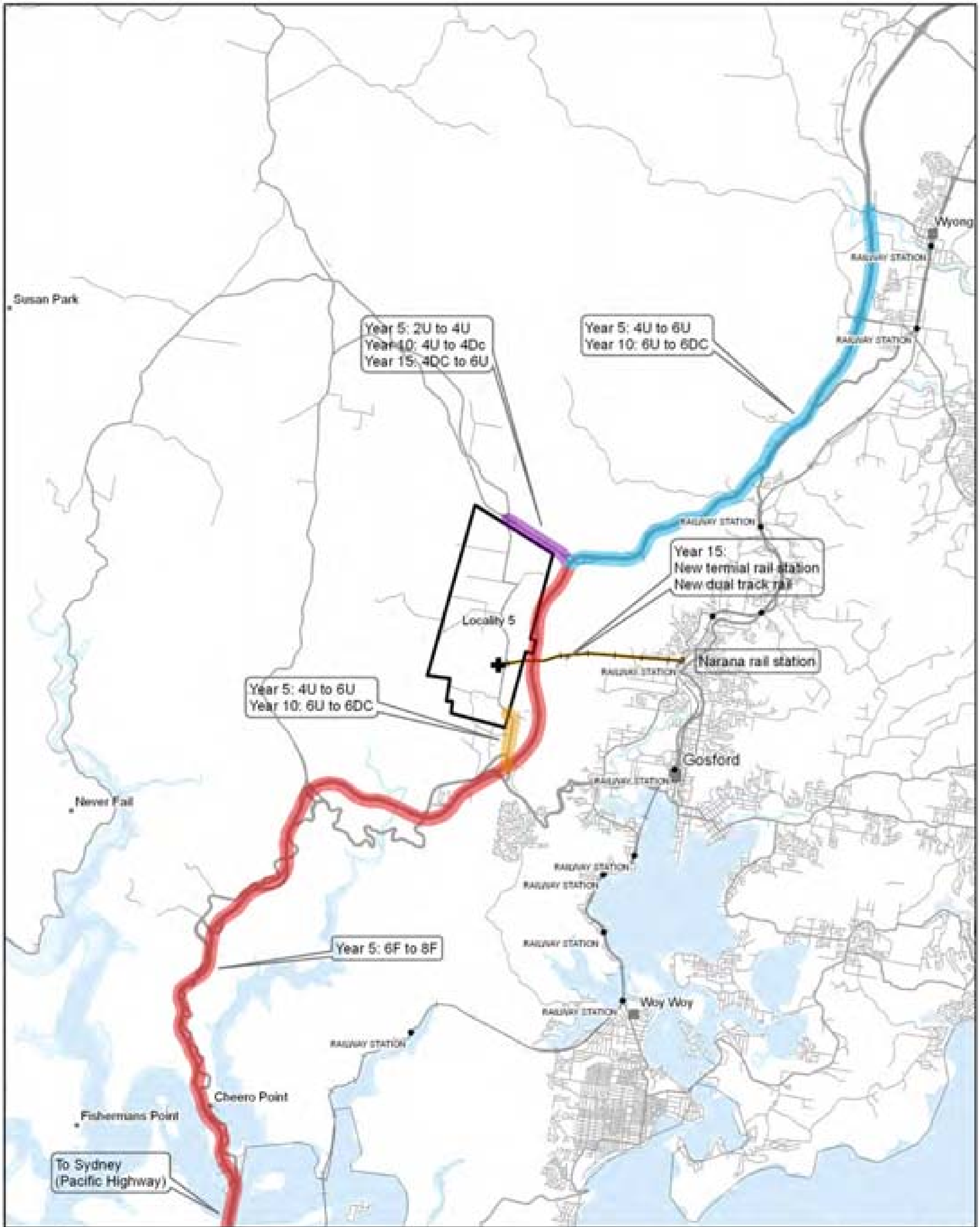
Figure 4-2/1-8

Site 4 Fuel Supply

Type 2 to 1 Airport

Kilometers

0 5 10 15 20 25



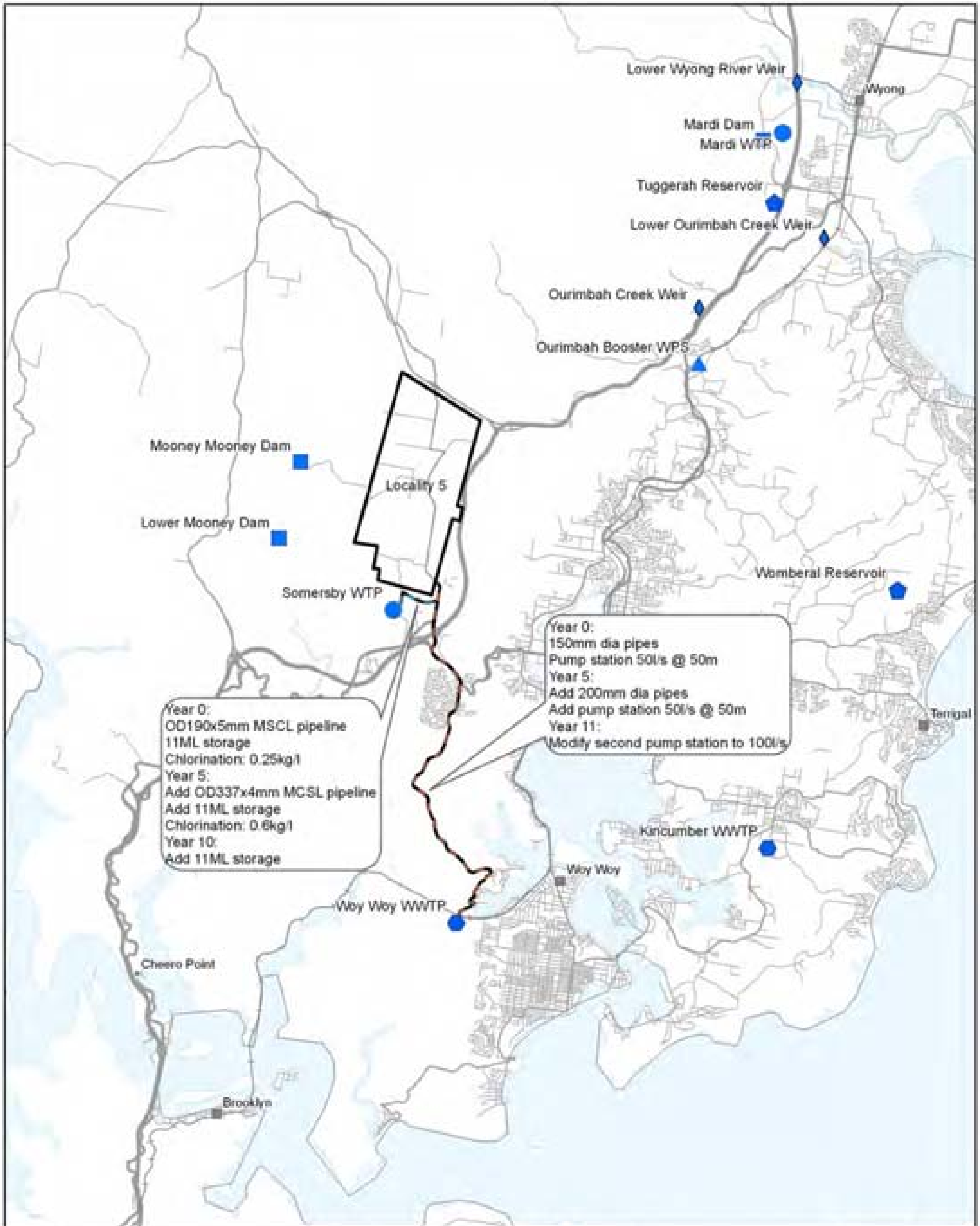
Proposed Site

Figure 5-2/1-3

Site 5 Roads - Surface Transport - Upgrades

Type 2 to 1 Airport

Kilometers
0 2 4 6 8 10



Proposed Site

Proposed Infrastructure

Proposed Sewer Connection

Proposed Water Connection

Existing Infrastructure

Dam

Reservoir

WFP

WPS

WTP

WWTP

Weir

Figure 5-2/1-4

Site 5 Water & Wastewater

Type 2 to 1 Airport

Kilometers

0 1 2 3 4 5

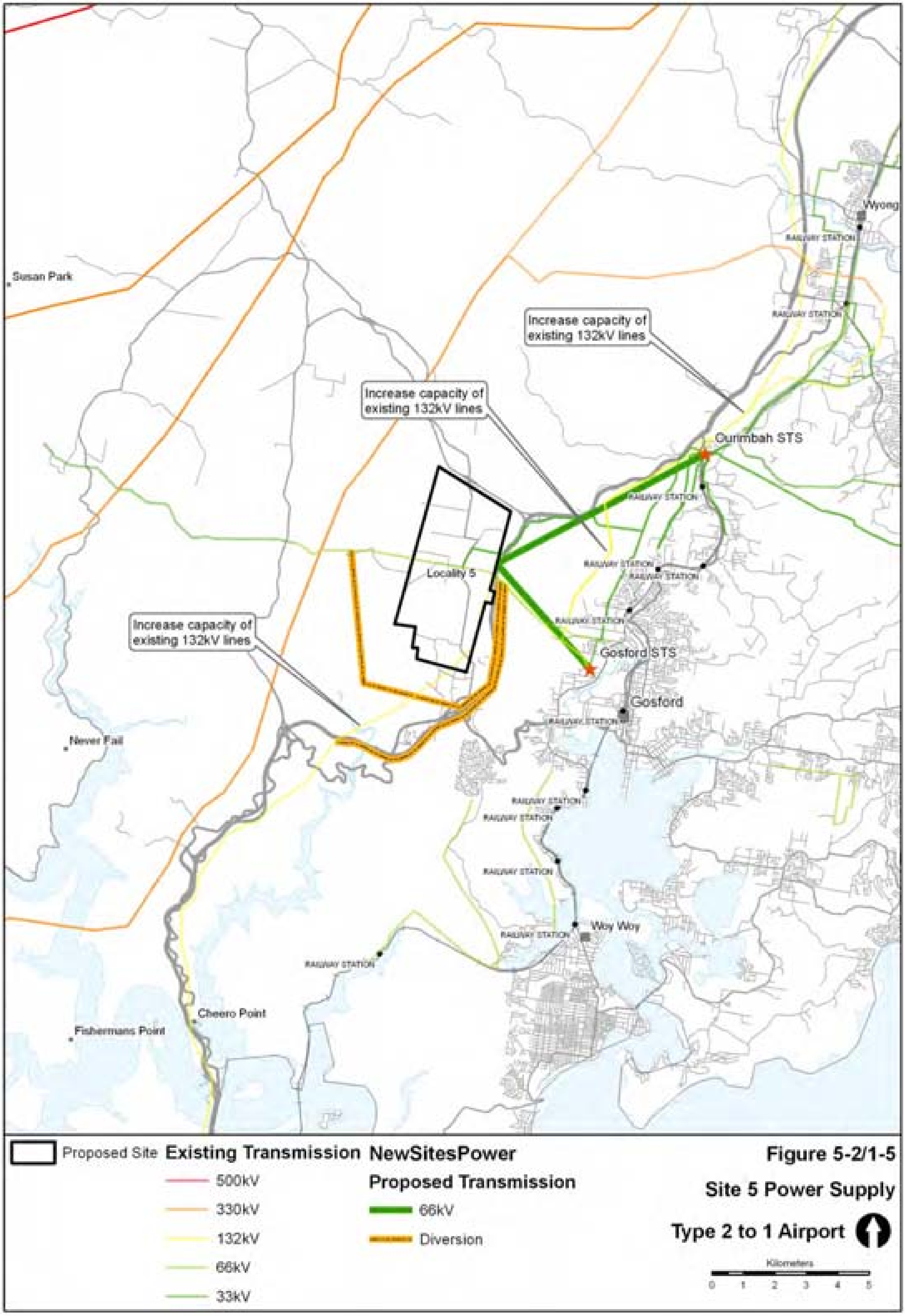
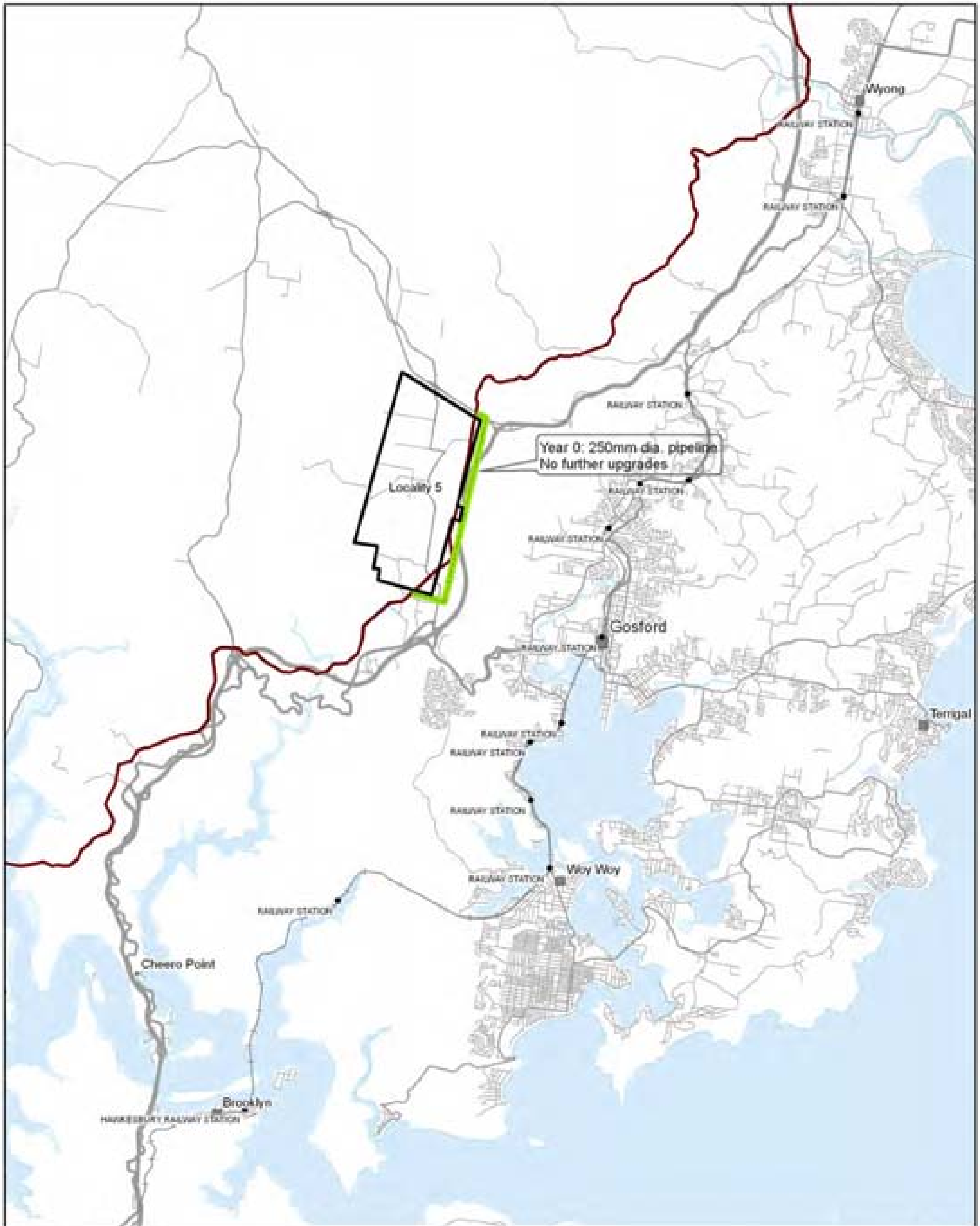


Figure 5-2/1-5

Site 5 Power Supply

Type 2 to 1 Airport



Legend

Proposed Site

Proposed Pipeline Diversion

Exisiting Pipelines

Gas Pipeline

Figure 5-2/1-7

Site 5 Gas Supply

Type 2 to 1 Airport

Kilometers

0 2 4 6 8 10

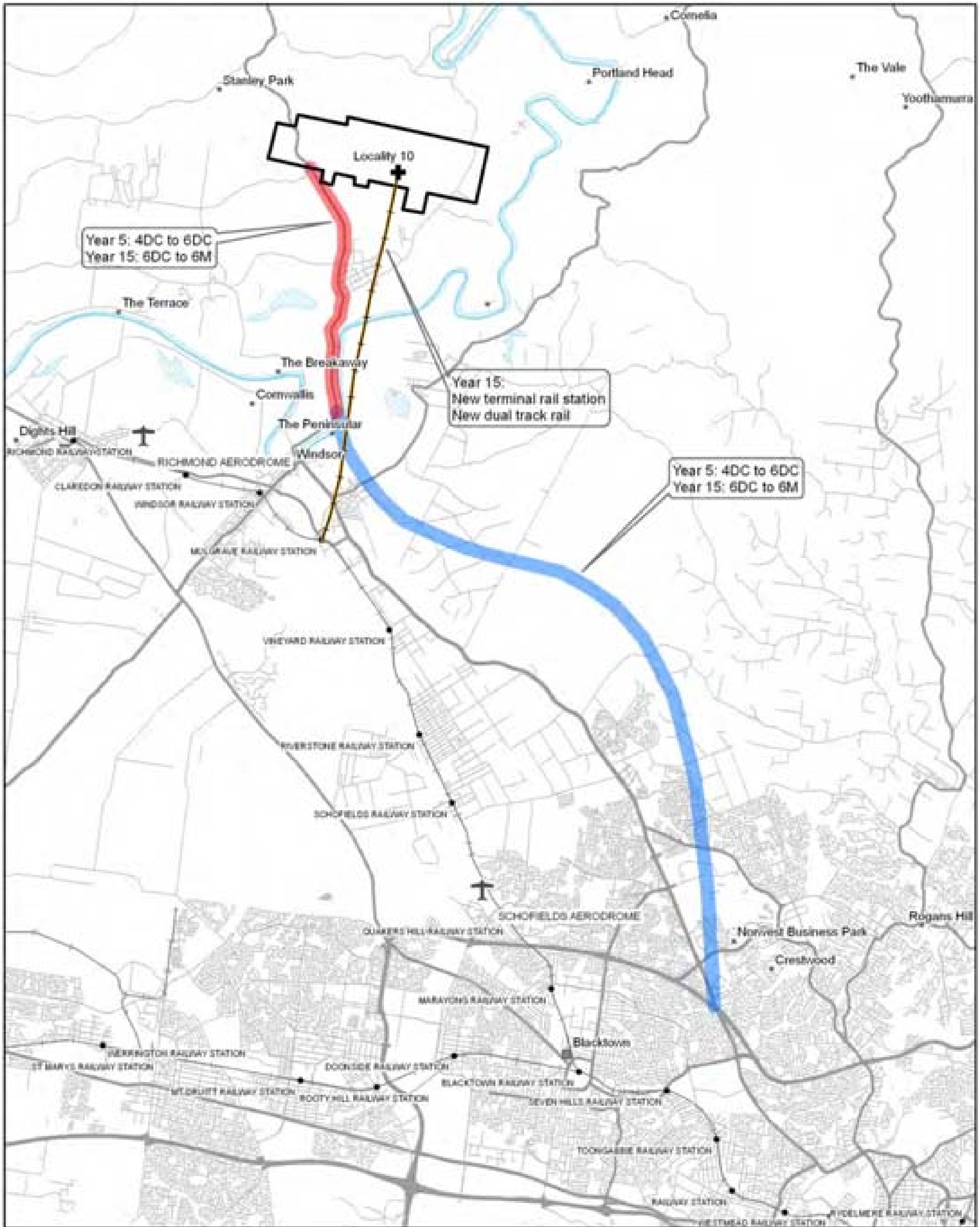
Proposed Site
Sea Terminals
Refineries
Exisitng
Exisitng
Proposed
Proposed Fuel Line
Second Independent Fuel Line - Redundancy

Kilometers
0 5 10 15 20

Figure 5-2/1-8

Site 5 Fuel Supply

Type 2 to 1 Airport



Proposed Site

Figure 10-2/1-3

Site 10 - Surface Transport - Upgrades

Type 2 to 1 Airport

Kilometers

0 2 4 6 8 10

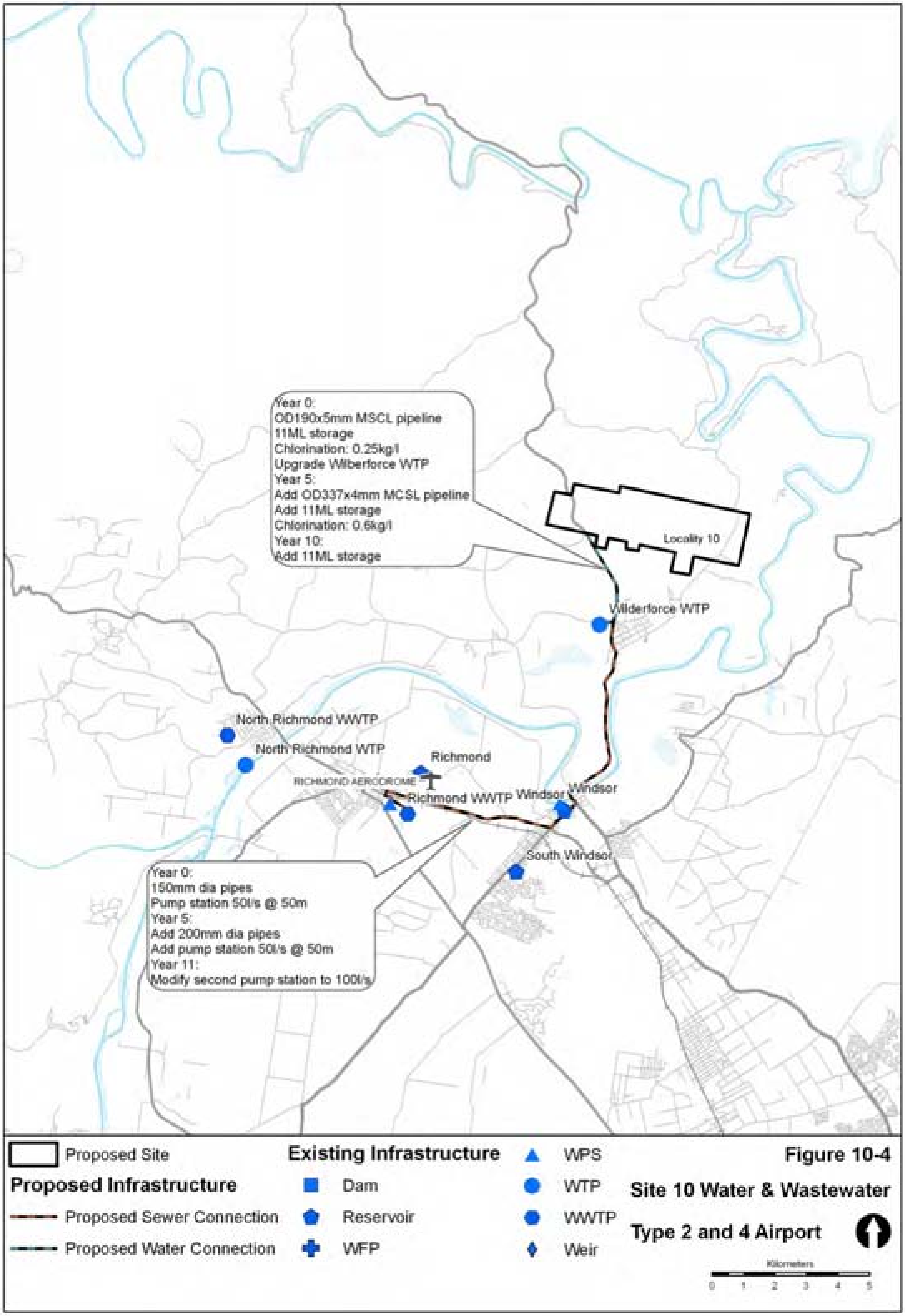
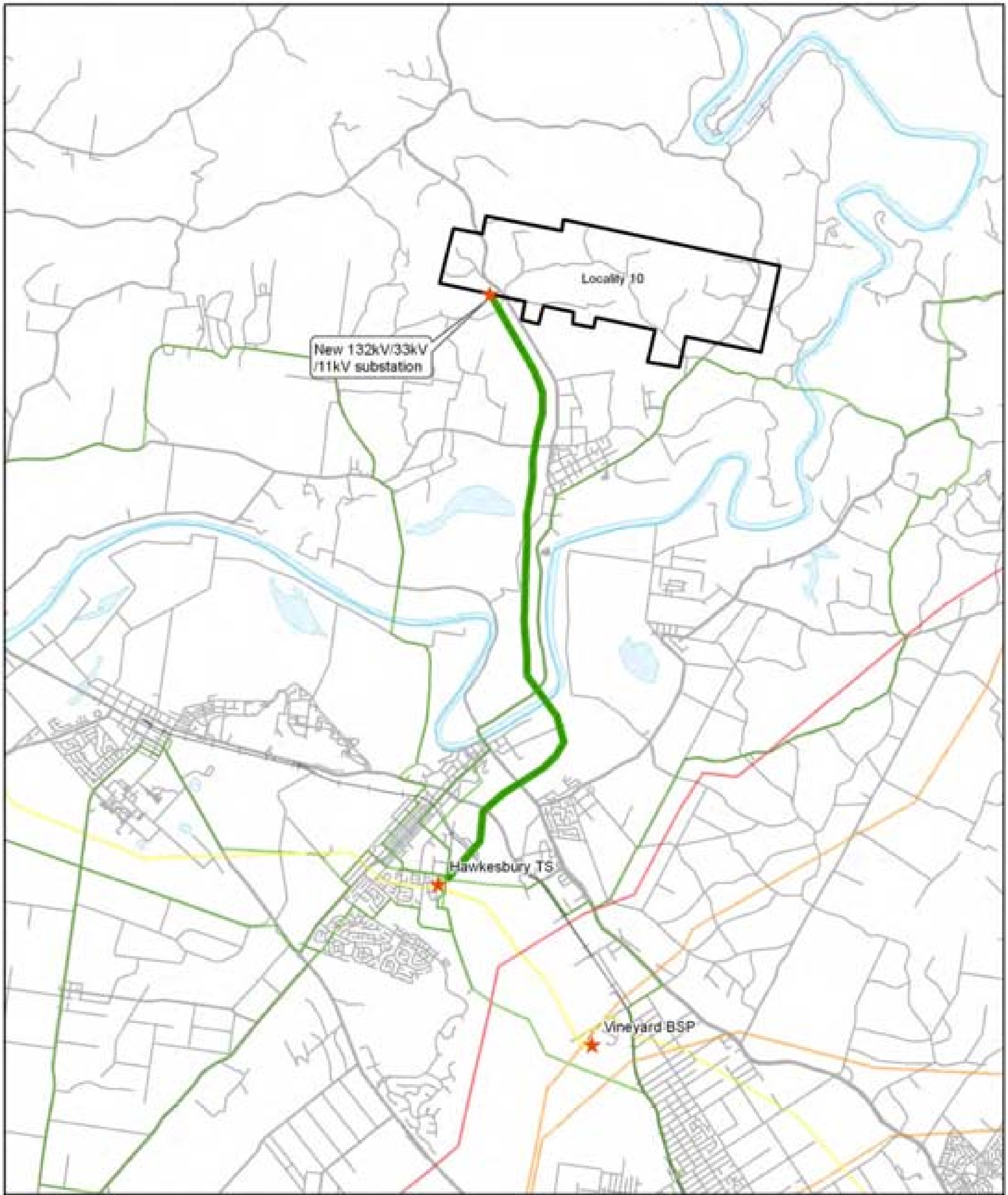


Figure 10-4

Site 10 Water & Wastewater

Type 2 and 4 Airport



Legend

Proposed Site

Exisitng Transmission

- 500kV
- 330kV
- 132kV
- 66kV
- 33kV

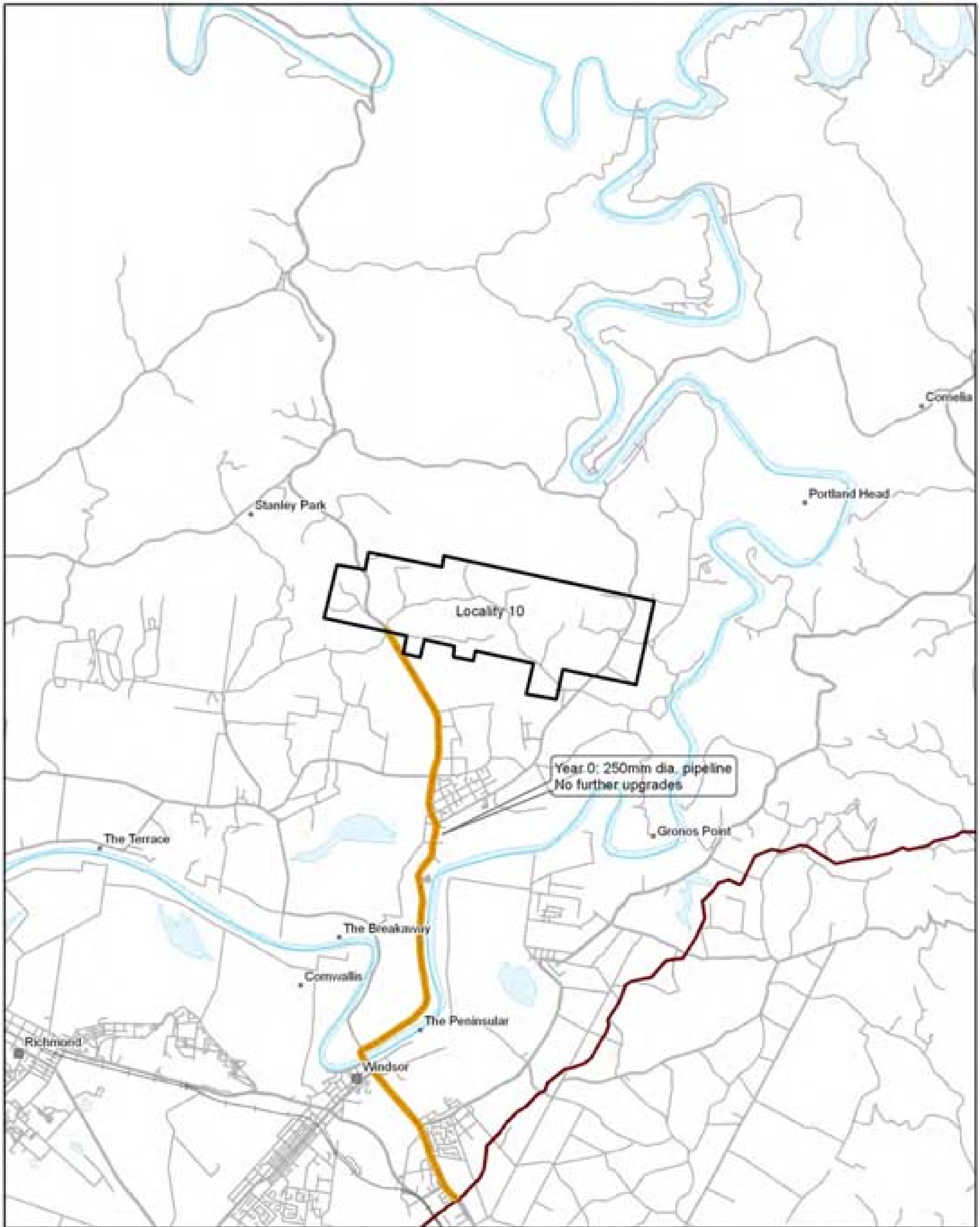
Proposed Transmission

- 132kV

Figure 10-2-1-5
Site 10 Power

Type 2 to 1 Airport

Kilometers
0 1 2 3 4 5



Legend

Proposed Location

Proposed Pipelines

Exisiting Pipelines

Gas Pipeline

Figure 10-2/1-7

Site 10 Gas Supply

Type 2 to 1 Airport

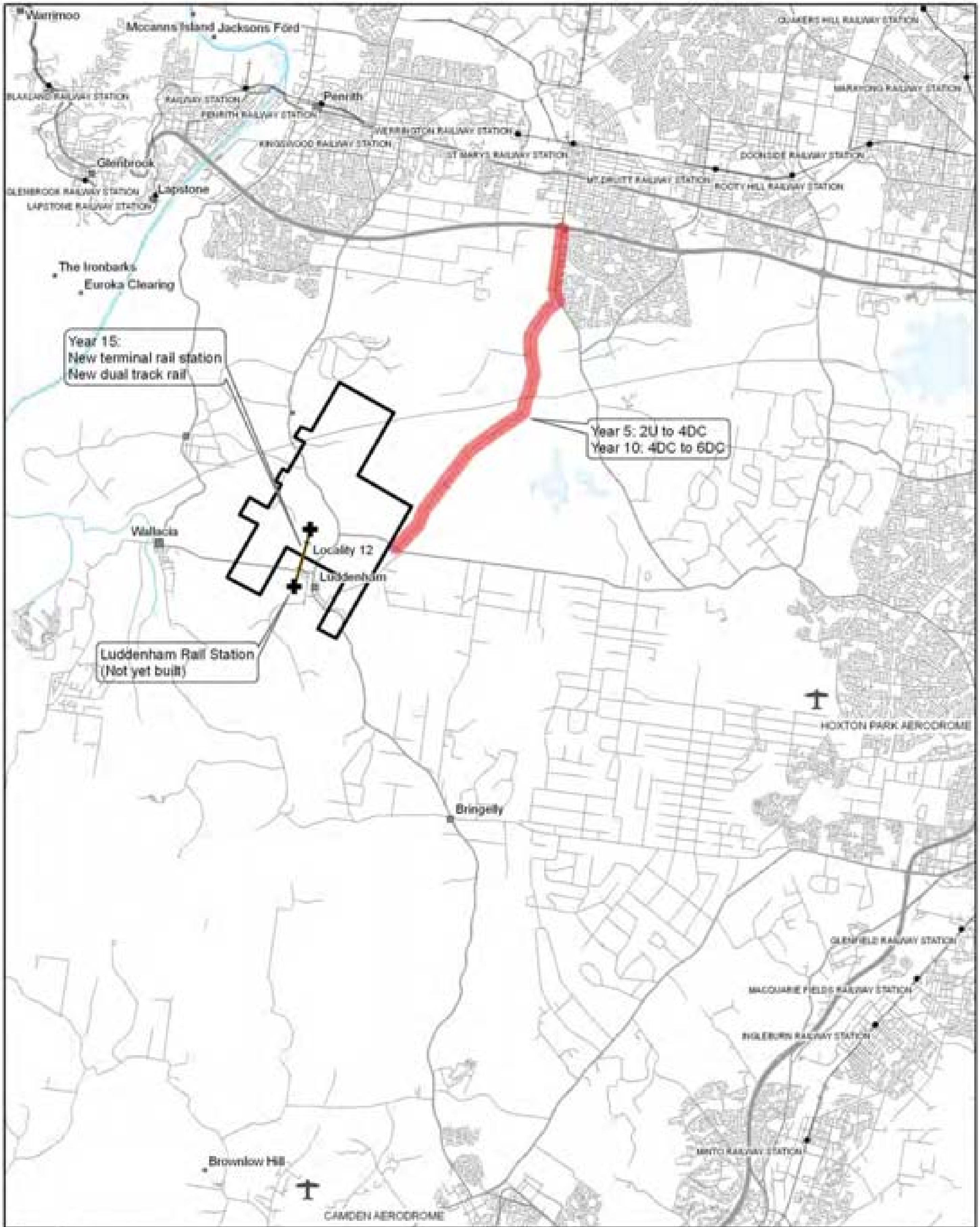
Kilometers

0 1 2 3 4 5

Figure 10-2/1-8

Site 10 Fuel Supply

Type 2 to 1 Airport



Proposed Site

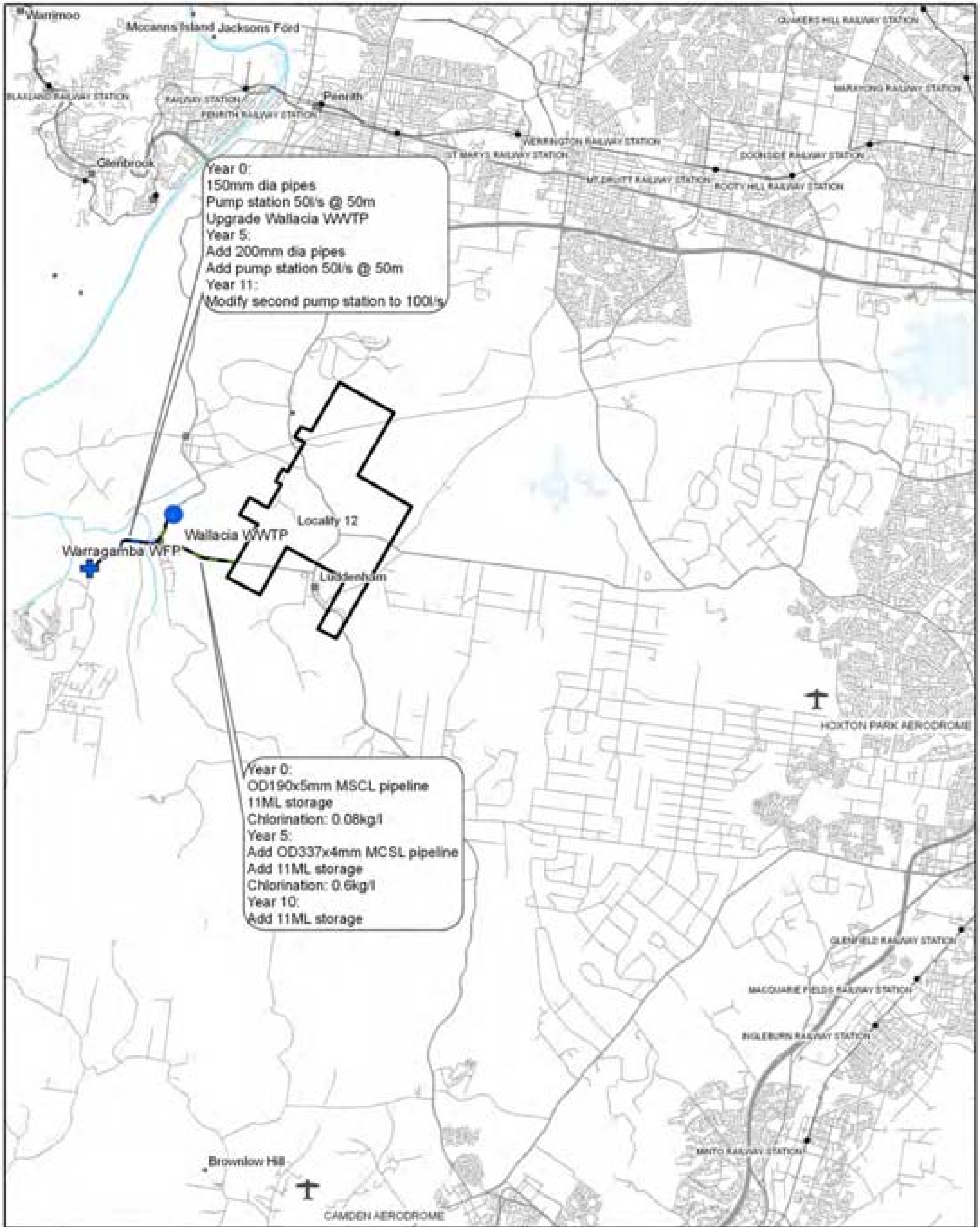
Figure 12-2/1-3

Site 12 Roads - Surface Transport - Upgrades

Type 2 to 1 Airport

Kilometers

0 2 4 6 8 10



Proposed Site

Proposed Infrastructure

Proposed Sewer Connection

Proposed Water Connection

Existing Infrastructure

WFP

WWTP

Figure 12-2-1-4

Site 12 Water & Wastewater

Type 2 to1 Airport

Kilometers

0 1 2 3 4 5

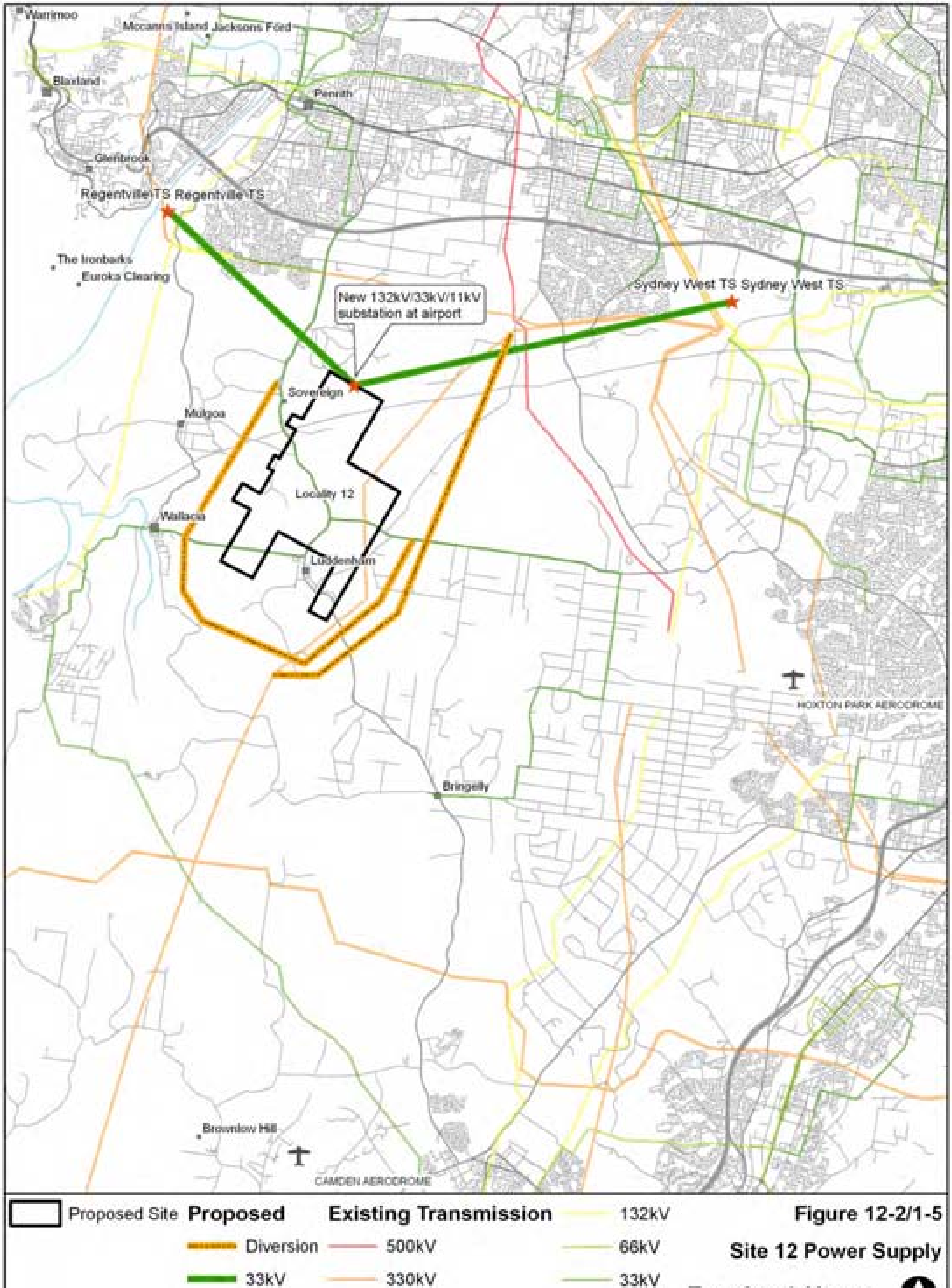
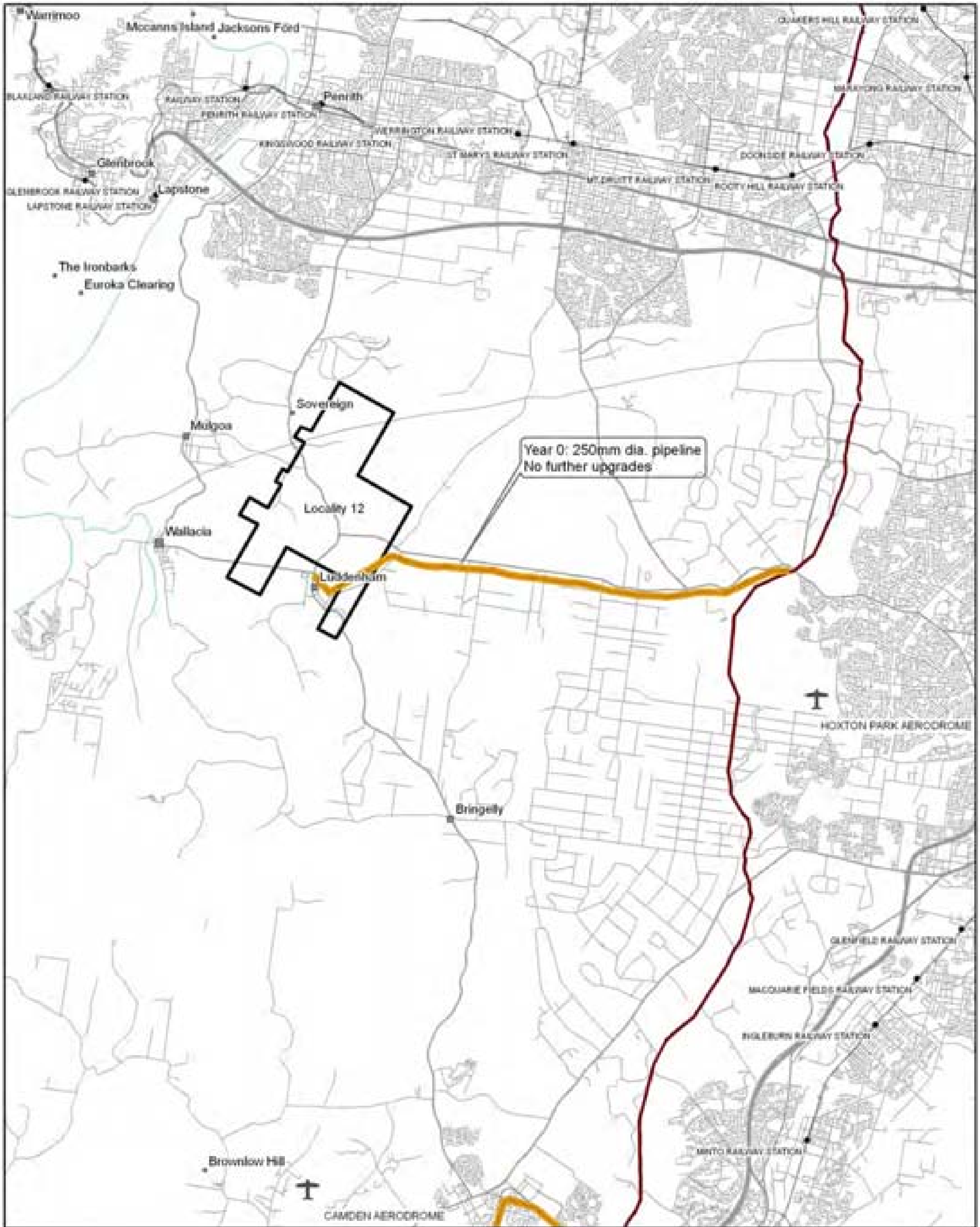


Figure 12-2/1-5

Site 12 Power Supply

Type 2 to 1 Airport



Legend

Proposed Gas Main (14.8km)

Exisitng Pipelines

Gas Pipeline

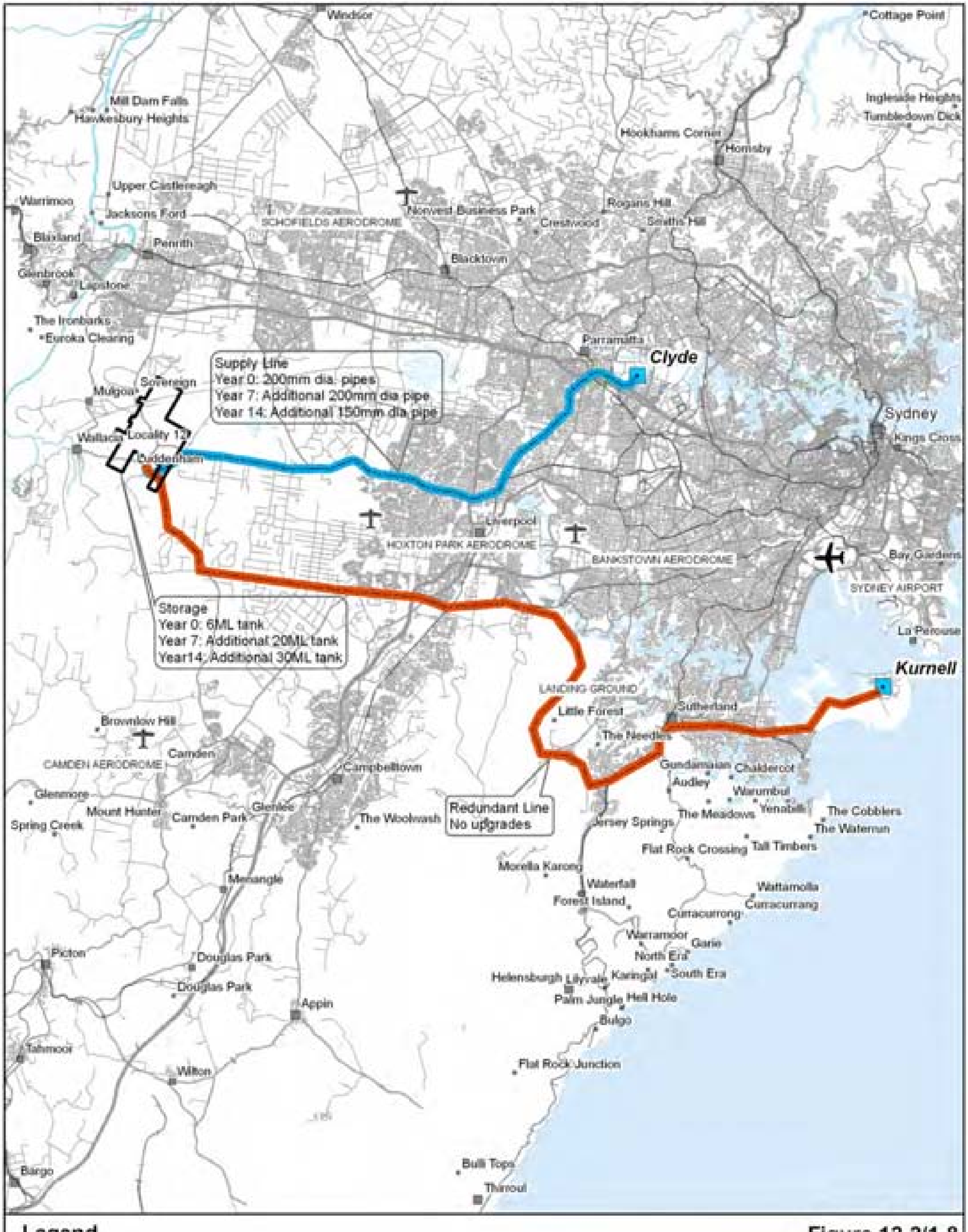
Figure 12-2/1-7

Site 12 Gas Supply

Type 2 to 1 Airport

Kilometers

0 2 4 6 8



Legend

Proposed Site — Proposed Fuel Line

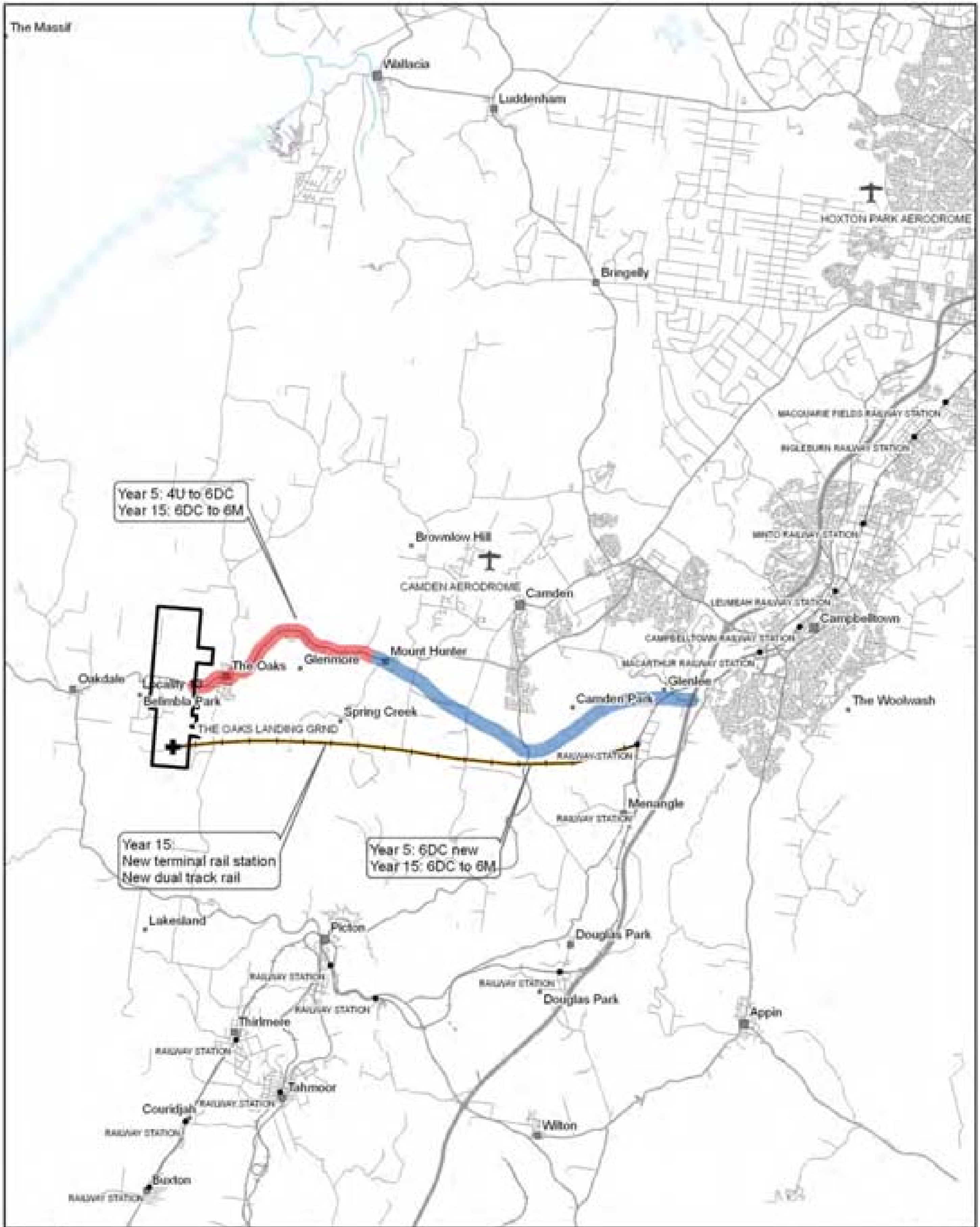
Secondary Independant Fuel Line

Figure 12-2/1-8

Site 12 Fuel Supply

Type 2 to 1 Airport

Kilometers
0 5 10 15 20



Proposed Site

Figure 13-2/1-3

Site 13 Roads - Surface Transport - Upgrades

Type 2 to 1 Airport

Kilometers

0 2 4 6 8 10

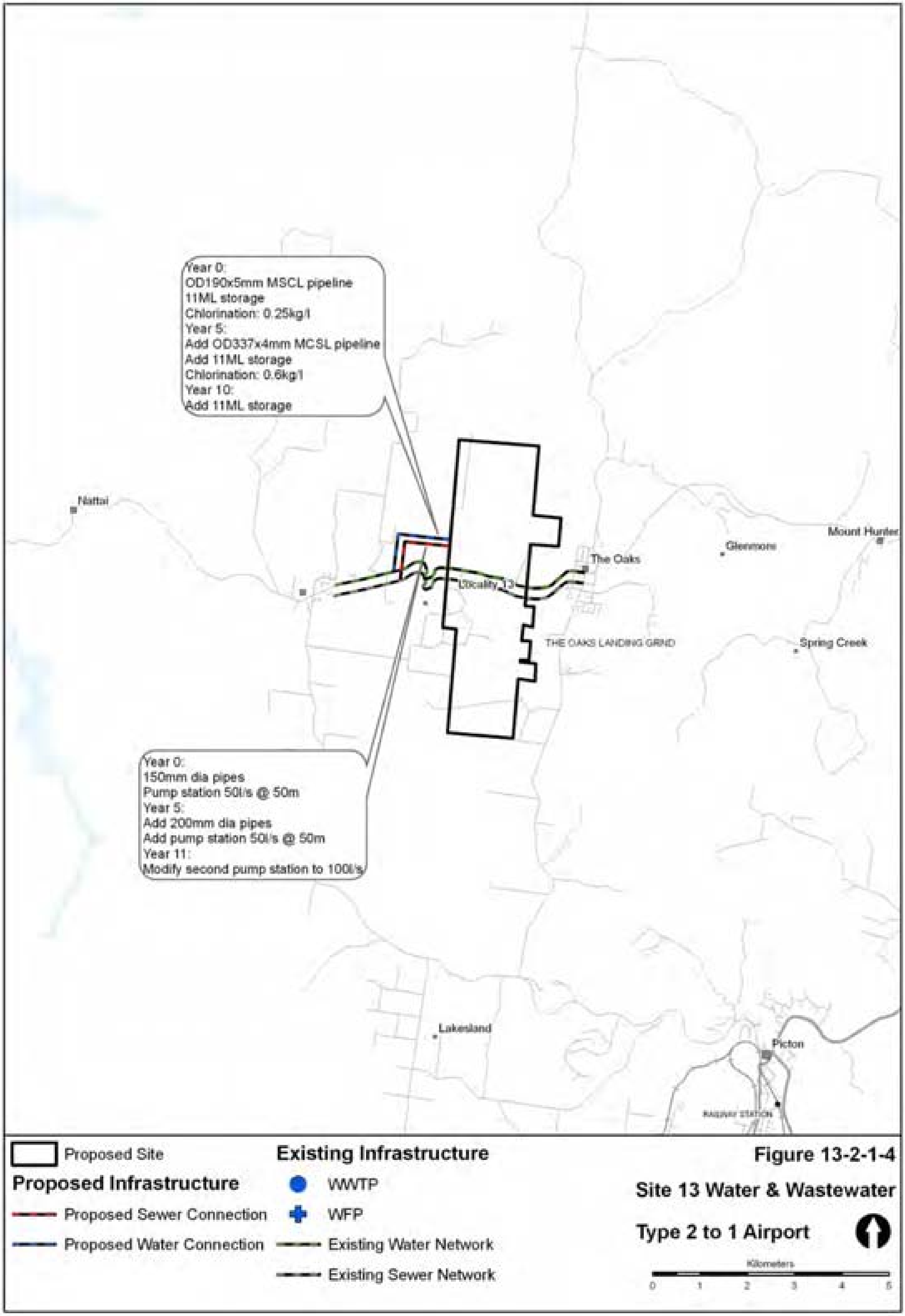
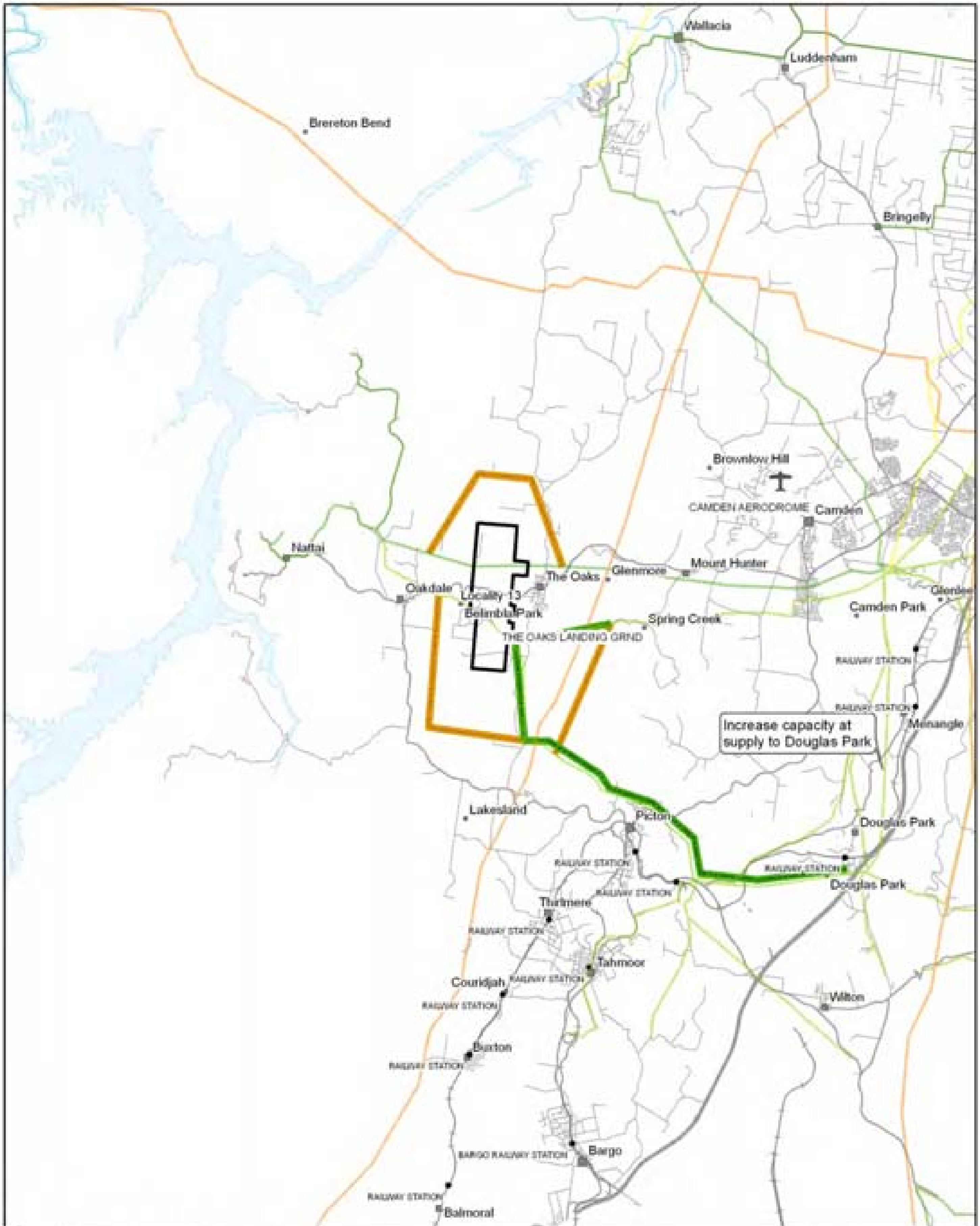


Figure 13-2-1-4

Site 13 Water & Wastewater

Type 2 to 1 Airport



Proposed Site

Existing Transmission

- 500kV
- 330kV
- 132kV
- 66kV
- 33kV

Proposed Transmission

- 66kV
- Diversion

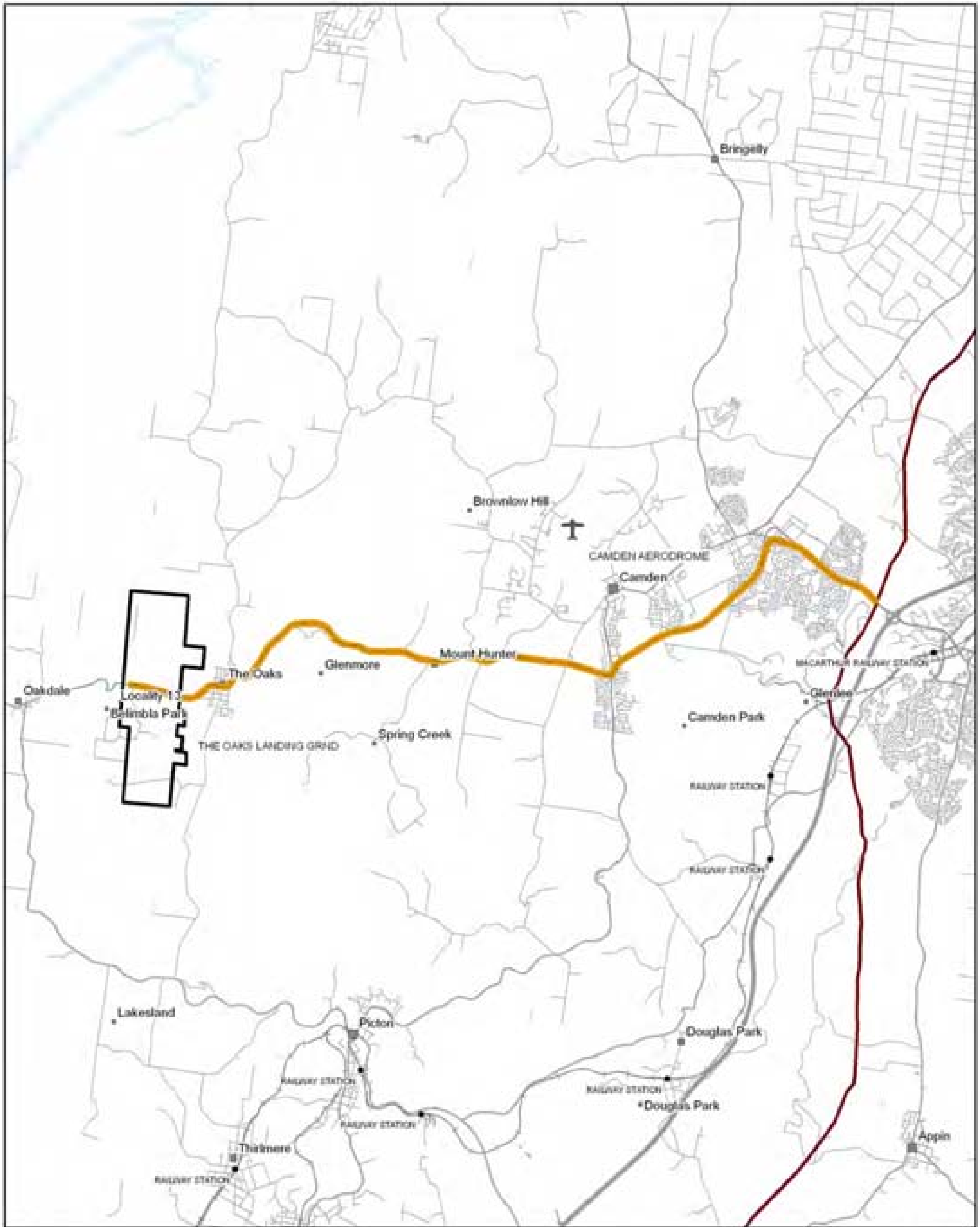
Figure 13-2-1-5

Site 13 Power Supply

Type 2 to 1 Airport

Kilometers

0 1 2 3 4 5



Legend

Proposed Site

Proposed Pipeline (25.8km)

Exisiting Pipelines

Gas Pipeline

Figure 13-2/1-7

Site 13 Gas Supply

Type 2 to 1 Airport

Kilometers

0 2 4 6 8 10

Proposed Site

Sea Terminals

Exisitng

Proposed

Refineries

Exisitng

Proposed Fuel Line

Second Independent Fuel Line - Redundancy

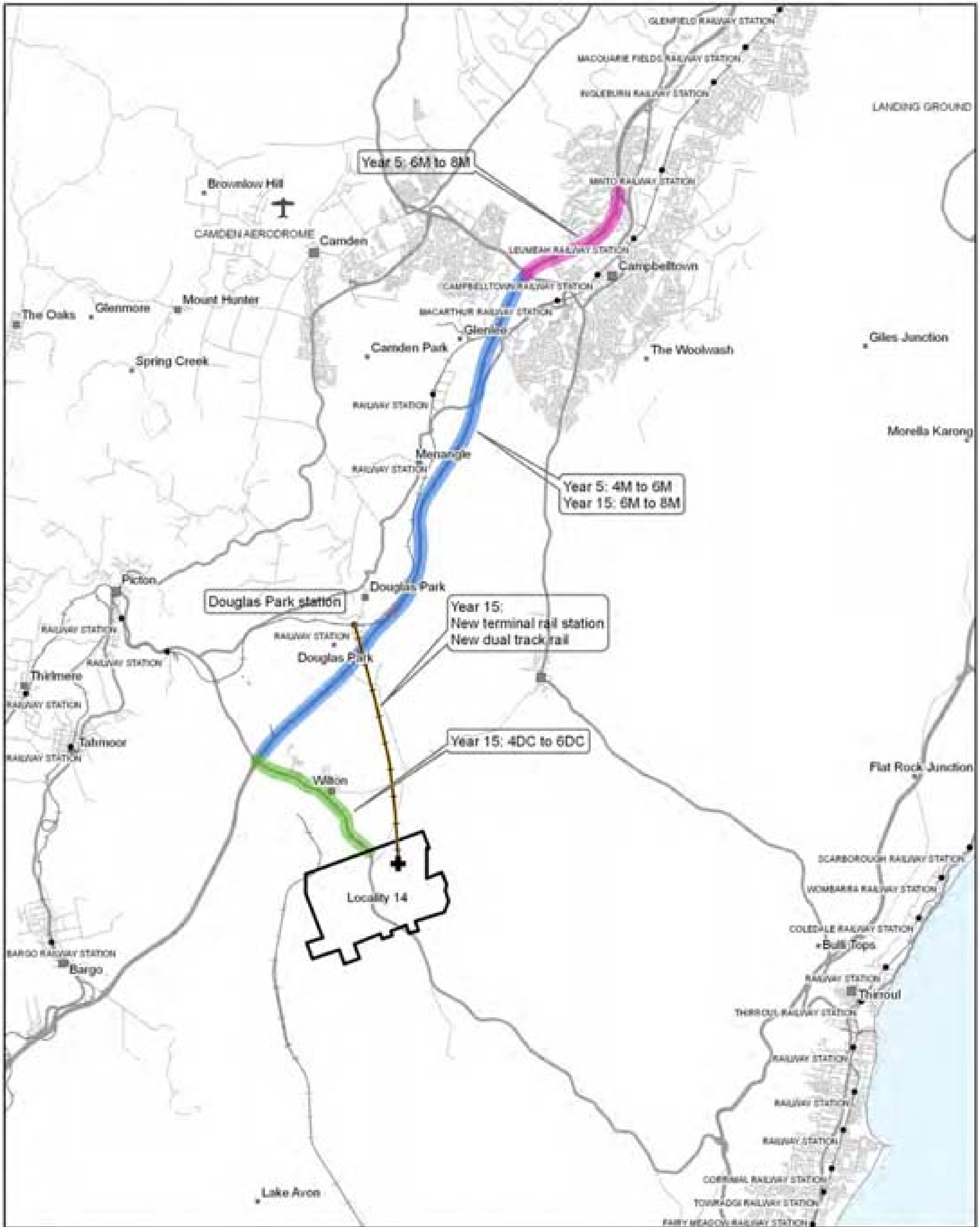
Figure 15-2/1-8

Site 15 Fuel Supply

Type 2 to 1 Airport

Kilometers

0 5 10 15 20



Proposed Site

Figure 14-2/1-3

Site 14 Roads - Surface Transport - Upgrades

Type 2 to 1 Airport

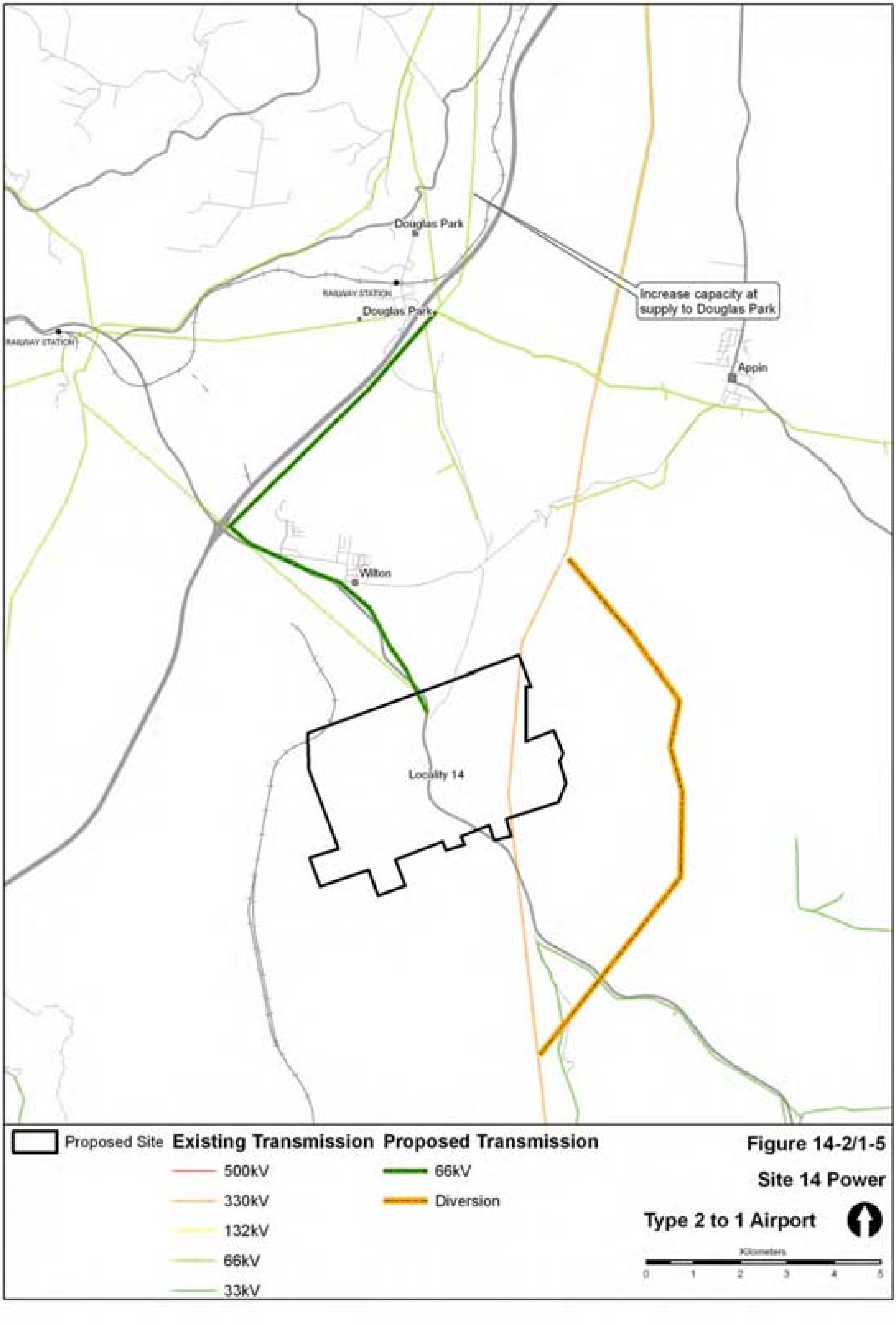
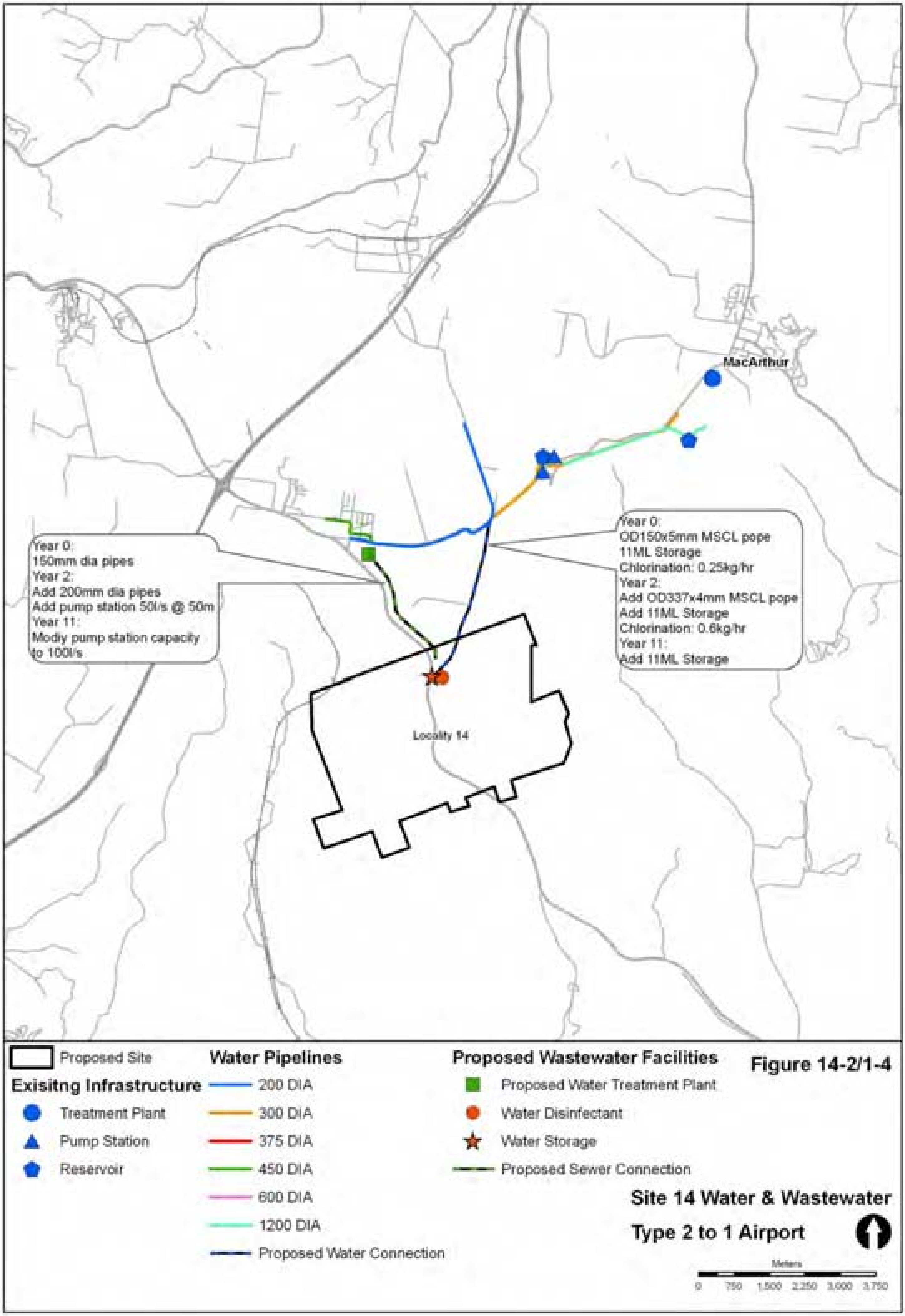


Figure 14-2/1-5

Site 14 Power

Type 2 to 1 Airport


MacArthur
Year 0:
150mm dia pipes
Year 2:
Add 200mm dia pipes
Add pump station 50l/s @ 50m
Year 11:
Modiy pump station capacity
to 100l/s
Year 0:
OD150x5mm MSCL pope
11ML Storage
Chlorination: 0.25kg/hr
Year 2:
Add OD337x4mm MSCL pope
Add 11ML Storage
Chlorination: 0.6kg/hr
Year 11:
Add 11ML Storage
Locality 14
Proposed Site
Exisitng Infrastructure
Treatment Plant
Pump Station
Reservoir
Water Pipelines
200 DIA
300 DIA
375 DIA
450 DIA
600 DIA
1200 DIA
Proposed Water Connection
Proposed Wastewater Facilities
Proposed Water Treatment Plant
Water Disinfectant
Water Storage
Proposed Sewer Connection
Figure 14-2/1-4
Site 14 Water & Wastewater
Type 2 to 1 Airport
Meters
0 750 1,500 2,250 3,000 3,750

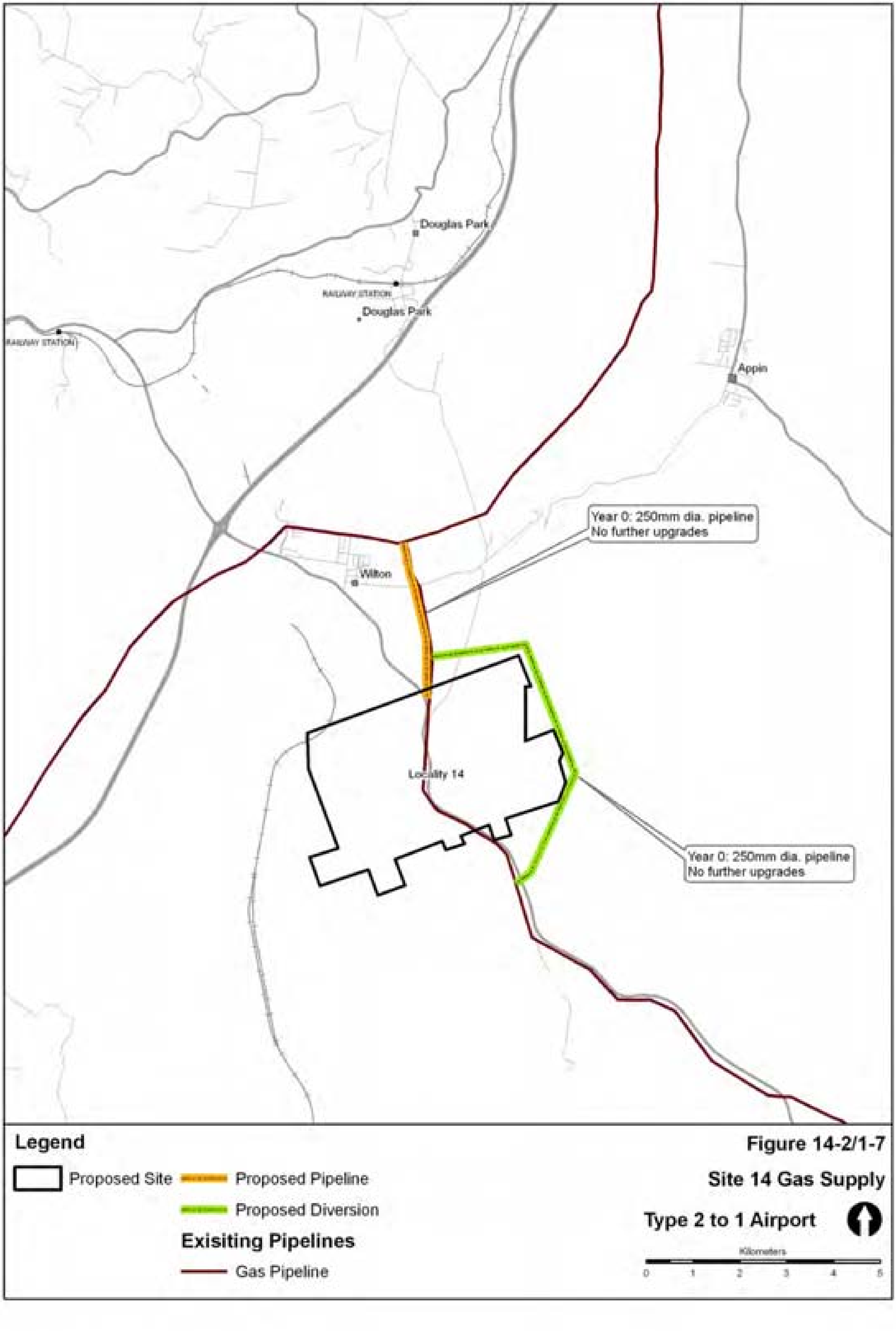


Figure 14-2/1-7

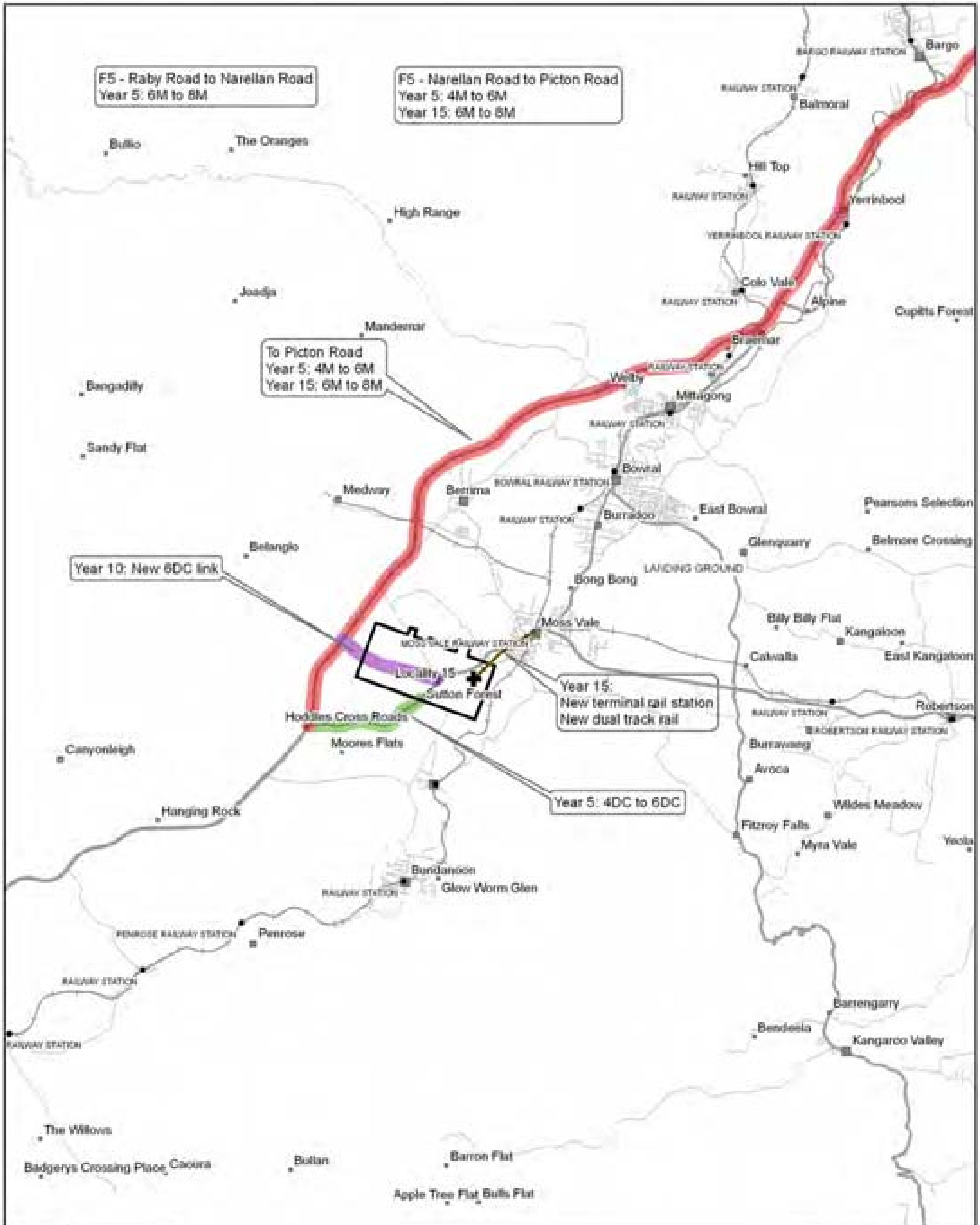
Site 14 Gas Supply

Type 2 to 1 Airport

Figure 14-2/1-8

Site 14 Fuel Supply

Type 2 to 1 Airport



Proposed Site

Figure 15-2/1-3

Site 15 Roads - Surface Transport - Upgrades

Type 2 to 1 Airport

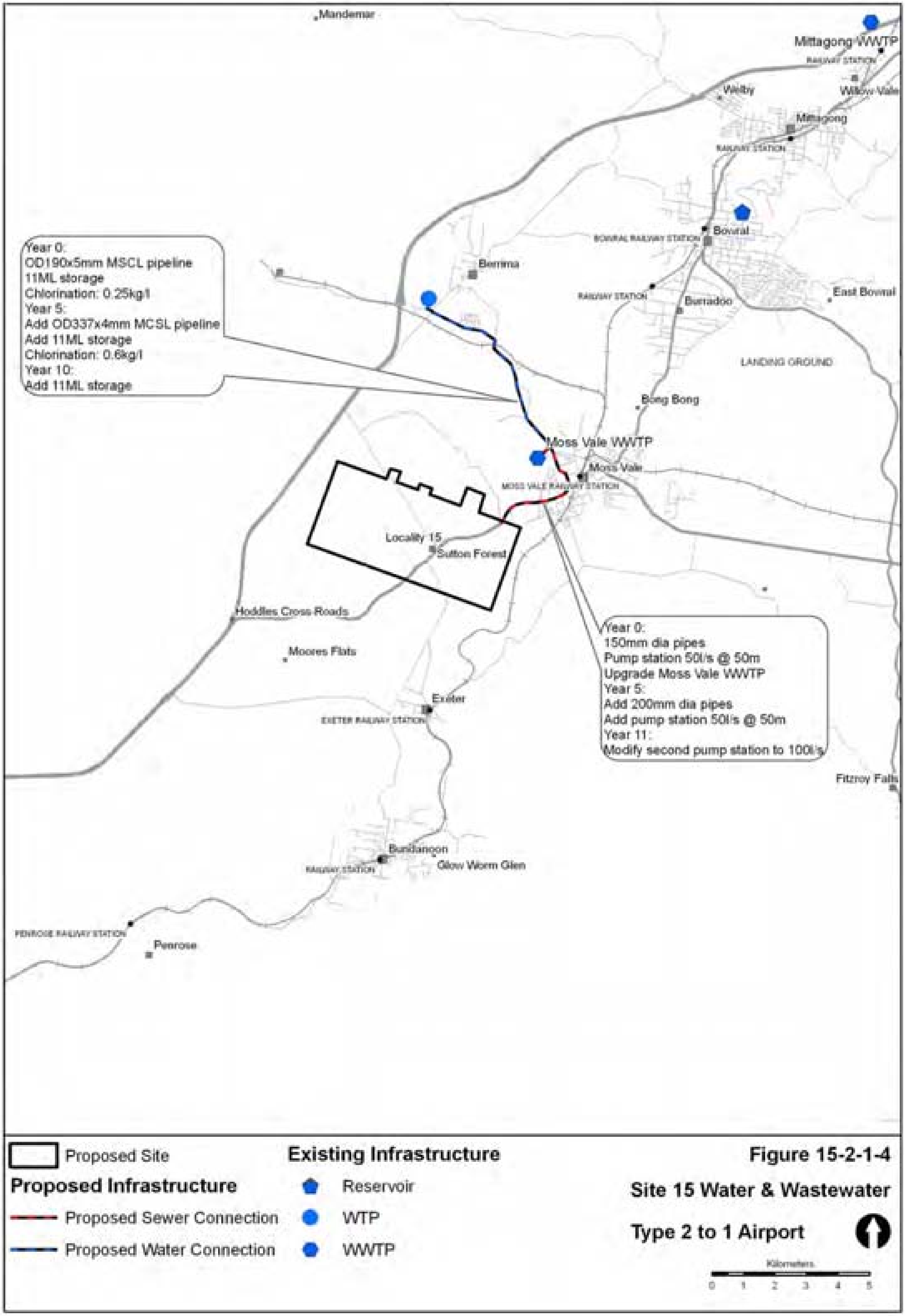


Figure 15-2-1-4

Site 15 Water & Wastewater

Type 2 to 1 Airport

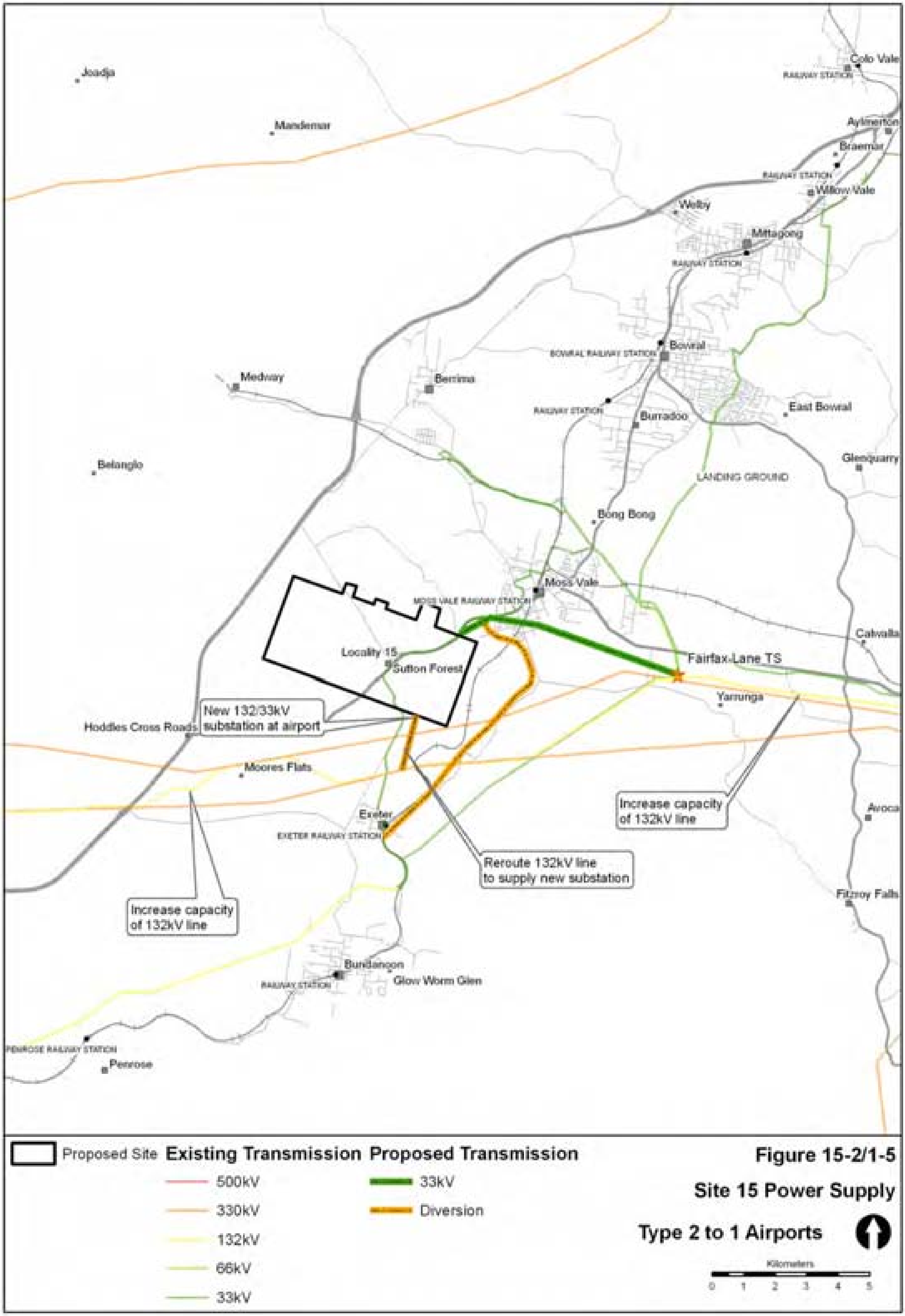
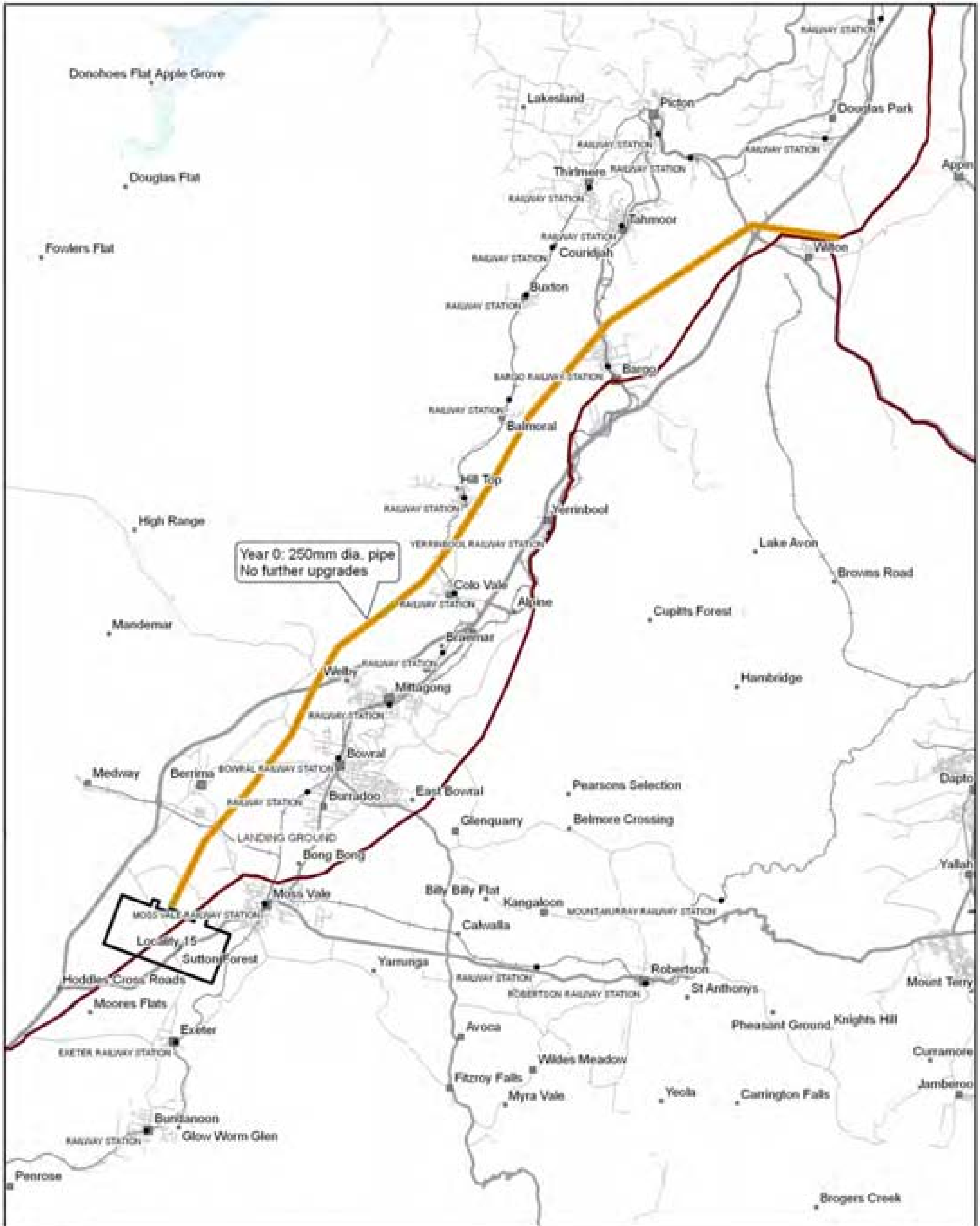


Figure 15-2/1-5

Site 15 Power Supply

Type 2 to 1 Airports



Legend

Proposed Site — Proposed Pipelines

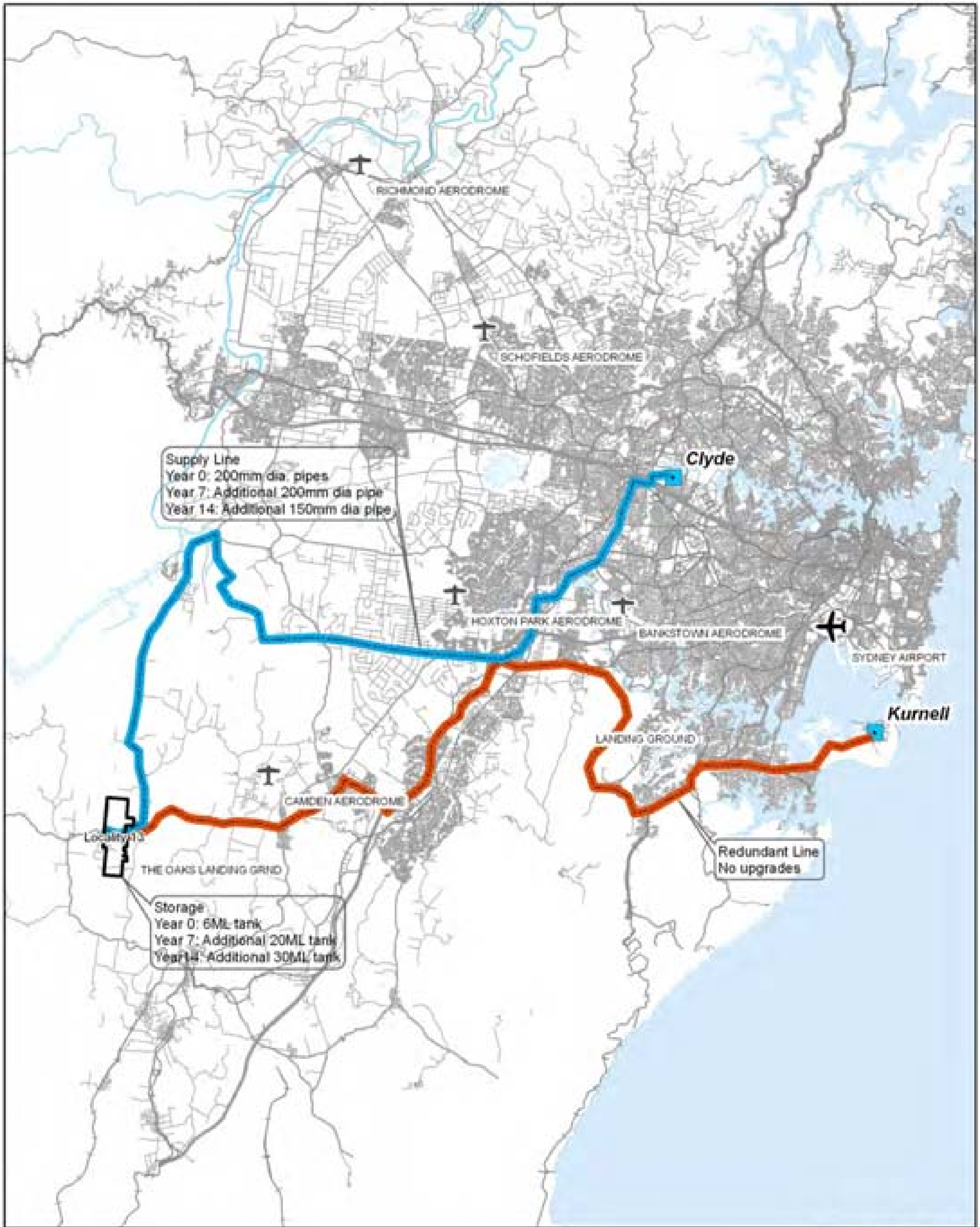
Exisiting Pipelines

Gas Pipeline

Figure 15-2/1-7

Site 15 Gas Supply

Type 2 to 1 Airport



Legend

Proposed Site

Proposed Fuel Line

Secondary Independant Fuel Line - Redundancy

Figure 13-2/1-8

Site 13 Fuel Supply

Type 2 to 1 Airport

Kilometers

0 5 10 15 20 25

Appendix B

Methodology – Supporting Infrastructure

Appendix B summarises the approach used in this study, including the characteristics for the template airports, the methodologies developed to determine the supporting infrastructure demand, the capital expenditure, the operational and maintenance expenditure as well as the site excavation and levelling quantities.

The structure of Appendix B is as follows:

Section	Description
B1 – Airport Scenarios	This section provides the characteristics for the template airports.
B2 – Localities	This section lists the localities provided by the Department.
B3 – Overall Methodology	This section presents the overall methodology adopted for this study.
B3.1 – Capital Expenditure	This section presents the costing approach for the capital expenditure.
B3.2 – Operational and Maintenance Expenditure	This section presents the costing approach for the operational and maintenance expenditure.
B3.3 – Site Excavation and Levelling	This section presents the costing approach for the site excavation and levelling.
B4 – Supporting Infrastructure.	This section includes the approach adopted to determine the supporting infrastructure.
B4.1 – Surface Transport	This section includes the approach adopted to determine the supporting surface transport infrastructure.
B4.2 – Water	This section includes the approach adopted to determine the supporting water infrastructure.
B4.3 – Wastewater	This section includes the approach adopted to determine the supporting wastewater infrastructure.
B4.4 – Power	This section includes the approach adopted to determine the supporting power infrastructure.
B4.5 – Communications	This section includes the approach adopted to determine the supporting communications infrastructure.
B4.6 – Gas	This section includes the approach adopted to determine the supporting gas supply infrastructure.
B4.7 – Fuel	This section includes the approach adopted to determine the supporting fuel supply infrastructure.

B1 Airport Scenarios

The supporting infrastructure has been developed based on the document *Airport characteristics for template airports* dated 3 December 2010 (supplied to Arup by Ernst & Young as provided by the Department of Infrastructure and Transport). Table B.1 below summarises the key statistics of each airport scenario for the initial development stage only.

Table B.1 Key Statistics for each Airport Scenario

Airport Development Scenario		**Type 2**	**Type 4**	**Transition from Type 2 to Type 1 (Type 1 statistics below)**
Category		Land Constrained full service international airports servicing all RPT segments	Minimum service airport servicing GA and limited RPT	Full Service International airport servicing all RPT segments
Indicative Land Use		400 Ha	120 Ha	Varies between 1,024 Ha and 1,793 Ha
Annual Passengers		5 million	0.5 million	32.6[1] million
Runways		1	2	3
Aircraft Maintenance Precinct		NA	NA	37 Ha
Fuel Facilities Precinct		5 Ha	0.2 Ha	5 Ha
Terminal Precinct (Including Aprons)	**Approx. Land Area**	10 Ha	1 Ha	90 Ha
	Approx. Contact Gates	10-15 nos	NA	60 nos
Freight Precinct (Including Aprons)		NA	NA	15 Ha
Car Park Areas – Public, Staff, Rental		4 Ha	NA	18 Ha
Airport City/Business Parks		NA	NA	30 Ha

Note 1: Based on passenger forecast at year 16 (Ernst & Young)

Type 2 and Type 4 Airport

For the purposed of this study, the characteristics described in the above table were considered static for Type 2 and Type 4 airports.

Transition from Type 2 to Type 1 Airport

When studying the transition from a Type 2 to a Type 1 airport, the following strategy was adopted:

- The passenger forecast supplied by Ernst & Young (provided by the Department of Infrastructure and Transport) was adopted and it was assumed that the demand for a Type 1 airport would be reached by year 16. Refer to Table below.
- In view of upgrading the asset to support the demand for a Type 1 airport, the Type 2 airport supporting infrastructure was modified as necessary.
- For each asset, a time interval was determined, based on the increase of passenger capacity, at which upgrades would be required to reach the adequate support for a Type 1 airport. These intervals varied for each asset.
- For each time increment, the additional infrastructure required was defined to support the respective capacity.

Table B.2 Transition from Type 2 to Type 1 Passenger Numbers

Year	Annual Passengers	Year	Annual Passengers
0	4,775,557	9	18,533,892
1	6,089,840	10	20,351,966
2	7,452,038	11	22,233,176
3	8,868,285	12	24,179,094
4	10,338,341	13	26,191,333
5	11,862,922	14	28,271,553
6	13,443,371	15	30,421,456
7	15,081,066	16	32,642,691
8	16,777,422		

B2 Localities

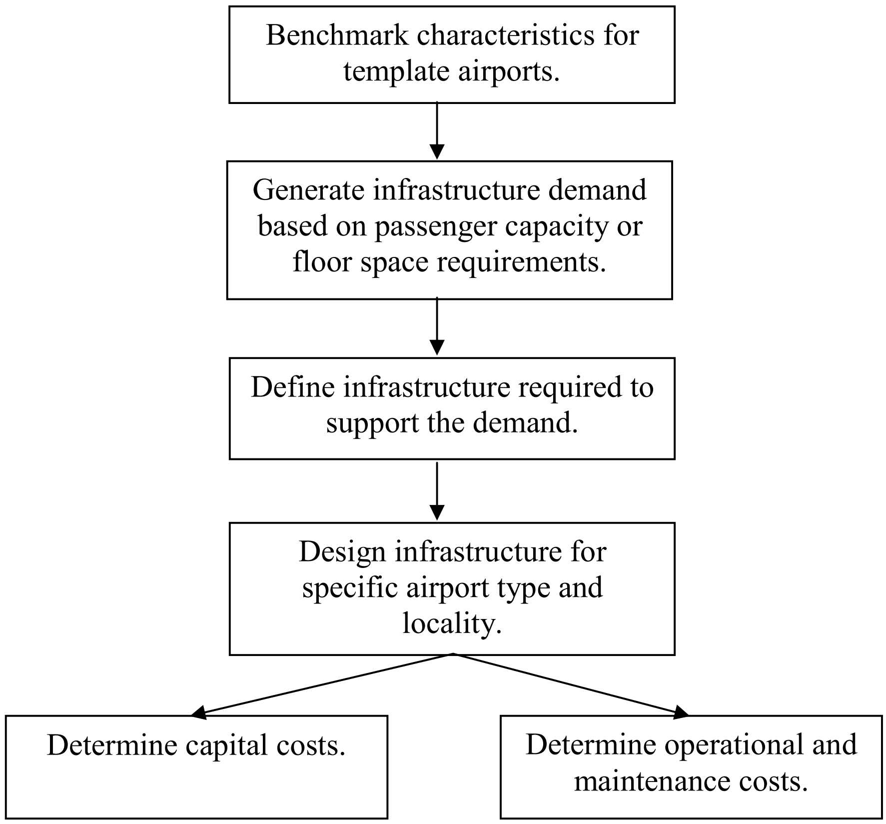
The Department requested to provide cost estimates for seven localities, as described below:

Table B.3 Localities

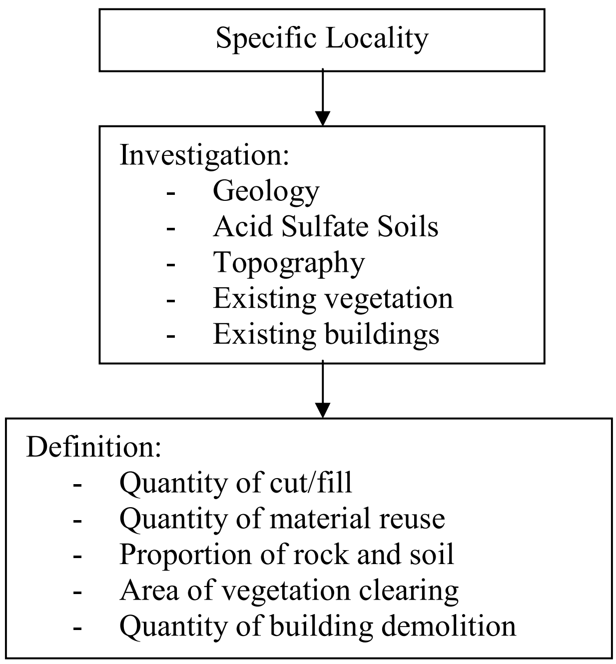
Locality	Geographic Locality descriptor	Principal Local Government Area
4	Kulnura	Gosford
5	Somersby	Gosford
10	Wilberforce	Hawkesbury
12	Luddenham	Liverpool
13	The Oaks	Wollondilly
14	Wilton	Wollondilly
15	Sutton Forest	Wingecarribee

B3 Overall Methodology

The overall methodology for determining capital expenditure as well as operational and maintenance expenditure is summarised below and is detailed further in sections B3.1 and 0:



The overall methodology for determining the nominal site excavation and levelling is summarised below and is described further in section B3.2.7:



B3.1 Capital Expenditure

B3.1.1 Introduction

Sources of Data

A selection of projects in New South Wales and across Australia have been used to source key cost information and various international projects have been used for comparison and benchmark validation purposes. This has been supplemented by expert knowledge from Turner & Townsend's extensive experience of infrastructure and transportation projects which in some cases confidential sources cannot be quoted to commercial sensitivities.

The unit rates represent an Indicative Order of Cost Budget based on limited information and appropriate assumptions with regard to scope and design and should not be used for any purpose other than intended in this report.

Price Base

All pricing used for the compilation of the cost models are based upon 1st Quarter 2011.

The costs include for all trade works and contractor's preliminaries and margin.

The unit rates exclude:

- Consultant fees
- Environmental studies
- Land
- Finance
- Authority costs
- Site remediation of contamination or asbestos
- Escalation
- Contingency
- GST

B3.1.2 General Assumptions & Benchmarks

Roads

The four lane dual carriageways assume that there will be a requirement for a limited quantity of short span road bridges, to allow for crossing creeks and the like. The rates do not allow for major bridge crossings other than identified in the Infrastructure Schedule. The rates allow for the preparation of the chosen route, the road sub-base, base, wearing course, etc. plus all necessary drainage, lighting, communication ducts, median strips and crash barriers.

A selection of historic, current and planned highways across NSW has been analysed to establish the most appropriate benchmark cost for both single and dual carriageway roads.

Rail

A heavy rail cost model has been developed based upon an at grade bi-directional electrified system connecting into the existing network and a single station within or adjacent to the main airport terminal building. The model allows for the preparation of the chosen alignment, laying of the track bed, track work, overhead line equipment, signalling and communications.

The model excludes any tunnels.

Water Supply

The water supply pipeline is assumed to consist of excavated trenches, inspection pits and chambers, pumps and pumping stations. Storage tanks are assumed to be steel or other alternative suitable materials and the reservoirs are constructed with earth embankments, lined and covered.

A selection of historic water pipelines and pumping stations across NSW, Victoria, Queensland and South Australia have been analysed to establish the most appropriate benchmark cost for this element of the supporting infrastructure.

Waste Water

The waste water pipeline is assumed to consist of excavated trenches, inspection pits and chambers, pumps and pumping stations.

A selection of historic pipelines and pumping stations across NSW, Victoria and Queensland have been analysed to establish the most appropriate benchmark cost for this element of the supporting infrastructure.

Power Supply

The power supply transmission for 330kV, 132kV and 33kV is based upon steel towers. The power transmission for the 11kV supply is based upon single concrete poles. An intake substation is included and all necessary transformers.

A selection of historic, current and planned power transmission lines across NSW and WA have been analysed to establish the most appropriate benchmark cost for all three power rated transmission systems.

The 33kV ring main for the airport is excluded.

Communications

The Point of Presence has not been costed – the scope needs to be developed for this item.

For the fibre optic pricing we have assumed 144 core cables running in underground ducts with pits every 100 m. The trenches are assumed to be 35% in soft ground (easy excavation) and 65% in roads, pavements or soft rock.

Gas

It has been assumed that a high pressure gas transmission pipeline would be attached to an existing system. The pipe is expected to be supplied in standard lengths, e.g. 18 m, which would be welded together on site and buried with at least 750 mm cover depending upon terrain and prevailing land use. The cost per km allows for typical valves, marker posts and cathodic protection inspection points.

A selection of historic and planned gas pipelines across NSW and Queensland have been analysed to establish the most appropriate benchmark cost for the gas supply pipeline.

Fuel

There is a very limited data available for dedicated jet fuel pipelines and storage tanks so we have widened the benchmark to encompass other fuel types as the engineering and infrastructure will be similar to that required for the airport supply line.

Drainage

Excluded – no design input at this stage.

Escalation

We recommend that escalation be included to adjust the cost plan allowance for each activity from the base date of 1Q11 to the date that the costs are incurred based on the delivery programme (to be developed).

A different annual rate for each financial year has been developed for all construction, design and management costs, based upon Turner & Townsend's independent economic and market assessment and view of the likely escalation that may prevail in Sydney for the period of the project. The percentages applicable for the financial periods ending June are as follows;

Table B.4 Escalation Annual Rates

2010/11	2011/12	2012/13	2014/15	2014/15	2015/16 and Future
0.0%	2.0%	3.5%	4.5%	5.0%	4.0%

GST

Goods and Services Tax is excluded from all of the cost models.

B3.1.3 Capital Cost Assumptions, Inclusions & Exclusions

Basis of Costs

The unit rates used for the compilation of the generic capital cost estimates are based upon the design criteria as defined by the engineering design team and endeavour to encompass the normal and expected scope of each infrastructure type. The four different airport types require varying infrastructure, which is detailed below.

Roads

All of the road types are assumed to be of a flexible type construction with a lane width of 4 metres.

The four lane dual carriageways assume that there will be a requirement for a limited quantity of short span road bridges, to allow for crossing creeks and the like. The rates do not allow for major bridge crossings other than identified in the Infrastructure Schedule. The rates allow for the preparation of the chosen route, the road sub-base, base and wearing course plus all necessary drainage, lighting, communication ducts, median strips, crash barriers and signage.

Rail

A heavy rail cost model has been developed based upon an at grade bi-directional electrified system connecting into the existing network and a single station within or adjacent to the main airport terminal building. The model allows for the preparation of the chosen alignment, laying of the trackbed, trackwork, overhead line equipment, signalling and communications.

The model excludes any tunnels.

Water Supply

The water supply pipework is specified as Ductile Iron Cement Lined (DICL) and varies in size according to the airport type as below. The rate includes for trench excavation, marker tapes, backfill and reinstatement and all pipe fittings, valves and sundries.

- Type 1 – 300 mm diameter initial size, 900 mm ultimate size.
- Type 2 – 100 mm diameter initial size, 600 m ultimate size.
- Type 3 & 4 - 100 mm diameter initial size, 300 m ultimate size.

Pumping stations are based on the following sizes and include for all civil, engineering and building works;

- Type 1 – 80 l/s @ 100 m initial size, 775 l/s ultimate size.
- Type 2 – 11 l/s @ 100 m initial size, 375 l/s ultimate size.
- Type 2 – 11 l/s @ 100 m initial size, 105 l/s ultimate size.

- Type 4 – no pumping required.

Water storage facilities have been costed on the following capacities and include for all necessary reinforced concrete bases and nominal external works;

- Type 1 – 2 Mega Litres initial size (steel tank(s)), ultimate size requires a 62 Mega Litre lined and covered reservoir.
- Type 2 – 1 Mega Litres initial size (steel tank(s)), ultimate size requires a 30 Mega Litre lined and covered reservoir.
- Type 3 – 1 Mega Litres initial size (steel tank(s)), ultimate size requires a 2 Mega Litre storage tank.
- Type 4 – 0.5 Mega Litres initial size (steel tank(s)), ultimate size requires a 2 Mega Litre storage tank.

Waste Water

The rising main for each airport utilises modified (PVC-M) pipelines of varying diameters, as below, and includes for below ground installation;

- Type 1 – 375 mm diameter initial size, 1200 mm ultimate size.
- Type 2 – 150 mm diameter initial size, 900 mm ultimate size.
- Type 3 - 150 mm diameter initial size, 450 mm ultimate size.
- Type 4 - 150 mm diameter initial size, 300 mm ultimate size.

Pumping stations have been priced on the following basis and include for the civil, engineering and building works for a ‘simple’ facility. High specification external and internal architectural finishes are excluded.

- Type 1 - 133 l/s @ 100 m head, 153 kW, 1,150 kL storage initial size, 1,641 l/s @ 100 m head, 1,893 kW, 17,718 kL storage ultimate size.
- Type 2 - 16 l/s @ 100 m head, 18 kW, 137 kL storage initial size, 851 l/s @ 100 m head, 982 kW, 9,192 kL storage ultimate size.
- Type 3 - 16 l/s @ 100 m head, 18 kW, 137 kL storage initial size, 205 l/s @ 100 m head, 237 kW, 2,217 kL storage ultimate size.
- Type 4 - 2 l/s @ 100 m head, 2 kW, 14 kL storage initial size, 91 l/s @ 100 m head, 105 kW, 987 kL storage ultimate size.

Power Supply

The power transmission line cost per kilometre is based upon aerial transmission and exclude below ground installation. The unit rates allow for the clearance of a typical corridor for the overhead power lines but exclude any exceptional circumstances such as exceptional deep ravines or the like requiring specific and costly modifications to standard installation techniques, e.g. towers over 50 m tall or of special design.
The transmission lines for each airport type is given below;

- Type 1 – 132 kV Transmission lines.

- Type 2 & 3- 33 kV Transmission lines.
- Type 4 - 11 kV Transmission lines.

Intake substations vary across the airport types and include all the civil and building works associated with the required reinforced concrete bases, above ground structures and associated external works. The different substations are based upon;

- Type 1 - Intake 132kV substation with switchgear and two 132kV/33kV 60MVA transformers.
- Type 2 & 3 - Intake 33kV substation with switchgear and 2 x 33kV/11kV 30MVA transformers.
- Type 4 – No intake substation specified.

Communications

The communications unit rate per kilometre assumes a 144 core fibre optic cables contained in a two conduit supply line with access pits every 100 metres. The rate includes for trench excavation (35% in soft ground, 65% in roads/pavements), marker tapes, backfill and reinstatement.

Gas

The high pressure gas supply pipeline is based upon 200 mm diameter for airport Types 1, 2 and 3 and 100 mm diameter for Type 4 and allows for the pipework to be buried in 'standard' type trenches at depths not less than 750 mm and not exceeding 1200 mm. All necessary regulator sets are deemed to be included in the rate per kilometre and cathodic protection.

Fuel

The fuel supply pipeline is specified as steel and varies in diameter across the various airport types. The rate includes for all necessary fittings and valves, cathodic protection, trench excavation, backfill and reinstatement. The pipe diameters are as follows;

- Type 1 – 300 mm
- Type 2 – 100 mm
- Type 3 – 80 mm
- Type 4 – no piped supply

Fuel storage tank rates include a 300 mm thick reinforced concrete base, reinforced concrete bund walls, perimeter security fencing and a nominal length of access road. The total storage tank capacities have been determined by the design team as;

- Type 1 – 60 Mega Litres
- Type 2 – 6 Mega Litres
- Type 3 – 4 Mega Litres

- Type 4 – 0.5 Mega Litres

Drainage

The specific drainage requirements for each generic airport type is to be determined.

B3.1.4 Risk & Contingency

A rate of 30% has been applied to the capital expenditure for risk and contingency.

B3.1.5 Design and Project Management

A rate of 20% has been applied to the capital expenditure for project management.

B3.2 Operational and Maintenance Expenditure

B3.2.1 Purpose

This section describes the approach taken to defining the future operational and maintenance (O&M) costs for supporting infrastructure required for the development of Type 2, Type 4 and Type 2 to 1 airport conceptual designs, at various sites provided by the Department of Infrastructure and Transport. This approach was applied to determine a potential preventive and maintenance cost for each asset of the supporting infrastructure.

B3.2.2 Scope

The analysis applied to the below listed systems from the point of existing community infrastructure until their connection with domestic distribution at the proposed airport boundary. A design life for costing purposes has been established for each asset, which is described in further details in Section B3.2.5.

The systems covered by this analysis are:

- Surface transport
- Water Supply
- Wastewater
- Power Supply
- Communications
- Gas Supply
- Fuel Supply

B3.2.3 Assumptions

The following assumptions were made in developing this methodology:

- Costs do not cover major adverse weather or equivalent acts of God
- Costs do not include loss of service value/cost
- Costs are not discounted
- Failure rates are random and equally spaced across the asset life

B3.2.4 Methodology

Costing the O&M costs over the expected life of a built system is a significant element of any lifecycle optimised design. In order to determine the O&M costs for each asset, the methodology adopted considered the following three items:

- Capital expenditures: it was assumed that the capital costs would be spent again at the end of the asset design life.

- Preventive maintenance costs: these have been assumed to be the same each year and applied annually during the asset design life. Preventive maintenance includes:
    - All statutory inspection or service activity appropriate to the system design
    - Condition monitoring programs intended to retain inherent design reliability
    - Age based service actions necessary to retain inherent design reliability

  Only significant failure modes were considered as they will drive cost with other tasks only adding minor additional cost to each inspection.

- Corrective maintenance costs: these include repairs and/or replacement costs for the asset which have been applied at a regular interval during the design life of the asset.

  Only repairs associated with significant events were assessed and costed, and frequencies were derived from benchmarked equivalent systems now in service. It was assumed that repairs would be planned and assessed in a timely manner allowing for minor activities to be grouped with significant maintenance actions to reduce overall cost.

  Certain systems are unlikely to last for the duration of the costing boundary period and will require replacement. This is generally caused by obsolescence or by normal degradation to point where continued preventive maintenance solutions are no longer cost effective versus complete replacement.

This methodology has been summarised in the figure below.

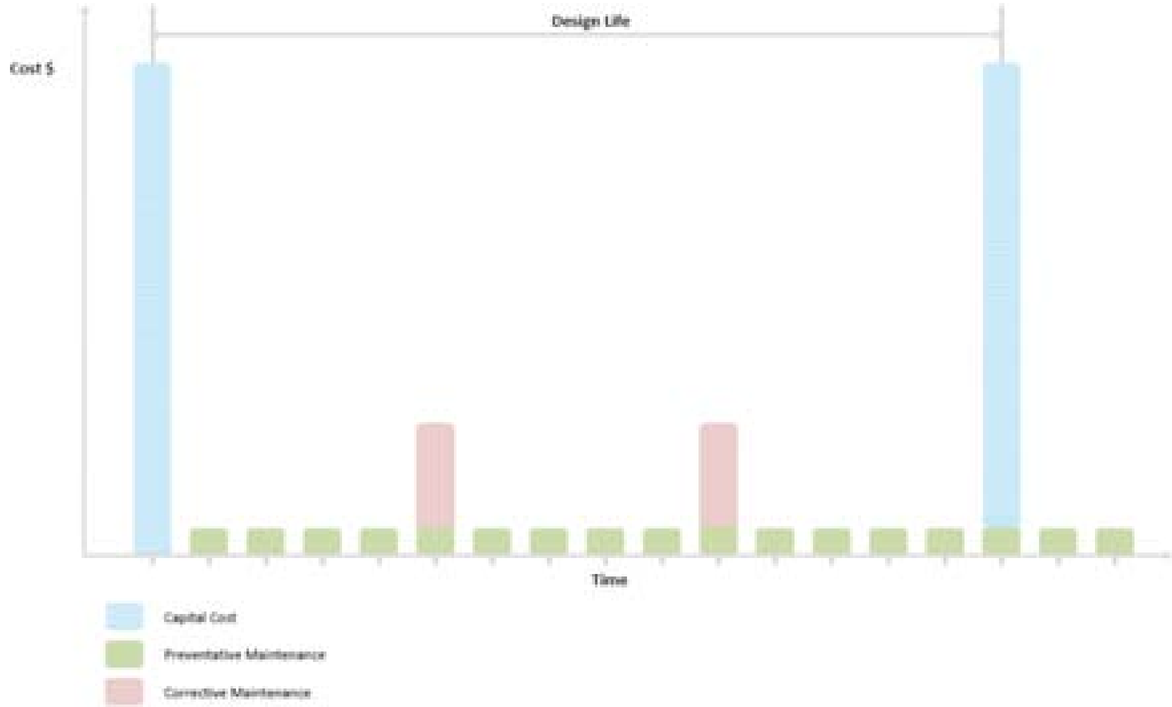


Figure B. 1 Supporting Infrastructure Asset Lifecycle

B3.2.5 Design Life

The adopted design life for each asset is shown in the table below. These design lives were determined based on known failure periods of existing assets and from subject matter expertise.

Table B.5 Asset Design Life

System	Equipment	Design Life (year)
Roads	Pavement	40
Water Supply	Pipe	100
	Pump Station	50
	Storage Tank	100
	Water Treatment Plant	30
Wastewater	Pipe	100
	Pump Station	50
	Water Treatment Plant	30
Power Supply	Transmission Line	35
	Transformer	35
	Switch	35
Communications	Cables and Ducting	35
Gas Supply	Pipe	50
	Valve Station	35
	Cathodic Protection	20
Fuel Supply	Pipe	35

System	Equipment	Design Life (year)
	Pump Station	20
	Controls	15
	Storage Tank	100
	Cathodic Protection	20

B3.2.6 Supporting Infrastructure

Surface Transport

Surface transport includes access and egress for both vehicular and train using roads and rail.

Roads

For the purpose of this study, the maintenance costs required for the road pavement have been used to determine the O&M costs for roads. It was assumed that the existing road network would require maintenance regardless of an airport development, and that in order to determine the cost specifically associated with the development of an airport, a percentage would be applied to the costs of maintaining both the existing and new roads. The adopted percentages are as follows:

- 2 to 4 lanes: 50%
- 2 to 6 lanes: 60%
- 4 to 6 lanes: 30%
- 4 to 8 lanes: 50%
- 6 to 8 lanes: 25%
- 6 lane divided clearway to 6 lane motorway: no O&M costs included as the road width is unchanged
- Realign 4 lane rural: no O&M costs included as the road width is unchanged
- Overtaking improvement: no O&M included as this work is relatively small compared to the proposed widening works.

In addition, the cost for a yearly inspection has been included into the O&M pavement costs.

Rail

The provision of a rail network was only deemed feasible for a Type 1 airport and the following was applied to the transition from a Type 2 to Type 1 airport scenario:

- $1,000,000 per km was allowed for annual preventive maintenance including infrastructure O&M, station(s) operational expenditure, train operations as well as planned and unplanned preventative maintenance.

- In terms of corrective maintenance, it was assumed that 15% of the capital expenditure would need to be spent every 20 years.

Water Supply

This asset addressed the supply of potable water for human consumption and maintenance functions not suitable for grey water. The O&M costs were based on the following items:

- Pipes: normal degradation has been assumed as the main failure mode for pipes. It was assumed that there would not be any preventive maintenance costs and that repairs would be required annually at a cost of $10,000 per km.
- Pump stations: normal wear and tear has been assumed as the main failure mode for pump stations. Four inspections per year have been allowed for at a cost of $1,000 per inspection. Repairs were assumed to occur every 5 years and would cost $50,000 per km. The pump stations have been assumed to be replaced every 25 years at a cost of $500,000 per pump station.
- Storage tanks: normal degradation has been assumed as the main failure mode for the storage tanks. An annual inspection has been allowed for at a cost of $1,000. Repairs have been assumed to occur every 5 years at a cost of $5,000 per tank while painting would only be required every 15 years at a cost of $15,000 per tank.
- Water treatment plant (new or upgrade): normal degradation has been assumed as the main failure mode for this asset. Weekly inspections have been allowed for at a cost of $500 per inspection and repairs were assumed to occur every 7 years, which would cost $300,000.

Wastewater

Wastewater included removal and where appropriate conversion to grey water for use on landscaped grounds. Items included in this analysis are as follows:

- Pipes: normal degradation has been assumed as the main failure mode for pipes. It was assumed that there would not be any preventive maintenance costs and that repairs would be required annually at a cost of $10,000 per km.
- Pump stations: normal use has been assumed as the main failure mode for pump stations. Monthly inspections have been allowed for at a cost of $1,000 per inspection. Repairs were assumed to occur every 5 years and would cost $50,000 per km. The pump stations have been assumed to be replaced every 15 years at a cost of $1,500,000 per pump station.
- Water treatment plant (new or upgrade): normal degradation has been assumed as the main failure mode for this asset. Weekly inspections have been allowed for at a cost of $500 per inspection and repairs were assumed to occur every 5 years, which would cost $530,000.

Power Supply

Power supply covered the transmission line for distribution and localised substation for conversion and control. An assumption was made that all transmission lines would be aerial and relocation of existing aerial lines has been excluded from this O&M analysis. The following items were considered in this O&M analysis:

- Transmission line: random failures such as weather events have been assumed as the main failure mode for transmission lines. Inspections have been allowed for at an interval of 4 years at a cost of $300 per km. Replacement of the transmission lines have been assumed to occur every 9 years at a cost of $50,000 per km.
- Transformer: three different sizes of transformers are required (132/33, 66/11, 33/11) for the different airport types. Normal usage was assumed as the main failure mode for these assets and annual inspections were allowed for at a cost of $20,000 for the larger transformers while inspecting the smaller transformer would cost $5,000. It was assumed that replacing any of these transformers would cost $5,000,000 and that over the design life, 40% of these transformers would fail.
- Switch: indoor (Gas Filled SF6) and outdoor (air switches) switches are required. Random failures such as overloading or human error have been assumed as the main failure mode. Two inspections per year have been allowed for at a cost of $3,000 per inspection. Minor repairs for indoor switches were assumed to cost $5,000 per switch and it was assumed that 10% of these indoor switches would fail over the design life. For outdoor switches, minor repairs were assumed occur every 2 years at a cost $10,000 per switch.
- Right of Way: vegetation clearance and road repairs were allowed for every 2 years at a cost of $49,500 per km. This cost is for 6 people working over a period of 10 days.

Communications

The communications infrastructure covers the transmission medium and associated conduits from the perimeter of the local telephone exchange to the precinct boundary of the airport.

The O&M cost estimate has been made on the following assumptions:

- The communications infrastructure consists of continuous cables and joints only. It does not contain any active equipment along the route.
- The design life of the fibre optic cabling and copper cabling is 35+ years. This estimate is based on the fact that fibre and copper infrastructure laid in the late 1970's has not systemically failed, implying that these systems will not fail for at least 35 years unless affected by exterior influences.
- The jointing associated with the fibre and copper infrastructure shall have the same level of reliability as the fibre optic and copper cabling itself.

- The pricing per failure does not take into account service outage costs, only the cost associated with fixing the physical asset.
- Cable diversion due to development site along the cable route is not included.

A standard metric for the number of failures that occur in metro-area communications infrastructure is 13 cuts per 1600km per cable per year (*Joint Capacity and Spare Capacity Placement with P-Cycles, Dale R. Thomson & Khalid Al-Snaie*), which encompasses both underground conduit systems and above ground catenary reticulation. This means that the number of failures and thus cost of O&M is linked directly to the length of cable from the exchange to the airport. The predominant cause of this failure rate is infrastructure related work that causes the fibre or copper to be damaged by workers digging in the area. Assuming three (3) cable assemblies, two (2) for fibre and one (1) for copper, the failure rate becomes approximately 0.024 failures per 1km per year. This metric is the basis of the estimated corrective O&M cost for all airport scenarios. The price per failure to fix this damage has been estimated at $15,000 per incident (this includes associated analysis work, civil work, repair and replacement costs) and it has been assumed that this would occur at mid-life.

For preventive maintenance costs, the predominant activity associated with this is assumed to be asset monitoring. This overhead has been priced at $40,000 per year. This cost is assumed to be non-dependent on the length of cable from the exchange to the airport, as the tasks associated with the asset monitoring task would not change significantly from site to site.

Gas Supply

Comprising piping and control equipment commensurate with demand and bulk mains connection configuration. Diversion of existing pipes has been excluded from this analysis and the following items were considered:

- Pipe: normal degradation has been assumed as the main failure mode for gas pipes and diversion of existing pipes has been excluded from this analysis. An inspection has been allowed for every 5 years at a cost of $10,000. Repairs were also assumed to occur every 5 years at a cost of $20,000. Costs have been defined as follows:

  Cost = 75% Cost (base fee) + 25% (cost per km)

- Valve station: normal degradation has been assumed as the main failure mode and annual inspections were included at a fee of $1,000 per inspection. Repairs were assumed to occur every 7 years at a cost of $5,000 per station.
- Cathodic protection: random failures such as human error have been assumed for the cathodic protection. Monthly inspections were allowed for at a cost of $500 per inspection. Repair and replacement costs were assumed to occur every 10 and 20 years, at a cost of $3,000 and $100,000 respectively.

An assumption was made that gas tanks would be leased and that the gas suppliers would be responsible for maintenance of the storage tanks.

Fuel Supply

Fuel supply includes pipeline supply of Avtur including pumping and control services until the site boundary. The following items were covered in this analysis:

- Pipe: random failures were assumed as the main failure mode for fuel pipes. An inspection has been allowed for every year at a cost of $10,000. Repairs were assumed to occur every 5 years at a cost of $20,000. Costs have been defined as follows:

  Cost = 75% Cost (base fee) + 25% (cost per km)

- Storage tanks: normal degradation has been assumed as the main failure mode for the storage tanks. An annual inspection has been allowed for at a cost of $1,000. Repairs have been assumed to occur every 5 years at a cost of $15,000 per tank while painting would only be required every 15 years at a cost of $15,000 per tank.

- Cathodic protection: random failures such as human error have been assumed for the cathodic protection. Monthly inspections were allowed for at a cost of $500 per inspection. Repair and replacement costs were assumed to occur every 10 and 20 years, at a cost of $3,000 and $100,000 respectively.

Diversions

Comprising works necessary to divert existing services around the site to assure continued functions have been excluded from this analysis. These costs are site specific and related to the design solution. The O&M costs are unlikely to change significantly between the before and after configurations and were assumed to have no additional future cost.

B3.2.7 Risk & Contingency

A rate of 30% has been applied to the O&M expenditure for risk and contingency.

B3.2.8 Design and Project Management

A contingency has not been applied to the O&M expenditure for project management.

B3.3 Site Excavation and Levelling

A geotechnical desk study has been undertaken on 7 potential sites for airport locations surrounding Sydney to provide comparison of site preparation costs. The assessments have been based on public domain spatial data sets (geology, topography) compiled in the project GIS. The cost estimates produced are the total nominal site preparation costs for each site.

The quantities of materials presented are estimates and for site comparison only. Unit rates have been provided based on the large quantities of materials involved. Rates for smaller quantities of materials are likely to increase. The assumptions made in preparation of these costs are detailed below.

B3.3.1 Site Excavation and levelling

- A finished site elevation was estimated by balancing cut and fill amounts using the published topographic contours in AutoCAD. For most sites 10m contours were available and 2m were available for a select number. An allowance for 10% unusable material is assumed and accounted for in the calculation.
- Material cutting percentages are based on materials shown in the NSW 1:250,000 scale geological map within the proposed cut area. Sandstone is assumed to require rock cutting, and interbedded sandstone and shales are assumed to be rippable by a standard excavator (e.g. Caterpillar D9).
- As the current site layouts assume complete site levelling, a detailed review of the site layouts with respect to local topography would likely reduce the amounts of cut and fill required.

B3.3.2 Material Re-use

- For all sites it is assumed that 10% of material will not be adequate to re-use.
- It is assumed sandstone will be useable on site as "general" fill.
- Mudstone, shales and interbedded shales and sandstones may be re-useable, however treatment and heavy compaction may be required.
- There has been no accounting for "select" fill.

B3.3.3 Acid Sulfate Soils (ASS)

The national ASS risk map provides three categories for soils within the sites;

High Potential (Class A) – greater than 70% likelihood that ASS may be present,
Low Potential (Class B) – between 6% and 70% likelihood of ASS being present,
Very Low Potential (Class C) – Less than 6% likelihood of ASS being present.

The High Potential (Class A) sites are likely to require removal on site and the volume has been estimated based on deposits being 1.5m deep. Normal rates are given as \$50/t. The conversion into cost per m^3 is given below;

Assume ASS soils weigh 20 kN/m^3.
1 m^3 = 2039.4 kg = 2.04 t
Cost per m^3 = 2.04 x \$50 = \$102

The Low Potential (Class B)I sites are likely to require an additional cost at site investigation stage, and a nominal amount has been included per m^2.

There has been no assumption of additional cost for the Very Low Potential (Class C) sites.

B3.3.4 Vegetation clearing

The quantity of vegetated areas has been calculated by image processing classification of the aerial photography on a 5m pixel resolution using GIS. The classification separated vegetated and non-vegetated areas of the imagery by assigning a colour range represented by vegetation. No account could be made for difference in light or heavily vegetated areas.

B3.3.5 Building demolition

A total count of buildings within the site areas was undertaken from aerial photography. Rates for demolition vary from \$7,000 for a timber house to \$160,000 for a heavy industrial warehouse.

As most sites appeared to contain houses with some farm warehouses, \$20,000 per building has been assumed.

B3.3.6 Risk & Contingency

A rate of 30% has been applied to the site preparation expenditure for risk and contingency.

B3.3.7 Design and Project Management

A rate of 20% has been applied to the site preparation expenditure for project management.

B4 Supporting Infrastructure

B4.1 Surface Transport

The patterns of airport traffic are normally highly dispersed by destination, with passengers accessing home and business origins and destinations throughout the wider city. Employee and commercial traffic related to the airport typically travels primarily to the edges of the city, linking the airport to those parts of the metropolitan area that are less expensive for housing and industry location.

Typically, relatively little traffic generated by airports is associated with the city centre. International observations are that the proportion of traffic related to the city centre tends to decrease for larger airports. This is partly due to the fact that larger airports tend to provide a greater transfer hub function, thereby having proportionally fewer originating and departing (O&D) passengers.

The primary concern for passengers accessing airports is reliability of travel. The penalty of missing a flight is high, so passengers value reliability more than travel speeds, and often travel early to ensure timely arrival (effectively sacrificing travel speed).

Airport connections also need to provide a high level of accessibility to distribute travellers and employees over the wider metropolitan area. Providing for widespread access to the entire metropolitan area is one reason that automobile travel is highly utilised for airport access. Automobile travel also creates demand for parking which is often a major source of revenue for airports. Taxi industry revenues are also dependent on airport road travel.

For these reasons, it is generally difficult for alternative airport access systems such as rail to be competitive with roads. Comprehensive analysis and study is needed to determine the appropriateness of providing rail services to airports. Among the factors that favour competitive rail service to airports are:

- *Airport size*, to generate sufficient passengers to cover operational costs and sustain sufficiently frequent services that reduce the time necessary to wait for trains;
- *Existing local rail service,* which lowers the cost of the dedicated airport connection and shares operating costs;
- *Easy connections to a wider metropolitan railway system,* to facilitate access to the wider metropolitan area; and,
- *Difficulty of automobile access to the airport*, which may be a factor for more distant airports.

B4.1.1 Road

The requirements for provision of a road connection(s) from an existing main arterial road to the airport were initially assessed in the absence of defined site locations. The assessment did not include the internal airport network or car parks.

A comprehensive transport network analysis would normally utilise formal transport modelling to forecast future traffic volumes in the context of planned population and employment growth. The timeframe of this study did not permit modelling analysis, so an approach was taken to develop trendline forecasts of baseline traffic growth on key airport access routes to 2021 (in some cases this indicated the need for upgrades regardless of airport traffic generation), and add airport related traffic generation to this.

Methodology

The design figures for road transportation were linked to the total passenger numbers for each airport scenario. Estimates of total daily vehicle trip generation were calculated based on a sliding scale of vehicle trips per passenger considering the increasing transfer and hub functions of larger airports, which thus generate relatively fewer vehicle trips per passenger than smaller airports. The vehicle trip generation outcomes were calibrated using observed data from other Australian airports with public transport access (dedicated bus or rail) and benchmarked against outcomes from previous EIS investigations for second Sydney airports.

Peak hour airport traffic volumes were then estimated by applying ratios based on typical traffic distribution patterns observed at other Australian airports. During the peak hour a directional bias was assumed where one direction is busier in the morning (and vice versa in the evening). An estimate of this directional bias was applied to the peak hour to arrive at the peak design figure. This amount was the basis for estimating the total number of traffic lanes (per direction) required to provide access to the airport site.

Road lane provision to meet the estimated demand was based not on the upper limit capacity of roadways, but on providing a minimum 'Level of Service' standard. Access roads to airports were nominated to a lane configuration such that the operating Level of Service would not deteriorate below a Level of Service D[1] in peak periods.

This road access model was validated by checking the predicted requirements for road provision against the actual road network provision for international airports, across the whole range of passenger numbers being considered.

Assumptions

The basic road access model incorporates the following assumptions:

- External vehicle trips generated per passenger per day = sliding scale dependent upon assumptions for mode share and hubbing (flight transfers) dependent upon airport type/size. Estimated by Arup based on data for existing Australian airports.
- Daily passengers at airport are approximately even throughout the year (i.e. daily passengers = annual passengers / 365).
- Peak hour is 10% of daily average. Estimated by Arup based on known typical traffic distribution patterns. This is a conservative figure as, for example, Melbourne and Brisbane average only 7-8%.

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[1] 'Level of Service' is a quality measure describing operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to manoeuvre, traffic interruptions, and comfort and convenience. Six Levels of Service are normally used in transport capacity and planning analysis, and are designated by letters at each level from A to F, with LOS A representing the best operating conditions and LOS F the worst.

- Each lane has 1,860 vehicles/hour maximum service flow rate at Level of Service D (prior to knowledge of the defined site locations, a standard rural arterial road was assumed with a 90km/h posted speed as the indicative road provision basis. Different service flow rates were used for existing urban roads and freeways connecting the Richmond and Wilton sites once these were specified).
- During peak hour 65% of vehicles are in one direction. Estimated by Arup based on known typical traffic distribution patterns.

Table B.6 below shows the basic road provision requirements computed for each of the airport types, excluding consideration of existing road network configurations and airport locations. Further analysis of the road connectivity for the Richmond and Wilton sites was undertaken in the context of the existing road network surrounding these sites.

Table B.6 Basic Road Access Provision Requirements

	Type 1	**Type 2**	**Type 4**
Vehicle trips per passenger per day:	1.0	1.5	1.5
Daily passengers:	82,192	13,699	1,370
Daily Trips (vehicles/day):	82,192	20,548	2,055
Peak - two directions (vehicles/hour):	8,219	2,054	205
Peak - one direction (vehicles/hour):	5,342	1,336	134
Number of lanes - one way:	3	1	1
Number of lanes - total:	6	2	2

B4.1.2 Road – Transition from Type 2 to 1 Airport

B4.1.2.1 Transport Analysis Background

This section provides a description of key background parameters and processes used in deriving the road infrastructure upgrade recommendations for different airport types.

Road infrastructure requirements were assessed by first considering ‘baseline’ or ‘business as usual’ traffic growth that would occur on key roads providing access to the airport sites, regardless of development of an airport at that site.

The timeframe and confidentiality arrangements for the work did not permit transport computer simulation modelling analysis, or the interrogation of existing transport models, to estimate future traffic volumes on the Sydney and regional network and the relationship between demographic and land-use development and traffic growth. As such, estimates of future baseline traffic volumes were derived from trend projections based on publicly available historical traffic data, which in many cases were dated.

Road vehicle traffic estimated to be generated by an airport, dependent upon the ‘size’ (i.e. number of passengers forecast per year for the airport) was then added to the baseline traffic to obtain estimates of traffic volumes for roadway capacity analysis.

Roadway capacities

The estimates of future year baseline-plus-airport generated traffic were used to derive recommendations for road upgrades based on 'Levels of Service' that describe the performance characteristics of roads.

Level of Service (LOS) is a quality measure describing operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to manoeuvre, traffic interruptions, and comfort and convenience.

Six Levels of Service are normally used in transport capacity and planning analysis, and are designated by letters at each level from A to F, with LOS A representing the best operating conditions and LOS F the worst. Each Level of Service represents a range of operating conditions and the driver's perception of those conditions.

In this study, roadway capacity planning was based on the general premise that operations on key roads should not deteriorate below LOS D in peak hours.

A conservative assumption was taken that the airport peak traffic would coincide with the general traffic peak. In practice, this is not always the case and airport peak traffic volumes can occur before or after the broader network traffic peaks.

Service flow rates for urban roads were used to determine the requirements for upgrading, as shown in Table B.6.

Upgrades were nominated such that key airport access roads would not deteriorate below a Level of Service D in the scenario where airport peak traffic generation coincides with the wider network peak.

Table B.7 Service Flow Rates for Urban Roads[2]

Service Flow Rates (one-way hourly vols) for Interrupted Flow Conditions on Urban Roads

Description	Type	Description	Level of Service				
			A	*B*	*C*	*D*	*E*
Urban	2U	2 lanes undivided	540	630	720	810	900
Urban	4U	4 lanes undivided	900	1,050	1,200	1,350	1,500
Urban	4UC	4 lanes undivided with clearways	1,080	1,260	1,440	1,620	1,800
Urban	4DC	4 lanes divided with clearways	1,140	1,330	1,520	1,710	1,900
Urban	6U	6 lanes undivided	1,440	1,680	1,920	2,160	2,400
Urban	6DC	6 lanes divided with clearways	1,740	2,030	2,320	2,610	2,900

Service Flow Rates (one-way hourly vols) for Uninterrupted Flow Conditions on Urban Roads

Description	Type	Description	Level of Service				
			A	*B*	*C*	*D*	*E*
Urban	2U - GS	2 lanes undivided	760	880	1,010	1,130	1,260
Urban	4U - GS	4 lanes undivided	1,260	1,470	1,680	1,890	2,100
Urban	4UC - GS	4 lanes undivided with clearways	1,510	1,760	2,020	2,270	2,520
Urban	4DC - GS	4 lanes divided with clearways	1,600	1,860	2,130	2,390	2,660
Urban	6U - GS	6 lanes undivided	2,020	2,350	2,690	3,020	3,360
Urban	6DC - GS	6 lanes divided with clearways	2,440	2,840	3,250	3,650	4,060
Motorway	4M	4 lane motorway	1,400	2,200	3,100	3,700	4,000
Motorway	6M	6 lane motorway	2,100	3,300	4,650	5,550	6,000
Motorway	8M	8 lane motorway	2,800	4,400	6,200	7,400	8,000

Some airport sites were located outside the Sydney urban network. Service flow rates for non-urban multi-lane highways and freeways are shown in Table B.7.

[2] PPK Second Sydney Airport, Technical Paper 13 - Land Transport, Dec 1997

Table B.8 LOS criteria for rural multi-lane highways[3]

		LOS				
Free-Flow Speed	Criteria	A	B	C	D	E
100 km/h	Maximum density (pc/km/ln)	7	11	16	22	25
	Average speed (km/h)	100.0	100.0	98.4	91.5	88.0
	Maximum volume to capacity ratio (v/c)	0.32	0.50	0.72	0.92	1.00
	Maximum service flow rate (pc/h/ln)	700	1100	1575	2015	2200
90 km/h	Maximum density (pc/km/ln)	7	11	16	22	26
	Average speed (km/h)	90.0	90.0	89.8	84.7	80.8
	Maximum v/c	0.30	0.47	0.68	0.89	1.00
	Maximum service flow rate (pc/h/ln)	630	990	1435	1860	2100
80 km/h	Maximum density (pc/km/ln)	7	11	16	22	27
	Average speed (km/h)	80.0	80.0	80.0	77.6	74.1
	Maximum v/c	0.28	0.44	0.64	0.85	1.00
	Maximum service flow rate (pc/h/ln)	560	880	1280	1705	2000
70 km/h	Maximum density (pc/km/ln)	7	11	16	22	28
	Average speed (km/h)	70.0	70.0	70.0	69.6	67.9
	Maximum	0.26	0.41	0.59	0.81	1.00
	Maximum service flow rate (pc/h/ln)	490	770	1120	1530	1900

Airport traffic generation assumptions

Total daily airport-related traffic generation was computed using an empirical relationship derived from publicly available traffic data for access roads to Australian airports (Melbourne and Brisbane). The timeframe and confidentiality arrangements for the work did not permit detailed examination of wider traffic data for a greater range of airports. Nonetheless, the empirical model was tested and verified across a range of international airports of different passenger demands[4] through assessment of the road requirements predicted to be necessary to cater for airport demand against the observed capacity of access roads for these existing airports, and also by back-calculations and comparisons to traffic demands predicted in previous EIS studies for second Sydney airports.

The form of the empirical model is shown in Figure B. 2.

[3] HCM2000

[4] Including Auckland 10.8m pax pa, Schipol 43.5m pax pa, Frankfurt 50.9m pax pa, Paris 57.9m pax pa, Chicago 64.1m pax pa, Atlanta 88m pax pa: these covering the range of demands projected for the Type4 to Type 1 airports of this study

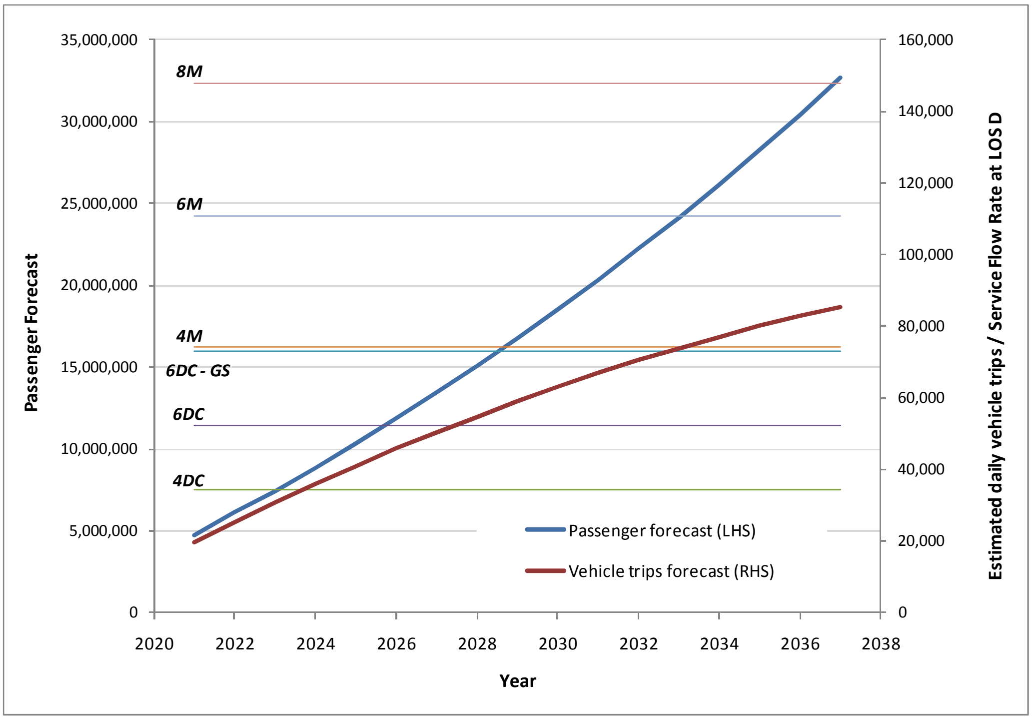

Figure B. 2 Empirical model for airport traffic generation

Figure B. 2 shows the passenger forecast projections for the transition from Type 2 airport to Type 1 airport that were provided to Arup to develop infrastructure requirements (blue line with scale on left hand side of chart), and the corresponding daily vehicle traffic generation assumed to derive road infrastructure capacity requirements (red line with scale on right hand side of chart).

As described in other working papers of this study, the empirical vehicle generation model includes an assumption that as airports increase in terms of annual passenger demands, they tend to provide an increasing transfer hub function, and improved public transport services are also normally provided including better and dedicated bus services if not rail services, thus the number of vehicle trips to/from the airport declines as a proportion of overall passenger numbers.

Figure B. 2 also shows the daily service flow rate capacities for Level of Service D used to derive upgrade recommendations for key road types (plotted against right hand scale of chart). The figure indicates, for example, that once an airport exceeds an annual passenger load of around 25m, the corresponding traffic demand is such that the ability of a four-lane two-way motorway standard road to provide access to the airport at LOS D in peak periods just begins to be exceeded, and an upgrade to a six-lane two-way motorway standard road is indicated (or alternatively two, three or more smaller roads that provide a corresponding total capacity). This is not including any baseline or background traffic that is already travelling on the existing access network.

Sydney and New South Wales population growth

Population growth is a key driver of travel growth, and as a benchmarking check the current population projections for Sydney Statistical Division and for New South Wales were reviewed to identify trends in population forecasts that might impact on baseline traffic growth for key airport access roads.

The current Australian Bureau of Statistics (ABS) and NSW Department of Planning Population projections for the Sydney Statistical Division are shown in Figure B. 3.

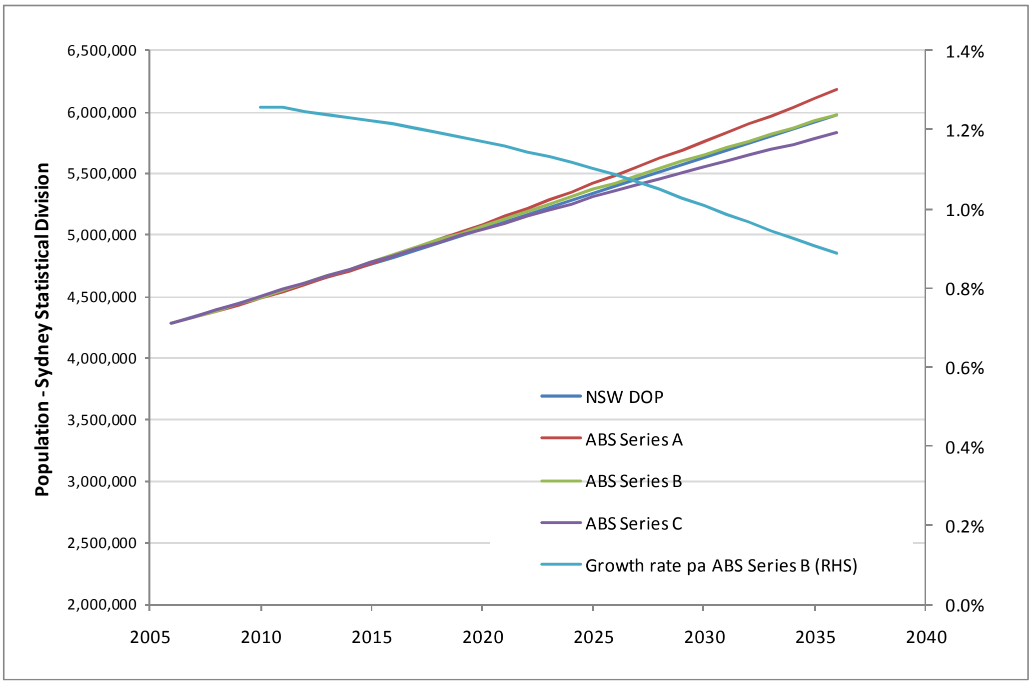

Figure B. 3 Population projections – Sydney Statistical Division

Figure B. 3 shows that the NSW Department of Planning Projections are approximately consistent with the ABS ‘Series B’ projections, with Sydney population projected to grow to around six million persons by 2036 under this scenario. The projections reflect population in Sydney continuing to grow with growth rates slightly declining from over 1.2% per annum in 2010 to 0.9% per annum by 2036.

The current Australian Bureau of Statistics (ABS) and NSW Department of Planning Population projections for New South Wales are shown in Figure B. 4.

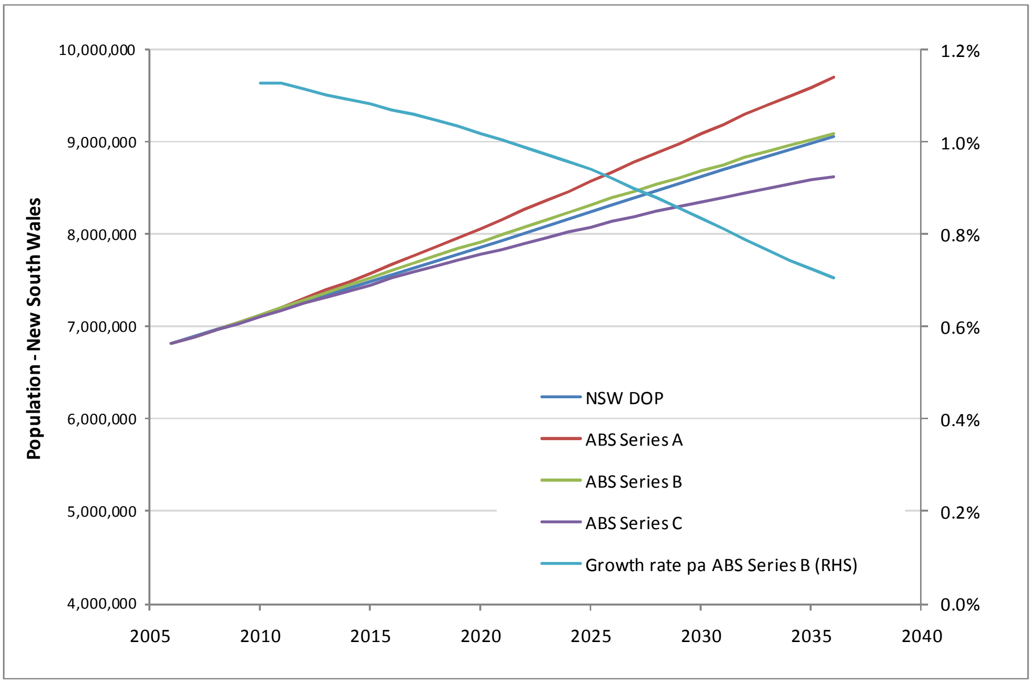

Figure B. 4 Population projections – New South Wales

Figure B. 4 shows that the NSW Department of Planning Projections are approximately consistent with the ABS 'Series B' projections. These projections reflect NSW population continuing to grow with growth rates slightly declining from over 1.1% per annum in 2010 to 0.7% per annum by 2036.

Trend / projected growth on key roads

For the purposes of airport traffic analysis it was assumed that any airport site could not be opened prior to a notional planning year of 2021, so as to allow for the necessary planning and environmental studies, processes and approvals to occur.

Baseline traffic already using the road network, regardless of an airport development, was therefore projected forward to a 2021 planning year to provide the basis for road capacity evaluations.

The only readily available source of traffic data for this analysis was from public material published by the NSW Roads and Traffic Authority (RTA) and from data collected by Arup in other studies. Whilst it holds more recent data, the RTA only makes data to 2005 publicly available for the Sydney region. Arup was not able to contact RTA to obtain more recent data for the analysis for confidentiality reasons. As the M7 was opened in December 2005, this impacted on traffic patterns and volumes on key roads providing access to some sites (Wilberforce, Luddenham).

<u>The outcomes of the analysis for all of the airport location sites under examination should therefore be considered in the context of the quality of available baseline traffic data.</u>

Baseline traffic for key roads providing access to airport locations was projected forwards based on trend growth rates observed in the historical data. Figure B. 5, Figure B. 6 and Figure B. 7 provide examples of the trendline projections for several locations on the F5

Freeway, F3 Freeway and Windsor Road respectively, these being key roads providing access to several of the locations under examination.

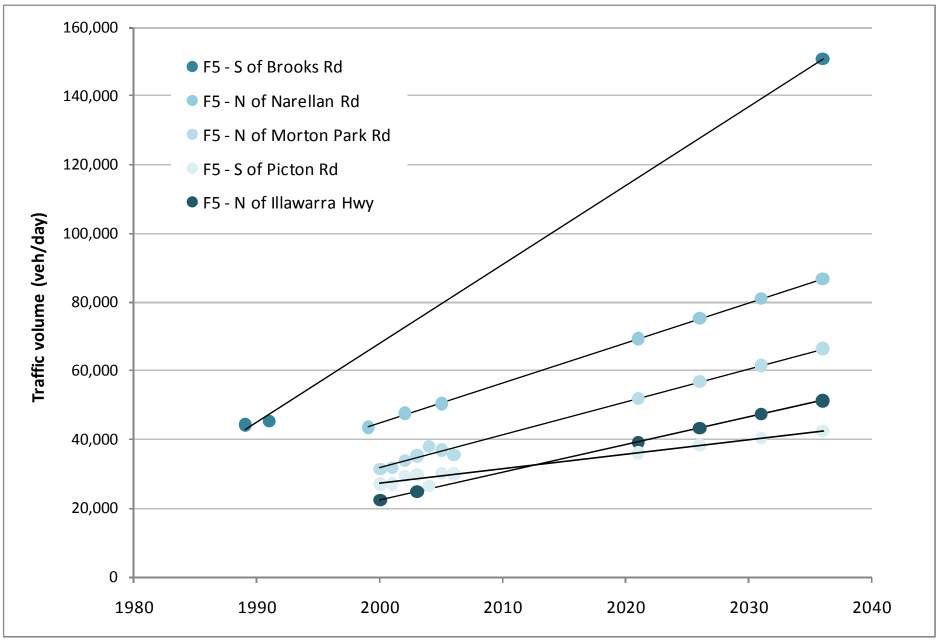

Figure B. 5 Trend projections from historical data – F5 Freeway

Trend growth rates for the F5 Freeway are generally lower than 3% per annum linear. The most significant growth in absolute terms is south of Brooks Road, where the historical trend growth rate of 3.07% per annum projects baseline traffic growth to 116,000 vehicles per day by 2021 and 150,000 vehicles per day by 2036. This trendline growth does not explicitly consider land-use changes such as development of the South West Growth Centre.

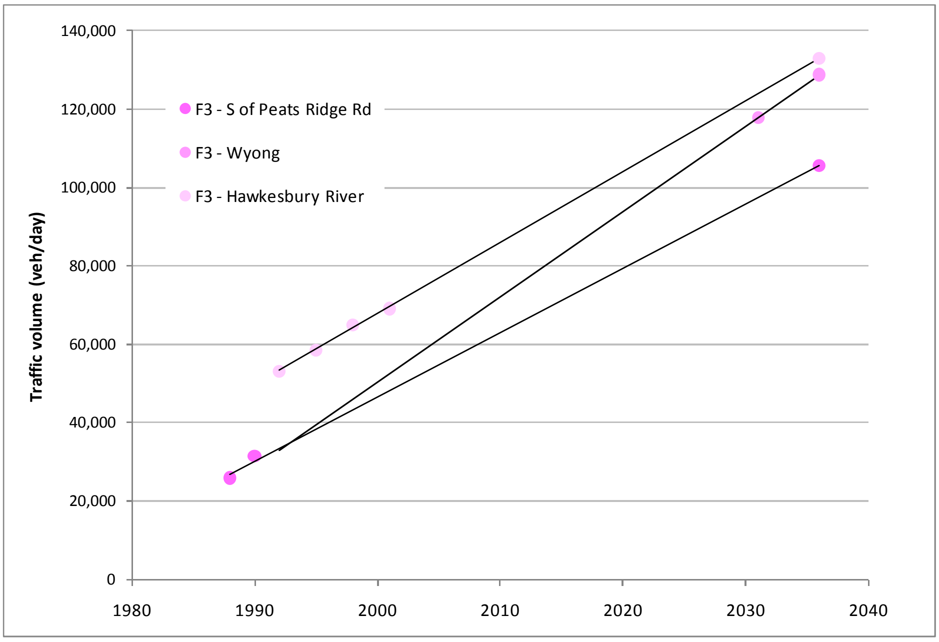

Figure B. 6 Trend projections from historical data – F3 Freeway

Historical growth rates for selected locations on the F3 Freeway are slightly higher, ranging from 2.6% (linear) at the Hawkesbury River to 4.2% per annum at Wyong. Figure B. 6 shows that at the historical trend rates, baseline traffic on the F3 at Wyong is projected to grow to 96,000 vehicles per day by 2021 and around 130,000 vehicles per day by 2036.

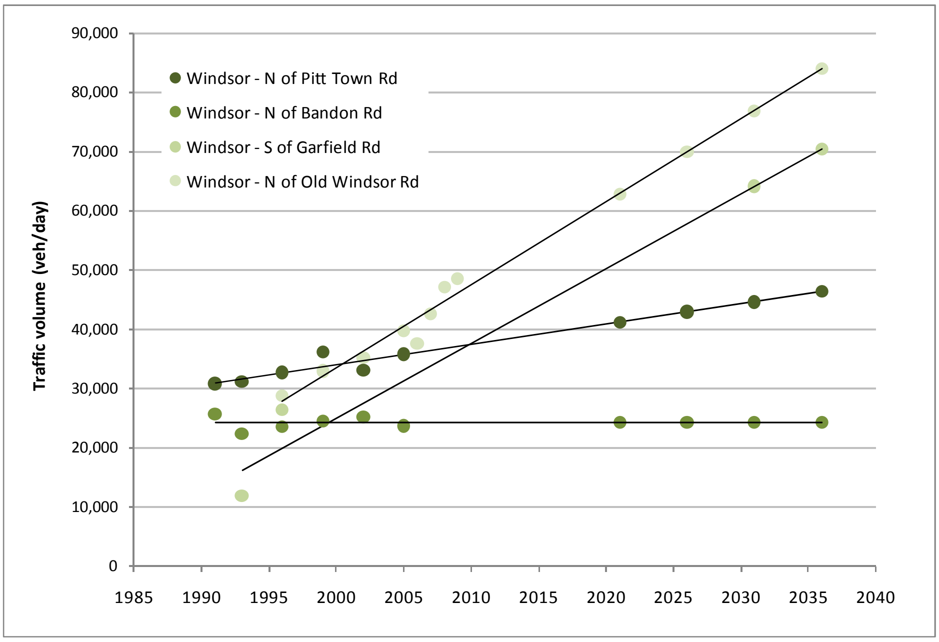

Figure B. 7 Trend projections from historical data – Windsor Road

Historical data for Windsor Road show diverging growth patterns, with low rates of growth north of Old Windsor Road (2.7%pa) and North of Pitt Town Road (1%pa), and higher rates of growth north of Bandon Road (5.8%pa) and south of Garfield Road (4.2%pa). The situation for future growth on Windsor Road will be further complicated into the future with development of the South West Growth Centre, which will result in significantly increased traffic use of Windsor Road without any additional airport development. Windsor Road will be required to have an ongoing role in providing for access to development in the South West Growth Centre, and is not suitable for upgrading to motorway standard to serve an airport development.

B4.1.3 Rail

Airport access mode choice decisions by air passengers and airport employees affect a wide range of airport planning and operational management decisions, including the development of landside facilities, airport revenue from parking and other ground transportation services, and programs to reduce growth in vehicle trips generated by the airport and associated emissions.

A variety of factors influence airport users' decisions to use rail to access airports. In an analysis of nine US airports with rail services[5], key factors identified as affecting the use of rail services to access airports were:

- The proportion of airport passengers familiar with the regional public transport system;
- The proportion of passengers with trip ends in the CBD area;
- Differential travel costs and travel times (and travel time reliability) for public transport and private car modes;
- Availability of parking both at the airport and at non-airport stations;
- Frequency of rail services;
- Proportion of passengers with little or no check-in luggage; and
- Level of convenience offered at the airport and non-airport ends of the trip (walking distances, number of level changes encountered between the ticket counters, baggage claim areas and the rail station, the need to transfer to other modes and proximity of the station to major destinations in the central business district and elsewhere in the region).

It was previously discussed that the set of travel factors specific to airports can make it difficult for rail access to be competitive to private car on a 'perceived user cost' basis. *In practice, planning for rail access to airports is normally then a policy rather than a capacity consideration*. In the majority of existing cases the capacity of bus, light rail, rapid transit, or commuter rail provided to airports is higher than that required for airport-related services[6].

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[5] Transit Cooperative Research Program Report 62, *'Improving Public Transportation Access to Large Airports'*, Transportation Research Board, 2000

[6] Transit Cooperative Research Program (TCRP) Report 83, *'Strategies for Improving Public Transportation Access to Large Airports'*, Transportation Research Board, 2002

The choice of airport access mode by passengers and employees thus has more to do with the policy decisions made for the rest of the regional transportation system than with capacity limitations inherent to any given mode. Policy issues influencing the decision to adopt/provide rail access include not only accessibility but additional considerations of sustainability, public transport usage goals, social equity, greenhouse gas emission goals etc. In these regards public transport including bus and rail has benefits over private car use.

Rail access is also seen as being important from the point of view of international service standards comparisons for airports, such as the Airports Council International (ACI) Airport Service Quality (ASQ) ratings. The overall quality of surface transport access is one of 34 components used to score an airport's ASQ rating, and the existence of rail connections is an important contributing factor to the perception of access quality. Sydney KSA (and Melbourne, Brisbane, Adelaide, Gold Coast and Cairns) is a participant in the ACI ASQ ratings system.

Given the many different factors influencing the proportions of airport travellers using different modes, it is normally considered unrealistic in practice to achieve quantitative estimates of mode use effects without the use of formalised airport ground access models. These consider the specific characteristics of the transport system and travel market, and model how airport users respond to changes in the available airport ground transportation services.

In the absence of detailed market and patronage analysis, an approach to determine the approximate timing (as distinct from 'need') for provision of rail access to each of the airport types was therefore adopted based on empirical data for primary markets associated with public transportation services at major US airports[7], shown in Table B.9 below.

Table B.9 Primary markets for public transportation services at major US airports

Mode	**Size of primary market for public mode (square km)**	**Total annualised origin/destination air passengers (one-way trips)**
Rail	155 – 230	6,600,000 – 8,200,000
Shared door-to-door bus	155 – 1,100	2,000,000 – 4,900,000
Regional express bus	700 – 1,400	1,200,000 – 1,600,000
CBD express bus	10	1,300,000
Multistop bus	200	1,000,000

Based on these data, with allowance for transfer passengers and assuming that a 'successful' rail service achieves a market share of at least 15% of airport trips, provision of a rail service was considered for inclusion for the Type 1 airport (only) after achieving a total passenger task of around 45m passengers per year. The Type 2 and Type 4 airports do not require rail access for capacity reasons.

Nonetheless a corridor for a rail service should be reserved to allow for ultimate development of dual lines to serve a Type 1 airport at a later stage of its development, although a single line may be implemented in the initial stages.

[7] TCRP Report 83

Even if not immediately implemented, it would be appropriate to plan for the integration of a rail service from the inception stage of the Type 1 airport. This would include identification and reservation of the rail corridor, planning for station locations, integration to the existing rail network and planning for interchange facilities at the airport. If the Type 1 airport were to be developed as a greenfield development, it would nonetheless be reasonable to allow and plan for the operation of rail services from the time of opening as a matter of transport policy.

Existing Public Transport Services to Australian Airports
In the current Australian context the Brisbane Airtrain carries some 9% of total passengers at around 1.5 million people per year and the Sydney Airport Link train carries some 12% of passengers at around 4 million people per year for the two airport stations (with a further 2 million per year using the two non-airport stations). The Melbourne Skybus service carries 8 percent of passengers at around 2 million passengers per year. A comparison of the operating characteristics of these services is given in Table B.9 below[8].

Table B.10 Comparison of Rail Travel to Airport in Melbourne, Sydney and Brisbane

	Melbourne SkyBus	Sydney Airport Link Train	Brisbane Airtrain
Standard full fare one-way	$16	$15	$15
Travel time to domestic airport from CBD*	20 minutes	9 minutes	23 minutes
Travel time to international airport from CBD*	20 minutes	11 minutes	19 minutes
Travel distance CBD* to domestic airport	23 km	6.6 km	15.8 km
Average speed to domestic airport	69 km/hr	44 km/hr	41 km/hr
Fare/km	$0.70	$2.27	$0.84
Peak frequency	6 per hour	8 per hour	4 per hour
Daytime frequency	6 per hour	6 per hour	2 per hour
First arrival	24 hour service	4:45 am	5:30 am
Last departure	24 hour service	11:45 pm (12:40 am Friday and Saturday)	8:00 pm
Current share of airport passengers	8.3%	12%	9%

* - Southern Cross Station in Melbourne, Central Station in Sydney, Central Station in Brisbane

The Sydney Airport Train Link was developed largely to provide enhanced facilities for the 2000 Sydney Olympics. Two Airport Express bus services (routes 300 and 350) from the city centre to the airport have been cancelled, removing competition from the rail service. There are bus services which stop at the airport but they are not dedicated

[8] *'Bus Solutions'*, Bus Association Victoria newsletter, Issue 03, October 2010

services (e.g. route 400). The Sydney Airport Corporation has stated that it is committed to increasing the public transport mode share from 15% to 20% by 2024[9].

The Brisbane Airtrain has no competition from other public transport services and operates only during more ‘economic/profitable’ times of higher passenger demand. At present, services are not available after 8:00pm, despite multiple flights arriving and departing after this time.

It has been seen that a critical success factor in the operation of airport rail services is integration into a wider regional rail system. In using existing rolling stock and sharing an existing line and stations however, a criticism of the current Sydney Airport Train has been that passengers must share and compete for space with commuters on the through railway service (the East Hills Line), and that trains have minimal provision for carrying luggage.

The selection of a train technology and rolling stock for an airport rail service is a matter of extensive study and competitive procurement process. It was therefore assumed for costing purposes that the rail link for the Type 1 airport is a heavy passenger rail system consistent with the CityRail system currently servicing metropolitan Sydney. In the event of planning a new rail system however, it would be expected that consideration should be given to the potential for a completely separate and dedicated railway service with separate track and rolling stock linking into transport hubs at key locations of the network. .

B4.2 Water

Water supply demand is assumed to be matched to passenger numbers for airport facilities and to gross floor area for business parks. Airport Business Parks vary significantly in size and are not directly related to annual passenger numbers. The water supply for business parks is matched to Gross Floor Area by industry standard estimating methodologies.

Water Supply – Airport Demand

Water demand adopted = 31 L/passenger.

This demand is assumed to include aircraft maintenance, fuel facilities, terminal precinct, freight precinct and car parks. It has been assumed to exclude Airport City/Business Parks. This demand has been benchmarked against existing water use at the below airports.

- Brisbane - 23.5 l/passenger (2007/08)
- Sydney - 31.0 l/passenger (2008)
- Munich - 28.9 l/passenger (2006-2009)

[9] Booz & Co., *‘Impact of Fare Reform on the Sydney Airport Rail Link’*, February 2010

Water Supply - Airport City/Business Park Demand

Water demand adopted = 41 kL / net ha / day

Water Supply Code of Australia, WSA 03-2002, Table 2.1, Commercial – Suburban

Water Supply - Peak Day Demand

Peak day demand = 2 x average day demand

Water Supply Code of Australia, WSA 03-2002, Section 2.2.3.2

Water Supply – Security

Two individual connections to the existing distribution network will be provided. Each will be sized for the peak day demand flow. This provides a redundancy of supply with each connection capable of supplying the airport's demands. This redundancy however is only on the airports own connection. Redundancy of the upstream supply infrastructure requires connections into separate networks. Refer to the site specific sections for further discussion on this issue.

Water Supply - Storage

Two days of on-site storage will be provided based on the average day water demand. This is an industry standard design guideline which provides the airport with two days of water supply as a back-up. The average day demand is estimated using methodology described above.

Water Supply Code of Australia, WSA 03-2002, Section 2.7

Water Supply - Infrastructure Requirements

The pumping station will be sized for transferring the peak day supply over 22 hours. This provides some redundancy to the pumping station system as the station does not need to operate continuously. This allows for a limited amount of down-time and maintenance without affecting supply.

The water demands per airport type are summarised in Table B.11.

Table B.11 Water Demand per Airport Type

	Type 1	Type 2	Type 4
Annual water usage (ML)	930	155	15.5
Average day demand (ML/day)	2.5	0.4	42.5 kL/day
Peak day demand (ML/day)	5.1	0.8	84.9 kL/day
Design flow (L/s)	80	11	1.1

B4.3 Wastewater

Wastewater flows are assumed to be matched to passenger numbers for airport facilities and to gross floor area for business parks. Airport Business Parks vary significantly in size and are not directly related to annual passenger numbers. The wastewater flows for business parks are matched to Gross Floor Area by industry standard estimating methodologies.

Wastewater Flows - Airports

Wastewater flow adopted = 25 l/passenger

This demand is assumed to include aircraft maintenance, fuel facilities, terminal precinct, freight precinct and car parks. It has been assumed to exclude Airport City/Business Parks. This demand has been benchmarked against existing wastewater flows at the below airports:

- Brisbane - 16.5 l/passenger (2007/08)
- Perth – 25.0 l/passenger
- Frankfurt – 29.0 l/passenger (2008)

Wastewater Flows – Business Parks

Equivalent Person (EP) for Business Parks = 300 EP/gross ha (WSA 02 Table A1)

Design flow assumptions

The following design flow assumptions are based on the Sewerage Code of Australia WSA 02-2002.

- Average Dry Weather Flow (ADWF) = 0.0021 * EP, based on 180L/d/EP
- Peak Dry Weather Flow (PDWF) = d * 0.0021*EP where d=2.4
- Peak Wet Weather Flow (PWWF) = ADWF * 4
- Rising main capacity = PWWF
- Sewage pumping station to have 4 hours of emergency storage

Table B.12 Wastewater Design Flow Assumption by Airport Type

	Type 1	Type 2	Type 4
Annual wastewater – airport (ML)	750	125	12.5
Annual wastewater - business park (ML)	298	0	0
Annual wastewater – total (ML)	1048	125	13
ADWF (ML/day)	2.9	0.3	0.0
PDWF (ML/day)	6.9	0.8	0.1
PWWF (ML/day)	11.5	1.4	0.1
Design Flow (L/s)	133	16	2

B4.4 Power

B4.4.1 General

The provision of a power supply to an airport is a critical infrastructure asset. Consideration must be given to providing the appropriate security of supply.

Prior to assessing the power supply requirements to each proposed site, a maximum demand for each of the airport scenarios was estimated. It has been assumed that regardless the site of the airport, the anticipated maximum demand will be consistent.

The maximum demand, and subsequent electrical infrastructure requirements, has only been based on the initial stage of the development.

The maximum demand has been estimated based on:

- The anticipated developed area and type of development for each scenario. As the majority of the demand is building loads dependent on building types, the developed areas are a key factor in estimating the total power demand;
- Using typical anticipated demand values for each different development use based on previous experience; and
- Benchmarking against other similar airports.

For all scenarios, a back up source of power is required for critical aviation services including control tower, runway/taxiway lighting, communications and navigational assets. Operational considerations may require back-up power to other services to ensure continuation of operations and thus minimising lost revenue, however this has not been considered in this assessment.

For resilience, the incoming supply for Airport Type 1 and Type 2 will require at least two separate incoming feeders each sized for the entire load. These will be supplied from either different zone substations (preferred), or if from the same zone substation, each supply will require to be supplied from separate transformers and separate bus bars. Each overhead line is to be located in separate physical easements in diverse routes to provide resilience and security of supply. This arrangement will allow the airport to continue operations in the event that one supply is interrupted.

For Airport Type 4, the alternative back-up supply could be provided from standby generators located on the site if an alternative supply is unavailable.

Discussions with Integral Energy and Transgrid, owners of the assets in the vicinity of the two sites, have not been undertaken. The assessment of likely suitable locations for supply connections has been made based on assessing available capacity of the assets in the vicinity of the two sites based on available published data. The defined works have been assumed, but confirmation of actual works will be required with both organisations.

In assessing available power options, it has been assumed, unless otherwise noted, that the existing electricity distribution networks have sufficient capacity for the airport demands and no additional power generation is required.

It has also been assumed that at the intake substation at the airport, the switchgear will be indoors and the transformers outdoors.

The areas of the Airport City / Business Park in the fully developed scenario for all airport types are significant. The exact composition of these areas is an important consideration in the calculation of the required power supply. Using the standard assumptions contained herein results in unfeasibly large power demands with the Airport City / Business Park dwarfing the airport in all scenarios. As such, no calculations for the fully developed scenarios are provided. Further information is required on the composition of these areas to provide a realistic power supply.

Consideration of installing a tri-generation facility at the airport has been considered and discussed in Section B4.6 For the purposes of this report it has been assumed that no tri-generation facility is installed.

B4.4.2 Electrical Terminology

- VA/m2 = Volt Amperes per square meter. This is a measurement of electrical power over an area.
- MVA = Mega Volt Amperes (Million Volt Amperes). This is a measurement of electrical power.
- GWh = Giga Watt Hours (10^9 Watt Hours). This is a measure of the amount of energy used.
- kWh = Kilo Watt Hours (1,000 Watt Hours). This is a measure of the amount of energy used.

B4.4.3 Land Use Assumptions

For planning and estimation purposes, there are six types of development that have been considered for each of the airport development scenarios. These are summarised, including the land use allocation, in Table B.13.

Table B.13 Summary of Stage 1 Development Type and Size

Development Type	Type 1	Type 2	Type 4
Aircraft Maintenance Hangars	37 ha	0 ha	0 ha
Fuel Facility Precinct	5 ha	5 ha	0.2 ha
Terminal	120 ha	10 ha	1 ha
Freight Precinct	15 ha	0 ha	0 ha
Car Park	5 ha	4 ha	0 ha
Business Park	30 ha	0 ha	0 ha

The following assumptions have been used to determine the maximum demand for each development type on the associated precincts:

- Aircraft Maintenance Hangars – Assumed to include aprons and hangar buildings. The built area for hangars has been assumed to be 40% of the precinct, with the demand to be similar to that for a light industrial development.
- Fuel Facility Precinct – For determination of maximum demand, it has been assumed that built area will be 100% of the entire precinct. This will allow for the main electrical demand, which is pumps and lighting.
- Terminal Precinct – This area includes the terminal building and aprons. The apron will generally take up the majority of the precinct. The demand for Airport Type 2 have been attributed a larger proportion due to higher proportion of smaller aircraft, thus less apron.
- Freight Precinct – Assumed to include aprons and warehouse buildings with airside and landside access. The built area for hangars has been assumed to be 40% of the precinct.
- Car Park – Includes car park and roads, with car parks assumed to be predominately at grade (except for Type 1 which will be multi-deck). As the demand for car parks are predominately lighting, the demand has been applied over the entire area.
- Business Park – It has been assumed that the built area will account 90% of the land area. This has been based on the following breakdown: 30% roads, 10% open space/detention, 50% site coverage of 60% developable land = 30%, average land area developed with 3 stories average height, this equates to 90% built land area.

The above is summarised in

Table B.14.

Table B.14 Summary of Stage 1 Anticipated Built Area Percentage for each Development Type

Development Type	Type 1	Type 2	Type 4
Aircraft Maintenance Hangars	40%	N/A	N/A
Fuel Facility Precinct	100%	100%	100%
Terminal	25%	50%	25%
Freight Precinct	25%	N/A	N/A
Car Park	50%	100%	N/A
Business Park	90%	N/A	N/A

B4.4.4 Maximum Demand Assumptions

For purposes of determining the maximum demand for the relevant airport types, the unit maximum demands in Table B.15 have been used. These values have been based on both recent experience and similar values used by Newcastle Airport (which in turn is based on guidelines published in Energy Australia's Network Standard NS112).

Table B.15 Summary of Maximum Power Demands

Development Type	Unit Maximum Demand [VA/m^2]	Calculated Maximum Demand [MVA]		
		Type 1	Type 2	Type 4
Aircraft Maintenance Hangars (assumed to be similar to light industrial)	15	2.2	0	0
Fuel Facility Precinct (Allowance)	5	0.3	0.3	0
Terminal	120	27	6	0.3
Freight Precinct (assumed to be similar to Warehouses)	15	0.6	0	0
Car Park	15 for multi-deck, 5 for grade	2.7	0.6	0
Business Park (Similar to an office)	100	27	0	0
Site services (Allowance)		4	2.5	0.5
TOTAL		**64**	**9.5**	**0.8**

B4.5 Communications

An airport requires a range of communications services such as voice, data and video. Some of these services will be vital to the continued and smooth running of the operation such as telephones, air traffic control links, navigation/radar data and of course ticketing and check-in data.

The communication demands at airports are:

1. Ground to air services – voice, radar, navigation, telemetry/data, etc.
2. Airfield services – navigation, weather, aircraft guidance/movement, ground services, security etc.
3. Terminal/Gate services – airline operations, passenger information, baggage, security etc.
4. Retail – shops, parking, car hire, cell phone (mobile network), freight, catering, etc
5. Business Park (if required) – offsite services, offices, freight, warehousing, parking, car hire etc.etc

There are also a series of remote aviation infrastructure that will require a communication connection. This includes remote radar, beacons, navigation aids and weather stations.

To give resilience to the communications supply it is usual to provide multiple physical routes onto the airport and engage a number of different suppliers. It is expected that the Type 1 and 2 airports will need this level of communications service. For a Type 4 airport a single supplier is sufficient.

High capacity communications connectivity is normally provided by the use of optical fibre cables or in some circumstances radio link. Some metallic multi-pair copper cables will be provided during the early phases and for ongoing emergency back-up purposes. For cable connectivity cable duct routes will be needed, and to provide competition it is usually necessary to have multiple parallel ducts. Resilience is achieved by multiple routes feeding onto the airport campus.

As the airport develops new services will be required and thus a multi-fibre cable is expected. For sizing purposes it is assumed that a large multi-fibre cable (144 core) and a moderate sized copper cable will be provided, although in practice a number of smaller cables of either type may be utilised to provide the necessary capacity and flexibility.

For the supply of high capacity services of this nature it would be usual to connect the airport systems into major telecommunications nodes. Without detailed investigation the characteristics of the local telecommunications, the exact supply points cannot be determined. From simple topological maps and external visual inspection of the facilities the capability of the local installation has been deduced.

The mode of supply for communications to the airport will depend upon the ownership structure of the airport and how the non-aeronautical income is generated. The following are some generic options:

1. Multiple telecommunication operators provide supplies to a Point of Presence(s) within the airport boundary. The Point of Presence is owned by the airport and is a “hub” for communication supplies. From the Point of Presence the airport owns the internal communication distribution network. The airport charges individual users (airlines, retail outlets) for their communication supply.

2. Telecom operators provide a connection directly to each building in the airport and the individual users (airlines, retail outlets) are charged directly by the operators.

For the purposes of this study we have assumed that Option 1 is the method of supply. The above is not relevant for Airport Type 4 as the demands and criticality of the supply are not sufficient to warrant Option 1 above. As such, Option 2 is assumed for the Type 4 airport.

For the purposes of this report the Point of Presence - Communications Hub has been considered to be a part of the internal airport infrastructure and is not included in the cost estimates.

Airports will have a high bandwidth high resilience demand and represent a source of revenue for telecommunication operators. It may be the case that the supply of the communication infrastructure to the airport boundary is provided by the operators at no cost. However, as no discussions with the operators have been conducted, the costs for a communication connection back to the nearest exchange has been included at this stage. For some of the more operationally critical service (Air Traffic Control, radar etc.) it is likely that there services will be on "private" networks, however these private networks are usually delivered via one of the established commercial network operators.

B4.6 Gas

Consideration of the major uses for gas at a site as significant and demanding as an airport will relate to the potential to use alternative fuel systems.

It is the industry standard to supply commercial catering facilities with gas as the preferred fuel. This approach has been adopted for this study. The base requirements for the gas supply for catering to the passenger throughput and the staff will be based on the passenger capacity to which the airport is sized.

The transportation of the gas is either by truck and store on-site or by a piped connection. The viability of a trucked and stored gas supply for a major development such as an airport needs to be considered against the following factors – lower security of supply, increased road connection and mass transportation of a hazardous material. A more detailed analysis based on specific sites will determine the appropriate transportation method. However, for the purposes of this report, a piped connection to the reticulated gas network has been adopted.

The use of gas as a heating medium is straightforward to assess for the size of the buildings being considered on each site and will be based on the infrastructure provided, however the abundance of flammable materials within aircraft maintenance areas will have a limiting effect on the use of gas if this is achieved with an exposed ignition source. This is a detailed design issue as the use of secondary heat, or indirect firing is readily undertaken.

The use of gas as a fuel source for cooling systems is one that can be assessed on a building by building basis with the detailed development plans for the airport. By the use of direct fired absorption chillers, this can be combined with the heating medium to maximise the end energy usage from the combustion of the fuel.

The core debate regarding gas consumption will relate to the combination of heating/cooling mediums with power generation. The readily accepted technology, in use in many systems in Sydney and around the world, is referred to as tri-generation. The gas supply is used to fuel a series of gas engine driven power generation units, with the "waste" heat from the exhaust flue and from the engine cooling water then being used to power absorption chillers and heating water clarifiers. The result is the provision of three energy streams from the one fuel source.

The viability of tri-generation systems will be dependent on many issues associated with power systems, primarily the consideration of the cost of carbon compared to the adoption of low carbon generation on the network and the escalation of the cost of gas. These issues have been studied previously and the comparative figures for gas consumption have been estimated within the 1997 Second Sydney Airport Planning Study, Planning and Design Summary Report.

The gas consumption estimates have been developed based on the 1997 report which defined 10 million passenger throughput requires 50,000 GJ/annum or 2,050,000

GJ/annum with tri-generation and for a 30 million passenger throughput, 160,000 GJ/annum or 6,160,000 GJ/annum with tri-generation. The use of these previous estimates allows a baseline equivalency to be used.

Table B.16 Gas Demand per Airport Type

		Type 1	Type 2	Type 4
No tri-generation	Annual Demand	160,000 GJ	27,000 GJ	3,000 GJ
	Connecting Pipe	225 dia	125 dia	50 dia
With tri-generation	Annual Demand	6,160,000 GJ	103,000 GJ	10,000 GJ
	Connecting Pipe	1,000 dia High Pressure	200 dia	75 dia

The ability to confirm an adequate reticulated gas supply have been limited by our inability to discuss the project or the sites with the gas supply companies. The available resource has thus been examined on a broad basis as to the potentially available resource connection location.

The major gas pipeline within the Sydney Basin is owned and operated by Jemena Gas Networks. The Jemena Gas Network are classified as distribution pipelines and are dealt with in a consolidated access arrangement for the purposes of the National Gas Law. The network receives gas from the Moomba-Sydney natural gas pipeline, the Eastern Gas Pipeline and coal seam methane from AGL at Camden.

The airport will be considered as part of the critical infrastructure for NSW. Should the use of tri-generation be considered as one of the primary power supplies to the airport, consideration would be required to duplicate the gas supply arrangements such that an alternative fuel access route would be available for redundancy. There is a significant cost associated with this and such a choice would need to be examined alongside issues of reliability with the power supplies. For this report, we have assumed the need for a high reliability, but no redundancy of the gas pipeline and supply point themselves. We have also assumed that no tri-generation system will be installed.

B4.7 Fuel

Airfields generally use two types of fuel, Avgas and Avtur. Avgas is used by predominately piston engine aircraft, the fuel being essentially high octane, clean petrol or gasoline. Avtur or its more common designation of Jet-A1 is used by jet or turbine aircraft and is essentially refined and clean paraffin. Continuity of supply usually means that bulk fuel storage is provided at the airport. This storage facility and the apron hydrant system (JUHI – Joint User Hydrant Installation) is usually owned and operated by a consortium of oil companies.

In the area of Australia under consideration there are currently three major sources of aviation fuel, the oil refineries of Shell and Caltex and sea transport. The Shell Clyde refinery is located near Parramatta and the Caltex Kurnell refinery is located in Botany Bay. The sea terminal in Botany Bay is used for aviation fuel and there are sea terminals used for other services (and perhaps aviation fuel) located at Gore Cove, Sydney Harbour, Port Kembla near Wollongong and Newcastle.

Fuel demand is related to the number of flights and the distance to be travelled from the airport. Hence an airport (such as Adelaide) with the majority of flights relatively short-haul domestic will have an average daily usage on the lower side, compared to Sydney (KSA) with a larger proportion of long-haul and ultra long-haul international flights.

For sites with 30M Pax or more a fuel pipeline will be the most cost effective and environmentally acceptable method. For smaller airports consideration must be given to the hazard of daily multiple fuel tanker deliveries against the capital expenditure of a piped supply.

Although rail transportation is used in some locations, this mode of fuel transport has largely disappeared as a capability in NSW and a demand that exceed a few trains per week become logistically difficult (for the railway with commuter demand). Dependent upon proximity of suitable rail link it is possible rail transport is viable for some of the airport options, but given the relatively short distances to fuel refineries/terminals a pipeline is considered the most probable.

Each fuel transport mode is discussed in the following sections.

B4.7.1 Road Transport

A semi trailer in Australia can carry 40,000 litres of unleaded petrol and a B double carries only 57,000 litres due to on road weight restrictions. B double fuel tankers have space to carry 68,000 litres of product which allows for future road weight law changes.

Tankers have to be designed to Australian Dangerous Goods (ADG) code and Australian Standards AS2809 and Road Tank Vehicles for Dangerous Goods. Parts 1 & 2.

It is considered that Avgas will be transported by road tanker for all airport types, Avtur will not except in the Type 4 scenario.

B4.7.2 Rail Transport

A standard US rail tankcar contains approx 34,500 gallons (US) or 134,400 litres. A range of other sizes are possible. Tankcars used in NSW contained approx 100,000 litres before the service was discontinued.

The end of the fuel trains in NSW came from a decision by Shell Australia to close the rail loading point at Sandown (near Parramatta). Located near the end of the short Sandown branch in Sydney’s western suburbs, the rail gantry had been the only place where liquid fuel could be loaded onto railway wagons for some years and was closed in 2010 due to the need to free-up train paths for passenger services and the need for extensive modernisation to meet current safety requirements.

Generally 20 railcars carry a total of about one million litres and thus suitable for the both Type 2 airfields. The number of trains required for a Type 1 airfield would be extremely difficult to supply without a dedicated freight rail link between the supply point and the airfield.

B4.7.3 Sea

Sea transport of aviation fuel is currently used for Sydney and other airports. Australia does not refine enough aviation fuel to meet its needs and thus imports fuel, predominately from Asia. Sea terminals (generally ports) are located close to several of the major airports and aviation fuel arriving by ship is then, in most cases, piped directly to the respective airport. A small amount of storage is usually located at the sea terminal.

B4.7.4 Pipeline

Pipelines are the most common method of transporting fuel to an airport and all major airports use this technique. A pipeline can be constructed to cater for any amount of fuel required and there are examples of new major airfields having a pipeline consisting of a single large supply pipe. In today's world security of supply must be a consideration. There are two refineries in the Sydney locality, Clyde and Kurnell, both currently supplying the existing international airport by pipelines.

A fuel pipeline will normally be constructed in steel and some environmental regulations require secondary containment with integral leak detection. Dependent upon the terrain a fuel pipeline can go approximately 60km without the need for intermediate facilities, such as pumps and regulators, but would require cathodic protection at regular intervals unless made of stainless steel.

Fuel pipelines generally follow major transport routes with environmental regulations requiring the pipeline to avoid water courses, water supply catchments and reservoirs and residential areas. A typical easement for a pipeline would require 1m wide strip of land. Fuel pipelines can be laid in the sea and this may be an alternative to difficult land routes in some circumstances.

An Environmental Impact Assessment would be required under NSW legislation.

B4.7.5 Design Assumptions

Avtur

The preliminary provision is for 5 days supply to be provided in on-site airport storage. The suitability of this level of storage depends upon the resilience of the supply, proximity to refinery, nearby off-site storage capacity and ratio of peak demand to average demand.

- 5 days supply to be provided in on-site storage;
- On-site storage is in above ground tanks;
- Piped fuel supply to Type 1 and 2 airports; and
- Road tankers to provide fuel for Type 4 airport.

Table B.17 Avtur Fuel Demand Assumptions

	Type 1	**Type 2**[2]	**Type 4**
Average Daily Use[1] (ML/day)	12	1.2	0.1
Storage (ML)	60	6	0.5

Section 3

Airport Infrastructure Costing Methodology

	Type 1	Type 2[2]	Type 4
Method of Supply	Dual pipelines to refinery	Dual pipelines to refinery	Tankers

1. Estimated based on anticipated number of flights and the distance to be travelled from the airport
2. Assumes 10% international flights. If 30% international flights, demand will increase to 1.8ML/day

Avgas

Avgas is only required for small piston engine aircraft (i.e. 6 seater aircraft). The general aviation use at each airport type has not been defined, hence it is not possible to definitively calculate the Avgas fuel demand. The Avgas demand will be dependent on the number of movements, the types of aircraft and the destinations of travel. The following assumptions have been made:

- Each airport scenario has the same general aviation use;
- 10 general aviation departures per day;
- 300L of fuel per departure (benchmarked against Dubbo Airport);
- Minimum on-site storage of 7 days;
- On-site storage volume of 50,000L (to match standard tank sizes); and
- Method of supply will be by tanker to all airport types.

Appendix C

Characteristics for Template Airports

All information in the table are indicative and solely for the purpose of an overview which should not be used for any other purposes.

22/02/2011

draft for discussion only

Airport characteristics		Characteristics for template airports																
		Type 1					Type 2				Type 3				Type 4			
Category		Full Service International airport servicing all RPT segments					Land Constrained full service interantional airports servicing all RPT segments				Limited service airports servicing all RPT segments				Minimum service airport servicing GA and limited RPT			
Indicative Land Use		Minimum 900 Ha		Modern Unconstrained Airport - with Airport City (4000 Ha)			Minimum approach 400 Ha		Max 2400 Ha		Minimum approach 250 Ha		600 Ha		Minimum Approach 120 Ha		400 Ha	
Capacity		Pax	aircraft /hr	Pax	Aircraft /hr		Pax	aircraft /hr	Pax	aircraft /hr	Pax	aircraft /hr	Pax	aircraft /hr	Pax	aircraft /hr	Pax	aircraft /hr
		30 million	90 nos	120 million	130 nos		5 million	40 nos	30 million	40 nos	5 million	40 nos	25m	40 nos	0.5 million	NA	1 million	NA
Airside	Runway	Cat I / II precision					Cat I / II precision				Cat I / II precision				I-NP -Code 3 , NI Code 3, NI Code 2			
		Geometry	Code	Aircraft	Strip width	Separation	Geometry	Code	Aircraft	Strip width	Geometry	Code	Aircraft	Strip width	Geometry	Code	Aircraft	Strip width
	Main Runway (1)	3500m - 4000m L 60m W	4F	A380	300m	1525m - 2600m	3000m - 3500m L 45m W	4E	B787	300m	1650 - 2200m L 45m W	4C (note4)	B737	300m	1600m L 30m W	3C	Ex jet	300m
	Parallel Runway (2)	3500m - 4000m L 60m W	4F	A380	300m		NA				NA				1100m L 23m W	2B	GA Flying Training	90m
	Future Runway(3) - 2km Stagger	3500m - 4000m L 45m W	4E	B747 / A340	300m	1036m - 1525m									Parrallel Runway (Note 6) wth runway separation at 214m			
	Taxiways	Clearance to Objects	Width	Rwy/Twy Separation		Twy/Twy Separation	Clearance to Objects	Width	Rwy/Twy Separation	Twy/Twy Separation	Clearance to Objects	Width	Rwy/Twy Separation	Twy/Twy Separation	Clearance to Objects	Width	Rwy/Twy Separation	Twy/Twy Separation
	Main Runway (1)	57.5m	25m	190m		97.5m	47.5m	23m	182.5m	80m	26m	18m	63m	44m	26m	18m	63m	44m
	Navaids																	
	ILS	yes					yes				yes				no			
	NP	yes					yes				yes				yes			
	DVOR/DME	yes					yes				yes				no			
	CT	yes					yes				yes				yes			
	ARFFS	yes					yes				yes				no			

	Public Safety Area (note 7)	yes		yes		yes		yes	
Airport characteristics		**Characteristics for template airports**							
		Type 1		**Type 2**		**Type 3**		**Type 4**	
Category		Full Service International airport servicing all RPT segments		Land Constrained full service interantional airports servicing all RPT segments		Limited service airports servicing all RPT segments		Minimum service airport servicing GA and limited RPT	
	Aircraft Maintenance Precinct								
	Approximate Land Area	37 Ha	75 Ha	NA	50 Ha	NA	5Ha	NA	3 Ha
	Fuel Facilities Precinct								
	Approximate Land Area	5 Ha	15 Ha	5 Ha	12 Ha	1 Ha	1 Ha	0.2 Ha	0.5 Ha
	Terminal Precinct (Including Aprons)								
	Approximate Land Area	90 Ha	450 Ha	10 Ha	60 Ha	5 Ha	40 Ha	1 Ha	5 Ha
	Approx. Contact Gates	60 nos	100 nos	10-15 nos	60 nos	10-15 nos	60 nos	NA	NA
	Freight Precinct (Including Aprons)								
	Approximate Land Area	15 Ha	100 Ha	NA	80 Ha	NA	10 Ha	NA	NA
Landside	**Car Park Areas - Public, Staff, Rental**								
	Approximate Car Park Areas	18 Ha	25 Ha	4 Ha	15 Ha	2.8 Ha	7 Ha	NA	1 Ha
	Airport City / Business Parks								
	Approximate Land Area	30 Ha	1000 Ha	NA	600 Ha	NA	100 Ha	NA	70 Ha

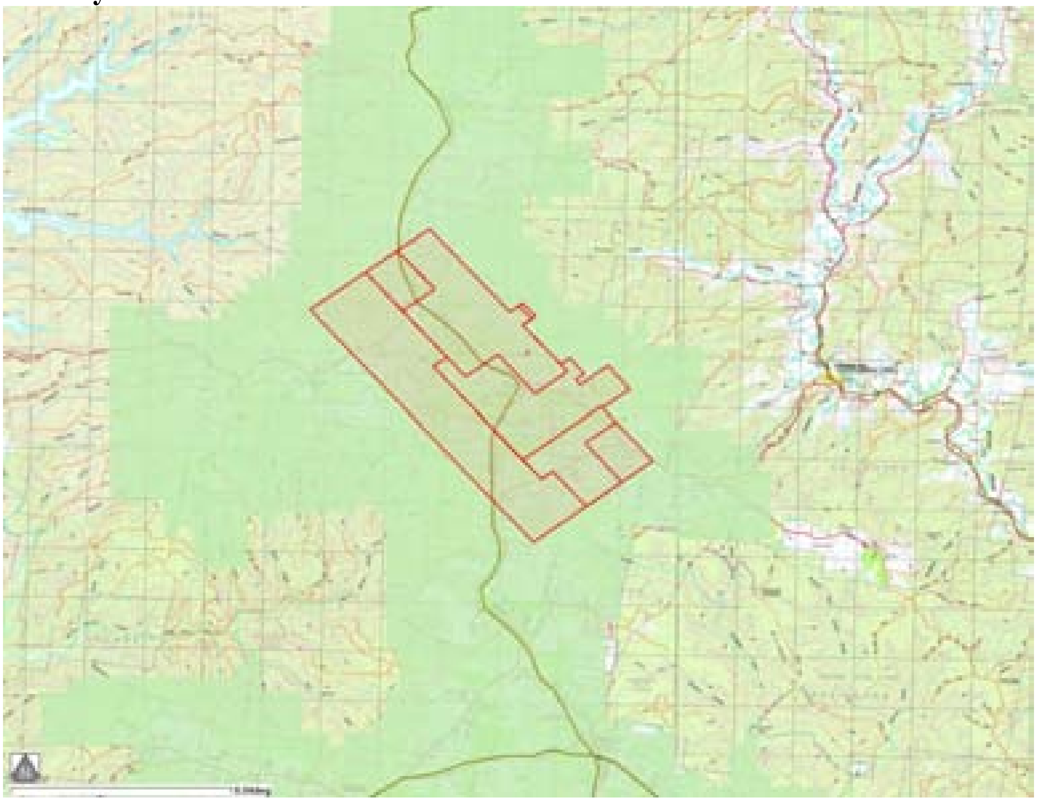
General Notes

All information in the table are indicative and solely for the purpose of an overview which should not be used for any other purposes.

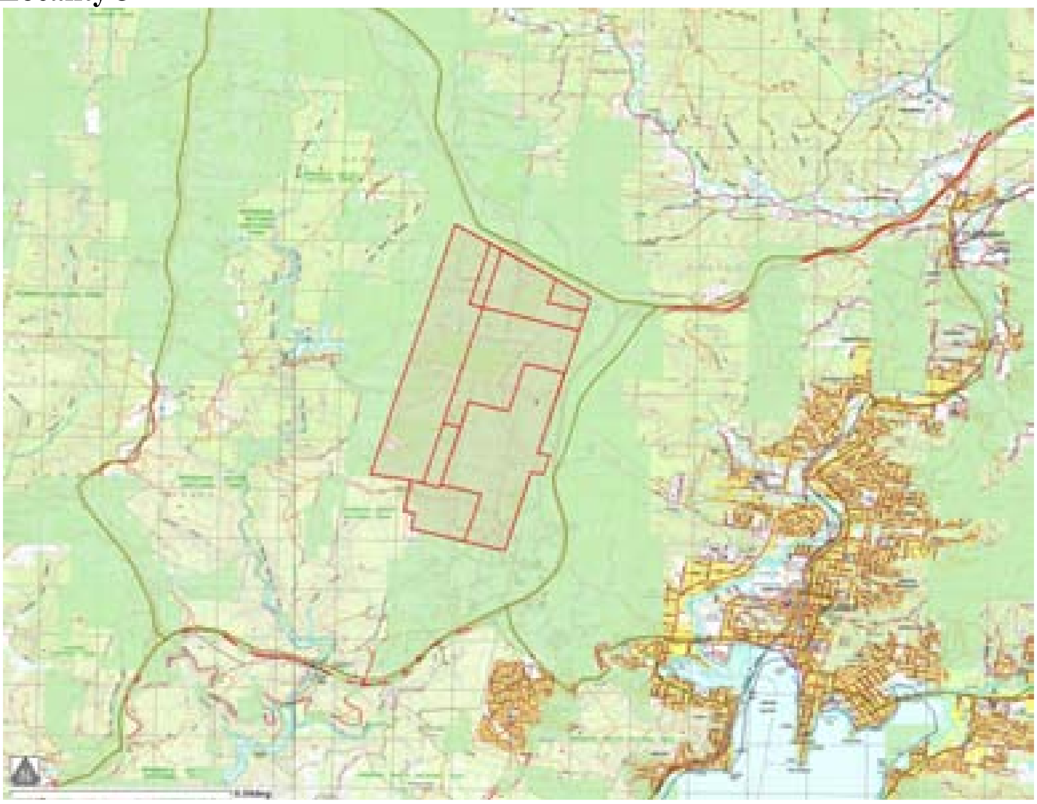
Appendix D

Airport Localities

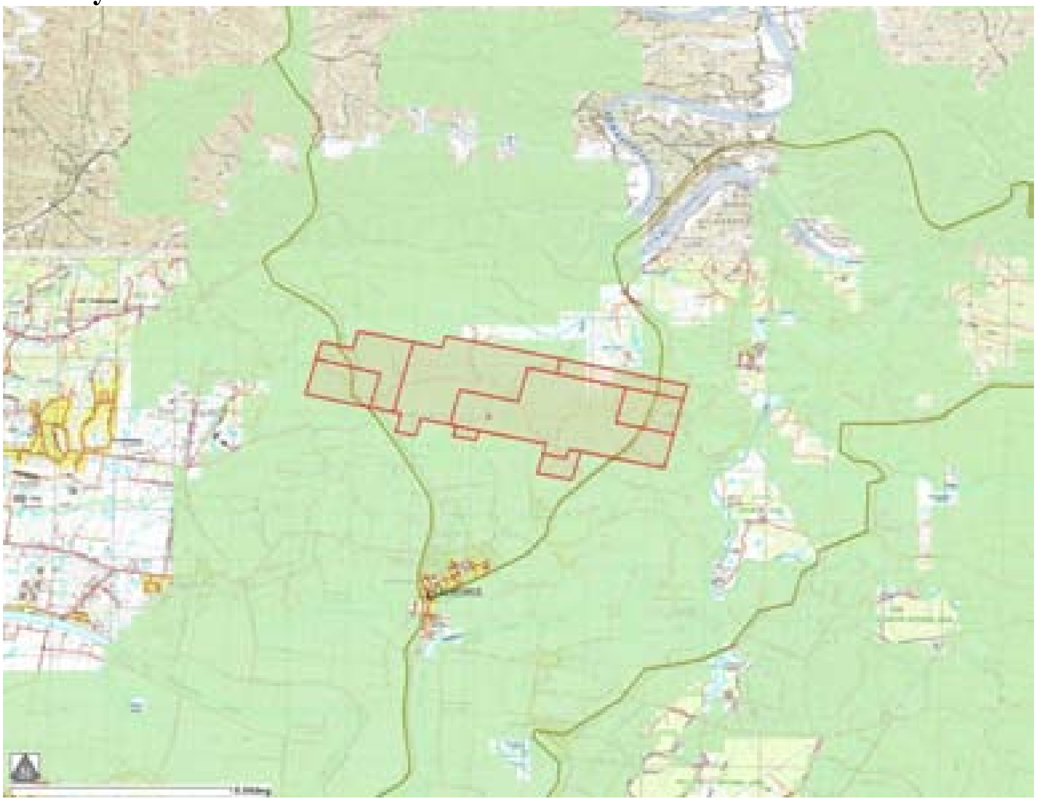
Locality 4



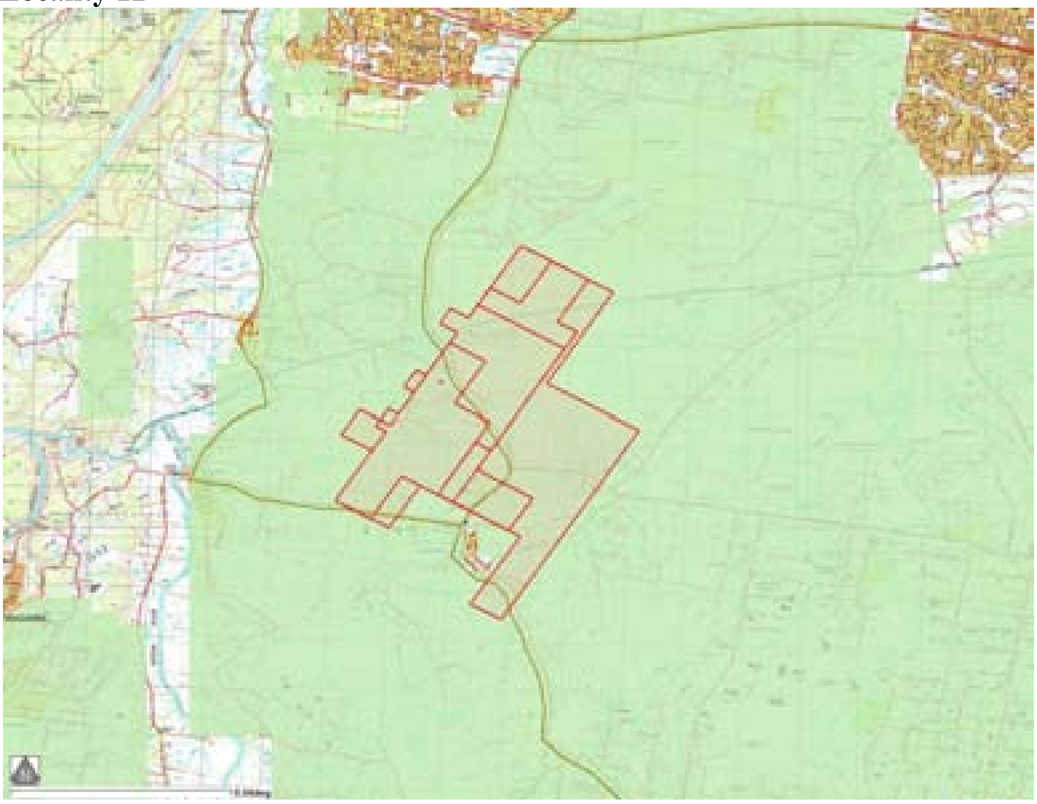
Locality 5



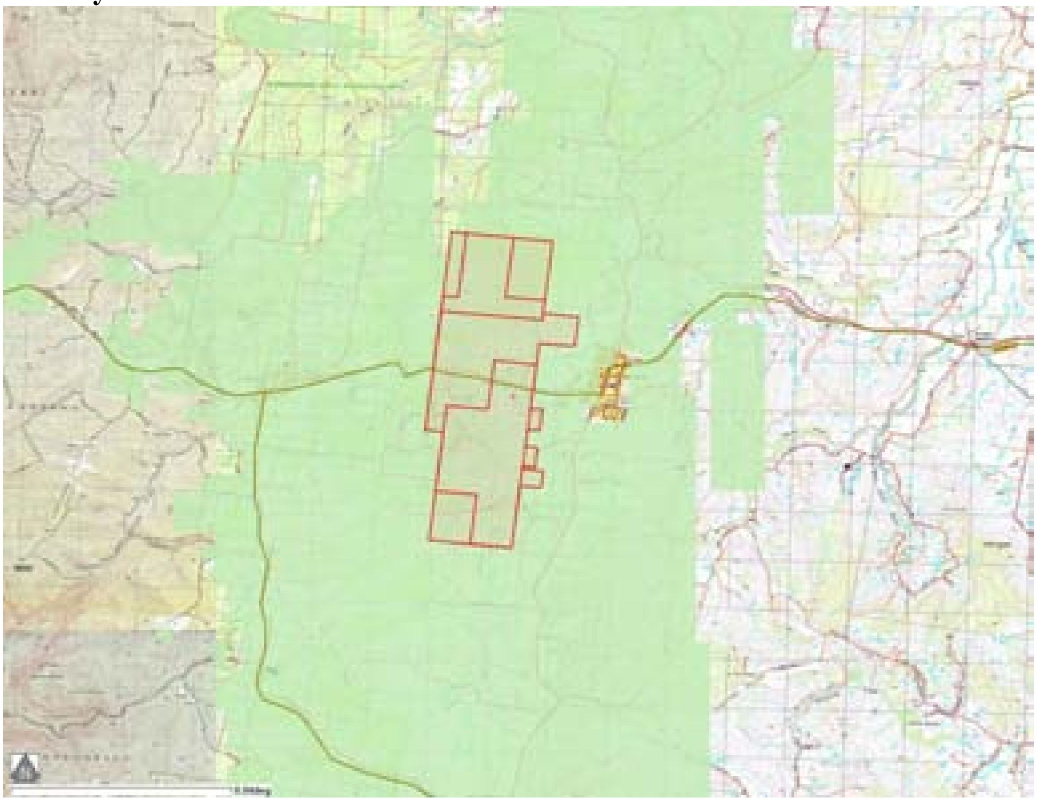
Locality 10



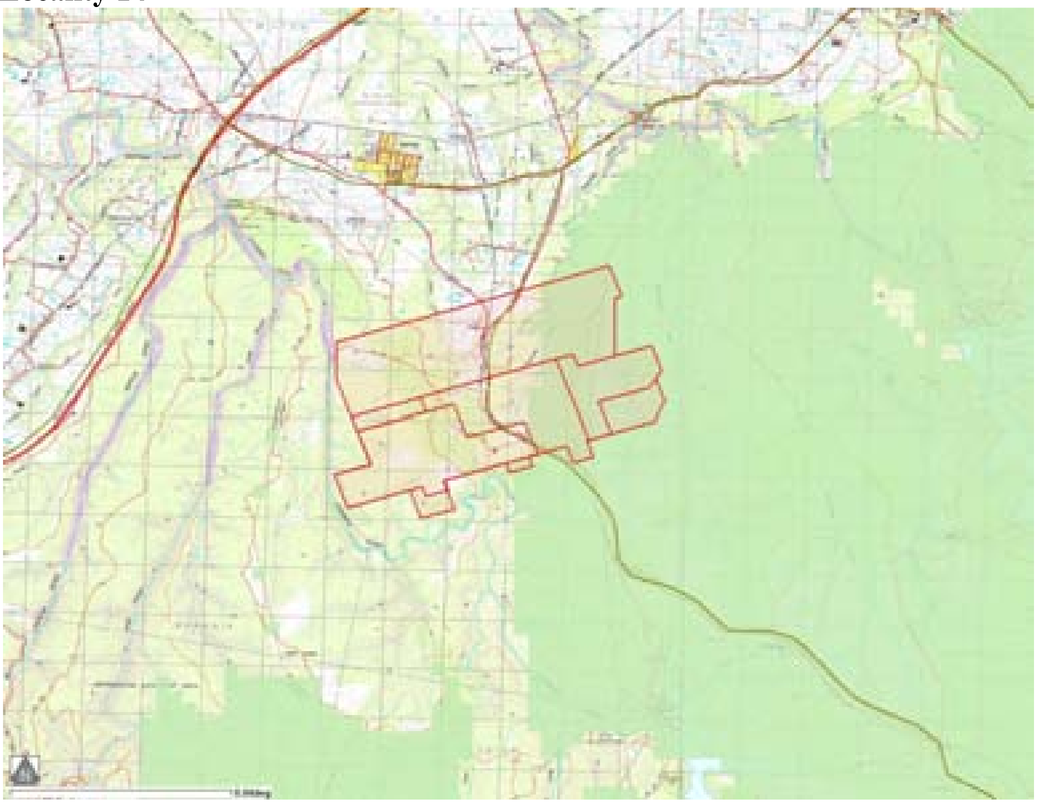
Locality 12



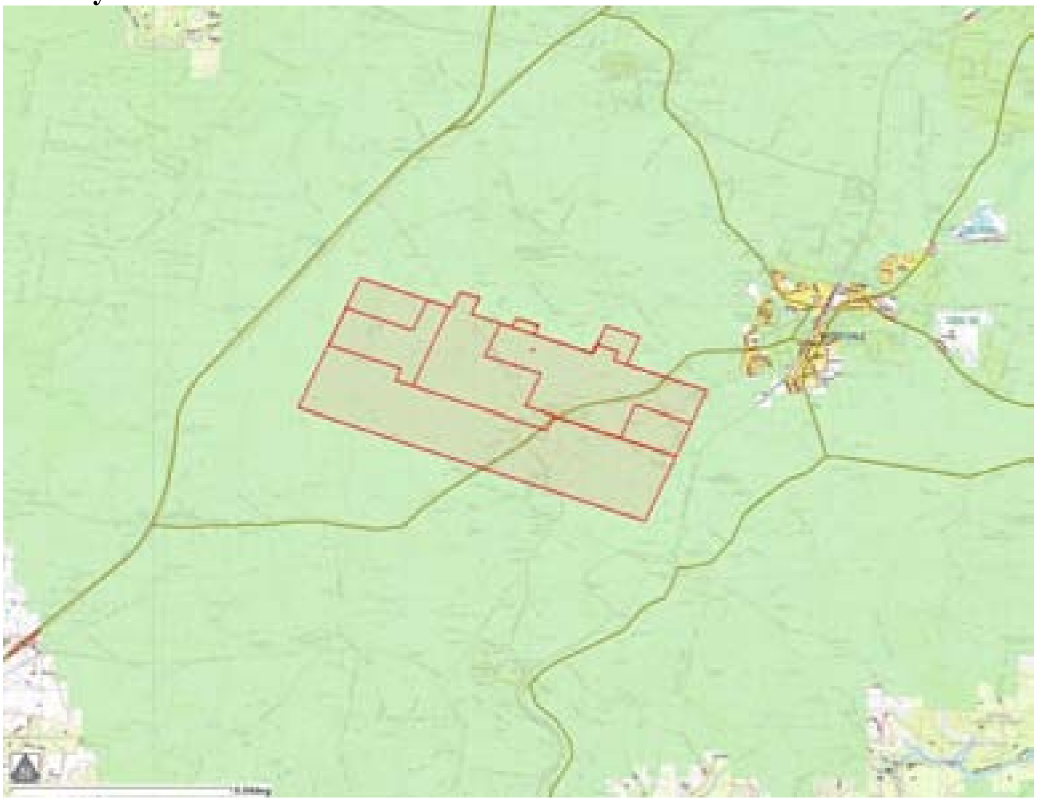
Locality 13



Locality 14



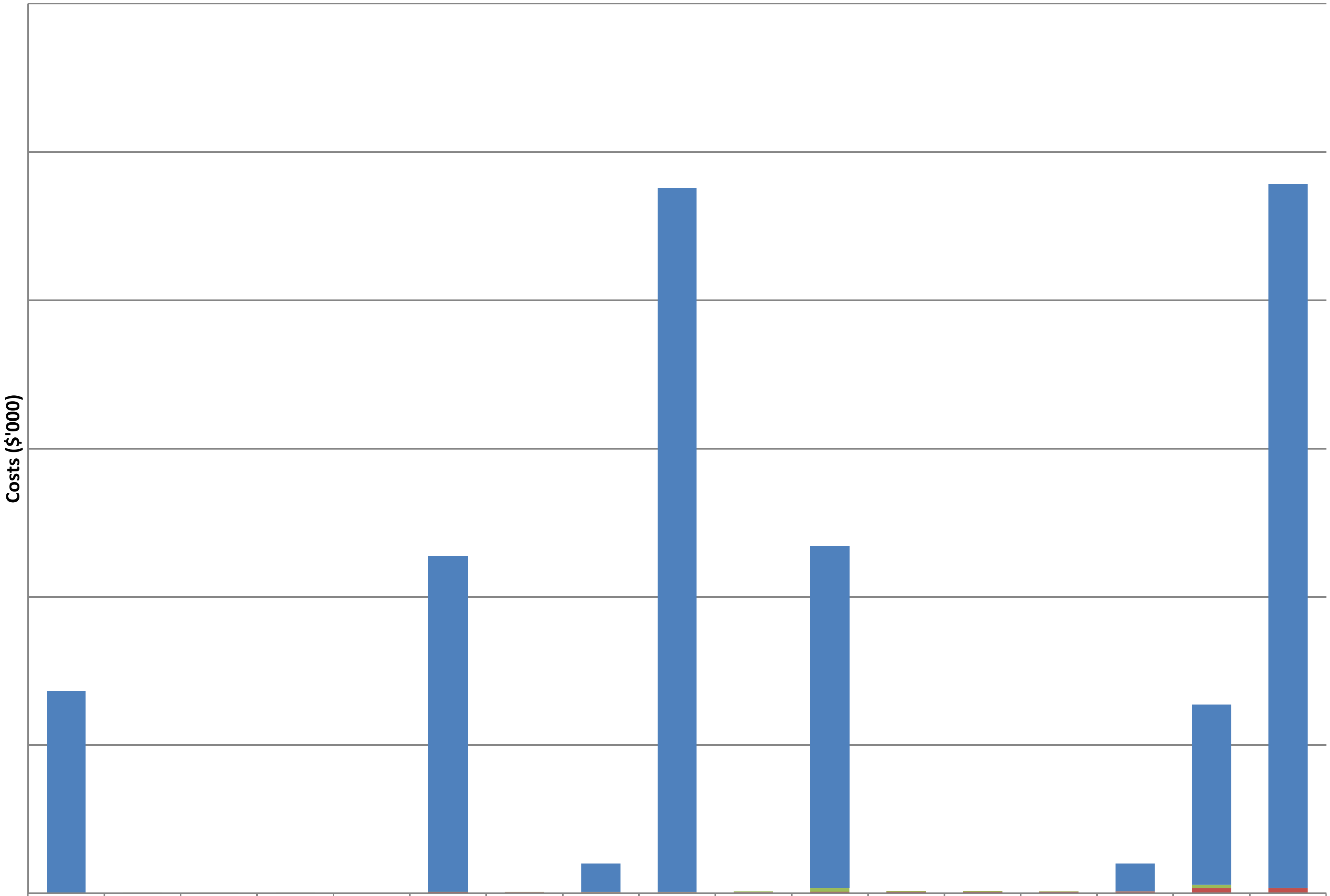
Locality 15



Appendix E

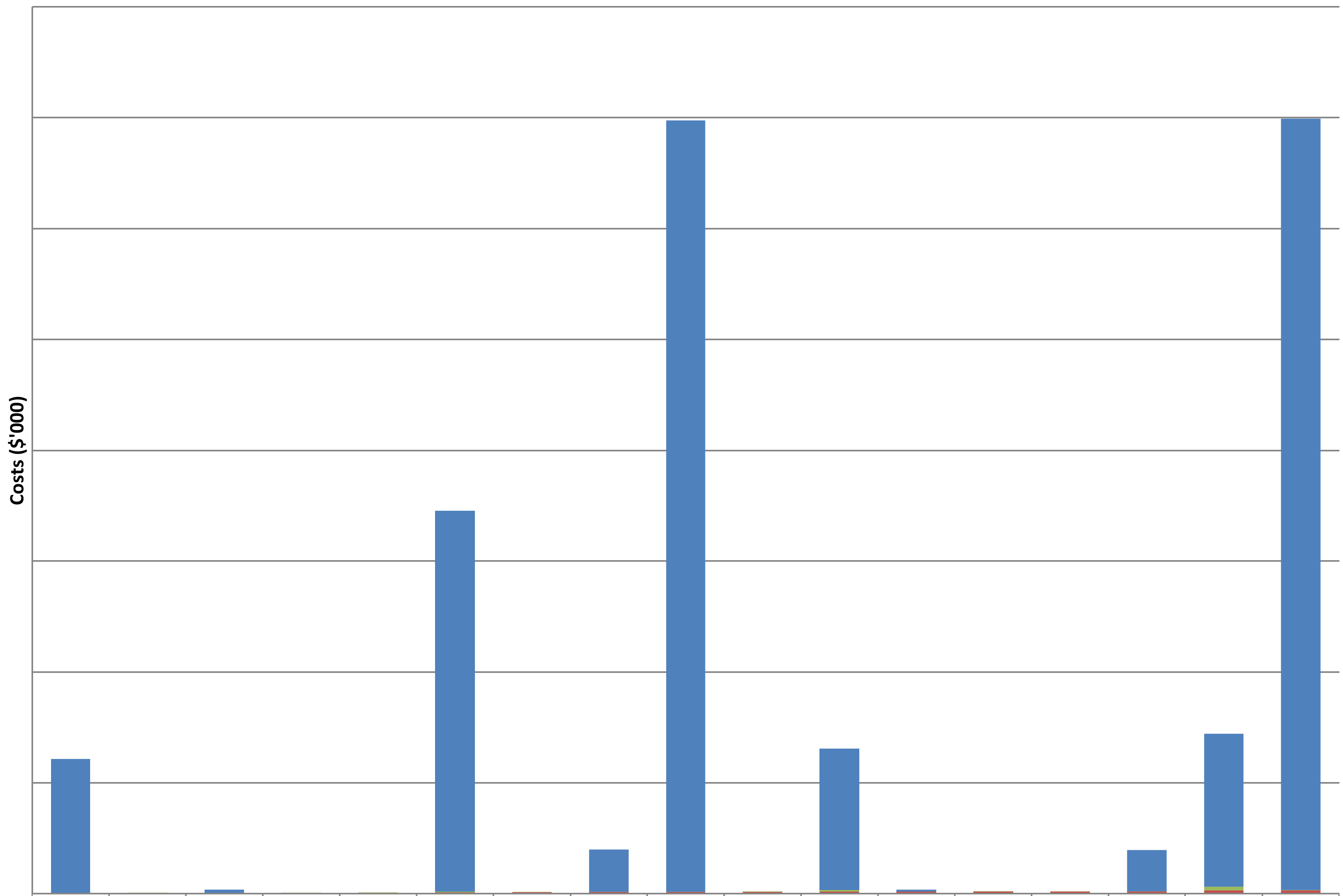
Input into Economic Modelling

Locality 4 - Kulnura
Type 2 to Type 1 Transition Costs



	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12	Yr 13	Yr 14	Yr 15	Yr 16
Capital Expenditures	$1,358,655	$-	$-	$-	$-	$2,265,450	$-	$191,625	$4,747,500	$-	$2,302,500	$-	$-	$-	$187,350	$1,216,950	$4,747,500
Corrective O&M Costs	$349	$349	$349	$349	$349	$4,767	$674	$681	$674	$3,924	$24,631	$674	$674	$674	$681	$20,968	$674
Preventive O&M Costs	$5,330	$5,330	$5,330	$5,330	$5,330	$8,464	$8,464	$9,332	$9,332	$9,332	$12,786	$12,786	$12,786	$12,786	$13,654	$37,964	$37,964

Locality 5 - Somersby
Type 2 to Type 1 Transition Costs



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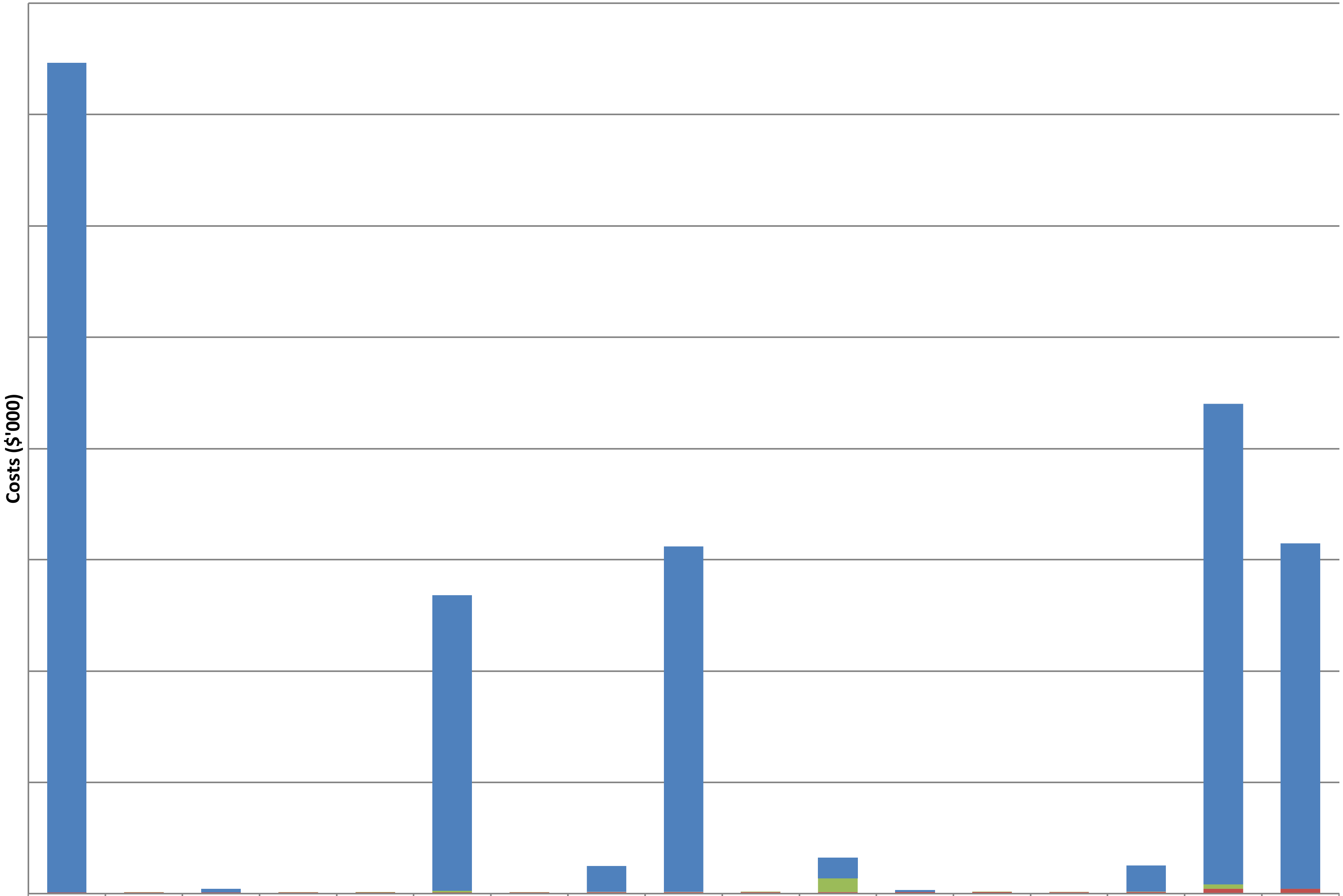
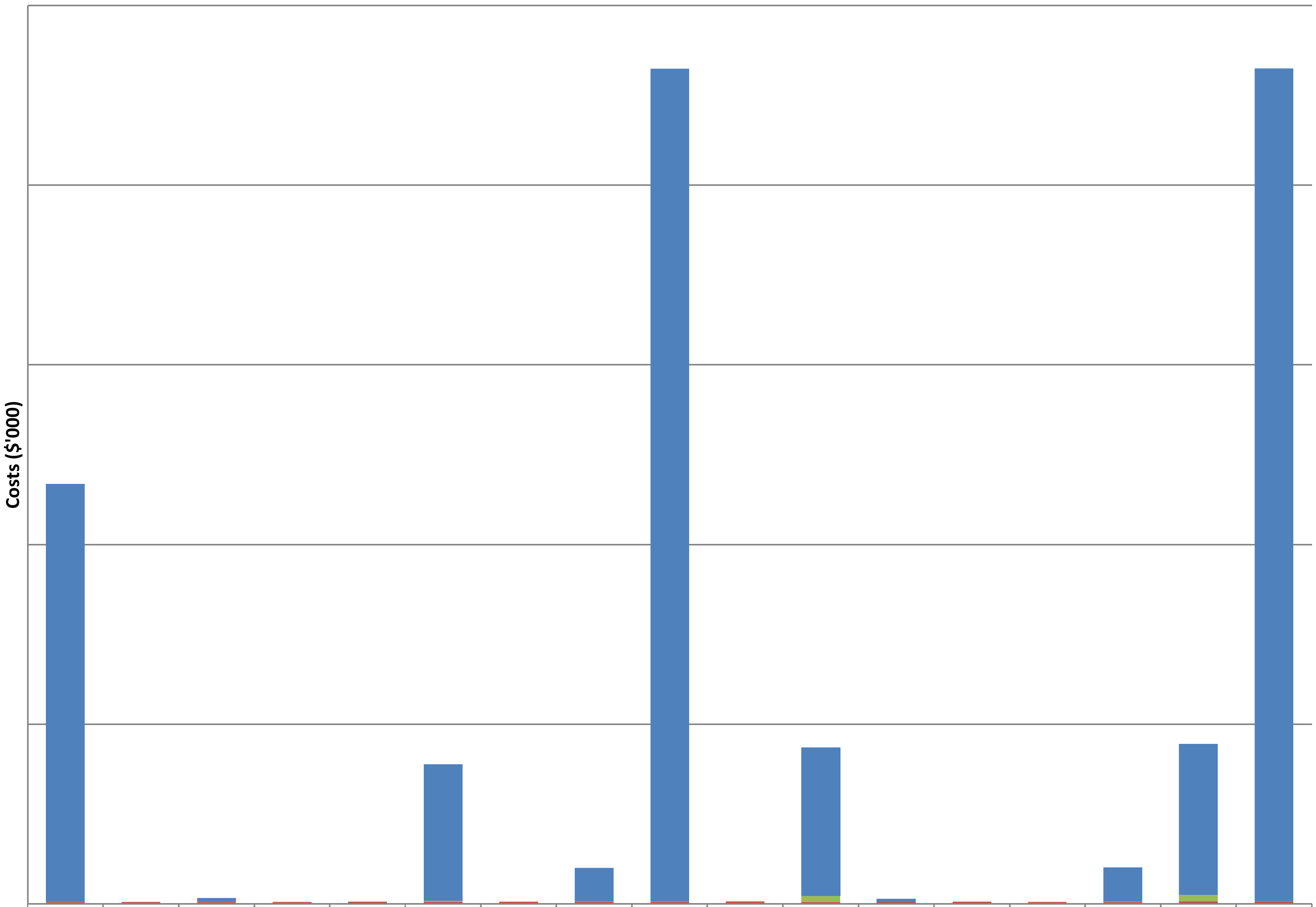
Capital Expenditures	$604,755	$-	$14,835	$-	$-	$1,716,450	$-	$190,500	$3,480,000	$-	$637,500	$9,000	$-	$-	$186,300	$688,950	$3,480,000
Corrective O&M Costs	$321	$321	$535	$535	$535	$2,167	$626	$633	$626	$1,926	$9,389	$626	$626	$626	$633	$16,194	$626
Preventive O&M Costs	$2,924	$2,924	$2,940	$2,940	$2,940	$6,361	$6,361	$7,224	$7,224	$7,224	$8,252	$8,252	$8,252	$8,252	$9,115	$15,142	$15,142

Locality 10 - Wilberforce
Type 2 to Type 1 Transition Costs



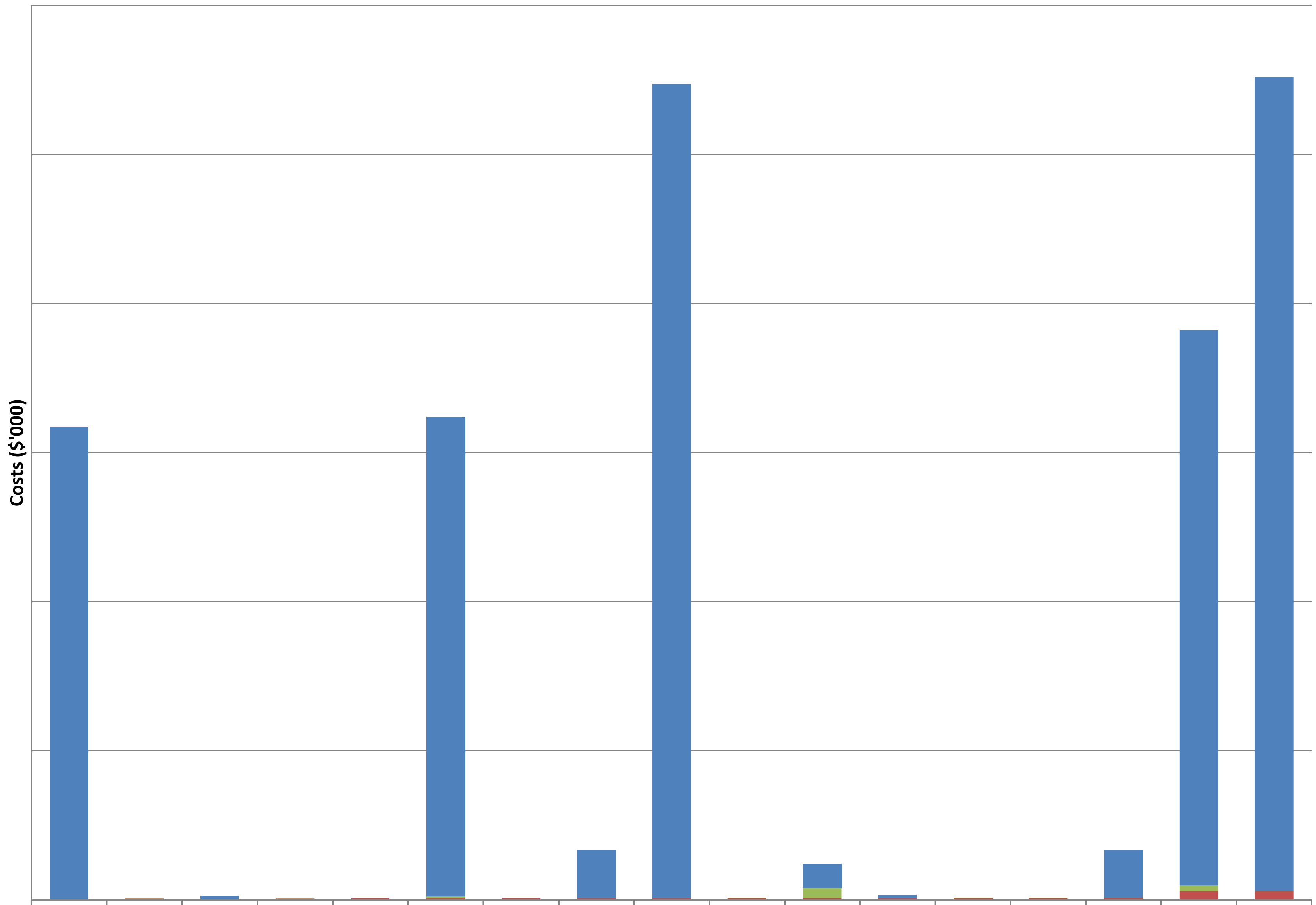
	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12	Yr 13	Yr 14	Yr 15	Yr 16
Capital Expenditures	$3,727,605	$-	$15,675	$-	$-	$1,326,450	$-	$116,700	$1,552,500	$-	$93,000	$9,000	$-	$-	$117,420	$2,160,450	$1,552,500
Corrective O&M Costs	$356	$356	$603	$603	$603	$8,828	$694	$1,090	$694	$2,644	$61,896	$694	$694	$694	$1,090	$19,538	$694
Preventive O&M Costs	$5,618	$5,618	$5,634	$5,634	$5,634	$5,640	$5,640	$6,141	$6,141	$6,141	$6,626	$6,626	$6,626	$6,626	$7,126	$21,426	$21,426

Locality 12 - Luddenham
Type 2 to Type 1 Transition Costs



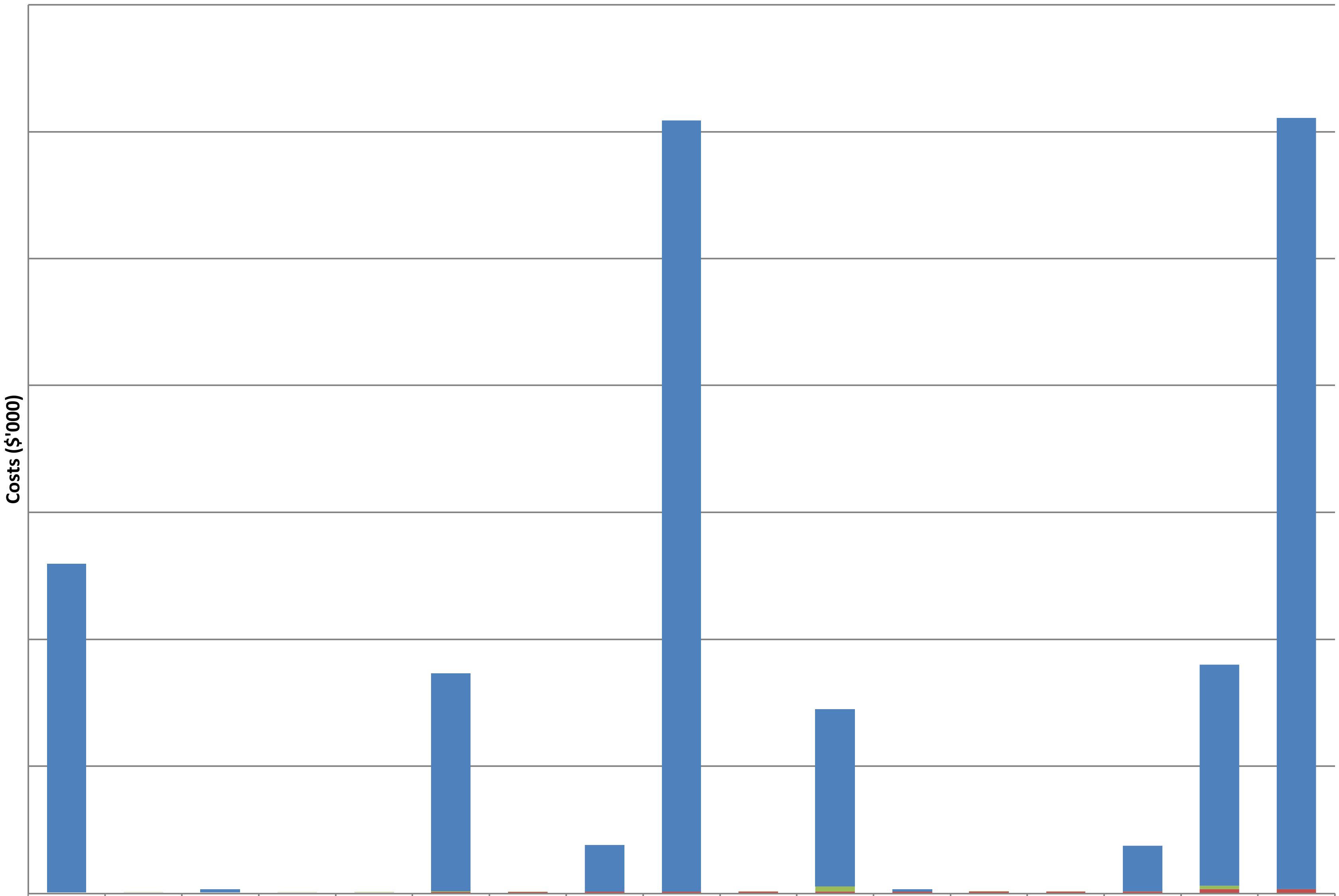
	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12	Yr 13	Yr 14	Yr 15	Yr 16
Capital Expenditures	$1,163,340	$-	$10,950	$-	$-	$378,450	$-	$93,750	$2,317,500	$-	$412,500	$9,000	$-	$-	$96,000	$420,450	$2,317,500
Corrective O&M Costs	$229	$229	$359	$294	$359	$3,848	$502	$444	$502	$1,737	$17,369	$437	$502	$437	$509	$18,582	$502
Preventive O&M Costs	$5,153	$5,153	$5,169	$5,169	$5,169	$5,877	$5,877	$6,265	$6,265	$6,265	$5,000	$5,000	$5,000	$5,000	$5,388	$6,688	$6,688

Locality 13 - The Oaks
Type 2 to Type 1 Transition Costs



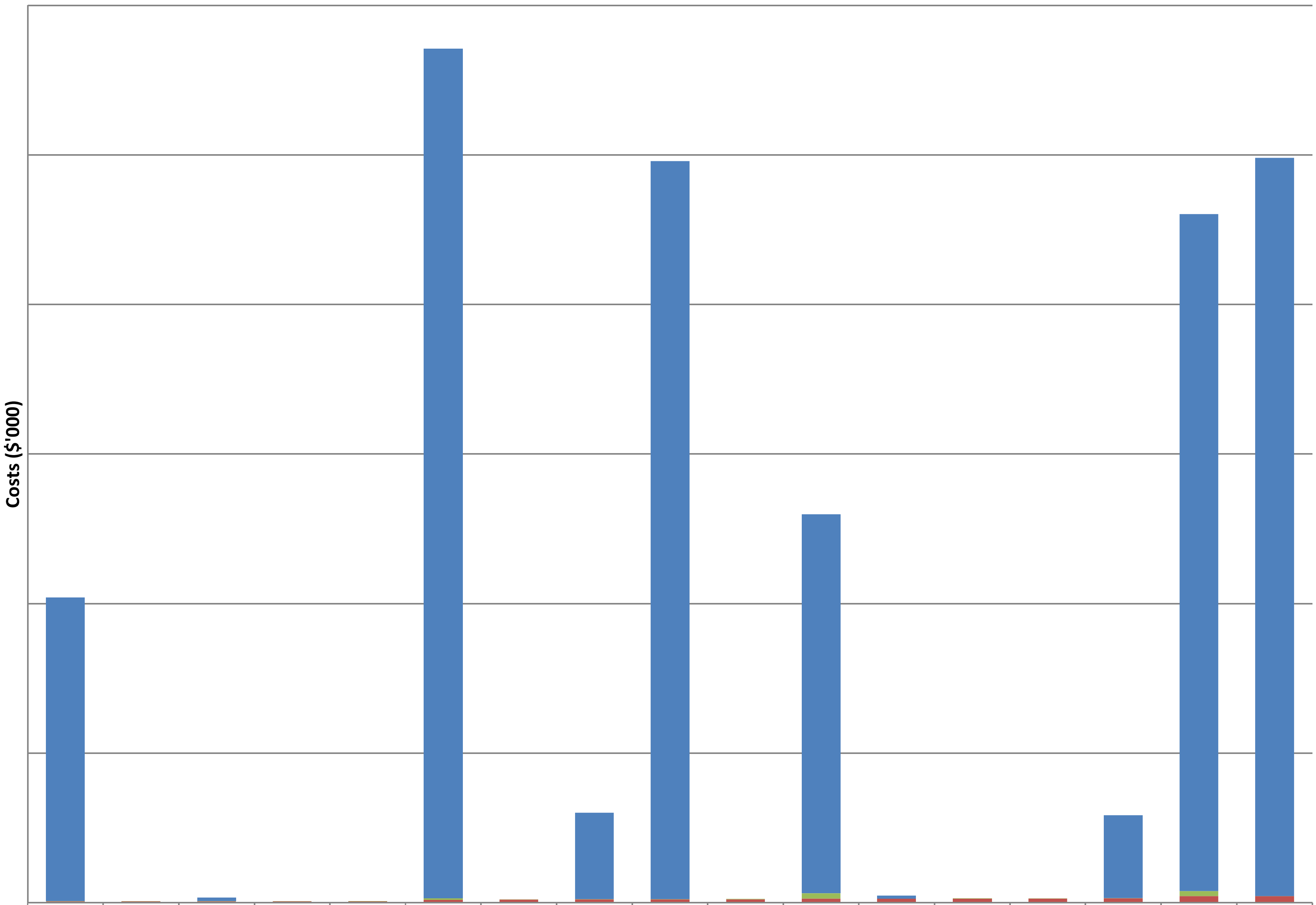
	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12	Yr 13	Yr 14	Yr 15	Yr 16
Capital Expenditures	$1,582,170	$-	$9,600	$-	$-	$1,608,450	$-	$162,375	$2,730,000	$-	$82,500	$9,000	$-	$-	$160,050	$1,861,950	$2,730,000
Corrective O&M Costs	$63	$63	$115	$76	$115	$5,872	$128	$95	$128	$479	$31,948	$89	$128	$89	$134	$18,440	$128
Preventive O&M Costs	$4,282	$4,282	$4,298	$4,298	$4,298	$5,772	$5,772	$6,497	$6,497	$6,497	$6,556	$6,556	$6,556	$6,556	$7,281	$30,291	$30,291

Locality 14 - Wilton
Type 2 to Type 1 Transition Costs



	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12	Yr 13	Yr 14	Yr 15	Yr 16
Capital Expenditures	$1,293,000	$-	$10,950	$-	$-	$857,850	$-	$183,750	$3,037,500	$-	$697,500	$9,000	$-	$-	$180,000	$870,450	$3,037,500
Corrective O&M Costs	$153	$153	$283	$218	$283	$3,528	$345	$287	$345	$1,093	$21,748	$280	$345	$280	$352	$13,725	$345
Preventive O&M Costs	$3,820	$3,820	$3,820	$3,820	$3,820	$5,588	$5,588	$6,418	$6,418	$6,418	$6,399	$6,399	$6,399	$6,399	$7,229	$16,355	$16,355

Locality 15 - Sutton Forest
Type 2 to Type 1 Transition Costs



	Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10	Yr 11	Yr 12	Yr 13	Yr 14	Yr 15	Yr 16
Capital Expenditures	$1,016,490	$-	$11,970	$-	$-	$2,839,950	$-	$288,375	$2,467,500	$-	$1,267,500	$9,000	$-	$-	$277,650	$2,262,450	$2,467,500
Corrective O&M Costs	$213	$213	$317	$317	$317	$3,978	$389	$395	$389	$1,039	$17,588	$389	$389	$389	$395	$17,541	$389
Preventive O&M Costs	$4,335	$4,335	$4,351	$4,351	$4,351	$10,332	$10,332	$11,676	$11,676	$11,676	$13,522	$13,522	$13,522	$13,522	$14,866	$22,011	$22,011

Appendix G Indicative generic airport costs

Confidential

Department of Infrastructure and Transport

Provision of advice and analysis relating to investment in airport infrastructure
Indicative Generic Airport Costs

24 June 2011

Ernst & Young
Quality In Everything We Do

Table of Contents

Section 1

Introduction and purpose

Introduction and purpose

- This report provides indicative estimates for the airport infrastructure and capital costs associated with each of the Generic Airport Types (refer Section 2) that have been identified by the Department. The report also provides a hypothetical cost for the development of a Generic Airport Type at the Richmond site based on modelling the main civil RPT elements in Worley Parsons (WP) Development Scenario A. The cost estimates have been prepared to enable a comparative assessment to be undertaken between the Generic Airport Types. The indicative cost information has been prepared using a benchmarking based approach and consequently include an number of significant limitations and exclusions (refer Section 4). Operating costs, revenue and funding costs have not been benchmarked or analysed as part of this assignment. The results presented should not be used for the purposes of preparing project budgets or project cost estimates as further detailed work, which is outside the scope of this study, would be required to provide such information.
- A detailed Assumptions Book has also been provided to support this analysis. The Assumptions Book contains supporting narrative and further background information to outline the methodology adopted (including relevant benchmarks) and the key assumptions used in the development of the indicative cost assumptions.
- The results highlight the indicative range of costs associated with the development of each of the generic airport types and identifies the relationships between key elements and drivers of cost for each airport type. A number of sensitivities (based on the ranges included in the Generic Airport Types descriptions) have also been provided to highlight the impact of changes in key assumptions on the indicative cost estimates.
- The approach, methodology and results generated from this analysis have also been subjected to a Peer Review process to confirm the validity of the approach and identify any areas for further consideration. The Peer Review team included Tony Canavan (Ernst & Young), Greg Fordham (Airbiz), Peter Gemell (Everything Infrastructure) and Tim Parker (Up Advisory). The comments and feedback from the Peer Review team have been incorporated.
- Given the generic nature of the analysis there are a number of key exclusions and limitations which may have a material impact on the results shown. In particular costs that are driven by site specific considerations including the purchase of the site, costs associated with site preparation, site remediation, environmental conditions and noise mitigation requirements have the potential to add significant additional costs (and time) which have not been included in the generic analysis and indicative estimates contained herein.

Section 2

Generic Airport Types

Generic Airport Types (as provided by the Department)

Generic Airport Types cont"d

Consistent Assumptions across all airport types

- All types are treated as greenfield airport developments based on the "Characteristics for template airports" provided to us by DOIT.
- All development, pre-approvals, clearing, levelling, site formation and site acquisition are assumed to have taken 11 years to complete. Construction costs differ according to each airport type. The specific construction costs for each airport type are detailed within section 6.
- A 30% contingency estimation along with a 20% cost for project management and design has been included in our analysis.
- Real capital costs have been escalated at an estimated BPI forecast rate of 4.5% to produce nominal costs.
- A generic construction S curve has been used to approximate a construction disbursement schedule
- Base date of all costs are 1 Jan 2011
- For more detailed assumptions, please refer to the draft assumptions book

Airport infrastructure costing methodology

Airport infrastructure costing methodology

The Model produces indicative capital costs for each of the four generic airport types defined by the Department.

The main inputs are:

- the number of runways (and design aircraft)
- the annual passenger projection
- the proportion of international passengers in this projection
- the assumed fleet mix and average load factor for aircraft
- the unit cost rates for aircraft pavements, terminal building and car parks

The main outputs are indicative comparative CAPEX for the key airport infrastructure elements

- Runways, taxiways and aprons (aircraft pavements) and associated airfield infrastructure
- Passenger terminal buildings (including aerobridges)
- Car parks

To generate the areas (m^2) for terminals, pavements (runways, taxiways, aprons) and car parks , the model uses a mixture of:

- Geometric calculation (for example the apron areas are calculation from the design aircraft dimensions for each main aircraft size category, multiplied by the fleet mix (proportion of each aircraft size category)
- Benchmarking (see examples below)

Benchmarking, with the potential to change values for the different airport types, was used for:

- Peaking factors
- Relationship of taxiway length to runway length
- Terminal area per aircraft gate
- Car park area per million passengers
- Unit cost rates for building and pavements

The relationship between pavement costs and other airfield costs such as navigation aids and airfield lighting

The peaking factor relates the annual passengers to the busy hour passengers. The busy hour passengers divided by the average passengers by aircraft (derived from the fleet mix) and the average load factor defines the number of aircraft apron movements in the busy period. With consideration of other factors (allowance for off-schedule arrivals and overnighting) the number of stands is determined. This determines apron areas (and therefore cost), when factored by the fleet mix and area requirements for aircraft size categories. The apron total pavement area is then scaled up by a factor for airside roads, tug zones, wing-tip clearances and aircraft manoeuvring (taxiways and taxilanes leading to the aircraft parking positions) by a factor based on geometric analysis.

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Airport infrastructure costing methodology (continued)

The taxiway area (and hence cost) is calculated from taxiway width multiplied by length. The width is based on the design aircraft (as specified for the runway). The length of taxiways is based on benchmarking the relationship between taxiways associated with runways to runway length (total length for all runways). For example if the sum of the runway length is 7,000m (two runways each of 3,500 length) and the factor (from benchmarking) is 2.2, then the assumed taxiway length is 2.2 x 7,000m = 15,400m. For a Code E runway this would imply taxiway width of 23m, and the taxiway area would be 23 x 15,400 = 354,200 m^2.

Benchmarking has been used to derive the relationship between the number of active gates and terminal area for international and domestic buildings separately (a user variable assumption). The aerobridges cost is added to terminal cost and is defined by the number of aircraft stands (separately grouped by aircraft size for international and domestics) and the average number of aerobridges per stand (a user defined assumption).

Unit cost rates are from recent projects. Generally the cost breakdowns are commercially confidential and only aggregate outcomes can be quoted. The total costs can be compared with those quoted in various sources for all up project costs for development such as the Canberra Airport terminal redevelopment (Stage 1 opened at the end of 2010) or the Adelaide MUIT (combined common-use international/domestic terminal).

Marginal additional costs for items such as apron lighting, airfield lighting and navigation aids are included by a cost multiplier based on benchmarking cost for these items against total runway pavement costs.

Section 4

Key Exclusions & limitations

Key Exclusions

Please refer to the accompanying assumptions book for our detailed assumptions and methodology relating to the generation of the outputs contained in this report.
For the purposes of this report our modelling outputs specifically exclude the following items (which may have a material impact on the results generated):

Exclusions	Rationale
Airport operating and revenue costs	This deliverable is focussed on the upfront infrastructure costs associated with the generic characteristics of the airport types provided by the Department and at this stage excludes operating revenue and cost assumptions.
Capital costs associated with supporting and connecting infrastructure (e.g. Transport, power, water, telecommunications, fuel, sewerage and gas)	This deliverable is specifically focussed on the upfront infrastructure costs associated with the generic characteristics of the airport types provided by the Department and at this stage excludes costs estimates relating to supporting infrastructure. Further information on the supporting infrastructure costs are included in the Assumptions Book and the Site Specific Supporting Infrastructure Report. Depending on the site location the costs associated with supporting infrastructure are likely to be material.
Costs associated with Land acquisition	This has been specifically excluded as land acquisition costs will be driven by site specific characteristics. Land acquisition costs are likely to be material.
Site specific remediation costs	This has been specifically excluded as site remediation costs will be driven by site specific characteristics. Depending on the site selected remediation costs may have a material impact on the results presented.
Capital costs associated with the construction of aircraft maintenance facilities	These are usually driven by and tied to specific leasing information e.g. Airlines or third party likely to fund the construction of the aircraft maintenance facility under a long-term lease arrangement. Therefore this has been excluded from the upfront infrastructure cost estimate.
Costs associated with clearing, levelling, drainage structures, site formation, gaining development approval and environmental protection and mitigation measures (e.g. noise, conservation)	These costs will be driven by site specific characteristics. The infrastructure cost estimates have been provided on the basis of a clear and level site . Depending on the site selected these costs may have a material impact on the results presented.
Capital costs associated with freight handling facilities	These are usually driven by and tied to specific leasing information e.g. Airlines or third party likely to fund the construction of freight handling facilities under a long-term lease arrangement. Therefore this has been excluded from the upfront infrastructure cost estimate.
Costs associated extensive ground works including voluminous basements, complex foundations and interfaces with rail stations or similar	These costs will be driven by site specific characteristics and have therefore been excluded from this analysis. These costs could have a significant impact on the overall costs, ranging from 10% to 50% or in extreme cases approaching 100% or more.
Third party funded infrastructure costs – e.g. Airline fit-outs, control tower and emergency services infrastructure, airport fuel infrastructure services	Elements of airport infrastructure and services may be provided directly by third party providers. Consequently these costs have been excluded.
Funding Costs	These costs have been specifically excluded as these costs will be driven by the procurement model selected, the funding market at the time and project specific factors such as the airport"s risk profile.

Limitations

- This is a draft report which presents the findings of our analysis. The results are cased on analysis undertaken in a limited timeframe and using a high-level benchmarking based approach to provide indicative estimates and are subject to a number of key exclusions and limitations which may be material in nature. The analysis provides a comparative analysis on a like-for-like basis between the generic airport types.

- At this stage the model and its methodology have been biased towards analysis of "generic" airport scenarios, and no account has yet been taken of site specific issues. Some notes have been made, where appropriate of issues to be addressed in the model development when site specific scenarios are provided. Our analysis does include a hypothetical cost for the development of a type 2 (brownfield) airport at Richmond based on modelling the main civil RPT elements in Worley Parsons (WP) Development Scenario A. Please note that this too was done on a "generic" basis, and the costs have been shown for illustrative purposes only.

- A range of possible outcomes should be considered to attach to the estimated, forecasts, and quantities presented. The forecasts presented in this report were prepared using the information and assumptions presented in this report plus our sub-consultants judgement and experience. Some of the assumptions used to develop the forecasts may not be realised and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the forecast and the actual results and these differences may be material.

- Whilst every care has been taken in preparing this report, the Ernst & Young, Airbiz , Arup and its sub consultants (including their collective directors, servants, and agents) will not accept any responsibility or liability to any person or corporation seeking to rely on information, advice or opinion provided in this publication for any loss or damage, whatever nature suffered by such person or corporation.

- Unit rates and cost estimates are provided in the draft assumptions book. These preliminary estimates should be reviewed by a Quantity Surveyor when site-specific information becomes available. Our scope has excluded investigations of land ownership/title/easements/services and utilities /zoning etc. They are not intended for tendering or contract purposes, and may exclude some contingency allowances, services connections costs, land acquisition and negotiation, site remediation of contamination, site access and security , environmental studies and impact mitigation measures, cost inflation or taxes such as the GST. Given the unusual nature of this project, tender prices may vary significantly from these preliminary estimates.

Section 5

Sensitivities

Sensitivities

The following sensitivities have been modelled to provide an indicative range and order magnitude for key airport capital costs. The results of these sensitivities are presented in Section 5. Rationale for each of the sensitivities are shown in parenthesis.

Type 1

Sensitivity 1	2x increase in Annual PAX; from 30 million to 60 million. (Higher pax estimate in the Generic Airports Types description)
Sensitivity 2	Length of runways reduced (from 4,000m to 3,500m), width of runways reduced (from 60m to 45m), % of Code F International fleet reduced (from 10% to 0%). (Shorter runway length per the Generic Airports Types description)
Sensitivity 3	International passengers reduced from 30% of Annual PAX to 20% of Annual PAX. (Sensitivity to highlight cost impact of change in international and domestic passenger mix)

Type 2

Sensitivity 1	6x increase in Annual PAX; from 5 million to 30 million. (Higher pax estimate in the Generic Airports Types description)
Sensitivity 2	Length of runway is reduced; from 3,500m to 3,000m. (Shorter runway length per the Generic Airports Types description)
Sensitivity 3	International passengers increased from 10% of Annual PAX to 20% of Annual PAX. (Sensitivity to highlight cost impact of change in international and domestic passenger mix)

Type 3

Sensitivity 1	5x increase in Annual PAX; from 5 million to 25 million; 6,000 car spaces in a multi-deck Carpark. . (Higher pax estimate in the Generic Airports Types description)
Sensitivity 2	Length of runway is reduced; from 2,200m to 1,650m. (Shorter runway length per the Generic Airports Types description)
Sensitivity 3	International passengers increased from 0% of Annual PAX to 10% of Annual PAX, international terminal and gates required. (Sensitivity to highlight cost impact of change in international and domestic passenger mix)

Type 4

Sensitivity 1	2x increase in Annual PAX; from 500,000 to 1 million. (Higher pax estimate in the Generic Airports Types description)

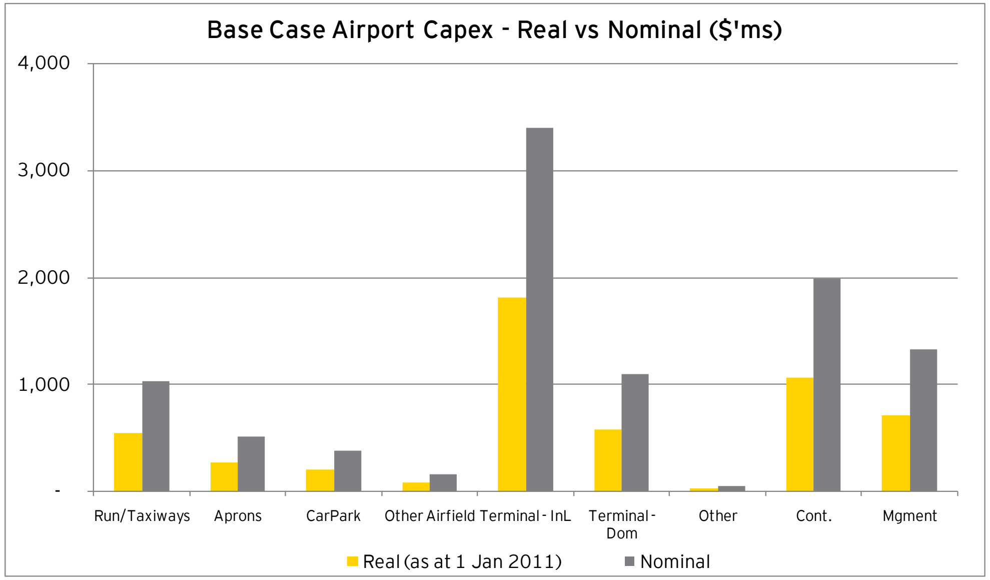
Section 6

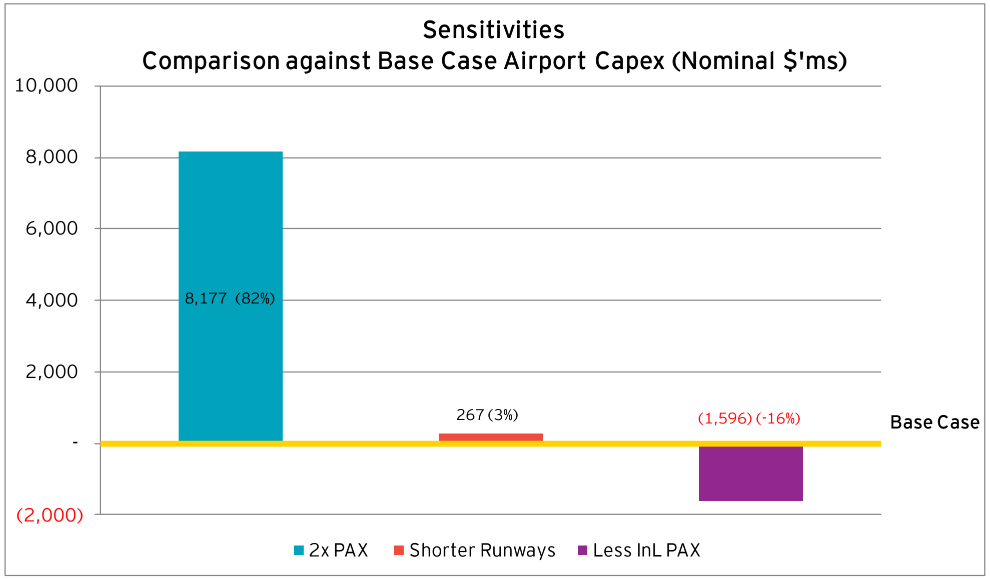
Airport Infrastructure Modelling

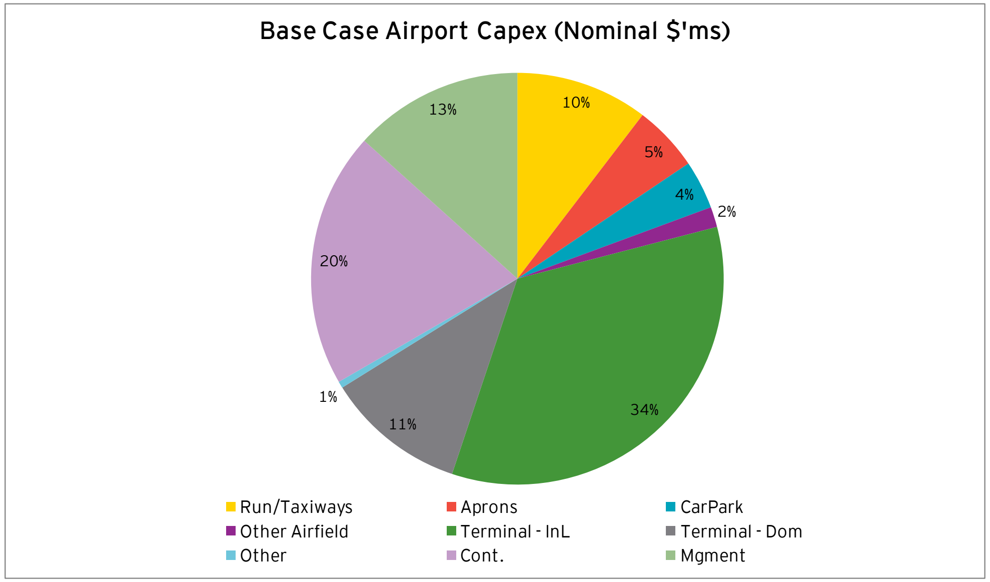
Generic Airport Type 1 – Full Service International

Comparison of Sensitivities to the Base Case

Capex ($'000s)	Base Real (as at 1 Jan 2011)	Base Nominal	Sensitivity 1 2x PAX	Sensitivity 2 Shorter Runways	Sensitivity 3 Less InL PAX
Run/Taxiways	551,040	1,032,752	1,032,752	815,103	1,032,752
Aprons	274,067	513,653	1,027,306	510,423	436,308
CarPark	201,600	377,836	755,673	377,836	377,836
Other Airfield	84,148	157,708	203,937	131,971	150,747
Terminal - InL	1,811,588	3,395,257	6,790,513	3,825,217	2,263,504
Terminal - Dom	583,190	1,093,008	2,186,016	1,093,008	1,249,152
Other	27,479	51,501	77,184	45,899	47,634
Cont.	1,059,934	1,986,515	3,622,015	2,039,837	1,667,380
Mgment	706,622	1,324,343	2,414,676	1,359,891	1,111,587
Total	**5,299,669**	**9,932,575**	**18,110,073**	**10,199,186**	**8,336,902**







Generic Airport Type 1– Full Service International

Commentary:

- Type 1 description – "A full service international airport", with parallel runways up to 4,000m in length and 60m in width and capable of carrying the largest passenger aircraft (A380). Such an airport would be expected to handle upward of 30 million annual passengers and have the capability to provide an additional parallel runway

- Indicative cost estimate of approximately $9.9 billion (nominal) on a benchmarked cost basis (also refer limitations and exclusions).

- All development, pre-approvals, clearing, levelling and site acquisition and procurement / tender processes are assumed to have taken 11 years to complete (refer Assumptions Book section 4.2). Airport construction is assumed to begin in 2022 and is a minimum of 5 years for this scale of airport.

- Passenger forecasts provided are for a total of 30 million annual passengers at start up. For the purposes of this analysis we have assumed a 32%/68% split between international passengers and domestic passengers as per current Sydney Kingsford Smith Airport traffic.

- The largest component of airport capital cost is the construction costs associated with international terminal facilities. This is assumed to be a multi-level terminal.

Sensitivities:

- 1 – Sensitivity highlights the impact of changes in total annual passengers on capital cost estimates. When total passengers are increased to 60 million annual passengers, the total capital costs for the airport double. Although no additional runway capacity is required to meet this sensitivity, all other infrastructure cost categories are increased to meet the additional demand.

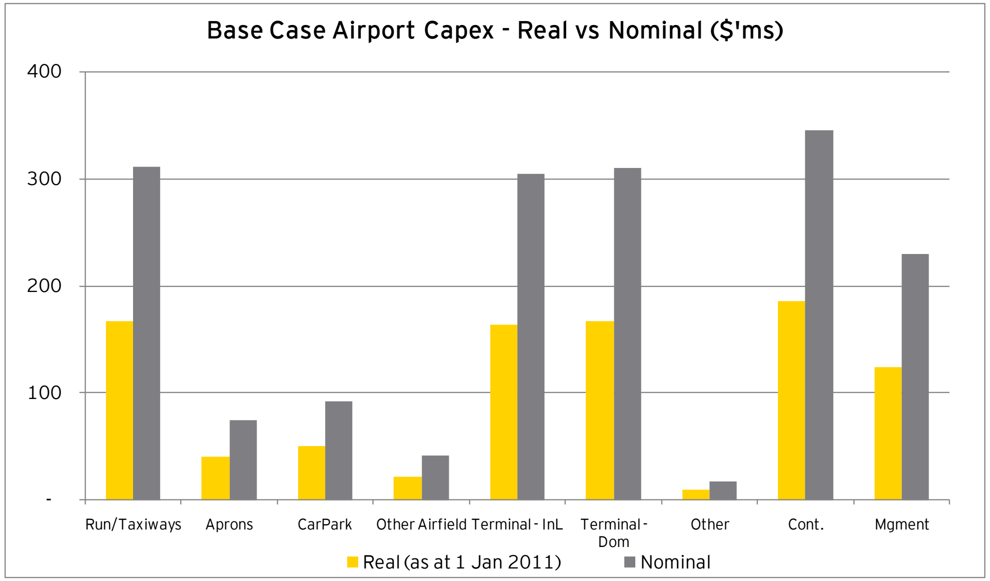
- 2 – Sensitivity highlights the impact of a 500m shorter runway (as per range shown in the Generic Airports Types description). This results in a marginal increase in total airport capital costs. The reduction in runway length reduces the capability of the airport to handle larger aircraft, therefore more smaller aircraft per hour are required to carry the same amount of passengers. Therefore terminal space needs to increase to accommodate more gates and the cost of providing more terminal space is greater than the saving realised from a shorter runway.

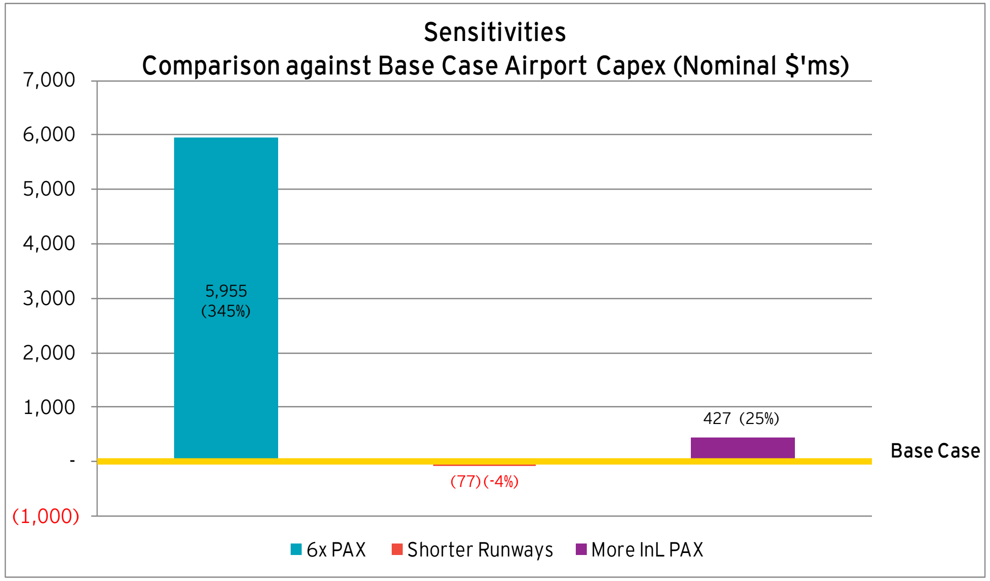
- 3 – Sensitivity highlights the impact of 10% reduction in the % of international passengers. A 10% reduction in international passengers results in a $1.6bn reduction in total capital costs. Costs of international terminal space have reduced. Costs of providing domestic terminal capacity have increased to accommodate more domestic passengers. The unit costs of constructing international terminal space exceed the unit costs of constructing domestic terminal space.

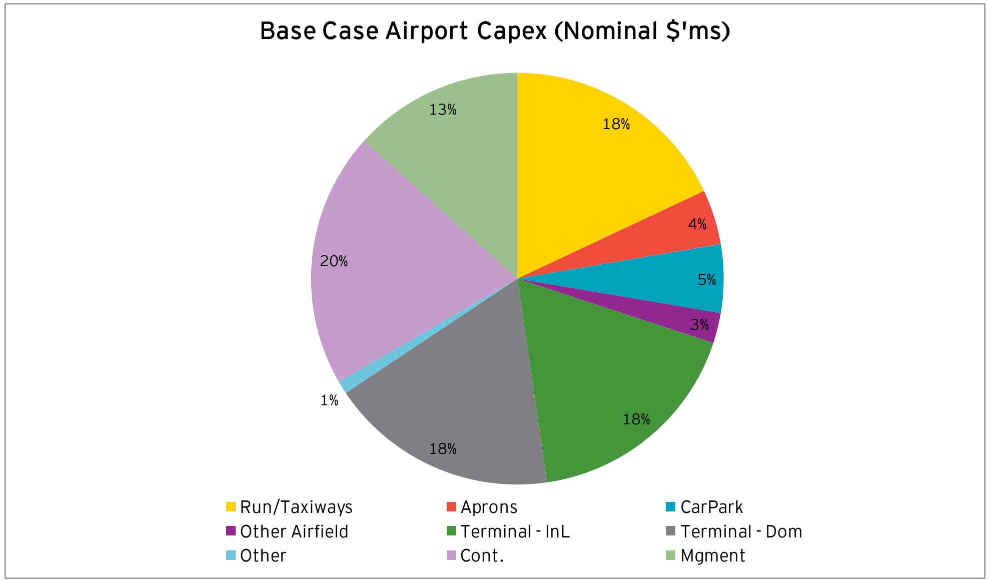
Generic Airport Type 2 – Land Constrained Full Service International

Comparison of Sensitivities to the Base Case

Capex ($'000s)	Base Real (as at 1 Jan 2011)	Base Nominal	Sensitivity 1 6x PAX	Sensitivity 2 Shorter Runways	Sensitivity 3 More InL PAX
Run/Taxiways	167,265	311,339	311,339	266,862	311,339
Aprons	39,879	74,229	445,376	74,229	86,306
CarPark	49,800	92,695	556,171	92,695	92,695
Other Airfield	22,024	40,994	74,398	36,092	42,081
Terminal - InL	163,884	305,046	1,830,275	305,046	610,092
Terminal - Dom	166,626	310,149	1,860,892	310,149	275,688
Other	9,482	17,650	43,630	15,871	18,495
Cont.	185,688	345,630	1,536,624	330,283	431,009
Mgment	123,792	230,420	1,024,416	220,189	287,339
Total	**928,441**	**1,728,152**	**7,683,121**	**1,651,415**	**2,155,043**







Generic Airport Type 2 – Land Constrained Full Service International

Commentary

- Type 2 description – “A land constrained international airport” with a single runway up to 3,500m in length and 45m width. This would be capable of taking large widebody international jets, but not the A380 (which would required a 60m wide runway for a new build airport). Such an airport would be expected to handle from 5 to 30 million annual passengers.
- Indicative cost estimate of approximately $1.7 billion (nominal) on a benchmarked cost basis (also refer limitations and exclusions).
- All development, pre-approvals, clearing, levelling and site acquisition and procurement / tender processes are assumed to have taken 11 years to complete (refer Assumptions Book section 4.2). Airport construction is assumed to begin in 2022 and is a minimum of 4 years for this scale of airport.
- Passenger forecasts provided are for a total of 5 million annual passenger at start up. For the purposes of this analysis we have assumed a nominal figure of 500,000 international passenger (10% of total).
- The capex for international terminal facilities and domestic terminal facilities are of similar proportions even though the airport caters for significantly more domestic passengers. For this airport type the costs for the international terminal is approximately $61/annual pax compared with the costs for the domestic terminal which are approximately $62/ annual pax. The reason for this is twofold. Firstly the international terminal requires more than double the terminal space on a per gate basis compared to the domestic terminal. Secondly, the unit costs for international terminal space are almost 1.25x more expensive than the unit costs for domestic terminals.
- The most expensive hard capex item is runways/taxiways. This cost makes up almost 20% of the total capex costs for the airport.

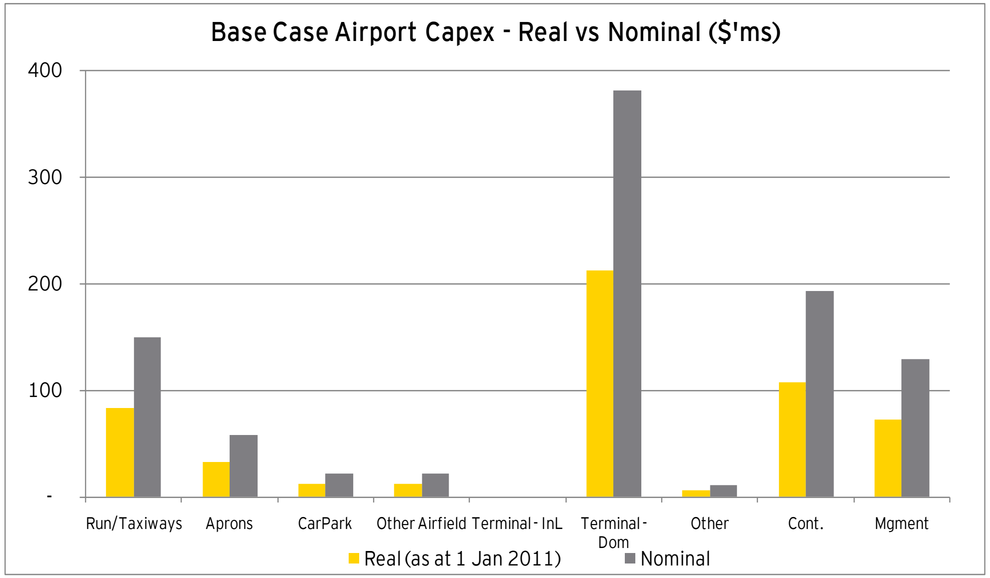
Sensitivities:

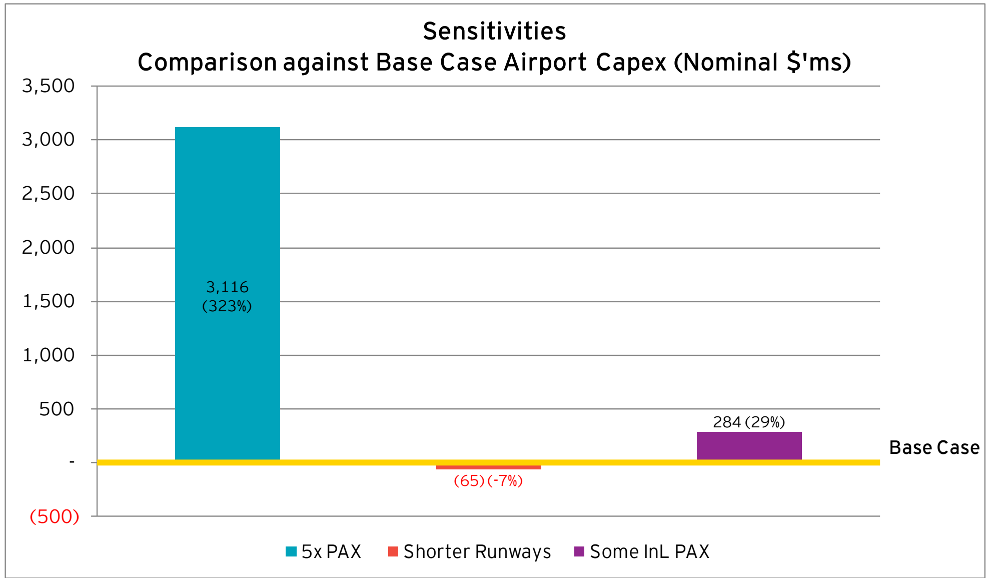
- 1 - Sensitivity highlights the impact of changes in total annual passengers on capital cost estimates. When total passengers are increased 6x (to the upper estimate provided in the Generic Airport Types description), the total capital costs for the airport increase approximately 4.5x.
- 2 – Sensitivity highlights the impact of a 500m shorter runway (as per range shown in the Generic Airports Types description). This results in a marginal decrease in total airport capital costs. The reduction in the runway length reduces the capital costs associated with building runway without reducing impacting on the type of aircraft which can access the airport therefore terminal and apron space are not adversely impacted.
- 3 – Sensitivity highlights the impact of 10% increase in the % of international passengers. This results in approximately a $427m or 25% increase in the total airport cost estimate. An increase in international passengers requires an increase the international terminal space, and an increase in the apron size to handle international aircraft.

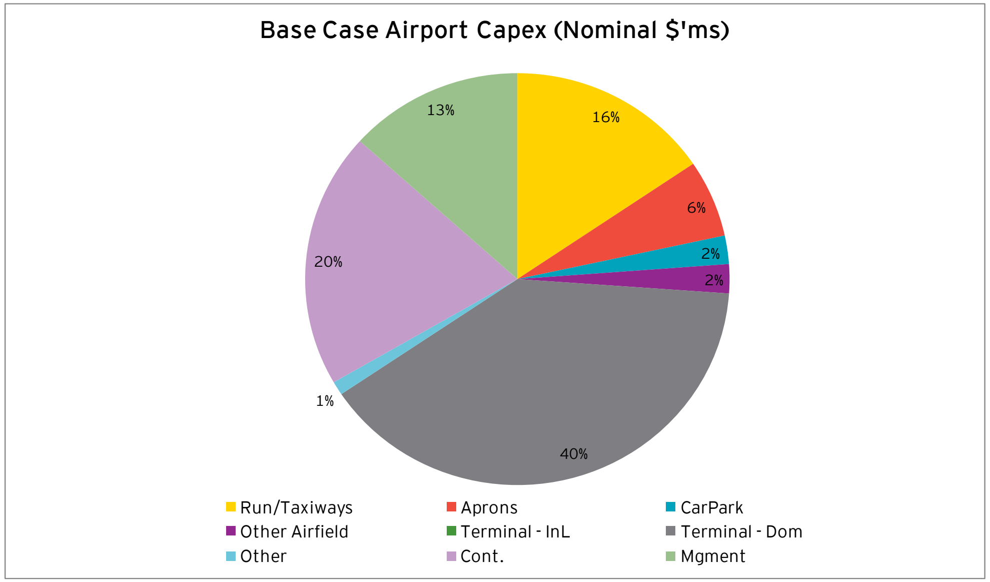
Generic Airport Type 3 – Limited Service Airport

Comparison of Sensitivities to the Base Case

	Base	Base	Sensitivity 1	Sensitivity 2	Sensitivity 3
Capex ($'000s)	Real (as at 1 Jan 2011)	Nominal	5x PAX	Shorter Runways	Some InL PAX
Run/Taxiways	83,985	150,355	150,355	112,767	150,355
Aprons	32,645	58,443	292,217	58,443	66,446
CarPark	12,000	21,483	300,764	21,483	21,483
Other Airfield	12,279	21,982	43,022	17,802	22,702
Terminal - InL	-	-	-	-	218,611
Terminal - Dom	213,056	381,426	1,907,129	381,426	343,283
Other	5,822	10,423	28,060	8,920	11,027
Cont.	107,936	193,234	816,464	180,252	250,172
Mgment	71,957	128,823	544,309	120,168	166,782
Total	**539,680**	**966,170**	**4,082,321**	**901,260**	**1,250,862**







Generic Airport Type 3 – Limited Service Airport

Commentary

- Type 3 description – "A limited service RPT airport" with a single runway up to 2,200 in length and 45m in width. This could still be capable of handling widebody international jets (excluding the A380), but the runway length would limit services to short-haul international destinations (e.g. Trans-Tasman). Such an airport would be expected to handle between 5 to 25 million passengers, predominantly on narrowbody jet services.
- Indicative cost estimate of approximately $966 million (nominal) on a benchmarked cost basis (also refer limitations and exclusions).
- All development, pre-approvals, clearing, levelling and site acquisition and procurement / tender processes are assumed to have taken 11 years to complete (refer Assumptions Book section 4.2). Airport construction is assumed to begin in 2022 and is a minimum of 3 years for this scale of airport.
- This airport only services domestic passengers with narrowbody jets only (Code C aircraft category such as B737 or A320 aircraft) – (per Generic Airports Types description)
- The domestic terminal is the largest component of airport capital costs comprising almost 40% of total airport capital costs. The domestic terminal costs approximately $76/annual pax.

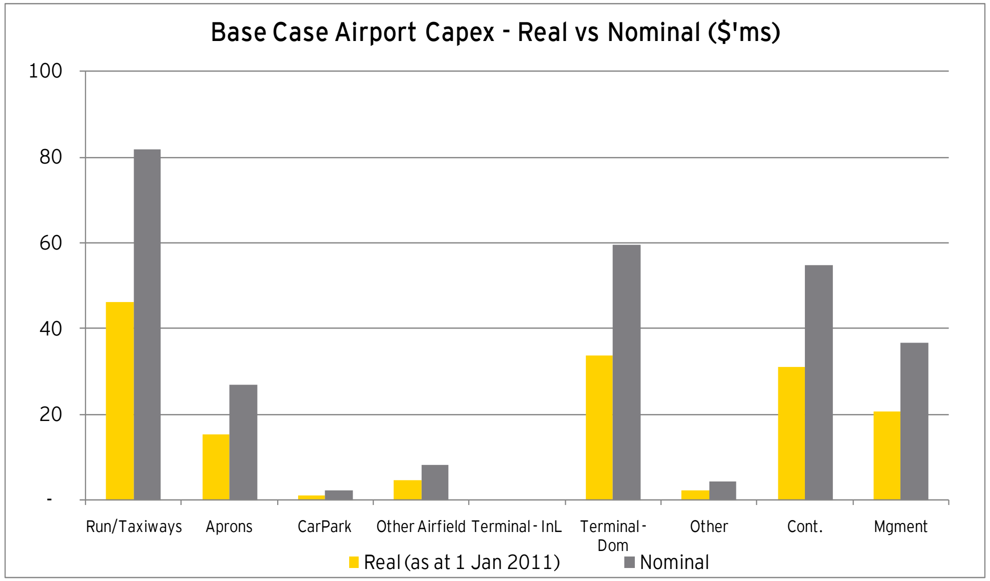
Sensitivities:

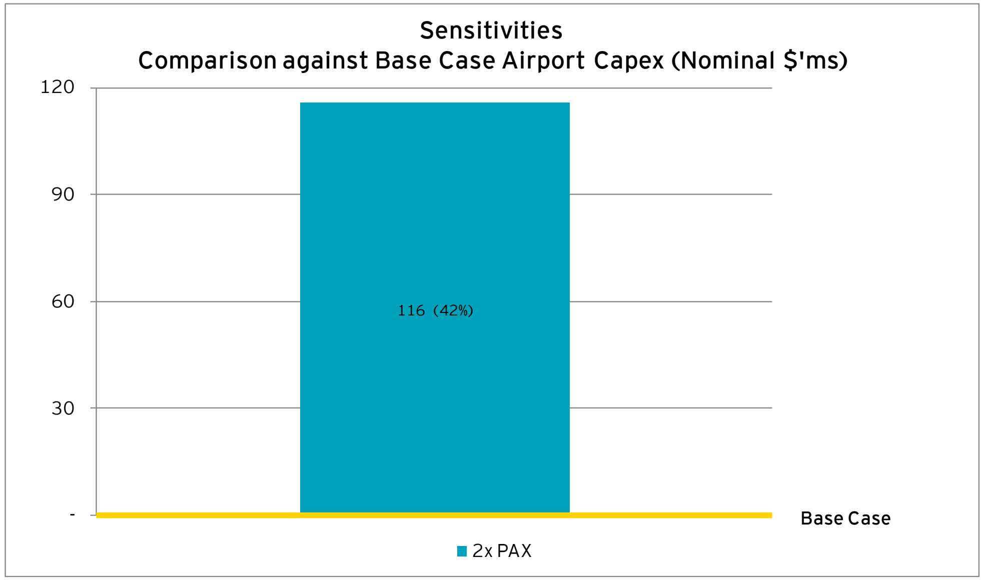
- 1 - Sensitivity highlights the impact of changes in total annual passengers on capital cost estimates. When total passengers are increased 5x (to the upper estimate provided in the Generic Airport Types description), the total capital costs for the airport increase approximately 4x.
- 2 – Sensitivity highlights the impact of a 550m shorter runway (as per range shown in the Generic Airports Types description. This results in a marginal decrease in total airport capital costs. The reduction in the runway length reduces the capital costs associated with building runway without impacting on the type of aircraft which can access the airport. Therefore terminal and apron space are not adversely impacted.
- 3 – Sensitivity highlights the impact of including 10% international passengers (changed from 100% domestic). This results in approximately $284m or a 30% increase in total airport costs. The inclusion of international passengers requires the construction of an international terminal and an increase the necessary apron space to accommodate higher peak aircraft movements.

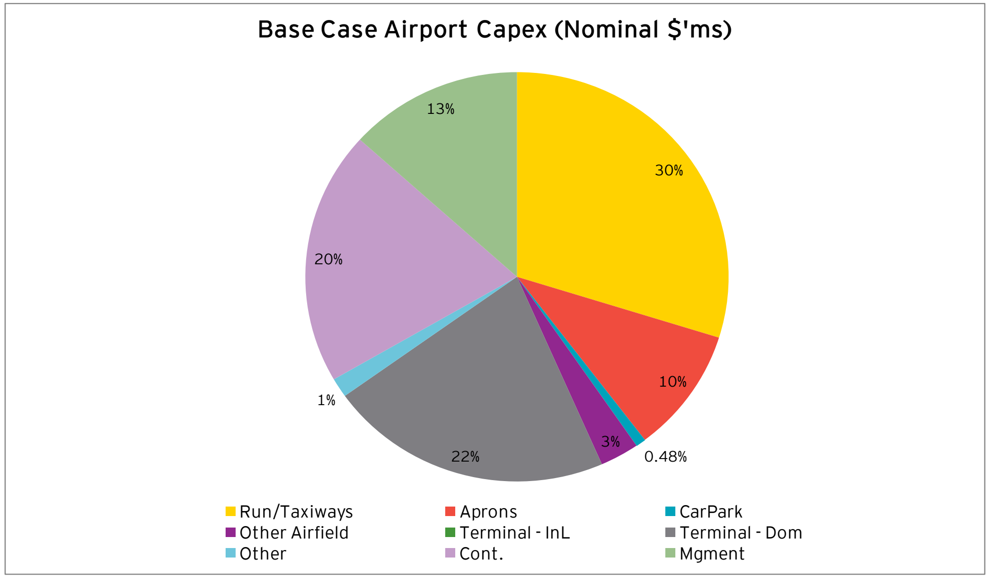
Generic Airport Type 4 – Minimum Service Airport (GA and limited RPT)

Comparison of Sensitivities to the Base Case

Capex ($'000s)	Base Real (as at 1 Jan 2011)	Base Nominal	Sensitivity 1 2x PAX
Run/Taxiways	46,143	81,734	81,734
Aprons	15,265	27,039	39,908
CarPark	1,200	2,126	4,251
Other Airfield	4,624	8,190	9,349
Terminal - InL	-	-	-
Terminal - Dom	33,654	59,612	119,223
Other	2,372	4,201	5,616
Cont.	30,977	54,871	78,024
Mgment	20,651	36,580	52,016
Total	**154,886**	**274,353**	**390,122**







Generic Airport Type 4 – Minimum Service Airport (GA and limited RPT)

Commentary

- Type 4 description – “A minimum service airport servicing GA and limited RPT” covering an area of between 120 and 400 hectares.
- Indicative cost estimate of approximately $274 million (nominal) on a benchmarked cost basis (also refer limitations and exclusions).
- All development, pre-approvals, clearing, levelling and site acquisition and procurement / tender processes are assumed to have taken 11 years to complete (refer Assumptions Book section 4.2). Airport construction is assumed to begin in 2022 and is a minimum of 2.5 years for this scale of airport.
- This airport only services domestic passengers of around 500,000 per annum on start-up. The runway specifications would appear to limit this to turboprop aircraft with seating capacity around 18 to 34 seats (per generic airport characteristics).
- We have assumed that this airport is a hybrid between a typical GA airport such as Bankstown airport for example and a typical RPT airport such as Hervey Bay airport for example.
- The largest capital cost component for this airport type is runways/taxiways at approximately $163/annual pax.
- Terminal facilities are only considered to apply to the RPT component of the airport.

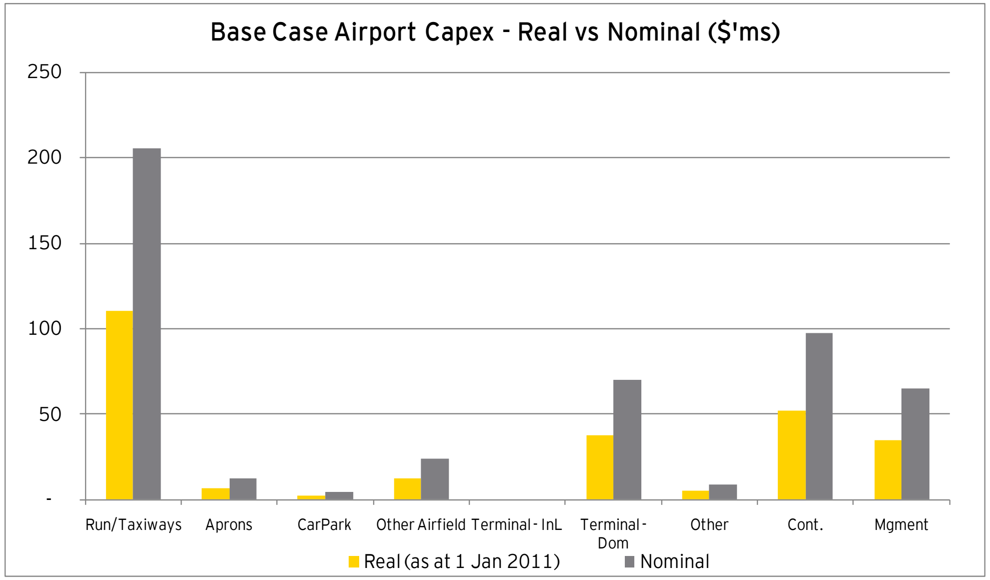
Sensitivities:

- 1 - Sensitivity highlights the impact of changes in total annual passengers on capital cost estimates. An increase in annual passengers of 500,000 annual passengers (or 2 x increase) increases airport capital costs by approximately $119m due to the increased terminal facilities and increased apron space to handle more aircraft.

Site Specific Airport Type 4 – Richmond A

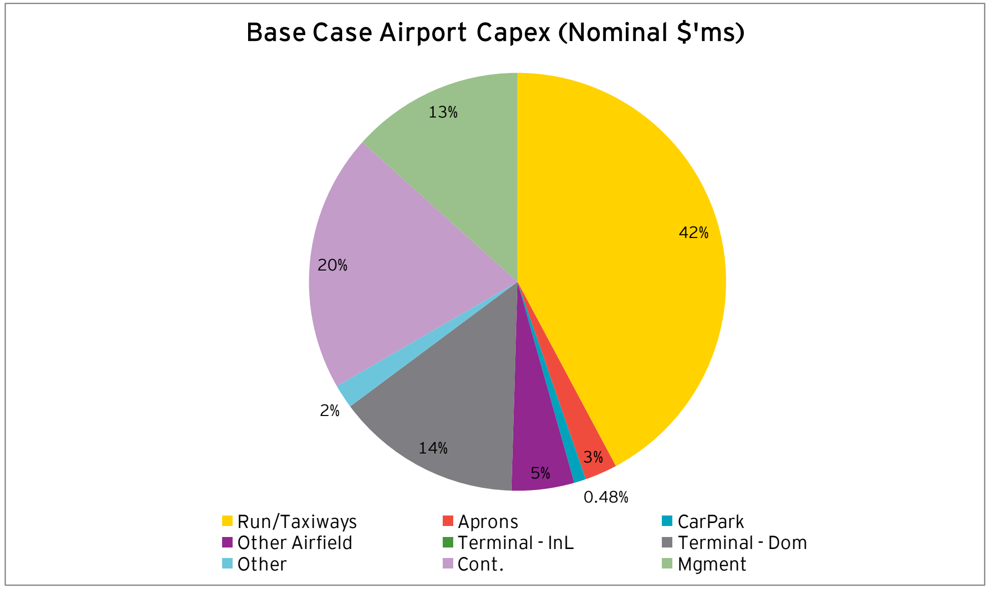
Background

- To provide a concrete example of the use of the CAPEX model to examine the brownfield scenarios, the main civil RPT elements in Workey Parsons (WP) Development Scenario A for Richmond were modelled.
- To generate the nominal capex values, the same construction period as a Type 2 airport was assumed; 4 years. In reality, the construction period for a brownfield airport will be dependent on site specific factors and could take a greater or shorter period of time than this.
- Please note that the costs for this example are purely illustrative and are designed to provide a hypothetical cost for a type 2 airport developed at Richmond.



Comparison of Sensitivities to the Base Case

	Base	Base
Capex ($'000s)	Real (as at 1 Jan 2011)	Nominal
Run/Taxiways	110,339	205,379
Aprons	6,542	12,177
CarPark	2,400	4,467
Other Airfield	12,644	23,536
Terminal - InL	-	-
Terminal - Dom	37,500	69,801
Other	4,872	9,068
Cont.	52,289	97,328
Mgment	34,859	64,886
Total	**261,446**	**486,641**



Site Specific Airport Type 4 – Richmond A

Commentary

- The key features as described in the Worley Parson report are 300m wide runway strip with full length Code E parallel taxiway for the existing 2134m x 45m runway
- Indicative cost estimate of approximately $486 million (nominal) on a benchmarked cost basis (also refer limitations and exclusions).
- The largest capital cost component for this airport type is runways/taxiways at approximately $205million or approximately 42% of the capital costs for this airport type
- For model demonstration purposes only we assumed:
  - Full rehabilitation of the runway for civil use of 2,200m x 45m requiring a cost similar to the construction of a new runway (this is of course subject to condition reports and detailed engineering and pavement studies) with CAT II capability
  - A relatively low cost (probably single level) domestic terminal (sized for 250 annual pax/m2 or alternative 2,500 m2 per stand) without aerobridges and peaking factor of 0.030%
  - Startup volume of 1 million annual domestic only passengers with Code C aircraft and average seats per aircraft of 150 and average load factor of 80%

Summary of Generic Airport Types & Sensitivities

Commentary

- The responsiveness of airport capital costs to movements in the annual passengers is consistent across airport types 1, 2 and 3. The capital costs at airport type 4 weren‟t as responsive as the other airport types to an increase in annual passengers. This is because airport type 4 services General Aviation customer segments and as result the capital costs are less responsive to movements in passenger numbers.

- Airport type 1 is the only airport to experience an increase in capital costs as a result of a reduction in runway length (per the Generic Airports Template). This is because airport type 1 is the only airport where a reduction in runway length affects the type of aircraft which the airport can accommodate, which in turn affects the size of the terminal building and the number of gates which are required to accommodate higher peak aircraft movements.

- The costs associated with accommodating international passengers are comparatively high, therefore reductions in international passengers tend to reduce total airport capital costs and increases in international passengers tend to increase overall airport capital costs.

Summary of generic airport types and sensitivities

Commentary

- Airport type 4 whilst being the least expensive in absolute terms, is more expensive than airport type 1 on a per passenger basis due to the significantly lower passenger volume.
- Terminal facilities are the biggest cost items for airport types 1,2 and 3, however the largest capital cost item for airport type 4 is aircraft pavements. This is because it services General Aviation customers (as well as RPT customers) and has less need for terminal facilities.

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Appendix H Indicative generic airport costs - assumptions book

Sydney Airports - Assumptions Book

Department of Infrastructure and Transport

24 June 2011

Ernst & Young

Contents

1. Introduction

1.1 Purpose of this document

This document is the assumptions book for the Sydney Airports Model developed by Ernst & Young, Airbiz, Arup and Turner & Townsend.

This document provides a detailed description of the assumptions, processes and methodologies used to estimate the indicative cost estimates associated with the development and operation of the Generic Airport Types provided to us by the Department.

The purpose of this analysis is to provide indicative cost estimates to enable a comparative analysis of costs between the Generic Airport Types on a like-for-like basis. Due to the generic nature of the process, the benchmarking nature of the analysis and the limitations and exclusions the indicative estimates are not sufficient to be relied upon for budget or project cost forecasting purposes.

Users of the model should refer to this document to understand how specific assumptions have been determined.

The results of the generic airports capital cost modelling have been presented in a separate document "Indicative Generic Airports Costs"

1.2 Composition of Model

The model comprises the following sheets:

Sheet	Function
Disclaimer	Outlines limitations on the model and its use
Contents	Outlines worksheets of the model
Capexscenario	Outlines the airport capital cost scenario the model is running
Capex calc	Calculates the real airport capital costs
InputsTI	Collates all time independent model inputs for the four types of airport
InputsTD	Collates all time dependent model inputs for the four types of airport
Calc	Performs all the necessary calculations for the financial statements
FS – Active	Displays the Profit and Loss, Balance Sheet and Cash Flow statement for the active airport type selected
Charts	Graphically displays selected outputs from the model
Outputs	Displays selected outputs from the models
Checks	Performs checks on the calculations and the consistency of the model
Temp	Reference page displaying the model template

1.3 Capability of Model

The model is designed to be able to show the procurement and operations of an airport business over a specific set of time.

The model has the following capabilities:

- Users can vary the volume of airport passengers within certain boundaries to generate specific infrastructure requirements for the airport. For example, the volume of passengers is an input in this model. If users wish to increase the volume of passengers within a specific range, the model will automatically determine the level of capital costs which need to be spent on terminals and car parks for each airport type.

(Please note that different cost drivers determine the costs of paved surfaces (runways, aprons and taxiways) and hence these drivers would need to be varied to determine the necessary paved surfaces capital costs).

- Users can vary the composition of airport passengers to generate specific infrastructure requirements for the airport. For example, the distribution between domestic and international passengers is an input in this model. If users wish to increase the volume of domestic passengers, the model will automatically determine the level of capital costs which need to be spent on terminal facilities

- Users have the ability to enter a variety of airport capital cost and operating cost assumptions to see how such costs are disbursed over time

- Users have the ability to adjust the construction and operation dates of the airport and adjust the construction disbursement profile to see how well the airport business operates under a variety of different timing assumptions

- Users have the ability to determine what level of aeronautical and non-aeronautical revenues are needed to generate a specific equity and project rate of return

1.4 Price base

All figures presented in this document are real amounts, unless otherwise stated. The base date of all costs is 1 January 2011.

1.5 Disclaimer to all analysis, costing and benchmarking

A range of possible outcomes should be considered to attach to the estimated, forecasts, and quantities presented. The forecasts presented in this report were prepared using the information and assumptions presented in this report plus the judgement and experience of those providing the assumptions. Some of the assumptions used to develop the forecasts may not be realised and unanticipated events and circumstances may occur. Therefore, there are likely to be differences between the forecast and the actual results and these differences may be material.

The estimates provided are for the purpose of undertaking a comparative assessment of the costs associated with the identified Generic Airport Types. Limitations on the accuracy of the results (due to the variability in the benchmarking subjects) and generic nature of the assessment mean that the results should not be used for budgeting purposes or project cost forecasting.

Whilst every care has been taken in preparing this report, Ernst & Young, Airbiz, Arup and its sub consultants (including their collective directors, servants, and agents) will not accept any responsibility or liability to any person or corporation seeking to rely on information, advice or opinion provided in this publication for any loss or damage, whatever nature suffered by such person or corporation.

Unit rates and cost estimates are provided. It should be noted that these preliminary cost estimates are based on no site information or schematic designs, only typical unit costs for construction and benchmarks against past projects. These preliminary estimates should be reviewed by a Quantity Surveyor when site-specific information becomes available. Our scope has excluded investigations of land ownership/title/easements/services and utilities /zoning etc. They are not intended for tendering or contract purposes, and may exclude some contingency allowances, services connections costs, land acquisition and negotiation, site remediation of contamination, site access and security , environmental studies and impact mitigation measures, cost inflation or taxes such as the GST. Given the unusual nature of this project, tender prices may vary significantly from these preliminary estimates.

1.6 Peer Review Process

The approach, methodology and results generated from this analysis have also been subjected to a Peer Review process to confirm the validity of the approach and identify any areas for further consideration. The Peer Review team included Tony Canavan (Ernst & Young), Greg Fordham (Airbiz), Peter Gemell (Everything Infrastructure) and Tim Parker (Up Advisory).

The comments and feedback from the Peer Review team have been incorporated.

1.7 Airport types and benchmarking

The following generic airport types have been described for the purposes of this study:

Table 1: Generic Airport Types

Type 1	"A full service international airport", with parallel runways up to 4,000m in length and 60m in width and capable of carrying the largest passenger aircraft (A380). Such an airport would be expected to handle upward of 30 million annual passengers and have the capability to provide an additional parallel runway.
Type 2	"A land constrained international airport" with a single runway up to 3,500m in length and 45m width. This would be capable of taking large widebody international jets, but not the A380 (which would require a 60m runway for a new build airport). Such an airport would be expected to handle from 5 to 30 million annual passengers.
Type 3	"A limited service RPT airport" with a single runway up to 2,200 in length and 45m in width. This could still be capable of handling widebody international jets (excluding the A380), but the runway length would limit services to short-haul international destinations (e.g. Trans-Tasman). Such an airport would be expected to handle between 5 to 25 million passengers, predominantly on narrowbody jet services.
Type 4	"A minimum service airport servicing GA and limited RPT" covering an area of between 120 and 400 hectares.

Benchmarking was used where appropriate to establish a range of values and relationships between traffic levels and generic airport infrastructure scale and relationships. This is discussed later, particularly under the airport capital expenditure section.

The airports benchmarked do not necessarily exactly match the descriptors above (for Type 1 to Type 3 airports) and comment is provided below on the characteristics where they are similar or differ from the "generic" airport types defined for the purposes of this study.

The Type 4 airport has been described as: "A minimum service airport servicing GA and limited RPT" covering an area of between 120 and 400 hectares. The indicative annual passenger at start-up is around 500,000 eventually reaching around 1 million. Airports suggested as having characteristics similar to this type of airport could include Albury, Hervey Bay (Fraser Coast), Mackay, Sunshine Coast (Maroochydore) and Wagga Wagga airports. Benchmarking material on these airports is also presented in the appropriate section to establish the range of values that may be appropriate assumptions in modelling scenarios.

Table 2: Benchmarked Airports

Airport	Commentary
Sydney	Around 30 million passengers, on a constrained site but with dual parallel runways (and a crossing runway). Handles A380 aircraft (despite 45m wide existing runways). Around 30% of traffic is international. Multi-level carparks in the separate international and domestic terminal precincts.
Melbourne	Around 25 million passengers, on a large site currently with crossing runways, and future plans for crossing parallel runways. Handles A380 aircraft on the 60m wide main runway. Common roof international and domestic terminal complex, and a separate additional low cost carrier terminal (T4). Around 20% of traffic is international.

Airport	Commentary
Brisbane	Around 20 million passengers, on a large site with main runways handling A380 aircraft, and a cross-wind runway limited to narrowbody turboprop aircraft. Approvals for a major parallel runway development. Separate international and domestic terminals, and a lot of intrastate regional traffic. Around 20% of traffic is international.
Auckland	Over 12 million passengers, with over 50% international as the international gateway to New Zealand with long-haul and short-haul traffic. A single runway, with plans for a future (domestic narrowbody capable) parallel runway. Domestic operations, including a high proportion of regional turboprop aircraft, are concentrated in a small terminal which has undergone numerous refurbishments but little expansion.
Perth	Around 10 million passengers, with over 25% internationals in a separate terminal. Crossing runways with long term plans for parallel main runways. Currently finalising major terminal redevelopments including a single level terminal and associated apron (no aerobridges) for low cost and significant charter flights (serving resource fly-in fly-out (FIFO) operations).
Adelaide	Around 5 million passengers. A recently (2006) redeveloped terminal area with a combined two level international/domestic terminal. Less than 10% of passengers are international.
Christchurch	Around 5 million passengers, with over 20% international (generally short-haul, as the gateway to the South Island). Currently undergoing major terminal area redevelopment, particularly for domestic and regional services.
Wellington	Around 5 million passengers on a very constrained site, with a single runway. Around 10% international traffic on short-haul routes using narrowbody jets. A recently redeveloped combined international/domestic terminal.
Canberra	Over 3 million passengers. A two level domestic terminal in the midst of a major terminal area redevelopment. Crossing runways, with the main runway extended to accommodate introductory international services at some stage in the future.
Cairns	Around 3 million passengers, including over 10% internationals (down from historic highs of over 30%). Separate international and domestic terminals, with the international currently underutilised and the domestic undergoing major redevelopment. The main runway takes long haul international wide-body jets, and a crosswind runway is limited to smaller General Aviation aircraft types. Longer term plans for a parallel domestic jet capable parallel runway.
Gold Coast	Around 5 million passengers, is the 6th busiest airport in Australia, and includes around 10% international on low cost type short to medium haul airlines with connections via Kuala Lumpur to long haul destinations. In January 2010 a $100 million terminal (low cost carrier) redevelopment was opened. Runway, taxiway and aprons extensions had been completed in previous years.

2. General Assumptions

General assumptions relating to timing and economic inputs have been provided by Ernst & Young.

Assumption	Input	Rationale/Source
Operating Period	50 years	This is the length of leases for the majority of major Australian city airports
Timing		
Base Date of Costs	1 January 2011	For simplicity and practicality this date was agreed upon as the base date for all costs.
Economic assumptions		
General inflation rate	2.5%	This is the inflation rate targeted by the Reserve Bank of Australia.
The model is GST exclusive		

2.1 Escalation Factors

All figures presented in this document are nominal amounts, unless otherwise stated. Where necessary, the financial model will escalate revenues and costs using an appropriate CPI assumption on a per-annum basis. All escalation factors associated with aeronautical and non-aeronautical revenues and costs have been supplied Airbiz. All escalation factors associated with supporting infrastructure have been supplied by Arup.

Table 3: Escalation factors

Classification	Escalation Factor	Reference date	Source
Aeronautical Revenue	2.5%	1 January 2011	Scales linearly with passenger growth
Non-Aeronautical Revenue	2.5%	1 January 2011	CPI growth in addition to passenger growth
Operating Expenses (Fixed)	2.5%	1 January 2011	Inflation
Operating Expenses (Variable)	2.5%	1 January 2011	Develop a relationship between Construction Industry Output Price Index and CPI
Aviation Capital Expenditure	4.5%	1 January 2011	Assumed BPI forecast
Supporting Infrastructure Capital Expenditure	0% (1/1/11 – 30/6/11) 2% (1/7/11 – 31/12/11) 2% (1/1/12 – 30/6/12) 3.5% (1/7/12 – 31/12/12) 3.5% (1/1/13 – 30/6/13) 4.5% (1/7/13 – 31/12/13) 4.5% (1/1/14 – 30/6/14) 5% (1/7/14 – 31/12/14) 5% (1/1/15 – 30/6/15) 4% (1/7/15 – 31/12/15) 4% (1/1/16– thereafter)	1 January 2011	Turner & Townsend economic and market assessment

2.2 Key exclusions & limitations

This exercise has been prepared using a benchmarking based approach to provide high level estimates of the potential costs of the generic airport types. This exercise has been performed under a short timeframe and it based on generic airport types.

For the purposes of this assumptions book, we have specifically excluded assessment of the following assumptions.

Table 4: Key exclusions and limitations

Exclusions	Rationale
Costs associated with Land acquisition	This has been specifically excluded as land acquisition costs will be driven by site specific characteristics. Land acquisition costs are likely to be material.
Site specific remediation costs	This has been specifically excluded as site remediation costs will be driven by site specific characteristics. Depending on the site selected remediation costs may have a material impact on the results presented.
Capital costs associated with the construction of terminal roads and landside structures	These are costs will be driven by site specific characteristics.
Capital costs associated with the construction of aircraft maintenance facilities	These are usually driven by and tied to specific leasing information e.g. Airlines or third party likely to fund the construction of the aircraft maintenance facility under a long-term lease arrangement. Therefore this has been excluded from the upfront infrastructure cost estimate.
Costs associated with clearing levelling, site formation and gaining development approval and environmental protection and mitigation measures (e.g. noise conservation)	These costs will be driven by site specific characteristics. The infrastructure cost estimates have been provided on the basis of a clear and level site. Depending on the site selected these costs may have a material impact on the results presented.
Costs associated extensive ground works including voluminous basements, complex foundations and interfaces with rail stations or similar	These costs will be driven by site specific characteristics and have therefore been excluded from this analysis. These costs could have a significant impact on the overall costs, ranging from 10% to 50% or in extreme cases approaching 100% or more.
Capital costs associated with freight handling facilities	These are usually driven by and tied to specific leasing information e.g. Airlines or third party likely to fund the construction of freight handling facilities under a long-term lease arrangement. Therefore this has been excluded from the upfront infrastructure cost estimate.
Third party funded infrastructure costs – e.g. Airline fit-outs, control tower and emergency services infrastructure, airport fuel infrastructure services.	Elements of airport infrastructure and services may be provided directly by third party providers. Consequently these costs have been excluded.
Risk Allowance	Detailed project risk analysis and estimation has not been undertaken. However, an estimated and indicative figure of 30% (based on total capital costs) for risk or contingency has been allowed in the generic cost estimates to date.
Project management & design	An estimated and indicative figure of 20% project management and design costs (based on total capital costs) has been allowed in the generic cost estimates to date.
Funding Costs	These costs have been specifically excluded as these costs will be driven by the funding market at the time and project specific factors such as the airport's risk profile.

3. Key model assumptions

Detailed below are the key model assumptions, the entity responsible for generating them and the section in the report which discusses it.

Table 5: Key model assumptions

Key Assumption	Source	Assumption book section
Airport timing assumptions		
Development timing	Arup/Turner Townsend	4.2
Construction timing	Airbiz	4.3
Demand		
Annual passengers	The Department	5.2
Aircraft movements	The Department	5.3
International/domestic passenger split	Airbiz	6.1
Aeronautical Income		
Per passenger aeronautical income	Airbiz	6.1
Per passenger non-aeronautical income	Airbiz	7.1
Airport operating costs		
Operating costs per passenger	Airbiz	8.1
Airport Capital Costs		
Paved surfaces	Airbiz	9.1
Domestic & International Terminal facilities on a per pax basis	Airbiz	9.2
Carparking costs	Airbiz	9.5
Supporting Infrastructure		
Road Connections costs	Arup/Turner Townsend	10.2
Rail Connections costs	Arup/Turner Townsend	10.3
Water supply costs	Arup/Turner Townsend	10.4
Wastewater costs	Arup/Turner Townsend	10.5
Power supply	Arup/Turner Townsend	10.6
Communications	Arup/Turner Townsend	10.7
Gas	Arup/Turner Townsend	10.8
Fuel supply	Arup/Turner Townsend	10.9
Drainage	Arup/Turner Townsend	10.10
Environment	Arup/Turner Townsend	10.11

A number of the assumptions that have been applied for the purposes of this analysis are estimates based on benchmark information. The basis for those estimates and assumptions are set out in this assumptions book. The Department should review the assumptions and methodologies made in this book to identify whether they are inconsistent with the Department's specifications or requirements.

4. Airport Type Specific Assumptions

4.1 General

Airport location - Airport site is land-based and no reclamation is required for construction.

4.2 Development Timing

The development stage for an airport in this context is considered to be from the initial announcement to the start of construction. During this period all environmental investigations, consultation, planning approvals and design will be completed. The duration of this period is dependent upon a number of variables including:

- The level of "Whole of Government" support from all levels of government. This will determine the ability to make quick decisions
- The airport type and size
- The site. Those remote from existing communities will have a shorter duration for the environmental and consultation periods than those close to existing communities.
- The existing use of the site (i.e. existing infrastructure or working during existing airport operations)

Due to the above variability we have developed a range of possible durations for the development phase and summarise these in the below table. These durations are consistent for airport types 1 – 4.

Table 6: Indicative Airport Development Timing

Stage	Example Timeline 15th percentile	Example Timeline 85th percentile
Site location study and confirmation	2 years	2 years
Draft EIS	2 years	3 years
Public consultation	Included in EIS	2 years
Final EIS	1 year	1 year
Planning application and rezoning	1 year	2 years
Preliminary design	Included in EIS/Planning	2 years
Detail design	2 years[1]	2 years
Total duration	8 years	14 years

Notes: 1 - may overlap into a PPP or another bid process

Therefore we have assumed a midpoint between these two periods of 11 years for completion of approvals across all scenarios prior to the commencement of construction activities.

4.3 Construction Timing

At this stage, discussions with the Department have confirmed that only the initial build is to be considered for the "template airports" provided by the Department.

For the purposes of this exercise we have assumed generic Construction 'S' Curves for each of the Airport types. As the construction and disbursement profile of airports are highly variable, the S curves used are indicative only.

Table 7: Construction timing

Timing	Type 1	Type 2	Type 3	Type 4
Airport				
Construction start date	1 January 2022	1 January 2022	1 January 2022	1 January 2022
Construction period	5 years	4 years	3 years	2.5 years
Operations start date	1 January 2027	1 January 2026	1 January 2025	1 July 2024
Supporting Infrastructure				
Construction start date	-	-	-	-
Construction end date	-	-	-	-

The following indicative construction periods have been supplied by Airbiz

4.3.1 Airport type 1 – Construction Period

For the generic airport, assumes all site acquisition, clearing, levelling is done. Project definition and all pre-approval processes have been completed. Indicative timeframe is for detailed design, construction and commissioning is a minimum of 5 years.

4.3.2 Airport type 2 – Construction Period

For the generic airport, assumes all site acquisition, clearing, levelling is done. Project definition and all pre-approval processes have been completed. Indicative timeframe is for detailed design, construction and commissioning is a minimum of 4 years. Reduced timescale compared to Type 1, is based on smaller scale and scope, hence reduced complexity in design, construction and commissioning.

4.3.3 Airport type 3 – Construction Period

For the generic airport, assumes all site acquisition, clearing, levelling is done. Project definition and all pre-approval processes have been completed. Indicative timeframe is for detailed design, construction and commissioning is a minimum of 3 years, similar to Type 2.

4.3.4 Airport type 4 – Construction Period

For the generic airport, assumes all site acquisition, clearing, levelling is done. Project definition and all pre-approval processes have been completed. Indicative timeframe is for detailed design, construction and commissioning is a minimum of 2.5 years. Significantly reduced airfield and terminal area construction compared to other Types.

5. Demand

5.1 Design Aircraft

Assumptions relating to design aircraft have been supplied by the Department.

Table 8: Design Aircraft

	Type 1	Type 2	Type 3	Type 4
Main Runway	A380	B787	B737	Ex Jet
Parallel Runway	A380			GA Flying Training
Future Runway	B747 A340			

For airport planning these aircraft types are translated into their airfield design codes as follows:

Table 9: Aircraft type and airfield design codes

Aircraft type	Description	Airfield design code
A380	Large widebody jet	Code F
B747, A340, B787	Widebody jet	Code E
B737, A320	Narrowbody jet	Code C
Dash8 series, SAAB340	Turboprop	Code C

Aircraft type is a driver for runway length (partial driver), width and strength, taxiway width and strength, apron width and strength. The length and width parameters are as provided in the templates.

For a Full Service International Airport, it is assumed that there are international, domestic and regional airline/aircraft operations, with their own terminals (potentially separate, single roof or common use).

The proportion of different aircraft types guide the proportional mix between aircraft parking positions for Code F (A380), Code E (B747, B777, A340, A330, B787 types – for example) and Code C (B737 and A320 families), as well as regional jets and larger turboprop aircraft).

In the absence of specific details within scenarios for a base case, for model testing a range of values has been suggest from benchmarking as discussed in Section 5.2 below. The model allows for sensitivity testing by altering the assumed percentage of international traffic (base case around 30% as per current Sydney Airport, or reduce to 20% as per Melbourne and Brisbane).

Table 10: Sydney Airport – Current Air Traffic Profile

	Annual passengers (million) and split		Annual aircraft movements and split	
International	11.1	32%	61,700	22%
Domestic/Regional	23.4	68%	213,400	78%
	34.5		**275,100**	

Source: BITRE for Sydney Airport 2009/10

Proportion split between international and domestic is discussed further in Section 5.2 and the aircraft mix in Section 5.3.

5.1.1 Airport type 1 – Design Aircraft

Aircraft type (Code F) as provided in the draft "Characteristics for template airports" as provided by the Department.

5.1.2 Airport type 2 – Design Aircraft

As above, with the aircraft maximum size limited to the B787 (Code E) type. Similar comments apply in relation to the percentage of international traffic. The model allows variation of this assumption.

5.1.3 Airport type 3 – Design Aircraft

As above, with the aircraft maximum size limited to the B737 (Code C) type. Runway length will limit destinations to medium and short-haul domestic destinations. The model allows for testing with a component of international traffic, which would be limited to short-haul international destinations by the design aircraft adopted.

5.1.4 Airport type 4 – Design Aircraft

Aircraft type as provided in the draft "Characteristics for template airports" as provided by the Department.

For the limited RPT operations, the largest aircraft is expressed as Executive Jet. Airfield length of 1600m (similar to Port Macquarie, for example) suggests operations limited to say 18 to 70 seat regional turboprop aircraft (such as the Metroliner, SAAB340 and Dash8-100, -200, -300, -400 series to local destinations. It precludes Regional jet aircraft operations. Benchmarking of the runway length and width is discussed in Section 9.1.

For the GA component the template suggests main use as flying training, but range of annual aircraft movements (order of magnitude 50,000, 100,000 or greater) from which to size apron and taxiways areas (and costs) is not yet provided.

5.2 Annual passengers

Initial and ultimate annual passenger assumptions have been supplied by the Department.

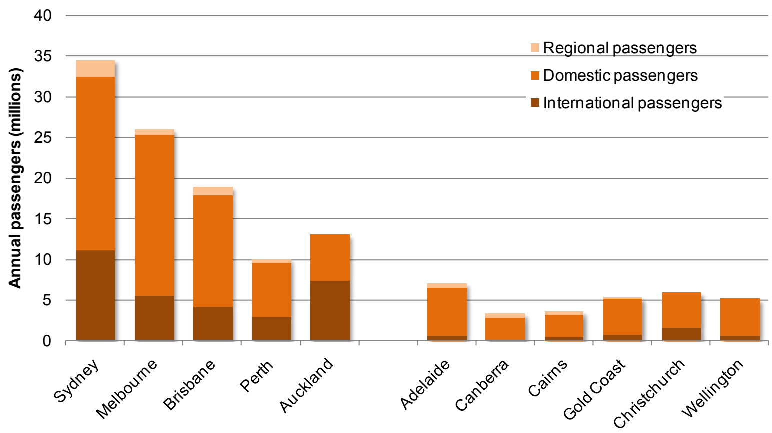
Table 11: Annual passenger data for generic airport types

	Type 1	Type 2	Type 3	Type 4
Annual total passengers	30m - 120m	5m - 30m	5m - 25m	0.5m - 1m

At this stage, discussions with the Department have confirmed that only the initial traffic level (start-up) is to be considered for the "template airports" provided by the Department. Sensitivity tests for capital expenditure have been generated in the model for increased traffic towards the upper limits.

Benchmarking of recent annual passenger and aircraft movement traffic for major Australian and New Zealand airports is shown below which could reflect Type 1, 2 or 3 airports in the range of 3 to 35 million annual passengers. To provide context, the current annual air traffic movements (passengers and aircraft) for these airports are summarised below and at the beginning of Section 5.3, using publicly available data (generally sourced from BITRE statistic 2008/09 and New Zealand statistic published by the airport), supplemented by unpublished reports for validation or where public information was not available.

Figure 1: Annual Passenger Movements by International, Domestic and Regional Segments



The split between international and domestic passengers is important for a traffic driven model.

In particular, capital expenditure for terminals is related to terminal sizing, which is related to busy hour passengers or derived from annual passengers by peaking factors.

The relationship between area required (sq m per million annual passengers) is quite different for an international than for a domestic terminal (of the order of a factor of 3 times the area per million annual passengers, although within each category there are also wide variations depending on the specifics of the air traffic passenger profiles and other port specific factors).

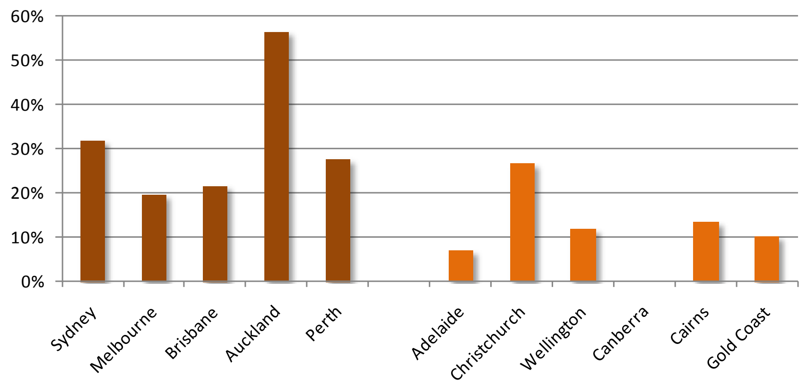
An international terminal requires additional areas for passenger processing and segregation of flows to meet border protection requirements, as well as the enhanced spend opportunities with terminal retail for international passengers. Depending on the nature of the international traffic (long-haul vs. short-haul) there are likely to be a larger proportion of wide-body aircraft in the international mix, which increases the areas required for aircraft parking and the interfaces with the terminal.

Aircraft pavement areas will therefore also be impacted by the proportion of wide-body to narrow-body assumed in the fleet mix for international and domestic. The apron area to park a Code E aircraft is roughly 2.5 times that for a Code C aircraft, and the taxiways abutting the aprons will be similarly deeper and wider.

The aeronautical and non-aeronautical revenue expectations are also different for international and domestic passengers. So the model allows for separate streams for international and domestic to be driven of the annual passenger assumptions.

The percentage of international passengers for the airports benchmarked is shown below.

Figure 2: Percentage of international passenger movements



The capital expenditure model allows the user to vary the following traffic characteristics which generate the annual aircraft movements from the assumed annual passengers. The table below includes some suggested base case default values from benchmarking a range of trunk Australian and New Zealand airports for each of the four types of airports. It shows the assumed percentage international passengers suggested for the base case for each of the airport types.

Table 12: Capex Model Assumption – Percentage International Passengers Suggested for Base Case

Airport	Type 1	Type 2	Type 3	Type 4
Scenario	Base	Base	Base	RPT Base
Annual passengers (millions)	30	5	5	0.5
Percentage international passengers	30%	10%	0%	0%

The model generates the split between international and domestic passenger and aircraft movements, as well as average passengers per aircraft movement which in turn are used to calculate area requirements for airport infrastructure elements. The annual passenger splits in Table 4 are a model output which will vary if the inputs in Table 3 are changed.

Table 13: Capex Model Output– Percentage International Passengers

Airport	Type 1	Type 2	Type 3	Type 4
Scenario	Base	Base	Base	RPT Base
Total annual passengers (millions)	30	5	5	0.5
International passengers (millions)	9	0.5	-	-
Domestic passengers (millions)	21	4.5	5	0.5

In the absence of any specific definition of the role of the type 1, 2 or 3 airports, in the Sydney context the above figures suggest that a Type 1 "full international airport" (30 million total passengers and upward) could have anywhere between 10% to 30% of its annual passengers as international traffic.

The split between international and domestic passengers for a Type 2, having a runway length and width to accommodate Code E (widebody jets) could have a similar range. From the definition provided (especially the runway/taxiway design aircraft being limited to narrowbody (737/A320 types), it appears that a Type 3 airport excludes international traffic. However, the benchmarking suggests that this sort of airport could still have some limited short-haul international traffic (similar to Gold Coast and Wellington) perhaps up to 10% of traffic (assuming this level of demand from the Sydney catchment to short-haul international destinations.

The busy hour passengers in turn drive passenger terminal functional areas, and stand demand (for an assumed fleet mix and average turnaround time).

Airport planning text books such as Hirst (2008) quotes the US Federal Aviation Administration (FAA) peaking factors decreasing as annual passengers increase (assumes peak spreading ranging) from 0.200 for below 100,000 annual passengers to 0.035 for 30 million and over. Similarly de Neufville and Odoni (2003) quote FAA (1969) values from 0.050% between 500,000 to 1 million passengers and decreasing to 0.030% for more than 20 million annual passengers.

The peaking factor will depend on the definition of "the peak" (there are a number of definitions, such as 30th busiest hour, peak hour peak month (PHPM)), whether clock or moving hour is used, the nature of the traffic, the demand profile (short-haul versus long-haul, domestic versus international, business versus leisure) and any constraints (such as curfews or scheduling windows).

Recent demand studies at Australian and New Zealand airport suggest the following ranges for the initial traffic levels, with the potential for further peak spreading (decrease in peaking factor) with increased annual passenger movements.

Table 14: Indicative One-Way Peaking Factor For Busy Hour Arrivals And Departure

Airport	Type 1	Type 2	Type 3	Type 4
Scenarios	Base	Base	Base	RPT Base
International	0.030%	0.035%	0.035%	N/A
Domestic	0.015%	0.020%	0.025%	0.040%

5.2.1 Airport type 1 – Annual passenger profile

In the absence of a defined role for the proposed airport, from the benchmarking it is suggested that for sensitivity testing of a generic Type 1 airport a range of percentage international passengers could be between 10% to 30%.

For planning purposes a linear growth of passenger segments is appropriate, except where there was introduction of a new traffic type (airport transitions for domestic to full service international), where the new traffic type would also induce an effect on the existing traffic type (more domestic traffic making international connections).

Scenarios can be built up in the model for discrete increments in traffic levels to show increments in capital expenditure without putting a specific time to when the traffic level is reached.

5.2.2 Airport type 2 – Annual passenger profile

As above, but assumes aircraft type limited to Code E (B787) wide-body aircraft type.

The terminal requirements for this Type 2 (5 million passengers at start-up) are significantly less than for Type 1 (30 million passengers), by a factor of six. As noted at the beginning of this section, for the percentage of international passengers for a Type 2 airport a value around 10% is suggested from the benchmarking, in the absence of a clear definition of the role of the airport and its target traffic

This is less in proportional and absolute terms compared to the Type 1 airport. Limited international passengers, compared to Type 1, will still require international passenger processing facilities (greater capex than domestic, but higher revenue) but the capital cost will be spread over a smaller passenger base (capex per passenger). The domestic terminal capex (driven by passengers and average aircraft size) will be more or less proportional to the relative reduction in annual passenger numbers, assuming a similar mix of domestic traffic to the Type 1 airport.

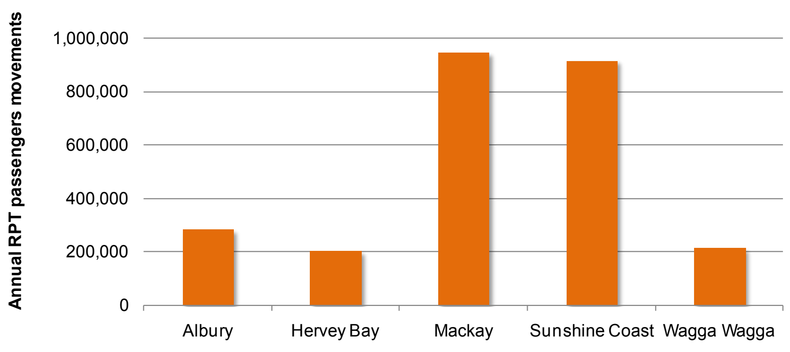
5.2.3 Airport type 3– Annual passenger profile

As above, but assumed no international passengers. May have a different domestic passenger profile, with the runway limiting the aircraft type to narrow-body jets on short to medium haul domestic operations.

5.2.4 Airport type 4 – Annual passenger profile

Further definition required on the assumed 500,000 start-up annual passengers. With the design aircraft this appears to be limited to local regional traffic on 18 to 50 seater (maximum size) aircraft. Annual passenger numbers for the airport suggested appropriate for benchmarking with annual regular public transport (RPT) passengers in the range 200,000 to 1,000,000 are shown below.

Figure 3: Annual passenger movements for regional airports



Source: BITRE statistic 2008/09 and Aeroplanner

The difference between the airports approaching the 1 million annual passengers in this set with the Type 4 airport definition is that airports such as Mackay and Sunshine Coast have a high level of traffic generated by the low cost carrier airlines such as Jetstar and VirginBlue operating Code C narrowbody jet aircraft (B737 and A320 types) on interstate routes.

5.3 Aircraft Movements

The following assumptions regarding aircraft movements have been provided by the Department and analysed by Airbiz.

Table 15: Runway Movements Per Hour (Not Annualised)

	Type 1	Type 2	Type 3	Type 4
Annual Aircraft Movements	90 - 130 aircraft/hr	40 aircraft/hr	40 aircraft/hr	-

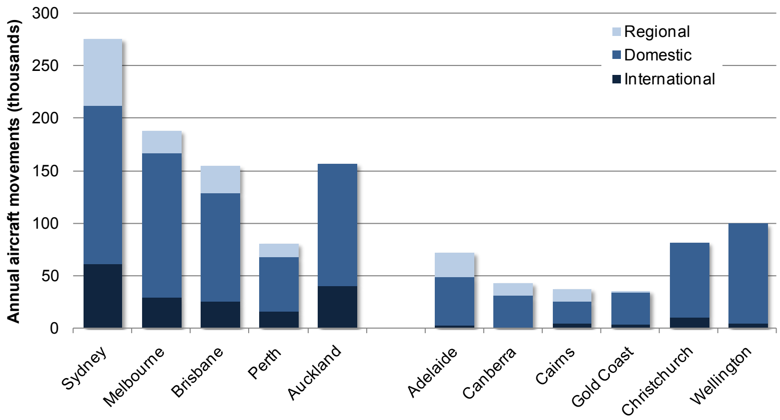
There is either an implicit or an explicit relationship between annual aircraft and annual passengers for each segment. If there are general assumptions available on fleet mix for each sector the annual aircraft movements can be generated in an internally consistent manner.

For planning purposes we would agree with a linear growth of passenger segments, except where there was introduction of a new traffic type (airport transitions for domestic to full service international), where the new traffic type would also induce an effect on the existing traffic type (more domestic traffic making international connections).

As discussed in Section 5.2, the proportional mix between international and domestic passenger assumptions will impact on terminal requirements, and per passenger costs and revenues. For more detailed analysis scenarios could be broken down further between domestic and regional traffic and also between full-service and low cost carriers. This is particularly so for domestic operations, where a separate low cost terminal (lower capex and opex) could be provided (cf T4 at Melbourne for Tiger, or operations at Avalon).

In the absence of definition from other forecasting studies values for assumptions to drive the CAPEX model are based on benchmarking discussed below. Benchmarking of recent aircraft movement traffic for major Australian and New Zealand airports is shown below which could reflect Type 1, 2 or 3 airports in the range of 3 to 35 million annual passengers.

Figure 4: Annual Aircraft Movements Broken Down By International, Domestic and Regional Segments



Source: BITRE statistics 2008/09

The capital expenditure model allows the user to vary the following traffic characteristics which generate the annual aircraft movements from the assumed annual passengers. The table below includes some suggested base case default values to populate the scenario assumptions input form. It shows the average load factor and seats for aircraft categories (Code F, Code E and Code C) for international and domestic aircraft types. Code C turboprop aircraft are separated out because of their difference in average seating compared with Code C jets (narrowbody B737 and A320 type aircraft)

Table 16: Capex Model – Conversion of Annual Passengers to Annual Aircraft Movements

Item	Assumption		Type 1	Type 2	Type 3	Type 4
			Base	Base	Base	RPT Base
Traffic		**Units**				
	Annual passengers (millions)	#	30	5	5	0.5
	Percentage international passengers	%	30%	10%	0%	0%
International fleet mix						
	Average load factor	%	75%	75%	75%	75%
	% Code F^	%	10%	0%	0%	0%
	% Code E^	%	50%	20%	0%	0%
	% Code C^	%	40%	80%	100%	100%
	Code F average seats	#	450			
	Code E average seats	#	300	300	300	300
	Code C average seats	#	150	150	150	150
Domestic fleet mix						
	Average load factor	%	75%	75%	75%	65%
	% Code F^	%	0%	0%	0%	0%
	% Code E^	%	20%	20%	0%	0%
	% Code C jets^	%	60%	60%	70%	0%
	% Code C turboprops^	%	20%	20%	30%	100%
	Code F average seats	#				
	Code E average seats	#	240	240	240	240
	Code C average seats	#	175	175	175	175
	Turboprop average seats	#	50	50	50	36

^ Note percentage of aircraft fleet mix is based in Airbiz expertise and judgement.

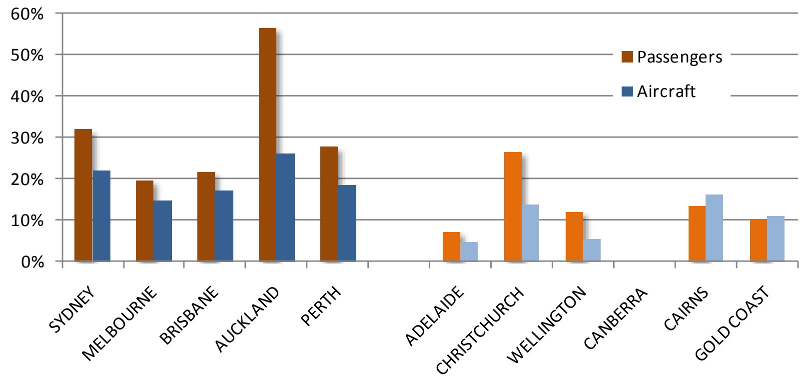
The model takes the input assumptions and generates the outputs of air traffic as shown in the Table below.

Table 17: Capex Model – Conversion of Annual Passengers to Annual Aircraft Movements

Airport	Type 1	Type 2	Type 3	Type 4
Scenario	Base	Base	Base	RPT Base
Annual international passengers	9,000,000	500,000	0	0
Annual domestic passengers	21,000,000	4,500,000	5,000,000	500,000
Total annual passengers	30,000,000	5,000,000	5,000,000	500,000
Annual international aircraft	47,059	3,704	0	0
Annual domestic aircraft	171,779	36,810	48,485	21,368
Total annual aircraft	218,838	40,514	48,485	21,368
Percentage international aircraft	22%	9%	0%	0%
Percentage domestic aircraft	78%	91%	100%	100%
Average pax./AC international	191	135		
Average pax/AC domestic	122	122	103	23
Overall average pax/AC	137	123	103	23

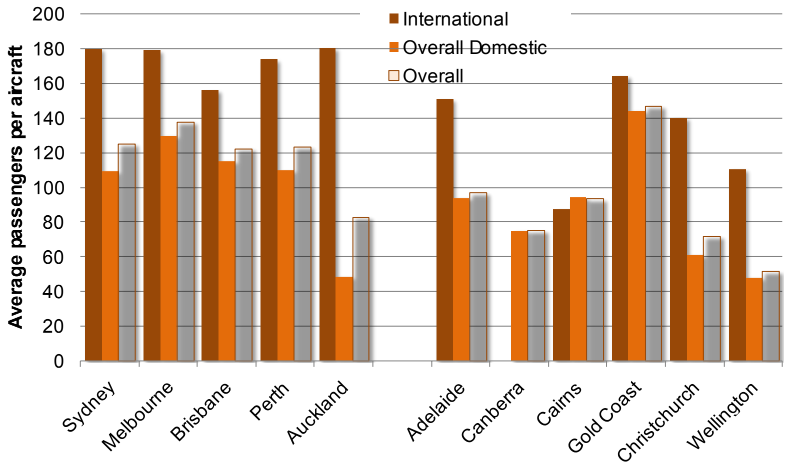
The splits for suggested for the base case scenarios can be compared with those from benchmarking shown below.

Figure 5: Percentage International Traffic – Passengers and Aircraft compared



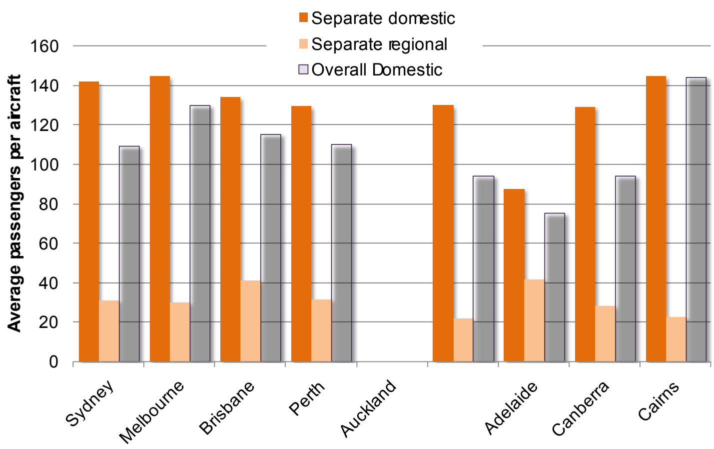
The average passengers per aircraft are simply calculated by dividing the annual passengers by the annual aircraft movements. They are influenced by both the aircraft size (average seating capacity) and the percentage load factor.

Figure 6: Average Passengers Per Aircraft



Domestic values include both domestic and regional services which may have different characteristics at the disaggregated level. This breakdown was not readily available for the New Zealand airports, but is shown in Figure 7 for the Australian airports.

Figure 7: Separate Domestic and Regional Average Passengers Per Aircraft



The implications of aircraft types and movements in terms of areas and cost of runways, taxiways and aprons (paved surfaces) is discussed further under Section 9.1.

Average load factors are based on recent BITRE data for primary Australian Trunk routes, but should be checked with those providing the forecasts. They may be lower in start up phase, and higher if there is a large proportion of low cost carrier airline.

If further information is available from forecasting studies on assumed or scenarios for the split between domestic and regional (smaller aircraft, lower average load factor than domestic) or low cost carrier (for domestic more average seats and higher average load factor, this would provide a further level of detail in the model of facility requirements, capex, opex and revenue).

5.3.1 Airport type 1 – Aircraft movements

Refer to Section 5.3 above.

5.3.2 Airport type 2 – Aircraft movements

Refer to Section 5.3 above.

5.3.3 Airport type 3 – Aircraft movements

Refer to Section 5.3 above.

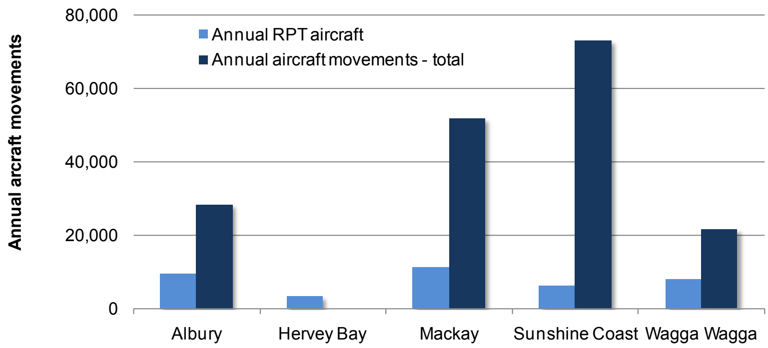
5.3.4 Airport type 4 – Aircraft movements

Without further information we would assume this generic scenario has some regional RPT (limited by runway design aircraft).

The annual aircraft movements include RPT aircraft (jets or turboprops, usually above 18 seats), as well as General Aviation (commercial and training), freight, helicopters and military. The range of RPT aircraft movements is around 3,000 to just over 10,000 annual movements for regional and domestic services by airlines such as QantasLink, Jetstar, Virgin, Tiger and Rex (source Aeroplanner 2010). The total aircraft movements are reported by Airservices Australia.

The aircraft movement numbers show less than 10,000 regular public transports (RPT) per annum and general aviation aircraft movements between 10,000 and 70,000 depending on the number of aircraft based at the airport and significant flying training schools for those with the highest level of movements.

Figure 8: Annual Aircraft Movements for Regional Airports



The average passengers per aircraft are calculated simply by dividing the annual passengers by the annual RPT aircraft. This gives an indication of average aircraft size, although the average load factor must also be considered.

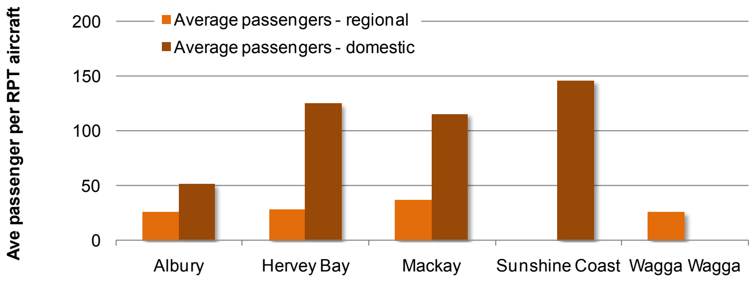
Annual average load factors on the top 54 routes in Australia, as reported by BITRE, ranged from around 55% to 85% with an average around 75%[1]. For example on the Sydney-Wagga Wagga route the load factor was round 67% for the year ending June 2010. Load factors for Brisbane-Mackay and Sunshine Coast-Sydney average around 80%. Albury-Sydney and Sydney-Wagga Wagga averaged between 65% and 70% and Melbourne-Sunshine Coast almost 85%. Generally one would expect higher load factors on low cost carrier routes (typically server by one or more of the low cost carriers – Jetstar, Tiger or VirginBlue, with A320 and 737 jet services) and the more mature routes. Regional routes with turboprop aircraft often have the lower load factors.

As noted previously, the difference between the airports approaching the 1 million annual passengers in this set with the Type 4 airport definition is that airports such as Mackay and Sunshine Coast have high level of traffic generated by the low cost carrier airlines such as Jetstar and VirginBlue operating Code C narrowbody jet aircraft (B737 and A320 types) on interstate routes. The design aircraft for the Type 4 airport is one level lower than this. The turboprop aircraft that could operate into a Type 4 airport would have average seating in the range 18, 36 or 50 seats, compared to the narrowbody jets in the low cost carrier fleets having around 180 seats. So for the same level of annual passengers there would be 3 to 10 times the number of aircraft movements.

Figure 9 below shows the differences between typical passengers per aircraft on domestic services (usually jets) at over 100 passenger per aircraft and regional services (turboprop aircraft) at under 50 passengers per aircraft. This has implications for busy hour passenger which in turn drive passenger terminal and potentially car park facility sizing to some extent.

[1] http://www.bitre.gov.au/publications/24/Files/Domestic%20Airline%20Activity%20Annual%20200910.pdf (accessed 22/12/10)

Figure 9: Average Passenger Per (RPT) Aircraft For Domestic And Regional Services



There is a big difference in average passengers per aircraft between domestic traffic (typically low cost carriers such as Jetstar and VirginBlue operating narrowbody jet aircraft such as the A320 or B737 with relatively high load factors, compared to the regional operations with smaller turboprop aircraft. The design aircraft for a Type 4 airport suggest around 25 to 55 average passengers per aircraft.

5.4 Maximum take-off weight

The following assumptions in relation to maximum take-off weight (MTOW) were supplied by Airbiz.

Table 18: Average maximum take-off weight for fleet

	Type 1	Type 2	Type 3	Type 4
Average maximum take-off weight for fleet	133,000	104,000	63,000	13,000

This is a derived value from the assumed fleet mix to generate aeronautical revenue for components based on weight based landing charges. Further information including changes over time of assumed fleet mix and average MTOW (growth in average aircraft size) from detailed forecasting exercises would be required to provide further information to support this assumption.

For model testing the values above are suggested based on fleet mix assumptions suggested for the base cases in Section 5.2. For the Type 4 airport the values are for the RPT component of the fleet (for the 500,000 annual passenger assumption).

6. Aeronautical Income

To take into account economies of scale aeronautical revenues are not expected to inflate with CPI but scale directly with passenger numbers going forward.

Aeronautical income assumptions have been provided by Airbiz.

6.1 Per Passenger Aeronautical Income

Benchmarking of key Australian airports has been used to estimate operational revenue and cost inputs for the financial model. The primary source for the operational revenues and expenses at these airports are the annual regulatory and financial reports. The primary sources for passenger and aircraft movements are Bureau of Infrastructure, Transport and Regional Economics (BITRE) and the annual reports. 2008-09 reports were used where possible for consistency

Consistent detailed accounts are only available for the five largest airports in Australia. For other airports Annual Reports have been used which do not consistently publish break downs of revenues and costs. In addition a number of the airports in Australia have terminals operated by airlines; these revenues have not been captured in this exercise. As such this top down approach is to give indicative values of Revenue and Operating Costs which can be scaled with passenger numbers for a generic high level model. In order to gain more granularity a bottom up approach would have to be adopted which would require site and business model specific assumptions to be made, which at this stage in the process the Department, is not in a position to provide.

Financial data is not consistently available from the same financial year. For consistency all financial data has been inflated to June 2010 using the CPI. For per passenger benchmarks, passenger numbers have been used from the same financial year as the financial data was reported.

Operational revenues and expenses have been standardised across all airports into the following categories:

- Aeronautical revenues
- Non Aeronautical revenues
- Operational Costs

These standardised values were converted into per passenger values for comparison across the selection of airports. This assumes that revenues and costs typically scale with passengers within airport types. The primary exception to this approximation is airfield maintenance which is dependent on the runway system in operation. Airfield maintenance costs were found to be relatively small compared to the rest of the maintenance costs as major runway maintenance is typically capitalised. For the purposes of this model it has been assumed that all operational costs scale with passengers (within an airport type).

An attempt has been made split the benchmarked airports into the four scenarios supplied in the "Characteristics for template airports" as provided by the Department. The airports have been characterised by a combination of the passenger numbers and the level of infrastructure (primarily runways) supplied in the template. However none of the airports benchmarked fit the description of the generic airports exactly; there is a lot of site and operation specific factors that determine revenue and costs. As such by taking an average across the airports the aim is to normalise some of these factors but the estimates should be treated as indicative only.

As explained in Section 1.7 of this assumptions book, four generic airport types were described by the Department for the purposes of this study. While benchmarking was used where appropriate to establish a range of values for operating expenses and revenue, the airports benchmarked do not neatly fit into the descriptors of Type 1, 2, 3 or 4 airports. Commentary on the main trunk airports and how certain aspects of their infrastructure, traffic and operation relate to the definitions developed for the convenience of this study are provided in Section 1.7.

In the Department's definition of Type 1 and 2 airports the key differences between the two airport types is that Type 1 is unconstrained and can handle up to code F aircraft where as Type 2 is constrained and can only handle up to Code E aircraft. Both airport types are able to process international passengers. These differences would not be expected to drive considerable difference between the revenue and operating costs per passenger. It is conceivable that a Type 2 airport at 30M passengers could be operating in a similar manner to a Type 1 airport with 30M passengers without further site specific information.

Sydney has over 30M passengers but is heavily constrained and at present does accommodate A380 operations such that it could fit into the Type 1 or 2 definition; the other Australian airports large capital city airports (Sydney, Melbourne, Brisbane, Perth) have traffic levels between 5M and 30M passengers including international . In order to be able to get a representative sample size the Type 1 and 2 airports have been considered together.

Type 3 airports are constrained to Code C aircraft only with primarily domestic traffic and the opportunity for some short haul international (although the strict definition of a Type 3 does not consider this). These airports potentially operate a different business model to the Type 1 and 2 airports with the focus largely on code C domestic jets. There is not a consistent financial data set on airports of this type publically available, benchmarks have been used where appropriate but where there is insufficient data, assumptions have been made using the Type 1 and 2 benchmarking and Airbiz's experience in the industry. The airports that could be considered with characteristics more closely matching this category include Adelaide, Canberra, Gold Coast, Cairns, Townsville and Mackay. They have traffic ranging between around 1M and 5M annual passengers and generally limited international traffic, although they serve the full range of airlines, not exclusively the low cost carriers. It should also be noted that there are also potentially some differences in traffic characteristics compared to a similar type of airport if it were located the Sydney Basin that may ultimately influence operating costs and revenues.

The Type 4 airport is a hybrid of GA and RPT operations which does not exist within Australia and New Zealand in the form outlined in the template. As a solution for the purposed of this study, the airport was modelled as pure GA airport with a small RPT terminal present. The GA component will need to be driven of GA aircraft movements where as the RPT component will be driven by passenger numbers.

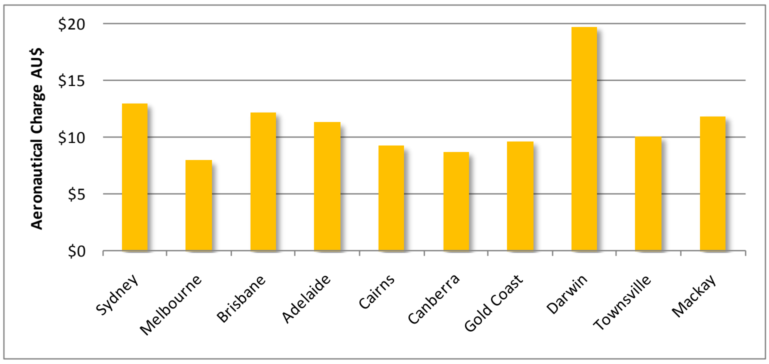
The split between international and domestic passengers is an important factor to consider for both aeronautical and non aeronautical revenues.

Aeronautical charging structures vary from airport to airport but are typically made up of the following components:

- Landing charges
- Per passenger airport/terminal charges
- Security charges

The weighting of each of these components will vary between airports depending on the dominant airline and the airport's operating model. It would be expected that aeronautical charges would be higher in an airport for an international passenger than an equivalent domestic passenger. However due to the variety in charging structures as can be seen in Figure 10 below there is no clear relationship between proportion of international passengers and aeronautical revenues:

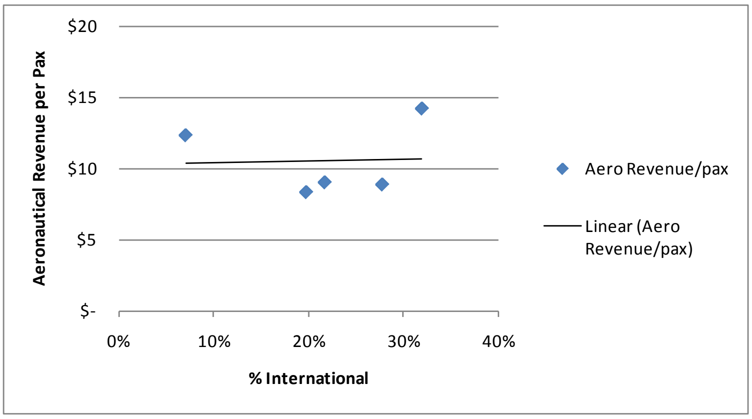
Figure 10: Sample Domestic Aeronautical Charges.



Source: Airport Websites

This variation across airports, results in there being too much "noise" in the data to build a relationship between proportion of international passengers and aeronautical revenues. The chart below of airports that publish their aeronautical revenue against the proportion of international revenue illustrates the lack of correlation. As such we are unable with the data publically available to estimate differential aeronautical revenue per passenger for international and domestic passengers. An average across airports benchmarked for each airport has been used instead.

Figure 11: Relationship between Aeronautical Revenue and Percentage of International Passengers



Source: Regulated Accounts

Airports: SYD, MEL, BNE, PER and ADL

Table 19: Aeronautical income per pax

Airbiz airport classification	Type 1	Type 2	Type 3	Type 4
Aeronautical Income per pax- International	$11.00	$11.00	$10.00	NA
Aeronautical Income per pax - Domestic	$11.00	$11.00	$10.00	$10

The methodology behind these assumptions is explained in the sections below.

6.1.1 Airport type 1 & 2

Airports with passenger numbers between 5 and 35M passengers able to accommodate aircraft at up to code E have been selected for benchmarking. The annual passenger make up of these airports is shown below.

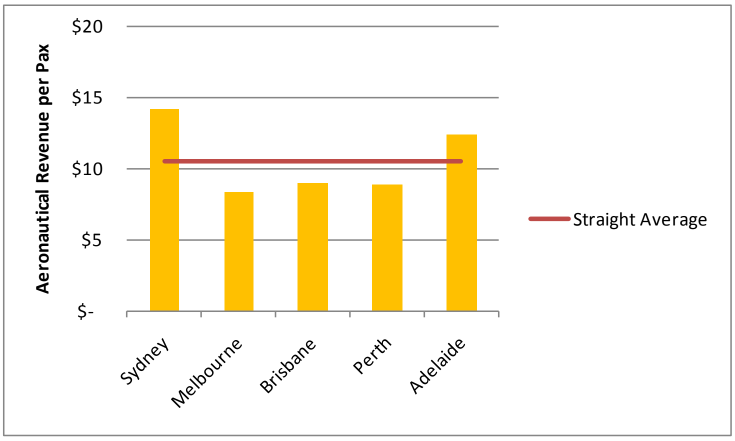
Table 20: International and domestic pax Type 1 and Type 2 Benchmarked Airports

2008-09	International Pax		Domestic Pax		Total	
Sydney (SYD)	10,339,000	32%	22,007,000	68%	32,346,000	100%
Melbourne (MEL)	4,831,000	20%	19,617,000	80%	24,448,000	100%
Brisbane (BNE)	4,066,000	22%	14,655,000	78%	18,721,000	100%
Perth (PER)	2,600,000	28%	6,759,000	72%	9,359,000	100%
Adelaide (ADL)	478,000	7%	6,306,000	93%	6,784,000	100%

Source: BITRE

It is worth noting that Sydney (SYD), Melbourne (MEL), Brisbane (BNE) and Perth (PER) all have some domestic passenger terminals that are leased to an airline (the Qantas domestic terminals). This means that some terminal charges are excluded for domestic passengers passing through these terminals. Taking BNE as an example; approximately 50% of their domestic passengers pass through the Qantas operated terminal. BNE charges approximately 50% for a Qantas domestic passenger compared to a Virgin passenger (Virgin do not operate their own domestic terminal) as Qantas operate the terminal. If all the terminals were fully owned and operated by the airport, it could be expected that aeronautical revenue would increase by approximately 20%. It is noted that at this stage an operating model for the proposed airport has not been defined in terms of whether the terminals are common use or airline operated. The Aeronautical Revenues published in the regulatory accounts have been normalised by the annual passengers at that airport and an average has been taken to give indicative aeronautical revenue per pax for the Type 1 and Type 2 airports.

Figure 12: Aeronautical Revenue per Passenger for Type 1 & 2 Airports



Source: Regulated Accounts

6.1.2 Airport type 3

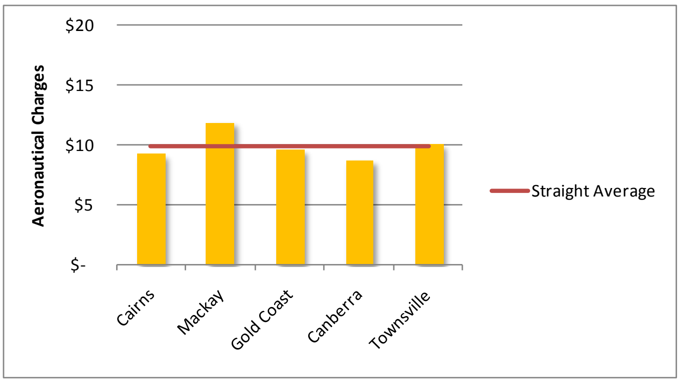
Airports with (predominantly domestic) traffic in the 1-5 million passenger range which focus on Code C aircraft operations have been selected for benchmarking. The following airports were considered as part of the benchmarking exercise: Cairns (CNS), Canberra (CBR), Gold Coast (OOL), Townsville (TSV) and Mackay (MKY). The split between aeronautical and non aeronautical revenues is not available for these airports (with the exception of Mackay). In the absence of regulated audited financial data a sample of domestic aeronautical charges built up from public sources have been used to estimate the aeronautical revenue per passenger. Charges charged to third parties such as Air services Australia were stripped out. Within this section Aeronautical Revenues are considered to be revenues quoted in the audited accounts (stated as being from aeronautical sources), charges are the summation of fees quoted by the airport (for the airline) for a passenger arriving at the airport. As aeronautical revenue is made up of revenue from charges, for the purposes of this report aeronautical revenue per passenger and charges are assumed to be synonymous. Although these charges are for domestic passengers the proportion of international traffic is small and assumed to have limited impact on the average aeronautical charge. The international traffic out of Gold Coast at the time of the annual report is assumed to be predominantly narrow body on short haul international routes.

Table 21: International and domestic passengers benchmarked for year of available financial data

		International Pax		Domestic Pax		Total	
Cairns (CNS)	**(2007-08)**	656,000	17%	3,121,000	83%	3,777,000	100%
Canberra (CBR)	**(2009-10)**	0	0%	3,258,000	100 %	3,258,000	100%
Gold Coast (OOL)	**(2002-03)**	136,000	6%	2,021,000	94%	2,178,000	100%
Townsville (TSV)	**(2009-10)**	0	0%	1,518,000	100 %	1,518,000	100%
Mackay (MKY)	**(2007-08)**	0	0%	696,000	100 %	696,000	100%

A straight average has been used across the Type 3 airports to determine typical aeronautical revenue of $10 per passenger.

Figure 13: Aeronautical Revenue per Pax for Type 3 Airports



Source: Airport charging sheets

6.1.3 Airport type 4

Newcastle Airport (NAL) has been identified as a potential benchmark for the RPT component of the Type 4 airport as it operates independently to the airfield operation. In addition at 1M passengers it is of a similar scale to the proposed RPT component of the Type 4 airport. However, it should be noted that Newcastle's aircraft mix is biased to Code C narrow body jet aircraft (low cost carriers – Virgin Blue, Jetstar) where as the Type 4 airport, based on runway length, is assumed to accommodate Turboprop aircraft. Newcastle does not publish a split between Aeronautical and non Aeronautical revenue so the ratio published by Mackay Airport has been applied to Newcastle's overall revenue.

6.2 GA Aeronautical Revenue per Movement

GA revenue and costs have been determined using Bankstown and Moorabbin airport's annual accounts and responses to the regulatory commission. These are the two largest GA airports in Australia with typically 300,000 to 400,000 annual movements dominated by pilot training. This may be more than the scale envisaged for the Type 4 airport, although no information on assumed GA traffic levels has been provided at this point. The revenue has been spit into aeronautical revenue and aviation leases. Aeronautical revenues are made up of the charges made on aircraft operators, and depend on the operator. Typical charges include; daily charges (for resident aircraft), movement based charges (by weight), landing Charges (by weight), parking charges. Aviation leases include all property revenues and costs relating to aeronautical activities. GA airports typically make a loss based purely on their aeronautical activities. Non-aeronautical revenues from property have been discussed in Section 7.2. GA revenues and costs are determined on a per movement basis as charging is typically done on a mix of landing charges and long term parking charges for the resident aircraft. It is suggested that GA aeronautical revenues and costs can be "bolted on" to the other scenarios to create a hybrid Type 4 airport.

Financial accounts for the major GA airports are no longer publically available. In order to determine typical aeronautical revenue per movement for these airports, historical annual accounts and regulatory reports were found and escalated up to 2011 values using CPI. Aeronautical revenue was calculated from the aeronautical charges revenue and the revenue from aeronautical property. Movement numbers were used for the equivalent year to determine a unit revenue for the GA component of the airport.

Table 22: GA Aeronautical revenue per movement

Airbiz airport classification	Full International	Full Domestic – Limited International	Low Cost – Mainly Domestic	GA
Aeronautical revenue per movement	na	na	na	$12

7. Non-Aeronautical Income

Non-aeronautical income assumptions have been provided by Airbiz.

7.1 Per Passenger non-Aeronautical Revenue

Table 23: Non-Aeronautical Revenue per pax

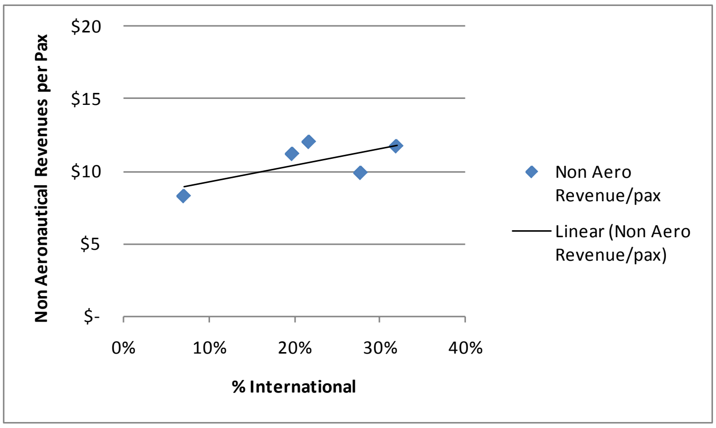
Airbiz airport classification	Type 1	Type 2	Type 3	Type 4
Non - Aeronautical Income per pax– International	$15.00	$15.00	$7.00	NA
Non- Aeronautical Income per pax - Domestic	$10.00	$10.00	$7.00	$4.00

Non-aeronautical revenue includes car parking, terminal retail and other rental income (property rental from leased sites within the airport boundary). These items have been calculated on a per passenger basis, based on regulatory reports. It is noted that other rental income although does not scale directly with passengers, larger airports can typically have more desirable leases and can generate more revenue, so for the purposes of this study it is assumed that the per passenger scaling assumption will suffice within an airport Type. It is worth noting that as with Aeronautical Revenue a number of the larger airports have domestic terminals operated by Qantas. In terms of the non aeronautical revenue the impact is less as car parking revenues are still fully recovered for all passengers with only the terminal retail income being lost to the Airline as the terminal operator.

As mentioned above the scale of the airport is a driver of retail revenue as retail offerings are dependent on a critical mass of passengers passing through the terminal. Generally speaking small airports (below 1 million passenger range) can only support simple food and beverage offering and potentially a "News and Books" store. Between 1 and 5 million passengers the airport may be able to draw in some branded food and beverage providers and depending on the passenger mix introduction of some specialist retailers. A terminal with over 5 million passengers per annum is able to support a wider range of specialist retail and demand from retailers is great enough to be able to charge a premium for retail space. The retail revenue potential will also be influenced by the type of traffic (business, leisure, Visiting Friends and Relatives (VFR)) and the population catchment. Revenues from car parking is dependent on a number of factors including, other modes of transport available to the airport, the demand will dictate whether it is possible to develop sophisticated tiered parking systems, propensity of people in the surrounding market to use cars, nature of the airports market (is it an inbound tourist market or an outbound market).

Non aeronautical revenue is also expected to be dependent on the proportion of international passengers, as international passengers spend more money in the airport through; parking longer, duty free, typically spending more time in an airport before a flight exposed to the retail offer. This trend is evident in the chart below when considering the regulated airports (where data is available on non aeronautical revenues).

Figure 14: Relationship between Non Aeronautical Revenue and Percentage of International Passengers



Source: Regulatory Accounts

Airports: SYD, MEL, BNE, PER and ADL

To estimate the split between non aeronautical revenue from international and domestic passengers a correlation analysis using "least squares" method was used. This analysis estimated the non aeronautical revenue per passenger for international passengers and domestic passengers based on the five regulated airports (SYD, MEL, BNE, PER and ADL).

7.1.1 Airport type 1 & 2

Non aeronautical revenues per passenger were calculated separately of international and domestic passenger based the correlation analysis described above in Section 6.1.1.

7.1.2 Airport type 3

There is not enough publically available data on smaller airports with Type 3 characteristics to estimate non aeronautical revenue directly. However we are able to give an order of magnitude estimate based on Airbiz's experience with airports. We would expect the non aeronautical revenue to be less than that estimated for the Type 1 & 2 airports for the following reasons:

- Retail revenue per passenger is expected to be less because there is not the demand to be able to support significant specialist retailer and branded retailers. In addition there will not be the competition between retailers to get space in the terminal that will drive up rental prices. As the airport grows towards 5M passengers it is likely that retail revenue will increase towards those observed in a Type 1 & 2 airport

- Car parking revenue is typically less because the airport does not have the volume of passengers to justify developing a sophisticated parking product, and there is not the demand to significantly differentiate the product. It is worth noting that smaller airports often have limited public transport options which increase the proportion of passengers parking their cars. Car park charges for capital city airports are often relative to car parking charges in the CBD, so location specific factors will also influence revenue potential. Hence a Type 3 airport in the Sydney area may have greater car parking revenue potential than a Type 3 airport in say Newcastle or Mackay.

Given the points above we have assumed a generic Type 3 airports would earn approximately 70% of the non aeronautical revenue estimated for Type 1 & 2 airports on a per passenger basis. This is in line with one data point we have for Mackay Airport at approximately $7 per passenger. Obviously this could be increased with creative business development but we believe this gives a starting point.

7.1.3 Airport type 4

See Section 6.1.3 for comments on benchmarking the RPT component of the airport.

GA airports non aeronautical revenue is discussed in Section 7.2.

7.2 GA Airport non aeronautical revenue

GA airports in Australia generally are not sustained on aeronautical revenue. A wide range of non-aeronautical revenue sources have been developed at the main capital city GA airports. However, accounting information for these airports detailing the revenue streams is not publicly available.

We have identified that there are three main options for development of commercial sites on an airport, and each will have its own risk/reward – cost/revenue structure as shown in the table below. The development costs and lease income is likely to be site specific and relative to similar industrial and commercial land in the vicinity and related to supply and demand, without a premium for an airport location unless the commercial activity was aviation related or access to air services (if there were limited regional services).

Table 24: GA Airport non aeronautical revenue

	Type 1	Type 2	Type 3	Type 4
Leased Raw Land	Na	Na	Na	Not Available
Leased Serviced Land	Na	Na	Na	Not Available
Leased Buildings	Na	Na	Na	Not Available

8. Airport Operating Expenditure

Airport operating expenditure assumptions have been provided by Airbiz.

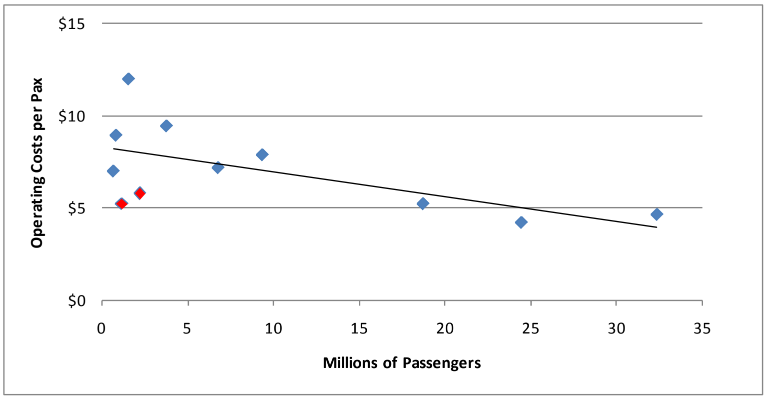
8.1 Operating Costs per Passenger

Operating costs have been estimated based on benchmarking airports which share some of the key characteristics to the each of the four generic airport types.

For the purposes of this study operating costs have been grouped together. The objective is to provide an estimate of how overall operating costs may vary by generic airport type; breaking the costs down adds little value to the model but requires further estimates to be made, diluting the quality of the data. Comparable data exists in the public domain for splits of operating costs for the major five airports; however it is hard to find equivalent data for the smaller airports. As discussed in Section 6, it is hard to differentiate between a Type 1 & 2 airports so we have considered them together.

It can be inferred from the available data that operational costs per passenger do gain some efficiencies from scale. The graph below illustrates how airports with higher passenger numbers typically have lower operating costs per passenger.

Figure 15: Relationship between Operating Costs per Passenger and Total Annual Passengers



Source: Regulatory and Annual Accounts

Airports included; SYD, MEL, BNE, PER, ADL, CNS, NCL, MKY, OOL, DRW, ASP (from right to left) Newcastle and Gold Coast Airport (highlighted in red) have lower operating costs than would be expected from this trend. Newcastle can be explained as it shares the operating costs of the airfield with the RAAF. Gold Coast airport (note 2002 figures escalated) operates primarily with low cost airlines and has adopted a business model with lower costs, due to simpler infrastructure and fewer employees.

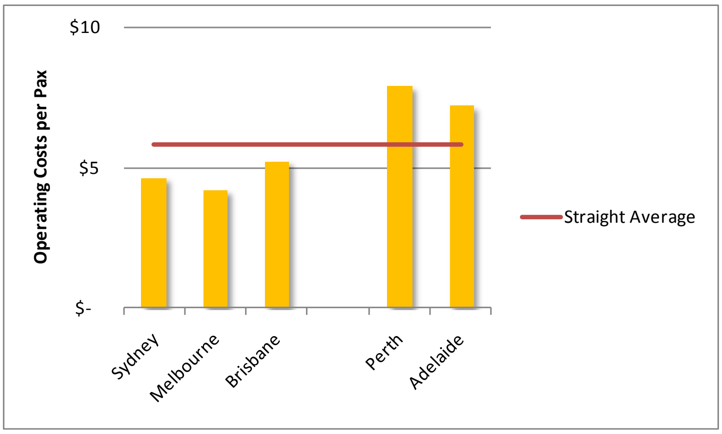
Table 25: Operating Costs per passenger

Airbiz airport classification	Type 1	Type 2	Type 3	Type 4
Operation Costs per Passenger	$6.00	$6.00	$8.00	$5.00

8.1.1 Airport type 1 & 2

As discussed in Section 6.1.1 above, the primary difference between Type 1 and Type 2 airports is the ability to handle code F aircraft not passenger numbers. For this reason a straight average has been taken across the five largest Australian airports, (SYD, MEL, BNE, PER, ADL) giving $6 per passenger. It is worth noting there is scalability within this 5-30M passenger per annum range; Airports operating in the 20-30M passenger per annum range typically appear to be operating with $5 operating costs per passenger, where as the two airports in the 5-10M passenger range appear to be operating in the $5-10 operating costs per passenger range.

Figure 16: Operating Cost Benchmark for Type 1 & 2 airports

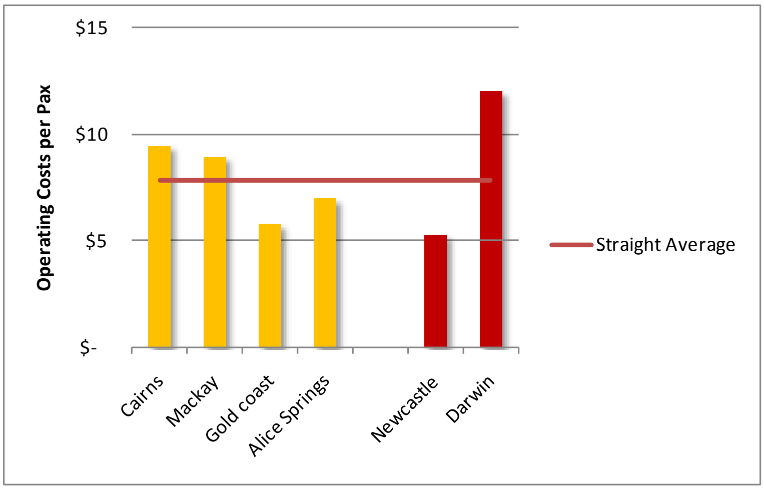


Source: Regulatory and Annual Accounts

8.1.2 Airport Type 3

There is limited data available on the smaller airports. The following airports have been benchmarked.

Figure 17: Operating Cost Benchmark for Type 3 airports



Source: Annual Accounts

Note: Darwin and Williamtown (Newcastle) airports have been excluded from the average calculation. Williamtown (Newcastle) only operates the terminal, airfield costs are shared with the RAAF. Darwin's operating costs are inflated due to its remote location.

A straight average has been taken excluding the special cases identified to give an approximation of the operating costs of $8 per passenger for a generic Type 3 airport. It is worth noting there is a spread between $5-9 over the benchmark, which is dependent on the operating model of the carriers, in airports dominated by LCCs where operating costs are typically closely monitored operating costs of $7 per passenger would be more typical. For airports catering for more business travellers with a mix of airlines an operating cost of $9 may be more typical.

8.1.3 Airport Type 4

Newcastle has been used to estimate the terminal operating costs for a Type 4 airport as it does not operate the airfield. Operating costs for the GA component of the airport are given below as a cost per aircraft movement. The actual charging regime at the larger GA airports can include a per movement charge, a weight based landing fee or parking charges (permitting unlimited runway usage) or a mixture.

8.2 GA Operating Costs

For methodology see Section 6.2.

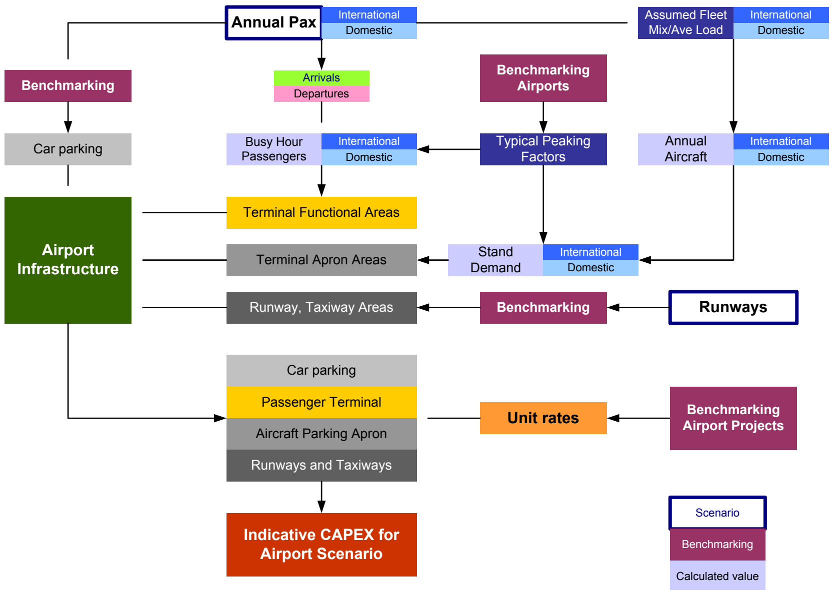
Airbiz airport classification	Type 1	Type 2	Type 3	Type 4
Operating costs per/movement	Na	Na	Na	$6.00

9. Airport Capital Expenditure

The diagram below shows a schematic of the inputs and key assumptions driving the capital expenditure of an airport development scenario. The airport is notionally divided between:

- Paved surfaces including the apron areas and the runways and taxiways;
- Airfield lighting and landing aids;
- Passenger terminal buildings;
- Car parks: and
- Other.

The key drivers are identified and where benchmarking has been used to generate or validate unit rates. The main input for this generic model is the annual passengers (and beside this the assumed split between international and domestics). This in turn goes through aircraft fleet mix and load factor assumptions to generate the annual aircraft movements. The other main input that drives airfield infrastructure are the definition of runway requirements (based on a design aircraft, the number of runways, length and width)



All inputs in relation to Airport capital costs have been supplied by Airbiz, with assistance from Arup and Turner and Townsend in benchmarking indicative unit rates for construction.

This section also includes outcomes from benchmarking of airports (predominantly in Australia and New Zealand) to provide the inputs to a CAPEX model for the airport infrastructure. The benchmarking was undertaken to derive relationships between airport type, annual aircraft and passenger movements and the following primary airport infrastructure elements:

Table 26: Key capex cost drivers

Element	CAPEX depends on
Runways	Length, design aircraft determining width (and strength)
Taxiways	Length, design aircraft determining width (and strength)
Aprons	Number of stands and design aircraft determining area (and strength)

Passenger terminal buildings	Floor area calculation and unit rates reflecting building type finish
Car parks	Number of car spaces, multi-level or at grade

The CAPEX airport model uses an area calculation based on the benchmarking outcomes multiplied by unit rates to give the relative costs for the different types of airports, including relativity between of the airport infrastructure elements listed above.

Separate line items are provided for input to include project management and contingency as a percentage of the summed capital cost of the infrastructure elements. For the purposes of this study we have assumed a project management cost of 20% of the total capital cost infrastructure elements and a contingency cost of 30% of the total capital cost infrastructure elements.

9.1 Paved surfaces

The following key assumptions have been supplied by the Department, and used in the analysis.

Table 27: Paved surface key assumptions

	Type 1	Type 2	Type 3	Type 4 RPT	Type 4 GA
Number of runways	2	1	1	1	1
Number length	3,500 – 4,000m	3,000 – 3500m	1650 - 2200m	1600m	1100m
Runway code	4F	4E	4C	3C	2B
Runway width	60m	60m	45m	30m	23m

Notes:
(1) Type 1 airport has option for an additional runway in the longer term
(2) Type 4 airport has two components - RPT and GA and these are separated for sake of convenience

The following unit costs have been prepared by with assistance from Arup and Turner and Townsend based on costs from similar projects.

Table 28: Pavement Unit Rate Assumptions

Unit rates	Type 1	Type 2	Type 3	Type 4(6)
Runway pavements ($\$/m^2$)(2)	450	450	450	450
Runway shoulders ($\$/m^2$)(3)(4)	260	260	260	N/A
Taxiway pavements ($\$/m^2$)(1)(5)	420	420	410	410
Taxiway shoulders ($\$/m^2$)(3)	360	360	360	360
Aprons ($\$/m^2$)(1)(5)	400	400	380	170

Notes:
(1) Construction of high strength reinforced concrete pavement including subgrade preparation, supply of bond breaker, 200mm thick base course, 150mm lean mix concrete, high strength PCC slab, blockouts, edge thickening, geogrids and joints
(2) Construction of high strength asphaltic concrete pavement including subgrade preparation, supply of multigrade breaker, 200mm thick Crushed Rock Basecourse, 160mm DG20 asphaltic base course, 50mm DG14 asphaltic binder course and 50mm DG14 asphaltic surface course.
(3) Supply, place and compact high quality Crushed Aggregate Rock
(4) Supply, place and compact low quality gravel
(5) Estimated Jointing Cost (Construction and Contraction Joints). 25% allowance made for tied, isolation and mesh reinforcement.
(6) Type 4 airport is for the RPT element only. The apron requirements for GA not defined at this stage, expected to be relative to the number of annual movements, which in turn should be relative to the number of aircraft parked at the airport.

The cost of aircraft pavements areas depends on the pavement type, area and unit cost. The pavement areas are split for convenience between runways, taxiways and aprons. These in turn depend on the design aircraft, the summed length and width of runways and taxiways, with the addition of the aircraft parking areas determined by the number and aircraft size of gates/stands in the terminal area.

For the based areas, the runway is assumed asphalt surface, with concrete taxiways and apron areas. Shoulders are included. Graded runway strip and RESA is not paved. Includes provision for landing aids (generally around 5% of runway cost).

The geometric assumptions for paved areas are summarised in the table below.

Generally three types of design aircraft are considered: Code F (large widebody such as the A380) Code E (widebody such as the B747, B777, future B787, A340/350) and Code C (narrowbody jet such as the B737 family and the A320/321 families, as well as F100 and Embraer jets (operated by VirginBlue), and the larger turboprop aircraft such as the Dash8 operated by Qantas Link).

Table 29: Dimension for Paved Surfaces

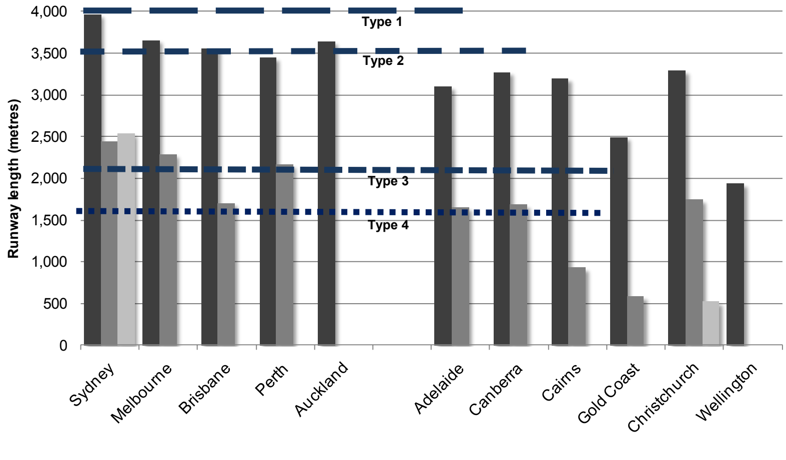
Element	Description	Unit	Value
Runways	Code F	Width	60m
	Code E	Width	45m
	Code C	Width	30m
Taxiways	Code F	Width	25m
	Code E	Width	23m
	Code C	Width	18m
Aprons(1)	Code F	Area	80m x 85m
	Code E	Area	65m x 78m
	Code C	Area	36m x 47m

Source: CASA Manual of Standards (MoS) and ICAO Annex 14
Note (1): Allowances for airside road and wingtip clearances are in addition

The B767 is a Code D aircraft, but will be phased out of the Australian fleet once the B787 aircraft is in operation (a Code E aircraft).

The figure below shows the runway lengths for the benchmarked airport compared to the maximum length specified for the Type 1, Type2 and Type 3 airports. The darker bar is the primary runway and the lighter bar is the secondary (crossing runway). Sydney has three runways (two parallels and one cross-wind runway). It is the only airport in the group that currently has a parallel runway system.

Figure 18: Runway Length (Metres) Comparison



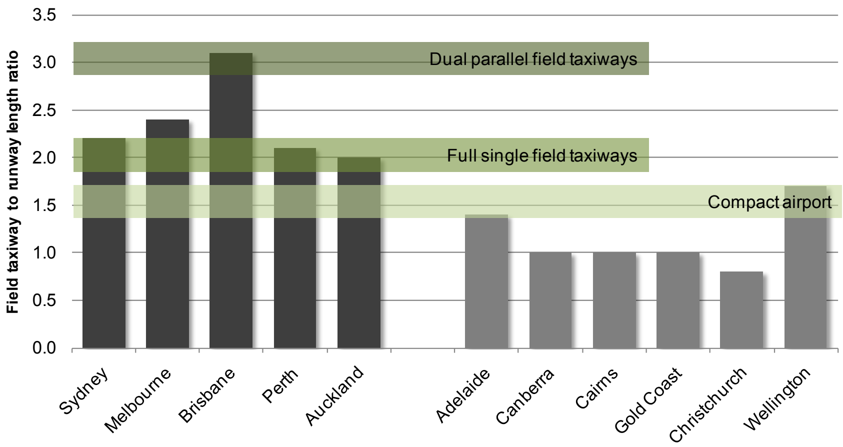
Source: Aeroplanner 2010

The CAPEX model works out the cost of the runways directly from the runway definition (number of runways, the area of each runway based on the design aircraft defining runway width and the runway length) and the pavement unit cost for maximum weight aircraft assuming a well prepared site without any specific geotechnical treatments.

The runway length will also determine the length of the field taxiway system providing access, egress and queuing to the runway system. For an efficient runway system, there should be dual parallel taxiways with rapid exit taxiways (RETs) for each runway (assumed for a Type 1 airport). Where there is a land constraint this may be limited to a single parallel taxiway system (as in a Type 2 or Type 3 airport). The design aircraft determining the width of the field taxiways should correspond to that for the runway. As a generic airport model, without reference to a specific airfield layout, the CAPEX model uses a relationship between the runway design aircraft, its length and the assumption on land constraint to arrive at a paved area for field taxiways directly supporting the runways.

The taxiways connecting the runway system to the terminal area are much more depend on the airport layout. However, for a generic model the benchmarking provided a ratio of taxiway length to runway length as shown in Figure 19.

Figure 19: Ratio of Runway Length to Taxiway Length



Source: Taxiway lengths summed from GoogleEarth™ aerial photos of airports, does not include apron edge taxiways which are included in apron areas

From the above analysis the following values are suggested for the based case.

Table 30: Taxiway to Runway Length Ratios Suggested for Base Case Scenarios

Airport Type	Taxiway to Runway length ratio	Comment
Type 1	3	Full dual parallel taxiways (as per Brisbane)
Type 2	2	Single parallel taxiway system (as per Melbourne, Sydney)
Type 3	1.5	Shorter runway with fewer Rapid Exit Taxiway (RET) links
Type 4	1.5	Shorter runway with fewer Rapid Exit Taxiway (RET) links

Apron areas (and cost) relate to the number and design aircraft for parking positions assumed in the terminal area. The fleet mix assumptions (refer Section 5.3 above) in conjunction with peaking factors (refer Section 5.2 above), average turnaround times and additional allowances are used to calculated the number of stands.

The turnaround times and allowance for off-schedule and overnight parking positions suggested for the Base Case scenarios are summarised in the Table below, based on Airbiz experience.

Table 31: Stand Demand Calculation Turnaround and Other Allowances

	Type 1	Type 2	Type 3	Type 4 RPT
Turnaround time plus buffer (min)				
International	130	130	120	N/A
Domestic	70	70	65	70
Off-schedule allowance (%)				
International	10%	10%	10%	N/A
Domestic	10%	10%	10%	10%
Allowance for overnight (%)				
International	20%	20%	20%	N/A
Domestic	20%	20%	20%	20%

The width and length of a parking position is determined by the aircraft code as shown in Table 13, which include wing tip clearances. Additional allowances are required to increase the depth (length) for an airside road, tug at the head of stand. This table also shows the relativity of areas required to park the various aircraft types (sizes) with a Code C (narrowbody aircraft such as the B737 and A320) only needing 36% of the apron space as a Code E (widebody jet such as the B747, B777, B787, A340/350), and a Code F (A380) requiring an additional 30% area compared to a Code E. This has significant impact on the pavement areas and consequential costs, and flows onto the taxiway areas (and costs) in the terminal area as explained below.

Table 32: Apron Dimensions For Various Aircraft Codes

Code	Area (m2)	% of Code E
Code F	11,200	137%
Code E	8,190	100%
Code C jet	3,050	37%
Code C turboprop	3,050	37%

Source: Calculation based on clearance in CASA Manual of Standards

For Type 1, 2 and 3 airports these are assumed to have aerobridges, with the number of aerobridges per stand being a user defined input for the selected scenario. Separate inputs are provided for international and domestic stands. The cost of aerobridges is added to the Terminal Building CAPEX. For aprons serving Code F and E international aircraft it is suggested that an allowance of 2 aerobridges per stand be allowed. Hence the overall assumption for the average number of aerobridges per international stand will depend on the relative proportion of widebody to narrowbody aircraft stands. Type 4 airports are assumed to not have aerobridges and a single level terminal (refer Section 9.2).

The taxiways serving the aprons depend on the terminal layout and the additional apron area is a model input expressed as a percentage of apron area based on geometric calculation. Suggested values for the base case scenarios are shown below.

Table 33: Suggested Values for Additional Area for Apron Taxiway as a Percentage of Apron Area

	Type 1	Type 2	Type 3	Type 4 RPT
Code F	65%	65%	65%	
Code E	65%	65%	65%	
Code C	65%	65%	65%	
Code C Turboprop	65%	65%	65%	65%

The apron flood lighting costs are added in the "other cost" items under the airside line. These are calculated as a percentage of the apron costs with the user defined percentage. Suggested values based on calculation of number of lights and apron area and costs for base case assumptions are given in the table below.

Table 34: Additional Cost Allowance for Apron Lighting

Airport Type	Percent of Apron Cost	Comment
Type 1	3%	
Type 2	3%	
Type 3	4%	Apron area (cost) is lower than Type 2,and lighting cost is relatively higher
Type 4	7%	Apron area (cost) is lower than Type 2,and lighting cost is relatively higher

Costs for navigation and landing aids are based on recent project estimates for equivalent equipment levels and include allowance for VOR/DME and ILS.

9.1.1 Airport type 1 - Paved Surfaces

As per the template airport sheet. Areas of runways are calculated with cost for typical pavement structure for design aircraft included (without site preparation and any subgrade replacement which will be site-specific). Areas of taxiways are estimated based on ratio total taxiway length to runway length form benchmark airports, biased towards those with fully developed parallel taxiway system to runways, but noting that some element of taxiway length will be proportional to extent of aprons and physical layout of airport which will be site specific.

Runways and taxiways to Code E width.

Apron areas are based on the fleet mix assumptions, annual passengers (peaking factors) and allowances for off-schedule and overnighting. For flexibility of operations and future proofing the proportion of Code F and E versus Code C capable stands should be considered.

9.1.2 Airport type 2 - Paved Surfaces

As noted in Section 9.1.1, assume all taxiways are to Code E standard for flexibility of routing.

Significant reduction compared to Type 1, due to:

- Single runway with reduced length and width, less supporting taxiways, taxiways to Code E width
- Significant reduction in apron pavements, limited internationals, no Code F aircraft and reduced proportion of Code E aircraft in mix.

9.1.3 Airport type 3 - Paved Surfaces

As per notes in Section 9.1.1.

Reduction compared to Type 2, due to:

- Runway with reduced length and less supporting taxiways designed to Code C width only.
- Reduction in apron pavements, no internationals (in base case) and sized to accommodate Code C aircraft only.

9.1.4 Airport type 4 - Paved Surfaces

Runways and taxiways as per notes in Section 9.1.1.

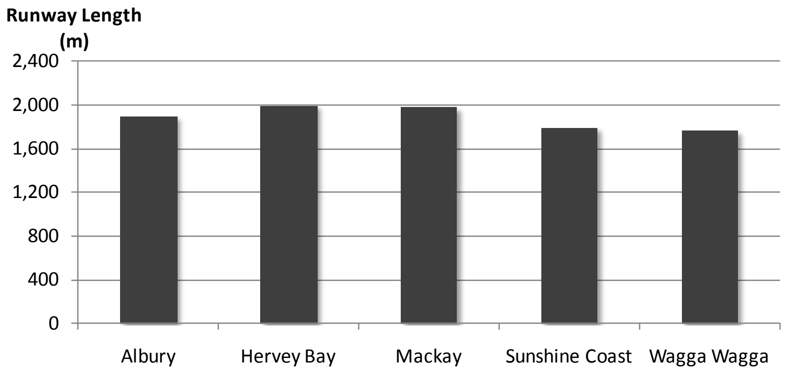
The Type 4 airport is characterised by a main runway 1600m x 30m (Code 3C category) and a parallel runway 1100m x 23m for GA flying raining (Code 2B category).

However, the runway lengths for the five airports characterised as similar to Type 4 are all longer than 1600m. They range between 1768m (Wagga Wagga) and 2000m (Hervey Bay)[2]. The design aircraft would be domestic narrowbody jets (A320/B737) on domestic routes.

The Type 4 runway at 1600m length would be limited to turboprop aircraft on regional routes.

There is significant GA traffic at Sunshine Coast and Mackay, including flying training, and the Wagga Wagga 2010 Master Plan talks about the potential for substantial increases in activity with the expansion of local flying schools. These airports have a crossing runway system (a grass runway at Wagga Wagga) but not a parallel runway system as described in the Type 4 airport.

Figure 20: Type 4 Runway Length Benchmarking



[2] Source: Aeroplanner, Airservices Australia En-route Supplement (ERSA) available on-line http://www.airservicesaustralia.com/publications/aip.asp (accessed 22/12/10)

Apron and taxiway lengths and areas were measured from aerial photos (Google Maps) and assessed as serving RPT or GA aircraft (based on location and width).

RPT aprons generally accommodate around four Code C aircraft (area around 20,000 m2) and a large range of separate General Aviation aprons. Benchmarking areas and areas per annual aircraft movement are shown in the Figures below.

Figure 21: Type 4 Airport Benchmarking - Apron Area (m2)

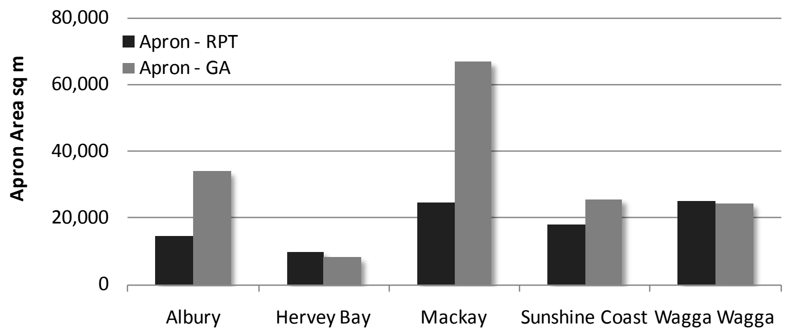
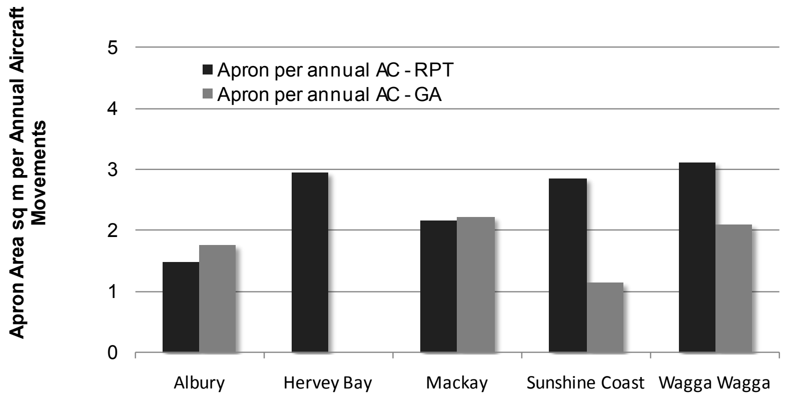


Figure 22: Type 4 Airport Benchmarking - Apron Area (m2) per Annual Aircraft Movement



From the benchmarking, the Figure above shows that approximately 3 m2 of apron is required per annual RPT aircraft movement. GA Apron areas are variable between 1 and 2 m2 per annual GA movement for these airports. For the Type 4 airport as currently defined a value of 2 m^2 per annual aircraft is suggested for the base case.

With limited RPT traffic (less than 12,000 annual aircraft movements, or only 30 movements a day), hourly runway movements are unlikely to justify a full length or even an extended partial parallel RPT taxiway. The five airports benchmarked generally have two taxiways directly from the runway to the apron, linked by a very short parallel taxiway or an apron edge taxiway. This arrangement determines the RPT taxiway lengths, areas and ratio of RPT taxiway area to annual RPT movements is as shown as Figures 5, 6 and 7.

Figure 23: Type 4 Airports Benchmarking - Taxiway Length

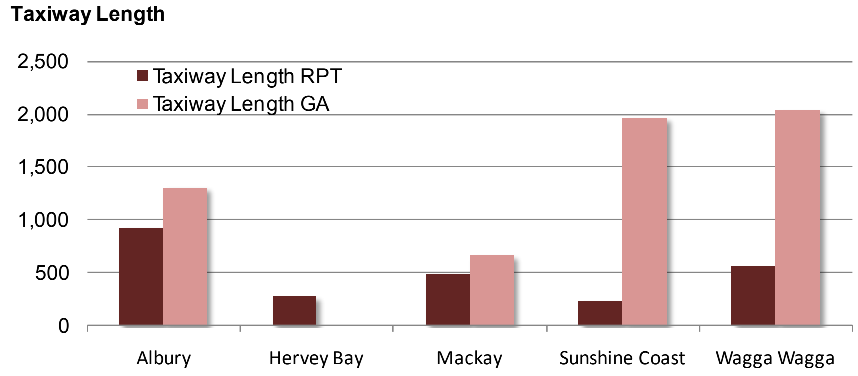
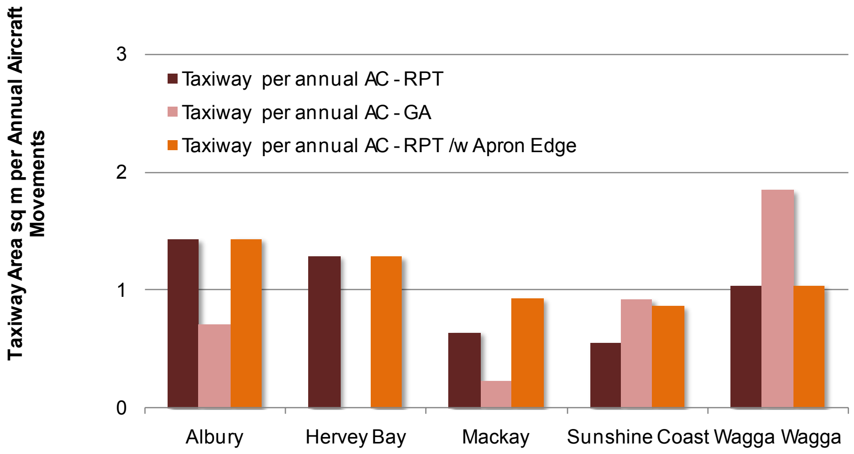


Figure 24: Type 4 Airports Benchmarking - Taxiway Area per Annual Aircraft Movements



Roughly 1 to 1.5 sq m of RPT taxiway is required per RPT aircraft movement. Mackay and Sunshine Coast airports have taxiway area requirements are lower, due to having apron edge taxiways. The figure above takes into account the apron edge taxiway as a part of the taxiway system, rather than the apron and gives a more consistent figure for RPT taxiway area to annual RPT aircraft movements for the airports benchmarked.

These figures also show the same metrics for the GA taxiways (assumed to be low strength and narrower pavements). Taxiway requirements leading to GA aprons are a little more varied, and are dependent on the layout of the airport and location of the GA apron(s). It appears that Wagga Wagga has a GA parallel taxiway system for the main runway, presumably to support increased flying training operations.

9.2 Terminal Facilities

Table 35: Terminal facilities capital cost / m2

	Type 1	Type 2	Type 3	Type 4
International Terminal	$7,500/ per m^2	$7,500/ per m^2	$7,500/ per m^2	N/A
Domestic Terminal	$6,000/per m^2	$6,000/ per m^2	$6,000/ per m^2	$4,500/per m^2

The capital cost of terminal buildings is based on the above unit rates, confirmed with Townsend and Turner and benchmarked against some recent terminal projects. They are applied to the terminal areas generated from the busy hour passenger. These rates include check-in concourse, checked baggage screening, departures lounge, departure gates, fixed links and nodes, vertical transportation (where required), mechanical, electrical, data & communications systems, architectural fit-out and baggage handling systems. The cost of aerobridges and associated docking systems is added at a rate of $1,750,000 per aerobridge for those terminals and stands with aerobridges. The cost of terminal roads and landside structures (elevated road, ground transport facilities) has been excluded from the generic airport model at this stage.

International terminal cost is not necessarily scalable for very large terminal which include people mover systems and remote satellites or multiple processors.

A more traditional approach for costing would be for a block of terminal capacity (to meet a design busy hour passenger throughput and build up of functional areas, allowances for circulation and an assumed ratio of retail space to terminal processing space. This would suit incremental build where additional processors or departure/arrival gates are added blocks and until capital is committed to next phase of terminal development the Level of Service (LoS) to the passenger decreases. Detailed terminal planning is based on an in depth assessment of airport traffic forecast for the terminal, including: the design aircraft, the average aircraft size, the busy hour (peak) hour passengers for separate arrival and departure processing, the proportion of area devoted to retail etc.

However, for the current goal of a "generic" model it is probably more appropriate to simplify the capex calculation to be driven from the passenger numbers directly and assume a continuum of terminal expansion, which could then be aggregated into blocks by time increment (say bring on new terminal capacity every 5 years assuming steady growth) or to suit capex blocks. For the terminal building a simplified calculation was based on benchmarking which assessed terminal area per annual passenger. An additional benchmarking of terminal area per gate (active stand assumed with aerobridge) is also described later in this section.

The variation in terminal area per annual passenger (or inversely passengers per terminal area) for the airports benchmarked will vary with a number of factors, including: the mix of traffic (short, medium or long haul, proportion of wide-body to narrowbody aircraft), the commercial strategy of the airport operator (and passenger profiles) determining the proportion of area devoted to retail and possibly most significantly the position in the terminal life-cycle (recently upgraded with room for growth versus a facility on the verge of a major terminal redevelopment/upgrade). The extent of commercial space provided in the terminal is a major issue given the increase in the proportion of revenues generated from non-aeronautical activities.

Major terminal expansions can take anywhere between 2 to 5 years from conception to becoming operational. While financially an airport would likely invest as late as possible, expansion of an existing facility while maintaining full operations is complex, and the risk of losing traffic due to lack of capacity is also not desirable. Hence a development cycle of around 5 years for an airport with continuous traffic growth is not unusual. With aviation worldwide and in Australia having a long term average growth of between 3% and 5% per annum, a 5 year cycle can mean building to a capacity of between 20% to 30% above current traffic levels.

International terminals are naturally larger than domestic terminals. They require additional areas for customs, immigration and quarantine processing, and generally will have a greater opportunity (and areas) devoted to airport retail.

Hirst (2008) on p185 quotes the a rules of thumb for terminal design of about 25 m^2 per peak hour passenger and a US FAA formula based method based on terminal peak hour passengers (TPHP) show in the Table below. The area per million passengers and passenger per m^2 metrics are added columns. It does not distinguish between international or domestic terminals.

The variation in area for different types of operations is however noted in the text saying that the 25m^2 could be reduced to 12.5 m^2 per peak hour passenger for a low-cost carrier terminal in Europe. The conclusion is that the terminal area will depend on the style of operation by up to a factor of two.

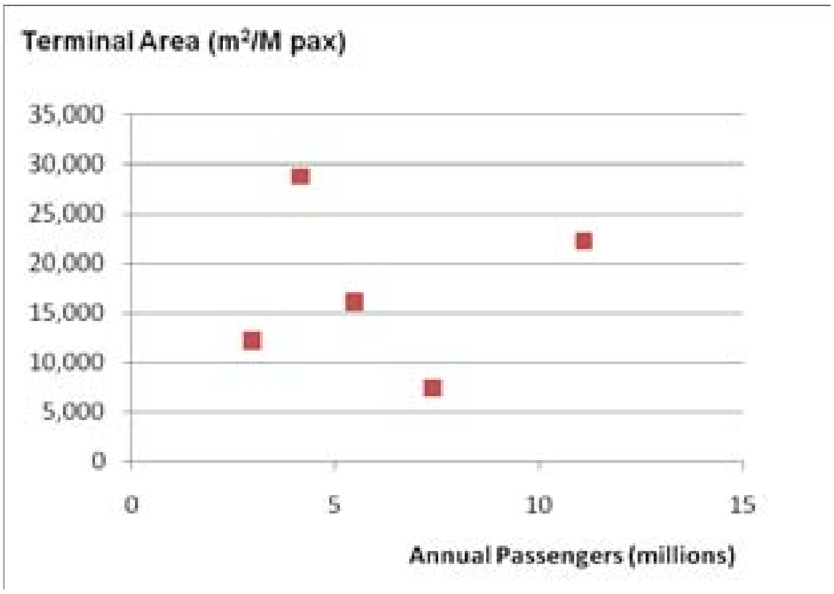
Table 36: FAA simple terminal area assessment based on annual passengers

Annual Passengers	TPHP	Terminal Area (m2)	Area/M pax	Pax / m2
100,000	200	5,000	50,000	20
500,000	400	10,000	20,000	50
1,000,000	500	12,500	12,500	80
5,000,000	2,250	56,250	11,250	89
10,000,000	4,500	112,500	11,250	89
30,000,000	10,500	262,500	8,750	114

Figure 25 shows a range of between 7,000 m2 to 30,000 m2 per million international passengers for airports in the range of 5 to 15 million annual international passengers with a median of around 16,000 m2 per million passengers. A confidential benchmarking study of some 10 major international terminals with design capacity upward of 20 million annual international passengers gave a consistent range of between 10,000 and 20,000 m^2 per million annual passengers. The larger areas than those quoted in Hirst, could reflect the continuing trend in international and domestic terminals of increased areas devoted to airport retail and commercial revenue generating opportunities.

As the table of areas above does not differentiate between international and domestic, it is difficult to reliably cross-check against areas calculated for this study. Despite this the grossed up areas calculated for the base case for terminals for between 5 million and 30 million passengers seem to agree within 20%.

Figure 25: Benchmarking International Terminal Area per Million Passengers



Source: Terminal areas from Aeroplanner, annual passengers from BITRE data

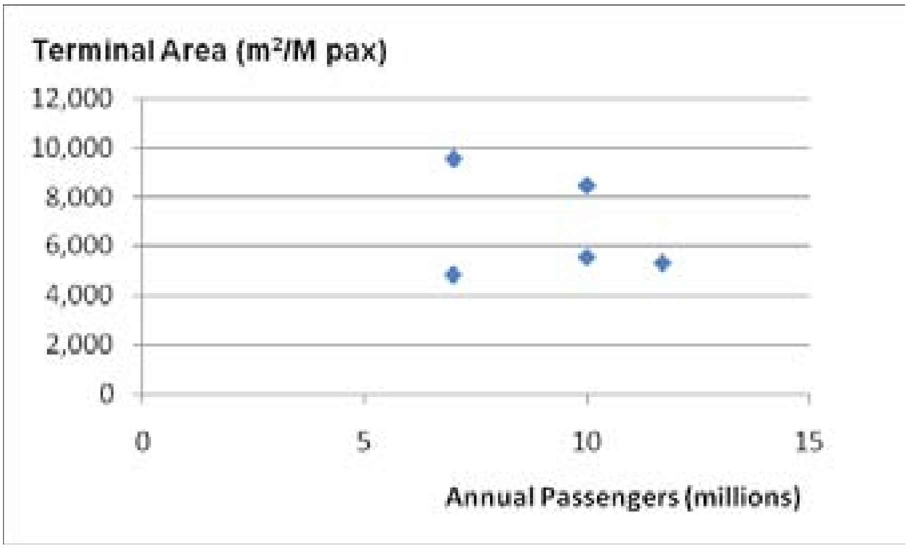
For the purposes of the CAPEX model an average of 16,500 m^2 per million annual passengers was initially adopted for international terminals. Another way of expressing this is annual passenger per m^2 of terminal building and the adopted value corresponding to average of 16,500 m^2 per million annual passengers is 65 annual passengers per $m^{2.}$

The unit cost for an international terminal reflects the cost of a multi-level building (between 3 and 5 levels) with a range of floor/finish types (baggage handling areas being industrial type finish; arrivals and departures levels being akin to a shopping centre; areas for office type accommodation for various terminal tenants and hotel type finishes for airline lounges), check-in concourse, checked baggage screening, departures lounge, departure gates, fixed links and nodes, vertical transportation (where required), mechanical, electrical, data & communications systems, architectural fit-out. The cost includes allowance for some specialist equipment (for example baggage handling), but not airline fit-out. It assumes a prepared site with no special foundation requirements.

Domestic terminals benchmarked (with between 5 and 15 million passengers per annum) had a range of between 4,000 and 10,000 m^2 per million annual passengers. The larger terminals have two levels (arrivals passengers proceed to the ground floor for baggage collection, and processing of departure passengers is on the upper level which includes airport retail areas and boarding lounges and gates). There may be a further mezzanine level for airline lounges. They may have an elevated road to increase the kerbside frontage for drop-off and pick-up.

For the purposes of the CAPEX model an average of 6,500 m^2 per million annual passengers was initially adopted. This corresponds to around 167 annual passengers per m^2. It is important to note the relativity between the area required per passenger for an international terminal versus that for a domestic terminal, which is around 2.5 times based on these figures.

Figure 26: Benchmarking Domestic Terminal Area per Million Passengers



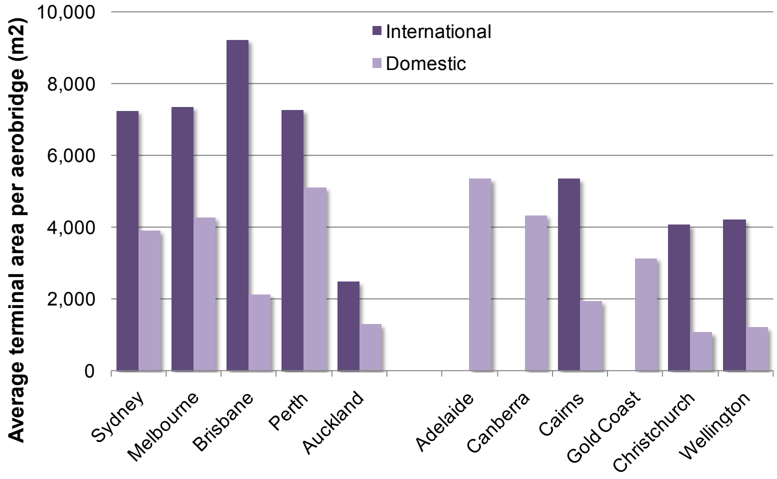
Source: Terminal areas from Aeroplanner, annual passengers from BITRE data

Where the traffic mix warrants consideration of a combined terminal (such as that at Adelaide or Gold Coast Airports) then the area required may be around 10,000 m^2 per million annual passengers. The international processing for customs, immigration and quarantine and separation of arrivals and departure flows increases the area requirements for the international component in the combined terminal.

A simpler method more suited to the modelling process was finally incorporated to calculate terminal areas based on the number of aircraft parking gates. The number of gates are themselves generated by the passenger peaking factors previously discussed, which in combination with aircraft fleet assumptions and turnaround times are used to calculate the aircraft stand demand. The benchmarking shown in the figure below shows the range of values, which vary significantly. Gold Coast and Adelaide have common use international and domestic terminals, but as shown in Section 5.2, only have a small percentage (around 10%) of international passengers. Some of the variation is explained by the proportion of aerobridge to non-aerobridge positions for active gates (e.g. for regional turboprop operations at Sydney, Brisbane and Melbourne).

The New Zealand airports all have smaller areas, and may reflect a combination of position in the upgrade cycle, smaller terminal retail areas and the low cost terminal (single level) configurations.

Figure 27: Benchmarking Terminal Area Per Aerobridge



The table below shows some suggested values for a base case analysis for each airport type. While the Type 3 airport does not necessarily have international traffic, if in the long term there were international services (limited to Code C aircraft as the runway design criteria on international short-haul routes), for the same number of annual and peak hour passengers, limiting aircraft to the smaller size would increase the number of gates, but reduce the apron and terminal requirements per gate.

Table 37: Simple terminal area assessment based on area per gate

	Type 1	Type 2	Type 3	Type 4
International Terminal	7,500 m^2/gate	7,500 m^2/gate	5,000 m^2/gate	
Domestic Terminal	3,000 m^2/gate	3,000 m^2/gate	2,500 m^2/gate	750 m^2/gate

For low cost carrier single level terminals the area requirements will fall to the lower range (assuming a high level of utilisation from constant demand throughout the day). Where there are pronounced peaks in the terminal demand (morning / afternoon peaks with significant flat periods during the middle of the day) then the area per annual passenger will increase.

The typical unit costs for domestic terminal buildings assume a two level terminal for Type 1, 2 and 3 airports (in the range 5 to 30 million passengers per annum, and a single level terminal for a Type 4 airport for between 500,000 and 1,000,000 limited to aircraft operating on an 1600m long and 30 m wide runway.

The model allows the user to specify the average number of aerobridges per stand. If half of the active stands have 2 aerobridges which is now becoming to server larger wide-body aircraft, then an average of 1.5 aerobridges per stand can be specified. Different values can be specific for international or domestic terminals. The stand calculation includes an allowance for off-schedule and overnighting aircraft (refer Section 9.1 above). These are typically remote positions and are not included in the aerobridge calculation. Typically one would expect two aerobridges for an international terminal with a high proportion of Code E (and Code F) operations. For a domestic terminal an average of one aerobridge per stand is considered appropriate. Low cost carrier terminals and those for a Type 4 airport with turboprop aircraft operations would not have aerobridges.

The cost of aerobridges is added to the terminal building cost.

9.2.1 Airport type 1 - Terminal Facilities

Includes elements of a Full International Terminal and a Full Domestic Terminal either as separate building or single roof structure.

- Derived areas based on benchmarks on other major international airports
- Areas calculations cross checked by two methods – area per annual passenger and per aircraft gate
- Terminal area costed based on a range of recent terminal projects in which Airbiz and Turner and Townsend have been involved (not all publicly available) and crosschecked against media releases of grossed up costs for terminal projects such as recent and current terminal development/redevelopment at Canberra (Stage 1 opened late 2010), Perth (WAC proposed terminal) and Adelaide (MUIT)
- Includes allowances for aerobridges, docking systems, Power and Air

International element is multi-level building (as per Sydney, Melbourne and Brisbane international terminals) and domestic is assumed as a two level structure (as per most capital city domestic terminals)

9.2.2 Airport type 2 - Terminal Facilities

Building costs derived as explained above.

Limited international services provided with a two level terminal building. Cost per passenger is high, due to low relative usage.

9.2.3 Airport type 3 - Terminal Facilities

Building costs derived as explained above.

While an initial assumption could be for a single level structure with no aerobridges, more in the style of low cost carrier terminals (as per Newcastle, Avalon, Melbourne T4), the traffic levels (starting at 5 million annual passengers), suggesting a two level terminal with aerobridges may be more appropriate (as per Canberra, Gold Coast and Cairns). The model allows the assumptions to be varied between costs for a two level terminal with aerobridges or a single level terminal without.

Area requirements relative to a Type 2 airport are reduced due to the Design Airport (for the runway and therefore the rest of the airfield) limited to narrowbody jet (B737/A320) Code C type aircraft.

9.2.4 Airport type 4 - Terminal Facilities

GA Airport with limited RPT regional services. Assume a single level structure for RPT services between 500,000 and 1 million annual passengers with no aerobridges, more in the style of low cost carrier terminals (as per Newcastle, Avalon, Melbourne T4) or even simpler with runway length and width limiting services to turboprop aircraft (up to 50 seats) on short-haul domestic routes.

Regional passenger terminals (all single level) for benchmarked airports ranging in size from just over 1,000 m2 (Wagga Wagga) to over 6,000 m^2 (Mackay with B737/A320 Code C jet services). The area per stand (no aerobridges for a mid-range airport such as Albury with almost 300,000 annual movements but no domestic jet services is around 750 m^2 per stand.

9.3 Aviation support facilities

In Airport Master Planning it is accepted practice to make reservations of land in appropriate locations on the airport for aviation support facilities such as aircraft maintenance, freight, catering etc.

The aviation support facilities are generally operated by a third party (airline or specialist aviation business) who will also develop their own purpose built facilities on a leased site. This may be raw land, or very often a serviced site. In rare instances the airport may build the site and lease it back to the operator. If apron frontage is required, the aprons may be provided by the airport with commercial agreements to cover the airside capital, maintenance and operating costs.

The demand and development of these facilities is more likely to be site specific rather than generic. For example aircraft maintenance is a global business, with regional competition between providers. A region may provide incentives to attract an operator as an economic benefit to the region, but this requires access to a skilled workforce in the region. Regions and their airports may be in competition to attract an operator, and a separate business case for each proposal would be required. Similar scenarios are relevant to large freight operations on an airport. Conversely, if there is perceived high demand, it may be the airport that invites tenders from interested operators to locate on the airport with exclusive rights or with multiple operators.

It is not considered appropriate at this stage to include specifics in a high level generic model. However, airport master planning should make land reservations in appropriate locations to cater for such developments which are now an integral part of any major airport development.

Similarly, in Australia, at present, air navigation services (air traffic control including the control tower and specific navigation aids on the airport and in the vicinity of the airport) and rescue and fire fighting services (RFFS) are provided by Airservices Australia. Airservices leases sites and provides its own purpose built facilities. Similarly for the Bureau of Meteorology which will maintain a weather station on airport.

The airport master plan will identify appropriate sites. The lease and provision of trunk services to these sites is a matter for negotiation between Airservices Australia and the airport owner/operator. These have not been included in the model at present.

9.4 Services sites

A modern airport is expected to have a wide range of amenities to serve the travelling public (such as hotels and other traveller related facilities), facilities used by the people employed at the airport by the various operators (airport, air traffic and fire rescue providers, airlines, third party service providers, terminal and retail staff, ground transport operators etc.

The airport community can often be of the scale and mix to be considered a suburb or city in its own right in terms of employment generation, transport and associated facility requirements. There are also opportunities for other commercial developments on land surplus to aviation. There may also be land available for interim and complementary and compatible uses (on land reserved to meed very long term aviation demand). These opportunities will necessarily be site specific in the context of the local community, urban land form, demographic etc. Developments will often be supported by their own business case accounting for demand, development cost and return on investment on.

It is not considered appropriate at this stage to include specifics in a high level generic model. However, airport master planning should make land reservations in appropriate locations to cater for such developments which are now an integral part of any major airport development.

In the case of a Type 4 airport in particular, where aeronautical revenue may not cover all operating and capital cost, revenue from commercial developments within the airport boundary may help to support the GA airport operation.

9.5 Car Park

An airport may have a mix of parking, some as unsealed gravel, some as sealed at grade and some as multi-deck. If there are large tracts of land available on the airport, albeit some distance from the terminal, then long-term car parking (at grade) may be provided. An airport may develop different offerings with different pricing structures (valet parking, short term close to the terminal, long term undercover, long term open etc.). Car parking may also be provided for staff of the various employers on airport and for car rental operators.

The number of parking spaces required is dependent on the arrival modal split, which is influenced by access options available at the airport (e.g. availability of train access, cost of taxis). Benchmarking suggests that typical values at trunk Australian airport are around 600 car spaces per million passengers serviced annually. It will also vary depending on the meeter/greeter ratio and dwell times in the car park. These may be influenced by site specific factors – proximity to the main population catchment and the availability of alternative modes, tollways or other disincentives to private vehicle travel.

Benchmarking showed a wide range of value for parking spaces per passenger, reflecting site specific issues (alternative modes of transport, proximity to these and relative costs). An average value of 600 spaces per million passengers has been suggested for the generic model of Type 1, 2 and 3 airports for simplicity and consistency. The proportion of multi-deck to at grade has been varied for the different airport types based on assumptions of the scale of the airport.

Table 38: Car Park key assumptions

	Type 1	Type 2	Type 3	Type 4
Parking spaces per passenger	600/million pax	600/million pax	600/million pax	600/million pax
Cost per space – multi-deck	$22,000	$22,000	$22,000	N/A
Cost per space – at grade sealed	$4,000	$4,000	$4,000	$4,000
Cost per space – at grade gravel	$1,000	$1,000	$1,000	$1,000
% multi-deck	40%	70%	0%	0%
Average cost per passenger	$6.72	$9.96	$2.4	$2.4

Due to the land constrained nature of airport type 2, we have assumed that the amount of multi-deck car-parking is significantly more than airport type 1 which has more land.

9.5.1 Airport type 1 - Car Park

Assumes a mix of multi-deck and at grade sealed car-parking.

Spaces per passenger from ACCC Airport Monitoring Reports 2007-08 and 2008-09.

Cost per space for multi-deck from ACCC Airport Monitoring Report 2007-08 for Brisbane and Sydney car park developments.

Indicative cost for at grade sealed carpark from recent airport project.

9.5.2 Airport type 2 - Car Park

Assumes a mix of multi-deck and at grade sealed car-parking.

Spaces per passenger from ACCC Airport Monitoring Reports 2007-08 and 2008-09.

Cost per space for multi-deck from ACCC Airport Monitoring Report 2007-08 for Brisbane and Sydney car park developments.

Indicative cost for at grade sealed carpark from recent airport project.

9.5.3 Airport type 3 - Car Park

Assumes a sealed carpark at grade. Indicative cost from recent projects.

9.5.4 Airport type 4 - Car Park

Car parking around the passenger terminal can be anywhere between 200 to over 600 spaces (including long term parking and car rental). When divided by annual passenger the range is from around can still be of the order of 600 per million passengers but will be dependent on local factors previously discussed. The terminal car parking area (for a facility handling upward of 500,000 passengers per annum) is assumed to be a sealed surface.

For the GA areas, it is expected that leased site will be made available to prospective tenants for them to develop. This could include gravel or sealed car parks depending on the nature of the business and facility. The size will also depend on the scale and type of facility – hangar, flying school, aircraft maintenance or sales, fuel facility, freight etc.

10. Supporting Infrastructure Capital Expenditure

Supporting infrastructure capital expenditure assumptions have been provided by Arup.

The methodology for determining the supporting infrastructure requirements has first been to assess the initial capacity of each airport scenario. Secondly, the ultimate capacity has been investigated and defined based on similar assumptions and benchmarks. Once these scenarios are defined, the appropriate implementation and upgrading of the supporting infrastructure over the design period has been considered.

To date, this staged implementation of the infrastructure from the initial capacity to the ultimate has not yet been considered.

The following are key considerations for the supporting infrastructure:

- All supporting infrastructure assets described herein have the potential to significantly change based upon a specific site location. The quantity, type and unit cost rate is likely to vary from the assumed when examined against an actual location.
- No land acquisition costs have been included in the cost estimates.
- The supporting infrastructure has been developed based on the airport characteristics for template airports dated 3-12-10. Further interpretation of these statistics has been required to develop the type and quantity of supporting infrastructure. There is a risk that these interpretations differ from the original intent of the Department.

10.1 Surface Transportation

In general terms, there are three major travel generating markets for airports:

- *Originating and terminating passengers*. These have only one access trip per flight, however access may involve a return trip if the passenger is delivered to the airport by a relative/friend or if the taxi is not allowed to pick up at the airport;
- *Airport employees*, who commute to and from the airport each day; and,
- *Supply, delivery and other commercial vehicles* that service the airport.

Originating or terminating passengers each make one trip to or from the airport, accounting for about one or less vehicle trips (more than one when the driver returns empty, less than one when multiple passengers travel in the same car). Employees and other commercial traffic make multiple trips each day, and may include additional trips for personal business purposes etc., thereby contributing around 500 or more trips per year each.

Typically each of these categories of traffic for airports are of similar orders of magnitude.

The patterns of airport traffic are highly dispersed. Passengers access home and business origins and destinations across the city. Employee and commercial traffic typically travels primarily to the edges of the city, linking the airport to those parts of the metropolitan area that are less expensive for housing and industry location. Typically, relatively little traffic generated by airports is associated with the city centre. International observations are that the proportion of traffic related to the city centre tends to decrease for larger airports. This is partly due to the fact that larger airports tend to provide a greater transfer hub function[3], thereby having proportionally fewer originating or terminating passengers.

The primary concern for passengers accessing airports is reliability of travel. The penalty of missing a flight is high, so passengers value reliability more than travel speeds, and often travel early to ensure timely arrival (effectively sacrificing travel speed).

Airport connections also need to provide a high level of accessibility to distribute travellers and employees over the wider metropolitan area. Providing for widespread access to the entire metropolitan area is one reason that automobile travel is highly utilised for airport access. Automobile travel also creates demand for parking which is often a major source of revenue for airports. Taxi industry revenues are also dependent on airport road travel.

For these reasons, it is generally difficult for alternative airport access systems such as rail to be competitive with roads. Comprehensive analysis and study is needed to determine the appropriateness of providing rail services to airports. Among the factors that favour competitive rail service to airports are:

- *Airport size*, to generate sufficient passengers to cover costs and sustain sufficiently frequent services that reduce the time necessary to wait for trains;
- *Existing local rail service,* which lowers the cost of the airport connection;
- *Easy connections to a wider metropolitan railway system,* to facilitate access to the wider metropolitan area; and,
- *Difficulty of automobile access to the airport*, which may be a factor for more distant airports.

Table 39: Benchmarked Airports – Traffic Modal Split

Airport	Sydney	Brisbane	Melbourne	London Heathrow	London Gatwick	Amsterdam Schiphol	Frankfurt
Year	2008	2008	2008	2007	2008	2000	2006
Annual PAX (Million)	32.9	18.5	26.3	67.8	30.1	39.6	52.8
Rail	11%	5%	0%	25%	30%	35%	28%
Private Car	44%	83%	69%	32%	48%	43%	41%
Rental Car	5%	0%[1]	0%[2]	2%	2%	0%[3]	5%
Bus	14%	3%	14%	13%	5%	7%	5%
Taxi	25%	8%	17%	27%	14%	12%	20%
Other	1%	1%	0%	0%	1%	3%[4]	1%

1 - Rental cars included in private car figure
2 - Rental cars included in private car figure
3 - Rental cars included in taxi figure
4 - Coach/hotel services included in other figure

10.2 Road Connection

The provision of a road connection from an existing main arterial road to the airport and does not include the internal airport network or the car parks.

[3] Most of the busiest airports in the world by passenger numbers are significant transfer hubs e.g. Atlanta, London Heathrow, Tokyo, Chicago O'Hare, Los Angeles International, Dallas Fort Worth, Paris Charles de Gaulle, Frankfurt, Hong Kong, Amsterdam, Dubai. The substantial growth in Dubai's passenger numbers (ranked 27th busiest in 2007 with 34.3m pax, up to 14th busiest in 2010 with over 45m pax, according to Airports Council International data) has been driven by its increasing function as an international transfer hub. Dubai is in fact forecast to overtake London Heathrow as an international transfer airport by late this decade (Centre for Asia Pacific Aviation).

Methodology

The design figures for road transportation are linked to the total passenger numbers for each airport scenario. Using a 'vehicle trips per passenger' ratio calculates a total daily number of vehicle trips to each airport. A peak hour figure can then be estimated by applying another ratio based on known typical traffic distribution patterns. During the peak hour there is a directional bias where one direction is typically busier in the morning and vice versa in the evenings. An estimate of this directional bias is applied to the peak hour to arrive at the peak design figure. This amount is the basis for estimating the number of traffic lanes required.

Assumptions

- External vehicle trips per passenger per day = sliding scale dependent upon assumptions for mode share and hubbing (flight transfers) dependent upon airport type/size. Estimated by Arup based on data for existing Australian airports.

- Daily passengers at airport are approximately even throughout the year. (i.e. daily passengers = annual passengers / 365)

- Peak hour is 10% of daily average. Estimated by Arup based on known typical traffic distribution patterns. This is a conservative figure as, for example, Melbourne and Brisbane average 7-8%.

- Each lane has 1,860 vehicles/hour maximum service flow rate at Level of Service D (high standard arterial road 90km/h posted speed, freeway capacities are higher)

- During peak hour 65% of vehicles are in one direction. Estimated by Arup based on known typical traffic distribution patterns.

Table 40: Summary of Design Assumptions

Descriptor	Value	Basis of Assumption
Vehicle trips per passenger per day:	sliding scale	Derived from benchmarks against existing airport traffic figures. Dependent upon airport size and therefore implied significance of transfer hub operations.
Peak hour factor:	10%	Estimated by Arup based on known typical traffic distribution patterns. This is a conservative figure; for example Melbourne and Brisbane average 7-8%.
Directional factor:	65%	Estimated by Arup based on known typical traffic distribution patterns.
Lane capacity	1,860 vehicles/hour	Service flow rate at Level of Service D (high standard arterial road 90km/h posted speed, freeway capacities are higher)

Table 41: Benchmarked Airports – Traffic volumes

Brisbane 2003/04

Annual passengers:	14,059,998	per year
Daily passengers:	38,521	per day
Average trips:	57,122	vehicles/day (Airport Drive 7 day average southbound doubled)
Trips per passenger:	1.48	trips/passenger
Peak - one direction:	2,400	vehicles /hour in one direction

Melbourne

Annual passengers:	26,290,000	per year

Daily passengers:	72,027	per day
Average trips:	75,330	vehicles/day
Trips per passenger:	1.05	trips/passenger
Peak - two directions:	5,800	vehicles /hour (graph in master plan)
Peak hour factor:	7.7%	of daily volume
Directional factor:	65%	Assumed
Peak - one direction:	3,770	vehicles /hour in one direction

10.2.1 Airport type 1 – Road Connection

The following assumed modal split is based on the understanding that a heavy rail connection will be available at the commencement of the project. As the airport increases in capacity, it is expected that the proportion of passengers utilising the rail service will increase. The figures in Table 42 are based upon the benchmarked data presented in Table 39.

Table 42: Type 1 Road connection transport modal split assumptions

	Initial Size	Ultimate Size
Rail	10%	30%
Private Car	50%	35%
Rental Car	5%	5%
Bus	10%	13%
Taxi	23%	15%
Other	2%	2%

Table 43: Type 1 Road connection design figures

	Initial Size	Ultimate Size	Explanation
Vehicle trips per passenger per day:	1.05	0.5	Derived from benchmarks against existing airports
Daily passengers:	82,192	328,767	Annual passengers / 365
Daily Trips (vehicles/day):	82,192	164,383	Daily passengers x vehicle trips per passenger ratio
Peak - two directions (vehicles/hour):	8,219	16,438	Daily trips x peak hour factor
Peak - one direction (vehicles/hour):	5,342	10,684	Peak – two directions x directional factor
Number of lanes - one way:	3	6	Based on maximum 1,860 vehicles/hour
Number of lanes - total:	6	12	Double number of lanes one way

Table 44: Type 1 Road connection schedule of infrastructure

Description	Unit	Unit Cost[1]	No.	Total
Initial Size				
Road No.1 - Dual carriageway with 3 lanes in each direction	km	$40,000,000		
Ultimate Size				

Road No.1 - Dual carriageway with 3 lanes in each direction	km	$40,000,000		
Road No.2 - Dual carriageway with 3 lanes in each direction	km	$40,000,000		

1 – Unit rates based on benchmarking of existing projects.

10.2.2 Airport type 2 – Road Connection

Table 45: Type 2 Road connection design figures

	Initial Size	Ultimate Size	Explanation
Vehicle trips per passenger per day:	1.5	1.0	Derived from benchmarks against existing airports
Daily passengers:	13,699	82,192	Annual passengers / 365
Daily Trips (vehicles/day):	20,548	82,192	Daily passengers x vehicle trips per passenger ratio
Peak - two directions:	2,054	8,219	Daily trips x peak hour factor
Peak - one direction:	1,336	5,342	Peak – two directions x directional factor
Number of lanes - one way:	1	3	Based on maximum 1,860 vehicles/hour
Number of lanes - total:	2	6	Double number of lanes one way

Table 46: Type 2 Road connection schedule of infrastructure

Description	Unit	Unit Cost[1]	No.	Total
Initial Size				
Road No.1 - 1 lane in each direction	km	$10,000,000		
Ultimate Size				
Road No.1 - Dual carriageway with 3 lanes in each direction	km	$40,000,000		

1 – Unit rates based on benchmarking of existing projects.

10.2.3 Airport type 3 - Road Connection

Table 47: Type 3 Road connection design figures

	Initial Size	Ultimate Size	Explanation
Vehicle trips per passenger per day:	1.5	1.1	Derived from benchmarks against existing airports
Daily passengers:	13,699	68,493	Annual passengers / 365
Daily Trips (vehicles/day):	20,548	75,342	Daily passengers x vehicle trips per passenger ratio
Peak - two directions:	2,055	7,534	Daily trips x peak hour factor
Peak - one direction:	1,336	4,897	Peak – two directions x directional factor
Number of lanes - one way:	1	3	Based on maximum 1,860 vehicles/hour
Number of lanes - total:	2	6	Double number of lanes one way

Table 48: Type 3 Road connection schedule of infrastructure

Description	Unit	Unit Cost[1]	No.	Total

Initial Size				
Road No.1 - 1 lane in each direction	km	$10,000,000		
Ultimate Size				
Road No.1 - Dual carriageway with 3 lanes in each direction	km	$40,000,000		

1 – Unit rates based on benchmarking of existing projects.

10.2.4 Airport type 4 – Road Connection

Table 49: Type 4 Road connection design figures

	Initial Size	Ultimate Size	Explanation
Vehicle trips per passenger per day:	1.5	1.5	Derived from benchmarks against existing airports
Daily passengers:	1,370	2,740	Annual passengers / 365
Daily Trips (vehicles/day):	2,055	4,110	Daily passengers x vehicle trips per passenger ratio
Peak - two directions:	205	411	Daily trips x peak hour factor
Peak - one direction:	134	267	Peak – two directions x directional factor
Number of lanes - one way:	1	1	Based on maximum 1,860 vehicles/hour
Number of lanes - total:	2	2	Double number of lanes one way

Table 50: Type 4 Road connection schedule of infrastructure

Description	Unit	Unit Cost[1]	No.	Total
Road No.1 - 1 lane in each direction	km	$10,000,000		

1 – Unit rates based on benchmarking of existing projects.

10.3 Rail Connection

Airport access mode choice decisions by air passengers and airport employees affect a wide range of airport planning and operational management decisions, including the development of landside facilities, airport revenue from parking and other ground transportation services, and programs to reduce growth in vehicle trips generated by the airport and associated emissions.

A variety of factors influence airport users' decisions to use rail to access airports. In an analysis of nine US airports with rail services[4], key factors identified as affecting the use of rail services to access airports were:

- The proportion of passengers with trip ends in the CBD area;
- The proportion of airport passengers familiar with the regional public transport system;
- Differential travel costs and travel times (and travel time reliability) for public transport and private car modes;
- Availability of parking both at the airport and at non-airport stations;

[4] Transit Cooperative Research Program Report 62, *'Improving Public Transportation Access to Large Airports'*, Transportation Research Board, 2000

- Frequency of rail services;
- Proportion of passengers with little or no check-in luggage; and
- Level of convenience offered at the airport and non-airport ends of the trip (walking distances, number of level changes encountered between the ticket counters, baggage claim areas and the rail station, the need to transfer to other modes and proximity of the station to major destinations in the central business district and elsewhere in the region).

It was previously discussed that the set of travel factors specific to airports can make it difficult for rail access to be competitive to private car on a 'perceived user cost' basis. In practice, planning for rail access to airports is normally then a policy rather than a capacity consideration. In virtually all existing cases the capacity of bus, light rail, rapid transit, or commuter rail is higher than that required for airport-related services[5].

The choice of airport access mode by passengers and employees thus has more to do with the policy decisions made for the rest of the regional transportation system than with capacity limitations inherent to any given mode. Policy issues influencing the decision to adopt/provide rail access include not only accessibility but additional considerations of sustainability, public transport usage goals, social equity, greenhouse gas emission goals etc. In these regards public transport including bus and rail has benefits over private car use.

Given the many different factors influencing the proportions of airport travellers using different modes, it is normally considered unrealistic in practice to achieve quantitative estimates of mode use effects without the use of formalised airport ground access models. These consider the specific characteristics of the transport system and travel market, and model how airport users respond to changes in the available airport ground transportation services.

An approach to determine the approximate timing (as distinct from 'need') for provision of rail access to each of the airport types has therefore been adopted based on empirical data on the primary markets associated with public transportation services at major US airports[6].

Table 51: Rail access provision benchmarking

Mode	Size of primary market for public mode (square km)	Total annualised origin/destination air passengers (one-way trips)
Rail	155 – 230	6,600,000 – 8,200,000
Shared door-to-door bus	155 – 1,100	2,000,000 – 4,900,000
Regional express bus	700 – 1,400	1,200,000 – 1,600,000
CBD express bus	10	1,300,000
Multistop bus	200	1,000,000

Based on these data, with allowance for transit passengers and assuming that a 'successful' rail service achieves a market share of at least 15% of airport trips, provision of a rail service would economically justifiable after achieving a total passenger task of around 45m passengers per year.

It is recommended that the corridor for a rail service should be reserved to allow for ultimate development of dual lines, although a single line may be implemented in the initial stages.

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[5] Transit Cooperative Research Program (TCRP) Report 83, *'Strategies for Improving Public Transportation Access to Large Airports'*, Transportation Research Board, 2002
[6] TCRP Report 83

It would be appropriate to plan for the integration of a rail service from the inception stage of the Type 1 airport. This would include identification and reservation of the rail corridor, planning for station locations, integration to the existing rail network and planning for interchange facilities at the airport. If the Type 1 airport were to be developed as a greenfield development, it would nonetheless be reasonable to allow and plan for the operation of rail services from the time of opening as a matter of transport policy.

By comparison, in the current Australian context the Brisbane Airtrain carries some 9% of total passengers at around 1.5 million people per year and the Sydney Airport Link train carries some 12% of passengers at around 4 million people per year for the two airport stations (with a further 2 million per year using the two non-airport stations). The Melbourne Skybus service carries 8 percent of passengers at around 2 million passengers per year. A comparison of the operating characteristics of these services is given below[7].

Table 52: Comparison of bus service operating characteristics

	Melbourne SkyBus	Sydney Airport Link Train	Brisbane Airtrain
Standard full fare one-way	$16	$15	$15
Travel time to domestic airport from CBD*	20 minutes	9 minutes	23 minutes
Travel time to international airport from CBD*	20 minutes	11 minutes	19 minutes
Travel distance CBD* to domestic airport	23 km	6.6 km	15.8 km
Average speed to domestic airport	69 km/hr	44 km/hr	41 km/hr
Fare/km	$0.70	$2.27	$0.84
Peak frequency	6 per hour	8 per hour	4 per hour
Daytime frequency	6 per hour	6 per hour	2 per hour
First arrival	24 hour service	4:45 am	5:30 am
Last departure	24 hour service	11:45 pm (12:40 am Friday and Saturday)	8:00 pm
Current share of airport passengers	8.3%	12%	9%

* - Southern Cross Station in Melbourne, Central Station in Sydney, Central Station in Brisbane

The Sydney Airport Train Link was developed largely to provide enhanced facilities for the 2000 Sydney Olympics. Two Airport Express bus services (routes 300 and 350) from the city centre to the airport have been cancelled, removing competition from the rail service. The Sydney Airport Corporation has stated that it is committed to increasing the public transport mode share from 15% to 20% by 2024[8].

The Brisbane Airtrain has no competition from other public transport services and operates only during more ‘economic/profitable’ times of higher passenger demand. At present, services are not available after 8:00pm, despite multiple flights arriving and departing after this time.

It has been seen that a critical success factor in the operation of airport rail services is integration into a wider regional rail system. In using existing rolling stock and sharing an existing line and stations however, a criticism of the Sydney Airport Train has been that passengers must share and compete for space with commuters on the through railway service (the East Hills Line), and trains have no provision for carrying luggage.

[7] *‘Bus Solutions’*, Bus Association Victoria newsletter, Issue 03, October 2010
[8] Booz & Co., *‘Impact of Fare Reform on the Sydney Airport Rail Link’*, February 2010

The selection of a train technology and rolling stock for an airport rail service is however a matter of extensive study and competitive procurement process. It has therefore been assumed for costing purposes that the rail link for the Type 1 airport is a heavy passenger rail system consistent with the CityRail system currently servicing metropolitan Sydney (however this approach will also be significantly influenced by site location considerations and also approach to key policy considerations in relation to the cost and benefits of a developing dedicated rail service to any new airport facility).

10.3.1 Airport type 1 – Rail Connection

Heavy passenger rail consistent with current CityRail rolling stock, with connections to existing CityRail network.

10.3.2 Airport type 2 – Rail Connection

No rail connection provided.

10.3.3 Airport type 3 – Rail Connection

No rail connection provided.

10.3.4 Airport type 1 – Rail Connection

No rail connection provided.

10.4 Water Supply

Water supply will be provided to the airport from a connection to the existing network (the cost and works required in relation to this will be a site specific consideration). This connection will be by two piped connections for security of supply. On site storage tanks will provide a buffer to the airport distribution network. The water supply network downstream of the onsite storage tanks (i.e. the internal airport network) is not discussed here.

Methodology

Water supply demand is assumed to be matched to passenger numbers for airport facilities and to gross floor area for business parks. Airport Business Parks vary significantly in size and are not directly related to annual passenger numbers. The water supply for business parks is matched to Gross Floor Area by industry standard estimating methodologies.

Water Supply – Airport Demand

Water demand adopted = 31 l/passenger.

This demand is assumed to include aircraft maintenance, fuel facilities, terminal precinct, freight precinct and car parks. It has been assumed to exclude Airport City/Business Parks. This demand has been benchmarked against existing water use at the below airports.

Benchmark Airports (Water demand per passenger):

- Brisbane - 23.5 l/passenger (2007/08)
- Sydney - 31.0 l/passenger (2008)
- Munich - 28.9 l/passenger (2006-2009)

Water Supply - Airport City/Business Park Demand

Water demand adopted = 41 kL / net ha / day

Water Supply Code of Australia, WSA 03-2002, Table 2.1, Commercial – Suburban

Water Supply - Peak Day Demand

Peak day demand = 2 x average day demand

Water Supply Code of Australia, WSA 03-2002, Section 2.2.3.2

Water Supply – Security

Two individual connections to the existing distribution network will be provided. Each will be sized for the peak day demand flow. This provides a redundancy of supply with each connection capable of supplying the airport's demands. This redundancy however is only on the airports own connection. Redundancy of the upstream supply infrastructure requires connections into separate networks and will be determined based on the available service at each site.

Water Supply - Storage

Two days of on-site storage will be provided based on the average day water demand. This is an industry standard design guideline which provides the airport with two days of water supply as a back-up. The average day demand is estimated using methodology described above.

Water Supply Code of Australia, WSA 03-2002, Section 2.7

Water Supply - Infrastructure Requirements

The pumping station will be sized for transferring the peak day supply over 22 hours. This provides some redundancy to the pumping station system as the station does not need to operate continuously. This allows for a limited amount of down-time and maintenance without affecting supply.

Total head is completely dependent on the length of delivery pipeline and topographical layout of the pipeline route. In the absence of a site location a figure of 100m has been arbitrarily allocated.

Table 53: Summary of Design Assumptions

Descriptor	Value	Basis of Assumption
Water use per passenger	31 l/passenger	Benchmarked against existing airports
Water use for Business Park	41 kL / net ha / day	Water Supply Code of Australia, WSA 03-2002, Table 2.1, Commercial – Suburban
Peak day demand	2 x average day demand	Water Supply Code of Australia, WSA 03-2002, Section 2.2.3.2
Storage	2 x average day demand	Water Supply Code of Australia, WSA 03-2002, Section 2.7
Pumping Station design flow	Transferring peak day supply over 12 hours	Water Supply Code of Australia, WSA 03-2002

10.4.1 Airport type 1 - Water Supply

Design flows based on the above demand assumptions.

Table 54: Type 1 Water Supply Design Figures

	Initial Size	Ultimate Size	Explanation
Annual water usage (ML)	930	3,720	Annual passengers x water use per passenger plus GFA of Business Park x water use for Business Park
Average day demand (ML/day)	2.5	10.2	Annual water use / 365
Peak day demand (ML/day)	5.1	20.4	Average daily demand x 2

Table 55: Type 1 Water Supply Schedule of Infrastructure

Description	Unit	Unit Cost[1]	No.	Total
Initial Size				
Water supply pipeline - 300mm DICL	km	$1,000,000		
Pumping Station - 80 l/s @ 100m	no.	$5,000,000	1	$5,000,000
Steel Storage Tank - 2ML	no.	$3,000,000	4	$12,000,000
Ultimate Size				
Water supply pipeline - 900mm DICL	km	$3,000,000		
Pumping Station - 775 l/s @ 100m	no.	$25,000,000	1	$25,000,000
Reservoir - Earth embankments - lined and covered - capacity 62ML	no.	$3,000,000	1	$3,000,000

1 – Unit rates based on benchmarking of existing projects.

10.4.2 Airport type 2 - Water Supply

Water Supply Design flows based on the above demand assumptions.

Table 56: Type 2 Water Supply Design Figures

	Initial Size	Ultimate Size	Explanation
Annual water usage (ML)	155	930	Annual passengers x water use per passenger plus GFA of Business Park x water use for Business Park
Average day demand (ML/day)	0.4	2.5	Annual water use / 365
Peak day demand (ML/day)	0.8	5.1	Average daily demand x 2

Table 57: Type 2 Water Supply Schedule of Infrastructure

Description	Unit	Unit Cost[1]	No.	Total
Initial Size				
Water supply pipeline - 100mm DICL	km	$800,000		
Pumping Station - 11 l/s @ 100m	no.	$1,000,000	1	$1,000,000
Steel Storage Tank - 1ML	no.	$1,000,000	1	$1,000,000
Ultimate Size				
Water supply pipeline - 600mm DICL	km	$2,000,000		
Pumping Station - 375 l/s @ 100m	no.	$15,000,000	1	$15,000,000
Reservoir - Earth embankments - lined and covered - capacity 30ML	no.	$2,000,000	1	$2,000,000

1 – Unit rates based on benchmarking of existing projects.

10.4.3 Airport type 3 - Water Supply

Water Supply Design flows based on the above demand assumptions.

Table 58: Type 3 Water Supply Design Figures

	Initial Size	Ultimate Size	Explanation
Annual water usage (ML)	115	775	Annual passengers x water use per passenger plus GFA of Business Park x water use for Business Park
Average day demand (ML/day)	0.4	2.1	Annual water use / 365
Peak day demand (ML/day)	0.8	4.2	Average daily demand x 2

Table 59: Type 3 Water Supply Schedule of Infrastructure

Description	Unit	Unit Cost[1]	No.	Total
Initial Size				
Water supply pipeline - 100mm DICL	km	$800,000		
Pumping Station - 11 l/s @ 100m	no.	$1,000,000	1	$1,000,000
Steel Storage Tank - 1ML	no.	$1,000,000	1	$1,000,000
Ultimate Size				
Water supply pipeline - 300mm DICL	km	$1,500,000		
Pumping Station - 105 l/s @ 100m	no.	$5,000,000	1	$5,000,000
Steel Storage Tank - 2ML	no.	$1,500,000	5	$7,500,000

1 – Unit rates based on benchmarking of existing projects.

10.4.4 Airport type 4 - Water Supply

Water Supply Design flows based on the above demand assumptions.

Table 60: Type 4 Water Supply Design Figures

	Initial Size	Ultimate Size	Explanation
Annual water usage (ML)	15.5	31.0	Annual passengers x water use per passenger plus GFA of Business Park x water use for Business Park
Average day demand (kL/day)	42.5	84.9	Annual water use / 365
Peak day demand (kL/day)	84.9	169.9	Average daily demand x 2

Table 61: Type 3 Water Supply Schedule of Infrastructure

Description	Unit	Unit Cost[1]	No.	Total
Initial Size				
Water supply pipeline - 100mm DICL	km	$800,000		
Steel Storage Tank - 0.5ML	no.	$500,000	1	$500,000
Ultimate Size				
Water supply pipeline - 450mm DICL	km	$1,500,000		
Steel Storage Tank - 2ML	no.	$1,500,000	2	$3,000,000

1 – Unit rates based on benchmarking of existing projects.

10.5 Wastewater

Wastewater will be generated at a number of locations throughout an airport. The wastewater will be collected across the airport in a network of pipes and pumping stations. The exact system design is dependent on the spatial distribution of the generation points and the topography of the site. It may be possible to gravitate everywhere or a number of pumping stations could be required. The connection from the airport to the external wastewater network could be completed in a number of connections or a single connection. Again, this is dependent on the topography of the site and the extent of the existing wastewater network in the vicinity of the airport site. For the purposes of this report it has been assumed that the airport's wastewater flows will combine to one common location on-site prior to a single discharge from the site. It is also assumed that the topography and distance to an existing wastewater network will require a pumping station. As such this common location will be termed the terminal pumping station. The description of infrastructure below is for the terminal pumping station and the rising main to connect into the existing wastewater network. The wastewater infrastructure upstream of the terminal pumping station is not discussed here.

Methodology

Wastewater flows are assumed to be matched to passenger numbers for airport facilities and to gross floor area for business parks. Airport Business Parks vary significantly in size and are not directly related to annual passenger numbers. The wastewater flows for business parks are matched to Gross Floor Area by industry standard estimating methodologies.

Wastewater Flows - Airports

Wastewater flow adopted = 25 l/passenger

This demand is assumed to include aircraft maintenance, fuel facilities, terminal precinct, freight precinct and car parks. It has been assumed to exclude Airport City/Business Parks. This demand has been benchmarked against existing wastewater flows at the below airports.

Benchmark Airports (Wastewater flow per passenger):

- Brisbane - 16.5 l/passenger (2007/08)
- Perth – 25.0 l/passenger
- Frankfurt – 29.0 l/passenger (2008)

Wastewater Flows – Business Parks

Equivalent Person (EP) for Business Parks = 300 EP/gross ha

Design flow assumptions

The following design flow assumptions are based on the Sewerage Code of Australia WSA 02-2002.

- Average Dry Weather Flow (ADWF) = 0.0021 * EP, based on 180L/d/EP
- Peak Dry Weather Flow (PDWF) = d * 0.0021*EP where d=2.4
- Peak Wet Weather Flow (PWWF) = ADWF * 4

- Rising main capacity = PWWF
- Sewage pumping station to have 4 hours of emergency storage

10.5.1 Airport type 1 - Wastewater

Table 62: Type 1 Wastewater Design Figures

	Initial Size	Ultimate Size	Explanation
Annual wastewater – airport (ML)	750	3,000	Annual passengers x water use per passenger
Annual wastewater - business park (ML)	298	9,934	GFA of Business Park x wastewater flows rates for Business Park
Annual wastewater – total (ML)	1048	12,934	Airport wastewater flows + Business Park wastewater flows
ADWF (ML/day)	2.9	35.4	Total wastewater flows /365
PDWF (ML/day)	6.9	106.3	ADWF x 2.4
PWWF (ML/day)	11.5	141.7	ADWF x 4

Table 63: Type 1 Wastewater Schedule of Infrastructure

Description	Unit	Unit Cost	No.	Total
Initial Size				
Rising main - 375mm PVC-M pipeline	km			
Pumping Station - 133 l/s @ 100m head, 153 kW, 1150kL storage	no.		1	
Ultimate Size				
Rising main - 1200mm MSCL pipeline	km			
Pumping Station - 1641 l/s @ 100m head, 1893 kW, 17718kL storage	no.		1	

10.5.2 Airport type 2 - Wastewater

Table 64: Type 2 Wastewater Design Figures

	Initial Size	Ultimate Size	Explanation
Annual wastewater – airport (ML)	125	750	Annual passengers x water use per passenger
Annual wastewater - business park (ML)	0	5,960	GFA of Business Park x wastewater flows rates for Business Park
Annual wastewater – total (ML)	125	6,710	Airport wastewater flows + Business Park wastewater flows
ADWF (ML/day)	0.3	18.4	Total wastewater flows /365
PDWF (ML/day)	0.8	55.2	ADWF x 2.4
PWWF (ML/day)	1.4	73.5	ADWF x 4

Table 65: Type 2 Wastewater Schedule of Infrastructure

Description	Unit	Unit Cost	No.	Total
Initial Size				
Rising main - 150mm PVC-M pipeline	km			

Description	Unit	Unit Cost	No.	Total
Pumping Station - 16 l/s @ 100m head, 18 kW, 137kL storage	no.		1	
Ultimate Size				
Rising main - 900mm MSCL pipeline	km			
Pumping Station - 851 l/s @ 100m head, 982 kW, 9192kL storage	no.		1	

10.5.3 Type 3 Airport - Wastewater

Table 66: Type 3 Wastewater Design Figures

	Initial Size	Ultimate Size	Explanation
Annual wastewater – airport (ML)	125	625	Annual passengers x water use per passenger
Annual wastewater - business park (ML)	0	993	GFA of Business Park x wastewater flows rates for Business Park
Annual wastewater – total (ML)	125	1,618	Airport wastewater flows + Business Park wastewater flows
ADWF (ML/day)	0.3	4.4	Total wastewater flows /365
PDWF (ML/day)	0.8	13.3	ADWF x 2.4
PWWF (ML/day)	1.4	17.7	ADWF x 4

Table 67: Type 3 Wastewater Schedule of Infrastructure

Description	Unit	Unit Cost	No.	Total
Initial Size				
Rising main - 150mm PVC-M pipeline	km			
Pumping Station - 16 l/s @ 100m head, 18 kW, 137kL storage	no.		1	
Ultimate Size				
Rising main - 450mm DICL pipeline	km			
Pumping Station - 205 l/s @ 100m head, 237 kW, 2217kL storage	no.		1	

10.5.4 Airport type 4 - Wastewater

Table 68: Type 4 Wastewater Design Figures

	Initial Size	Ultimate Size	Explanation
Annual wastewater - airport:	12.5	25	Annual passengers x water use per passenger
Annual wastewater - business park:	0	695	GFA of Business Park x wastewater flows rates for Business Park
Annual wastewater - total:	13	720	Airport wastewater flows + Business Park wastewater flows
ADWF:	0.0	2.0	Total wastewater flows /365
PDWF:	0.1	5.9	ADWF x 2.4
PWWF:	0.1	7.9	ADWF x 4

Table 69: Type 4 Wastewater Schedule of Infrastructure

Description	Unit	Unit Cost	No.	Total
Initial Size				
Rising main - 150mm PVC-M pipeline	km			
Pumping Station - 2 l/s @ 100m head, 2 kW, 14kL storage	no.		1	
Ultimate Size				
Rising main - 300mm DICL pipeline	km			
Pumping Station - 91 l/s @ 100m head, 105 kW, 987kL storage	no.		1	

10.6 Power Supply

The provision of a power supply to an airport is a critical infrastructure asset. Consideration must be given to providing the appropriate security of supply.

The bulk supply of power to the airport and the major intake substation is described below. The cost of connecting to the existing power network will be determined by site specific characteristics. The internal distribution of power around the airport itself is not described below. Note that this may include multiple high voltage networks and substations.

The major power demands at an airport are:

- Terminal(s) - lighting and power
- Terminal(s) - baggage handling
- Terminal(s) - air conditioning
- Terminal(s) - retail
- Terminal(s) - vertical transportation (lifts, escalators, moving walkways)
- Terminal(s) - aerobridges
- Terminal(s) - ground power units (GPUs), landside support
- Carpark(s) - lighting and power
- Runway/taxiway lighting
- Control tower
- External lighting - roads and public realm
- Hangars - maintenance
- Freight warehouse facilities
- Airport City / Business Park

For all scenarios a back up source of power is required for critical aviation services including control tower, runway/taxiway lighting, communications and navigational assets. This will be provided by a diesel generator likely located adjacent to the control tower.

Methodology

The maximum demand has been estimated based on:

- The anticipated developed area and type of development for each airport scenario. As the majority of the power demand is building loads dependent on building types, the developed areas are a key factor in estimating the total power demand;
- Using typical anticipated demand values for each different development use based on previous experience; and
- Benchmarking against other similar airports.

Electrical Terminology

- VA/m2 = Volt Amperes per square meter. This is a measurement of electrical power over an area.
- MVA = Mega Volt Amperes (Million Volt Amperes). This is a measurement of electrical power.
- GWh = Giga Watt Hours (109 Watt Hours). This is a measure of the amount of energy used.
- kWh = Kilo Watt Hours (1,000 Watt Hours). This is a measure of the amount of energy used.

Assumptions

- Electrical power distribution from the existing power network to the airport site will be by overhead transmission lines.

- The existing electricity distribution networks have sufficient capacity for the airport demands and no additional power generation is required

- At the intake substation at the airport, the switchgear will be indoors and the transformers outdoors.

- The areas of the Airport City / Business Park in the fully developed scenario for all airport types are significant. The exact composition of these areas is an important consideration in the calculation of the required power supply. Using the standard assumptions contained herein results in unfeasibly large power demands with the Airport City / Business Park dwarfing the airport in all scenarios. As such, no calculations for the fully developed scenarios are provided. Further information is required on the composition of these areas to provide a realistic power supply.

Demand Estimation

Table 70:Power Supply Demand Estimation

Unit Rate Demands	Value	Unit	Benchmark
Aircraft maintenance (hangars - light industrial)	15	VA/m2	Newcastle airport
Fuel facility precinct	5	VA/m2	Assumed from industry experience
Terminal precinct	120	VA/m2	Newcastle airport, industry experience
Freight precinct	15	VA/m2	Assumed from industry experience
Car park	5	VA/m2	Newcastle airport
Airport City / Business Park	100	VA/m2	Newcastle airport, industry experience

Land Use Assumptions

Each of the generic airport scenarios provided contains a gross area figure. In order to calculate the power demand for each item, the Gross Floor Area of each portion of the airport is required. As such, we have assumed the following floor space ratios.

Table 71: Power Supply Assumed Gross Floor Areas

Category	Floor Space Ratio	Background
Aircraft maintenance	25%	assumed
Fuel facility precinct	10%	assumed

Terminal precinct	25%	assumed
Freight precinct	25%	assumed
Car park	50%	assumed
Business park	90%	30% roads, 10% open space / detention, 50% site coverage of 60% developable land = 30%, average 3 stories high

Benchmark Airports

Table 72: Power Supply Benchmarked Airports

Airport	Year	Annual Passengers	Annual energy usage (GWh)	Energy use per passenger (kWh)	Maximum demand (MVA)
Brisbane	2007/08	18,523,979	136	7.34	
Sydney	2007	32,998,000	85	2.58	
Melbourne	2008	26,290,000			23
Munich	2009	32,701,759	399	12.2	
Zurich	2006	19,200,000	320	16.7	
Denver	2006	22,822,111		5.26	
Seattle-Tacoma	2006	14,703,928		5.03	
Frankfurt	2008	53,467,450		14.4	
Oakland International	2006	7,076,936		1.27	
Austin-Bergstrom International	2006	3,945,020		2.5	

10.6.1 Airport type 1 – Power Supply

Table 73: Type 1 Power Supply Design Figures

Demands	Initial Size
Aircraft maintenance (MVA)	1.4
Fuel facility precinct (MVA)	0.0
Terminal precinct (MVA)	27.0
Freight precinct (MVA)	0.6
Car park (MVA)	0.5
Business park (MVA)	27.0
Total (MVA)	**56**

Table 74: Type 1 Power Supply Schedule of Infrastructure

Description	Unit	Unit Cost	No.	Total
Transmission Lines - 132kV	km			
Intake 132kV substation with switchgear and two 132kV/33kV 60MVA transformers	no.		1	

10.6.2 Airport type 2 – Power Supply

Table 75: Type 2 Power Supply Design Figures

Demands	Initial Size
Aircraft maintenance (MVA)	0.0
Fuel facility precinct (MVA)	0.0
Terminal precinct (MVA)	3.0
Freight precinct (MVA)	0.0
Car park (MVA)	0.1
Business park (MVA)	0.0
Total (MVA)	3

Table 76: Type 2 Power Supply Schedule of Infrastructure

Description	Unit	Unit Cost	No.	Total
Transmission Line - 33kV	km			
Intake 33kV substation with switchgear and 2 x 33kV/11kV 30MVA transformers	no.		1	

10.6.3 Airport type 3 – Power Supply

Table 77: Type 3 Power Supply Design Figures

Demands	Initial Size
Aircraft maintenance (MVA)	0.00
Fuel facility precinct (MVA)	0.01
Terminal precinct (MVA)	1.50
Freight precinct (MVA)	0.00
Car park (MVA)	0.07
Business park (MVA)	0.00
Total (MVA)	1.58

Table 78: Type 3 Power Supply Schedule of Infrastructure

Description	Unit	Unit Cost	No.	Total
Transmission Line - 33kV	km			
Intake 33kV substation with switchgear and 2 x 33kV/11kV 30MVA transformers	no.		1	

10.6.4 Airport type 4 – Power Supply

Table 79: Type 4 Power Supply Design Figures

Demands	Initial Size
Aircraft maintenance (MVA)	0.00
Fuel facility precinct (MVA)	0.00
Terminal precinct (MVA)	0.30
Freight precinct (MVA)	0.00
Car park (MVA)	0.00

Business park (MVA)	0.00
Total (MVA)	**0.30**

Table 80: Type 4 Power Supply Schedule of Infrastructure

Description	Unit	Unit Cost	No.	Total
Transmission Lines - 11kV	km			

10.7 Communications

Important considerations are the redundancy of operators and redundancy of supply. Depending upon the critical nature and size of the airport the appropriate level of redundancy will vary.

For redundancy of operators, multiple telecommunication operators will provide connections to the airport in the event that one of their networks goes off-line.

Redundancy of supply is the provision of physical separate routes to the airport from different network nodes or access points (often at 'telephone exchanges'). The cost of providing this level of redundancy and separate network connection points will be determined by site specific factors and distances to connect to two separate exchanges.

The communication demands at airports are:

1. Ground to air services – voice, radar, navigation, telemetry/data, etc.

2. Airfield services – navigation, weather, aircraft guidance/movement, ground services, security etc.

3. Terminal/Gate services – airline operations, passenger information, baggage, security etc.

4. Retail – shops, parking, car hire, cell phone (mobile network), freight, catering, etc

5. Business Park (if required) – offsite services, offices, freight, warehousing, parking, car hire etc.etc

There are also a series of remote aviation infrastructure that will require a communication connection. This includes remote radar, beacons, navigation aids and weather stations.

The mode of supply for communications to the airport will depend upon the ownership structure of the airport and how the non-aeronautical income is generated. The following are some generic options:

1. Multiple telecommunication operators provide supplies to a Point of Presence(s) within the airport boundary. The Point of Presence is owned by the airport and is a "hub" for communication supplies. From the Point of Presence the airport owns the internal communication distribution network. The airport charges individual users (airlines, retail outlets) for their communication supply.

2. Telecom operators provide a connection directly to each building in the airport and the individual users (airlines, retail outlets) are charged directly by the operators.

For the purposes of this study we have assumed that Option 1 is the method of supply. The above is not relevant for Airport Type 4 as the demands and criticality of the supply are not sufficient to warrant Option 1 above. As such, Option 2 is assumed for the Type 4 airport.

Airports will have a high bandwidth high resilience demand and represent a source of revenue for telecommunication operators. As such the supply of the communication infrastructure to the airport boundary is assumed to be provided by the operators at no cost. For some of the more operationally critical service (Air Traffic Control, radar etc.) it is likely that there services will be on "private" networks, however these private networks are usually delivered via one of the established commercial network operators. The infrastructure may include for each operator – 144 core fibre optic cables contained in a 2 conduit supply line with separate access pits. This has been assumed by Arup as a reasonably sized communication connection based on the anticipated bandwidth demand.

10.7.1 Airport type 1 - Communications

Table 81: Type 1 Communications

Number of Operators	Infrastructure per Operator	Security of Supply	Point of Presence
4 (minimum)	144 core fibre optic cables contained in a 2 conduit supply line with access pits	Two physically separate routes back to separate exchanges (node points)	2

10.7.2 Airport type 2 – Communications

Table 82: Type 2 Communications

Number of Operators	Infrastructure per Operator	Security of Supply	Point of Presence
3 (minimum)	144 core fibre optic cables contained in a 2 conduit supply line with access pits	Two physically separate routes back to separate exchanges (node points)	2

10.7.3 Type 3 Airport - Communications

Table 83: Type 3 Communications

Number of Operators	Infrastructure per Operator	Security of Supply	Point of Presence
3 (minimum)	144 core fibre optic cables contained in a 2 conduit supply line with access pits	Two physically separate routes back to separate exchanges (node points)	2

10.7.4 Type 4 Airport – Communications

Table 84: Type 4 Communications

Number of Operators	Infrastructure per Operator	Security of Supply	Point of Presence
1	144 core fibre optic cables contained in a 2 conduit supply line with access pits	One connection	0

10.8 Gas

Consideration of the major uses for gas at a site as significant and demanding as an airport will relate to the potential to use alternative fuel systems. The cost of connecting to the gas network will be driven by site specific characteristics and the distance required to connect into the gas network.

It is the industry standard to supply commercial catering facilities with gas as the preferred fuel. This approach has been adopted for this study. The base requirements for the gas supply for catering to the passenger throughput and the staff will be based on the passenger capacity to which the airport is sized.

The transportation of the gas is either by truck and store on-site or by a piped connection. The viability of a trucked and stored gas supply for a major development such as an airport needs to be considered against the following factors – lower security of supply, increased road connection and mass transportation of a hazardous material. A more detailed analysis based on specific sites will determine the appropriate transportation method. However, for the purposes of this report, a piped connection to the reticulated gas network has been adopted.

The use of gas as a heating medium is straightforward to assess for the size of the buildings being considered on each site and will be based on the infrastructure provided, however the abundance of flammable materials within aircraft maintenance areas will have a limiting effect on the use of gas if this is achieved with an exposed ignition source. This is a detailed design issue as the use of secondary heat, or indirect firing is readily undertaken.

The use of gas as a fuel source for cooling systems is one that can be assessed on a building by building basis with the detailed development plans for the airport. By the use of direct fired absorption chillers, this can be combined with the heating medium to maximise the end energy usage from the combustion of the fuel.

The core debate regarding gas consumption will relate to the combination of heating/cooling mediums with power generation. The readily accepted technology, in use in many systems in Sydney and around the world, is referred to as Tri-Generation/. The gas supply is used to fuel a series of gas engine driven power generation units, with the "waste" heat from the exhaust flue and from the engine cooling water then being used to power absorption chillers and heating water clarifiers. The result is the provision of three energy streams from the one fuel source.

The viability of tri-generation systems will be dependent on many issues associated with power systems, primarily the consideration of the cost of carbon compared to the adoption of low carbon generation on the network and the escalation of the cost of gas. These issues have been studied previously and the comparative figures for gas consumption have been estimated within the 1997 Second Sydney Airport Planning Study [9].

The gas consumption estimates have been developed, based on the 1997 Second Sydney Airport Planning Study which defined 10 million passenger throughput requires 50,000 GJ/annum or 2,050,000 GJ/annum with co-generation and for a 30 million passenger throughput 160,000 GJ/annum or 6,160,000 GJ/annum with co-generation. With no specific built area plans available, the use of these previous estimates allows a baseline equivalency to be seen between the consecutive reports.

The Airport will be considered as part of the critical infrastructure for NSW. Should the use of tri-generation be considered as one of the primary power supplies to the airport, consideration would be required to duplicate the gas supply arrangements such that an alternative fuel access route would be available for redundancy. There is a significant cost associated with this and such a choice would need to be examined alongside issues of reliability with the power supplies. For this report, we have assumed the need for a high reliability supply, but no redundancy of the pipeline and supply point themselves.

[9] Second Sydney Airport Planning Study, Planning and Design Summary Report, Airport Planning, 1997.

10.8.1 Airport type 1 – Gas

Table 85: Type 1 Gas

Annual Passengers	Gas – No Trigeneration		Gas – with Trigeneration	
30M	160,000 GJ/a	225 dia main	6,160,000 GJ/a	1000 dia HP main
120M	640,000 GJ/a	450 dia main	24,640,000 GJ/a	2000 dia HP main

10.8.2 Airport type 2 – Gas

Table 86: Type 2 Gas

Annual Passengers	Gas – No Trigeneration		Gas – with Trigeneration	
5M	27,000 GJ/a	125 dia main	103,000 GJ/a	200 dia main
30M	160,000 GJ/a	225 dia main	6,160,000 GJ/a	1000 dia HP main

10.8.3 Airport type 3 – Gas

Table 87: Type 3 Gas

Annual Passengers	Gas – No Trigeneration		Gas – with Trigeneration	
5M	27,000 GJ/a	125 dia main	103,000 GJ/a	200 dia main
25M	135,000 GJ/a	200 dia main	5,140,000 GJ/a	1000 dia HP main

10.8.4 Airport type 4 – Gas

Table 88: Type 4 Gas

Annual Passengers	Gas – No Trigeneration		Gas – with Trigeneration	
0.5M	3,000 GJ/a	50 dia main	10,000 GJ/a	75 dia main
1.0M	6,000 GJ/a	75 dia main	205,000 GJ/a	250 dia main

10.9 Fuel Supply

Efficient and reliable provision of aviation fuel is a critical component of an airport's infrastructure. This section covers the bulk supply and storage of fuel to the airport. It does not cover the distribution of the fuel within the airport itself. The preliminary provision is for 5 days supply to be provided in on-site airport storage. The suitability of this level of storage depends upon the resilience of the supply, proximity to refinery, nearby off-site storage capacity and ratio of peak demand to average demand. The provision of the fuel supply installation would be a commercial provision with contributions being provided by private sector operators.

The supply of fuel to the airport is by the following methods:

- Pipeline directly to refinery or major storage facility
- Road tankers
- Railway containers

Transportation of fuel by pipeline is suitable for large airports. For Sydney and Brisbane airports, each has a dual piped fuel supply. For smaller airports consideration must be given to the hazard of daily multiple fuel tanker deliveries against the capital expenditure of a piped supply. It is not considered feasible to utilise railway containers for fuel supply in Sydney.

Fuel demand is related to the number of flights and the distance to be travelled from the airport. Hence an airport (such as Adelaide) with the majority of flights relatively short-haul domestic will have an average daily usage on the lower side, compared to Sydney (KSA) with a larger proportion of long-haul international flights.

Assumptions:

- 5 days' supply to be provided in on-site storage
- On-site storage is in above ground tanks
- Piped fuel supply to Type 1, 2 and 3 airports
- Road tankers to provide fuel for Type 4 airport

10.9.1 Airport type 1 – Fuel Supply

Table 89: Type 1 Fuel Supply

Annual passengers (M)	Average Daily Use[1] (ML/day)	Days of Storage	Storage (ML)	Method of Supply
30	12	5	60	Dual pipelines to refinery
120	48	5	240	Dual pipelines to refinery

1 - Estimated based on anticipated number of flights and the distance to be travelled from the airport

10.9.2 Airport type 2 – Fuel Supply

Table 90: Type 2 Fuel Supply

Annual passengers (M)	Average Daily Use[1] (ML/day)	Days of Storage	Storage (ML)	Method of Supply
5	1.2	5	6	Dual pipelines to refinery
30	7.2	5	36	Dual pipelines to refinery

1 - Estimated based on anticipated number of flights and the distance to be travelled from the airport

10.9.3 Airport type 3 – Fuel Supply

Table 91: Type 3 Fuel Supply

Annual passengers (M)	Average Daily Use[1] (ML/day)	Days of Storage	Storage (ML)	Method of Supply
5	0.8	5	4	Dual pipelines to refinery
25	4.0	5	20	Dual pipelines to refinery

1 - Estimated based on anticipated number of flights and the distance to be travelled from the airport

10.9.4 Airport type 4 – Fuel Supply

Table 92: Type 4 Fuel Supply

Annual passengers (M)	Average Daily Use[1] (ML/day)	Days of Storage	Storage (ML)	Method of Supply
0.5	0.1	5	0.5	Fuel tankers
1.0	0.2	5	1.0	Fuel tankers

1 - Estimated based on anticipated number of flights and the distance to be travelled from the airport

10.10 Drainage

This section describes the external drainage infrastructure.

The external drainage infrastructure required for the discharge of stormwater from the airport to the surrounding area is completely dependent upon the location of the airport. The specifics of the locality will determine:

- The distance from the site to a suitable discharge location.
- The allowable rate of discharge into the existing system which will determine the requirement for on-site storage.
- The allowable discharge water quality which will determine the requirements for treatment prior to discharge.
- The ground conditions and local groundwater system and the ability to infiltrate stormwater.
- The topography of the site which will govern the geometry of the drainage network and the number of discharge points the airport will require.
- The surrounding land use and the ability to use surface drainage systems (swales and channels) or buried systems (pipe and culverts).

The likely drainage arrangement would have the collection, storage and treatment drainage infrastructure located within the airport boundary. The only external drainage network is likely to be the transmission (pipes, channels) and connection to existing networks (outfalls). The internal drainage network is not discussed in detail here and is subject to the same site specific considerations noted above.

10.11 Environment

The infrastructure requirements and costs and program of an airport and airport-related uses and infrastructure will be strongly affected by environmental and sustainability issues. Major sites and their supporting connections to the urban fabric may require long and exhaustive environmental studies. These studies can become "show stoppers" in the case of say aircraft noise or regional air quality effects at Badgerys Creek. So general issues to be considered as part of environmental approvals that may take over 15 years for airports are:

Physical context - characteristics of local area, soil and geology, topography, hydrology, flora, fauna, heritage (European and indigenous), ecological, air quality and climate (e.g. fog, prevailing winds)

Access and movement - key access routes, capacity for growth, public transport, access for servicing and ancillary uses, options for access between terminals

Land use - ancillary land uses (e.g. catering, freight and couriers), availability of land, land ownership patterns location of workforce, strategic context (population growth) tourism, capacity of location for growth and change

Environmental impact - energy and carbon, noise (including noise insulation and compensation over a very wide area of flight paths) , traffic, visual, economic including impact on future development of surrounding area and limitations on building heights, environmental

Sustainability - emerging infrastructure, bio fuels and climate change (e.g. sea level rise, changing fog environment)

Airport site is land-based and no reclamation is required for construction. Significant cost differential across a range of supporting infrastructure disciplines if reclamation is required.

Another way of classifying this might be represented by the table below (this is a summary of the Battelle System without weightings)[10]:

Ecology	Aesthetics	Physical /Chemical	Human/Social
Terrestrial species and populations including birds	Land	Water quality	Education including archeologically
Aquatic Species	Air (odour/visual/sound)	Air Quality	Historical
Terrestrial habitats	Water	Land pollution	Cultures and religions
Ecosystems	Biota	Noise pollution	Mood/atmosphere
	Composite effect		Life patterns, employment , housing, social interactions

These environmental and aesthetic influences expressed through urban design can be major effects on the viability and value of an airport. Rather than being perceived as an ugly "blot on the landscape" a well-designed airport and approach corridors over tens of kilometres can add value to the user experience of the airport and to the everyday experience of the wider community. Examples such as the tropical esplanade approach to Changi Airport contrast with the industrial wasteland blight on approaches to airports such as Sydney KSA or Los Angeles. The urban design land value benefits of these corridors tens of kilometres long and several kilometres wide may be comparable to the airport itself.

These environmental effects have not been included in the infrastructure analysis at this stage.

10.12 Infrastructure Issues

The provision of infrastructure is a complex balance of supply and demand, and funding and pricing and resources and choices. Adding infrastructure for a new airport is often not just a local action of adding another link to the existing network. There are usually wider network issues that are difficult to quantify without wider analysis and consultation and negotiation with infrastructure service providers and the wider community.

This analysis and consultation is impractical in a situation where the location of the proposed (airport) facility is not known. Perhaps the best that can be done in this circumstance is some level of constraints mapping, identifying a contoured surface of opportunities that favour particular locations (such as near a gas pipeline with reserve

[10] Environmental Impact Assessment in Australia, Theory and Practice, 5th Edition, Mandy Elliot and Ian Thomas, 2009

capacity) and mitigate against other locations (such as water supply to a hilltop, or location in a drought-prone region).

There is also a further dimension to infrastructure that is related to the wider network effects, perhaps illustrated by examples:

- Adding a 10-kilometre rail spur line and station is relatively easily quantified. However, many existing rail links are operating near capacity and some locations for spur lines will require wider network upgrading such as rail duplication, grade separation, new signalling, etc. Even if the spur line privately operated and is not integrated with the existing (say CityRail) network, there will be a need to augment CityRail delivery to the interchange station. Identifying this augmentation is not feasible if the airport locations is not identified, and have not been included.

- This augmentation is not always easily possible in a given timescale. Areas of the Sydney basin have not been available for development because of a lack of water supply. These issues of scarcity of cost premium have not been applied at this non-site-specific stage.

- Major developments such as airports have a multiplier effect. Whilst the scenarios provided by the Department have attempted to specify an airport related Business Park or Airport City up to 1,000 hectares in area (Type 1 airport ultimate size), some forms of airport will have a much wider multiplier effect on the extent and location of population and workforce and land uses. An airport might vastly increase the number of jobs or houses in western Sydney or a regional city centre. A freight airport would stimulate freight operations and perhaps even local manufacturing or processing or agriculture. This multiplier effect can have a profound effect on needs for new infrastructure not at or even connected to the airport. This unspecified multiplier effect on infrastructure is likely to be quite site specific and has not been included at this stage. Examples at some Australian airports are:

    - Darwin International Airport Business Park - 87ha of undeveloped airport property, divided into four broad land uses: business park; service industry; airport business; tourist facilities

    - Melbourne Airport Business Park - 220ha zoned industrial and business use

    - Brisbane Airport Industrial Park - 100ha zoned for a mix of light and general industry

    - Brindabella Business Park (Canberra Airport) - 28ha of business park

- Some unknowns are showstoppers. An example is discovery of endangered species within a preferred infrastructure corridor. These effects are excluded.

- The time dimension means that current infrastructure will change over the procurement period. Examples might include use of PVC pipes for the 2000 Olympics, copper versus fibre optic communications cabling, and demand for petroleum fuels such as electric cars and avgas versus emerging biofuels.

- The provision on the basis of existing infrastructure demand trends is the best tool available for forecasting, but may prove wrong. An example might be the impact of road pricing or oil price shocks reducing car volumes in the peaks or green- building sustainability advances reducing the demand for electricity and gas. The infrastructure analysis is generally based on recent historic trends and case studies of existing airports and cities.

- Infrastructure requires the availability of physical resources. This is for the construction of the asset, but also for the supply and maintenance and periodic replacement of the service. An example of this might be a pumping station refurbishment every 20 years, repaving of a motorway every 30 years, or replacement of rail rolling stock after 20 years. We assume that these will remain available in a similar way to existing, but are not costed.

- Infrastructure requires the availability of suitably skilled staff for design, construction, operation, maintenance. Severe skills shortages are emerging in many areas of infrastructure, and will have implications for costs and programs. With imminent retirement of many baby boomers in the infrastructure industry, this is emerging as a critical issue in areas such as railway designers and constructors and operators.

Essential infrastructure is usually required 24/7. Whilst some back up can be provided on-site such as fuel and water storage tanks and emergency generators, there is a general desire to provide infrastructure networks that have some reserve capacity, some redundancy, and are robust to threats of attack, failure, maintenance outages, or other disruption. The infrastructure provisions have generally been scoped with some allowance for redundancy. For example two four lane approach roads rather than one eight lane road, a rail loop rather than a single spur line, two storage tanks rather than one large tank, etc.

The estimates for broadacre urban uses outside the airport perimeter, and around airports are not defined at this stage, but are substantial. Recent plans for development of say a thousand hectares of intensive new town have an outcome value of four million dollars[11]. A recent study in the area of infrastructure costs for new developments included this assessment "*The resulting cost of upfront infrastructure provision for an inner city and fringe development in 2007 prices were $50.5 million and $136.0 million respectively*"[12] These infrastructures and costs are excluded at this stage.

[11] The Age, December 7, 2010, "Stockland buys $4b site for new Melbourne suburb"

[12] Assessing the Costs of Alternative Development Paths in Australian Cities (Trubka, Newman and Bilsborough, Curtin University)

11. Depreciation

11.1 Depreciation Method

The straight line depreciation method has been adopted in this model.

11.2 Useful Life

The depreciation rate applied to the components of the Airport is based on the ATO effective life tables, as shown in Table 93.

Table 93: New infrastructure depreciation rates

Classification	Effective Life	% p/year
Runways, taxiways and aprons	20 years	5%
Terminal	40 years	3%
Roads and Car Parks	9 years	11%
Buildings and services	40 years	3%
Vehicles, plant and equipment	10 years	10%
Land	-	0

For regulatory and tax purposes, the depreciation is assumed to be straight line.

Appendix A Sources of Data

Information sources used by Airbiz

Below are the key sources used i*n the benchmarking ex*ercises. This has been supplemented by expert knowledge from Airbiz's extensive experience within the aviation industry which in some cases confidential sources cannot be quoted to commercial sensitivities.

- Australian Competition Commission "Airport monitoring report 2008–09" aeronautical revenues and costs as well as other key financial metrics for aeronautical activities in Sydney (SYD), Brisbane (BNE), Melbourne (MEL), Perth (PER) and Adelaide (ADL).

- Annual disclosure documents (regulated financial accounts in New Zealand) for aeronautical revenues and costs as well as other key financial metrics for aeronautical activities in Auckland (AKL), Christchurch (CHC), Wellington (WLG) and Queenstown (ZQN)

- Annual financial accounts for all major Australian airports noted above as well as Bankstown (BWU) and Newcastle (NTL) to derive total operational revenues and costs (including non aeronautical) and in the case of New Zealand airports passenger and aircraft movement numbers

- Bureau of Infrastructure, Transport and Regional Economics (BITRE) to derive current and historical passenger and aircraft movement numbers for Australian RPT Airports

- Airservices Australia to derive aircraft movement numbers at Australian GA airports

- Aeroplanner 2010 – "easy-find, one-stop" reference for airport and aircraft data, statistics and information, Airbiz, 2010

- Peaking factors quoted in Table 7.3, Hirst, *The air transport system,* 2008(Woodhead) and Table 24-1, de Neufville and Odoni, *Airport Systems – planning, design and management* (2003 (McGraw-Hill)

Information sources used by Arup

Supporting Infrastructure sources of data are listed below.

- Melbourne Airport Ground Transport Plan July 2009 to derive airport traffic generation and transport modal split

- Melbourne Airport 2008 Master Plan "Proposals for airport development" to derive existing water supply and existing electricity supply

- Brisbane Airport Corporation Pty Ltd 2009 Master Plan "The four pillars of sustainability: social" to derive surface transport traffic, gas, utilities and supporting infrastructure

- Brisbane's Airtrain 2010 "Airtrain on track for 2 million passengers in 2009-10" to derive figures and information on rail mode of transport for Brisbane Airport

- Sydney Airport Master Plan 2009 "Aviation support – facilities and utilities – master plan concept" to derive current capacity of aviation fuel and electricity supply

- Newcastle Airport 2007 Master Plan to derive current water reticulation network, annual domestic and international passenger movements, gas, sewerage system and power supply

- Airport Consulting Winter 2007/2008, Airports Consultants Council by Carol Lurie, Principal, VHB and Sarah Townsend "How do airports stack up? Measuring environmental performance?" to derive energy usage and water usage and quality

- Environmental Impact Assessment Review "Environmental impact assessment including indirect effects—a case study using input–output analysis" M. Lenzen, S. A. Murray, B. Korte, C. J. Dey to derive information on figures on land use, water and fuel for Second Sydney Airport

- Sydney Airport Environment Strategy 2010-2015 "Chapter 4: Environmental Action Plans" to derive energy consumption, water consumption and ground transport information and modal split

- Booz & Co. "Impact of fare reform on the Sydney Airport rail link" Sydney Airport Corporation Limited February 2010 to derive estimated passenger figures for the Sydney Airport rail link

- Perth Airport Master Plan 2009 to derive power supply capacity and surface access, utilities and drainage information

- CML Services and Infrastructure Sewerage Disposal Westralian Airports Corporation May 2006 to derive average flow and flow contribution for Perth Airport

- Munich Airport Perspectives Sustainability Report 2009 to derive key figures on air traffic, energy consumption, water consumption, reclaimed materials/waste and passenger and employee access modes

- Munich Airport Perspectives Environmental Statement 2008 to derive traffic and infrastructure and consumption data

- Fraport AG 2004-2010 Sustainability "Climate protection and energy" to derive figures on energy, water, sewage consumption for Frankfurt Airport 2008

- Energy Management Zurich Airport to derive annual energy consumption

- 2009 Hobart Airport Master Plan to derive estimated daily traffic on existing road network and road access information

- Master Plan Adelaide Airport Volume 1: Airport Master Plan December 2009 to derive airport access points, road traffic volumes and information on modes of transport and major utilities

- The Master Plan January 2010 Wellington Airport to derive airport vehicle demand and car parking forecasts and information on utilities

- Moorabbin Airport Master Plan 25 June 2010 to derive information on airport accessibility, supporting infrastructure and water quality

- Bankstown Airport Preliminary Draft Master Plan 2010 Part C: Issues Management to derive assumed trip distribution in peak periods, electricity supply, water supply and sewer network figures and information on surface transport/access and utilities

- Jandakot Airport Master Plan 2009 to derive traffic generation, water supply and electricity supply figures and information on road access system and services infrastructure
- Jandakot Airport Environment Strategy 2009 to derive figures on annual electricity and water consumption
- Archerfield Airport Environment Strategy 2010-2015 to derive water usage, stormwater drainage and groundwater figures
- Parafield Airport Master Plan 3rd November 2004 to derive information on existing and future engineering services
- A Surface Access Strategy for Heathrow Sustaining the transport vision: 2008-2012 to derive passenger and employee transport modal share
- A Study of Airport Ground Access Mode Choice in Hong Kong 84th Annual Meeting, January 11, 2005 Washington, D.C. to derive transport modal split figures
- Amsterdam Schiphol Airport Source: Schiphol Group to derive passenger and employee transport modal split
- London Gatwick Airport Surface Access Action Plan December 2009 to derive passenger mode of transport
- Airport Design and Operation, 2007 Second Edition A. Kazda and R.E. Caves
- Planning and Design of Airports, 1994 Fourth Edition R. Horonjeff and F.X. McKelvey
- Airport Planning and Development Handbook – A Global Survey ,2000 P.S. Dempsey
- Airport Development Reference Manual 8th Edition ,April 1995 International Air Transport Association

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Appendix I Land price assessment of alternative sites

Land price assessment for a second airport in Sydney – REAS

1.1 Introduction

The purpose of this engagement is to assist Ernst & Young's Infrastructure Advisory team with establishing a high level potential acquisition price for each of the eight proposed second Sydney airport sites. The potential acquisition price for each site will be utilised in the BCA being collaborated by Infrastructure Advisory.

Our investigation was undertaking through the use of a number of independent sources, with reliance placed upon these sources for the property description. Our sales analysis comprised a mix of improved (buildings and residences) and vacant land, without us having specific knowledge of the actual properties or improvements, if any, thereon. We have applied a high-level averaging methodology which will reflect both improved and vacant land sales and, should the site be consolidated for a second airport, acquisition of property with both improvements and vacant land may be necessary.

High level details of each of the eight sites are provided below. Table 1 below, outlines information on each of the proposed sites.

Table 1: Details of each proposed site

	Site 4	Site 5	Site 6	Site 10	Site 12	Site 13	Site 14	Site 15
General location	Somersby & Kulnura	Central Coast	Greater Colo	Northern Hawkesbury River Valley and Slopes	Nepean River Valley and slopes	The Oaks & surrounds	Wilton - Appin	Moss Vale
Major towns in proximity	Gosford and Wyong	Gosford, Lake Macquarie and Wyong	Nil	Penrith, Richmond, Windsor, Hills District and NW Metro Sydney	Glenmore Park, Luddenham and Bringelly	Oakdake and the Oaks	Wilton and Appin	Mittagong, Bowral, Moss Vale, Bundanoon, Hilltop and Colo Vale
No. of allotments	45	182	9	Not known	Not known	150	17	18
Site population	59	168	10	Not known	Not known	500	63	72

1.2 Approach and methodology

To calculate the potential site acquisition prices, we undertook the following:

- Searches of recent sales in proximity to each of the proposed sites. We utilised information from a range of sources including RP Data, real estate agent websites, the Land and Property Management Authority, local valuers and real estate agents.

- Based on size, we categorised each of the sales based on the size of the property which enabled us to undertake our high-level analysis.

- Analysed and reviewed every sale on a rate per hectare basis.

- We analysed the above sample of sales for each site and excluded any sales that appeared to be out of line, not at arms length, or were for unique properties i.e. golf courses, resorts etc.

- Collected and analysed information on rural properties for sale from publicly available sources to assist us with determining whether the market has moved materially from the dates of the recent sales.

- Randomly selected a number of properties within each of the proposed sites to establish a mean size.

- Based on the mean allotment size and our sales analyses, we calculated an estimated upper and lower potential site acquisition price range per hectare for each site.

- We have averaged across both lot sizes and rates per hectare. Given we did not have the ability to inspect either the proposed site or the sales, some sales will be for properties with improvements thereon, hence the averaging approach.

1.3 Assumptions

For this component of the engagement we have made the following assumptions:

- The land within each of the sites has the same or a similar zoning to the analysed sales which is assumed to be rural.

- The land within each of the sites is similar in contour to the analysed sales. This is assumed to be flat to gently undulating.

- The land within each of the sites is utilised for similar purposes to the analysed sales.

- The improvements on the land within each of the sites are in line with the analysed sales.

- The areas of the properties within each of the sites are similar to the analysed sales

1.4 Limitations

This component of the engagement has the following limitations:

- Due to the short timeframe in which this component of the engagement was required, we have placed a large reliance on sales sourced from desktop searches; we have not inspected any of the sites or analysed sales.

- Due to the confidentiality of this engagement, we have not been able to undertake certain enquiries or obtain specific information on each of the proposed sites.

- We are providing a high level potential acquisition price for each site which is to be utilised in a BCA. For this reason, we are not providing any form of valuation advice. Our potential acquisitions costs are high level calculations designed for initial BCA purposes only. We understand that a more detailed analysis of each site potential acquisition price may be required at a later point in time.

- We have not made any enquires with the relevant authorities (i.e. councils and state government departments etc) in regards to any of the sales or sites.

- Our potential acquisitions costs are high level estimates that do not take into account:

    - Other payments that may be required under state and federal legislation (i.e. the Land Acquisition (Just Terms Compensation) Act 1991 etc) like special value, losses attributable to severance and disturbance or solatiums etc.

    - Other expenses like legal and valuations fees, stamp duty and procurement costs etc.

- We have not investigated water entitlements for any of the properties within the sites or analysed sales and the impact this may have on acquisition prices.

- We have made no investigations into soil and/or water contamination, encroachment, flora and fauna, bio-diversity offsets or flooding etc and have assumed that each site could be used for its intended purpose.

- Our estimated acquisition prices are as at 25 March 2011. Due to the volatility experienced in real estate markets from time to time and the nature of this engagement, our potential acquisition prices should not be utilised more than three months after the above date.

1.5 Market commentary

According to leading rural market participants, the New South Wales rural property market remains subdued. With heavy rain falls in late 2010 and early 2011, seasonal conditions across most districts are good. International farming commodity prices are high however the strong Australian Dollar is hampering returns.

According to Herron Todd White, the number of farm sales in New South Wales has halved since peaking around 2002 while values have largely remained steady throughout the state since 2007.

Lenders have reduced their loan to value ratios and are continuing to review serviceability levels. This has resulted in financiers reducing the amount of finance to the rural sector.

Properties within and around the proposed sites are generally smaller uneconomical land holdings i.e. hobby farms or weekend farms. These farmers are often higher wealth individuals who generally earn the majority of their income away from the land and own the property for lifestyle reasons. Like much of the rural market, this market has been subdued/patchy since the onset of the global financial crisis. There have been a limited number of transactions due mainly to the difference in buyer and seller expectations. We have been informed of properties being on the market for at least a year or two before being sold at a significant discount to the original asking price.

Rural commodity prices have a limited impact on this market, as the main drivers are economic sentiment, business confidence, consumer confidence and returns from the global market place.

Other larger holdings in proximity to the proposed sites are generally owned by developers who are seeking to subdivide the property into smaller holdings or are making strategic acquisitions in the anticipation the property will be rezoned. This market has experienced mixed results recently with some properties achieving high prices per hectare (For example, a 324 hectare property in Luddenham NSW sold for $40,000,000) while others fail to attract a bid at auction.

The value of properties in this market is largely influenced by location and their accessibility to Sydney and/or another major New South Wales city, topography, aspect, natural features i.e. views, river frontage etc, the market's anticipation on when the property will be rezoned, coverage and size.

1.6 Findings

The rates below are averages and are not likely to be applicable to individual properties within each of the proposed sites.

Generally speaking larger properties have a lower rate per hectare then smaller properties.

The rates outlined in Table 2 below have no regard to the size of the proposed site and are based on the mean sized property (established from a random sample) within each of the proposed sites. The Suggested Value for BCA is an adopted value between the mean and median. The provided range for each site is an estimated of high and low indicative value at the 25th and 75th percentile of our sales analysis.

Table 2: Key findings

	Site 4	Site 5	Site 6	Site 10	Site 12	Site 13	Site 14	Site 15
Mean Property size (hectares)*	19	12	44	9	33	4	22	28
Suggest price for BCA ($/hectare)**	$50,000	$70,000	$15,000	$140,000	$65,000	$215,000	$40,000	$50,000
Average property cost	$912,000	$816,000	$660,000	$1,260,000	$2,145,000	$860,000	$836,000	$1,400,000
Range								
Low ($/hectare)	$35,000	$55,000	$9,000	$120,000	$38,000	169,000	$34,000	$37,000
High ($/hectare)	$67,000	$76,000	$21,000	$167,000	$68,000	260,000	$40,000	$65,000

Source: EY analysis

* This is the average property size determined by our analysis of property sizes which fall within the location of each proposed airport location.

** The suggest price for BCA analysis is not based on the acquisition of a single hectare, rather the acquisition of the mean property size shown above.

1.7 Site Identification

A summary of the general location, site description and general range of allotment sizes within each of the proposed sites is outlined in Table 3 below.

Table 3: Proposed airport location and site summary

Proposed site	General location	Site description	General range of property sizes (hectare)	Mean size found by random sample (hectare)
Site 4	Somersby-Kulnura	Situated on a plateau between two ridges and appears to be level to slightly undulating in contour. The land appears to generally comprise small rural holdings. Appears to be situated to the east of the McPherson State Forest, Mangrove Creek Dam, west of Cedar Bush Creek and is in proximity to the township of Kulnura. George Downes Drive appears to be the main road used to access this area. This site forms part of the Central Coast area of New South Wales, is approximately 100 kilometres north of the Sydney CBD and 90 kilometres south west of Newcastle.	10 to 50	19
Site 5	Central Coast	Comprises part of an undulating coastal plain with some areas of higher ground. Most of the area appears to be occupied by small rural holdings predominately used for agricultural purposes. Appears to be situated along the western boundary of Wisemans Ferry Road, is in proximity to the Sydney Newcastle Freeway, Mooney Dam and Mooney Mooney Creek. The nearest rail service being the Newcastle Railway Line is located approximately six kilometres to the east. This site forms part of the Central Coast area of New South Wales and is located in proximity to the township of Somersby, approximately 10 kilometres north west of Gosford, approximately 80 kilometres north of the Sydney CBD and 84 kilometres south of Newcastle.	2 to 30	12
Site 6	Putty Road, Hawkesbury	Appears to comprise of forested land with some long linear ridge lines. The site appears to include part of the Parr State Recreation Area and Comleroy State Forest. Appears to be situated in proximity to the Colo River and the townships of Wheeny Creek and Central Colo. Putty Road appears to be the main road leading to the site. This site forms part of the Hawkesbury region of New South Wales and is located approximately 85 kilometres north west of the Sydney CBD.	10 to 55	44
Site 10	Northern Hawkesbury River Valley and Slopes	Appears to comprise gently undulating terrane in the west rising to higher ground in the east. The land appears to be a mix of forested areas and small rural holdings. The site appears to be situated to the west of the Hawkesbury River and Cattai National Park and appears to incorporate part of the Chain of Ponds Reserve. It is located between Putty and Sackville Roads on the northern outskirts of the township of Wilberforce and just south of the township of Ebenezer. The site is located approximately 20 kilometres north of the Richmond Railway Line. This site forms part of the Hawkesbury region of New South Wales and is located approximately 65 kilometres north west of the Sydney CBD.	1 to 20	9

Proposed site	General location	Site description	General range of property sizes (hectare)	Mean size found by random sample (hectare)
Site 12	Nepean River Valley and Slopes	Comprises gently undulating terrain to the east of the Nepean River with higher ground rising west from the river. Most of the area appears to be occupied by small rural holdings predominately used for agricultural purposes. The site appears to be located on The Northern Road, which provides access to the M5 and M4 Motorways. The nearest train service is the Western Railway Line, located in Penrith, approximately 15 kilometres to the north. The site is located close to Luddenham and just west of the Warragamba township. This site forms part of the Greater Western Sydney region of New South Wales and is located approximately 70 kilometres west of the Sydney CBD.	3 to 50	33
Site 13	The Oaks and surrounds	Comprises a mix of undulating open rural properties, small to medium rural residential allotments and rising rugged bushland to the west. The site appears to be approximately two kilometres west of The Oaks township, adjoins the privately owned Oaks Airfield, is approximately 15 kilometres south west of the Camden Airport, 20 kilometres west of the Hume Highway and Burragorang Road dissects the site in half This site forms part of the Greater Camden region of New South Wales and is located approximately 80 kilometres south west of the Sydney CBD.	0.01 to 20	4
Site 14	Wilton-Appin and surrounds	Predominately comprises of forested, undulating terrain with some open rural areas adjoining deep river gorges to the east and west. The site appears to be dissected by Picton Road which provides access to the Hume Highway. It is located just south of the township of Wilton and adjoins the Courdeaux River to the west and Cataract River to the east. This site forms part of the Picton/Appin region of New South Wales and is located approximately 84 kilometres south west of the Sydney CBD and approximately 23 kilometres north west of Wollongong.	1 to 40	22
Site 15	Mittagong, Moss Vale, Berrima and surrounds	Appears to comprise of a number of undulating rural properties predominantly used for agricultural purposes with some small forested areas. The site is dissected by the Illawarra Highway at Sutton Forest, is located approximately ten kilometres from the Hume/Illawarra Highway interchange and is approximately five kilometres south west of the Moss Vale township and railway line leading into the township. This site forms part of the Southern Highlands region of New South Wales and is located approximately 137 kilometres south west of the Sydney CBD and approximately 75 kilometres north west of Wollongong.	1 to 50	28

Appendix J Richmond RAAF Air Base land acquisition costs

Advice on potential property acquisition costs for three scenarios around the Richmond RAAF Air Base

Department of Infrastructure and Transport

27 September 2011

Contents

1. Executive Summary

This Executive Summary should be read in conjunction with the balance of the report.

1.1 Introduction

Ernst & Young was engaged by the Department of Infrastructure and Transport ('DOIT'), Work Order Deed Number SON 130043, to undertake an assessment of the potential acquisition costs, as per the Lands Acquisition Act 1989, for three scenarios. The three potential acquisition scenarios we assessed are outlined below:

Scenario 1 ('As Is')	The potential acquisition of the Richmond RAAF Air Base. (This is being done for comparative purposes and we acknowledge that the Base is under Federal Government ownership).
Scenario 2 ('North South 1')	The potential acquisition of the Richmond RAAF Air Base and other land to the north and south as outlined in diagrams provided by Worley Parsons.
Scenario 3 ('North South 2')	The potential acquisition of the Richmond RAAF Air Base and rural land to the north. More specifically, as advised by Worley Parsons, a 4,000m x 300m strip north of the current Richmond RAAF Air Base runway.

Due to the short timeframe and limitations placed on us, our research was restricted to high level preliminary investigations. For this reason, we suggest including a contingency amount of up to 25% when relying on the estimated acquisition costs adopted in this report. This report is not a valuation and should not be construed as a valuation.

1.2 Purpose of our report and restrictions on its use

This report was prepared on DOIT's instructions solely for the purpose of providing advice in relation to the potential property acquisition costs (as per the Lands Acquisition Act 1989) for three possible scenarios (as outlined above) around the Richmond RAAF Air Base and should not be relied upon for any other purpose or by any other parties. This report should not be quoted, referred to or shown to any other parties unless so required by court order or a regulatory authority, without our prior consent in writing. In carrying out our work and preparing our report, we have worked solely on the instructions of DOIT and for DOIT's purposes.

1.3 Our scope of work and approach

1.3.1 Our scope

Our scope for this engagement was to calculate the potential property acquisition costs (assuming the properties are compulsorily acquired under the Lands Acquisition Act 1989) for the three scenarios outlined above. To view diagrams outlining each scenario please refer to Section 4.

1.3.2 Our Methodology

Given the sensitive nature of this engagement we were expressly excluded from conducting any physical inspections of the facilities and site (other than the drive by observations noted below), and making detailed inquiries that may lead to arousal of interest or identify the nature of our work. To assist us with calculating the potential property acquisition costs for each of the above scenarios we undertook the following:

- Based on what we could identify from the desktop using Google Maps and Google Earth, we researched a number of sales in the greater area using RP Data, zoning maps and other sources of publicly available information.

- A road side viewing of the larger properties and some of the residential dwellings neighbouring the Richmond RAAF Air Base that fall within either of the proposed North South scenarios. Other smaller properties were viewed from the desktop using Google Maps and Google Earth.

- A road side viewing of many of the comparable sales we researched earlier. This included a number of rural, industrial and special purpose sales. Residential sales were viewed from the desktop using Google Maps and Google Earth.

- Buildings and improvements were identified and measured using Google Earth with limited verification from a road side viewing. The improvements we have identified can be categorised as follows:

  - Buildings/houses

  - General site improvements (roads, car parks, hardstands)

  - Airport surfaces (runways, taxiways, aprons, shoulders)

  - Site services & infrastructure (electrics, pipelines, lighting, fences, communications)

- We undertook an indicative Depreciated Replacement Cost ('DRC') assessment for the improvements on the applicable RAAF Air Base land, University of Western Sydney land, and the Hawkesbury Showgrounds land. For all the other properties (i.e. rural, residential, industrial and lifestyle) we undertook a direct comparison approach.

- Based on our research, viewing notes, knowledge of the Lands Acquisition Act 1989 in particular (but not limited to) sections 56 – 61, costs derived from an indicative DRC calculation of the improvements, and the information provided by Worley Parsons, we calculated the potential acquisition costs for each of the properties that may be acquired under each scenario. When undertaking the calculations, we took into account the highest and best use of the properties, their location, age, and condition along with a number of other factors.

- Due to the materiality of the special uses land (i.e. the RAAF Air Base land, University of Western Sydney land, Hawkesbury Showgrounds land and Hawkesbury City Waste Management Facility land), we spent the majority of our time determining the extent and estimated cost of the improvements on these properties and the estimated cost of the respective land parcels.

  To assess the land parcels, we compared the properties to other large land parcels with a limited number of alternative uses. This included large rural properties in proximity to Richmond.

- Compiled this report which outlines the methodology, assumptions, limitations, main comparable sales, analysis, findings, and the factors identified as significantly impacting on land acquisition costs.

1.4 Key constraints

Some of the key constraints and limitations experienced when undertaking this engagement include:

- Due to the confidentiality of this engagement, we were not able to obtain all the specific information that may assist us with calculating more accurate acquisition costs. This included detailed information on buildings, land areas, individual businesses, services and the tenure under which each property is occupied. For this reason, we have made several broad assumptions which are detailed in Section 2.6.

- Due to information limitations and accessibility restrictions, this report only provides estimated acquisition costs for the three potential scenarios outlined above. This report is not a valuation and should not be represented as a valuation report.

- We have not been provided with site information, had access to management for questions, or been given access to conduct a formal site inspection. The only inspection of the improvements we were able to conduct was a drive by the surrounding streets which provided a visual inspection of some buildings from a distance.

- We have been unable to identify the purpose, construction type, utilisation, age, and condition of each building/improvement.

- We have been unable to obtain current aerial photographic records. The Google Earth software reports the available photographs as 1 September 2009 for the Richmond area. Any buildings or improvements that have been constructed, demolished or modified since this date will not be accounted for in our analysis.

- We have been unable to identify improvements which are not visible using aerial photography. This primarily relates to site services such as electrical distribution, water management, lighting, fencing etc. These asset types were estimated using the Worley Parsons report as discussed below.

1.5 Estimated Acquisition Costs

Our calculated acquisition costs for each potential scenario are outlined below. For a more detailed breakdown of these costs please refer to Section 7.

A range of potential acquisition costs was calculated due largely to us being unable to obtain accurate and complete information on the nature, extent and age of the improvements. The lower end of the range below assumes a 1970 build unless we have been able to determine the approximate age of the improvements. A lesser value was calculated due to the higher age and deemed lower useful economic life of the improvements. The upper end of the range assumes an average build year of 1980 unless we have been able to determine the approximate age of the improvements. Our ranges are as follows:

- As Is scenario $107,000,000 - $210,000,000

- North South 1 scenario $264,000,000 - $370,000,000.

- North South 2 scenario $132,000,000 - $235,000,000

To be conservative we suggest adopting a value at the upper end of the above ranges.

As Is	North South 1	North South 2
$210,000,000 (GST exclusive)	$370,000,000 (GST exclusive)	$235,000,000 (GST exclusive)
Two Hundred and Ten Million Dollars (GST exclusive)	**Three Hundred and Seventy Million Dollars (GST exclusive)**	**Two Hundred and Thirty Five Million Dollars (GST exclusive)**

In the event more detailed information was to be provided and inspections were able to be undertaken, we would be in a better position to provide more accurate assessments.

2. Introduction

2.1 Background

In accordance with our Work Order (Deed Number SON 130043) dated 17 May 2011, we have undertaken acquisition cost estimates for the following three scenarios:

Scenario 1 ('As Is')	The potential acquisition of the Richmond RAAF Air Base. (This is being done for comparative purposes and we acknowledge that the Base is under Federal Government ownership).
Scenario 2 ('North South 1')	The potential acquisition of the Richmond RAAF Air Base and other land to the north and south as outlined in diagrams provided by Worley Parsons.
Scenario 3 ('North South 2')	The potential acquisition of the Richmond RAAF Air Base and rural land to the north. More specifically, as advised by Worley Parsons, a 4,000m x 300m strip north of the current Richmond RAAF Air Base runway.

A photocopy of your instructions is contained within Appendix A.

Due to the short timeframe and limitations placed on us, our research was restricted to high level preliminary investigations. For this reason, we suggest including a contingency amount of up to 25% when relying on the estimated acquisition costs adopted in this report. This report is not a valuation and should not be construed as a valuation.

2.2 Purpose

The purpose of this engagement is to assist the Department of Infrastructure and Transport ('DOIT') in determining the potential acquisition costs for the three scenarios outlined above.

This report was prepared on the Department of Infrastructure and Transport's ('DOIT's') instructions for the purpose of providing DOIT with advice in relation to the potential property acquisition costs for three scenarios around the Richmond RAAF Air Base (as stated above) and should not be relied upon for any other purpose. As others may seek to use it for different purposes, this report should not be quoted, referred to or shown to any other parties unless so required by court order or a regulatory authority, without our prior consent in writing. In carrying out our work and preparing our report, we have worked solely on the instructions of DOIT and for DOIT's purposes.

Our report may not have considered all the issues relevant to any third parties. Any use such third parties may choose to make of our report is entirely at their own risk and we shall have no responsibility whatsoever in relation to any such use. This report should not be provided to any third parties without our prior approval and without them recognising in writing that we assume no responsibility or liability whatsoever to them in respect of the contents of our deliverables.

We further confirm that Ernst & Young employees involved in this engagement do not have any financial interest in properties within the greater Richmond area.

2.3 Our Scope

Our scope for this engagement was to calculate the potential property acquisition costs (assuming the properties are compulsorily acquired under the Lands Acquisition Act 1989) for the three scenarios outlined above. To view diagrams outlining each scenario please refer to Section 4.

2.4 Our Methodology

Given the sensitive nature of this engagement we were expressly excluded from conducting any physical inspections of the facilities and site (other than the drive by observations noted below), and making detailed inquiries that may lead to arousal of interest or identify the nature of our work. To assist us with calculating the potential property acquisition costs for each of the above scenarios we undertook the following:

- Based on what we could identify from the desktop using Google Maps and Google Earth, we researched a number of sales in the greater area using RP Data, zoning maps and other sources of publicly available information.

- A road side viewing of the larger properties and some of the residential dwellings neighbouring the Richmond RAAF Air Base that fall within either of the proposed North South scenarios. Other smaller properties were viewed from the desktop using Google Maps and Google Earth.

- A road side viewing of many of the comparable sales we researched earlier. This included a number of rural, industrial and special purpose sales. Residential sales were viewed from the desktop using Google Maps and Google Earth.

- Buildings and improvements were identified and measured using Google Earth with limited verification from a road side viewing. The improvements we have identified can be categorised as follows:

  - Buildings/houses

  - General site improvements (roads, car parks, hardstands)

  - Airport surfaces (runways, taxiways, aprons, shoulders)

  - Site services & infrastructure (electrics, pipelines, lighting, fences, communications)

- We undertook an indicative Depreciated Replacement Cost ('DRC') assessment for the improvements on the applicable RAAF Air Base land, University of Western Sydney land, and the Hawkesbury Showgrounds land. For all the other properties (i.e. rural, residential, industrial and lifestyle) we undertook a direct comparison approach.

- Based on our research, viewing notes, knowledge of the Lands Acquisition Act 1989 in particular (but not limited to) sections 56 – 61, costs derived from an indicative DRC calculation of the improvements, and the information provided by Worley Parsons, we calculated the potential acquisition costs for each of the properties that may be acquired under each scenario. When undertaking the calculations, we took into account the highest and best use of the properties, their location, age, and condition along with a number of other factors.

- Due to the materiality of the special uses land (i.e. the RAAF Air Base land, University of Western Sydney land, Hawkesbury Showgrounds land and Hawkesbury

City Waste Management Facility land), we spent the majority of our time determining the extent and estimated cost of the improvements on these properties and the estimated cost of the respective land parcels.

To assess the land parcels, we compared the properties to other large land parcels with a limited number of alternative uses. This included large rural properties in proximity to Richmond.

- Compiled this report which outlines the methodology, assumptions, limitations, main comparable sales, analysis, findings, and the factors identified as significantly impacting on land acquisition costs.

2.5 Key Constraints

Some of the key constraints and limitations experienced when undertaking this engagement include:

- Due to the confidentiality of this engagement, we were not able to obtain all the specific information that may assist us with calculating more accurate acquisition costs. This included detailed information on buildings, land areas, individual businesses, services and the tenure under which each property is occupied. For this reason, we have made several broad assumptions which are detailed in Section 2.6.

- Due to information limitations and accessibility restrictions, this report provides estimated acquisition costs for the three potential scenarios outlined above. This report is not a valuation and should not be represented as a valuation report.

- We have not been provided with site information, had access to management for questions, or been given access to conduct a formal site inspection. The only inspection of the improvements we were able to conduct was a drive by the surrounding streets which provided a visual inspection of some buildings from a distance.

- We have been unable to identify the purpose, construction type, utilisation, age, and condition of each building/improvement.

- We have been unable to obtain current aerial photographic records. The Google Earth software reports the available photographs as 1 September 2009 for the Richmond area. Any buildings or improvements that have been constructed, demolished or modified since this date will not be accounted for in our analysis.

- We have been unable to identify improvements which are not visible using aerial photography. This primarily relates to site services such as electrical distribution, water management, lighting, fencing etc. These asset types were estimated using the Worley Parsons report as discussed below.

2.6 Critical Assumptions

The acquisition cost estimates rely on a number of critical assumptions which are outlined below:

- We have assumed all the properties that may be acquired are owner occupied (i.e. are not rented or leased). We made this assumption because rented or leased properties under the Lands Acquisition Act 1989 may obtain a different amount of compensation i.e. the lessor and lessee may be entitled to the market value of their interests in addition to other compensation. Without detailed information on each property, it is difficult to determine if it is owner occupied, leased or rented.

- We have assumed all the properties that may be acquired are freehold and unencumbered (i.e. free of any mortgages). We made this assumption because under the Lands Acquisition Act 1989, properties that are encumbered by a mortgage may be acquired differently. Without detailed information on each property, it is difficult to know what level of debt (if any) has been secured against it.

- We have relied on verbal advice and selected diagrams provided by Worley Parsons. We have assumed them to be accurate and inclusive of all the land required (including public safety areas) under the relevant guidelines and legislation. If the diagrams or verbal advice provided are not accurate then our acquisition cost estimates may need revision

- We have placed a large reliance on internet based information including RP Data, Google and other property databases. We have therefore assumed that the information we obtain from these sources, including the approximate measurements of various buildings and parts of land parcels, is complete and accurate. If this is not correct then our acquisition cost estimates may need revision.

- We have assumed that all the sites we viewed are free of adverse contamination including asbestos, are geotechnically sound, are not encroached upon, are free of any flora or fauna that may impact on a proposed development, heritage issues and aboriginal land claims etc. As we do not have a detailed knowledge of each property we have made this assumption. If any of the properties within the scenario areas have any of the above then our estimated acquisition cost may need revision.

- Under each of the scenarios, we have assumed that an entire property will be acquired if more than 50% falls within a scenario area or the main dwelling falls within a scenario area or the remaining parcel, after the proposed potential acquisition, is land locked. This assumption was made as we are of the view that many owners would seek for their entire property to be acquired if any of the above eventuated. If this assumption is changed then we may need to revise our acquisition cost estimates.

- In considering the compensation amounts for individual and business occupants, we have based our assessments on our understanding of the Lands Compensation Act 1989. As we do not have the relevant details for each of the business occupants, we have made broad allowances for compensation covering factors such as relocation costs and loss of business etc. If our broad assumptions are incorrect then our estimated acquisition costs may need revision.

- The report is believed to be accurate as at the date it was undertaken. No responsibility is taken for changes in market conditions and no obligation is assumed to revise this report to reflect events or conditions which occur subsequent to the date hereof. Due to the volatility sometimes experienced in the property market, this report should not be relied upon more than three months after it is dated as there is a risk that the market conditions impacting on the relevant scenarios may have changed.

- The infrastructure services outlined in the Worley Parsons report have been used as a basis to estimate the existing services at the Richmond site. For this reason, we have assumed it to be accurate. If this is incorrect we may need to revise our estimated acquisition cost estimates.

2.7 Date of Acquisition Cost Assessment

14 September 2011

2.8 Date of Viewing

14 September 2011

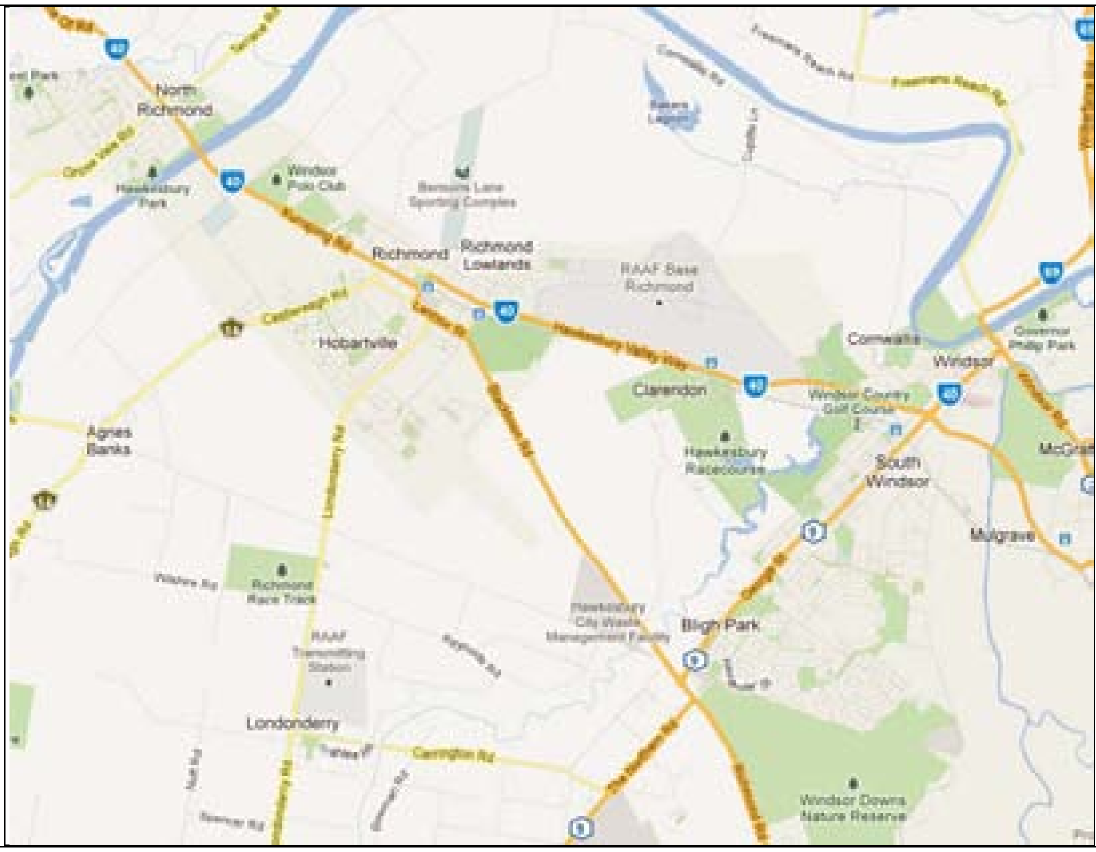
3. Location

The proposed site for each of the scenarios is located between the larger townships of Richmond and Windsor and incorporates parts of the Clarendon and Londonderry townships. It is approximately 60 kilometres by road north-west of the Sydney CBD and is in proximity to arterial roads, passenger rail facilities and large tracts of predominantly rural land used for various agricultural and horticultural purposes.

According to the Australian Bureau of Statistics, the Richmond-Windsor area had a population in 2006 of approximately 26,000 residents. This area experienced significant population growth in the preceding decade (i.e. up to 2006) due to better transportation links, more affordable housing when compared to other parts of Sydney, and proximity to developing employment markets such as Norwest Business Park. While the latest census results are yet to be released, the local population is thought to have increased above the 2006 result.

A locality map identifying the general locality is provided below.

Location Map



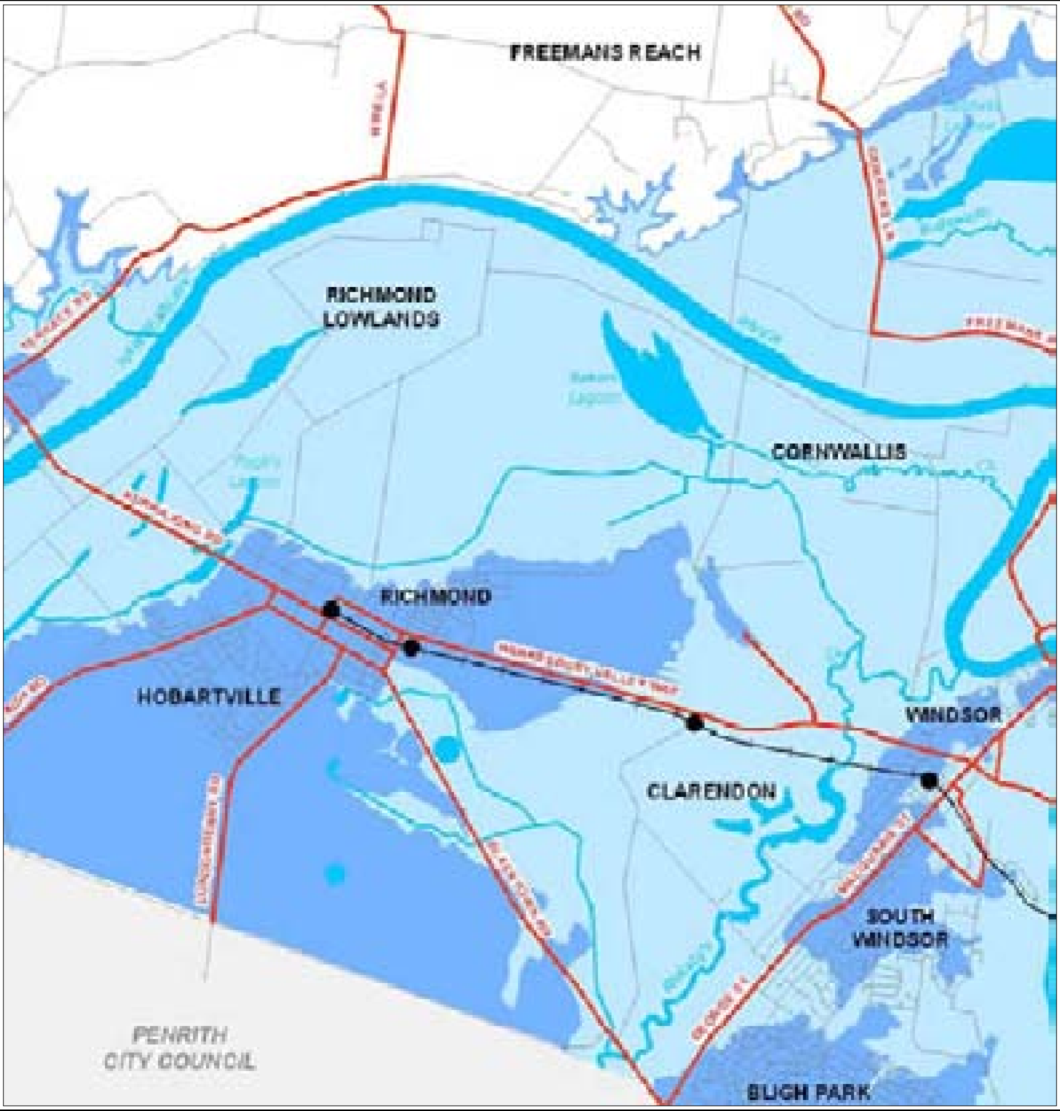
Source: Google Maps 2011

The land south of Kurrajong Road and Hawkesbury Valley Way is generally level in contour and improved with residential dwellings on residential or lifestyle blocks. The developed areas are generally above the one in 100 year flood line with other areas including large parts of the University of Western Sydney (which occupies land on either side of Blacktown Road) and the Hawkesbury City Waste Management Facility falling below the one in 100 year flood line.

Most of the land to the north of Kurrajong Road and Hawkesbury Valley Way including parts of the Richmond RAAF Base is level and flood prone (i.e. is below the one in 100 year flood line). This area is called Richmond Lowlands. Much of Richmond Lowlands is uninhabitable due to the likelihood of flooding and therefore is used largely for equestrian and horticultural purposes.

The diagram below is an extract from the Hawkesbury City Council flood map. The darker blue areas indicate land above the one in 100 hundred year flood line. The white areas indicate that the flooding probability is unknown and the lighter shades of blue indicate a natural water course and/or land below the one in 100 year flood line.

Hawkesbury River Flood Map



Source: Hawkesbury City Council 2011

Many properties in the Richmond Lowlands and Cornwallis area have water entitlements from the Hawkesbury River. This area has a long history of being used for agricultural and horticultural production.

4. Scenarios

4.1 As Is Scenario

The As Is scenario incorporates a large part of the Richmond RAAF Air Base. As per the Deposited Plans, it has a total area of 279.14 hectares and is zoned Special Uses 5(a) as indicated in the top diagram below by the unbroken red line.

Diagrams of the As Is Scenario

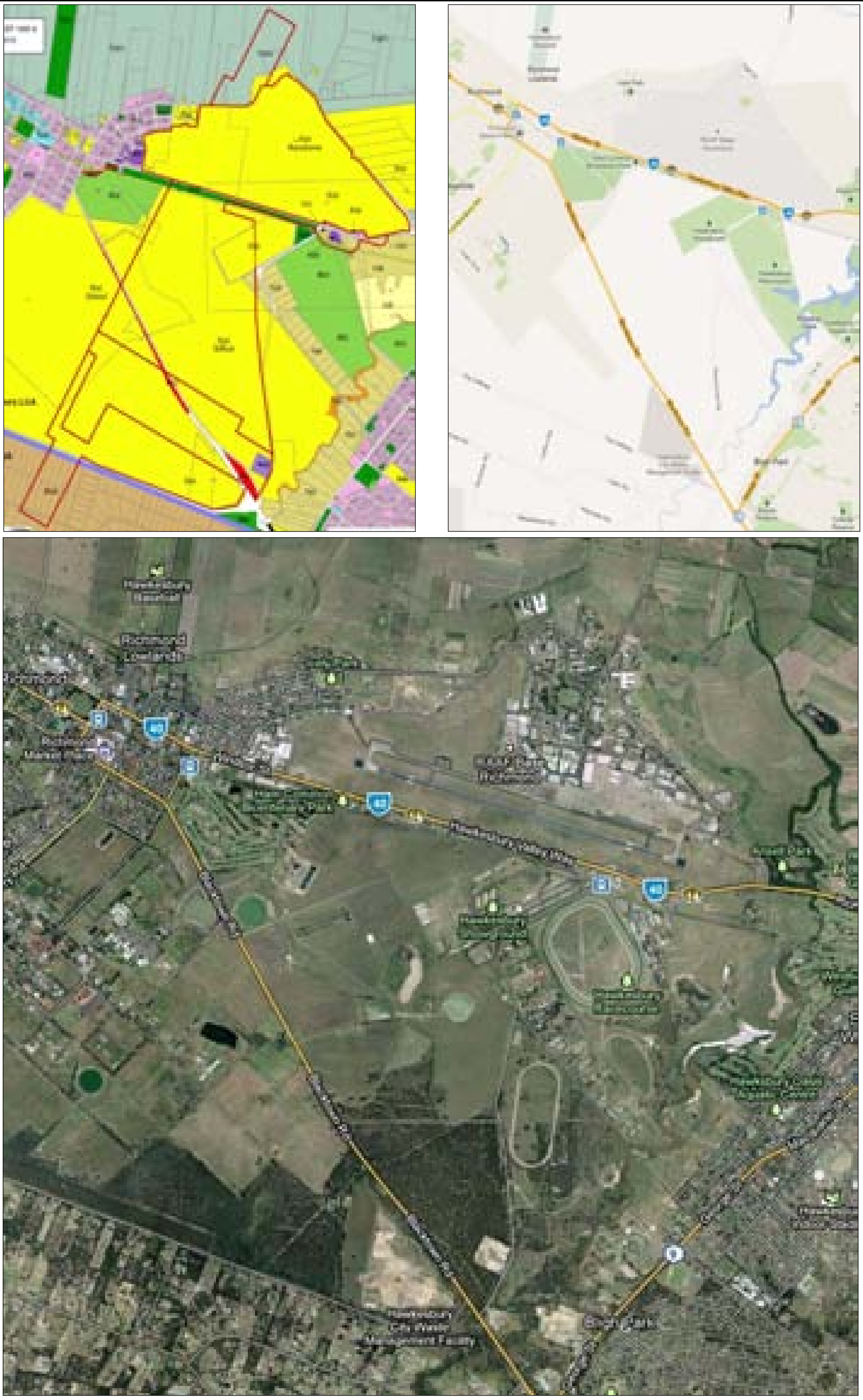
Source: Google 2011,Worley Parsons 2011

The middle and lower diagrams are extracts from Google Maps. These diagrams indicate that the proposed scenario site is largely bound by Hawkesbury Valley Way to the south, Percival Street to the north east, Dight Street to the North, a cemetery, residential housing, and Hobart Street to the West.

4.2 North South 1 Scenario

The North South 1 scenario includes a large part of the Richmond RAAF Air Base, University of Western Sydney (which appears to generally comprise a working/research farm), Hawkesbury Showgrounds, Hawkesbury City Waste Management Facility and several surrounding properties. It incorporates a total area of approximately 1,110 hectares. An outline (outer red line) of the scenario area is located in the top left hand diagram below.

Diagrams of the North South 1 Scenario



Source: Google 2011,Worley Parsons 2011

The top left diagram on the previous page indicates that the proposed scenario site will include the following areas. Parts of the calculated areas have been scaled from various diagrams and should be confirmed by a registered surveyor.

Type of land	Area (Ha)
Residential	2
Lifestyle	50
Rural	175
Industrial	6
Special purpose	877
Total	**1,110**

We have been provided with several different diagrams for the North South 1 scenario. We adopted the one indicated on the previous page as it more clearly delineates the areas within the proposed scenario area. We have sought confirmation, but are yet to receive a response, from Worley Parsons confirming that the above diagram is inclusive of all the necessary public safety land.

4.3 North South 2 Scenario

The North South 2 scenario includes a large part of the Richmond RAAF Air Base, in addition to a strip of land 300 metres wide and up to four kilometres long. This is indicated by the grey rectangles in the diagrams below. In total, this potential scenario incorporates an area of approximately 537 hectares.

Diagrams of the North South 2 Scenario

Source: Google 2011

Parts of the calculated areas below have been scaled from various diagrams and should be confirmed by a registered surveyor.

Type of land	Area (Ha)
Rural	257
Special purpose	280
Total	**537**

As indicated in the diagrams on the previous page, if a 4,000 metre long strip of land is required to the north of the current runway then it is likely to breach the Hawkesbury River and Bakers Lagoon. If DOIT choose to further investigate this option they may wish to consider the potential acquisition of a shorter strip of land, slightly repositioning the proposed strip and/or bridging (possibly redirecting/positioning) the Hawkesbury River and Bakers Lagoon so they remain unimpeded.

The current positioning of the runway may result in the neighbouring cemetery being encroached upon. If this scenario is selected then much of the land to the north of the Richmond RAAF Air Base may need to be built up as there is a fall in the contour and it is below the one in 100 year flood line. Please refer to Section 3 for more information.

As verbally advised by Worley Parsons, in this scenario, we have allowed for an additional 300m x 4,000m (up to) strip of land from the Richmond RAAF Air Base runway. In addition to this, we have allowed for a limited amount of additional land to be acquired (i.e. in line with our assumptions in Section 2.6).

For this scenario, we understand that Worley Parsons have not undertaken the required drawings due to them not being engaged to do so. For this reason, the proposed scenario area is significantly smaller than the proposed North South 1 Scenario area.

If additional land is required (for whatever purpose) so the overall land area is in line with the North South 1 scenario area then it may be possible to acquire additional rural land at a relatively low cost when compared to the other surrounding uses. We note that much of the surrounding rural land is below the one in 100 year flood line.

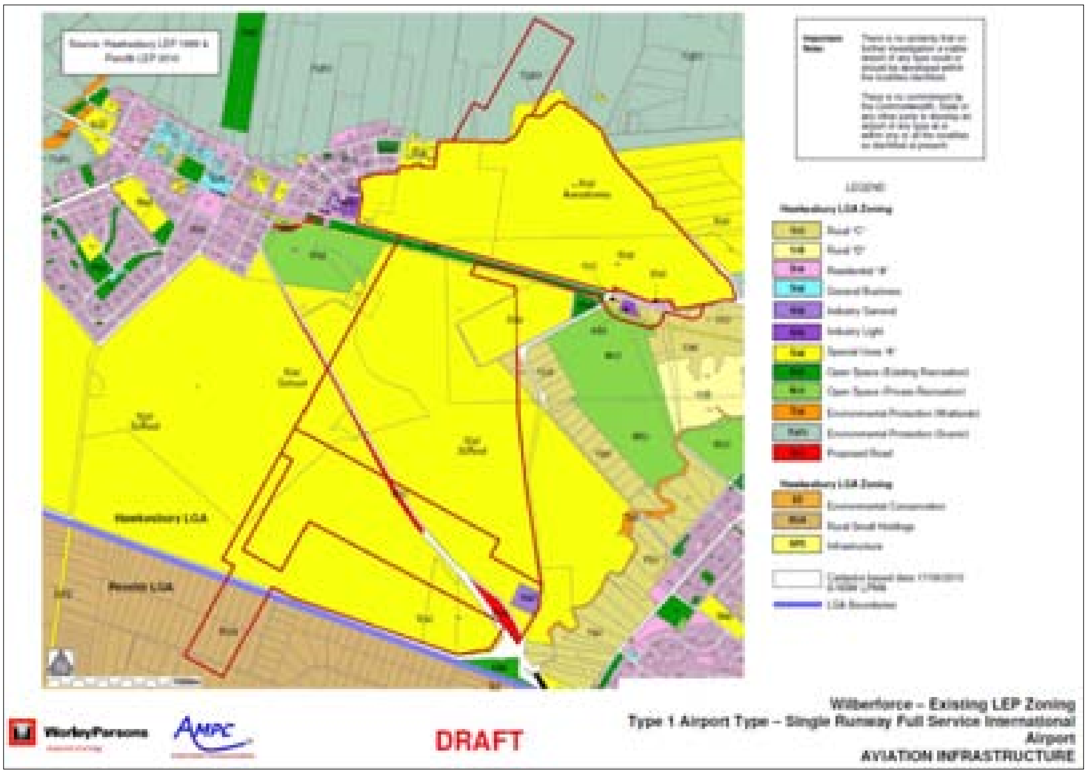
If additional surrounding rural land is required and it does not front the Hawkesbury River, we estimate that an acquisition cost allowance in the order of $30,000 to $60,000 per hectare should be allowed. Should DOIT require further information, we will be happy to assist.

5. Zoning

5.1 Zoning Map

The diagram below was prepared by Worley Parsons and relied upon by us for the purpose of this report. It provides an indication of the applicable zonings for the As Is, North South 1 and part of North South 2 scenario. The zonings should be confirmed by obtaining a Section 149 Certificate in accordance with the Environmental Planning and Assessment Act 1979 from the relevant local authority. The 7 (a) land and some of the 7 (d1) land, north of Richmond RAAF Air Base which may need to be acquired under scenario North South 2 is not shown in the diagram below.

For more information on the relevant zoning objectives please refer to Appendix B



6. Key Considerations

6.1 Sales

As part of our research, we viewed and analysed a number of sales around the greater Richmond area. The sales can be broadly defined into one of the following categories:

- Residential: These sales generally comprise of single residential dwellings on blocks zoned for residential uses.

- Lifestyle: These sales generally comprise of single residential dwellings on blocks up to four hectares and located within a specific zoning that allows for this type of development.

- Rural: These sales generally comprise of large improved or vacant blocks of land suitable for agricultural and/or horticultural uses.

- Industrial: These sales generally comprise of vacant or largely unimproved blocks of land suitable for industrial development.

- Special Purpose: These sales generally comprise of vacant blocks of land of various sizes where the zoning allows for a limited number of specific uses.

For more details on each of the sales that we researched please refer to Appendix C.

When comparing the sales to each of the scenarios, we made adjustments for a number of factors including location, highest and best use of the comparable sale and each of the properties within the scenario area, the market conditions at the time of sale, condition and age of the improvements, size, contour, views and permitted activities/zoning etc.

6.2 Determining Special Use Site Values

When considering the cost to acquire land zoned for special or unique purposes, we took into account a number of factors including permitted alternative uses, highest and best use, location, size, shape, contour and coverage etc. As the special use land (i.e. Richmond RAAF Air Base, University of Western Sydney and Hawkesbury Showgrounds and Hawkesbury City Waste Management Facility) under each scenario has a limited number of alternative uses, we compared it to other large parcels of land with limited alternative uses and then added the estimated depreciated replacement cost of the improvements.

The other parcels of land include special use sites of various sizes and large rural holdings in proximity to Richmond. Given the location of the special use parcels we assessed in comparison to the other larger parcels we researched, a premium was adopted due to their location i.e. proximity to residential development and the townships of Windsor and Richmond.

To assist us with calculating the value of the improvements on many of the special use parcels, we utilised the depreciated replacement cost methodology. This is where the improvements are effectively depreciated over their useful lives. For further information on the depreciated replacement cost approach please refer to Section 6.5.

The improvements generally comprise buildings, houses, general site improvements (roads, car parks, and hardstands), airport surfaces (runways, taxiways, aprons, and shoulders), site services and infrastructure (electrics, pipelines, lighting, fences and communications).

6.3 Section 58 of the Lands Acquisition Act 1989

Section 58 of the Lands Acquisition Act 1989 refers to unique properties which are traded infrequently i.e. Air Force bases, Showgrounds and Waste Management Facilities etc. Under the Lands Acquisition Act 1989 properties that are infrequently traded should be costed at their replacement cost on a new site plus the costs of relocating the enterprise and any additional ongoing expenses that may occur less the present value of any savings.

We were explicitly instructed (verbally) by DOIT not to undertake this approach due to the number of high level assumptions that may be required.

It should be noted that if the acquisition cost is recalculated using this methodology then it may result in a significantly higher amount.

6.4 Other Relevant Parts of the Lands Acquisition Act 1989

When referring to the Lands Acquisition Act 1989 we had consideration for a number of other sections including but not limited to:

- Section 55 outlines the general principles for determining the amount of compensation that each stakeholder may be entitled to.
- Section 56 outlines the definition of market value.
- Section 57 outlines a special provision for when the market value is determined by a use that is different to what the property is currently utilised for.
- Section 59 outlines how planning restrictions are to be taken into in account when determining the cost of acquisition. Special Use zoning appears to be a planning restriction under this section.
- Section 60 outlines the matters to be disregarded when assessing the amount of compensation. This includes the change in value of the property due to the proposed use of the land for which it is being acquired for.
- Section 61 applies when an interest in land is acquired from a person by compulsion. This section was used to assist us with estimating the required amount of compensation for each property.

  We used the following guidance to estimate the amount of compensation that may be required to compulsorily acquire each property:

  - The market value of the interest being acquired. For the purpose of this report we have assumed each property is unencumbered and owner occupied.
  - The amount necessary to reimburse a person to acquire a reasonably equivalent interest in a reasonably equivalent dwelling. To estimate this, we calculated the stamp duty that would be payable if a property was acquired at the same price as the assumed purchase cost, $10,000 for professional fees and 5% of the purchase cost for loss, injury and relocation etc.
  - $10,000 indexed at CPI (All Groups Australia) from the when this Act came into force. This is estimated to be $18,719 as at the date of this report. From our understanding of the Lands Acquisition Act 1989, this amount is payable to those with an interest in land acquired compulsorily.

- Where we noted that a business was operating from a property within each of the scenario areas we made a broad compensation allowance for their loss of trade, business disruption and relocation etc. The compensation amounts vary from $100,000 for home office type operations to $5,000,000 for larger enterprises like fuel stations. These amounts should be reviewed after obtaining the relevant information.

  If our broad compensation amounts are incorrect this may lead to additional costs for the Australian Government.

- For some of the larger enterprises within each of the scenario areas we allowed $100,000 for professional fees as we are of the view that their professional requirements are likely to be more complex and expensive when compared to others.

We have assumed all the properties proposed to be acquired are owner occupied and unencumbered. For this reason, we are of the view that the other sections of the Lands Acquisition Act 1989, in regards to calculating the amount of compensation payable, are unlikely to be applicable (i.e. those in Division three and four).

6.5 1970 versus 1980 Depreciated Replacement Cost

The Depreciated Replacement Cost approach is where we estimate the cost to replace the asset as new and then depreciate the cost over its useful life to estimate its worth today. This methodology is generally used on specialised assets that do not frequently trade in the market.

When estimating the value of the improvements on the Richmond RAAF Air Base, Hawkesbury Showgrounds and University of Western Sydney land we were limited to taking notes from our road side viewings in addition to what we could see from the desk top. For this reason, when undertaking the depreciated replacement cost approach we used two mean build years for the improvements we could not accurately age. The adopted mean build years were 1970 and 1980.

We note that our ranges in the next section are quite large. This is largely due to calculating the replacement cost of the improvements and using two mean build years that are ten years apart. These ranges could be reduced significantly if we were able to obtain the relevant information.

7. Estimated Acquisition Costs

Based on our understanding of the Lands Compensation Act 1989 and the market evidence we obtained, we calculated the following estimated acquisition costs. All the costs are exclusive of GST and subject to all the assumptions stated within the report.

A range of potential acquisition costs was calculated due largely to us being unable to obtain accurate and complete information on the nature, extent and age of the improvements. The improvements generally comprise buildings, houses, general site improvements (roads, car parks, and hardstands), airport surfaces (runways, taxiways, aprons, and shoulders), site services and infrastructure (electrics, pipelines, lighting, fences and communications).

The lower end of the range below assumes a 1970 build unless we have been able to determine the approximate age of the improvements. A lesser value was calculated due to the higher age and deemed lower useful economic life of the improvements. The upper end of the range assumes an average build year of 1980 unless we have been able to determine the approximate age of the improvements. Our ranges are detailed below:

To be conservative we suggest adopting a value at the upper end of the above ranges.

The estimated additional compensation includes items such as stamp duty, professional fees and other compensation amounts stipulated in s61 of the Lands Acquisition Act 1989.

7.1 As Is

We have calculated a potential acquisition cost range for this scenario of $107,000,000 - $210,000,000. Our suggested amount is detailed below.

Land Use Category	Estimated cost of Property	Estimated Additional Compensation	Total	Area (Ha)
Special Purpose	$210,000,000	$0	$210,000,000	279.14
Total	**$210,000,000**	**$0**	**$210,000,000**	**279.14**

7.2 North South 1

We have calculated a potential acquisition cost range for this scenario of $264,000,000 - $370,000,000. Our suggested amount is detailed below.

Land Use Category	Estimated cost of Property	Estimated Additional Compensation	Total	Area (Ha)
Special Purpose	$300,000,000	$10,000,000	$310,000,000	877
Rural	$9,800,000	$1,200,000	$11,000,000	175
Lifestyle	$26,300,000	$8,200,000	$34,500,000	50
Residential	$5,400,000	$1,100,000	$6,500,000	2
Industrial	$7,500,000	$500,000	$8,000,000	6
Total			**$370,00,000**	**1,100**

7.3 North South 2

We have calculated a potential acquisition cost range for this scenario of $132,000,000 - $235,000,000. Our suggested amount is detailed below.

Land Use Category	Estimated cost of Property	Estimated Additional Compensation	Total	Area (Ha)
Special Purpose	$211,000,000	$0	$211,000,000	280
Rural	$20,100,000	$3,900,000	$24,000,000	257
Total			**$235,00,000**	**537**

If additional surrounding rural land is required so that the total land area is more in line with the North South 1 land area and assuming it does not front the Hawkesbury River, we estimate that an acquisition cost allowance of $30,000 to $60,000 per hectare should be allowed. Should you require further information, we will be happy to assist.

Appendix A Zoning Objectives

The table below outlines the objectives for the relevant zones and the applicable scenarios. The information has been extracted from the relevant Local Environment Plan (i.e. Hawkesbury Local Environment Plan 1989 or Penrith Local Environment Plan 2010). We note that Hawkesbury City Council have a Draft Local Environment Plan on display. We have viewed this document but have not taken it into account due to it still being in draft. Many of the applicable properties under the draft local environment plan appear to have similar zonings and objectives to those in the current Local Environment Plan

Zone	Applicable Scenario	Zone Objectives
Special Uses "A" 5 (a)	As Is North South 1 and 2	(a) Recognise existing public and private land uses and to enable their continued operation, growth and expansion to accommodate associated, ancillary or otherwise related uses, (b) Set aside certain land (being land that the Council or another public authority proposes to acquire) for a variety of purposes, as indicated on the map, for which development is to be carried out by the Council or other public authority, and (c) Restrict development on land which will be required for future community facilities.
Rural Housing 7 (d1)	North South 1 and 2	(a) To provide primarily for low density residential housing and associated facilities, (b) To minimise conflict with rural land uses, (c) To preserve and maintain the rural character of the locality and ensure building and works are designed to be in sympathy with the character of the locality, (d) To ensure that development occurs in a manner that satisfy best management guidelines for the protection of water catchments, water quality, land surface conditions and important ecosystems, (e) To prevent the establishment of traffic generating development along main and arterial roads, (f) To ensure that development does not create unreasonable demands for the provision or extension of public amenities or services, (g) To enable development for purposes other than residential only if it is compatible with the character of the living area and has a domestic scale and character.
Rural Living 1(c)	North South 1	(a) To provide primarily for a rural residential lifestyle, (b) To enable identified agricultural land uses to continue in operation, (c) To minimise conflict with rural living land uses, (d) To ensure that agricultural activity is sustainable, (e) To provide for rural residential development on former agricultural land if the land has been remediated, (f) To preserve the rural landscape character of the area by controlling the choice and colour of building materials and the position of buildings, access roads and landscaping, (g) To allow for agricultural land uses that are ancillary to an approved rural residential land use that will not have significant adverse environmental effects or conflict with other land uses in the locality, (h) To ensure that development occurs in a manner: (i) that does not have a significant adverse effect on water catchments, including surface and groundwater quality and flows, land surface conditions and important ecosystems such as streams and wetlands, and (ii) that satisfies best practice guidelines and best management practices, (i) To prevent the establishment of traffic generating development along main and arterial roads, (j) To ensure that development does not create unreasonable economic demands for the provision or extension of public amenities or services.
Industrial General 4 (a)	North South 1	(a) Set aside certain land for the purposes of general industry within convenient distances of the urban centres of the City of Hawkesbury, (b) Allow commercial and retail development involving: (i) uses ancillary to the main use of land within the zone, (ii) the display and sale of bulky goods, and (iii) the day-to-day needs of the occupants and employees of the surrounding industrial area, and (c) Ensure that industrial development creates areas which are pleasant to work in and safe and efficient in terms of transportation, land utilisation and services distribution.

Light Industry 4 (b)	North South 1	(a) Set aside certain land for development for the purpose of light industry within convenient distances of the urban centres of the City of Hawkesbury, (b) To allow commercial and retail development involving: (i) uses ancillary to the main use of land within the zone, (ii) the display and sale of bulky goods, and (iii) the day-to-day needs of the occupants and employees of the surrounding industrial area, and (c) Ensure that industrial development creates areas which are pleasant to work in and safe and efficient in terms of transportation, land utilisation and services distribution.
Special Uses (Railways) 5 (b)	North South 1	(a) Recognise existing railway land and to enable future development for railway and associated purposes, and (b) Prohibit advertising structures and hoardings on railway land.
Open Space (Existing Recreation) 6 (a)	North South 1	(a) Identify existing publicly owned land that is used or is capable of being used for active or passive recreational purposes, (b) Encourage the development of public open space in a manner which maximises the satisfaction of the community's diverse recreational needs, (c) Enable development associated with, ancillary to or supportive of public recreational use, and (d) Encourage the development of open spaces as major urban landscape elements.
Open Space (Private Recreation) 6 (c)	North South 1	(a) The objectives of this zone are to identify and set aside certain private land where private recreational activities are and may be developed.
Proposed Roads 9 (b)	North South 1	(a) The objective of this zone is to set aside land (being land that the Council or another public authority proposes to acquire) for various proposed roads.
Housing Zone 2 (a)	North South 1	(a) To provide for low density housing and associated facilities in locations of high amenity and accessibility, (b) To protect the character of traditional residential development and streetscapes, (c) To ensure that new development retains and enhances the existing character, (d) To ensure that development is sympathetic to the natural amenity and ecological processes of the area, (e) To enable development for purposes other than residential only if it is compatible with the character of the living area and has a domestic scale and character, (f) To control subdivision so that the provision for water supply and sewerage disposal on each resultant lot is satisfactory to the Council, (g) To ensure that development does not create unreasonable economic demands for the provision or extension of public amenities or services.
Environmental Protection (Wetlands) 7 (a)	North South 2	(a) Protect wetland areas from development that could adversely affect their preservation and conservation, and (b) Preserve wetland areas as habitats for indigenous and migratory wildlife.
Primary Production Small Lots (RU4)	North South 1	(a) To enable sustainable primary industry and other compatible land uses. (b) To encourage and promote diversity and employment opportunities in relation to primary industry enterprises, particularly those that require smaller lots or that are more intensive in nature. (c) To minimise conflict between land uses within this zone and land uses within adjoining zones. (d) To ensure land uses are of a scale and nature that is compatible with the environmental capabilities of the land. (e) To preserve and improve natural resources through appropriate land management practices.

Appendix B Comparable Sales

Below is a selection of the sales that we considered when placing acquisition costs on the properties within each of the three scenarios.

Residential sales

Address	Sale Date	Area (m²)	Sale Price
32 Church Street, South Windsor	April 2011	727	$355,000
80 Church Street, South Windsor	November 2010	1,006	$465,000
86 Church Street, South Windsor	3 May 2011	961	$410,000
547 George Street, South Windsor	27 May 2011	639	$320,000
560 George Street, South Windsor	16 March 2011	765	$320,000
566 George Street, South Windsor	30 November 2010	734	$270,000
580 George Street, South Windsor	3 March 2011	771	$270,000
10 James Street, South Windsor	16 April 2011	417	$220,000
271 Macquarie Street, South Windsor	15 June 2011	816	$300,000
50 Richmond Road, Windsor	30 June 2011	556	$366,000
221 Richmond Road, Clarendon	Asking	2,378	$600,000
215 Richmond Road, Clarendon	Asking	2,985	$499,000

Lifestyle sales

Address	Sale Date	Area (Ha)	Sale Price
351 Londonderry Road, Londonderry	June 2011	2.5400	$683,000
395 Londonderry Road, Londonderry	March 2011	1.2690	$745,000
409 Londonderry Road, Londonderry	May 2011	2.2300	$660,000
43 Macpherson Road, Londonderry	December 2010	1.6240	$860,000
93 Macpherson Road, Londonderry	October 2010	1.8650	$625,000
44 Macpherson Road, Londonderry	August 2011	1.5880	$735,000
79 Bennett Road, Londonderry	July 2011	2.8700	$825,000

Rural sales

Address	Sale Date	Area (Ha)	Sale Price	$/Ha
46 Mulgrave Road, Mulgrave	September 2010	26.42	$1,150,000	$43,528
374 Freemans Reach Road, Freemans Reach	February 2011	25.24	$1,200,000	$47,544
88 Spinks Road, Glossodia	July 2011	80.20	$6,500,000	$81,047
789 Kurmond Road, Freemans Reach	March 2010	34.15	$3,100,000	$90,776
841 Kurmond Road, North Richmond	May 2010	5.60	$760,000	$135,714
1049 Kurmond Road, North Richmond	June 2010	10.12	$1,700,000	$167,984
266 Crooked Lane, North Richmond	July 2010	5.34	$995,000	$186,330
88 Cornwells Road, Richmond Lowlands	April 2011	9.33	$271,000	$29,046
114 Cornwells Road, Richmond Lowland	April 2011	20.23	$456,000	$22,541
166 Cornwallis Road, Cornwallis	December 2010	16.30	$800,000	$49,080
4 Digit Street, Richmond Lowlands	August 2011	137.60	$4,100,000	$29,797
1 Old Kurrajong Road, Richmond Lowlands	Asking	21.00	$1,100,000	$52,381
Kurrajong Polo Field, Richmond Lowlands	Asking	28.89	$2,000,000	$69,228
149 Edwards Road, Richmond Lowlands	Asking	31.20	$3,500,000	$112,179
96 Dight Street, Richmond	Asking	107.64	$6,500,000	$60,386
Lot 27 Pecks Road, North Richmond	February 2007	179.30	$40,000,000	$223,090
Kingsly Pastoral Block, North Richmond	Advised recent offer	280.00	$60,000,000	$214,286

Vacant industrial sales

Address	Sale Date	Area (m²)	Sale Price	$/m²
Richmond Road, Clarendon	December 2010	14,350	$2,825,000	$197
47-67 Mulgrave Road, Mulgrave	March 2011	37,500	$4,875,000	$130
11 Railway Road North, Mulgrave	September 2009	2,022	$625,000	$309
19 Railway Road North, Mulgrave	December 2009	2,064	$760,000	$368
1 Walker Street, Mulgrave	Asking	4,857	$1,457,100	$300

Special purpose sales

Address	Sale Date	Area (Ha)	Sale Price	$/Ha
829 The Northern Road, Cranebrook	June 2009	181.11	$17,500,000	$96,626
21 Smeeton Road, Londonderry	December 2007	2.66	$173,438	$65,202

During our road side viewings we noted 96 Dight Street, Richmond was currently on the market for $6.5 million. This rural property is approximately 107.64 hectares and is required under both of the North South scenarios should DOIT wish to precede. For this reason and to avoid paying compensation, DOIT may want to consider acquiring the property or a controlling interest (i.e. long dated call option), should DOIT wish to precede with either of the North South scenarios. This may result in a future cost saving.

We also note that several of the larger residential properties bordering the Richmond RAAF Air Base are also presently on the market. One of the properties operates as a Bed & Breakfast and is on the market for approximately $600,000. The other property comprises a four bedroom, two level dwelling on a 2,985m² block of land. This property is on the market for approximately $499,000. Should DOIT wish to proceed, both of these properties are required under the North South 1 scenario.

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Preliminary evaluation of potential future uses of Commonwealth Land at Badgerys Creek

D1

Preliminary evaluation of potential future uses of Commonwealth land at Badgerys Creek

July 2011

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Executive summary

The Commonwealth owned Badgerys Creek site is 1 693 hectares or approximately 17 km^2 with 80 per cent capable of supporting urban development.

The site is located 51 kilometres west of Sydney CBD in the Liverpool local government area abuts the north west boundary of the South West Growth Centre (SWGC) adjacent to the Western Sydney Employment Area potential expansion (refer location map page 7).

Key findings

The site may have strategic value in the longer-term as an extension to the South West Growth Centre providing housing, employment and services coupled with improved public transport.

In the short to medium-term its strategic value remains largely as a site for agriculture.

Option comparison matrix (medium to long-term use options)

Criteria	Residential only	Employment only	Mixed use- growth centre extension
Site capability	• ~ 80 per cent of site potential	• ~ 80 per cent of site potential	• ~ 80 per cent of site potential
Strategic alignment	• Not consistent with current Metropolitan Plan. • Long-term possibility to extend SWGC subject to demand.	• Broadly consistent with current Metropolitan Plan but in short and medium-term would represent an oversupply.	• Not consistent with current Metro Plan • Longer-term possibility to extend SWGC subject to demand.
Demand	• Beyond 20 years.	• Remote - Beyond 20 years.	• Beyond 20 years.
Infrastructure scheduling	• Able to be scheduled as extension to SWGC	• Able to be scheduled following rezoning of more accessible lands	• Able to be scheduled as extension to SWGC
Infrastructure costs [1]. (refer Appendix A)	• c.$1 billion cost of social and rail extension if proposed	• c.$1 billion cost of social and freight rail extension if proposed.	• c.$1 billion cost of social and rail extension if proposed.
Transport accessibility	• Road and bus network derived from SWGC-requires capacity improvements. • M9 corridor linking key centres of Liverpool and Penrith has potential to serve the site. • Rail - potential for a passenger rail link to Leppington.	• Access to motorway network is critical – Improved links to M7 and connection with M9 is important. • Improved access to any western freight line intermodal terminal in the vicinity of WSEA critical.	• Road and bus network derived from SWGC. Needs capacity improvements. M9 corridor has potential to serve the site. • Rail - potential for a passenger rail link to Leppington.

[1] Further modelling required by Transport for NSW

Employment lands option - snapshot

Opportunity:

- Providing for employment growth to support residential land release and promote job self containment in Western Sydney and the south west subregion.
- Relatively unconstrained land; remote from incompatible uses; could accommodate large floor plates.

Constraints:

- Insufficient current demand given oversupply and remote location; distance from planned infrastructure, markets and labour; better current locations around Western Sydney employment area to meet current supply needs.

Triggers:

- Increased demand for accessible employment lands close to Western Sydney Employment Area following take-up of Erskine Park and other employment land at M4/M7 freight hub.
- Provision of trunk infrastructure extending from SWGC.
- Construction of M9 Motorway providing an improved link between the regional cities of Liverpool and Penrith.

Residential (growth centre expansion) option - snapshot

Opportunity:

- Could be serviced as part of extension to SWGC; could be preferred extension to urban footprint when SWGC complete.

Constraints:

- Demand for residential use is unlikely to warrant release before take-up of supply in the SWGC (2040+) unless greenfield delivery across metropolitan area is accelerated.
- Residential use would place additional pressure on infrastructure costs (soft infrastructure and services).

Triggers:

- Take-up of northern residential precincts in the SWGC complete.
- Provision of trunk infrastructure extending from the SWGC.

Agribusiness option – snapshot

Opportunity:

- Good access to markets and proposed use provides buffers to urban areas and site is well located for displaced businesses.
- Flexibility to be short to medium-term land use with options for varying degrees of infrastructure investment dependent on intensity of land use.

Constraints:

- Provision of a sustainable water supply would require significant government investment and planning.
- Further market sounding and analysis of demand.
- Assessment of biosecurity risks.

Triggers:

- Delivery of water infrastructure.
- Economic development initiatives.

Infrastructure costs

Indicative infrastructure costs are provided in this report for broad comparative analysis purposes only. Infrastructure costs provided are based on high level order of magnitude unit costs only. Further detailed evaluation of infrastructure options and cost analysis will be required during subsequent stages of planning and will require verification by Transport for NSW and other infrastructure providers.

Infrastructure costs summary (long-term use options only)[2]

	Employment	Residential	Mixed
Regional roads	c.$300m	c.$300m	c.$300m
Utilities	c.$650-750m	c.$650-750m	c.$650-750m
Social infrastructure	Likely to be minor	Likely to be significant	Likely to be significant
Rail	n/a	Possible rail link from Leppington (uncosted)	Possible rail link from Leppington (uncosted)
TOTAL	$1bn	$1bn+ social and possible rail	$1bn+ social and possible rail

[2] Further modelling required by Transport for NSW

1.0 Introduction

1.1 Purpose

This report provides a preliminary evaluation of alternative uses for Commonwealth land on the site formerly proposed as a second Sydney airport at Badgerys Creek. The purpose of the report is to inform the Joint Study on aviation capacity for the Sydney region.

The key considerations in assessing possible land uses included:

- Metropolitan Plan strategic context
- demand for housing and employment
- accessibility and transport opportunities
- other infrastructure / servicing opportunities and costs
- other site opportunities and constraints
- physical site capability
- surrounding land uses and planned initiatives in the adjoining South West Growth Centre (SWGC) and the Western Sydney Employment Area -potential expansion – within which the site is located.

The report describes and evaluates potential options for the alternative use of the site. Options evaluated include:

- employment land use
- residential use
- combination of residential and employment uses (extension of the South West Growth Centre)
- other uses.

1.2 The site

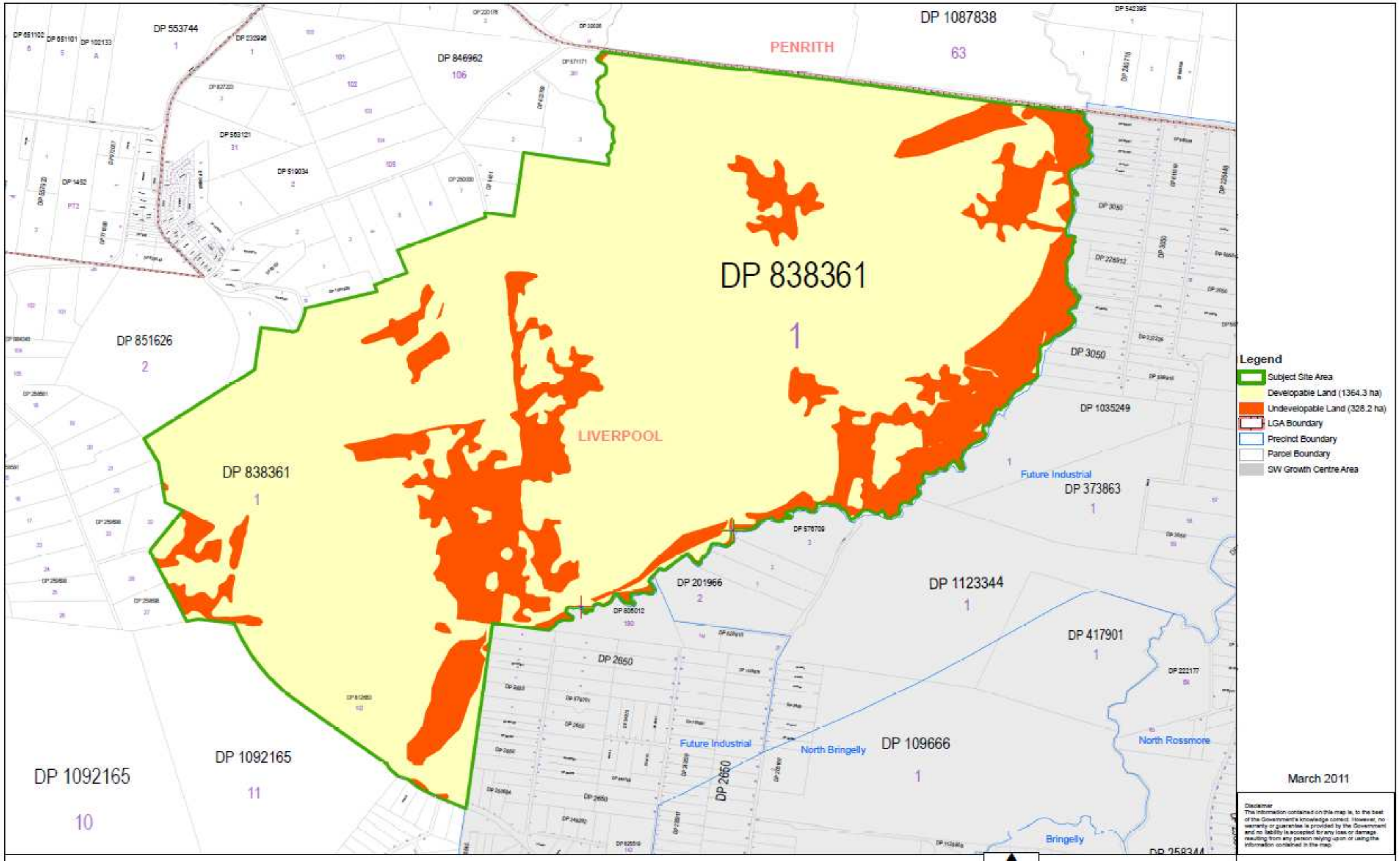
The location of the site within Metropolitan Sydney is highlighted on Map 1. The extent of the Commonwealth owned Badgerys Creek site is shown on the site capability map (Map 2). Site area is 1 693 ha or approximately 17 km^2 however approximately 20 per cent of the site is constrained leaving 80 per cent (1,364 ha) capable of supporting urban development.

Site constraints relate primarily to ecologically endangered communities, sites of aboriginal significance and a riparian corridor running along Badgerys Creek. Appendix B provides an overview of urban capability including those areas affected by scheduled communities under the *Commonwealth Environment Protection (Biodiversity Conservation) Act*.

The site is located 51 kilometres west of Sydney CBD in the Liverpool local government area. It lies adjacent to the north west boundary of the South West Growth Centre and is at the far western edge of the Western Sydney Employment Area (potential expansion area). This entire employment area, including its potential expansion, covers 110 km^2 an area equivalent to the entire East Subregion of Sydney running from Sydney Harbour to Botany Bay.

Map 1 - Location and metropolitan context

Map 2 - Site capability



N.b. Constraints have been identified using available mapping data. Further analysis of site constraints will be required.

2.0 Summary of land use options evaluation

2.1 Key findings

Preliminary evaluation of the land use options has identified that the site has potential long-term strategic value as an extension to the South West Growth Centre providing housing, employment and services. These uses would require significant infrastructure investment including improved public transport links when the current South West Growth Centre is complete. In the short to medium term, its strategic value remains largely as a site for agriculture.

2.2 Option comparison matrix

Criteria	Residential only	Employment only	Mixed use- Growth Centre Extension
Site capability	• ~ 80 per cent of the site (1,364ha) has potential.	• ~ 80 per cent of the site (1,364ha) has potential.	• ~ 80 per cent of the site (1,364ha) has potential.
Strategic alignment	• Not consistent with current Metropolitan Plan as greenfield residential growth is focussed in the North West and South West Growth Centres. • Potential long-term extension to the SWGC.	• Broadly consistent with current Metropolitan Plan. • Would represent oversupply in short to medium-term shifting demand from more strategically accessible locations close to WSEA.	• Not consistent with current Metropolitan Plan as greenfield residential growth is focussed in the North West and South West Growth Centres. • Potential long-term extension to the SWGC.
Demand	• Beyond 20 years.	• Remote - Beyond 20 years assuming more easily serviced areas rezoned first(ie closer to WSEA M4/M7)	• Beyond 20 years.
Infrastructure scheduling	• Able to be scheduled as extension to SWGC following the Bringelly and Kemps Creek Precincts.	• Able to be scheduled following rezoning of more accessible lands to the east.	• Able to be scheduled as extension to SWGC following the Bringelly and Kemps Creek Precincts.
Infrastructure costs[3] (refer Appendix A)	• c.$1 billion cost of social and rail extension if proposed	• c.$1 billion cost of social and freight rail extension if proposed.	• c.$1 billion cost of social and rail extension if proposed.
Transport accessibility	• Road and bus network derived from SWGC and is likely to require capacity improvements to Northern Road and Elizabeth Drive. • Future M9 corridor has potential to link the site to Liverpool and Penrith. • Potential for a	• Improved access to motorway network is critical including improved links to M7 via Elizabeth Drive and connection with future M9. • Improved access to any Western Freight Line intermodal terminal in the vicinity of WSEA critical.	• Road and bus network derived from SWGC and is likely to require capacity improvements to Northern Road and Elizabeth Drive. • Future M9 corridor has potential to link the site to Liverpool and Penrith.

[3] Further modelling required by Transport for NSW

	passenger rail link to Leppington.	• Freight rail access to passenger line to Leppington not supported by Transport for NSW.	Potential for a passenger rail link to Leppington.

The above matrix provides a comparison of residential and employment uses. Strategic planning and infrastructure issues are likely to be the same whether the site was to be proposed for solely residential or mixed employment / residential, as the inclusion of any residential component gives rise to demand for social infrastructure suitable access to public transport.

Alternative potential land uses considered for the site include:

- Agribusiness (high intensity) – in line with current strategic planning and sufficiently buffered from residential uses. This use has potential as a cluster but only with accompanying economic development support. Further exploration of the potential for this use is supported Transport for NSW.
- Agriculture (low intensity) – as the current predominant land use and in line with current strategic planning. This use represents a suitable interim use given the potential long-term strategic value of the site being retained in single ownership for strategic planning and possible development.
- Other commercial (including tourist uses) – not in line with current strategic planning this use would require a specific concept or use with targeted economic development investment. Such uses are generally proposed by specific proponents.

3.0 Strategic planning context

3.1 Current status

The site has an approval for an airport use under the *Commonwealth Environment Protection (Impact of Proposals) Act* (Badgerys Creek Airport EIS).

The site is currently zoned for rural uses under *Liverpool Local Environmental Plan 2008* and is mostly used as pasture for grazing. Major surrounding uses include:

- small lot rural enterprises in the northern portion of the SWGC and elsewhere around the site.
- CSIRO research station, University of Sydney Veterinary Farm and Badgerys Creek Landfill to the immediate north.
- RAAF defence lands are located 2 kilometres to the north.

The site is subject to a Ministerial Direction (no.24 Second Sydney Airport Badgerys Creek) that states *'Draft Local Environmental Plans shall not contain provisions that enable the carrying out of development, either with or without development consent, which at the date of this Direction, could hinder the potential for development of a Second Sydney Airport'*. Local Environmental Plans may be inconsistent with this direction where justified by an adopted strategic planning strategy.

3.2 Metropolitan Plan for Sydney and draft subregional strategy

The Metropolitan Plan for Sydney sets the strategic direction for the amount and location of housing and jobs in the metropolitan area, (including the Central Coast), for the period 2006 to 2036. It plans for the land use, service provision and infrastructure capacity for 770 000 additional homes and 760 000 new jobs for the period 2006 to 2036.

The Metropolitan Plan aims to locate 80 per cent of all new housing within the walking catchments of existing and planned centres of all sizes with good public transport. This applies to existing centres in the existing urban area, and new centres being planned in new release areas.

In the North West and South West Growth Centres, a network of new strategic and local centres will provide a focus for new apartments, townhouses, semi-detached dwellings and detached dwellings. The growth centres include the new planned major centres of Leppington (in the south west) and Rouse Hill (in the north west). These new major centres fit within a metropolitan-wide network of strategic centres and are designed to support the regional cities of Liverpool and Penrith which are the principal centres for the south west and north west subregions.

The North West and South West Growth Centres are identified as the principal new greenfield release areas for accommodating up to 30 per cent of new housing development over the life of the Metropolitan Plan. Evidence supporting the Metropolitan Plan concludes that there is no need for additional greenfield release areas beyond the North West and South West Growth Centres within the period to 2036 at this policy setting. There is currently greenfield land committed with capacity for 125 000 potential dwellings, with a further 105 000 dwellings on land (yet to be released) in the growth centres providing total future urban land capacity of 230 000 dwellings.

With a change in policy settings towards an increase in the proportion of greenfield development – for example to 50 per cent of all new dwellings – land for up to an additional 154 000 dwellings may need to identified and planned for housing release. That is, if Sydney's growth was still to be accommodated in the metropolitan area rather than diverted to regional areas.

The Metropolitan Plan for Sydney proposes the examination of the potential for expansion of the Western Sydney Employment Area from its existing 'hub' around the M4 /M7 intersection, approximately 10 kilometres south west to the Badgerys Creek site. A structure plan is to be developed to further investigate the capability for this expansion subject to detailed precinct and infrastructure planning.

The Metropolitan Plan also seeks to maintain and protect agricultural activities and resource lands. Agricultural uses are vital assets underpinning the sustainable and efficient use of land within the Sydney metropolitan area. Agriculture in Sydney takes advantage of mild coastal climates, a range of suitable soils (although not all forms of agriculture are soil dependent) and access to reliable water, transport, labour and markets.

3.3 Interface with the South West Growth Centre

The South West Growth Centre covers approximately 17 000 hectares and is expected to provide up to 110 000 new dwellings, a new major centre providing up to 13 000 jobs, seven town centres in addition to numerous neighbourhood centres and other employment land. Land for almost 20 000 new dwellings and 9 000 jobs has already been rezoned. Planning is well advanced to provide a further 20 000 dwellings and construct the proposed major centre in Leppington.

The Badgerys Creek site is adjacent to the north western boundary of the South West Growth Centre. At the time of structure planning being carried out for the growth centre, the site was earmarked for Sydney's second airport. As a result, structure planning outcomes ensured future uses on land in the growth centre in close proximity to the site would support the proposed airport through complementary land uses and by addressing the potential for future land use conflicts from aircraft noise. This resulted in large areas of the growth centre being identified as future industrial land. (refer to map 3A and 3B - growth centres structure plan maps).

Independent analysis of demand for employment land (across a range of industry sectors including general and light industrial, office, commercial and business park sectors) has been undertaken by Hill PDA (report completed but not yet publicly available) to inform precinct planning. This analysis indicates that even with some allowances for more ambitious growth in employment land uses, land identified as 'future industrial' on the South West Growth Centre Precinct map (map 3B) is in excess of that required to meet demand and support job self containment. The identification of future industrial areas in the structure plan solely as a response to the airport proposal is therefore in line with Hill PDA's analysis, and points to the importance of considering the future of the Badgerys Creek site as part of an overall review of the South West Structure Plan.

This will ensure future outcomes for the site are complementary to the Growth Centre and constitute an extension of it. Such a broader review must ensure infrastructure requirements and infrastructure delivery mechanisms are considered as part of broader planning processes for the growth centre.

3.4 South West Growth Centre release schedule

Under the sequence for development in both the North West and South West Growth Centres, based on the most economic provision of infrastructure, areas in the north west of the South West Growth Centre would be the last to be released and developed.

The Growth Centres Precinct Release Sequencing Review 2010 indicates the residential lands at North Bringelly and Kemps Creek and future industrial precincts adjacent to the study site would be the last to be released. Servicing costs for new sewer carriers and the construction of new South Creek and Kemps Creek sewage treatment plants drive this sequence.

The later release schedule is reinforced by the absence of the economic stimulus that would have been generated by the development of an Airport at Badgerys Creek.

3.5 Centres in the South West Growth Centre

The role of Leppington as the primary centre servicing the South West Growth Centre is well established. It is identified in both the South West Structure Plan and the Metropolitan Plan as a future major centre. The NSW Department of Infrastructure and Planning is currently preparing a precinct plan for the Austral and Leppington North Precincts, including a masterplan for the development of Leppington. The draft precinct plan is scheduled for exhibition in the second half of 2011, and while the plan is still in development, clear planning outcomes have emerged in relation to the mix of land uses, scale of development and likely employment capacity within the centre.

Leppington will be a major focus for retailing, with large scale retail development planned to occur in stages reflecting growth in the residential population within the South West Growth Centre. Current planning is catering for up to 120 000m^2 of retail floorspace, with potential for increases beyond this depending on population growth. Up to 65 hectares of land is nominated within the centre for a business park, providing for a mix of office and hybrid office/industrial development. Leppington is intended to be a major focus for human services including health, education, recreation, justice and cultural facilities.

Leppington is well placed to be a central location for higher order services, employment, entertainment and retail for the South West Growth Centre. The major centre is located at the new Leppington Station, on the extended South West Rail Line, and is well serviced by major roads including Bringelly Road and Camden Valley Way.

Consideration of future land uses within the Badgerys Creek site should recognise the commitment of the NSW Government to Leppington, not only in strategic land use policies such as the structure plan and Metropolitan Plan, but in terms of committed infrastructure investment, (primarily in the South West Rail Line). Work on developing a new centre, including new employment uses at Badgerys Creek, would need to consider how these would relate to Leppington to ensure the infrastructure investment being made at this major centre is not undermined.

Advice from Hill PDA (report completed but not yet publicly available) in relation to the hierarchy of retail centres in the South West Growth Centre indicates that the provision of higher order centres in the South West Structure Plan may not be sufficient to cater for long term demand. With a future total population in the order of 300 000, the South West Growth Centre may be able to sustain larger centres, in addition to the Leppington Major Centre. Hill PDA suggests that consideration may be given to enabling some town centres to grow beyond the capacity identified in the structure plan. The advice suggests that Leppington should continue to be planned as the dominant centre (because of the transport/accessibility advantages over other locations) but that centres such as Oran Park may be able to grow to become large town centres. Should residential land uses be considered for the Badgerys Creek site and the future industrial precincts in the north west of the growth centre, this would generate demand for another large town centre in the north west of the South West Growth Centre close to Badgerys Creek.

3.6 Western Sydney Employment Area (potential expansion)

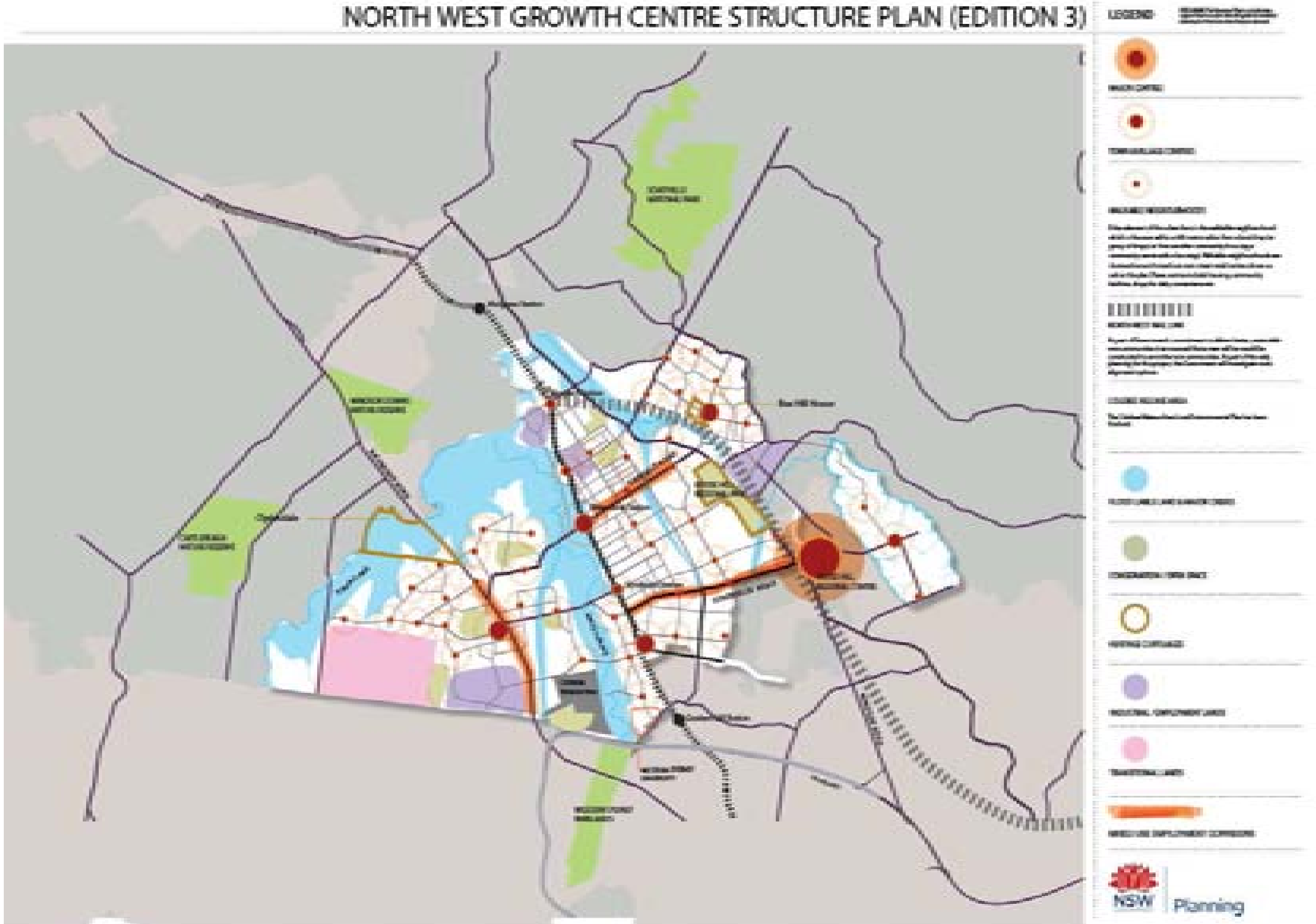
The Western Sydney Employment Area (potential expansion) covers around 110km^2 between Eastern Creek and the South West Growth Centre – including the subject site. Action E5.3 of the Metropolitan Plan identifies the need to prepare a structure plan for the area taking into account desired employment types and numbers, infrastructure needs, development staging and appropriate governance and resourcing.

A draft structure plan was prepared in 2008 for the majority of the area, then known as the Western Sydney Employment Lands Investigation Area (WSELIA). The draft structure plan, which was not released, anticipated capacity to support 50 000 jobs as an extension from the Western Sydney Employment Hub, now known as the Western Sydney Employment Area.

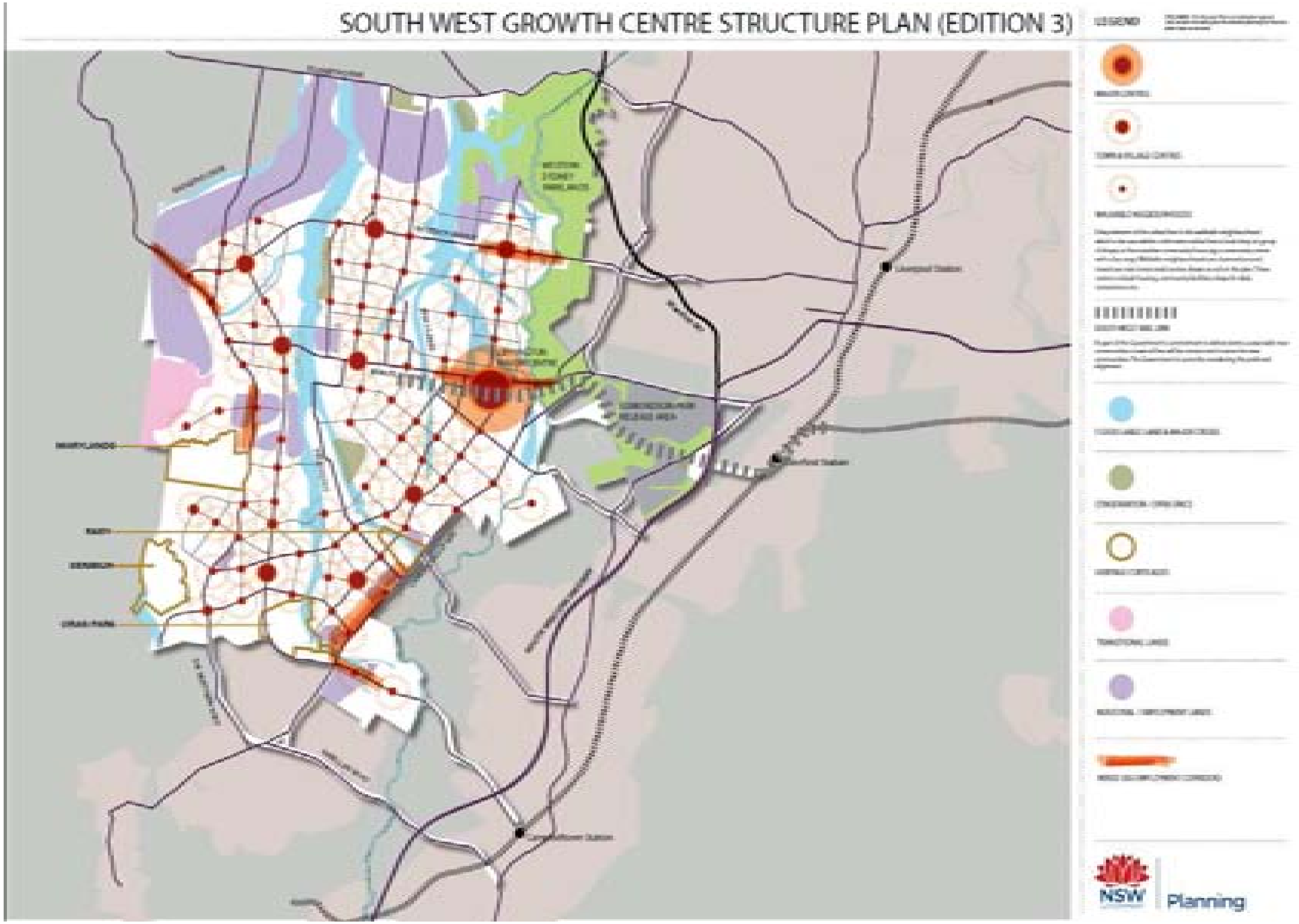
The 2008 WSELIA draft structure plan proposed a two phase release commencing with land closest to the land in the WSEA near the M7/Erskine Park precinct at the highest job densities; and a second phase (between Mamre and Luddenham Roads) for low employment density opportunities for broad acre logistics and warehouse uses. It was suggested that these two phases would satisfy demand until 2031 using estimates made in 2008. The 2008 draft structure plan also recommended that further lands in the balance of the Western Sydney Employment Area (Potential Expansion) - including the Badgerys Creek site - would be reserved for long term employment needs and retained in their current non-urban character until required (beyond 2031).

The 2008 draft structure plan assumes employment uses would develop in the future industrial lands in the north west of the South West Growth Centre as indicated on the structure plan for the latter (map 3B), associated with the former Badgerys Creek airport noise affected area.

Map 3A - North West Growth Centre Structure Plan



Map 3B - South West Growth Centre Structure Plan



4.0 Demand for housing and employment land

4.1 Population growth

Sydney is planning for its population to grow by 1.7 million people over the period 2006 – 2036. This is projected to require 770 000 additional dwellings and 760 000 more jobs.

The higher scale of growth compared to the basis for the 2005 Metropolitan Strategy arises from new population projections released in late 2008. The 2008 projections were informed by new data particularly on fertility and overseas migration flows. Overseas migration historically is the most volatile of the assumptions used in population projections.

The apparent change in sentiment on the scale of growth, evidenced by the release of the Commonwealth Government's discussion paper *A Sustainable Population Strategy for Australia*, plus the tightening of the eligibility criteria for permanent residency and the impact of global economic conditions, could result in further changes to assumptions used in future population growth projections.

4.2 Housing demand

Greenfield development plays a lesser role in meeting Sydney's needs for additional dwellings compared to the role of infill or brownfield development. The policy setting adopted in the Metropolitan Plan is that at least 70 per cent of the 769 000 dwellings required over the 30 years to 2036 be located in established areas. Under the subregional targets set out in the plan (refer to table 4.1 below) this equates to 199 000 dwellings in greenfield (new release areas). This does not include greenfield development in the North East Subregion (Warriewood Valley and Ingleside release areas) which could have potential for up to 5 000 dwellings.

Table 4.1 - Subregional net additional dwelling targets

TABLE D1
SUBREGIONAL NET
ADDITIONAL DWELLING TARGETS

SUBREGION	NEW 2006–2036 DWELLING TARGET
SYDNEY CITY	61,000
EAST	23,000
SOUTH	58,000
INNER WEST	35,000
INNER NORTH	44,000
NORTH	29,000
NORTH EAST	29,000
WEST CENTRAL	96,000
NORTH WEST	169,000 inc. 87,000 in new release areas
SOUTH WEST	155,000 inc. 83,000 in new release areas
CENTRAL COAST*	70,000 inc. 29,000 in greenfield areas
TOTAL	769,000

*The Central Coast is subject to a separate Regional Strategy. Dwelling targets are for the combined greenfield and existing urban area. New release area figures include both Growth Centres and other greenfield releases in the subregion. A small amount of greenfield development also occurs in the North East Subregion (not included here).

For metropolitan Sydney (i.e. excluding the Central Coast) the greenfield targets add to 175 000 dwellings (assuming 5 000 in the north east). Current committed capacity in Metropolitan Sydney to meet that is 230 000 potential dwellings, consisting:

- 125 000 in existing release areas (those listed on the NSW Metropolitan Development Program, including 69 000 in the precincts of the growth centres that have already been released).
- 105 000 in precincts in the growth centres yet to be released.

The existing release areas outside the growth centres have been released, rezoned and under development for significantly longer than the growth centre precincts. It is therefore expected they will be built out before the full potential of the growth centres is utilised. Deducting their 56 000 dwelling potential and the 69 000 potential of the released growth centre precincts means by 2036 only land with potential for another 50 000 dwellings will need to be developed of the 105 000 unreleased potential.

The policy setting of at least 70 per cent of the additional required dwellings being located in the existing urban areas is based on three factors:

- The historical pattern of development in Sydney over the last 30 years.
- Analysis undertaken by the Centre for International Economics for the NSW Department of Planning and Infrastructure in 2010 into the benefits and costs of alternative growth paths for Sydney. This analysis found that growth paths accommodating more than 70 per cent of new dwellings in existing urban areas had the greatest net benefits to society.
- Changing housing preferences of Sydneysiders.

With regard to changed housing preferences, one indicator is the level of development of multi-unit housing. This averaged under 40 per cent of new dwelling construction in the second half of the 1980s. Since then this has progressively increased, reaching 50 per cent in 1994/95 and remaining above 60 per cent since 1999/00 and going as high as 80 per cent in 2004/05. In earlier periods before dropping below 40 per cent, the share had been in the range of 40-50 per cent in the late 1960s through the to the early 1970s when significant numbers of predominantly three storey walk-up apartment buildings were constructed, providing large numbers of an alternative housing choice.

Furthermore, evidence shows that people moving into greenfield release areas come from increasingly localised sub-markets. Some 69 per cent come from the same or the adjoining local government area. The 'conveyor belts' of movement from older areas to new release areas have weakened with the reluctance of purchasers to spend a substantial amount more to buy a new house compared to the price and other attributes of an existing house and location being among the key factors.

Nonetheless, should the current policy setting of up to 30 per cent of Sydney's housing being provided in greenfield locations be increased to a figure closer to 50 per cent, while at the same time striving to accommodate all of Sydney's growth within the Metropolitan area, this will require new land for up to an additional 154 000 dwellings over the life of the Metropolitan Plan. At such a point, the development of Badgerys Creek could become feasible.

4.3 Employment land demand

For the purposes of this report, employment lands are areas zoned for industrial or related uses. Jobs in employment lands currently total about 470 000 which represents a little over 20 per cent of all jobs across the metropolitan area. About 57 per cent of these are located in Western Sydney. One of the objectives of the Metropolitan Plan is for half of Sydney's future jobs growth to be accommodated in Western Sydney, (refer table 4.2 below).

Table 4.2 - Employment capacity targets by subregion

SUBREGION	BASE EMPLOYMENT 2006	LONG TERM EMPLOYMENT CAPACITY TARGET 2036	EMPLOYMENT GROWTH 2006-2036	EMPLOYMENT GROWTH 2006-2036
SYDNEY CITY	429,000	543,000	+114,000	27%
EAST	136,000	167,000	+31,000	23%
SOUTH	193,000	245,000	+52,000	27%
INNER WEST	99,000	124,000	+25,000	25%
INNER NORTH	238,000	300,000	+62,000	26%
NORTH	83,000	98,000	+15,000	18%
NORTH EAST	89,000	112,000	+23,000	26%
WEST CENTRAL	322,000	420,000	+98,000	30%
NORTH WEST	266,000	411,000	+145,000	55%
SOUTH WEST	133,000	274,000	+141,000	106%
CENTRAL COAST	104,000	158,000	+54,000	52%
TOTAL	**2,092,000**	**2,852,000**	**+760,000**	**36%**
Share in Western Sydney	34%	39%	50%	

Note: all employment targets are rounded to the nearest 1,000. Source: Department of Planning 2010

Employment lands will play a role in this but the changing nature of industry and the advantages of greenfield sites close to motorway links for land extensive types of development suggest that the majority of new development in employment lands in Western Sydney will be low density. Assessing the role and requirement for additional employment lands in Western Sydney therefore relates to the total demand for new land for Sydney. This is most effectively established by looking at land take-up rates rather than seeking to convert workforce growth into demand for floorspace and then land.

The Metropolitan Plan identifies that 8 500 hectares of new employment lands will be required over the 30 years to 2036, based on annual take-up being in the range of 275 – 300 hectares per annum. A level of 300 hectares per annum is a high growth scenario – data for the last three years show take-up rates of 264 hectares in 2008, 205 hectares in 2009 and 110 hectares in 2010 (preliminary estimate).

At January 2010, Sydney had around 4 480 hectares of zoned and undeveloped (or relatively undeveloped) employment land. Sydney has a further 3 540 hectares of land that has been identified, but not yet zoned, for employment land in the future. This primarily comprises the land identified in the structure plans for the North West and South West Growth Centres (refer maps 3A and 3B).

The above two categories of land comprise Sydney's total currently committed future employment lands. This combination of the zoned developable land with the identified potential future land totals just over 8 000 hectares. A 300 hectare per annum take-up rate represents over 26 years of supply. This stock is gross supply from which land will be taken out in the development process to provide for roads, drainage and other infrastructure, and conservation protection. Even if as a result the amount of land directly available for development was reduced to 7 000 hectares, this would represent 23 years of supply. This means Sydney already has a substantial proportion of the overall stock of potential developable employment lands needed to meet the 8 500 hectare requirement.

Supply of employment lands has to meet needs from a variety of geographic locations and industry sectors. For this reason, it is important to explore additional options for the supply of employment land in the longer-term. Land close to the motorway network and significant concentrations of the workforce will be the most desirable for that purpose. Sydney has a further opportunity for supply of employment land in the Western Sydney Employment Area (potential expansion) identified in the Metropolitan Plan. This area includes the Badgerys Creek site, and has an area in the order of 10 000 hectares. The Metropolitan Plan contains an action to prepare a structure plan for the area which will help in assessing the constraints and opportunities, infrastructure costings, and preferred land uses and their locations.

Given the significant size of the potential expansion, it is likely only a proportion of it will be required to meet the scale of overall demand. As well, demand for land in this area is only likely to be longer term given the existing concentration in the Western Sydney Employment Area of Sydney's current stocks of undeveloped industrial land (refer map 7) and the need to provide land across many parts of the metropolitan area.

5.0 Alternative land use options

5.1 Employment use option

The Metropolitan Plan for Sydney 2036 sets the direction for development of new employment lands in Sydney. An objective (E1) of the plan is to ensure adequate land supply for economic activity, investment and jobs in the right locations. Another objective (E5) of the plan is to increase and diversify the jobs and skills base of Western Sydney.

The Metropolitan Plan states that Sydney will need an estimated 8 500 hectares of employment lands by 2036 and that the levels of supply and demand will need to be monitored over time.

At January 2010, Sydney had around 15 400 hectares of zoned employment lands which includes 4 480 hectares of undeveloped land being land that is either vacant or developed for a purpose that could enable industrial land development on it such as agriculture, rural residential, low density housing.

There is currently insufficient demand to justify servicing further employment lands in such a remote location (more than 15 kilometres from Penrith and Liverpool and 11 kilometres from the M7 Motorway). The prospects for employment lands on the site are long-term without a significant driver of demand such as an airport in the vicinity (refer map 7).

It is possible that a substantial portion of planned regional employment lands in the north of the South West Growth Centre (SWGC) might be reassigned and concentrated closer to the Western Sydney Employment Area (WSEA) where there is better access to the M4/M7 motorways as well as potential access to any future intermodal terminal associated with a Western Sydney Freight Line. This would be a more productive distribution of employment land uses than a dispersed oversupply of employment uses throughout the subregion.

The Metropolitan and Western Sydney Employment lands demand and supply context will continue to be considered through the NSW Government's Employment Lands Development Program and Employment Lands Taskforce.

Employment lands option - snapshot

Opportunity:

- Providing for employment growth to support residential land release and promote job self containment in Western Sydney and the south west subregion.
- Relatively unconstrained land; remote from incompatible uses; could accommodate large floor plates.

Constraints:

- Insufficient current demand given oversupply and remote location; distance from planned infrastructure, markets and labour; better current locations around Western Sydney employment area to meet current supply needs.

Triggers:

- Increased demand for accessible employment lands close to Western Sydney Employment Area following take-up of Erskine Park and other employment land at M4/M7 freight hub.
- Provision of trunk infrastructure extending from SWGC.
- Construction of M9 motorway linking the major centres of Liverpool and Penrith.

Arguments for provision of employment land at Badgerys Creek

- The site represents a long term strategic holding for employment lands development.
- The majority of the Badgerys Creek site is relatively unconstrained and could be easily developed as employment land. A smaller proportion of the site is moderately constrained, and could potentially support some forms of development.
- The site could accommodate industrial (including agricultural) uses that need large buffers, as it is remote from existing urban areas, and buffers could be incorporated in the structure planning for the adjacent precincts in the South West Growth Centre.
- The site could be developed by businesses that require large floor plates. The scale of the site is such that it could accommodate similar sized buildings to those that have recently been constructed in the Western Sydney Employment Area at Eastern Creek and Erskine Park.

Arguments against provision of employment land at Badgerys Creek

- Development of the Badgerys Creek site would require significant investment in new infrastructure including water, electricity, gas, telecommunications and transport infrastructure. Industrial development could not be adequately serviced by the existing transport network.
- The site is not close to the proposed alignment of the Western Sydney Freight Line, which would rule out the possibility of development the site as a new intermodal terminal as an option.
- Development of the site for employment could jeopardise the orderly development of other employment precincts, which could leave under-utilised infrastructure in both the Badgerys Creek and other employment precincts.
- More employment land may perpetuate oversupply unless it fills a particular niche or is scheduled for longer term development (possibly beyond 2036) – the negatives of this are inefficient investment in dispersed infrastructure, infrastructure not utilised to optimum capacity, full potential of agglomeration economies not achieved and difficulty in planning and delivering supporting infrastructure including transport services.
- It is unlikely that there will be strong demand for employment land in Badgerys Creek, given its distance from markets, transport routes and labour compared to other major employment precincts in Sydney. The costs for development in isolation

are likely to make the prospective sale price uneconomic to develop and uncompetitive against other lands.

- Developers would more likely choose other more advantageous locations. Badgerys Creek might only serve local demand for employment land rather than play a metropolitan wide role.
- Subdivision and development of the site as employment land might limit the potential for the site to be developed for a major public purpose beyond 2036.

5.2 Residential use (growth centre extension) option

The Metropolitan Plan for Sydney identifies the North West and South West Growth Sectors as the principal greenfield release areas for the Sydney Metropolitan Area in the period up to 2036. The plan contains a policy setting to establish no new greenfield fronts to Sydney's existing urban footprint under the plan. Any consideration of the Badgerys Creek site for residential development, including new centres, would be made in this context.

With a change in policy settings towards an increase in the proportion of greenfield development, for example to 50 per cent of all new dwellings would result in land for up to an additional 154 000 dwellings being required to be found over the life of the plan. That is, if Sydney's growth was still to be accommodated within the metropolitan area rather than accommodated in other regions. Should a shift in policy setting or housing demand occur, Badgery's Creek may be considered appropriate for residential purposes following uptake of the final northern precincts of the South West Growth Centre. This proposition would optimise infrastructure costs as an extension of the planning for the South West Growth Centre.

The potential residential density of the site would depend on the success in generating activity in accessible centres. A passenger rail extension from Leppington would improve the prospects for planning a future major centre. Without rail, although development would not be precluded, low densities around smaller local centres would be a more likely outcome.

The site would not represent a southern extension of urban growth in Penrith due to the distance as well as its separation by Orchard Hills and the RAAF site.

Capacity of Badgerys Creek site for residential development

The site has an area of approximately 1 693 hectares. It is estimated that 80 per cent of that area, or 1 364 hectares could be available for urban development. Assuming an average gross or neighbourhood residential density of 15 dwellings per hectare, the site, subject to detailed constraints mapping and precinct planning, could possibly accommodate up to 20 000 dwellings. At an average occupancy rate of 2.3 people per dwelling, this would result in approximately 47 000 residents.

It is more likely that a yield of 20 000 (or more) dwellings would be achieved with provision of a new major centre located on a rail extension into the site from Leppington. Without the scale of activity and accessibility offered by a rail connection the site could probably only support smaller, local centres.

However, it is important to consider the residential development potential of the site in conjunction with the additional capacity for residential development potentially available in the north-western part of the South West Growth Sector – an area currently identified for industrial and employment uses to complement an adjacent airport. Combined with additional capacity in the South West Growth Centre, the area could potentially provide capacity for in excess of 26 000 dwellings or 60 000 additional residents.

Need for new centres
The structure planning for the South West Growth Centre sets a local precedent for the coordinated planning of greenfield release areas, which provides an urban structure based upon a network of centres connected by a legible and predictable street pattern, with a mixture of different housing typologies at varied densities. Any future residential development on the Badgerys Creek site would have to be planned and delivered following a similar pattern.

In particular, new development of the site for residential development would need to make provision for the extension of the network of Local Centres provided for in the South West Structure Plan.

The potential for a new Major Centre would be dependant upon a range of factors, including:

- extension of the South West Rail Link beyond Leppington
- future uses of non-urban land to the north of the site, extending towards the southern urban area of Penrith; and
- the extent of additional demand for retail premises, business premises and office premises generated by residential development on the site, and potentially on parts of the north-western section of the South West Growth Centre (SWGC) currently identified for industrial/employment purposes.

Residential (growth centre expansion) option - snapshot

Opportunity:

- Could be serviced as part of extension to SWGC; could be preferred extension to urban footprint when SWGC complete.

Constraints:

- Demand for residential use is unlikely to warrant release before take-up of supply in the SWGC (2040+) unless greenfield delivery across metropolitan area is accelerated.
- Residential use would place additional pressure on infrastructure costs (soft infrastructure and services).

Triggers:

- Take-up of northern residential precincts in the SWGC complete.
- Provision of trunk infrastructure extending from the SWGC.

Arguments for residential development at Badgerys Creek

- The site represents a long term strategic holding for residential development.
- There is likely to be housing demand in the very long term in outer Western Sydney.
- The single ownership of such a large (relatively unconstrained) site would improve prospects for orderly release and quality urban design.
- The site would be able to be serviced economically as an extension of staged residential growth in the SWGC.
- There is an opportunity to tie-in with centres structure and transport concepts of SWGC – including the potential for a major centre based on a passenger rail extension from Leppington.
- Would avoid the need to open more costly and less environmentally suitable development fronts in South West Sydney (e.g. Macarthur South).

Arguments against residential development at Badgerys Creek

- The demand is currently beyond the timeframe of the SWGC.

- There is no existing infrastructure and transport capacity – this relies on the long term success of the SWGC and associated infrastructure investment.
- If released early, the site would compete with and possibly compromise the orderly economic development of the Growth Centres which relies on prioritisation of infrastructure funding.
- Subdivision and development of the site as residential land might limit the potential for the site to be developed for a major public purpose beyond 2036.

5.3 Agribusiness option

The site currently has agricultural uses operating and has good land capability for additional agricultural activities because of favourable site conditions and its strategic location. Other advantages of the site that would support agribusiness use include:

- Good infrastructure (water, electricity, roads) for agricultural activities and suitable topography and soils.
- Good access to market, with access to the motorway network. This is of particular importance to industries that produce perishable goods and require direct access to metropolitan markets such as poultry and vegetables.
- Appropriate buffers that are needed for agricultural production to be separated sufficiently from urban areas. Land use conflict arises through urban encroachment in established agricultural areas and it becomes increasingly difficulty for producers to provide these buffers.
- The site is well located to potentially provide sites for new and displaced producers following urban development. A 2009 study by Industry and Investment NSW show that more than 50 per cent of Sydney's identified vegetable farms are in the North West and South West Growth Centres. While agricultural uses in these areas may continue for many years, they may face increased restrictions in their activities as a result of other land uses.

Agricultural uses are currently operating on the site on a limited basis. There are various opportunities for agriculture to operate on the site and are explored below.

Agricultural uses - short to medium-term and co-location

Opportunities for agriculture could be explored and promoted for the short and medium-term. This could include granting of medium term leases for agricultural uses on the site which may be designated for other purposes in the long term. Through government working with private sector these operations could come on line in a relatively short time period with minimal infrastructure investment. Some industries have the flexibility to operate with short to medium term leases, for example mushroom industry (with high turnover) and field vegetable growers (minimal infrastructure investment).

If employment (industrial) land uses are earmarked, co-location opportunities may exist for industrial and hi tech agricultural business in the long term. For example greenhouse horticulture has similar attributes and challenges to industrial activities. Greenhouses are typically not soil dependent and could locate with certain industrial activities, with potentially water reuse and energy sharing from adjacent buildings.

Source and sustainability of water supply will be required to be considered. Government would work with private operators to explore leasing opportunities and demand for viable industries being attracted to the site. Other issues to consider may be biosecurity (for some industries) and the source and sustainability of water supply. Depending on the types of industries, additional infrastructure may be required to the site. Government assistance in attracting business to lease the site will be required.

Agribusiness park

An ‘agribusiness park’, similar to industrial park, is where a site is dedicated to attract new agriculture related businesses by providing integrated infrastructure in one location. The parks are usually located on the fringe of major urban areas, have good transportation access and provide for localised planning and environmental controls that are specific to the needs of the area. Agribusiness parks are suitable to accommodate a range of hi tech and industrialised agricultural businesses such as poultry, greenhouse and speciality food and co-located businesses such as freight, packing, manufacturing and research centres.

Agribusinesses operate successfully overseas such as Singapore, New Zealand and China. Australia does not currently have any agribusiness parks, however there is a proposal for a privately funded park ‘Produce from Heaven’ in Devonport, Tasmania. This park will combine producers, the private sector, office facilities, commercial test kitchens and packing facilities. The benefits of designated parks for agriculture may include:

- Long-term investment in high tech and innovative agricultural practices and increase employment and export opportunities.
- Concentrate dedicated infrastructure in area to reduce the per-business expense of that infrastructure.
- Foster industry confidence through certainty.
- Provide shared facilities – such as bulk purchasing, recycling waste by products, share knowledge and research.
- Monitor and control environmental impacts collectively.

An Agribusiness model could require private sector working with government to attract business, current and proposed adjacent land uses and environmental and planning controls. It is considered infrastructure requirements, similar to an industrial park, would be upgrades to roads, provision of electricity, gas, water and sewerage. Other key issues to consider would be biosecurity (for some industries) and the source and sustainability of water supply.

Agribusiness option – snapshot

Opportunity:

- Good access to markets and proposed use provides buffers to urban areas and site is well located for displaced businesses.
- Flexibility to be short to medium-term land use with options for varying degrees of infrastructure investment dependent on intensity of land use.

Constraints:

- Provision of a sustainable water supply would require significant government investment and planning.
- Further market sounding and analysis of demand.
- Assessment of biosecurity risks.

Triggers:

- Delivery of water infrastructure.
- Economic development initiatives.

5.4 Other commercial (tourism/education)

Other commercial are generally identified and developed on-foot of a specific concept or use with targeted economic development investment. Such uses are generally proposed by specific proponents in form of unsolicited proposals to government. In lieu of a specific proposal emerging no detailed evaluation has been undertaken in this regard.

5.5 Transport impacts and scenarios

The future mix and intensity of land uses on the Badgerys Creek site will determine the transport needs of the site. In any case, the transport needs of the site will need to be considered in the context of growth and development in Western Sydney, and the South West Growth Centre and the Western Sydney Employment Area in particular. Given the growth path for Western Sydney and the South West Growth Centre are more certain, transport planning for these areas might influence the possible uses for the Badgerys Creek site.

The Metropolitan Plan for Sydney 2036 outlines several key transport projects that could help shape development patterns at the Badgerys Creek site, such as the Western Sydney Freight Line, the Eastern Creek Intermodal Terminal and the Outer Western Sydney Major Orbital Corridor.

Current transport services

The Northern Road is a major arterial road that skirts the west of the Badgerys Creek site. It connects the South West Subregion to Penrith Regional City. Elizabeth Drive connects the site to the M7 Motorway and Liverpool Regional City. Badgerys Creek Road is a collector road running north-south through the site. There are also several local and rural roads. At present, three local bus routes serve the Badgerys Creek/Bringelly/Luddenham area, providing links to Liverpool and Penrith. There are no heavy rail services to the area at present, either for freight or passenger transport.

Potential future transport requirements for an employment use option

As stated earlier, the Metropolitan Plan for Sydney 2036 includes several major transport projects that could have some bearing on the Badgerys Creek site. Development of the Badgerys Creek site for non-aviation purposes would not trigger the need to review the Metropolitan Plan, but would require detailed structure planning to resolve future transport infrastructure requirements.

The Eastern Creek area, near the junction of the M4 and M7 Motorways, has been identified as a possible location for a new intermodal terminal, associated with the potential Western Sydney Freight Line. The indicative alignment and freight line, as shown in the Metropolitan Plan, does not connect to the Badgerys Creek site. Therefore, the site has very limited potential to be developed as an intermodal terminal associated with the dedicated freight rail and motorway network. Furthermore, given the site's relative distance from the dedicated freight rail and motorway network, it would be difficult to manage the transport of freight to and from this location without significant investment in transport infrastructure. It may also bring forward the timeframe for selecting a corridor and constructing an Outer Western Sydney Orbital Motorway.

The Western Sydney Employment Area – Potential Expansion extends south west from the Western Sydney Employment Area at the junction of the M4/M7 motorways, down to and including the Badgerys Creek site. It is expected that a large proportion of Sydney's future employment land could be accommodated here. Development of the Western Sydney Employment Area will have significant implications for transport infrastructure. This could include new and upgraded arterial roads and interchanges with the M7 Motorway, as well as the dedicated freight rail and intermodal terminal infrastructure identified in the Metropolitan Plan.

Potential future transport requirements for a residential use option
The Metropolitan Plan for Sydney sets clear policy with regard to areas for urban expansion and integrating transport and land use. Development of the South West Growth Centre will be supported by the South West Rail Link, as well as strategic bus corridors. At present, there is insufficient transport infrastructure and road capacity in and around the Badgerys Creek site to allow development of the site for residential purposes.

If the Badgerys Creek site were to be developed as a residential release area, it is assumed that it would be developed to a similar intensity as nearby residential precincts in the South-West Growth centre. It is acknowledged that there is potential for the site to be developed to contain a new major centre similar to Leppington or Rouse Hill, however even without this level of development, significant investment in additional transport capacity would be required.

Construction of stage two of the South West Rail Link from Glenfield to Leppington has been approved and is expected to complete by 2016. Development of the site could be supported by an extension of the South West Rail Link beyond Leppington via Bringelly, which is beyond current transport plans to 2036.

Residential development would also require major improvements to the arterial road network, such as The Northern Road, Elizabeth Drive and Bringelly Road. Residential development may also bring forward the timeframe for selecting a corridor and constructing an Outer Western Sydney Orbital Motorway. There may be a need to upgrade the capacity of interchange connections to the existing motorway network as well, however it is not likely that is would be solely as a result residential development at Badgerys Creek.

Strategic bus corridors will play an important role in connecting the South West Growth Centre to other strategic centres in Western Sydney such as Penrith, Liverpool, Campbelltown-Macarthur and the planned major centre at Leppington. A planned strategic bus corridor linking Leppington to Penrith is included in the Metropolitan Plan, following The Northern Road corridor along the south-western edge of the Badgerys Creek site. Additional strategic bus corridors may be required to service residential development at the site, and this will depend to a large degree on the scale of residential development and the hierarchy of centres planned for the site.

Potential future transport requirements for an agricultural use option
The development of the Badgerys Creek site as an agricultural or agribusiness precinct may have some implications for transport, such as the need for road or intersection upgrades. These requirements could be similar to the transport requirements for light industrial development with a low employment density, but would not be as great as if the site were developed for more intense employment or residential purposes. This would need to be confirmed by more detailed analysis.

The Metropolitan Plan for Sydney anticipates the development of very fast rail corridors linking Sydney to other cities in Eastern Australia. Indicative corridors are shown leading to the south from Liverpool and to the north from Hornsby.

Active transport including walking and cycling is an important form of transport. As with any major land release, detailed structure planning will be essential to create urban environments which can support active transport. There will be costs associated with the provision of walking and cycling paths and infrastructure, which are not likely to be significant, compared to other transport infrastructure requirements. At present, the site is not connected to the regional cycleway network, and the NSW Bike Plan does not propose any new regional cycleway links in this area.

6.0 Infrastructure costs

The information provided in Appendix A outlines the potential infrastructure requirements identified through the Western Sydney Employment Lands Investigation Area (WSELIA) Infrastructure Plan 2008 and considerations in the context of planning for the South West Growth Centre. The WSELIA Infrastructure Plan was prepared in conjunction with the WSELIA draft structure plan which was presented as a draft in September 2008 but not released. It should be noted that the WSELIA draft Structure Plan does not represent a funding commitment from government.

Indicative infrastructure costs are provided for this report. Infrastructure costs for the Badgerys Creek site will require specific detailed investigation during subsequent stages of planning.

Infrastructure costs summary (long-term use options only)[4]

	Employment	Residential	Mixed
Regional roads	c.$300m	c.$300m	c.$300m
Utilities	c.$650-750m	c.$650-750m	c.$650-750m
Social infrastructure	Likely to be minor	Likely to be significant	Likely to be significant
Rail	n/a	Possible rail link from Leppington (uncosted)	Possible rail link from Leppington (uncosted)
TOTAL	$1bn	$1bn+ social and possible rail	$1bn+ social and possible rail

Estimated social infrastructure requirements

Social infrastructure requirements	
Primary Schools	13
High Schools	4
TAFE / University	Not considered
Hospital beds (nearest hospital)	45
Community health centre	2
Youth centre	2
Community service centre	1
Childcare	1 per 5 preschool children

[4] Further modelling required by Transport for NSW

Branch library	1.5
District	1
Performing arts centre	1.5
Emergency services	To be determined
Local community centre	7.5
District community centre	2

Project specific infrastructure cost estimates (as currently available)[5]

	Heavy industrial	Light industrial	Residential
Upgrade of The Northern Road	$275 million	$275 million	$275 million
Badgerys Creek Road extension	$36 million	$36 million	$36 million
Rail from Leppington to site	N/A*	N/A*	$1,600 million
Electricity	Not available	Not available	$75 million
Wastewater and recycled water	$678 million	$678 million	$578 million
Total	**$989 million**	**$989 million**	**$2,564 million**

* A dedicated freight rail connection via a corridor other than the South West Rail Link has not been considered.

[5] Further modelling required by Transport for NSW

Appendix A - Indicative infrastructure costs using WSELIA draft report (2008)

Infrastructure items and requirements that could be considered specific needs of the Badgerys Creek site are highlighted in italics in the infrastructure table below. The costs can only be treated as indicative strategic costs. Both the specific infrastructure needs and associated costs for the Badgerys Creek site will require specific detailed investigation. Please note the telecommunications and gas requirements have not been included as part of this strategic exercise.

Item	Description	Broader WSELIA requirement cost including Badgerys Creek specific costs	Badgerys Creek specific cost	Badgerys Creek specific costs including indicative rail
Rail	Rail opportunities require further investigation. A rail link from the existing Glenfield to Leppington line would require a minimum of 9km of line. The cost of the Glenfield to Leppington component of the South West Rail Link has varied from $1.4 billion in November 2009 to $2.1 billion in May 2010. The line length of the current project is 11.4 km.			$1.6bn
Roads - regional	*Upgrade Northern Road to 6 lanes divided between Great Western Highway and Bringelly Road*	*$275m*	*$275m*	*$275m*
	Upgrade Mamre Road to 4 lanes divided between Great Western Highway and Elizabeth Road	$440m		
	Upgrade M7 to 6 lanes divided	$400m		
	Badgerys Creek Road extension past Elizabeth Drive, connecting with Luddenham Road (2 lanes/2 ways).	*$36m*	*$36m*	*$36m*
Roads - South West Growth Centre	*Upgrade Elizabeth Drive to 4 lanes divided between Northern Road and Edmondson Avenue*	*$150m*	*$150m*	*$150m*
	Upgrade Devonshire Road to 4 lanes divided between Fifteenth	$120m		

	Avenue and Elizabeth Drive			
	Upgrade section of Fifteenth Avenue to 4 lanes divided from Devonshire Road	$200m		
	Upgrade and extend Edmondson Avenue to 4 lanes to Elizabeth Drive at Mamre Road	$200m		
	Fifteenth Avenue extension west to Northern Road.			
Roads - future regional roads	Construct 4 lane divided link road between Mamre Road and Great Western Highway on towards Werrington Arterial	$60m		
	Upgrade Wallgrove Road to 4 lanes divided between Elizabeth Drive and Rousell Road as required (subject to M7 saturation)	$180m		
Electricity	Strategic cost estimate proportional based on Integral Growth Centre cost estimate of $250 M for 110,000 lots. At 15 ha/lot at Badgerys Creek with a site area of 1,700 ha. Contingency cost estimate $3,000 per lot.		$75m	
Telecommunications	*Develop and adopt a common strategy for delivery of high speed broadband services*			
	Develop and adopt a common planning scheme for telecommunication infrastructure			
Gas	*Boost supply pressure and amplify piping as based on demand*			
Water - potable water	Connect supply line between trunk main planned for South West Growth Centre for WSELIA (2 phase strategy with phase 1 [i.e. north east WSELIA] estimated at $45M by Sydney Water)			
	Identify and reserve suitable land for two potable water reservoirs; one east and one west of South Creek			
Wastewater and recycled water	Identify site for new sewerage treatment plant			
	Evaluate best option for wastewater management and excess recycled water: *Option A* - build a typical storage system and discharge excess			

	recycled water to South Creek; or *Option B* - construct significant recycled water storage to store all excess recycled water in dry weather conditions and discharge excess water to South Creek			
	Connect planned recycled water assets with those planned in WSELIA to create an integrated recycled water network			
	Strategic cost estimates for the provision of providing water/waste water. Costs include all trunk infrastructure (network and treatment), lead ins and associated land acquisition.			
	Full residential - $22,000/ET x	*$578m*	*$578m*	*$578m*
	Full light industrial - $26,000/ET =	*$678m*	*$678m*	*$678m*
	Warehousing - $13,000/ET =	*$339m*	*$339m*	*$339m*
	Heavy Industrial – estimated to be above full light industrial estimate but depends on the use.	*$678m*	*$678m*	*$678m*
Total strategic infrastructure costs				
Full residential		**$2.7bn**	**$1.1bn**	**$2.7bn**
Full light industrial		**$2.8bn**	**$1.2bn**	**$2.8bn**
Full heavy industrial (costs would vary depending on end use)		**$2.8bn**	**$1.2bn**	**$2.8bn**

Full warehousing		**$2.5bn**	**$860m**	**$2.5bn**
Full agribusiness park		**$2.8bn**	**$1.2bn**	**$2.8bn**

* Items taken from WSELIA Infrastructure Plan at pages 21 – 24 and informed by strategic requirements identified by Infrastructure Coordination

** Costs taken from WSELIA Infrastructure Plan at pages 26, 34 and 35 and informed by strategic estimates for water/waste water and electricity servicing requirements from Infrastructure Coordination.

*** The infrastructure estimates for the Badgerys Creek site are based on a site area of 1 800 ha and 15 lot/ha yield for residential assumption.

**** Agribusiness Infrastructure requirement are based solely on light industrial costs. Detailed investigation is required to determine specific infrastructure needs.

N.b. All road and rail costs require further modelling by Transport for NSW.

Appendix B - urban capability

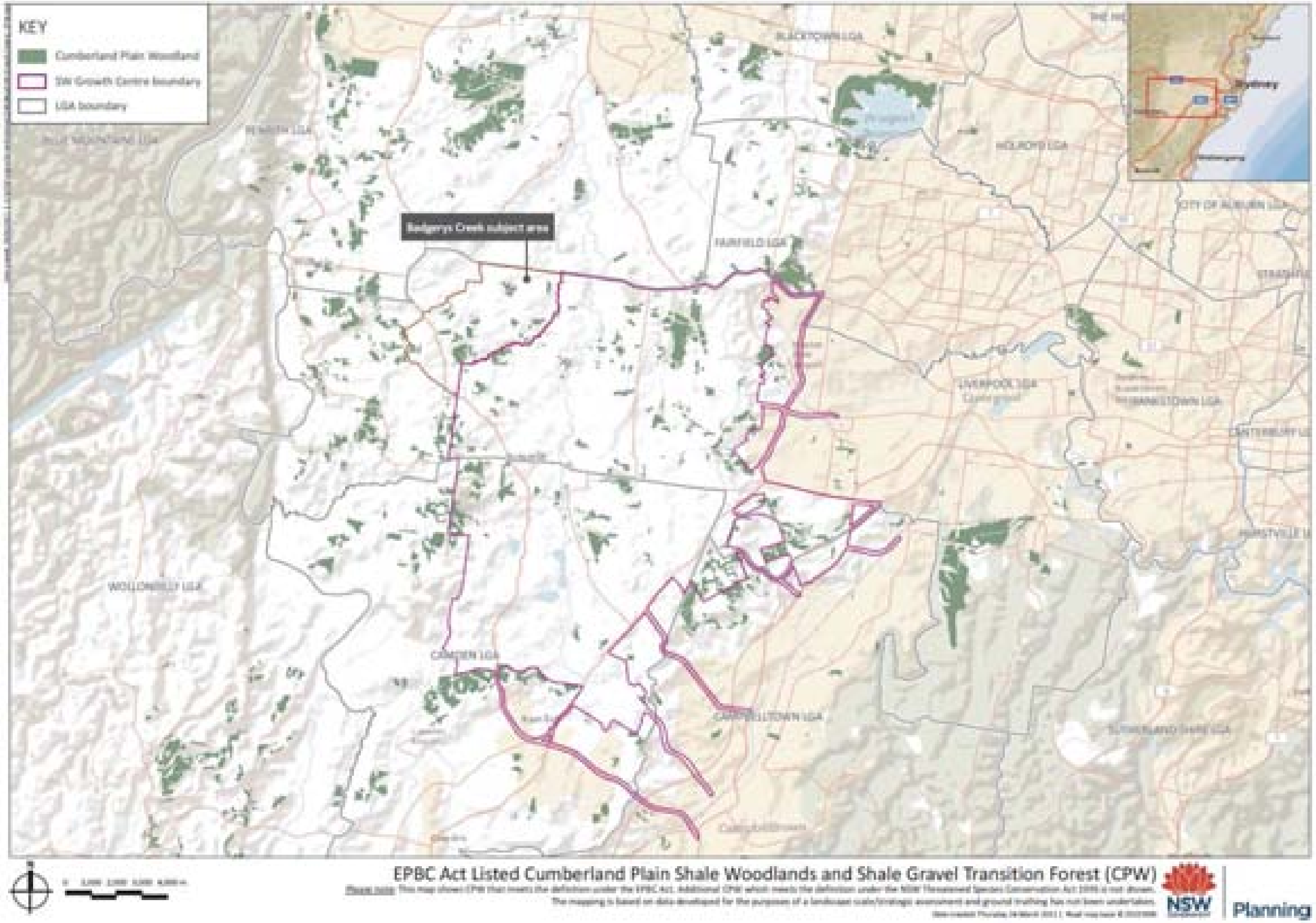
Desktop assessment indicates that scattered pockets and some larger areas of shale plains woodland and shale hills woodland (Cumberland Plain Woodland) are located on the site. These are endangered ecological communities under the NSW *Threatened Species Conservation Act 1995* and *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). Map 4 shows the location of the Commonwealth listed Cumberland Plain Woodland mapped at the landscape scale for the Growth Centres Strategic Assessment. Maps 5 and 6 show site and regional context.

Under the EPBC Act any proposal, including the sale of the land that would impact on the Cumberland Plain Woodland or other matters of National Environmental Significance would require referral to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities to ensure matters of biodiversity are addressed.

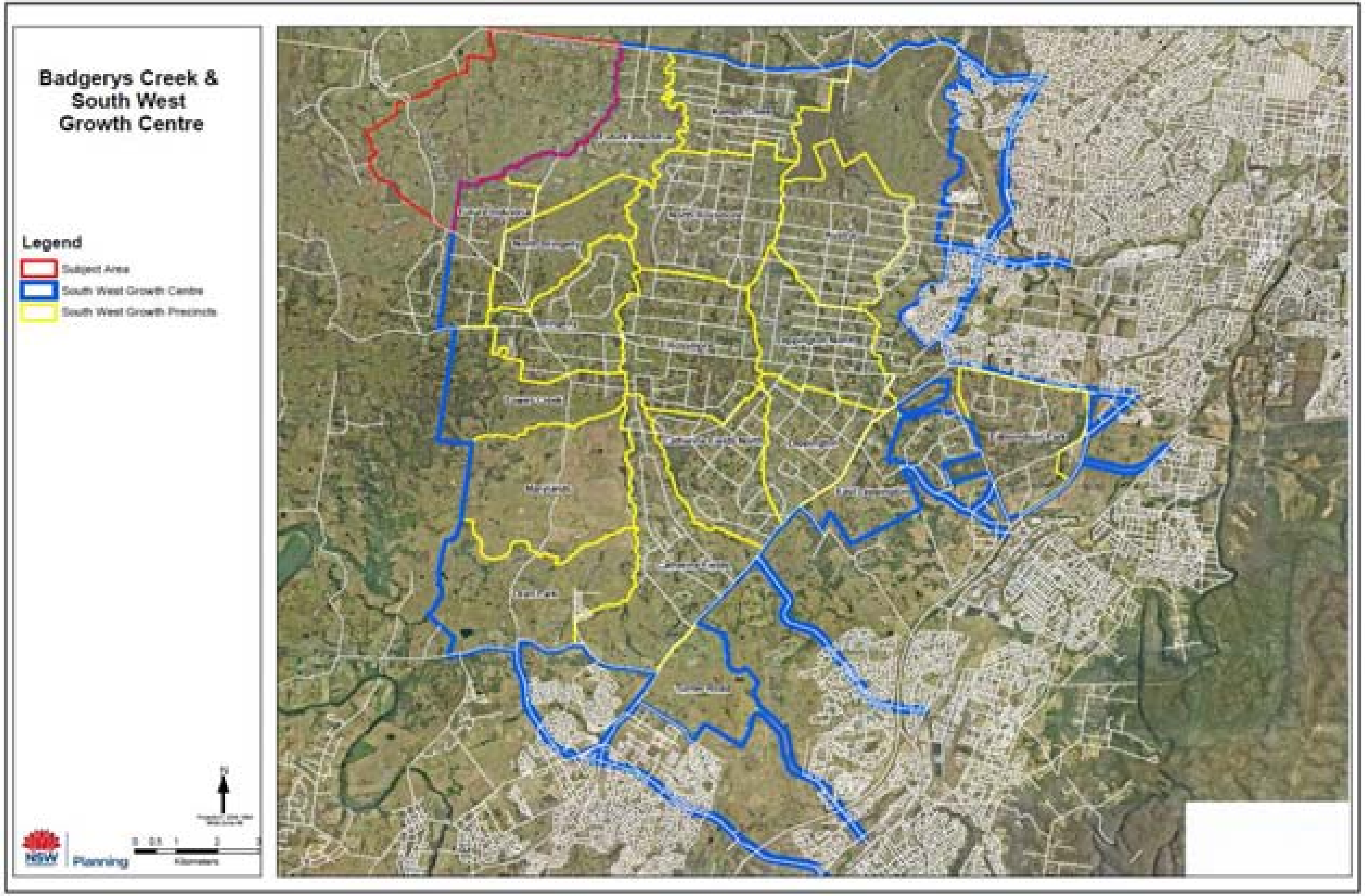
Threatened fauna (Cumberland Plain Land Snail and Eastern Bent-wing Bat) and flora (Pultenaea Parviflora) have been previously recorded in the area. Any proposal on the site would require referrals to the NSW Department of Environment, Climate Change and Water.

Based on previous heritage studies, there are identified recorded indigenous and non-indigenous sites at Badgerys Creek. Any development proposed on the site should consider this and undertake a field survey, consultation with the aboriginal community and additional historic research be undertaken to better determine development constraints of the land.

Map 4 - Cumberland Plain Woodland



Map 5 - Badgerys Creek and SWGC precincts



Map 6 - Badgerys Creek site aerial photo