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M12 Motorway Strategic Route Options Analysis

Options Identification Report

December 2015

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Executive summary

The project

The Australian and NSW governments are funding a 10 year, $3.6 billion road investment program for western Sydney. The Western Sydney Infrastructure Plan will deliver new and upgraded roads to support integrated transport in the region and capitalise on the economic benefits from developing the proposed western Sydney airport at Badgerys Creek.

As part of the plan, Roads and Maritime Services (Roads and Maritime) are proposing to build a new M12 Motorway which will provide direct access to a western Sydney airport at Badgerys Creek and connect to Sydney's motorway network.

Roads and Maritime has engaged Aurecon Australasia Pty Ltd to carry out a strategic route options analysis to determine the preferred route for the M12 Motorway between the M7 Motorway, Cecil Park and The Northern Road, Luddenham (the project). This report identifies the long list route options for the M12 Motorway and describes the process that was used to generate the long list. The M12 Motorway forms part of the Western Sydney Infrastructure Plan.

Purpose of the report

The purpose of this report is to develop and assess potential route options for the development of the M12 Motorway. The report identified long list of route options and considers the social, environmental and engineering constraints of the study area.

Need for the project

The Australian Government announced the site of a proposed western Sydney airport at Badgerys Creek in April 2014, with construction of the airport expected to begin in 2016. The M12 Motorway is required to support the opening of the proposed western Sydney airport at Badgerys Creek, expected to commence operations in the mid 2020's.

The M12 Motorway will be a four lane (with capacity for a future six lanes) motorway between the M7 Motorway and The Northern Road. As well as supporting the proposed western Sydney airport, Western Sydney Priority Growth Area (WSPGA) and to address the future use of Elizabeth Drive; the motorway will be an important component of the Western Sydney road network that would cater for increased traffic volumes from future developments such as the South West Priority Land Release Area and the WSPGA.

The study area

The M12 Motorway study area has been developed around Elizabeth Drive. Elizabeth Drive is bounded to the north by the Western Sydney Priority Growth Area (WSPGA) and the suburbs of Kemps Creek, Mt Vernon and Cecil Park. To the south, Elizabeth Drive is bounded by the proposed western Sydney airport at Badgerys Creek, the WSPGA and Western Sydney Parklands.

Identification of long list route options

To help identify potential route options, the study area was assessed for potential environmental and engineering opportunities and constraints. These constraints included vegetation communities, heritage sites, land uses and proposed development, soil and water quality, flooding behaviour, geotechnical aspects and utility installations.

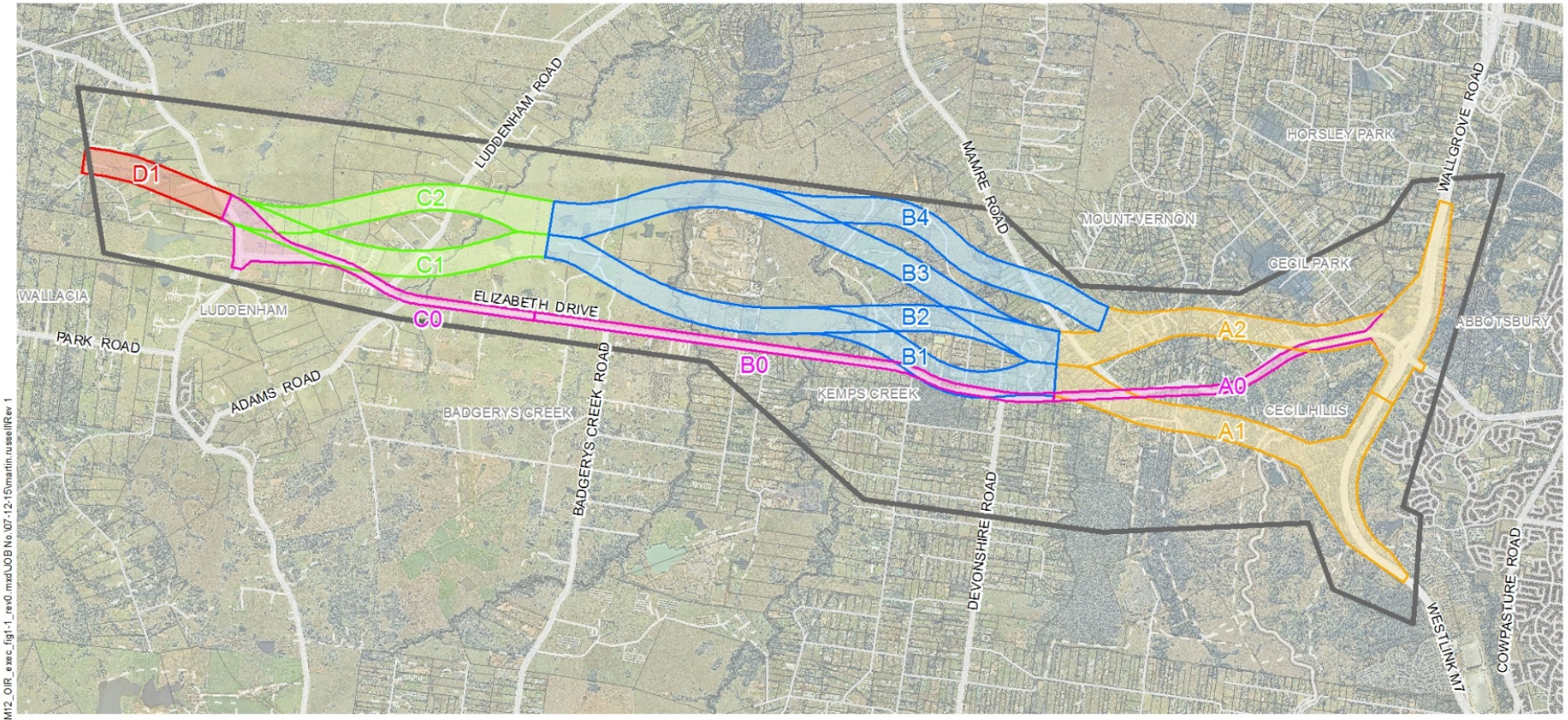
The Quantm software package identified a long list of feasible route options based on a combination of design standards, terrain, geological, and hydrological data, environmental areas, property ownership, and cost information.

Long list of route options

The study area was divided into four zones (labelled A to D) representing sections from east to west. Within each zone, a variety of corridor options were identified which provided the basis for identifying a long list of route options (refer to Table 1-1 and Figure 1-1).

Table 1-1 Long list of route options and their corridor option components

Route option	Zone A	Zone B	Zone C	Zone D
1	A0	B0	C0	D1
2	A1	B1	C1	D1
3	A1	B1	C2	D1
4	A1	B2	C1	D1
5	A1	B2	C2	D1
6	A1	B3	C1	D1
7	A1	B3	C2	D1
8	A2	B1	C1	D1
9	A2	B1	C2	D1
10	A2	B2	C1	D1
11	A2	B2	C2	D1
12	A2	B3	C1	D1
13	A2	B3	C2	D1
14	A2	B4	C1	D1
15	A2	B4	C2	D1



Legend

Long list corridor options

- Option A0
- Option B0
- Option C0
- Option A1
- Option A2
- Option B1
- Option B2
- Option B3
- Option B4
- Option C1
- Option C2
- Option D1
- M12 study area
- Major road
- Local Road
- Track

Source: Nearmap, LPI, Aurecon

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Projection: GDA 1994 MGA Zone 56

M12 Strategic Route Options Analysis **Options Identification Report**

FIGURE 1.1: Long list corridor options

Next steps

Roads and Maritime will undertake a value management workshop to short list of route options. This workshop will gain stakeholder input into the relative benefits of each route option and the assessment of the options done to date.

Once a short list of route options is selected, Roads and Maritime will consult with the community about the selected route options and undertake additional investigations.

Roads and Maritime will consider community feedback and additional investigations to select a preferred route. The selection would be undertaken once a Value Management workshop has been undertaken and stakeholders have had input into the short listed options.

The preferred route, once selected will be made public to the community. The project will then be further refined and project approval sought from the NSW Government.

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Appendices

1 Introduction

1.1 Project background

Roads and Maritime Services (Roads and Maritime) has engaged Aurecon Australasia Pty Ltd to carry out an options analysis study to determine the preferred route for the M12 Motorway between the M7 Motorway, Cecil Park and The Northern Road, Luddenham (the project). The M12 Motorway forms part of the Western Sydney Infrastructure Plan (WSIP).

1.1.1 Western Sydney Infrastructure Plan

The WSIP is a joint initiative of the Australian and NSW governments to fund a $3.6 billion road investment program for western Sydney. WSIP will deliver major road infrastructure upgrades to support an integrated transport solution for the western Sydney region and capitalise on the economic benefits from developing the proposed western Sydney airport at Badgerys Creek. WSIP will improve road transport capacity ahead of future traffic demand generated by the planned residential and employment development for the Western Sydney Priority Growth Area. This work will transform the region's economy and make western Sydney an even better place to live and do business.

There are five main projects included in the WSIP. These are split into 10 stages ranging from early development to construction. The projects include the construction of new roads and significant road upgrades, as follows:

- M12 Motorway between the M7 Motorway and The Northern Road generally parallel to the Elizabeth Drive alignment (the subject of this study)
- The Northern Road upgrade between Narellan and the M4 Motorway (four stages)
- Bringelly Road upgrade between The Northern Road and Camden Valley Way (two stages)
- Werrington Arterial Road Stage 1
- Additional local road upgrades near the proposed western Sydney airport at Badgerys Creek, to be proposed and managed by local councils.

1.2 Need for the project

1.2.1 Strategic need

The M12 Motorway is required to support the opening of the proposed western Sydney airport at Badgerys Creek. The M12 Motorway will be a four lane (facilitating a future six lane) motorway between the M7 Motorway and The Northern Road.

The Australian Government announced the site of the western Sydney airport in 2014. The environmental impact statement for the western Sydney airport been prepared, and was placed on public display towards the end of 2015. If the project is approved, construction is expected to begin in 2016, becoming operational in the mid 2020s.

The M12 Motorway is also required to cater for the increased traffic volumes from future development in areas surrounding the proposed western Sydney airport, which are to be further developed into the Western Sydney Priority Growth Area. Other planned road upgrades in western Sydney would also cater for increased traffic volumes from these future developments.

1.2.2 State Plans

State Priorities

In 2015, the NSW Government released the State Priorities to grow the economy, deliver infrastructure, and improve health, education and other services across NSW. There are 30 state priorities. Twelve of these form the Premier's Priorities.
There are three priorities that are relevant to the project, being:

- Reducing road fatalities
- 90 per cent of peak travel on key road routes is on time
- Maintain or improve reliability of public transport services over the next four years.

The project would provide improved road capacity and be the main access from Sydney to the western Sydney airport at Badgerys Creek. In addition, the motorway will reduce road fatalities.

Metropolitan Strategy for Sydney to 2036

The Metropolitan Strategy for Sydney (DP&I, 2013a) sets out a long-term strategy to develop Sydney as a 'city of cities'. This includes developing cross-regional transport connections. The plan commits to managing demand on the road network through measures such as strategic road upgrades.

One of the objectives in the strategy is to transform the productivity of western Sydney through growth and investment. As part of this objective, the aim is to improve transport links to support the growth of the western Sydney airport at Badgerys Creek.

The project is therefore consistent with the *Metropolitan Strategy for Sydney*.

NSW Long Term Transport Master Plan

The NSW Government released the *Long Term Transport Master Plan* in December 2012 (NSW Government, 2012). The Master Plan outlines planned and coordinated actions to meet the challenges of the NSW transport system, including the road network, in the next 20 years.

In particular, the Master Plan identifies the need to develop new transport connections to areas that support the South West Growth Centre (now the Western Sydney Priority Growth Area) as well as completing the Western Sydney Employment Area arterial road network. The project will therefore help to meet the actions identified in the Master Plan.

NSW State Infrastructure Strategy 2012

The NSW Government's *State Infrastructure Strategy* sets out the Government's commitment to infrastructure delivery and reform initiatives to December 2017 (NSW Government, 2012a). The strategy notes the need for new transport infrastructure for the North West and Western Sydney Priority Growth Areas.

While the strategy does not specifically identify the project, the *State Infrastructure Strategy Update* (NSW Government, 2014) notes that planning for the western Sydney airport at Badgerys Creek is proceeding and recommends that future transport corridors are required to connect the airport to the wider Sydney metropolitan area.

The project therefore aligns with the *State Infrastructure Strategy Update*.

Restart NSW

In June 2011, the NSW Government established Restart NSW, to fund a range of high priority future infrastructure projects in NSW. One of the infrastructure projects identified is the development of a road network to support the western Sydney airport at Badgerys Creek.

The project therefore aligns with Restart NSW.

National Infrastructure Plan

The *National Infrastructure Plan* was released in June 2013 (Australian Government, 2013). The plan acknowledges the future development of western Sydney as well as the potential western Sydney airport site as important areas for infrastructure investment. While the plan does not identify the M12 Motorway, it does include a program for bus priority and road upgrades.

However, overall the project is consistent with the *National Infrastructure Plan* by facilitating the growth and improving access of western Sydney.

Western Sydney Priority Growth Area

The M12 Motorway study area falls in the Western Sydney Priority Growth Area, located either side of Elizabeth Drive. The NSW Government is investigating opportunities for new jobs, homes and services around the planned western Sydney airport at Badgerys Creek and are in the process of preparing a draft Land Use and Infrastructure Strategy to guide new infrastructure investment, identify new homes and jobs close to transport, and coordinate services in the area.

1.2.3 Project objectives

Western Sydney Infrastructure Plan program objectives

As part of the WSIP project and the development of the M12 Motorway project, project objectives have been developed by Roads and Maritime. These project objectives provide goals and assessment measures for achieving project justification, fitness-for-purpose, and to guide success of the completed project.

The overarching WSIP program objectives are:

- Development and demand – Support the western Sydney airport, land use change, and residential growth; balancing functional, social, environmental and value for money considerations
- Connectivity to airport – Provide a resilient connection for freight and people to the proposed western Sydney airport
- Integrated network – Provide road improvements to support and integrate with the broader transport network
- Customer focus – Provide meaningful engagement with customers and stakeholders throughout the program life.

Project objectives

Roads and Maritime have set project specific objectives for the M12 Motorway being to:

- Provide direct motorway standard east –west connection between the M7 Motorway and The Northern Road via the proposed western Sydney airport allowing for future north–south connections
- Support the provision of an integrated regional and local public transport system
- Preserve the local access function of existing Elizabeth Drive
- Provide active transport in the east–west corridor
- Provision for future connection to Outer Sydney Orbital.

1.3 Purpose of the report

The purpose of this report is to develop and assess potential route options for the development of the M12 Motorway. The report identified long list of route options and considers the social, environmental and engineering constraints of the study area.

2 Community consultation

2.1 Community consultation activities

This section provides a summary of the community consultation carried out by Roads and Maritime Services (Roads and Maritime) to support the Western Sydney Infrastructure Plan (WSIP) between 13 July and 14 August 2015.

Consultation focused on four WSIP projects including the announcement of the proposed M12 Motorway project. The consultation tools and consultation activities used are presented in Table 2-1. The process included a number of community events to give the community a chance to hear more about the projects, meet the project team and have their say. Community members were encouraged to provide feedback to the project team through submissions at the information sessions or via mail, email or phone.

Table 2-1 Consultation tools and activities

Tool/activity	Details
Community update newsletter	Community update newsletters were produced for each of the projects on public display. Each included a general overview of WSIP, key features of the specific proposal and further information on providing feedback (including the information sessions). The newsletters were available online and at all community information sessions, and were also letterbox dropped to 20,700 local residences across the different project areas.
Postcard	A postcard was mailed to 47,000 local residences outlining WSIP, the projects on public display and further information on providing feedback (including the information sessions).
Door knock	590 homes were door knocked at the beginning of consultation. The purpose was to notify impacted home owners and residents of the projects and provide dates for the upcoming community information sessions. The relevant community update newsletter was passed to the resident. Where the door knock was unsuccessful, a 'Sorry We Missed You' flyer was left at the premises.
Media release	A media release was distributed to all major Sydney metro and local western Sydney publications on 14 July. It was titled 'Next major road upgrade stages announced for western Sydney' and encouraged local community members and stakeholders to get involved in the consultation process.
Newspaper advertisement	Eleven newspaper advertisements appeared between 14 and 21 July to raise awareness of the consultation and information sessions. Publications included the Penrith Press, Penrith Gazette, Penrith Western Weekender, South West Advertiser, Macarthur Chronicle, Liverpool Leader, Liverpool Champion, Sydney Morning Herald and Daily Telegraph.
Email	Direct emails were sent from Roads and Maritime to general stakeholders (community members and groups), local members of parliament (MPs) and other government stakeholders to raise awareness of the consultation and information sessions. A reminder email noting that consultation was closing on 14 August was also sent to stakeholders.
SMS	Reminder SMS messages were sent to an existing stakeholder and community database on the day before each information session.
Webpage	The project webpage (www.rms.nsw.gov.au/wsip) was updated on 13 July with the latest project information including all relevant community update newsletters and information on how to submit feedback. There were total of 3856 unique page visitors during the consultation period.

Tool/activity	Details
WSIP Portal	An interactive and user-friendly web portal (www.communityanalytics.com.au/wsip) covering all aspects of the WSIP was launched on 13 July. The web portal also includes a video outlining the plan and provides a space for viewers to leave feedback. There were a total of 2836 unique visitors to the web portal during the consultation period. A banner directing people to the portal was placed on the Roads and Maritime home page.
Information sessions	Six community information and feedback sessions were held between 22 July and 8 August 2015. The purpose was to provide the community with an opportunity to view all display materials, talk with members of the project team and submit their feedback in person. Project teams from Transport for NSW, Sydney Water, Department of Planning and Environment, and the Department of Infrastructure and Regional Development were also present at the sessions to provide information on other projects in the area. The community information and feedback sessions were: **Wednesday 22 July, 4pm – 8pm** Penrith Anglican College Gymnasium **Saturday 25 July, 12pm – 3pm** Bringelly Community Centre **Wednesday 29 July, 3pm – 7pm** Holy Family Primary School Hall **Saturday 1 August, 11am – 2pm** Glenmore Park Youth and Community Centre **Thursday 6 August, 3pm – 7pm** Kemps Creek Public School Hall **Saturday 8 August, 12pm – 3pm** Holy Family Primary School Hall
Electronic variable message signs (VMS)	Eight VMS were on display across The Northern Road, Elizabeth Drive and Bringelly Road during the consultation period to notify the community about upcoming information sessions.
Project posters	Project posters were displayed during the consultation period at Penrith Library, Penrith Civic Centre, Narellan Library, Camden Council, Camden Library, Liverpool Library, Liverpool Council and Fairfield Council.
Stakeholder briefings and one-to-one property owner meetings with property owners	The project team held one-to-one meetings with stakeholders and property owners such as private property owners; Penrith City Council; Liverpool City Council; Department of Defence; Heritage Branch, NSW Office of Environment and Heritage; University of Sydney; Penrith Golf and Recreation Club Ltd; Kindelon Pty Ltd; Westlink M7; Jamie Briggs' Office; Luddenham Public School; Holy Family Catholic Primary School; Luddenham Post Office; Duncan Gay, Minister for Roads, Maritime and Freight; Stuart Ayres, Member for Penrith; Tanya Davies, Member for Mulgoa; and Fiona Scott; Member for Lindsay.

2.2 Submissions received

Across the consultation period for the entire WSIP program, 296 submissions were received. Key feedback topics included:

- Property acquisition
- Property value
- Property access
- Noise and air quality impacts
- Construction impacts on the local community and businesses
- Traffic impacts and management (congestion)
- Access to Glenmore Parkway, Mulgoa Road and the M4 Motorway

- Cycle access and facilities
- Design recommendations, particularly about intersection locations and the need to increase capacity
- Route options.

For the M12 Motorway project, submissions raised the following issues:

- Lack of consultation
- Design of the project and consideration of limitations from the western Sydney airport
- Impacts on existing homes
- Direct impacts on operating farms and commercial properties including farm dams and access
- Property acquisition
- Identification of threatened species in the study area
- Need to preserve vegetation in the study area and the Western Sydney Parklands
- Suggestion for the location of the M12 Motorway
- Request for a dedicated cycleway or shared paths in the M12 Motorway design
- Need to limit impact on the Wylde Mountain Bike Trail
- Economic impact on existing businesses on Elizabeth Drive
- Consideration for the upgrade of Elizabeth Drive rather than a M12 Motorway.

3 Constraints identification

3.1 Study area

The project is required to provide access to the western Sydney airport at Badgerys Creek, with the airport layout facilitating access from the north and Elizabeth Drive. As such, the study area for the project has been developed around Elizabeth Drive, connecting to The Northern Road and the rest of Sydney through the M7 Motorway (refer to Figure 3-1).

Elizabeth Drive is bounded to the north by the WSPGA and the suburbs of Mount Vernon and Cecil Park, and, to the south, by the proposed western Sydney airport at Badgerys Creek, the WSPGA, the suburbs of Kemps Creek and Badgerys Creek and the Western Sydney Parklands.

The topography in and around the study area is rolling hills and small valleys between generally north–south ridge lines. In the east and west of the study area, topography is gently undulating, flattening out in the middle of the study area, where it passes through the floodplains associated with Cosgrove Creek, Oaky Creek, Badgerys Creek, South Creek and Kemps Creek. There are also numerous farm dams in the area.

The study area is predominantly semi-rural and includes residential, agricultural, recreational, commercial and industrial land uses.

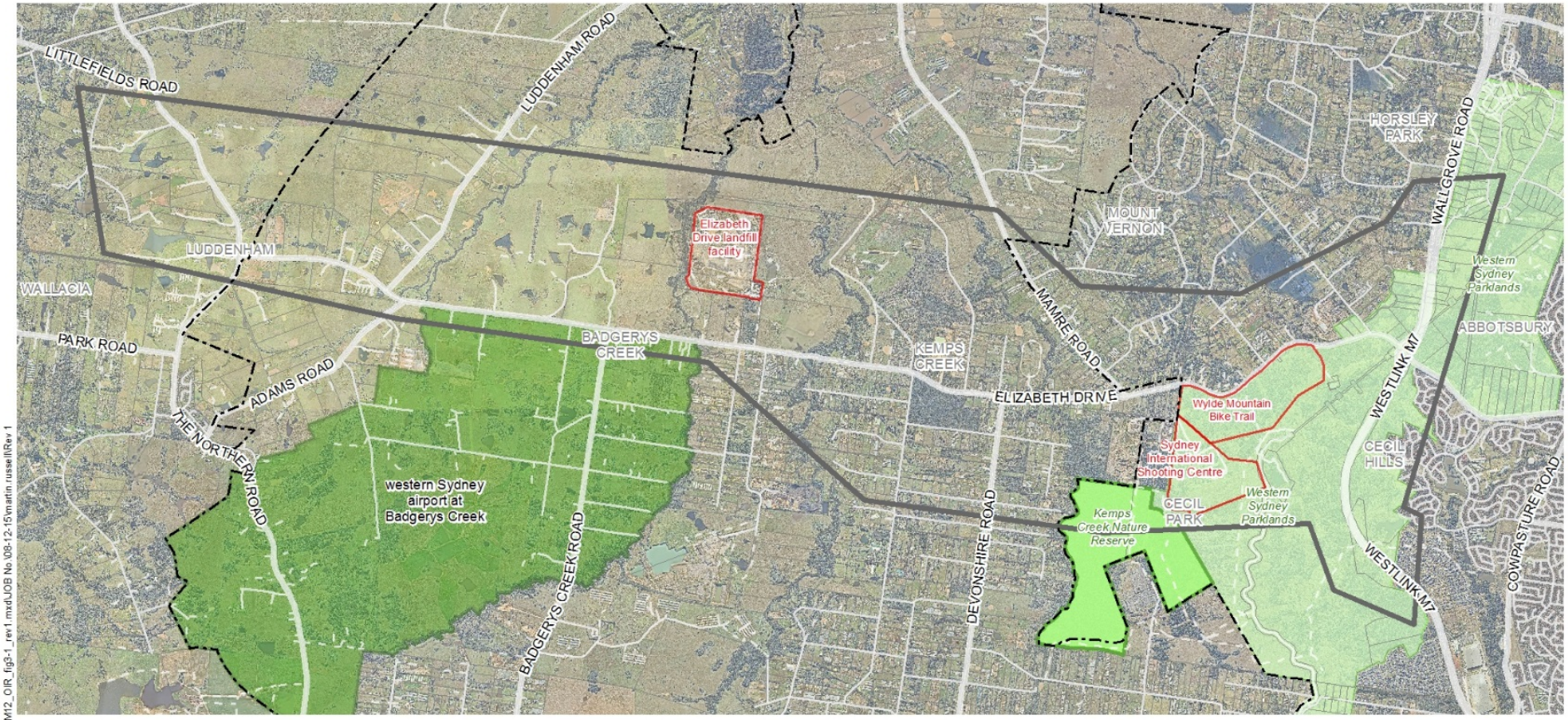
The main population centres are the suburbs of Kemps Creek, Mount Vernon and Horsley Park.

Agricultural land uses include poultry farming, farms producing tomatoes and cucumbers, commercial operations producing Christmas trees and Andreasens Green Wholesale Nurseries.

Recreational and community facilities include educational facilities such as schools and social facilities such as the Kemps Creek Sporting and Bowling Club, the Western Sydney Parklands (including the Wylde Mountain Bike Trail), Kemps Creek Nature Reserve and the Sydney International Shooting Centre.

Commercial uses are mainly associated with the Kemps Creek village including service stations, food stores and hardware/ maintenance shops.

Industrial uses include the Elizabeth Drive landfill and quarry sites.



Legend

- M12 study area
- western Sydney airport at Badgerys Creek
- Notable facilities
- Western Sydney Priority Growth Area
- Nature Reserve
- Western Sydney Parklands

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Source: Nearmap, LPI, Aurecon

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Projection: GDA 1994 MGA Zone 56

M12 Strategic Route Options Analysis **Options Identification Report**

FIGURE 3.1: Study area

3.2 Biodiversity

3.2.1 Overview

The study area is in the Cumberland Plain, which is an area of fertile soils west of the Sydney central business district. Most remnant native vegetation in this region is a fragmented fraction of what was originally present due to historical clearing; for agriculture and urban development. The majority of the remnant native vegetation in the study area is classified as threatened due to these previous impacts. As such, the study area contains threatened vegetation communities and species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or the NSW *Threatened Species Conservation Act 1995* (TSC Act).

Some regional-scale planning in the study area has already occurred for the former South West Growth Centre and the former Broader Western Sydney Employment Area (now the Western Sydney Priority Growth Area). Under the SEPP (Sydney Region Growth Centres) 2006[1], a certification was given to areas of land that have been certified for vegetation removal due to development or activities in the area under both Commonwealth and NSW legislation. This land is known as certified lands. Land that is not included in this area (ie non-certified lands) may be cleared of native vegetation for key infrastructure subject to addition approval, however impacts should be avoided where possible. In addition to retaining vegetation in the non-certified lands, ecological offsets from the Western Sydney Priority Growth Area are being sought outside the growth centre precincts in 'priority conservation lands'. These are key areas of larger and/or better connected native vegetation which are considered by the Office of Environment and Heritage as priority areas to conserve ecological values, and where greater conservation effort is being directed.

3.2.2 Conservation areas

The WSPGA and South West Priority Land Release Area (SWPLRA) south of Elizabeth Drive includes around 849 hectares of habitat identified for conservation and vegetation retention in the bio-certification order for the State Environmental Planning Policy (SEPP) (Sydney Region Growth Centres) 2006. This area includes 162 hectares of extant native vegetation (ENV) on non-certified land.

Kemps Creek Nature Reserve is in the south of the study area, next to the Western Sydney Parklands.

The study area also includes four areas, covering around 375 hectares, identified as a 'priority for conservation' as part of the Cumberland Plain Recovery Plan. One of these areas includes Kemps Creek Nature Reserve. However, the majority of the areas include a mix of tenure (both public and privately owned), including parts of the Western Sydney Parklands. These lands are identified as core biodiversity areas and priorities for investment to be secured for biodiversity conservation and protection as an offset to impacts in the Cumberland Plain.

There are also a number of regional habitat corridors, mostly associated with the riparian areas of the rivers and creeks that cross the area. These habitat corridors include South Creek, Badgerys Creek, Oaky Creek and Cosgroves Creek. These

[1] The State Environmental Planning Policy (SEPP) (Sydney Region Growth Centres) 2006 is still applicable to the Western Sydney Priority Growth Area.

corridors form a series of habitat linkages between priority conservation lands (identified as areas of core biodiversity) across the region. Many of the corridors include threatened vegetation and potential fish habitat.

Western Sydney Parklands

The Western Sydney Parklands are located at the eastern end of the study area. The parklands were originally identified in the 1968 Sydney Region Outline Plan to provide for infrastructure and future regional open space needs for a growing Western Sydney. Regeneration of the parklands has been ongoing since its establishment, including the Greening Western Sydney Program. This program started in 1992, with revegetation of Cecil Hills to Kemps Creek (in the M12 Motorway study area) occurring in 1998 (WSPT, 2013).

A Parklands Plan of Management has been prepared and includes a number of objectives relating to the use of the parklands. This includes for recreation and education, community facilities, biodiversity conservation, cultural community awareness, sustainable urban farming and water management (WSPT, 2010).

The Parklands Plan of Management identifies areas along the length of the parklands – in the Abbotsbury, Cecil Park North, Cowpasture and Cecil Park precincts – for management as bushland corridors to provide habitat connectivity. These areas have progressively seen extensive investment in revegetation to help re-create the vegetation communities that previously existed on the site, and contribute to the regional biodiversity connectivity of western Sydney (WSPT, 2010). Since 2010, about 180,000 plants added to the parklands, with about 1000 hectares of Cumberland Plain Woodlands regeneration undertaken.

Over 400 biobanking credits were created (since 2010) and just under 300 credits sold (WSPT, 2010).

Further information is provided in the land use section of the report (Table 3-8).

3.2.3 Vegetation communities

Seven vegetation communities are found in the study area in varying condition:

- Castlereagh Scribbly Gum Woodland – this occurs in and around Bill Anderson Park, Kemps Creek
- Castlereagh Swamp Woodland – there is a small amount in the Kemps Creek area, primarily in the Kemps Creek Nature Reserve
- Cooks River / Castlereagh Ironbark Forest – there is a relatively large area of this community south of Elizabeth Drive, next to Bill Anderson Park
- Cumberland Plain Woodland – this occurs across the study area, with concentrations and larger fragments between Kemps Creek and the eastern extent of the study area
- Moist Shale Woodland – this occurs to the east of the study area in the Western Sydney Parklands
- River-flat Eucalypt Forest – this is located along the creek lines that intersect the study area, particularly South, Kemps and Badgerys creeks
- Castlereagh Shale Gravel Transition Forest – this occurs in and around Kemps Creek, including in the Kemps Creek Nature Reserve.

A number of these vegetation communities are associated with threatened ecological

communities. These are:

- Six threatened ecological communities on the NSW *Threatened Species Conservation Act 1995* (TSC Act), listed as either vulnerable (VEC), endangered (EEC) or critically endangered (CEEC):
  - Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion (VEC)
  - Cooks River / Castlereagh Ironbark Forest in the Sydney Basin Bioregion (EEC)
  - Cumberland Plain Woodland in the Sydney Basin Bioregion (CEEC)
  - Moist Shale Woodland in the Sydney Basin Bioregion (EEC)
  - River-flat Eucalypt Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (EEC)
  - Castlereagh Shale Gravel Transition Forest in the Sydney Basin Bioregion (CEEC)
- Three vegetation communities with the potential to be listed as critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act):
  - Cooks River / Castlereagh Ironbark Forest in the Sydney Basin Bioregion
  - Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest
  - Western Sydney Dry Rainforest and Moist Woodland on Shale.

Threatened ecological communities in the study area are shown in Figure 3-2. Table 3-1 lists the area of vegetation communities in the study area and identifies the potential EPBC Act listed EEC that could be associated with that vegetation community.

Table 3-1 Vegetation communities in the study area

Vegetation community	Status (TSC Act)	Potential associated EECs (EPBC Act)	Total in study area (ha)
Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	EEC		53
Cooks River / Castlereagh Ironbark Forest in the Sydney Basin Bioregion*	EEC	Cooks River / Castlereagh Ironbark Forest in the Sydney Basin Bioregion (CEEC)	69
Cumberland Plain Woodland in the Sydney Basin Bioregion *	CEEC	Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC)	425
Moist Shale Woodland in the Sydney Basin Bioregion*	EEC	Western Sydney Dry Rainforest and Moist Woodland on Shale (CEEC)	15
River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC		205
Castlereagh Shale Gravel Transition Forest in the Sydney Basin Bioregion*	CEEC	Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC)	124
Total			892

* potentially listed as critically endangered under the EPBC Act
^ Vegetation mapped as having a relatively intact native tree canopy, midstorey or understorey
^^ Vegetation mapped with <10% canopy cover, in areas in rural or urban influence and land use
EEC – endangered ecological community; CEEC – critically endangered ecological community

3.2.4 Threatened species

Roads and Maritime undertook a review of the Atlas of NSW Wildlife (Bionet) in 2014. This review identified 41 threatened fauna and flora species in 10 kilometres of the study area. Thirty threatened fauna species have either been recorded or are known to occur. Threatened fauna species of concern due to their presence in the study area are:

- Varied Sittella – there is one record in the north of the study area to the east of The Northern Road, one along Elizabeth Drive, three to the west of Kemps Creek Nature Reserve and two along the M7 Motorway at the Elizabeth Drive interchange
- Microbats (*Mormopterus norfolkensis* and *Scoteanax ruepellii*) – there are eight records in the study area, the majority occurred in and around the Western Sydney Parklands
- Cumberland Plain Land Snail – there are 49 records in the study area, mainly occurring in Cumberland Plain Woodland associated with Kemps Creek Nature Reserve and the Western Sydney Parklands, as well as in the Cooks River Castlereagh Ironbark Forest south of Elizabeth Drive next to Bill Anderson Park
- Grey-headed Flying-fox – there is one record at Kemps Creek Nature Reserve. This is a broad-ranging species that could occur across the study area, most likely in the more vegetated eastern half.

Eleven threatened flora species have either been recorded in the study area or are known to occur. Threatened flora species of note are:

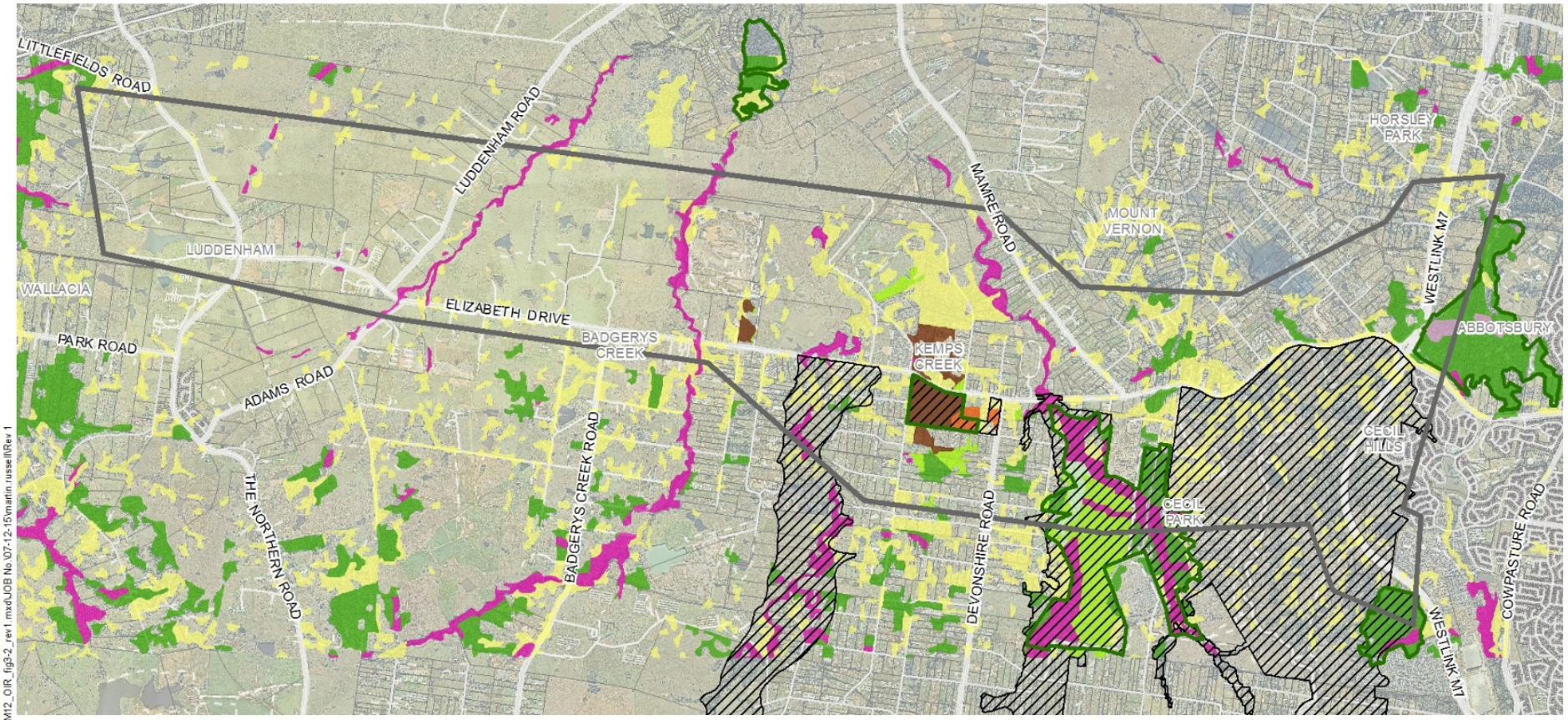
- *Dillwynia tenuifolia* – there is a TSC Act listed endangered population (Kemps Creek) occurring mainly in Cooks River Castlereagh Ironbark Forest (EEC) south of Elizabeth Drive next to Bill Anderson Park (bounded by Western Road, Elizabeth Drive, Devonshire Road and Cross Street)
- *Acacia pubescens* – there are seven records in the study area, all near Kemps Creek Public School and Bill Anderson Park
- *Grevillea juniperina subsp. juniperina* – there is one record near Bill Anderson Park
- *Grevillea parviflora subsp.* parviflora – there are 12 records concentrated at Kemps Creek in Cooks River Castlereagh Ironbark Forest (EEC) south of Elizabeth Drive in the vicinity of Bill Anderson Park
- *Persoonia nutans* – there are eight records, mostly near Kemps Creek and one along South Creek to the north of Elizabeth Drive
- *Pimelea spicata* – there are two records near the Luddenham Road / Elizabeth Drive intersection and near the end of Brolen Way
- *Pultenaea parviflora* – there are 15 records concentrated around Kemps Creek in the Cooks River Castlereagh Ironbark Forest (EEC), mainly south of Elizabeth Drive in the vicinity of Bill Anderson Park, and one record on Elizabeth Drive towards the western end of the study area.

An assessment of likelihood of occurrence was made for all 41 threatened species. There are a number of other threatened species that have the potential to occur in the study area. This assessment was based on database records, suitable habitat in the study area and professional judgement. Those species with a likelihood of occurrence in the study area are detailed in Table 3-2.

Four terms for the likelihood of occurrence of species are used in this report:

- Known – the species was or has been observed on the site

- Likely – there is a medium to high probability that a species uses the site
- Potential – there is suitable habitat for a species occurs on the site, but insufficient information to categorise the species as likely to occur, or unlikely to occur
- Unlikely – there is a very low to low probability that a species uses the site.



Legend

- M12 study area
- Priority conservation lands
- Non-certified land
- Castlereagh Scribbly Gum Woodland
- Shale Gravel Transition Forest
- Cooks River / Castlereagh Ironbark Forest
- Cumberland Plain Woodland
- Moist Shale Woodland
- River-flat Eucalypt Forest
- Other vegetation
- TEC poor condition

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Source: Ecological, Nearmap, LPI, Aurecon

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Projection: GDA 1994 MGA Zone 56

M12 Strategic Route Options Analysis **Options Identification Report**

FIGURE 3.2: Biodiversity features

Table 3-2 Threatened species with a likelihood of occurrence in the study area

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence
Fauna					
Anthochaera phrygia	Regent Honeyeater	E4A	E	Eucalypt woodland and open forest, wooded farmland and urban areas with mature eucalypts, and riparian forests of *Casuarina cunninghamiana (*River Oak).	Potential
Apus pacificus	Fork-tailed Swift	P	C,J,K, Mar	Riparian woodland, swamps, low scrub, heathland, saltmarsh, grassland, Spinifex sandplains, open farmland and inland and coastal sand-dunes.	Potential
Ardea ibis	Cattle Egret	P	C,J, Mar	Grassland, wooded land and terrestrial wetland.	Known
Callocephalon fimbriatum	Gang-gang Cockatoo	V		Tall mountain forests and woodland in summer; in winter, may occur at lower altitudes in open eucalypt forests and woodland, and urban areas.	Potential
Chthonicola sagittata	Speckled Warbler	V		*Eucalyptus*-dominated communities with a grassy understorey and sparse shrub layer, often on rocky ridges or in gullies.	Likely
Daphoenositta chrysoptera	Varied Sittella	V		Inhabits eucalypt forests and woodland, mallee and *Acacia* woodland.	Known
Dasyurus maculatus	Spotted-tailed Quoll	V	E	Rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	Unlikely
Ephippiorhynchus asiaticus	Black-necked Stork	E1		In NSW, floodplain wetlands of the major coastal rivers are key habitat. Also minor floodplains, coastal sandplain wetlands and estuaries.	Unlikely
Falco subniger	Black Falcon	V		Woodland, shrubland and grassland, especially riparian woodland and agricultural land. Often associated with streams or wetlands.	Unlikely
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		Tall (higher than 20 m), moist habitats.	Potential
Gallinago hardwickii	Latham's Snipe	P	C,J,R, Mar	Freshwater, saline or brackish wetlands up to 2000 m above sea-level; usually freshwater swamps, flooded grassland or heathland.	Potential
Glossopsitta pusilla	Little Lorikeet	V		Dry, open eucalypt forest and woodland, including remnant woodland patches and roadside vegetation.	Likely
Haliaeetus leucogaster	White-bellied Sea-Eagle	P	C	Freshwater swamps, rivers, lakes, reservoirs, billabongs, saltmarsh and sewage ponds and coastal waters. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest and urban areas.	Likely
Hieraaetus morphnoides	Little Eagle	V		Open eucalypt forest, woodland or open woodland, including sheoak or *Acacia* woodland and riparian woodland of interior NSW.	Known

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence
Lathamus discolor	Swift Parrot	E1	E	Box-ironbark forest and woodland.	Known
Limosa limosa	Black-tailed Godwit	V	C,J,K	Usually sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found around muddy lakes and swamps.	Potential
Litoria aurea	Green and Golden Bell Frog	E1	V	Marshes, dams and stream-sides, particularly those containing Typha spp. (bullrushes) or *Eleocharis* spp. (spikerushes). Some populations occur in highly disturbed areas.	Potential
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V		Open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas.	Unlikely
Meridolum corneovirens	Cumberland Plain Land Snail	E1		Primarily inhabits Cumberland Plain Woodland. Also known in Shale Gravel Transition Forests, Castlereagh Swamp Woodland and the margins of River-flat Eucalypt Forest.	Known
Merops ornatus	Rainbow Bee-eater	P	J	Open forests and woodland, shrublands, farmland, areas of human habitation, inland and coastal sand dune systems, heathland, sedgeland, vine forest and vine thicket.	Likely
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V		Rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland.	Likely
Mormopterus norfolkensis	Eastern Freetail-bat	V		Dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range.	Known
Myotis macropus	Southern Myotis	V		Foraging habitat is water bodies (including streams, or lakes or reservoirs) and fringing areas of vegetation in 20 m.	Likely
Petroica phoenicea	Flame Robin	V		Breeds in upland tall moist eucalypt forests and woodland. In winter uses dry forests, open woodland, heathland, pastures and native grasslands. Occasionally occurs in temperate rainforest, herbfields, heathland, shrublands and sedgelands at high altitudes.	Likely
Phascolarctos cinereus	Koala	V	V	Eucalypt woodland and forests.	Potential
Plegadis falcinellus	Glossy Ibis	P	C	Edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. Occasionally estuaries, deltas, saltmarshes and coastal lagoons.	Likely
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Subtropical and temperate rainforest, tall sclerophyll forest and woodland, heathland and swamp as well as urban gardens and cultivated fruit crops.	Known

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence
Scoteanax rueppellii	Greater Broad-nosed Bat	V		Woodland, moist and dry eucalypt forest and rainforest.	Known
Stagonopleura guttata	Diamond Firetail	V		Grassy eucalypt woodland, open forest, mallee, Natural Temperate Grassland, secondary derived grassland, riparian areas and lightly wooded farmland.	Likely
Tringa nebularia	Common Greenshank	P	C,J,K	Terrestrial wetlands (swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans, saltflats, sewage farms and saltworks dams, inundated rice crops and bores) and sheltered coastal habitats (mudflats, saltmarsh, mangroves, embayments, harbours, river estuaries, deltas, lagoons, tidal pools, rock-flats and rock platforms).	Potential
Flora					
Acacia pubescens	Downy Wattle	V	V	Open woodland and forest, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland. Occurs on alluviums, shales and at the intergrade between shales and sandstones.	Known
Cynanchum elegans	White-flowered Wax Plant	E1	E	Dry rainforest; littoral rainforest; *Leptospermum laevigatum-Banksia integrifolia subsp. integrifolia* (Coastal Tea-tree– Coastal Banksia) coastal scrub; *Eucalyptus tereticornis* (Forest Red Gum) or *Corymbia maculata* (Spotted Gum) open forest and woodland; and *Melaleuca armillaris* (Bracelet Honeymyrtle) scrub.	Potential
Dillwynia tenuifolia	Dillwynia tenuifolia, Kemps Creek	E2,V		Transition from Castlereagh Ironbark Forest to Castlereagh Scribbly Gum Woodland.	Known
Dillwynia tenuifolia		V		Scrubby/dry heath areas in Castlereagh Ironbark Forest and Shale Gravel Transition Forest, transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland, and disturbed escarpment woodland on Narrabeen sandstone.	Known
Eucalyptus benthamii	Camden White Gum	V	V	Occurs in open forest. Requires a combination of deep alluvial sands and a flooding regime.	Unlikely
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	V		Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forest, on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium.	Known
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V	Heath and shrubby woodland to open forest on sandy or light clay soils usually over thin shales.	Known

Scientific name	Common name	TSC Act	EPBC Act	Habitat	Likelihood of occurrence
Marsdenia viridiflora subsp. *viridiflora*	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	E2		Vine thickets and open shale woodland.	Potential
Persoonia nutans	Nodding Geebung	E1	E	Northern populations: sclerophyll forest and woodland (Agnes Banks Woodland, Castlereagh Scribbly Gum Woodland and Cooks River / Castlereagh Ironbark Forest) on aeolian and alluvial sediments. Southern populations: tertiary alluvium, shale sandstone transition communities and Cooks River / Castlereagh Ironbark Forest.	Known
Pimelea spicata	Spiked Rice-flower	E1	E	Well-structured clay soils. *Eucalyptus moluccana* (Grey Box) communities and in areas of ironbark on the Cumberland Plain. Coast Banksia open woodland or coastal grassland in the Illawarra.	Known
Pultenaea parviflora		E1	V	Dry sclerophyll forest, especially Castlereagh Ironbark Forest, Shale Gravel Transition Forest and transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland.	Known

3.3 Aboriginal heritage

3.3.1 Previous Aboriginal heritage studies

Numerous previous Aboriginal heritage studies have been undertaken in and around the study area.

In 1978, Haglund (1978) conducted an archaeological assessment as part of a preliminary study of possible western Sydney airport locations – it is generally referred to as the MANS (Major Airport Needs of Sydney) study. Records of the areas subject to archaeological survey for this study have not survived. In the survey, Haglund located three sites – two artefact scatters (sites 45-5-213 and 45-5-214), and the South Creek grinding groove (site 45-5-215) north of Elizabeth Drive. Two of these sites are recorded as occurring in the M12 Motorway study area – artefact scatter site 45-5-214, and grinding groove site 45-5-215.

In 1984–85, Rhodes and Dunnett (1985) conducted an Aboriginal Resources Planning Study for the City of Penrith. The study identified two sites in the M12 Motorway study area – artefact scatters Fleurs 1 (45-5-0496) and Fleurs 2 (45-5-0528).

In 1995, Brayshaw and Rich (1995) conducted an Aboriginal archaeological assessment for the proposed upgrade of the Western Sydney Orbital – Prestons to Cecil Park. The assessment identified five sites in the M12 Motorway study area. These were three artefact scatters P-CP8 (45-5-2308), P-CP9 (45-5-2307) and P CP14 (45-5-2468) and two isolated finds IF10 (45-5-2476) and IF11 (45-5-2477). Another two artefact scatters, BC/ED1 (45-5-2309) and KC/ED2 (45-5-2310), had also been recorded as occurring in the M12 Motorway study area.

In 1995, Brayshaw (1995) located two Aboriginal sites and six areas of potential archaeological deposit in the course of the 1995 archaeological survey of the Elizabeth Drive upgrade. These sites are in the M12 Motorway study area.

In 1997, the Olympic Co-ordination Authority (OCA) carried out investigations into the suitability of potential alternative sites for the Sydney International Shooting Centre for the 2000 Olympic Games. Navin Officer conducted a cultural heritage assessment of a proposed Cecil Park site as part of the preliminary statement of environmental effects for the development (NOHC, 1997a). Two artefact scatters and six isolated finds were located in the course of the 1997 field survey.

The area required for the shooting centre was subsequently increased by about 32 hectares. An assessment of the additional area was carried out in 1998 (Navin, 1998). One site (an artefact scatter) and five isolated finds were located in the shooting centre study area. Three sites, artefact scatter CPSC3 (45-5-2429) isolated finds SC7 (45-5-2430) and SC11 (45-5-2430), are recorded as occurring in the M12 Motorway study area.

In 1999, Nicholson conducted a survey of the Eastern Gas Pipeline – Wilton to Horsley (Nicholson: AHIMS Site Card; no report). Three sites, artefact scatters GLC1 (45-5-2561), DLC2 (45-5-2563) and EG6 (45-5-2562) are recorded as occurring in the M12 Motorway study area. The map reference on the original site recording for site EG6 is in error; consequently, this site plots outside of the M12 Motorway study area. The location presented in this survey has been confirmed from the site description.

In 2001, JMCHM (2001) conducted an archaeological survey for the proposed redevelopment of Nolans Quarry at Kemps Creek. The survey located KC PAD 1 (45-

5-3106) and a quartz flake located on the northern side of the quarry site. These are recorded as occurring in the M12 Motorway study area.

In 2002, Mills (no date) conducted a program of archaeological subsurface testing for the Western Sydney Orbital – Prestons to Cecil Park upgrades. The survey located potential archaeological deposit PAD-OS-6 on the eastern side of Wallgrove Road on an upper tributary of Ropes Creek. Ninety-five auger pits were excavated and 34 artefacts were recovered from the PAD. The survey also located PAD-OS-7 on the banks of an unnamed watercourse which formed part of the headwaters of Hinchinbrook Creek. Forty-three auger pits were excavated and five artefacts were recovered from the PAD. Two sites are recorded as occurring in the M12 Motorway study area, PAD-OS-6 (45-5-2722) and PAD-OS-7 (45-5-2721).

In 2009, Navin Officer conducted a Land Capability Assessment Study of a 321 hectare property at Luddenham in the western part of the M12 Motorway study area (NOHC, 2009). The study located eight Aboriginal sites, including four artefact scatters and four isolated finds. Seven sites are recorded as occurring in the M12 Motorway study area – artefact scatters LAS2, LAS3 and LAS4 and isolated finds LIF1, LIF2, LIF3 and LIF4.

In 2010, AHMS (2010) conducted an Aboriginal heritage impact assessment for water related services for the Northwest and Southwest Sydney Growth Centres (AHMS, 2010). Nine items are recorded as occurring in the M12 Motorway study area –two artefact scatters 2007-4 (45-5-4006) and 2008-4 (45-5-4007), three isolated finds 2009-5 (45-5-4008), 2010-5 (45-5-4009) and 2011-5 (45-5-4010), three PADs 2001-6 (45-5-3999, 2054-6 (45-5-4049) and 2063-6 (45-5-4056), and one PAD/artefact 2023-846 (45-5-4022).

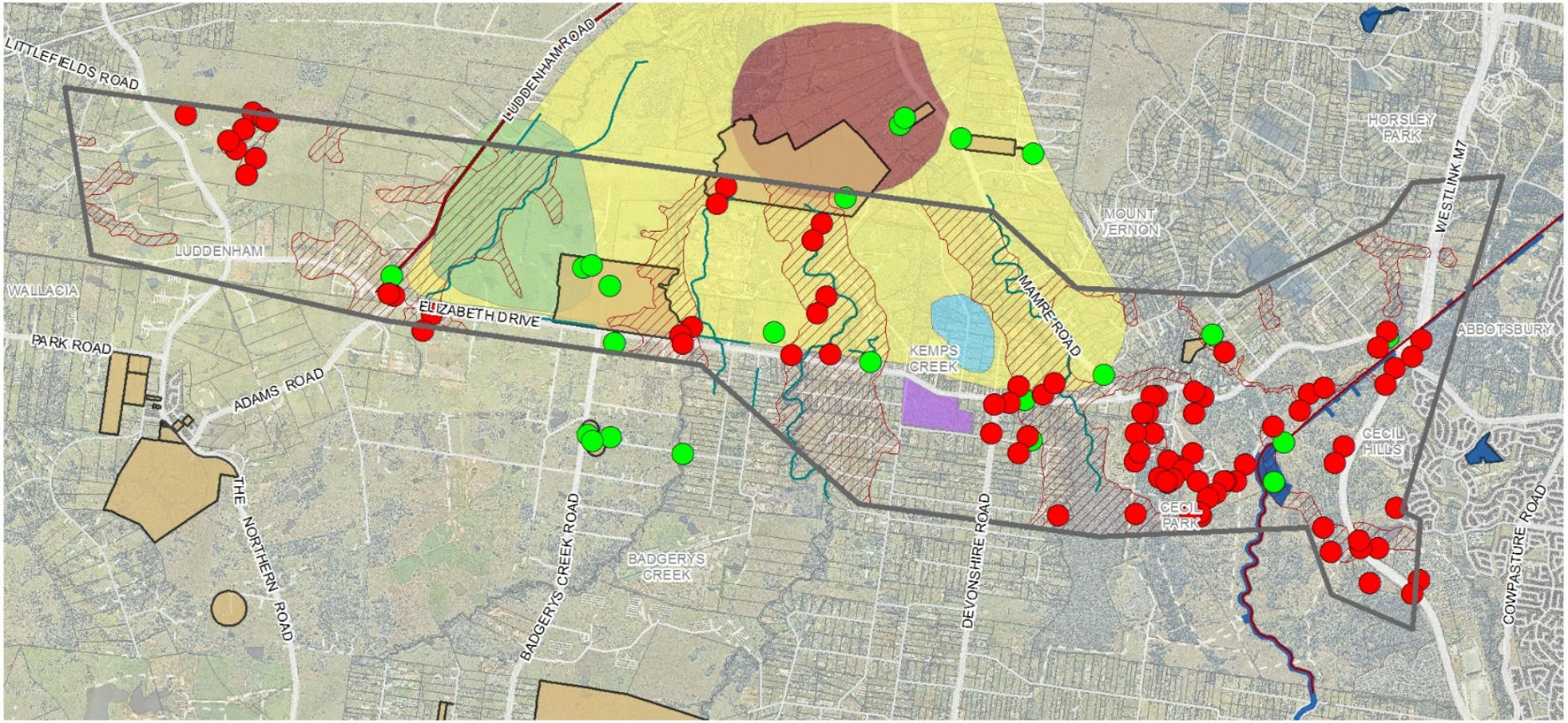
In 2014, Artefact Heritage (no date) recorded an artefact scatter – CP AS1 (45-5-4374) – along a vehicle access track parallel to Elizabeth Drive in the M12 Motorway study area.

3.3.2 Heritage recordings in the study area

A search of the Office of Environment and Heritage (OEH) Aboriginal Heritage Information Management System (AHIMS) on 29 July, 2015, combined with a review of relevant heritage reports, identified 39 Aboriginal heritage items/recordings in the M12 Motorway study area, and six in the immediate vicinity of the study area. These are:

- 18 stone artefact scatters
- 13 isolated finds (single stone artefacts)
- One grinding groove site
- Two subsurface stone artefact scatter sites (previously potential archaeological deposits)
- Two sites with stone artefacts and potential archaeological deposits
- Three potential archaeological deposits.

A summary of sites recorded as occurring in the M12 Motorway study area is provided in Table 3-3. The locations of these recordings are shown in Figure 3-3.



Legend

- M12 study area
- Aboriginal site
- Non-Aboriginal site
- Non-Aboriginal site
- Cultural landscapes
- Archaeological sensitivity
- State heritage register
- Local heritage item

Cultural landscapes

- KC-1
- L12
- L27
- L29
- L30

Note: Aboriginal heritage site locations are general in nature to protect exact locations

Source: Navin Officer, Nearmap, LPI, Aurecon

1:65,000

0 500 1000 m

Projection: GDA 1994 MGA Zone 56

M12 Strategic Route Options Analysis **Options Identification Report**

FIGURE 3.3: Heritage features

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Table 3-3 Summary of sites recorded in the M12 Motorway study area

AHIMS site ID	Site name	Site context	Site type	Recorder
45-5-0214	Kemps Creek	open site	artefact scatter	Haglund (1978)
45-5-0215	South Creek	open site	grinding groove	Haglund (1978)
45-5-0496	Fleurs 1	open site	artefact scatter	Sydney University (1984–5)
45-5-0528	Fleurs 2	open site	artefact scatter	Sydney University (1984–5)
45-5-2308	P-CP8	open site	artefact scatter	Brayshaw & Rich(1995)
45-5-2307	P-CP9	open site	artefact scatter	Brayshaw & Rich(1995)
45-5-2468	P-CP14	open site	artefact scatter	Brayshaw & Rich (1995)
45-5-2476	IF10	open site	isolated find	Brayshaw & Rich (1995)
45-5-2477	IF11	open site	isolated find	Brayshaw & Rich (1995)
45-5-2309	BC/ED1	open site	artefact scatter	Brayshaw (1995)
45-5-2310	KC/ED2	open site	artefact scatter	Brayshaw (1995)
45-5-2429	CPSC 3; Cecil Park	open site	artefact scatter	NOHC (1997b)
45-5-2430	IFSC 7;Cecil Park	open site	isolated find	NOHC (1997b)
45-5-2426	IFSC 11; Cecil Park	open site	isolated find	NOHC (1997b)
45-5-2561	GLC1	open site	artefact scatter	Nicholson (1999)
45-5-2562	EG6	open site	artefact scatter	Nicholson (1999)
45-5-2563	DLC2	open site	artefact scatter	Nicholson (1999)
45-5-2722	PAD-OS-6	open site	subsurface artefact scatter	Mills
45-5-2721	PAD-OS-7	open site	subsurface artefact scatter	Mills
45-5-3106	Kemps Creek (KC PAD 1)	open site	PAD/artefact	JMCHM (2001)
45-5-3802	Isolated Artefact 1 (Penrith)	open site	isolated find	Dallas
45-5-3804	Isolated Artefact 4 (Penrith)	open site	isolated find	Dallas
	LAS2	open site	artefact scatter	NOHC 2009
	LAS3	open site	artefact scatter	NOHC 2009
	LAS4	open site	artefact scatter	NOHC 2009
	LIF1	open site	isolated find	NOHC 2009
	LIF2	open site	isolated find	NOHC 2009
	LIF3	open site	isolated find	NOHC 2009
	LIF3	open site	isolated find	NOHC 2009
45-5-3999	PAD 2001-6	open site	PAD	AHMS
45-5-4006	Artefact Scatter PAD 2007-4	open site	artefact scatter	AHMS
45-5-4007	Artefact Scatter 2008-4	open site	artefact scatter	AHMS
45-5-4008	Isolated Object 2009-5	open site	isolated find	AHMS
45-5-4009	Isolated Object 2010-5	open site	isolated find	AHMS
45-5-4010	Isolated Object 2011-5	open site	isolated find	AHMS
45-5-4022	Artefact Scatter PAD 2023-846	open site	PAD/artefact	AHMS
45-5-4049	PAD 2054-6	open site	PAD	AHMS
45-5-4056	PAD 2063-6	open site	PAD	AHMS
45-5-4374	CP AS1	open site	artefact scatter	Madden

3.4 Non-Aboriginal heritage

3.4.1 Early historical overview

Europeans first entered the Nepean district 11 years before they returned to stay permanently. During 1788, the Governor, Arthur Phillip, led exploring parties to probe the outlying regions that had never been visited by Europeans. From a rise near the present Pennant Hills, Phillip first observed the Blue Mountains, but called the northern portion the Carmarthen Hills (after the Secretary of State for the British Foreign Office) and the southern portion the Lansdowne Hills. From the rising of these mountains he had no doubt a large river would be found. However, at that time his search for the river proved unsuccessful (Murray and White, 1988).

In June 1789, almost 18 months after the arrival of the First Fleet, Phillip's predictions were confirmed. Captain Watkin Tench (Marine in charge of the new outpost at Rose Hill) led an expeditionary party to the banks of the Nepean River 'through a country untrodden before by a European foot' (Power, 1983).

The alluvial flats adjoining the Nepean River and the woodlands that occupied the rolling country of the Sydney hinterlands were quickly recognised as an essential agricultural and pastoral resource for the new colony. By the 1820s and 1830s most of the hinterland had been alienated through a patchwork of land grants. Large estates quickly developed through buying and selling, some controlled by absentee landlords, and others by families who established residential farms.

The M12 Motorway study area is situated around three early key access roads, Cowpasture Road in the east, The Northern Road in the west, and Elizabeth Drive, linking the two.

The Cowpastures Road dates from a route surveyed in 1805 that provided a route southwards from Prospect to the Nepean Crossing and the self-selected pastures of the colony's wild cattle (http://www.camdenhistory.org.au/).

Elizabeth Drive dates from the early 1800s and was originally constructed as a 'corduroy' road, using round logs as a base. It was established to provide access to the areas' land grants and was originally known as the Orphan School Road as it extended west from the Orphan School in what is now Bonnyrigg. Its name was later changed to Mulgoa Road, in reference to its western extent, but subsequently changed again in 1952 to honour the visit of Queen Elizabeth II (http://penrithhistory.com/mt-vernon/).

The pattern of early European land ownership across the study area was dominated by a small number of individuals and their families, notably Wylde, Kemp, Bayly, Badgery, Piper, Johnston, Smith, Blaxland and Henderson (Figure 3-3).

Anthony Fenn Kemp was an officer in the NSW Corps and was in the vanguard of those who arrested Governor Bligh in 1808. Kemp received two land grants in the study area, 300 acres in 1810 (Parishes of Melville and Cabramatta), and 500 acres in 1820 (Parish of Melville). Kemp named his estate 'Mount Vernon', presumably after George Washington's home in Virginia in the United States of America. He subsequently settled in Tasmania where he died in 1868. Kemps Creek is named after him (SM&DHS, 2009).

In 1799, James Badgery and his wife Elizabeth arrived in the new colony. As James had few financial resources he was not eligible for a grant of land so he leased property

in Sydney and 11 acres on the Hawkesbury where he undertook intensive farming. By 1803 James was granted 100 acres along the Hawkesbury.

After the floods of 1806 he started looking for land elsewhere. He was granted 840 acres along South Creek and what would become Badgerys Creek, in the names of his three children, Ann, Henry and Andrew and his then unborn child William. When Governor Macquarie confirmed the grant he refused William's 200 acres and granted the 640 acres all in the name of James Badgery. He called his property Exeter Farm after his home town in England. James continued to expand his holdings, buying up other properties on what is now the southern side of Elizabeth Drive. These properties were subdivided in the 1880s as the Exeter Farms subdivision.

In November 1813, John Blaxland, (elder brother of Gregory Blaxland) was granted 6,710 acres of land between the Nepean River and Badgerys Creek which he named Luddenham after his former home in England. The residential and business focus of the estate was on the river at Wallacia. The remaining lands were used for grazing.

Nicholas Bayly, an officer in the NSW Corps, received two land grants in 1799 and 1800, totalling 566 acres at the 'Eastern Farms' and at Cabramatta. The latter he named 'Bayly Park'. By 1814, he had established his family home there. After his death in 1823, Bayly Park, then 2500 acres, was purchased by Richard Jones who renamed the property 'Fleurs' (SM&DHS, 2009).

Other early industries in the Liverpool area included a tanning pit on Orange Grove Road, brickfields on Orange Grove Road and along Brickmaker's Creek and one steam mill and one windmill (Keating, 1996). One of the earliest shipbuilding yards was built on the river near its junction with Williams Creek, where ships of up to 40 tons were built. A quarry almost opposite this property provided stone for the building of the Lansdowne Bridge. The district continued as a farming village on the outskirts of Liverpool. The area still grows grapes and the Vicary's Winery, commenced in 1923, is still an important industry in the area.

The arrival of the railway in 1856 encouraged local businessmen to start businesses in the area. J.H. Atkinson bought the estates of Collingwood and Sophienburgh and made the necessary improvements on these properties to induce teamsters to unload at Liverpool and send their loads to Sydney by rail. In the early 1900s there were about 40 families living in Badgerys Creek including some, the Nobbs, Freeburn, Shadlow and Dorahy families, who remained in the area until properties began to be resumed for the proposed western airport for the Sydney region from 1986.

3.4.2 Previous heritage studies

Most of the heritage studies conducted in and around the M12 Motorway study area have involved assessments of Aboriginal heritage. Few have included an assessment of non-Aboriginal heritage. The following listed heritage sites were identified in heritage studies:

- The Liverpool Offtake Reservoir – This is included in the Liverpool Heritage Study (Neustein & Associates, 1992) and the Liverpool Heritage Study Review (Form architects Aust Pty Ltd, 2004)
- The Sydney Water Supply Upper Canal System - Pheasants Nest Weir to Prospect Reservoir – This is included in a Heritage Study of the Upper Canal, Prospect Reservoir and Lower Canal (Upper Nepean Scheme) (Higginbotham et al, 1992)

- The Luddenham Road Alignment – This is included in the Penrith Local Environmental Plan 2010.

A number of other items and a range of landscape recordings are documented in these studies but are not included in heritage listings or schedules.

One historic site was identified in the 2009 assessment of a 321 hectare property at Luddenham which is located in the western part of the M12 Motorway study area (NOHC, 2009). The site, building piers and barbeque remains (Luddenham Historic Site 1 – LH1) did not meet the threshold for assessment against the NSW Heritage Council's heritage significance criteria and was considered to have little heritage significance.

3.4.3 Listed heritage items

Heritage items on the State Heritage Inventory in and next to the M12 Motorway study area are presented in Table 3-4. As shown, there are 10 heritage recordings in the M12 Motorway study area boundary, and eight near the study area boundary, including four in the Commonwealth-owned lands of the proposed western Sydney airport site. Five recordings in the study area are listed on statutory registers.
These are:

- The Sydney Water Supply Upper Canal System
- An inter-war Spanish Mission styled house
- The Luddenham Road Alignment
- The Sydney University McGarvie-Smith Farm
- The site of the former Fleurs radio telescope arrays.

The Fleurs Radio Telescope Arrays is listed on the *Penrith Local Environmental Plan 2010* and recognised for its local significance. This item, however, may be of greater historical significance. Between 1954 and 1963, Fleurs was the leading field station of the CSIRO's Division of Radiophysics, and was home to three innovative cross-type radio telescopes, the Mills Cross, Shain Cross and the Chris Cross. Additionally, the Chris Cross was the world's first cross-grating interferometer and the first radio telescope to provide a two-dimensional daily map of the Sun (Orchiston 2004) Members of the Australian astronomical community consider the site to be historically important. It is likely that the site is of national significance, and it therefore requires further assessment.

There are four unlisted items in the study area being:

- a fibro building on the McGarvie-Smith Farm (University of Sydney)
- an iron shed on the McGarvie-Smith Farm (University of Sydney)
- the 'Big Chook' – a large chook sculpture for the promotion for a local egg merchant
- the Liverpool Offtake Reservoir.

Eight items are situated outside, but near, the northern boundary of the study area. These are the Bayly Park homestead (subsequently 'Fleurs'), and gardens, a brick farmhouse on Aldington Road and remnant Gateposts. The four remaining sites are located on the Commonwealth-owned lands of the proposed western Sydney airport site: the St Johns Anglican Cemetery, Badgerys Creek Public School, St Johns Anglican Church group and Road Bridge.

Table 3-4 Heritage items in and next to the M12 study area

Heritage item	Location	Property description	Significance	LGA	SHI number
In study area					
Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)	Lat: 33.91548201400 Long: 150.828630839	Utilities – Infrastructure	State (SHR)	Liverpool and Fairfield	5051481
Sydney Water Supply Upper Canal System	Off Elizabeth Drive Lot 1 DP 725231, Lots 1 –4 DP 596351	Utilities – water supply	Local	Liverpool	1970096
Liverpool Offtake Reservoir	Off Elizabeth Drive (opposite intersection with Wallgrove Road) Cecil Hills	Utilities – water supply	Local	Liverpool	1970060
Inter-war Spanish Mission House	41 –51 Warana Road, Cecil Park Lot 190 DP 590666	Residential	Local	Fairfield	1570069
Luddenham Road Alignment	Luddenham Road	Road	Local	Penrith	2260843
McGarvie-Smith Farm	1793 –1951 Elizabeth Drive, Badgerys Creek Lot 63, DP 1087838	Educational	Local	Penrith	
The Fleurs Radio Telescope	885(a) Mamre Road Lot 21 DP 258414	Scientific / educational	Local	Penrith	
Fibro building, McGarvie-Smith FarmIron Shed McGarvie-Smith Farm	Off Elizabeth Drive	Agricultural – Built environment	Requires further investigation	Penrith	
The Big Chook	Intersection of Mount Vernon and Mamre Road, Kemps Creek	Agricultural – Promotional feature	Local		
Near the study area					
'Bayley [Bayly] Park'	919 –929 Mamre Road, Kemps Creek Lot 35 DP 258414	Residential	Local	Penrith	2260104
'Fleurs Stud' [Bayly Park] garden and tree avenue	Mamre Road, Kemps Creek Lot 35 DP 258414	Residential (cultural landscape)	Local	Penrith	
Brick Farmhouse	282 Aldington Road, Kemps Creek Lot 142 DP 1033686	Residential		Penrith	2260106
Gateposts to Colesbrook	269 –258 Mamre Rd, Kemps Creek Lot 8 DP 253503	Residential	Local	Penrith	2260105
Road Bridge	Pitt Street over Badgery's Creek, Badgerys Creek	Bridge	Local	Liverpool	1970101
St. John's Anglican Church Cemetery	Pitt Street, Badgerys Creek Part Lot 1, DP 838361	Cemetery/ Graveyard	Local	Liverpool	1970450
St. John's Anglican Church Group incl church	Pitt Street, Badgerys Creek Part Lot 1, DP 838361	Churchyard Archaeological-Terrestrial	Local	Liverpool	1970061

Heritage item	Location	Property description	Significance	LGA	SHI number
and cemetery					
Badgerys Creek Public School	NE cnr of Pitt Street and Badgerys Creek Road Part Lot 1 DP 838361	School	Local	Liverpool	1970043

3.4.4 Heritage landscapes

Heritage landscapes in and near the study area have been assessed in South Creek Valley Heritage Study, Perumal Murphy 1990 and Penrith Heritage Study (Fox Associates 1987). Items with high local or regional significance are detailed in Table 3-5 and shown in Figure 3-3.

Table 3-5 Heritage landscapes

	Heritage item	Description	Listings
KC-1	South Creek Basin	A landscape of high local 'visual/natural importance' consisting of undulating hills with remnant Paper Bark (*Melaleuca* sp.) and River She-Oak (*Casuarina* sp.) vegetation groves along creek banks and paddocks.	Penrith Heritage Study
L1	South Creek remnant native vegetation corridor	An area of regional importance as a natural area wildlife habitat and scenic area. Has pockets of vegetation varying in size along its length.	South Creek Heritage Study
L12	Vegetation community, Clifton Avenue, Kemps Creek	Remnant native vegetation mostly in private lots, bounded by Elizabeth Drive, Western Road and Kemps Creek Public School. Assessed as having regional significance.	South Creek Heritage Study
L13	Badgerys Creek remnant native vegetation corridor	An area of regional importance as a natural area wildlife habitat and scenic area. Has pockets of vegetation varying in size along its length.	South Creek Heritage Study
L23	Kemps Creek remnant native vegetation corridor	An area of regional importance as a natural area wildlife habitat and scenic area. Has pockets of vegetation varying in size along its length.	South Creek Heritage Study
L27	South, Kemps and Badgerys Creek confluence weirs scenic landscape	A scenic landscape of assessed regional significance comprising the weirs and surrounds at the confluences of Badgerys and Kemps creeks with South Creek. The Badgerys Creek weir is no longer functioning.	South Creek Heritage Study
L29	Vegetation community, Clifton Ave, Kemps Creek	Remnant native vegetation mostly in private lots. Assessed as having regional significance.	South Creek Heritage Study
L30	McMaster Field Station Scenic Landscape, Elizabeth Drive, Badgerys Creek	A pastoral landscape with lake-like water bodies, native vegetation and a backdrop of green hills. Of regional significance. Lack of intrusive transmission wires is important.	South Creek Heritage Study
L45	Cosgrove Creek remnant native vegetation corridor	An area of regional importance as a natural area, wildlife habitat and scenic area. Has pockets of excellent creekside vegetation varying in size along its length.	South Creek Heritage Study
L47	Row of Tallowwood trees Luddenham Road	Avenue of planted tallowwood trees, forming a cultural landscape of local significance	South Creek Heritage Study
L48	Remnant vegetation along Lawson Road, Badgerys Creek	A group of native trees on Lawson Road, forming a cultural landscape of local significance	South Creek Heritage Study
L54	Remnant vegetation along Elizabeth Drive	Indigenous roadside eucalypts forming a natural avenue with other native trees along Elizabeth Drive. Assessed as having regional significance	South Creek Heritage Study
L55	Remnant vegetation along Elizabeth Drive	Indigenous roadside eucalypts forming a natural avenue with other native trees along Elizabeth Drive, contiguous with Badgerys Creek corridor. Assessed as having regional significance	South Creek Heritage Study

Source: Elizabeth Drive Upgrade EIS (Rust PPK, 1995)

3.4.5 Potential non-Aboriginal heritage items

A review of early mapping and aerial photography of the study area has facilitated the identification of locations of potential non-Aboriginal heritage items. These comprise potential archaeological deposits and standing structures which may have heritage significance. These locations have not been verified by 'ground-truthing' and are indicative only.

These items are outlined in Table 3-6 and mapped in Figure 3-3.

Table 3-6 Potential non-Aboriginal heritage items

ID	Location		Name/description	Date	Source
	Easting	Northing			
1	296167.3	6248910	Cottage and sheds	1918	Crown plan C.3163.2030
5	291475.3	6249560	Pennall (residence)	No date	Roll plan 4 – Roll Plan LTO Charting Maps
4	294406.8	6249345	Woodbine cottage	1982	DP58544
3	296248.5	6248448	Cooloo (residence)	1866?	DP51358
2	293300.5	6249680	Exeter House estate/ Badgerys Homestead	1920	Crown plan C.3391.2030
6	300327.7	6249617	Cecil Park Public School	1906	Reconnaissance map of the neighbourhood of Liverpool Camp
7	299985	6250284	Structure	1906	Reconnaissance map of the neighbourhood of Liverpool Camp
8	300559.8	6250422	Standing structure	1930	1930 Cecil Hills aerial photograph
9	300607.9	6249817	Standing structure	1930/06	1930 Cecil Hills aerial photograph and reconnaissance map of the neighbourhood of Liverpool Camp
10	300629.1	6250023	Structure	1930	1930 Cecil Hills aerial photograph

3.5 Landscape character

The landscape character of the study area varies from rural in the west, around the Western Sydney Parklands, to semi-rural through the remainder of the study area.

3.5.1 Topography

The topography in and around the study area is considered to be typical of the Cumberland Plain, with rolling hills and small valleys between generally north–south ridge lines. In the east and west of the study area, topography is gently undulating, flattening out in the middle of the study area, where it passes through the floodplains associated with Cosgrove Creek, Oaky Creek, Badgerys Creek, South Creek and Kemps Creek. There are also numerous farm dams in the area.

Elizabeth Drive follows the undulating topography, crossing over ridge lines while avoiding the steepest slopes. The degree of modification to the landscape, in terms of cut and fill embankments, is relatively low and this is helped by the relatively narrow footprint of the road, which consists of only one lane in each direction, with occasional turning lanes and breakdown shoulders.

The undulating topography of the study area means there are some wide-ranging views providing pastoral scenic views. In the western part of the study area, as it rises to meet The Northern Road, there are views west to the World Heritage listed Greater Blue Mountains World Heritage Area.

3.5.2 Land use

The land use in the study area is a mix of semi-rural residences, agriculture and commercial properties. Features in the study area include the Elizabeth Drive landfill site, quarries, and farm dams. To the east of the study area, the suburbs of Kemps Creek, Cecil Park and, more so, Mount Vernon, are associated with smaller rural-residential property lots. These areas are characterised by urban and village features including schools and local retail/commercial outlets as well as residential properties.

A number of roads traverse the study area. The main arterial roads are Elizabeth Drive, Mamre Road and The Northern Road. The M7 Motorway is located at the eastern extent of the study area.

3.5.3 Vegetation

Most of the study area has been cleared or modified due to urban development for agricultural, commercial, rural residential and industrial land uses. The remaining large stands of vegetation are either connected to riparian corridors or in parks and reserves, such as Kemps Creek Nature Reserve, Overett Park, Western Sydney Parklands and Bill Anderson Park.

The Elizabeth Drive road reserve is generally tree lined. However, other local roads in the study area are mostly cleared, partially due to utility easements.

While limited, vegetation corridors do make a significant visual contribution to the scale and character of the study area.

3.5.4 Hydrology and drainage

Five creeks traverse the study area in a north–south orientation. Kemps Creek, South Creek Badgerys Creek, Oaky Creek and Cosgrove Creek are tributaries of the South Creek sub-catchment, which falls in the Hawkesbury Nepean River system.

Generally, all of these watercourses are quite degraded and have been adversely affected by domestic livestock, urban expansion and intensive agricultural activities including grazing and cropping. Typically, all five creeks have a permanent creek line with a continuous tree canopy in the study area and each is prone to flooding.

3.5.5 Future development

There is substantial new development planned either side of Elizabeth Drive, associated with the Western Sydney Priority Growth Area. This will fundamentally change the land use and landscape character of the area, as will the development of

the proposed western Sydney airport at Badgerys Creek. The project provides an opportunity to provide an urban design solution as a gateway to Sydney.

3.5.6 Views

Views across the study area are shown in Plates 1 to 8 over the next few pages.

Plate 1: Tree-lined Elizabeth Drive

Plate 2: Open pastoral views

Plate 3: Rural view with views towards a quarry-

Plate 4: Rural view with views towards a farm

Plate 5: Views towards Blue Mountains from The Northern Road

Plate 6: Rural view

Plate 7: Kemps Creek village shops on Elizabeth Drive

Plate 8: Rural view

3.6 Land use and planning

3.6.1 Land uses by locality

The study area is located across three local government areas: Penrith City, Fairfield City and Liverpool City. Land use in the area is regulated by these councils and by State environmental planning policies (SEPPs) and State and Commonwealth Government strategies.

The suburbs in the study area are:

- Cecil Park
- Mount Vernon
- Kemps Creek
- Badgerys Creek
- Luddenham.

Land uses in the study area are described in Table 3-7 and shown in Figure 3-4. Information was obtained from council profiles and census data.

Table 3-7 Suburb land uses and features

Locality	Description
Luddenham – Wallacia	• The locality of Luddenham – Wallacia is in the Penrith City Council area. • It is located north of Elizabeth Drive (where it is in the study area). • Only the suburb of Luddenham falls in the study area. • Land use in Luddenham is rural and rural-residential. Rural land uses consist of agriculture, especially market gardens, hobby farms and poultry farms. • Major features in the suburb include Luddenham Showground, Twin Creeks Golf and Country Club, Sydney Society of Model Engineers Model Park, and Luddenham Raceway. • There is a low population density (0.54 people per hectare) reflective of the rural and agricultural nature of the suburb.
Mt Vernon – Kemps Creek – Badgery Creek	• The locality of Mount Vernon – Kemps Creek – Badgerys Creek is in the Penrith City Council area. • The suburbs of Mt Vernon, Kemps Creek and Badgerys Creek are in the study area. • Land use in these suburbs is rural and rural-residential. Rural land uses consist of agriculture, especially market gardens, hobby farms and poultry farms. • Main features in the suburb include a number of schools and the Elizabeth Drive landfill facility. • There is a low population density (0.45 people per hectare) reflective of the rural and agricultural nature of the suburbs.
Cecil Hills	• The locality of Cecil Hills is in the Liverpool City Council area. • The portion of this area that falls in the study area is south of Elizabeth Drive and contains the Western Sydney Parklands, which is the main feature in the profile area. • Outside of the study area, east of the M7 Motorway, there has been intensive residential development, which is why the population density of this area is higher than most of the study area, with 11.16 people per hectare.
Cecil Park	• The locality of Cecil Park is in the Fairfield City Council area. • Land use in this area is rural and rural-residential, with rural activities mostly agricultural and some extractive industries. • Major features include the Western Sydney Parklands and (in the study area) the CSR brick factory. • As the majority of the area is residential land, it has the highest population density in the study area, with 1.23 people per hectare.
Bringelly	• The locality of Bringelly is in the Liverpool Council area. • Suburbs in the locality that are in the study area are Badgerys Creek, Cecil Park, Kemps Creek and Luddenham. • Land use is mostly rural, with some rural-residential activities including farms

Locality	Description
	and orchards. • Major features in or near the study area include Sydney International Shooting Centre, RAAF telecommunications unit, University of Sydney John Bruce Pye Farm and Wolverton Farm, Western Sydney Parklands, Badgerys Creek Oval, Bill Anderson Park, Kemps Creek Nature Reserve and Overett Park. • Due to the rural nature of the area, there is a low population density, with 0.53 people per hectare.

3.6.2 Existing land use

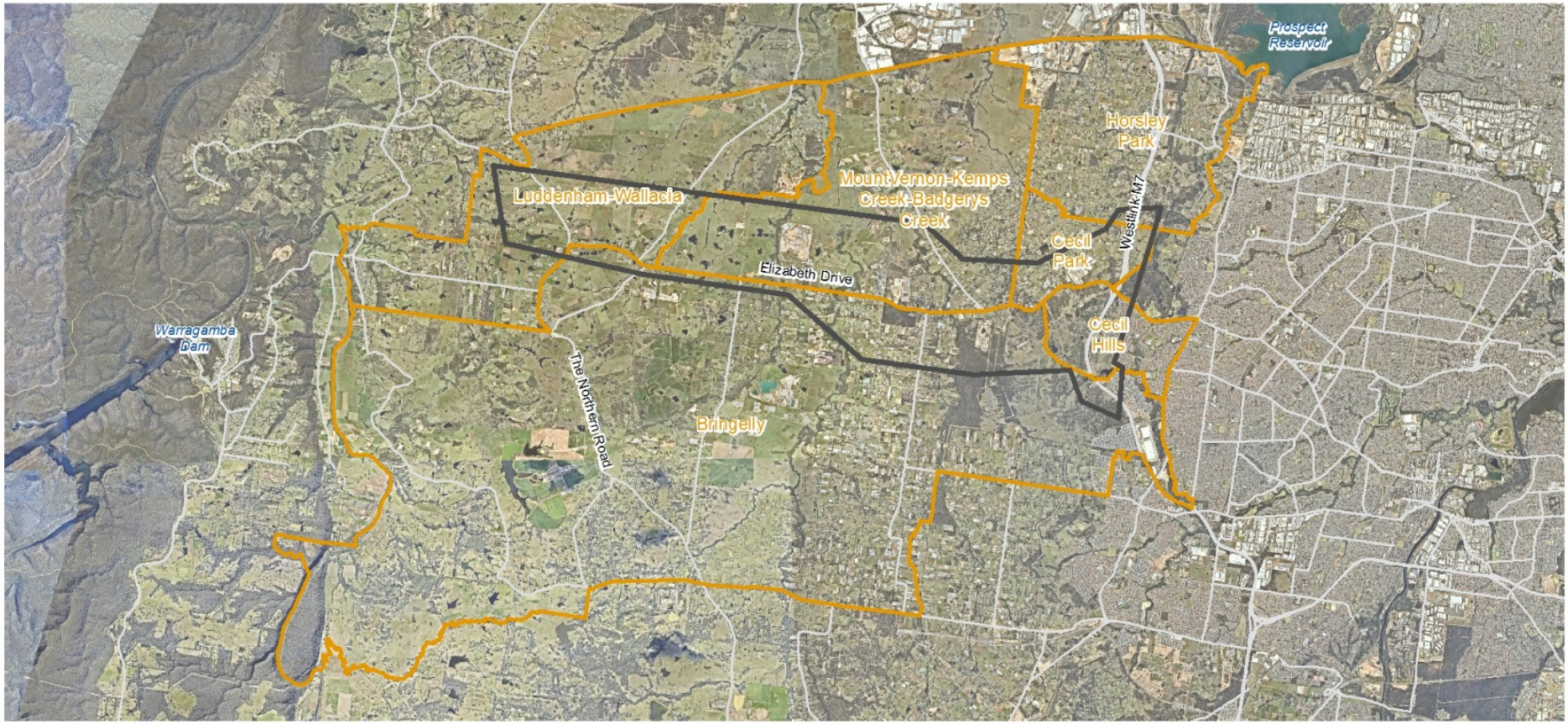
Zoning

The study area is located in the Penrith City, Liverpool City and Fairfield City local government areas. The zoning maps for these areas – *Penrith Local Environmental Plan 2010*, the *Penrith Local Environmental Plan (Glenmore Park Stage 2) 2009*, *Liverpool Local Environmental Plan 2008* and *Fairfield Local Environmental Plan 2013* – identify a range of existing zonings. Most of the zonings are rural in nature and include:

- RU1 primary production
- RU4 primary production small lots
- RU2 rural landscape
- E2 Environmental conservation
- E4 Environmental living
- RE1 Public recreation
- Western Sydney Parklands.

Land uses

The zones in the study area include a wide array of land uses which are described in Table 3-8 and shown in Figure 3-5.



Legend

- M12 study area
- Locality

Source: Navin Officer, Nearmap, LPI, Aurecon

1:140,000

0 2 4km

Projection: GDA 1994 MGA Zone 56

M12 Strategic Route Options Analysis **Options Identification Report**

FIGURE 3.4: Community localities

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Table 3-8: Land uses in the study area

Land use	Description
Residential	The main residential precincts are in the suburbs of Kemps Creek, Mt Vernon and Cecil Park, but there are rural residential properties throughout the rest of the study area and residences on some agricultural properties and hobby farms. The Western Sydney Priority Growth Area located across the majority of the study area will limit future residential development, while increasing industrial and commercial development in the study area.
Commercial	Commercial land uses encompass a wide cross sector including agriculture, industrial (see separate section following) and retail activities. Agricultural land uses in the study area include hobby and commercial farms largely producing crops (such as vegetables), poultry, Christmas trees, nurseries and the University of Sydney John Bruce Pye farm. An Industry & Investment NSW report (*Analysis of Population Census and Agriculture Census Data in Sydney Statistical Division*, July 2010) identifies the importance of agricultural activities in the Penrith and Liverpool local government areas. Vegetable farming in these areas resulted in almost $16 million of produce, while poultry farming was valued at over $17 million in Penrith City and $19 million in Liverpool City. Retail activities with small scale services are connected to some of these agricultural properties and mostly associated with the suburb of Kemps Creek. These activities include service stations, hardware stores, machinery and automotive repairs, ducting and supply stores, cafes and groceries and liquor stores. Other facilities include the Animal League NSW.
Western Sydney Parklands	Western Sydney Parklands is on the eastern extent of the study area, to the south of Elizabeth Drive. The idea of a 'green girdle' through Western Sydney was identified in the Cumberland County Plan of 1949. However, the Western Sydney Parklands were originally identified in the 1968 Sydney Region Outline Plan to provide for infrastructure and future regional open space needs for a growing Western Sydney. The parklands are now managed under the Western Sydney Parklands Act 2006 and strategic direction provided under the State Environmental Planning Policy (Western Sydney Parklands) and the Western Sydney Parklands Plan of Management 2020. The parklands comprise 5280 hectares and stretch 27 kilometres from Blacktown in the north to Leppington in the south. It is 16 times the size of Sydney's Centennial Parklands. The parklands are in the Blacktown, Fairfield and Liverpool local government areas. When developed, the parklands will become the largest urban parkland system in Australia and one of the largest in the world. Much of the land is still to be developed for its long-term purpose. The parklands have recreational space as well as infrastructure, agriculture, water supply and other essential community facilities. The Parklands Plan of Management 2020 Supplement, indicates the area of parkland south of Elizabeth Drive will continue to contain a range of mixed uses including the Sydney International Shooting Centre (existing), Wylde Mountain Bike Trail (existing), Kemps Creek Nature Reserve (existing, and gazetted as conservation area), water supply canal (existing), and development of a bushland corridor to connect Kemps Creek Nature Reserve to the bushland corridor that runs north–south through the parklands. There are also a number of biobanking agreements sites (including M7 West and Cecil Park SE). A business hub (Elizabeth Drive business hub) has also been identified that spans Elizabeth Drive. To the north of Elizabeth Drive, the Western Sydney Parklands currently consists of environmental bushland corridor or vacant land. As well as a site identified for the Elizabeth Drive business hub, another hub along Wallgrove Road (known as the Wallgrove Road business hub) has been identified in the Parklands Park of Management 2020 Supplement.

Land use	Description
Industrial	There are a number of industrial developments including the Elizabeth Drive landfill, a number of quarries and brick factories. These are located in the more populous areas to the east of the study area.
Educational facilities	There are few educational facilities in or next to the study area. Facilities include Kemps Creek Public School, Irfan College and Christadelphian Heritage College. In addition, along Elizabeth Drive, there is the Science of the Soul Study Centre. Badgerys Creek Public School has recently closed.
Religious facilities	There are no churches and other facilities in the study area (with the exception of those educational facilities above). Two mosques have been approved in the Kemps Creek area by Penrith City Council and are located in the study area.
Utilities infrastructure	Utility infrastructure includes large facilities such as substations, mobile telecommunications towers and a radar installation. Other utilities include gas pipelines and electrical transmission lines. Sydney Water facilities include the Upper Canal system in the eastern part of the study area.
Recreational facilities	Recreational facilities include Sydney International Shooting Centre and Wylde Mountain Bike Trail (both in Western Sydney Parklands) and other reserves/parks including Bill Anderson Park and Overett Reserve. Kemps Creek Nature Reserve is to the south of the study area, next to the Western Sydney Parklands. Other recreational facilities include the Twin Creeks Golf and Country Club, Luddenham Raceway, the Sydney Society of Model Engineers Model Park, and the Kemps Creek Sporting and Bowling Club.
Proposed western Sydney airport at Badgerys Creek	While this is not a current land use in the study area, land has been allocated and reserved for the airport with an environmental impact statement placed on public display in November 2015. The airport site is located south of Elizabeth Drive in the western part of the study area between Badgerys Creek and Cosgroves Creek.

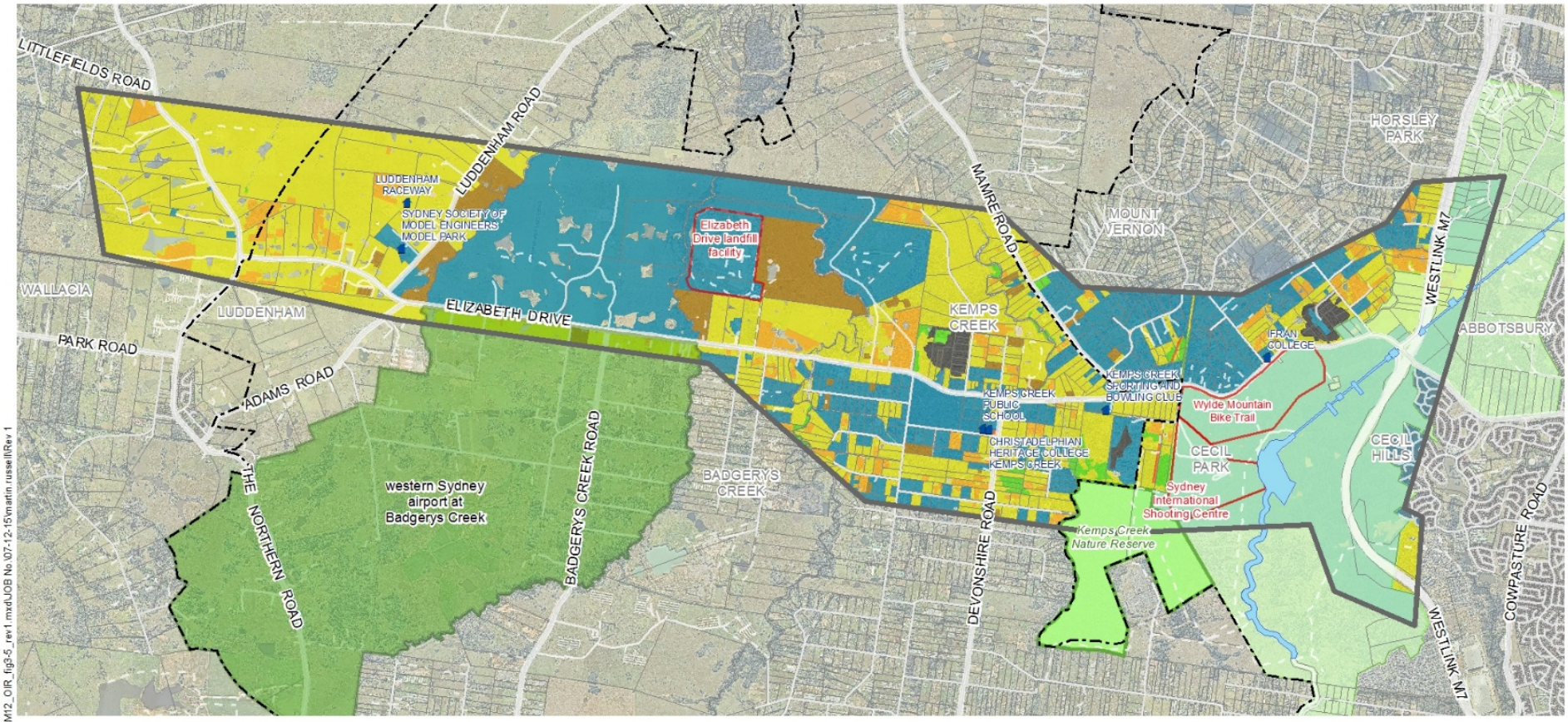

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FIGURE 3.5: Land use features

3.6.3 Land development activity

Future land use will be different to the current land use in and around the study area. Of particular relevance is the proposed western Sydney airport at Badgerys Creek and the Western Sydney Priority Growth Area (refer to Figure 3-5).

Western Sydney Priority Growth Area

The Western Sydney Priority Growth Area is located in Liverpool and Penrith council areas and encompasses the majority of the study area. The NSW Government is investigating opportunities for new jobs, homes and services around the planned Badgerys Creek Airport in Sydney's west and propose to prepare a draft Land Use and Infrastructure Strategy to guide new infrastructure investment, identify new homes and jobs close to transport, and coordinate services in the area.

Roads and Maritime are consulting with Department of Planning and Environment in regards to this growth area. The M12 Motorway would improve access to the growth area.

3.7 Soil and water quality

3.7.1 Soil contamination

The study area comprises largely rural-residential and open space land uses. This includes agricultural land uses (market gardens, horticultural and grazing lands). The Elizabeth Drive landfill is in the study area, north of Elizabeth Drive. There are a number of waterway crossings: Badgerys Creek, South Creek and Kemps Creek.

A search of the NSW Environment Protection Authority (EPA) Contaminated Land records register on 11 August 2015 identified:

- Eleven notices relating to four sites in the Fairfield local government area (LGA)
- Twelve notices relating to two sites in the Liverpool LGA
- Twenty-two notices relating to seven sites in the Penrith LGA (Refer to Appendix A)
- No declared and/or notified contaminated sites in and/or near the study area.

Based on the limited desktop review of data the indicative contamination risk is likely to be associated with the following:

- Agricultural land usage based on potential for contamination via the application of pesticides, herbicides and fertilisers
- Elizabeth Drive landfill (EPL 4068)
- Localised hydrocarbon contamination associated with service stations, vehicle access tracks, roads and onsite fuel tanks on farmland
- Industrial sites including the brickworks and quarry sites
- Asbestos Containing Material (ACM) associated with former farm infrastructure
- Buried fill material (including ACM)
- Inappropriate waste disposal
- Previous use of septic tanks in the agricultural areas
- There is also heavy metals potential associated with old fertilisers or previous activities.

Environmental field survey of Commonwealth land at Badgerys Creek identified that 'the site of the former Anchau vineyard (1880 The Northern Road) had been used for the illegal dumping of waste material. This may have resulted in contamination of the land and there may also be hazardous materials present.' This is well outside the study area, but upstream of Oaky Creek.

The Elizabeth Drive landfill facility takes waste from Penrith and Liverpool council areas and is next to the SITA Advanced Waste Treatment Facility at Kemps Creek. The landfill accepts solid non-putrescible, commercial and industrial waste, construction and demolition waste and restricted waste. It is the only landfill site that can accept restricted solid waste in NSW. The landfill site is subject to an Environment Protection Licence under the *Protection of the Environment Operations Act 1997*. As part of this licence, regular monitoring is required for leachate, groundwater and wet weather discharges. The latest reporting shows there are no exceedances of the parameters controlled by the licence. A section on the southern portion of the landfill site has been filled to capacity and is capped.

3.7.2 Salinity

Salinity in western Sydney was mapped as part of the then NSW Department of Infrastructure, Planning and Natural Resources salinity potential map (2002). These maps show land in the study area to generally have moderate salinity potential. Smaller areas associated with drainage lines were mapped as having known salinity or high salinity potential.

3.7.3 Groundwater

The direction of groundwater flow is likely to be controlled by the proximity to local surface water bodies and areas of higher permeability alluvium. Regional groundwater flow direction is expected to be consistent with the topography: generally south to north towards South Creek.

Field survey of Commonwealth land at Badgerys Creek identified 'two aquifers in the airport options sites, a shallow aquifer in Quaternary alluvium and a deeper regional aquifer in the Bringelly Shale formation. Groundwater flow is in a north-east direction and water quality in both aquifers is saline'.

3.7.4 Surface water

Field survey of Commonwealth land at Badgerys Creek in September 2014 involved some water quality testing. Slightly higher than normal levels of hydrocarbons were identified. These exceedances were at very low levels and could be due to several causes. As the sample location is close to roads, the water quality could have been influenced by stormwater runoff. Low levels of hydrocarbons can also occur naturally and be associated with certain types of vegetation (such as camphor laurel).

Based on the limited desktop review of data, the indicative contamination risk is likely to be associated with:

- Agricultural land use based on potential for contamination via the application of pesticides, herbicides and fertilisers
- Elizabeth Drive landfill (Environment Protection Licence 4068) accepts general solid waste (non-putrescible), asbestos waste, waste tyres and restricted solid industrial waste

- Hydrocarbon contamination associated with vehicle access tracks, roads and on-site fuel tanks on farmland
- Asbestos containing material (ACM) associated with former farm infrastructure
- Buried fill material (including ACM)
- Inappropriately disposed waste
- Previous use of septic tanks in agricultural areas
- Heavy metals potentially associated with old fertilizers or previous activities.

3.8 Hydrology and flooding

The study area is in the South Creek sub-catchment, which is a sub-catchment of the Hawkesbury-Nepean River. The sub-catchment covers around 490 square kilometres. In the study area, South Creek generally flows from south to north. The sub-catchment area at Elizabeth Drive is around 90 square kilometres. The catchment area at Elizabeth Drive is around 90 square kilometres. The major creeks in the study area are:

- Kemps Creek
- South Creek
- Badgerys Creek
- Oaky Creek
- Cosgroves Creek.

Kemps Creek is a major tributary of South Creek, while Cosgroves and Badgerys creeks are minor tributaries. There are also a number of smaller unnamed tributaries in the study area. Most of the creeks in the study area have been modified as a result of development in the area – mainly through the inclusion of farm dams.

The areas around Badgerys Creek, South Creek and Kemps Creek are subject to localised flooding (Figure 3-6). The topography of the study area is relatively flat however, to the north of Elizabeth Drive the land consists of undulating plains.

It is known that flooding through South Creek typically occurs as a result of local catchment runoff. However, in the lower reaches of South Creek (north of the study area) the floodplain forms a large flood storage area during major floods on the Hawkesbury – Nepean River system.

3.8.1 Historic flood levels

Flood levels for local flood events in 1986 and 1988 through the study area were obtained from the Flood Study Report, South Creek (NSW Department of Water Resources, 1990) (refer to Table 3-9). The locations in the study area are Elizabeth Drive (where it crosses South Creek) and Overett Avenue, Kemps Creek (south of Elizabeth Drive).

The locations of Bringelly and Luddenham Road, St Clair are provided as they are south and north of the study area, respectively, and show the change in flood levels in the area. Creeks flow from south to north through the study area. Table 3-9 shows flood levels are deeper to the south and shallower north.

Table 3-9 Historic flood levels

Location	1986 flood level	1988 flood level
Bringelly Road – downstream	-	57.59
Overett Avenue	-	43.41
Elizabeth Drive – upstream	42.73	43.33
Elizabeth Drive – downstream	42.06	42.66
Luddenham Road	29.5	29.8

3.8.2 Modelled flood behaviour

The Updated South Creek Flood Study (Worley Parsons, 2015) was undertaken to update the model of the flood behaviour of the sub-catchment. This was due to the substantial change that had occurred in the sub-catchment since the 1990 Flood Study Report.

The results for the 100-year annual recurrence interval (ARI) flood event are shown in Table 3-10. These results show the water surface profile (that is levels modelled in the creeks) and include the influence from elevated flood levels from the Hawkesbury Nepean flood event.

Table 3-10: Peak 100 –year ARI flood levels

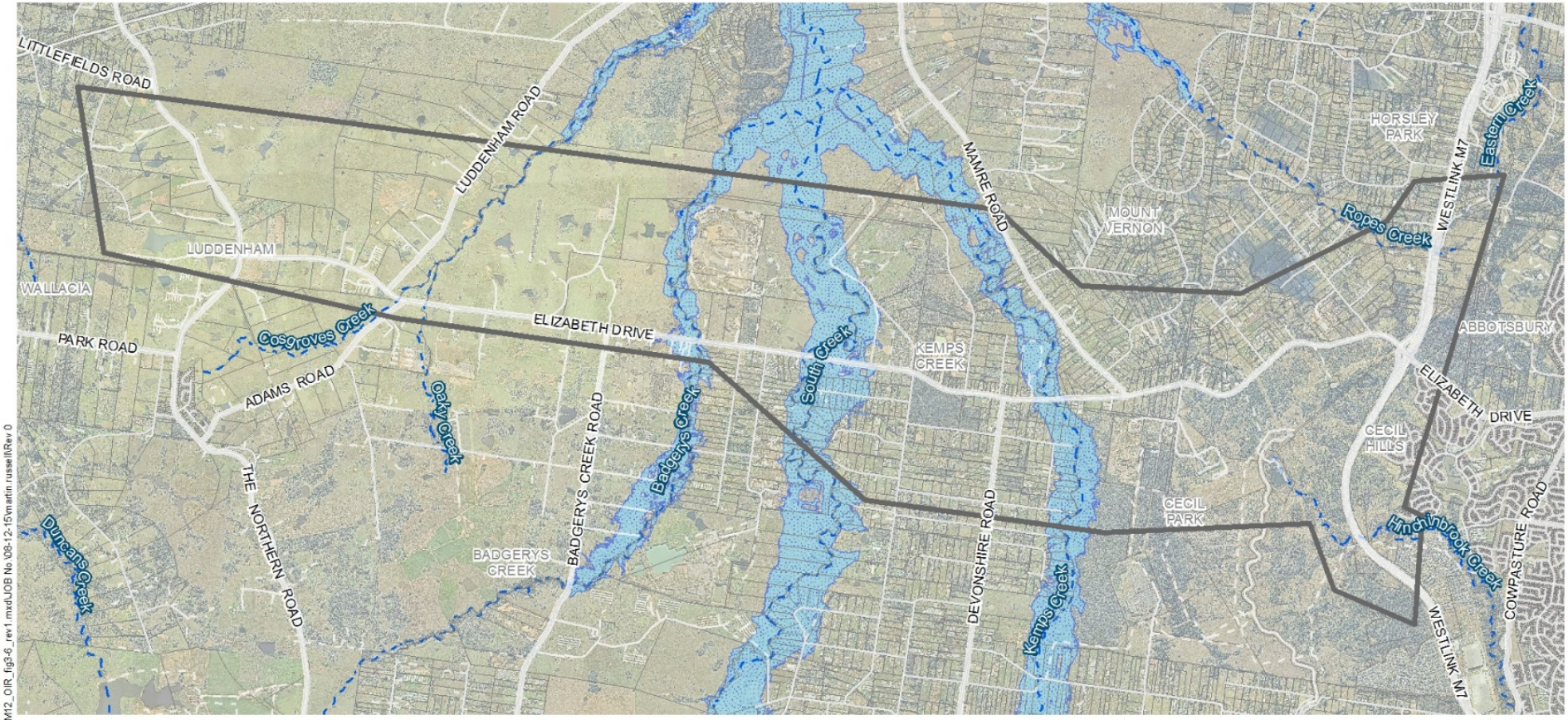
Creeks	Peak flood levels		
	Upstream of Elizabeth Drive	Downstream of Elizabeth Drive	Overett Avenue
South Creek	42.9	42.8	43.6
Kemps Creek	47.7	46.7	
Badgerys Creek	46.5	46.2	

The study found the extent of inundation during the 100-year ARI flood event is mostly through undeveloped or rural areas. However, pockets of inundation do occur on developed land in the study area, this is through the suburb of Kemps Creek.

As expected, flow velocities vary across the study area with the highest velocities recorded in South Creek and its tributaries. For a 100-year ARI flood event, peak in - channel velocities of South Creek upstream of Elizabeth Drive typically range between 0.8 and 1.0 metres per second (m/s). Badgerys Creek in – channel velocities are similar to South Creek, but for Kemps Creek, lower velocities between 0.6 and 0.8m/s are experienced.

Flooding depths for a 100-year ARI event (that is, water above the existing ground level) varies across the study area. In-stream depths for South Creek are up to over five metres. However, across the floodplains for all the creeks (South Creek, Kemps Creek and Badgerys Creek) flood depths vary from 0.5 metres to up to 2.5 metres. Upstream of Elizabeth Drive, flood depths can get up to one metre deep. With this amount of water across Elizabeth Drive, the road becomes impassable.

All of the road and rail crossings assessed in the South Creek sub- catchment are predicted to experience some inundation during flood events. In the study area, Elizabeth Drive is overtopped in all flood events at all three creek crossings (Badgerys Creek, South Creek and Kemps Creek). Results for overtopping of Elizabeth Drive in the 100-year ARI flood event are shown in Table 3-11.



Legend

- M12 study area
- 100 - year ARI flood extent
- Creek

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Source: Cardno, Nearmap, LPI, Aurecon

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Projection: GDA 1994 MGA Zone 56

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FIGURE 3.6: 100 - year ARI flood extents

Table 3-11 Overtopping of Elizabeth Drive during the peak 100-year ARI flood event

Creeks	Depth of water on Elizabeth Drive
South Creek	180 mm
Kemps Creek	500 mm
Badgerys Creek	270 mm

3.8.3 Flood mitigation

The South Creek Floodplain Risk Management Study and Plan (Liverpool City Council, 2004) identified flood mitigation structures to be constructed in the South Creek sub-catchment to minimise the impact of flooding. In the study area, this took the form of a relief floodway channel and bridge crossing along Elizabeth Drive at Kemps Creek. This work involved:

- Acquiring three properties adjoining South Creek (western extent of Overett Avenue)
- Constructing a relief floodway to the west of Overett Avenue
- Constructing an additional bridge over Elizabeth Drive and connecting floodway upstream and downstream of the bridge.

These flood relief works were included in the Updated South Creek Flood Study (Worley Parsons, 2015) and are reflected in the flood behaviour in Section 3.8.2. While difficult to quantify, the flood relief works have resulted in a reduction in flooding impact. It is estimated to have reduced the flood levels upstream of Elizabeth Drive by up to 0.3 metres for all flood events (so much so, that Elizabeth Drive is no longer inundated by South Creek in a 20-year ARI flood event).

3.9 Socio economic

3.9.1 Community profile

The study area is in western Sydney, encompassing a number of different suburbs across three local government areas (Penrith City Council, Fairfield City Council and Liverpool City Council).

The following suburbs are in the study area:

- Cecil Park
- Mt Vernon
- Kemps Creek
- Badgerys Creek
- Luddenham.

The following sections detail the current demographic profiles of western Sydney and the study area.

3.9.2 Demographic profile

Population

The population of the three local government areas located in the study area (based on ABS Census of Population and Housing, 2011) and a breakdown of the population by age brackets is provided in Table 3-12.

Table 3-12 Age breakdown of local government areas that fall in the study area

Age bracket	Penrith City		Liverpool City		Fairfield City		Greater Sydney
	Number	%	Number	%	Number	%	%
2011 population	178,465	*100*	180,142	*100*	187,768	*100*	
0 – 9	26,047	*14.6*	28,203	*15.6*	25,006	*13.3*	*13.1*
10–19	25,752	*14.4*	27,777	*15.4*	27,573	*14.6*	*12.4*
20–29	26,729	*14.9*	25,688	*14.2*	27,012	*14.3*	*14.8*
30–39	25,806	*14.4*	26,901	*14.9*	24,307	*12.9*	*15.3*
40–49	24,374	*13.6*	26,445	*14.7*	26,413	*14.1*	*14.3*
50–59	23,018	*12.9*	20,912	*11.6*	25,271	*13.4*	*12.2*
60–64	9600	*5.4*	7726	*4.3*	9634	*5.1*	*5.1*
65+	17,139	*9.7*	16,490	*9.2*	22,552	*12.0*	*12.7*

Population growth has varied across the local government areas. Between 2006 and 2011, Penrith City grew by 3.7 per cent, Fairfield City by 4.4 per cent and Liverpool City by 9.4 per cent. The population of Western Sydney is predicted to grow by one million people over the next 25 years.

Employment

Employment across the three local government areas varies substantially, with Penrith recording a higher percentage of employment and lower percentage of unemployment when compared with Greater Sydney. However, Liverpool City and Fairfield City have a lower proportion of employment and a higher rate of unemployment, with Fairfield City's unemployment rate being 4 per cent above that of Greater Sydney (refer to Table 3-13).

Table 3-13 Employment indicators

Indicator	Penrith	Liverpool	Fairfield	Greater Sydney
Size of employed labour force	87,229	80,192	75,949	-
Percent of employed labour force	94.5%	93.0%	90.3%	94.3%
Unemployment rate	5.5%	7.0%	9.7%	5.7%

In terms of the industries where the majority of people are employed, the top three industries are the same across the three local government areas. These are:

- Manufacturing
- Retail trade
- Health care and social assistance.

A comparison of the number of people employed in these areas as a percentage of the total employed resident population is provided in Table 3-14.

Table 3-14 Most popular employment industries

Indicator	Number and percentage of labour force			
	Penrith	Liverpool	Fairfield	Greater Sydney
Manufacturing	10,262 (11.8%)	10,411 (14.0%)	12,234 (17.8%)	8.5%
Retail trade	9,903 (11.4%)	7,786 (10.4%)	7,921 (11.5%)	9.8%
Health care and social assistance	8,867 (10.2%)	7,560 (10.1%)	5,885 (8.6%)	10.9%
TOTAL	29,032 (33.3%)	25,757 (34.5%)	26,040 (38.0%)	29.2%

In all three local government areas, more than half of the labour force travelled outside the local government area to work. The greatest of these is in Liverpool City, where 57 per cent of the population travel outside the area.

Section 3.9.4 discusses the industries that generate employment in the three local government areas.

Income

An analysis of census and Council data shows that compared to Greater Sydney:

- Penrith City has a lower proportion of people earning a high income ($1500 per week or more) and a lower proportion of people earning a low income (less than $400 per week). Overall, 10.1 per cent of the population earned a high income
- Liverpool City and Fairfield City have a lower proportion of people earning a high income, and a higher proportion of people earning a low income. This correlates with the high unemployment and low workforce participation experienced in these local government areas. Only 7.9 per cent and 4.4 per cent of the population earned a high income in Liverpool City and Fairfield City respectively.

Accommodation

Housing and residences through the three local government areas are similar, with most types of housing being separate dwellings with lower proportions of medium density dwellings and even lower proportions of high density dwellings. In particular:

- In Penrith City, 80.5 per cent of all dwellings (52,096) were separate houses; 14.8 per cent (9598) were medium density dwellings, and 4.1 per cent (2635) were high density dwellings
- In Liverpool City, 73.8 per cent of all dwellings (43,448) were separate houses, 15.1 per cent (8884) were medium density dwellings, and 10.8 per cent (6348) were in high density dwellings
- In Fairfield City, 73.6 per cent of all dwellings (44,300) were separate houses, 18.3 per cent (11,005) were medium density dwellings, and 7.7 per cent (4651) were in high density dwellings.

In comparison, Greater Sydney has a lower proportion of separate houses and a higher proportion of medium and high density dwellings.

Place of birth and ethnicity

Western Sydney is a multicultural area. The data show that Liverpool City and Fairfield City have a higher proportion of residents born overseas and from non-English speaking backgrounds than Greater Sydney, but Penrith City has a lower proportion of people born overseas and from non-English speaking backgrounds.

In Penrith City, 20.9 per cent of the population was born overseas, with 13.3 per cent from non-English speaking countries. The main countries of birth are United Kingdom (4.7 per cent), New Zealand (1.8 per cent) and the Philippines (1.7 per cent).

In Liverpool City, 39.8 per cent of the population was born overseas, with 35.9 per cent from non-English speaking countries. The main countries of birth in Liverpool City are

Fiji (3.6 per cent), Iraq (3.4 per cent) and Vietnam (2.9 per cent).

In Fairfield City, 52.5 per cent of the population was born overseas, with 50.1 per cent from non-English speaking countries. The main countries of birth are Vietnam (14.6 per cent), Iraq (7.7 per cent) and Cambodia (3.7 per cent).

3.9.3 Transport and access

As mentioned in section 3.9.2, more than half of the labour force travels outside the local government areas to work.

In all three local government areas, the majority of people use a private vehicle (car – as driver, car – as passenger, motorbike, or truck) to get to work, and only a small proportion uses public transport. Details on the transport mode of choice is shown in Table 3-15.

Table 3-15 Modes of transport use

Type	Percentage of transport use			
	Penrith	Liverpool	Fairfield	Greater Sydney
Private vehicles	72.9%	72.1%	72.6%	60.0%
Public transport	10.7%	12.4%	13.7%	20.0%

The consistent use of private vehicles far above the average of Greater Sydney indicates that there is a lack of regular public transport services to places of employment from these areas, which makes the private vehicle the only feasible options for many people.

3.9.4 Business activity

This section identifies the main employment industries in the three local government areas.

Penrith City

In Penrith City (2013–14 data):

- The three largest industries were health care and social assistance, retail trade, and education and training. These industries accounted for 37.9 per cent of people working in the local government area
- The local economy generated $7438 million (in 2014 dollar values)
- To get to their jobs in the Penrith City local government area, over 74 per cent of workers travel by private vehicle.

Liverpool City

In Liverpool City (2011 data):

- The three largest industries were health care and social assistance, retail trade, and manufacturing. These industries accounted for 40.8 per cent of people working in the local government area
- The local economy generated $7880 million (in 2011 dollar values)
- To get to their jobs in the Liverpool City local government area, over 75 per cent of workers travel by private vehicle.

Fairfield City

In Fairfield City (2011 data):

- The three largest industries were health care and social assistance, retail trade, and manufacturing. These industries accounted for 42.7 per cent of people working in the local government area
- The local economy generated $6558 million (in 2011 dollar values)
- To get to their jobs in the Fairfield City local government area, almost 80 per cent of workers travel by private vehicle.

3.9.5 Study area demographic profile

This section presents the study area's demographics based on the results of the 2011 ABS Census data for the suburbs that fall fully or partially in the study area.

Cecil Park

- Population of 1477 people with a median age of 31
- 498 people were born overseas (top three birthplaces are Italy, Iraq and Fiji)
- 600 people speak a language other than English; the main languages are Italian, Assyrian and Arabic
- 95 per cent of households have one or more motor vehicles
- Unemployment rate is 4.5 per cent
- Top three industries that residents work in are manufacturing, retail trade and construction
- 78 per cent of people travelling to work either all the way or part way as driver or passenger in a private vehicle.

Mt Vernon

- Population of 1036 people, with a median age of 39
- 263 people were born overseas (top three birthplaces are Italy, Iraq and Malta)
- 344 people speak a language other than English; the main languages are Italian, Maltese, Assyrian
- 95.6 per cent of households have one or more motor vehicles
- Unemployment rate is 3.2 per cent
- Top three industries that residents work in are construction, retail trade and manufacturing
- 80 per cent of people travelling to work either all the way or part way as driver or passenger in a private vehicle.

Kemps Creek

- Population of 2309 people, with a median age of 38
- 650 people were born overseas (top three birthplaces are Italy, China and Malta)
- 957 people speak a language other than English; the main languages are Italian, Arabic and Chinese

- 91 per cent of dwellings have one or more motor vehicle
- Unemployment rate is 3.5 per cent
- Top three industries that residents work in are construction; retail trade; and agriculture, forestry and fishing
- 75 per cent of people travelling to work either all the way or part way as driver or passenger in a private vehicle.

Badgerys Creek

- Population of 455 people, with a median age of 34
- 97 people were born overseas (top three birthplaces are China, Malta and New Zealand)
- 103 people speak a language other than English; the main languages are Chinese, Maltese and Italian
- 94 per cent of dwellings have one or more motor vehicles
- Unemployment rate is 6.1 per cent
- Top three industries that residents work in are construction; agriculture, forestry and fishing; and retail trade
- Around 72.5 per cent of residents travel to work either all the way or part way as driver or passenger in a private vehicle.

Luddenham

- Population of 1496, with a median age of 36
- 212 people were born overseas (top three birthplaces are UK, Italy and Malta)
- 196 people speak a language other than English; the main languages are Arabic and Italian
- 96 per cent of dwellings have one or more motor vehicles
- Unemployment rate is 4.3 per cent
- Top three industries that residents work in are construction, retail trade and manufacturing
- Around 78 per cent of residents travel to work either all the way or part way as driver or passenger in a private vehicle.

3.9.6 Community services and facilities

There are a number of community services and facilities throughout the study area. These consist of educational, recreational and leisure facilities. These are discussed in further detail in Section 3.6 of this report.

3.9.7 Property

The study area has 1416 property lots, with a number of different property types (mainly residential, commercial, industrial and general rural).

As well as residences, there are a number of other assets on the properties including:

- Agricultural properties: sheds, dams, stock infrastructure
- Commercial properties: structures, fencing
- Industrial properties: structures, storage laydown areas, fencing.

There are 170 sensitive receivers in the study area. These include residences and schools identified in Figure 6-5.

3.10 Traffic

There are a number of motorways, main arterials and sub-arterials that traverse the study area. These include:

- M7 Motorway
- A9 – The Northern Road
- Elizabeth Drive
- Mamre Road
- Wallgrove Road.

Other main roads include Badgerys Creek Road, Devonshire Road and Luddenham Road.

As part of the Western Sydney Infrastructure Plan (WSIP), Bringelly Road and The Northern Road are being upgraded. The plan has also identified the need to provide a new motorway connecting the M7 Motorway to The Northern Road (this project). Another road project currently underway that may interact with the M12 Motorway is the Outer Sydney Orbital (M9), the exact location of which is still to be determined.

3.10.1 General traffic

Existing situation

Elizabeth Drive is a two-lane arterial road in Western Sydney. There are no pedestrian or cycle paths along most of its length. The existing seven-day annual average daily traffic (AADT) volumes along Elizabeth Drive (collected by Tracsis in 2015) are shown in Figure 3-7 below.

Existing traffic volumes along Elizabeth Drive have been further extrapolated into eastbound, westbound and peak demands, as shown in Table 3-16. The weekend traffic volumes are significantly less than the weekday volumes as noted by the much higher weekday five-day AADT compared to the seven day AADT.

Table 3-16 Elizabeth Drive traffic counts by direction

Elizabeth Drive monitoring location	Direction	7-day AADT (veh)	5-day AADT (veh)	AM peak (veh/hr)	PM peak (veh/hr)
A9 The Northern Road to Luddenham Road	EB WB	4200 4200	4600 4600	670 250	270 610
Badgerys Creek Road to Devonshire Road	EB WB	5500 5700	6230 6500	890 350	390 830
Devonshire Road to Mamre Road	EB WB	8000 9000	9900 10,800	940 540	630 1200
Mamre Road to Wallgrove Road	EB WB	10,200 10,800	12,300 13,100	1200 730	800 1400
Wallgrove Road to M7 southbound on/off ramps	EB WB	12,800 12,800	14,800 14,700	1000 1000	1200 1300

While the traffic volumes in Table 3-16 highlight current traffic volumes in the study area, the justification for a new motorway connection, the M12 Motorway, is the future development of the area. This includes the development of the western Sydney airport

at Badgerys Creek and urban development through the Western Sydney Priority Growth Area.

Legend

M12 study area

11,100 7-day AADT volumes

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Source: Nearmap, LPI, Aurecon

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0 500 1000 m

Projection: GDA 1994 MGA Zone 56

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FIGURE 3.7: Two-way, 7-day AADT volumes

Western Sydney Priority Growth Area

Assessment of potential road networks in the Western Sydney Priority Growth Area have been discussed in section 3.6.3. Structure plans for the former Broader Western Sydney Employment Area and the former South West Growth Centre were released prior to the announcement of the amalgamation of these two areas to the Western Sydney Priority Growth Area. These structure plans included the road network plans and showed that the plans between the two precincts were consistent. There was a proposed deviation of Mamre Road to connect to Devonshire Road at Elizabeth Drive to provide a north-south connection between Broader Western Sydney Employment Area and the South West Growth Centre. The other main north-south connections identified were:

- Badgerys Creek Road, which would be extended north of Elizabeth Drive (identified in the WSEA Transport Planning – Preliminary Analysis, June 2013)
- Lawsons Road, which would be extended north of Elizabeth Drive (instead of Badgerys Creek Road) (identified in the SWGC Integrated Transport and Land Use Planning, July 2015).

With the development of the western Sydney airport and Badgerys Creek Road being in the airport site, it is unlikely that the option to use Badgerys Creek Road as a main arterial through the Western Sydney Priority Growth Area would be feasible. As such, it is more likely that Lawsons Road will be the north-south arterial road.

The M12 Motorway forms an important piece of infrastructure for the area and Roads and Maritime are consulting with Department of Planning and Environment on integration with future land use plans for the area.

Western Sydney airport at Badgerys Creek

Based on the western Sydney airport draft Environmental Impact Statement (DIRD, 2015), around 42,000 daily traffic movements (to and from the airport) is anticipated. This consists of around 31,500 passenger movements, 10,000 staff movements and just under 600 freight vehicle movements.

The proposed M12 Motorway would need to cater for all traffic generated by the new airport as well as increased local development and regional traffic. This includes the support services to the airport, which would develop around the airport site. The M12 Motorway would have provision for three interchanges to cater for this traffic. These would be at:

- The Northern Road (to accommodate traffic from the Western Sydney Priority Growth Area and further afield)
- Airport access road (to accommodate airport visitors and staff, including bus services and freight vehicles)
- M7 Motorway (to accommodate traffic from wider afield – such as Sydney and the M4 Motorway).

In addition, the M12 Motorway would not preclude an interchange at Mamre Road, should one be required in the future due to traffic numbers.

As the M12 Motorway would be a controlled access motorway (that is, it would have limited access points), Elizabeth Drive would continue to cater for local trips.

3.10.2 Freight

Existing situation

Elizabeth Drive is designated a heavy vehicle route for use by 4.6 metre high vehicles, 19 metre B-double vehicles, 23 metre B-double vehicles and 25/26 metre B-double vehicles.

Eighty seven per cent of vehicles travelling along the western end of Elizabeth Drive are classified as light vehicles (C1 and C2). Of the 13 per cent heavy vehicle volumes (recorded by Tracsis, July 2015), the main types of trucks using this road are classified C3 (two-axle trucks) or C9 (six-axle articulated).

As with the traffic flow patterns noted in Section 3.10.1, the commercial vehicle flows are much higher along the eastern end of Elizabeth Drive than the western end. Between Mamre Road and Wallgrove Road the two-way seven-day AADT for commercial vehicles is around 3500 vehicles per day. The daily flow along the western end between The Northern Road and Luddenham Road is almost a third of this with only 1300 vehicles per day.

Future demands

Future freight demands are expected to grow considerably with the development of the Western Sydney Priority Growth Area and the western Sydney airport which will attract major freight and logistics companies. As well as the need to provide improved road access, a freight line is currently being considered to the west of the study area.

3.10.3 Active transport (walking and cycling)

There are no existing, dedicated walking and cycling facilities in the study area. There are a number of active transport paths on adjoining routes including an off-road facility along the length of the M7 and an on-road path along the eastern end of Elizabeth Drive, from the M7 through to Liverpool (outside the scope of this study). Cycleway infrastructure in the study area is shown in Figure 3-8.

There is also a popular mountain bike trail through the Western Sydney Parklands south of Elizabeth Drive. This is a recreational cyclist facility and does not provide any connectivity to other cycleways for commuter cyclists.

3.10.4 Public transport

As the land use in the study area is semi-rural, the population density is low and there are limited public transport options. There are two public bus services that operate along Elizabeth Drive:

- Route 801 – Liverpool to Badgerys Creek,
- Route 813 – Fairfield to Bonnyrigg.

Bus route 789 also runs perpendicular to the study area along The Northern Road, between Luddenham and Penrith. All bus routes through the study area are shown in Figure 3-9.

Legend

- Off-road cycle facilities and shared paths
- On-road (high difficulty)
- On-road (medium difficulty)
- M12 study area

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Source: Nearmap, LPI, Aurecon

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Projection: GDA 1994 MGA Zone 56

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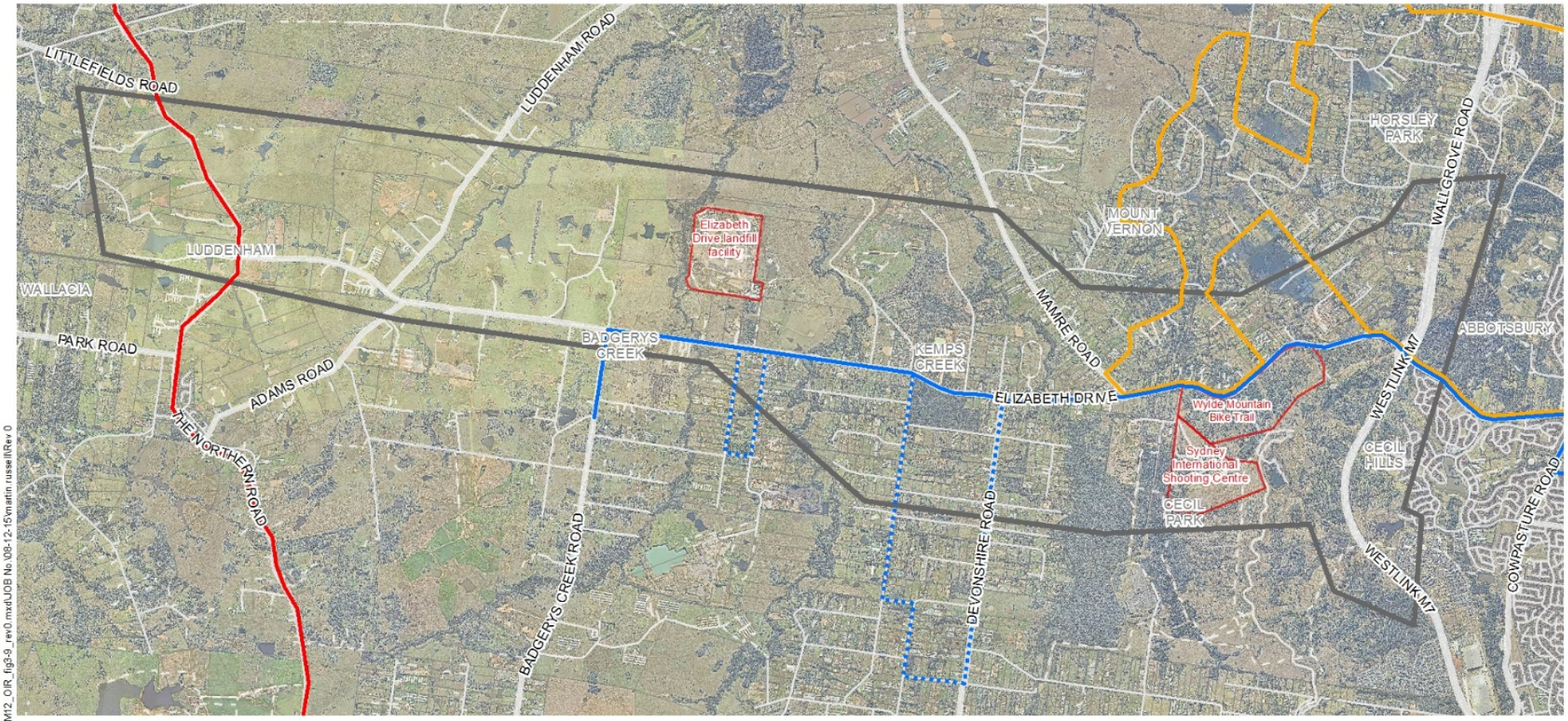
FIGURE 3.8: Existing cycleways



Legend

- 789 bus route
- 801 bus route
- 801 (selected services only)
- 813 bus route
- M12 study area

Source: Nearmap, LPI, Aurecon

1:65,000

0 500 1000 m

Projection: GDA 1994 MGA Zone 56

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FIGURE 3.9: Public transport

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As shown in these route diagrams, buses only travel along the eastern end of Elizabeth Drive; there are no bus services or bus facilities along the western end.

There are no rail facilities in the study area. The closest interchange to the study area is Liverpool Station, around 11 kilometres east of Elizabeth Drive, where passengers can travel on the Cumberland Line, Airport/Inner West & South Line, Bankstown Line and the South West Rail Link services.

However, with the area to be substantially developed, rail infrastructure is also being proposed, with services to use through the Southern Sydney Freight line. This would provide an additional rail line through the Western Sydney Priority Growth Area and BWSEA, incorporating a stop at the western Sydney airport at Badgerys Creek.

3.11 Geotechnical

3.11.1 General topography

The study area generally comprises fairly flat-lying or gently undulating topography across the western half, with some low, rolling hills across the eastern boundary near Mt Vernon and the Western Sydney Parklands. While ground elevations vary from about 90 metres Australian Height Datum (AHD) in the west to about 110 metres AHD in the east, the lowest lying areas are in the middle of the study area. This area is dissected by the natural system of creeks and minor channels that flow from south to north. The lowest point is between the Badgerys Creek and South Creek crossings at about 40 metres AHD.

3.11.2 Soils

Based on the Soils Landscapes Map (Penrith Sheet 9030), four types of soil landscapes occur in the study area: Blacktown, Luddenham, Picton and South Creek. The first three are associated with the Wianamatta Group shales which underlie the whole of the study area. The soils can be up to 1.5 metres thick, derived from weathering of the shales, and typically display a high erosion potential and moderate to high reactivity. The Blacktown and Luddenham soils predominate, with Picton soils expected to be found near the eastern and western boundaries of the study area.

The South Creek soils are deep, layered, alluvial soils occurring in the creek channels and floodplain areas. The depth of alluvium, particularly in the main creek channels, may be several metres thick. Red and yellow podzolic soils (these are typically leached soils) are commonly found in the floodplain terraces.

3.11.3 Acid sulfate soils

Acid sulfate soils are typically found in estuarine and alluvial environments that are low-lying and close to the coastline (generally at less than 10 metres AHD). Based on the ground elevations and the nature of the alluvium in this area, the Acid Sulfate Soils probability map shows that the probability of encountering acid sulfate soils in the study area is extremely low.

3.11.4 Bedrock geology

The bedrock geology in the study area is dominated by the Bringelly Shale formation of the Wianamatta Group. The Bringelly shale readily breaks down or weathers on exposure primarily due to the particular clay mineral content. The shale weathers to an orange-brown and grey clay soil, which is typically moderately to highly reactive and consequently prone to a high shrink–swell potential under varying moisture content.

The clay soils are also highly dispersive, and the intact shale is commonly prone to slaking.

Due to its weathering characteristics, very limited natural shale rock exposures can be expected to be found across the study area. A mantle of residual clayey soils covers the shale bedrock across most of the area, possibly with some minor colluvial soils in the Cecil Hills area. In the creeks and floodplain areas, the shale is overlain by younger alluvial soils, which comprise variable sequences of clays, silts and sands.

There are minor siltstone and sandstone layers in the Bringelly shale, although these are typically less than two metres thick and discontinuous. The lower 30 metres of the Bringelly Shale sequence also contains some carbonaceous claystone layers, with some minor coal seams in places.

A persistent sandstone layer (the Minchinbury Sandstone), typically about three metres thick, defines the base of the Bringelly Shale, and differentiates it from the underlying Ashfield Shale formation. Based on current knowledge, neither the Ashfield Shale nor the Minchinbury Sandstone are expected to be found across the study area, at less than 10 metre depth.

3.11.5 Alluvial deposits

Generally fine grained, clayey and silty soils of alluvial origin may be found in various parts of the study area, associated with creeks and natural drainage channels. Sand layers may also be found, but are likely to be subordinate to the finer grained alluvial soils. The thicker alluvial deposits occur in the middle part of the study area, where the main creeks draining the area are located.

These fine-grained sediments represent unconsolidated or normally consolidated soils that are typically of low strength and compressible. Given the location in drainage channels and floodplain, these soils are likely to be saturated at relatively shallow depth (groundwater is expected to be shallow in these areas).

3.11.6 Fills

Constructed fills are expected to be found in built-up areas and brownfield sites. Paved areas may include asphalt, concrete, and base course materials at least 0.5 metres thick. Deeper, undocumented fills in certain areas cannot be discounted. These could be found in areas of previous excavations, workings, or landfills (such as the Elizabeth Drive landfill facility).

3.11.7 Geological lineaments

The Triassic rocks (including the Wianamatta Group) have been affected by later tectonic activity, and this is evident by jointing and faulting in the rock masses of the Sydney Basin. Geological structures associated with the Triassic rock formations may include doleritic dykes (igneous intrusives), either singly or in swarms, and minor faults.

The main dyke orientations are associated with faulting, with strike in a north-west to south-east direction predominating. Faulting (and associated jointing), however, is not extensively developed in the Wianamatta Group. Faults typically have steep dips (greater than 60 degrees) and mainly strike nor-north-west and north-west.

3.11.8 Groundwater

Groundwater levels along the proposed route alignments can be expected to vary depending on topography, proximity to creeks, and stratigraphic profile. Shallow, perched groundwater tables can be expected to be found in the lower-lying floodplain areas near natural creek channels.

3.11.9 Assessed ground profiles

The logs of two test pits excavated during the design of the M7 motorway, at Cecil Park and Horsley Park, show a similar ground profile of firm to stiff clay (assumed to be residual clay) to about 1.4 metres depth over extremely weathered, low to medium strength, grey shale (assumed to be Bringelly Shale). This ground profile may be assumed to be representative of the route corridor areas in the eastern part of the study area.

A very similar ground profile was found in a borehole on The Northern Road, near the intersection with Littlefields Road. Dark grey shale was intersected at 1.9 metres depth in this borehole (to at least 4.2 metres depth).

3.12 Utilities

There are a wide arrange of utilities installations and facilities including water and gas pipelines, overhead electrical transmission lines, substations, mobile phone towers and radar installations.

A summary of utility issues and their potential risks is presented in Table 3-17 and shown in Figure 3-10.

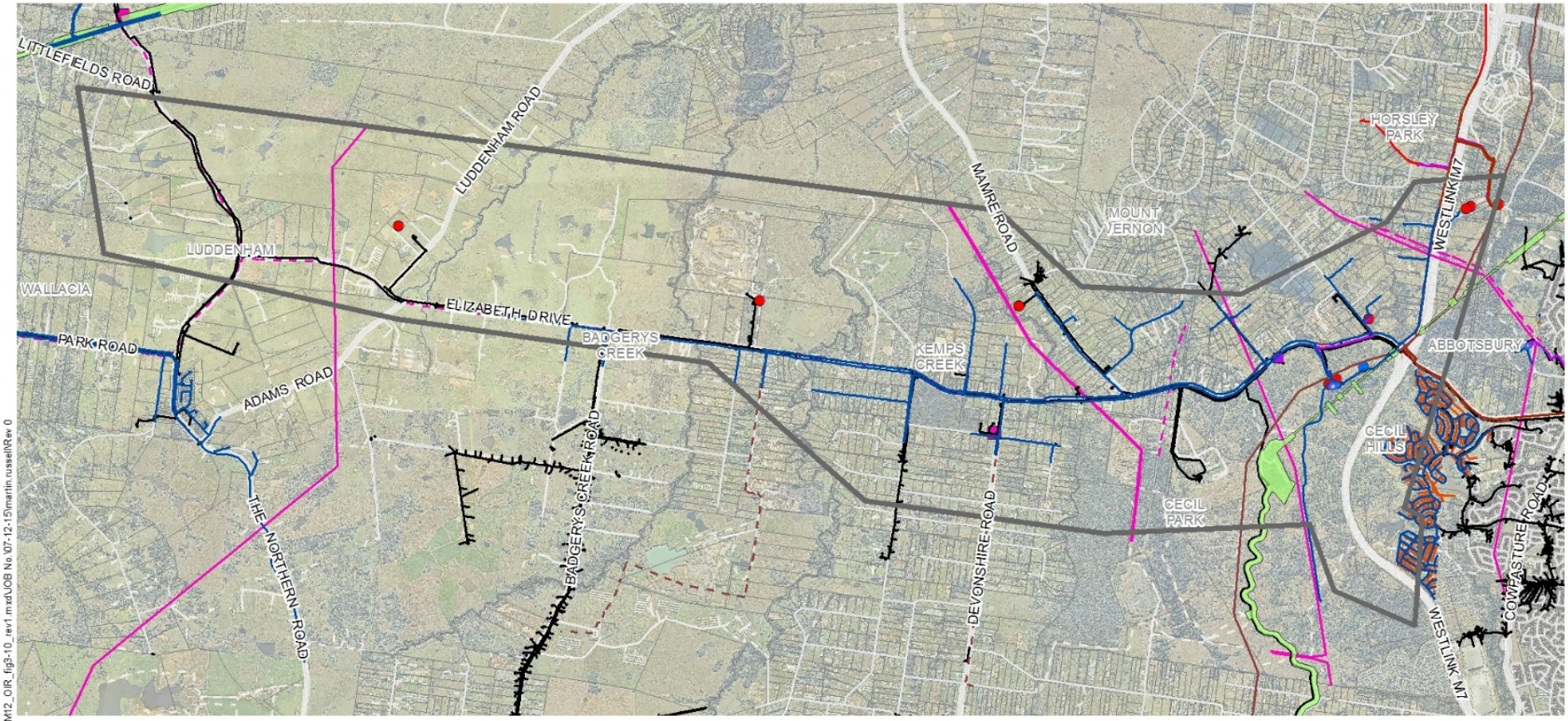
The long list route options have been designed to avoid the major and critical utility infrastructure. Other utilities would be appropriately designed around or managed during the shortlisting and concept design phases of the project.

Table 3-17 Summary of utility facilities and potential risk

Utility authority	Asset	Location	Risk
Sydney Water	General water mains	Many and varied	Normal
	DN450 DICL/CICL & DN300 CICL	Along Elizabeth Drive from Cecil Park Reservoir to Devonshire Road SyW3.1	Major
	DN500 CICL	From Cecil Park Reservoir, crossing Elizabeth Drive, and along Wallgrove Road SyW3.2	Major
	DN450 DICL	Exits Cecil Park Reservoir, running in direction of M7 south SyW3.3	Major
	Future plans for a 4.3 km long DN1200 water main	From Cecil Park Reservoir, parallel to future M12, up to Devonshire Road and Western Road.	Normal
	Future plans for additional reservoir at Cecil Park Reservoir.		Normal
Water NSW (State Water & Sydney Catchment Authority)	Upper Canal	Runs north-south near M7 Motorway interchange	Critical
Telstra	Minor services	Many and varied	Normal
	Exchanges	Kemps Creek (Elizabeth Drive just east of Duff Road)	Critical
	Mobile Towers	Luddenham Road Off Elizabeth Drive opposite Lawson Road Mamre Road Next to Cecil Park Radio Tower	Critical
	Main distribution fibre optic and copper cables	Along most main roads: Elizabeth Drive, Cecil Road, Duff Road, Mamre Road, Devonshire Road, Western Road, Badgerys Creek Road, Luddenham Road.	Major
	Cable amplifications (mainly fibre optic)	Along future M12 Motorway from Kemps Creek to the proposed western Sydney airport.	Normal
Jemena	Central trunk –Primary Main 5000 – 7000 kPa	N-S Wilton to Horsley Park near M7/Elizabeth Drive JG3.1	Critical
	150 mm diameter main 1200 kPa	Along Elizabeth Drive JG3.2	Critical
	100 mm diameter main 1050 kPa	Along Devonshire Road JG3.3	Critical
	Possible new pipeline to supply western Sydney airport	Elizabeth Drive or M12	Normal
Transgrid	Overhead Power – 500kV double circuit line	Crossing Elizabeth Drive near Mamre Road TG3.1	Critical
	Overhead Power – 330kV single circuit line	Crossing Elizabeth Drive near Duff Road TG3.2 Crossing Elizabeth Drive near Kosovich Close TG3.3	Major

Utility authority	Asset	Location	Risk
	Overhead Power – 330kV single circuit line	Crossing Elizabeth Drive near Adams Road (near Airport site) TG2.1	Major
Endeavour Energy	465 – 33kV	Parallel to Elizabeth Drive	Major
	93X – 132kV	Crossing east of Elizabeth Drive/Mamre Road intersection	Critical
	93U – 132kV	Crossing south of M7/Elizabeth Drive intersection	Critical
	Substations	Kemps Creek Substation near Devonshire Road	Critical
	Future feeders eg 33 kV line (not confirmed)	Western Sydney Employment Area	Normal
	Future 132 kV line	From Kemps Creek bulk supply north across Elizabeth Drive and connecting to the site of the western Sydney airport.	Normal
	Future 132 kV line	From Kemps Creek bulk supply to Kemps Creek substation.	Normal
Optus	General	Various	Normal
	Cecil Park radio tower	South of Elizabeth Drive between Cecil Road and Duff Road.	Critical
	Optic fibre	Cross the M4 Motorway at the corner of The Northern Road and Homestead Road.	Critical National significance
Fuel supplier, eg. Caltex	Aviation fuel line	Feasibility study indicates routes either from Plumpton, Clyde Sydney Airport or Kurnell	Normal
Sydney Trains	Galvanised steel troughing and high voltage provision for traction power	To service the North West Rail Line extension	Normal
	Radar installation	South of Elizabeth Drive between Cecil Road and Duff Road.	Critical

Critical: a utility severely restricted in relocation/ movement.
Major: a utility that would require a long lead time to enable relocation.
Normal: General utilities relocation that can be carried out at the start of the project construction period with little disruption.



Legend

- M12 study area
- Water reservoir/structure
- Water main
- Water NSW (controlled area)
- Sewer main
- Gas main - central trunk (Wilton to Horsley Park)
- Gas main
- Uecomm fibre
- Optus fibre cable - aerial
- Optus fibre cable - ugrd
- Telstra fibre assets
- Radar site
- Mobile tower
- Exchange
- High voltage lines (Endeavour Energy)
- Transmission lines (Transgrid)
- Electrical substation

Source: Transgrid, Endeavour Energy, Telstra, Optus, Uecomm, Jemena, WaterNSW, Sydney Water, Nearmap, LPI, Aurecon

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M12 Strategic Route Options Analysis **Options Identification Report**

FIGURE 3.10: Utilities

4 Development of route options

This section provides an overview of the process and activities that led to the identification of the long list of route options for the M12 Motorway.

4.1 Previous Roads and Maritime route options

In 2014, Roads and Maritime developed four preliminary route alignments for a proposed M7 to The Northern Road Motorway between a point two kilometres west of The Northern Road and a single connection to the M7 Motorway at the existing Elizabeth Drive interchange. Some of the features of the options included:

- Common western end point 4.2 kilometres west of The Northern Road
- Options were to the north and south of Elizabeth Drive intersection with The Northern Road
- All options were south of the Elizabeth Drive landfill facility
- East of the proposed western Sydney airport site, all options were located to the north of Elizabeth Drive
- Interchange at the western Sydney airport at Badgerys Creek
- One option went through Kemps Creek village and another two located 700 metres to the north
- The interchange at M7 Motorway was just north of Elizabeth Drive to provide for all traffic movements, but did not consider alterations to existing ramps and the road network that would be required
- The route options were developed in two dimensions only and developed prior to the mapping of constraints.

Three options were identified in a similar study area to that currently being considered for the project.

4.2 Elizabeth Drive upgrade

In 1995, an EIS was completed for the upgrade of Elizabeth Drive with the aim of providing access to the proposed western Sydney airport at Badgerys Creek. The objective of the project was the importance of Elizabeth Drive in linking the 'Sydney West airport, the (then) proposed Western Sydney Orbital (now the M7 Motorway) and the eastern, north-eastern and south-eastern areas of Sydney' (Rust PPK, 1995).

Four different options were considered:

- The upgrade of Bringelly Road and Camden Valley Way between the proposed western Sydney airport at Badgerys Creek and the M5 Motorway at Prestons
- The upgrade of Fifteenth Avenue and Hoxton Park Road between the proposed western Sydney airport at Badgerys Creek and Liverpool or the Western Sydney Orbital at Hoxton Park
- The upgrade of Elizabeth Drive between the proposed western Sydney airport at Badgerys Creek and Liverpool or the Western Sydney Orbital
- The construction of a new motorway between the proposed western Sydney airport at Badgerys Creek and Liverpool or the Western Sydney Orbital.

The upgrade of Elizabeth Drive was identified as the preferred option. This option consisted of:

- Upgrading to a four-lane road (two lanes in each direction)

- Upgrading between 600 metres east of the intersection of Mamre Road to the intersection of Luddenham Road
- Building new bridges at Badgerys Creek, South Creek and Kemps Creek crossings
- Installing culverts at Oaky and Cosgrove creeks (and other locations)
- Widening to a six-lane road (in the median) east of the main entrance to the proposed western Sydney airport at Badgerys Creek
- Confining most existing driveways on Elizabeth Drive to left-in / left-out only
- Locating roundabouts at Luddenham Road intersection, Badgerys Creek Road intersection, in Martin Road (away from Elizabeth Drive) and Mamre Road intersection
- Providing local service roads at Kemps Creek village
- Providing seagull intersections at:
  - The Elizabeth Drive landfill facility
  - Martin Road
  - Western Road
- Providing T-intersections at other local road intersections.

The upgrading of Elizabeth Drive is an option that is being considered as part of the analysis in this report. This option is identified in Chapter 5 as 'Route 1', which is made up of corridor options A0, B0, C0 and D1.

4.3 Methodology for generating the long list of route options

The process for generating a long list of options involved establishing feasible corridor options driven by the project objectives and design principles. It takes into account opportunities and constraints in the study area and seeks to generate corridor options that meet engineering standards and consider environmental and socio-economic issues (as outlined earlier in this document).

To generate the long list of route options, a software package called Quantm was used to identify a range of feasible corridor options for the M12 Motorway alignment. Quantm combines the elements in design standards, terrain, geological and hydrological data, environmental areas, property ownership, and cost information to identify feasible alignment alternatives.

The key steps in generating a long list of route options are presented below.

Data preparation

- Carrying out extensive and detailed analysis of the entire study area and beyond to identify the engineering, environmental and socio-economic features. These include geology, soil profiles, 100-year ARI flood zones / levels, the proposed western Sydney airport, other road project constraints and environmental constraints mapping
- Establishing and agreeing road standards and criteria for the project
- Establishing cost parameters for construction, land acquisition (based on current land use) and clearing.

Options generation

- Input the gathered data into Quantm

- Generating corridor options with varying constraints and opportunities to ensure the analysis extends over the whole study area using a range of scenarios if required
- Conducting sensitivity analysis to test the adequacy of the study area and level of constraint.

Fatal flaw analysis

- Assessing each corridor option against fatal flaws
- Discarding any corridor option with fatal flaws.

Identification of trends

- Overlaying the exports from Quantm to determine the horizontal corridor option trends
- Identifying trends and patterns for draft list of options
- Assessing corridor options with refined scenarios
- Comparing corridor options.

Consolidation of options

- Creating the study area boundaries (offsets from centre line) for the corridor options considered as candidates for the long list. The corridor widths of the options located away from the Elizabeth Drive alignment were identified as 300 metres
- Identifying the long list of route options.

4.3.1 Road design parameters

As part of the Quantm assessment, design parameters needed to be included as part of inputs into the software. The design parameters were largely based on the Austroads Design Guides with Roads and Maritime supplements and the scope of the project. The inputs used are detailed in Table 4-1.

Table 4-1: Design parameters

Item	Value	Details
Design parameters for M12 main line		
Design speed	110 km/h	100km/h posted speed plus 10 km/h
Minimum horizontal radius	2000 m	Minimum radius with standard cross fall
Minimum horizontal radius	1200 m	Preferred minimum for the 100 km/h motorway with superelevated cross fall
Minimum vertical radius – crest	K 99	About 990 m radii based on 2.5 second reaction time
Minimum vertical radius – sag	K 51	About 510 m radii based on urban and rural roads without head lighting
Maximum longitudinal grade	3 %	Preferred maximum for this terrain/project
Maximum sustained grade	3 % / 1000 m	Maximum length at maximum grade
Pavement depth and sub-grade thickness	900 mm	Derived from existing M7 pavement – 30 mm AC over, 270 mm CRCP, over 400 mm DGS/DGB, plus averaged drainage blanket 0 – 300 mm
Pavement width (per carriageway)	14 m	3 x 3.5 m traffic lanes in each direction excluding, 2.5 m to 3 m nearside shoulder, 1 m offside (median) shoulder
Pavement cross fall (%)	3 % to 5 %	Typically 3 % max5%

Shoulder in fill	3 m	Assumes next to guardrail
Shoulder in cut	3.5 m	Includes SO gutter
Super-elevation	5 %	Maximum
Ditch Width	4 m	across top, with sloped sides to invert below
Ditch Depth	0.5 m	assumed invert at centre
Maximum Fill/Cut Limit	21 m	
Fill side slope (V:H)	1 in 3	Trade-off between low and high fill embankments
Fill step width	4 m	Benching
Fill step height	10 m	Toe of fill
Cut side slope (V:H)	1 in 3	Poor erosive soils
Cut step width	4 m	Benching
Cut step height	7 m	Top of cut
Median width	12 m	Measured from lane edge
Design criteria for ramp connections to M7 and airport spur (not run in Quantm)		
Design speed	90 km/h	80 km/h posted speed plus 10 km/h
Minimum horizontal radius absolute min	400 m	Absolute minimum mainline
Minimum vertical radius – crest curve	K 35.5	About 350 m radii based on 2.5s Rt
Minimum vertical radius – sag	K 22	About 220 m radii based on urban and rural roads without head-lighting
Maximum design grade	2% uphill	At ramps uphill

4.3.2 Inputs of avoidance into Quantm

Constraints and opportunities in the study area were identified to inform those areas that need to be avoided by any identified corridor options. Not all potential constraints were imported into Quantm, due to limitations of the software, which would constrain the identification of potential options. Only those items with an extremely high environmental sensitivity or constructability constraint were included.

Other constraints will be identified and assessed as part of the value management and shortlisting route option process.

There are two categories of avoidance in Quantm:

- High avoid – routes will try and avoid these
- Medium avoid – where possible, routes will try and avoid these.

The following are the ‘high avoid’ and ‘medium avoid’ sites:

- High avoid
  - Western Sydney airport at Badgerys Creek
  - Diversion of Elizabeth Drive around the proposed western Sydney airport at Badgerys Creek
  - School sites
  - Elizabeth Drive landfill site
  - Telstra exchanges
  - Mobile towers
  - Endeavour Energy substations
  - Cecil Park radio tower

- Radar installation
- Aboriginal heritage land claim
- Petrol stations
- Upper Canal water system tunnel entrance with buffer zone.

- Medium avoid
  - Quarry sites
  - Existing native vegetation (ENV) on non-certified land
  - Areas of “priority for conservation” as part of the Cumberland Plain Recovery Plan.
  - Endangered Ecological Communities
  - Upper Canal water system.

4.3.3 Generated options

The software generated hundreds of possible route alignments. The commonality of a number of corridor options allowed these to be consolidated to 15 different route options (these are broader areas in which the alignments could be located). These are described in Chapter 5.

5 Description of the route options

5.1 Introduction

As discussed in section 4.3, the Quantm software produced several hundred alignments using varying parameters and sensitivity analysis. From these alignments, trends emerged that enabled the project team to identify corridor options in the study area. It became evident the study area could be divided into four clear zones from east to west for ease of assessment and comparison. These zones are named A, B, C and D, described in Table 5-1 and shown in Figure 5-1.

The zones contain corridor options which are numbered from zero (the option in the Elizabeth Drive EIS, 1995) to four, as follows:

- Zone A – A0, A1 or A2
- Zone B – B0, B1, B2, B3 or B4
- Zone C – C0, C1 or C2
- Zone D – D1.

5.2 Zone corridor options

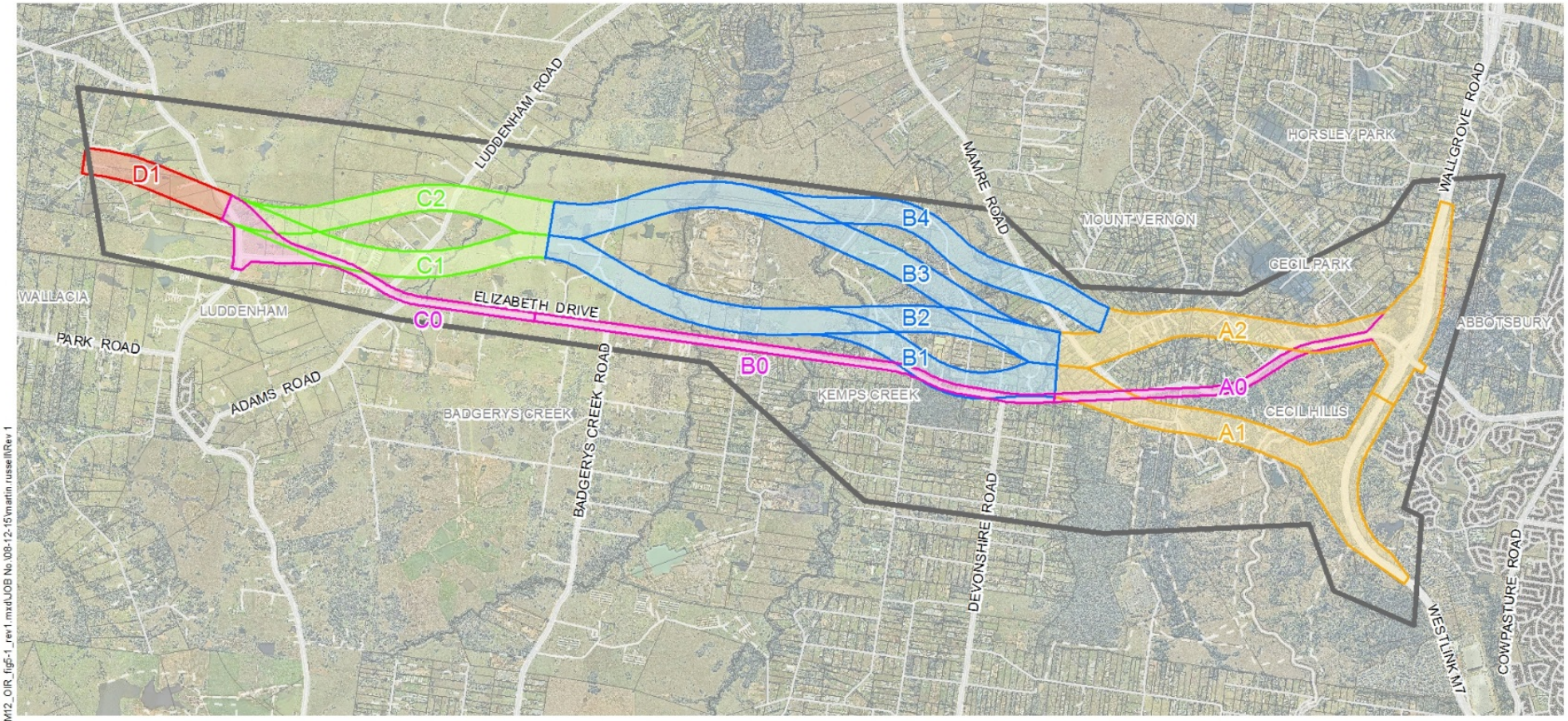
End – to – end route options (discussed in section 5.3) are made up of a combination of four corridor options, one from each zone, noting that there is only one option in Zone D, so Option D1 is common to all route options. The corridor widths for the corridor options are 300 metres wide with the exception of A0, B0 and C0 which are only 100 metres wide to show the realistic width of a final footprint.

The corridor options are described in Table 5-1.

Table 5-1: Zone corridor options

Corridor option	Description
Zone A	It traverses about four kilometres from the existing M7 Motorway to near Mamre Road.
Corridor option A0	This corridor option follows the existing alignment of Elizabeth Drive where possible to maximise use of the existing road reserve. This would replicate the proposed upgrade of Elizabeth Drive documented in the 1995 EIS (RustPPK, 1995) as far as possible. However, to meet current design standards, east of Mamre Road, the corridor option has been straightened. This option would meet the M7 Motorway at the existing interchange with Elizabeth Drive. As part of this option, Elizabeth Drive would also be upgraded to two lanes either direction. This corridor option connects only to the corridor option B0.
Corridor option A1	This corridor option ties into the M7 Motorway about three kilometres south of the Elizabeth Drive interchange. It traverses the Western Sydney Parklands in a north west direction, before crossing over Elizabeth Drive west of Mamre Road. This corridor option connects to corridor options B1, B2 and B3.
Corridor option A2	This corridor option connects to the M7 Motorway north of the existing Elizabeth Drive interchange before joining the Elizabeth Drive alignment west of the M7 Motorway. It traverses through the most densely populated area in the study area of Mount Vernon before crossing Mamre Road. This corridor option connects to corridor options B1, B2, B3 and B4.
Zone B	Zone B traverses around six kilometres from Mamre Road to the west of the Elizabeth Drive landfill facility.
Corridor option B0	This corridor option follows the existing alignment of Elizabeth Drive where possible to maximise use of the existing road reserve. This would replicate the Upgrade of Elizabeth

Corridor option	Description
	Drive corridor from 1997 as far as possible. It has been modified to meet some of the project criteria including consideration of high avoidance areas and future airport operations. As part of this option, Elizabeth Drive would also be upgraded to two lanes either direction. This corridor option connects only to corridor option C0.
Corridor option B1	This is the southern-most corridor option in this zone and nearest to Elizabeth Drive. It is next to the existing Elizabeth Drive road reserve, passing through the Kemps Creek village shops. It traverses further north away from the existing road reserve, but south of the landfill facility. This corridor option crosses Kemps Creek, South Creek and Badgerys Creek. This corridor option connects to corridor options C1 and C2.
Corridor option B2	This corridor option starts at Mamre Road around 1.2 kilometres north of Elizabeth Drive. It travels north of option B1 around Kemps Creek. West of Western Road, this option joins the B1 option. This option crosses Kemps Creek, South Creek and Badgerys Creek. This corridor option connects to corridor options C1 and C2.
Corridor option B3	This corridor option has the same eastern extent as zone option B2, before travelling west, passing north of the Elizabeth Drive landfill facility, before turning south to meet Zone C. This corridor option crosses Kemps Creek, South Creek and Badgerys Creek. This corridor option connects to corridor options C1 and C2.
Corridor option B4	This corridor option starts east of Mamre Road in the vicinity of Kerrs Road, turning north to traverse near the northern extent of the study area. It passes to the north of the landfill facility, before merging with the B3 corridor. This corridor option connects to corridor options C1 and C2.
Zone C	Zone C traverses about four kilometres from just west of the Elizabeth Drive landfill facility to The Northern Road.
Corridor option C0	This corridor option follows the existing alignment of Elizabeth Drive where possible to maximise use of the existing road reserve. This would replicate the Upgrade of Elizabeth Drive corridor from 1997 as far as possible. It has been modified to meet some of the project criteria including consideration of high avoidance areas and future airport operations. As part of this option, Elizabeth Drive would also be upgraded to two lanes either direction. This corridor option connects only to corridor option B0 and corridor option D1.
Corridor option C1	This corridor option crosses Cosgrove Creek and then runs south of Blackford Hill, crossing Luddenham Road. It is generally between 50 to 500 metres north of Elizabeth Drive and connects to The Northern Road at its western end, around 500 metres north of Elizabeth Drive. This corridor option connects to corridor option D1 and all corridor options in Zone B.
Corridor option C2	This corridor option crosses Cosgrove Creek and then runs north of Blackford Hill, crossing Luddenham Road north of corridor option C1, before turning south and merging with corridor option C1. This corridor option is typically 400 – 750 metres north of Elizabeth Drive and connects to The Northern Road at its western end, around 500 metres north of Elizabeth Drive. This corridor option connects to corridor option D1 and all corridor options in Zone B.
Zone D	This is the western-most zone from The Northern Road to the connection to the future M9 Outer Sydney Orbital (which is still subject to a separate route options study).
Corridor option D1	This corridor option starts at The Northern Road, north of the roundabout with Elizabeth Drive and has been placed to tie-in to the M9 Outer Sydney Orbital subject to the route option study being undertaken by Transport for NSW. However, this point has yet to be defined. This corridor option ties into all corridor options in Zone C.



Legend

Long list corridor options

- Option A0
- Option B0
- Option C0
- Option A1
- Option A2
- Option B1
- Option B2
- Option B3
- Option B4
- Option C1
- Option C2
- Option D1
- M12 study area
- Major road
- Local road
- Track

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Source: Nearmap, LPI, Aurecon

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Projection: GDA 1994 MGA Zone 56

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FIGURE 5.1: Long list corridor options

5.3 Long list of route options

By connecting the corridor options in each zone (mentioned in section 5.1 through to section 0), a number of 'end – to – end' route options were identified.

However, there were a few notable connections:

- Corridor option D1 was common to all route options
- Corridor options A0, B0 and C0 could only connect to one another
- Corridor option B4 could only connect to corridor option A2.

The 15 possible route options identified are shown in Figure 5-1 and described in Table 5-2.

Table 5-2 Long list of route options and their corridor option components

Route option	Zone A	Zone B	Zone C	Zone D
1	A0	B0	C0	D1
2	A1	B1	C1	D1
3	A1	B1	C2	D1
4	A1	B2	C1	D1
5	A1	B2	C2	D1
6	A1	B3	C1	D1
7	A1	B3	C2	D1
8	A2	B1	C1	D1
9	A2	B1	C2	D1
10	A2	B2	C1	D1
11	A2	B2	C2	D1
12	A2	B3	C1	D1
13	A2	B3	C2	D1
14	A2	B4	C1	D1
15	A2	B4	C2	D1

5.3.1 Option 1 - A0, B0, C0, D1

Route option 1 is 15 kilometres in length, predominantly following the Elizabeth Drive alignment, replicating the 1997 upgrade of Elizabeth Drive alignment. However, this deviates from the existing alignment in the eastern portion of the study area to smooth out a number of curves to ensure the design meets with current design standards. This option maximises the existing road corridor, reducing the need to acquire land and the length of greenfield construction.

This option connects to the M7 Motorway at the same location as the Elizabeth Drive interchange. The option would have edge effects to the Western Sydney Parklands and the Wylde Bike Trail. It would also pass over existing residences and businesses fronting Elizabeth Drive, particularly the Kemps Creek village with the requirement for acquisition either side of the road reserve to widen the existing corridor. As this option would be mostly within the existing road reserve, there would be constructability issues, with working near or under live traffic. This option falls within the glide path of the airport which would need to be shifted to meet CASA safety guidelines.

The interchange at The Northern Road would have a widest footprint of all options, needing to connect to corridor option D1, while maintaining all traffic movements to

The Northern Road. Option D1 connects to The Northern Road about 500 metres north of the existing Elizabeth Drive roundabout before connecting to the future Outer Sydney Orbital.

Option 1 is shown in Figure 5-2.

5.3.2 Option 2 - A1, B1, C1, D1

Route option 2 is 14 kilometres in length, connecting to the M7 Motorway about three kilometres south of the Elizabeth Drive interchange. It crosses the Western Sydney Parklands in a north-westerly direction before crossing Elizabeth Drive to the west of the existing Mamre Road intersection. The option is located north of Elizabeth Drive corridor for the remainder of the study area. While the distance between the corridor and Elizabeth Drive varies, at its greatest separation, it is 700 metres away.

This option would pass through the Kemps Creek village north of Elizabeth Drive, and could impact on the Kemps Creek Bowling and Sporting Club. It crosses South and Badgerys creeks about 200 metres north of Elizabeth Drive, and skirts to the south of the landfill site, crossing Luddenham Road just north of the intersection with Elizabeth Drive. Opposite the western Sydney airport site, the option deviates to the north where an interchange would be located. Its proximity to the airport would result in a shorter interchange spur than some other options. It then passes to the south of Blackford Hill, crossing Luddenham Road 200 metres north of Elizabeth Drive.

This option connects with The Northern Road about 500 metres north of the existing Elizabeth Drive roundabout before connecting to the future Outer Sydney Orbital.

Option 2 is shown in Figure 5-2.

5.3.3 Option 3 - A1, B1, C2, D1

Route option 3 is 14 kilometres in length, connecting to the M7 Motorway three kilometres south of the Elizabeth Drive interchange. It crosses the Western Sydney Parklands in a north-westerly direction before crossing Elizabeth Drive to the west of the existing Mamre Road intersection. The option is north of Elizabeth Drive corridor for the remainder of the study area. While the distance between the corridor and Elizabeth Drive varies, at its greatest separation, it is 900 metres away.

This option would pass through the Kemps Creek village north of Elizabeth Drive, and could impact on the Kemps Creek Bowling and Sporting Club. It skirts to the south of the landfill site and crosses Luddenham Road about 1.1 kilometres north of Elizabeth Drive.

Opposite the western Sydney airport site, the option travels to the north where an interchange would be located. It then passes to the north of Blackford Hill, crossing Luddenham Road about one kilometre north of Elizabeth Drive. This option connects with The Northern Road about 500 metres north of the existing Elizabeth Drive roundabout before connecting to the future Outer Sydney Orbital.

Option 3 is shown in Figure 5-3.

5.3.4 Option 4 - A1, B2, C1, D1

Route option 4 is 14 kilometres in length, connecting to the M7 Motorway three kilometres south of the Elizabeth Drive interchange. It crosses the Western Sydney Parklands in a north-westerly direction before crossing Elizabeth Drive to the west of the existing Mamre Road intersection. The option is located north of Elizabeth Drive corridor for the remainder of the study area.

It travels along the edge of Mamre Road for around one kilometre, before heading in a westerly direction. This option travels to the north across Kemps Creek and north of the village without impacting on the shops fronting Elizabeth Drive. It crosses South Creek and skirts to the south of the landfill site and crosses Badgerys Creek before providing an interchange to the proposed western Sydney airport site. While the distance between the corridor and Elizabeth Drive varies, at its greatest separation, it is 700 metres away.

This option then crosses Cosgrove and Oaky creeks near the confluence of the creeks, before crossing Luddenham Road just north of the intersection with Elizabeth Drive. It is typically 50–500 metres north of Elizabeth Drive in this section. It connects with The Northern Road about 500 metres north of the existing Elizabeth Drive roundabout before connecting to the future Outer Sydney Orbital.

Option 4 is shown in Figure 5-3.

5.3.5 Option 5 - A1, B2, C2, D1

Route option 5 is 14 kilometres in length, connecting to the M7 Motorway three kilometres south of the Elizabeth Drive interchange. It crosses the Western Sydney Parklands in a north-westerly direction before crossing Elizabeth Drive to the west of the existing Mamre Road intersection.

It travels along the edge of Mamre Road for around one kilometre, before heading in a westerly direction. This option travels to the north around Kemps Creek and the village without impacting on the shops fronting Elizabeth Drive. It crosses South Creek and skirts to the south of the landfill site and crosses Badgerys Creek before providing an interchange to the proposed western Sydney airport site. The distance between the corridor and Elizabeth Drive varies, at its greatest separation it is 700 metres away.

Opposite the western Sydney airport site, the option travels to the north where an interchange would be located. It then passes to the north of Blackford Hill, crossing Luddenham Road about one kilometre north of Elizabeth Drive. It connects with The Northern Road about 500 metres north of the existing Elizabeth Drive roundabout before connecting to the future Outer Sydney Orbital.

Option 5 is shown in Figure 5-4.

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Source: Nearmap, LPI, Aurecon

Projection: GDA 1994 MGA Zone 56

M12 Strategic Route Options Analysis **Options Identification Report**

FIGURE 5.2: Long list route options: Options 1 and 2

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Source: Nearmap, LPI, Aurecon

Projection: GDA 1994 MGA Zone 56

M12 Strategic Route Options Analysis **Options Identification Report**

FIGURE 5.3: Long list route options: Options 3 and 4

5.3.6 Option 6 - A1, B3, C1, D1

Route option 6 is 14 kilometres in length, connecting to the M7 Motorway three kilometres south of the Elizabeth Drive interchange. It crosses the Western Sydney Parklands in a north-westerly direction before crossing Elizabeth Drive to the west of the existing Mamre Road intersection.

It travels along the edge of Mamre Road for around one kilometre, before heading in a westerly direction, passing north of the Elizabeth Drive landfill facility, being over 1.5 kilometres north of the Elizabeth Drive. While the route would pass through some of Kemps Creek, it passes further north, through larger rural properties to miss the smaller lots along Elizabeth Drive in Kemps Creek. It crosses South and Badgerys creeks about 200 metres north of Elizabeth Drive and passes to the south of the landfill facility.

Opposite the western Sydney airport site, the option deviates to the north where an interchange would be located. It then passes to the south of Blackford Hill, crossing Luddenham Road 200 metres north of Elizabeth Drive. It connects with The Northern Road about 500 metres north of the existing Elizabeth Drive roundabout before connecting to the future Outer Sydney Orbital.

Option 6 is shown in Figure 5-4.

5.3.7 Option 7 - A1, B3, C2, D1

Route option 7 is 14 kilometres in length, connecting to the M7 Motorway three kilometres south of the Elizabeth Drive interchange. It crosses the Western Sydney Parklands in a north-westerly direction before crossing Elizabeth Drive to the west of the existing Mamre Road intersection.

It travels along the edge of Mamre Road for around one kilometre, before heading in a westerly direction, passing north of the Elizabeth Drive landfill facility, being over 1.5 kilometres north of the Elizabeth Drive. While the route would pass through some of Kemps Creek, it passes further north, through larger rural properties to miss the smaller lots along Elizabeth Drive in Kemps Creek. It crosses South and Badgerys creeks about 200 metres north of Elizabeth Drive.

Opposite the western Sydney airport site, the option travels to the north where an interchange would be located. It then passes to the north of Blackford Hill, crossing Luddenham Road about one kilometre north of Elizabeth Drive. It connects with The Northern Road about 500 metres north of the existing Elizabeth Drive roundabout before connecting to the future Outer Sydney Orbital.

Option 7 is shown in Figure 5-4.

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Source: Nearmap, LPI, Aurecon

Projection: GDA 1994 MGA Zone 56

M12 Strategic Route Options Analysis **Options Identification Report**

FIGURE 5.4: Long list route options: Options 5 and 6

5.3.8 Option 8 - A2, B1, C1, D1

Route option 8 is 15 kilometres in length, connecting to the M7 Motorway at the same location as the existing Elizabeth Drive interchange. This option is entirely to the north of the Elizabeth Drive corridor. It travels west, sharing the same alignment as Elizabeth Drive before deviating north to the east of Duff Road. The option passes through Mount Vernon and crosses Mamre Road 400–700 metres north of Elizabeth Drive.

It travels to the north of the existing Elizabeth Drive road reserve, passing through the Kemps Creek village shops. It crosses South and Badgerys creeks about 200 metres north of Elizabeth Drive and passes to the south of the landfill facility.

Opposite the western Sydney airport site, the option deviates to the north where an interchange would be located. It then passes to the south of Blackford Hill, crossing Luddenham Road 200 metres north of Elizabeth Drive. It connects with The Northern Road about 500 metres north of the existing Elizabeth Drive roundabout before connecting to the future Outer Sydney Orbital.

Option 8 is shown in Figure 5-5.

5.3.9 Option 9 - A2, B1, C2, D1

Route option 9 is 15 kilometres in length, connecting to the M7 Motorway at the same location as the existing Elizabeth Drive interchange. This option is entirely to the north of the Elizabeth Drive corridor. It travels west, sharing the same alignment as Elizabeth Drive before deviating north to the east of Duff Road. The option passes through Mount Vernon and crosses Mamre Road 400–700 metres north of Elizabeth Drive.

It travels to the north of the existing Elizabeth Drive road reserve, passing through the Kemps Creek village shops. It crosses South and Badgerys creeks about 200 metres north of Elizabeth Drive and passes to the south of the landfill facility.

Opposite the western Sydney airport site, the option travels to the north where an interchange would be located. It then passes to the north of Blackford Hill, crossing Luddenham Road about one kilometre north of Elizabeth Drive. It connects with The Northern Road about 500 metres north of the existing Elizabeth Drive roundabout before connecting to the future Outer Sydney Orbital.

Option 9 is shown in Figure 5-6.

5.3.10 Option 10 - A2, B2, C1, D1

Route option 10 is about 15 kilometres in length, connecting to the M7 Motorway at the same location as the existing Elizabeth Drive interchange. This option is entirely to the north of the Elizabeth Drive corridor. It travels west, sharing the same alignment as Elizabeth Drive before deviating north to the east of Duff Road. The option passes through Mount Vernon and crosses Mamre Road 400–700 metres north of Elizabeth Drive.

It travels along the edge of Mamre Road for around one kilometre, before heading in a westerly direction. This option travels to the north around Kemps Creek and the village without impacting on the shops fronting Elizabeth Drive. It crosses South Creek and skirts to the south of the landfill site and crosses Badgerys Creek before providing an interchange to the proposed western Sydney airport site. The distance between the corridor and Elizabeth Drive varies, at its greatest separation it is 700 metres away.

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Source: Nearmap, LPI, Aurecon

Projection: GDA 1994 MGA Zone 56

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FIGURE 5.5: Long list route options: Options 7 and 8

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Source: Nearmap, LPI, Aurecon

Projection: GDA 1994 MGA Zone 56

M12 Strategic Route Options Analysis **Options Identification Report**

FIGURE 5.6: Long list route options: Options 9 and 10

This option then crosses Cosgrove and Oaky creeks near the confluence of the creeks, before crossing Luddenham Road just north of the intersection with Elizabeth Drive. It is typically 50–500 metres north of Elizabeth Drive in this section. It connects with The Northern Road about 500 metres north of the existing Elizabeth Drive roundabout before connecting to the future Outer Sydney Orbital.

Option 10 is shown in Figure 5-6.

5.3.11 Option 11 - A2, B2, C2, D1

Route option 11 is about 15 kilometres in length, connecting to the M7 Motorway at the same location as the existing Elizabeth Drive interchange. This option is entirely to the north of the Elizabeth Drive corridor. It travels west, sharing the same alignment as Elizabeth Drive before deviating north to the east of Duff Road. The option passes through Mount Vernon and crosses Mamre Road 400–700 metres north of Elizabeth Drive.

It travels along the edge of Mamre Road for around one kilometre, before heading in a westerly direction. This option travels to the north around Kemps Creek and the village without impacting on the shops fronting Elizabeth Drive. It crosses South Creek and skirts to the south of the landfill site and crosses Badgerys Creek before providing an interchange to the proposed western Sydney airport site. The distance between the corridor and Elizabeth Drive varies, at its greatest separation it is 700 metres away.

Opposite the western Sydney airport site, the option travels to the north where an interchange would be located. It then passes to the north of Blackford Hill, crossing Luddenham Road about one kilometre north of Elizabeth Drive. It connects with The Northern Road about 500 metres north of the existing Elizabeth Drive roundabout before connecting to the future Outer Sydney Orbital.

Option 11 is shown in Figure 5-7.

5.3.12 Option 12 - A2, B3, C1, D1

Route option 12 is 15 kilometres in length, connecting to the M7 Motorway at the same location as the existing Elizabeth Drive interchange. This option is entirely to the north of the Elizabeth Drive corridor. It travels west, sharing the same alignment as Elizabeth Drive before deviating north to the east of Duff Road. The option passes through Mount Vernon and crosses Mamre Road 400–700 metres north of Elizabeth Drive.

It travels along the edge of Mamre Road for around one kilometre, before heading in a westerly direction, passing north of the Elizabeth Drive landfill facility. It crosses South and Badgerys creeks about 200 metres north of Elizabeth Drive.

Opposite the western Sydney airport site, the option deviates to the north where an interchange would be located. It then passes to the south of Blackford Hill, crossing Luddenham Road 200 metres north of Elizabeth Drive. It connects with The Northern Road about 500 metres north of the existing Elizabeth Drive roundabout before connecting to the future Outer Sydney Orbital.

Option 12 is shown in Figure 5-7.

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Source: Nearmap, LPI, Aurecon

Projection: GDA 1994 MGA Zone 56

M12 Strategic Route Options Analysis **Options Identification Report**

FIGURE 5.7: Long list route options: Options 11 and 12

5.3.13 Option 13 - A2, B3, C2, D1

Route option 13 is 15 kilometres in length, connecting to the M7 Motorway at the same location as the existing Elizabeth Drive interchange. This option is entirely to the north of the Elizabeth Drive corridor. It travels west, sharing the same alignment as Elizabeth Drive before deviating north to the east of Duff Road. The option passes through Mount Vernon and crosses Mamre Road 400–700 metres north of Elizabeth Drive.

It travels along the edge of Mamre Road for around one kilometre, before heading in a westerly direction, passing north of the Elizabeth Drive landfill facility. It crosses South and Badgerys creeks about 200 metres north of Elizabeth Drive and passes to the south of the landfill facility.

Opposite the western Sydney airport site, the option travels to the north where an interchange would be located. It then passes to the north of Blackford Hill, crossing Luddenham Road about one kilometre north of Elizabeth Drive. It connects with The Northern Road about 500 metres north of the existing Elizabeth Drive roundabout before connecting to the future Outer Sydney Orbital.

Option 13 is shown in Figure 5-8.

5.3.14 Option 14 - A2, B4, C1, D1

Route option 14 is 15 kilometres in length, connecting to the M7 Motorway at the same location as the existing Elizabeth Drive interchange. This option is entirely to the north of the Elizabeth Drive corridor. It travels west, sharing the same alignment as Elizabeth Drive before deviating north to the east of Duff Road. The option passes through Mount Vernon and along Mamre Road, before crossing Mamre Road near Kerrs Road.

It travels north-west then westerly, crossing Kemps and South creeks to pass north of the Elizabeth Drive landfill facility, before crossing Badgerys Creek about 1.5 kilometres north of Elizabeth Drive. The option then travels south with an interchange located for access to the western Sydney airport.

It then passes to the south of Blackford Hill, crossing Luddenham Road 200 metres north of Elizabeth Drive. It connects with The Northern Road about 500 metres north of the existing Elizabeth Drive roundabout before connecting to the future Outer Sydney Orbital.

Option 14 is shown in Figure 5-8.

5.3.15 Option 15 - A2, B4, C2, D1

Route option 15 is about 15 kilometres in length, connecting to the M7 Motorway at the same location as the existing Elizabeth Drive interchange. This option is entirely to the north of the Elizabeth Drive corridor and is the northernmost option. It travels west, sharing the same alignment as Elizabeth Drive before deviating north to the east of Duff Road. The option passes through Mount Vernon and along Mamre Road, before crossing Mamre Road near Kerrs Road.

It travels north-west then westerly, crossing Kemps and South creeks to pass north of the Elizabeth Drive landfill facility, before crossing Badgerys Creek about 1.5 kilometres north of Elizabeth Drive. The option then travels south with an interchange located for access to the western Sydney airport.

It then passes to the north of Blackford Hill, crossing Luddenham Road about one kilometre north of Elizabeth Drive. It connects with The Northern Road about 500 metres north of the existing Elizabeth Drive roundabout before connecting to the future Outer Sydney Orbital.

Option 15 is shown in Figure 5-9.

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Source: Nearmap, LPI, Aurecon

Projection: GDA 1994 MGA Zone 56

M12 Strategic Route Options Analysis **Options Identification Report**

FIGURE 5.8: Long list route options: Options 13 and 14

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Source: Nearmap, LPI, Aurecon

Projection: GDA 1994 MGA Zone 56

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FIGURE 5.9: Long list route options: Option 15

6 Discussion of corridor options

This chapter presents an overview of the potential effects of each corridor option and provides a point of discussion for assessing and further refining the options. The assessment of the long list of route options is based on the individual corridor options rather than the long list of route options as the individual corridor options are replicated across numerous route options. However, a table outlining the key environmental features and constraints in the long list of route options is provided in Appendix A.

The assessments are based on the width of each of the options (being 300 metres, except for A0, B0 and C0 which are 100 metres).

6.1 Biodiversity

The biodiversity assessment is based on desktop assessments only. Biodiversity constraints in each corridor option are shown in Figure 6-1.

6.1.1 Zone A

Corridor option A0

Option A0 contains around 50.2 hectares of threatened vegetation in varying condition – listed as either endangered ecological community (EEC) or critically endangered ecological community (CEEC) under the NSW *Threatened Species Conservation Act 1995*). Around 48.4 hectares (see Table 6-2) may meet the critically endangered criteria under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Table 6-1: Significant vegetation in corridor option A0

Vegetation community	Status (TSC Act)	Total
Cumberland Plain Woodland in the Sydney Basin Bioregion *	CEEC	46.2
Moist Shale Woodland in the Sydney Basin Bioregion*	EEC	2.2
River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC	1.8
Total		**50.2**

* listed as Critically Endangered under the EPBC Act
EEC – Endangered Ecological Community; CEEC – Critically Endangered Ecological Community

One threatened fauna species has either been recorded in the corridor option or is known to occur nearby. This is:

- Varied Sittella – Recorded in the Western Sydney Parklands to the east of the option near the M7 Motorway.

The corridor option:

- Passes through around 35 hectares of land classified as non-certified lands as part of the bio certification order for SEPP (Sydney Region Growth Centres) 2006
- Contains around 38 hectares of Cumberland Plain Recovery Plan priority conservation lands
- Crosses two regional corridors that link priority conservation lands, and contains 24.5 hectares of mapped regional corridor, all in the Western Sydney

Parkland to be managed as bushland corridor.

- Includes six hectares of the M7 Motorway biobanking agreement site. The very south eastern end of this option is immediately next to the Cecil Park South-East biobanking agreement (ID number 70) made under the TSC Act for Western Sydney Parklands Trust.

Relative to the other options in Zone A, this corridor option would have a moderate effect on biodiversity.

Corridor option A1

The corridor option A1 contains around 36 hectares of threatened vegetation in varying condition (listed as EEC or CEEC under the TSC Act). About 33 hectares may meet critically endangered criteria under the EPBC Act. Table 6-2 shows the composition of this threatened vegetation.

Table 6-2: Significant vegetation in corridor option A1

Vegetation community	Status (TSC Act)	Total
Cumberland Plain Woodland in the Sydney Basin Bioregion *	CEEC	32.7
River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC	3.2
Total		**35.9**

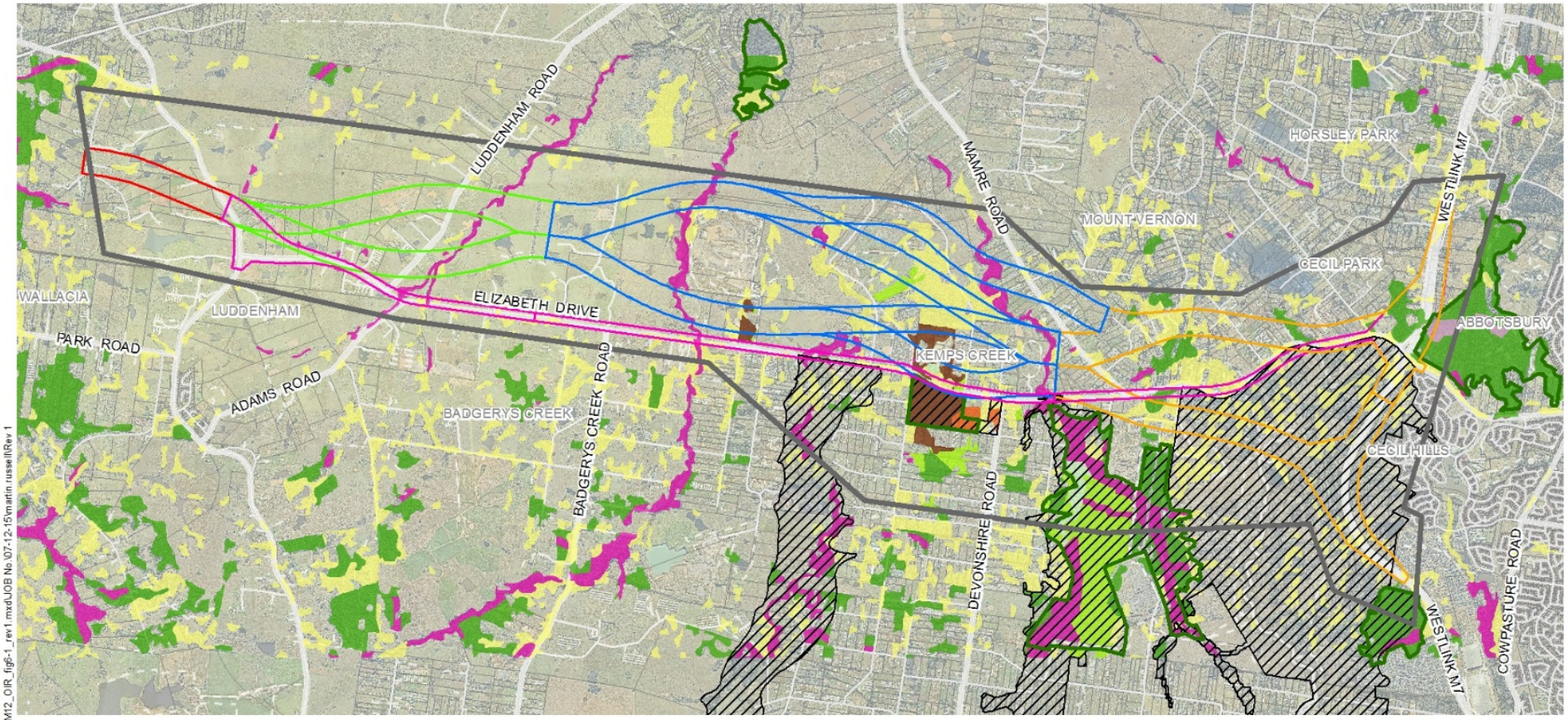
* listed as Critically Endangered under the EPBC Act
EEC – Endangered Ecological Community; CEEC – Critically Endangered Ecological Community

There are no recorded threatened species in this corridor option.

The corridor option:

- Passes through around 134 hectares of land classified as non-certified lands as part of the bio certification order for SEPP (Sydney Region Growth Centres) 2006
- Contains around four hectares of Cumberland Plain Recovery Plan priority conservation lands
- Crosses two regional biodiversity corridors that link priority conservation lands, and contains 52 hectares of mapped regional corridor, all in the Western Sydney Parklands to be managed as bushland corridor
- Potentially impacts 68 hectares of land that have been actively regenerated since 1997 to enhance the identified bushland corridor in Western Sydney Parklands
- Contains over six hectares of the M7 Motorway biobanking agreement site. Also, the very south-eastern end of corridor option A1 is immediately next to the Cecil Park South-East biobanking agreement (ID number 70) made under the TSC Act for Western Sydney Parklands Trust.

Relative to the other options in Zone A, this corridor option has a lower effect on biodiversity.



Legend

- M12 study area
- Priority conservation lands
- Non-certified land
- Castlereagh Scribbly Gum Woodland
- Shale Gravel Transition Forest
- Cooks River / Castlereagh Ironbark Forest
- Cumberland Plain Woodland
- Moist Shale Woodland
- River-flat Eucalypt Forest
- Other vegetation
- TEC poor condition

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Source: Nearmap, LPI, Aurecon

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Projection: GDA 1994 MGA Zone 56

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FIGURE 6.1: Biodiversity features within the corridor options

Corridor option A2

The corridor option A2 contains around 67 hectares of threatened vegetation in varying condition (listed as EEC or CEEC under the TSC Act). About 66 hectares may meet critically endangered criteria under the EPBC Act. Table 6-3 shows the composition of this threatened vegetation.

Table 6-3: Significant vegetation in corridor option A2

Vegetation community	Status (TSC Act)	Total
Cumberland Plain Woodland in the Sydney Basin Bioregion *	CEEC	64
Moist Shale Woodland in the Sydney Basin Bioregion*	EEC	2.2
River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC	0.9
Total		**67.1**

* listed as Critically Endangered under the EPBC Act
EEC – Endangered Ecological Community; CEEC – Critically Endangered Ecological Community

Two threatened fauna species have either been recorded in the corridor option or are known to occur nearby. These are:

- Eastern Freetail-bat – Recorded near Mount Vernon Road towards the west of the corridor option
- Varied Sittella – Recorded in the Western Sydney Parklands to the east of the corridor option near the M7 Motorway.

The corridor option:

- Passes through areas of around 26 hectares of land classified as non-certified lands as part of the bio-certification order for SEPP (Sydney Region Growth Centres) 2006
- Contains around 40 hectares of Cumberland Plain Recovery Plan priority conservation lands
- Crosses two regional corridors that are either contained in or link priority conservation lands, and contains 24 hectares of mapped regional corridors, all in Western Sydney Parklands to be managed as bushland corridor
- Potentially impacts eight hectares of land that have been actively regenerated since 1997 to enhance the identified bushland corridor in Western Sydney Parklands
- Potentially impacts around three hectares of the M7 Motorway biobanking agreement site.

Relative to the other options in Zone A, this corridor option would have a higher effect on biodiversity.

6.1.2 Zone B

Corridor option B0

The corridor option B0 contains around 18.8 hectares of threatened vegetation in varying condition (listed as EEC or CEEC under the TSC Act). About 11 hectares may meet critically endangered criteria under the EPBC Act. Table 6-5 shows the composition of this threatened vegetation.

Table 6-4: Significant vegetation in corridor option B0

Vegetation community	Status (TSC Act)	Total
Castlereagh Shale Gravel Transition Forest in the Sydney Basin Bioregion*	CEEC	4.5
Cooks River / Castlereagh Ironbark Forest in the Sydney Basin Bioregion*	EEC	3.9
Cumberland Plain Woodland in the Sydney Basin Bioregion *	CEEC	2.5
River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC	7.8
Total		**18.8**

* listed as Critically Endangered under the EPBC Act
EEC – Endangered Ecological Community; CEEC – Critically Endangered Ecological Community

Three threatened fauna and flora species have been recorded in the corridor option. These are:

- Cumberland Plain Land Snail – Recorded near Badgerys Creek Road on Elizabeth Drive
- Varied Sittella – Recorded near Badgerys Creek
- *Pultenaea parviflora* – Recorded on Elizabeth Drive near Devonshire Road.

The corridor option:

- Contains around three hectares of Cumberland Plain Recovery Plan priority conservation lands
- Crosses three identified regional corridors that link priority conservation lands, primarily associated with drainage lines, and contains 3.5 hectares of mapped regional corridors.

Relative to the other options in Zone B, this corridor option would have a lower effect on biodiversity.

Corridor option B1

The corridor option B1 contains around 40 hectares of threatened vegetation in varying condition (listed as EEC or CEEC under the TSC Act). Up to 27 hectares may meet critically endangered criteria under the EPBC Act. Table 6-5 shows the composition of this threatened vegetation.

Table 6-5: Significant vegetation in corridor option B1

Vegetation community	Status (TSC Act)	Total
Cooks River / Castlereagh Ironbark Forest in the Sydney Basin Bioregion*	EEC	20.0
Castlereagh Swamp Woodland	EEC	1.2
River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC	12.5
Castlereagh Shale Gravel Transition Forest in the Sydney Basin Bioregion*	CEEC	6.4
Total		**40.1**

* listed as Critically Endangered under the EPBC Act
EEC – Endangered Ecological Community; CEEC – Critically Endangered Ecological Community

One threatened flora species has been recorded in the corridor option. This is *Grevillea parviflora subsp. Parviflora*. It has been recorded to the north of Kemps Creek Nature Reserve.

The corridor option:

- Is next to (but does not encompass) lands classified as non-certified lands as part of the bio-certification order for SEPP (Sydney Region Growth Centres) 2006
- Contains around eight hectares of Cumberland Plain Recovery Plan priority conservation lands
- Crosses three regional corridors that link priority conservation lands, primarily associated with drainage lines, and contains 28 hectares of mapped regional corridors.

Relative to the other options in Zone B, this corridor option would have a moderate effect on biodiversity.

Corridor option B2

The corridor option B2 contains 47 hectares of threatened vegetation in varying condition (listed as EEC or CEEC under the TSC Act). Up to 34 hectares may meet critically endangered or endangered criteria under the EPBC Act. Table 6-6 shows the composition of this threatened vegetation.

Table 6-6: Significant vegetation in corridor option B2

Vegetation community	Status (TSC Act)	Total
Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	VEC	13.6
Cooks River / Castlereagh Ironbark Forest in the Sydney Basin Bioregion*	EEC	6.8
Cumberland Plain Woodland in the Sydney Basin Bioregion *	CEEC	1.3
River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC	13.1
Castlereagh Shale Gravel Transition Forest in the Sydney Basin Bioregion*	CEEC	12.2
Total		**47.0**

* listed as Critically Endangered or Endangered under the EPBC Act
EEC – Endangered Ecological Community; CEEC – Critically Endangered Ecological Community

One threatened flora species has been recorded in the corridor option. This is *Dillwynia tenuifolia*. This has been recorded next to identified priority conservation lands.

The corridor option:

- Contains around four hectares of Cumberland Plain Recovery Plan priority conservation lands
- Crosses three regional corridors that link priority conservation lands, primarily associated with drainage lines and contains 40 hectares of mapped regional corridors.

Relative to the other options in Zone B, this corridor option would have a moderate effect on biodiversity.

Corridor option B3

The corridor option B3 contains around 54 hectares of threatened vegetation in varying condition (listed as EEC or CEEC under the TSC Act). Up to 38 hectares may meet critically endangered or endangered criteria under the EPBC Act. Table 6-7 shows the composition of this threatened vegetation.

Table 6-7: Significant vegetation in corridor option B3

Vegetation community	Status (TSC Act)	Total
Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	VEC	19
Cumberland Plain Woodland in the Sydney Basin Bioregion *	CEEC	5.8
River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC	15.5
Castlereagh Shale Gravel Transition Forest in the Sydney Basin Bioregion*	CEEC	13.6
Total		**54**

* listed as Critically Endangered under the EPBC Act
EEC – Endangered Ecological Community; CEEC – Critically Endangered Ecological Community

There are no recorded threatened species in this corridor option.

The option crosses three identified regional corridors that link priority conservation lands primarily associated with drainage lines, and contains 53 hectares of mapped regional corridors.

Relative to the other options in Zone B, this corridor option would have a higher effect on biodiversity.

Corridor option B4

The corridor option B4 contains around 25 hectares of threatened vegetation in varying condition (listed as EEC or CEEC under the TSC Act). Up to 12 hectares may meet critically endangered or endangered criteria under the EPBC Act. Table 6-8 shows the composition of this threatened vegetation.

Table 6-8: Significant vegetation in corridor option B4

Vegetation community	Status (TSC Act)	Total
Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	VEC	1.3
Cumberland Plain Woodland in the Sydney Basin Bioregion*	CEEC	9.3
River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC	12.3
Castlereagh Shale Gravel Transition Forest in the Sydney Basin Bioregion*	CEEC	1.7
Total		**24.6**

* listed as Critically Endangered under the EPBC Act
EEC – Endangered Ecological Community; CEEC – Critically Endangered Ecological Community

There are no recorded threatened species in this corridor option.

The option crosses two regional corridors that link priority conservation lands primarily associated with drainage lines and contains 22 hectares of mapped regional corridors.

Relative to the other options in Zone B, this corridor option would have a lower effect on biodiversity.

6.1.3 Zone C

Corridor option C0

The corridor option C0 contains 4.9 hectares of threatened vegetation in varying condition (listed as EEC or CEEC under the TSC Act). Up to 2.6 hectares may meet critically endangered or endangered criteria under the EPBC Act. This vegetation type is not listed under the EPBC Act. Table 6-10 shows the composition of this threatened vegetation.

Table 6-9: Significant vegetation in corridor option C0

Vegetation community	Status (TSC Act)	Total
Cumberland Plain Woodland in the Sydney Basin Bioregion *	CEEC	2.6
River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC	2.4
Total		**4.9**

* listed as Critically Endangered under the EPBC Act
EEC – Endangered Ecological Community; CEEC – Critically Endangered Ecological Community

There are no recorded threatened species in this corridor option.

Relative to the other options in Zone C, this corridor option would have a higher effect on biodiversity.

Corridor option C1

The corridor option C1 contains five hectares of threatened vegetation in varying condition (listed as EEC or CEEC under the TSC Act). This vegetation type is not listed under the EPBC Act. Table 6-10 shows the composition of this threatened vegetation.

Table 6-10: Significant vegetation in corridor option C1

Vegetation community	Status (TSC Act)	Total
River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC	4.5
Total		**4.5**

EEC – Endangered Ecological Community; CEEC – Critically Endangered Ecological Community

Two threatened flora species have been recorded in the corridor option, both to the west of Luddenham road:

- *Dillwynia tenuifolia*
- *Pimelea spicata.*

Relative to the other options in Zone C, this corridor option would have a moderate effect on biodiversity.

Corridor option C2

The corridor option C2 contains around two hectares of threatened vegetation in varying condition (listed as EEC or CEEC under the TSC Act). This vegetation type is not listed under the EPBC Act. Table 6-11 shows the composition of this threatened vegetation.

Table 6-11: Significant vegetation in corridor option C2

Vegetation community	Status (TSC Act)	Total
River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC	1.9
Total		**1.9**

EEC – Endangered Ecological Community; CEEC – Critically Endangered Ecological Community

There are no other biodiversity features in corridor option C2.

Relative to the other options in Zone C, this corridor option would have a lower effect on biodiversity.

6.1.4 Zone D

Corridor option D1

The corridor option D1 contains two hectares of threatened vegetation in varying condition (listed as EEC or CEEC under the TSC Act). Up to 1.7 hectares may meet critically endangered criteria under the EPBC Act. Table 6-12 shows the composition of this threatened vegetation.

Table 6-12: Significant vegetation in corridor option D1

Vegetation community	Status (TSC Act)	Total
Cumberland Plain Woodland in the Sydney Basin Bioregion *	CEEC	1.7
River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	EEC	0.5
Total		**2.2**

* listed as Critically Endangered under the EPBC Act
EEC – Endangered Ecological Community; CEEC – Critically Endangered Ecological Community

There are no other biodiversity features in corridor option D1.

6.2 Heritage

The heritage assessment is based on the full width of the corridor options and reflects the environment in each corridor option. It is based on desktop assessments only. Heritage features are shown in Figure 6-2.

6.2.1 Aboriginal heritage

Zone A

The heritage features in each corridor options in Zone A are listed in Table 6-13.

Table 6-13: Aboriginal heritage items in Zone A

Corridor option	Sites in the corridor option	Length through Aboriginal archaeological sensitivity intersected by option (km)
A0	KC/ED2, P-CP8, C AS1, P-CP9, P-CP14, IF10, DLC2	0.81
A1	CH-ST-1, artefact scatter 2008-4, PAD-OS-4, PAD-OS-5, PAD-OS-6, PAD 2054-6	1.75
A2	P-CP14, IF10, DLC2	1.2

Relative to the other options in Zone A, corridor option A1 has a higher potential to affect Aboriginal heritage items and sensitive areas than corridor option A2, while corridor option A0 has a lower potential.

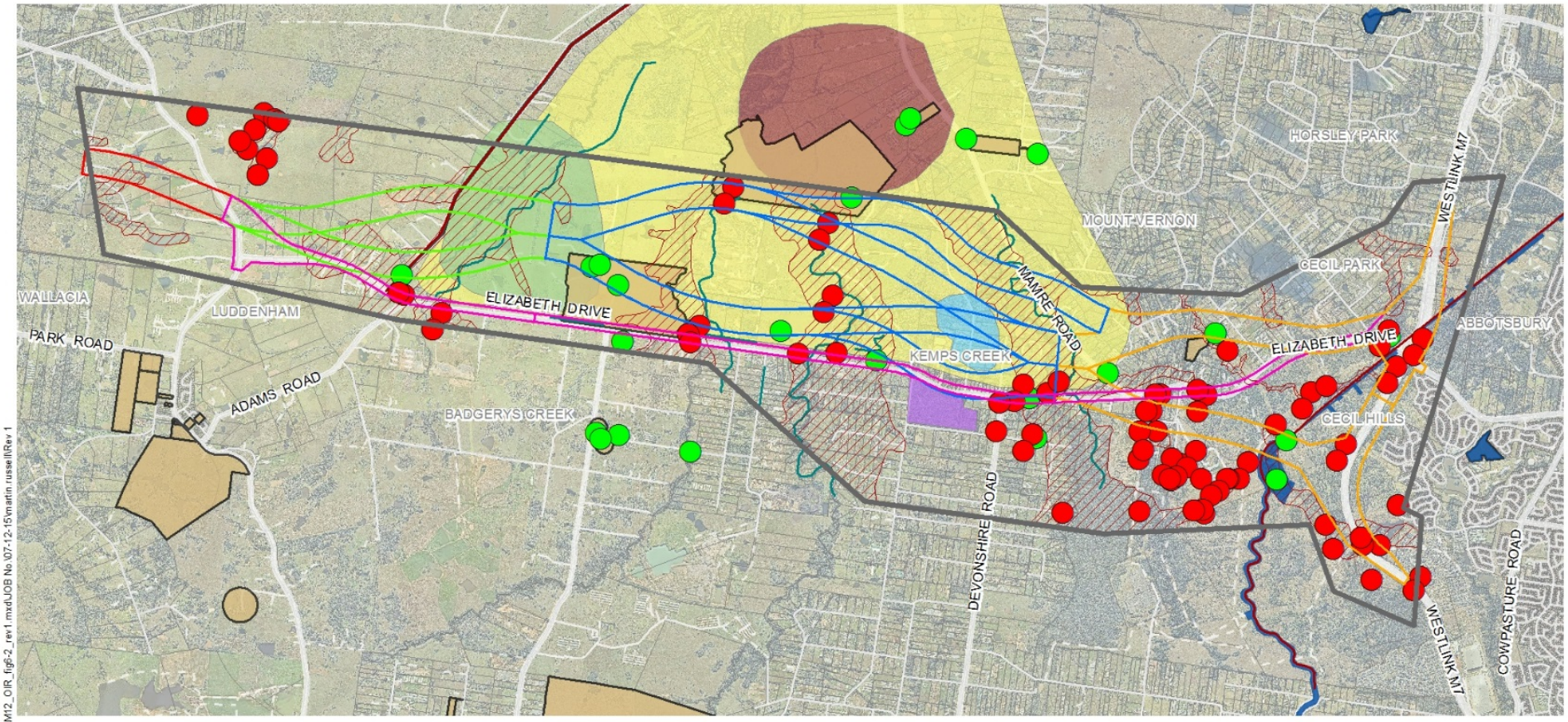
Zone B

The heritage features in each corridor options in Zone B are listed in Table 6-14.

Table 6-14: Aboriginal heritage items in Zone B

Corridor option	Sites in the corridor option	Length through Aboriginal archaeological sensitivity intersected by option (km)
B0	PAD1, PAD2, PAD3, PAD5, PAD6, PAD 2001-6	2.2
B1	BC/ED1, PAD4, KC PAD1	2.2
B2	BC/ED1	2.4
B3	Fleurs 1, Fleurs 2	3.02
B4	Fleurs 1, Fleurs 2	3.7

Relative to the other options in Zone B, corridor options B3 and B4 have a higher potential to affect Aboriginal heritage items and archaeological sensitive areas to the corridor option B2, while corridor options B0 and B1 has a lower potential.



Legend

- M12 study area
- Aboriginal site
- Non-Aboriginal site
- Non-Aboriginal site
- Cultural landscapes
- Archaeological sensitivity
- State heritage register
- Local heritage item

Cultural landscapes

- KC-1
- L12
- L27
- L29
- L30

Note:
Aboriginal heritage site locations are general in nature to protect exact locations

Source: Nearmap, LPI, Aurecon

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Projection: GDA 1994 MGA Zone 56

M12 Strategic Route Options Analysis **Options Identification Report**

FIGURE 6.2: Heritage items within the corridor options

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Zone C

There are no heritage items identified in the corridor options in Zone C. However, all corridor options pass through Aboriginal archaeological sensitivity areas. The lengths of each of the options are:

- Corridor option C0: 1.8 kilometres
- Corridor option C1: 2.5 kilometres
- Corridor option C2: 1.9 kilometres.

Relative to option C2, corridor option C1 has a higher potential to affect Aboriginal heritage items and archaeological sensitive areas, while Option C0 has a lower potential.

Zone D

There are no heritage items identified in the corridor option in Zone D. However, a 0.36 kilometre length of the corridor option passes through an Aboriginal archaeological sensitivity area.

6.2.2 Non-Aboriginal heritage

Zone A

The non-Aboriginal heritage features in each corridor option in Zone A are listed in Table 6-15.

Table 6-15: Non-Aboriginal heritage items in Zone A

Corridor option	Site name	Significance level	Heritage landscape item	Potential heritage sites
A0	Nil	Nil	South Creek Basin	Nil
A1	Upper Canal System (tunnel and open canal)	State	South Creek Basin	• Cecil Park Public School • Standing structure 1930/06 • Structure 1930
A2	Upper Canal System (tunnel)	State	South Creek Basin	Nil

Relative to the other options in Zone A, corridor option A1 has a moderate potential to affect non-Aboriginal heritage items, while corridor option A0 has a lower potential and corridor option A2 has a higher potential.

Zone B

The non-Aboriginal heritage features in each corridor option in Zone B are detailed in Table 6-16.

Table 6-16: Non-Aboriginal heritage items in Zone B

Corridor option	Site name	Significance level	Heritage landscape	Potential heritage sites
B0	Nil	Nil	• South Creek remnant vegetation corridor • Badgerys Creek remnant vegetation corridor • Kemps Creek remnant vegetation corridor • Remnant vegetation along Elizabeth Drive	• Cottage and sheds (lot B DP102214) • Woodbine cottage (lot 3 DP 255566)

Corridor option	Site name	Significance level	Heritage landscape	Potential heritage sites
B1	Mc Garvie-Smith farm, Iron shed, fibro building	Local	• South Creek remnant vegetation corridor • Badgerys Creek remnant vegetation corridor • Kemps Creek remnant vegetation corridor • South Creek Basin • McMaster Field Station Scenic landscape, Elizabeth Drive, Badgerys Creek • Remnant vegetation along Elizabeth Drive	• Cottage and sheds (lot B DP102214) • Exeter House estate/ Badgerys Homestead • Woodbine cottage (lot 3 DP 255566)
B2	Mc Garvie-Smith farm, Iron shed, fibro building	Local	• South Creek remnant vegetation corridor • Badgerys Creek remnant vegetation corridor • Kemps Creek remnant vegetation corridor • South Creek Basin • McMaster Field Station Scenic landscape, Elizabeth Drive, Badgerys Creek • Remnant vegetation along Elizabeth Drive • Vegetation Community, Clifton Ave, Kemps Creek	• Exeter House estate/ Badgerys Homestead • Woodbine cottage (lot 3 DP 255566)
B3	Nil	Nil	• South Creek remnant vegetation corridor • Badgerys Creek remnant vegetation corridor • Kemps Creek remnant vegetation corridor • South Creek Basin • McMaster Field Station Scenic landscape, Elizabeth Drive, Badgerys Creek	Nil
B4	Fleurs Radio Telescope Site	Local (possible National)	• South Creek remnant vegetation corridor • Badgerys Creek remnant vegetation corridor • Kemps Creek remnant vegetation corridor • South Creek Basin • McMaster Field Station Scenic landscape, Elizabeth Drive, Badgerys Creek	Nil

Relative to the other options in Zone B, corridor options B1 and B2 have a higher potential to affect non-Aboriginal heritage items, while corridor option B0 has a lower potential. Options B3 and B4 have moderate potential to affect non-Aboriginal heritage items (should Fleurs Radio telescope be identified as being of national importance, corridor option B4 would have a high potential).

Zone C

The non-Aboriginal heritage features in each corridor option in Zone C are listed in Table 6-17.

Table 6-17: Non-Aboriginal heritage items in Zone C

Corridor option	Site name	Significance level	Heritage landscape	Potential heritage sites
C0	Luddenham Road Alignment	Local	• Remnant vegetation along Elizabeth Drive	Nil
C1	Luddenham Road Alignment	Local	• South Creek Basin • McMaster Field Station Scenic landscape, Elizabeth Drive, • Cosgrove Creek remnant native vegetation corridor	Nil
C2	Luddenham Road Alignment	Local	• South Creek Basin • McMaster Field Station Scenic landscape, Elizabeth Drive, • Cosgrove Creek remnant native vegetation corridor	Nil

Options C1 and C2 have a moderate potential to affect non-Aboriginal heritage items, while corridor option C0 has a lower potential.

Zone D

There are no non-Aboriginal heritage items in corridor option D1.

6.3 Land use

Land use zones and features are shown in Figure 6-3.

6.3.1 Zone A

Corridor option A0

The majority of the corridor option A0 includes the existing Elizabeth Drive road reserve and the following land use zones: RU1 Primary production, RU4 Rural small holdings, E4 Environmental living, and Western Sydney Parklands. The corridor option contains:

- Rural residential properties
- The CSR brick factory on Cecil Road
- The Hi Quality facility on Mamre Road and other commercial properties fronting Elizabeth Drive
- Western Sydney Parklands (including the Wylde Mountain Bike Trail) (refer to Figure 6-3)
- Three farm dams.

Relative to the other options in Zone A, this corridor option would have a moderate effect on land use.

Corridor option A1

Option A1 includes the following land use zones: RU4 Rural small holdings, and Western Sydney Parklands. The corridor option contains:

- Kemps Creek Sporting and Bowling Club and a number of other subdivided vacant lands on Elizabeth Drive
- A part of Brandown quarry
- Parts of Western Sydney Parklands
- A section of the Wylde Mountain Bike Trail
- Northern extent of the Sydney International Shooting Centre
- Nine farm dams.

Relative to the other options in Zone A, this corridor option would have a lower effect on land use.

Corridor option A2

Corridor option A2 includes the following land use zones: RU1 Primary production, RU4 Rural small holdings, E4 Environmental living, and Western Sydney Parklands. The corridor option contains:

- Intensive rural residential properties in Mount Vernon
- A number of commercial properties fronting Mamre Road and Cecil Road, including the CSR brick factory
- The Western Sydney Parklands adjacent to the M7 Motorway north of Elizabeth Drive
- Fifteen farm dams.

This corridor option passes through land uses further away from Elizabeth Drive compared to corridor options A0 and A1, and would intersect an established residential area.

Relative to the other options in Zone A, this corridor option would have a higher effect on land use.

6.3.2 Zone B

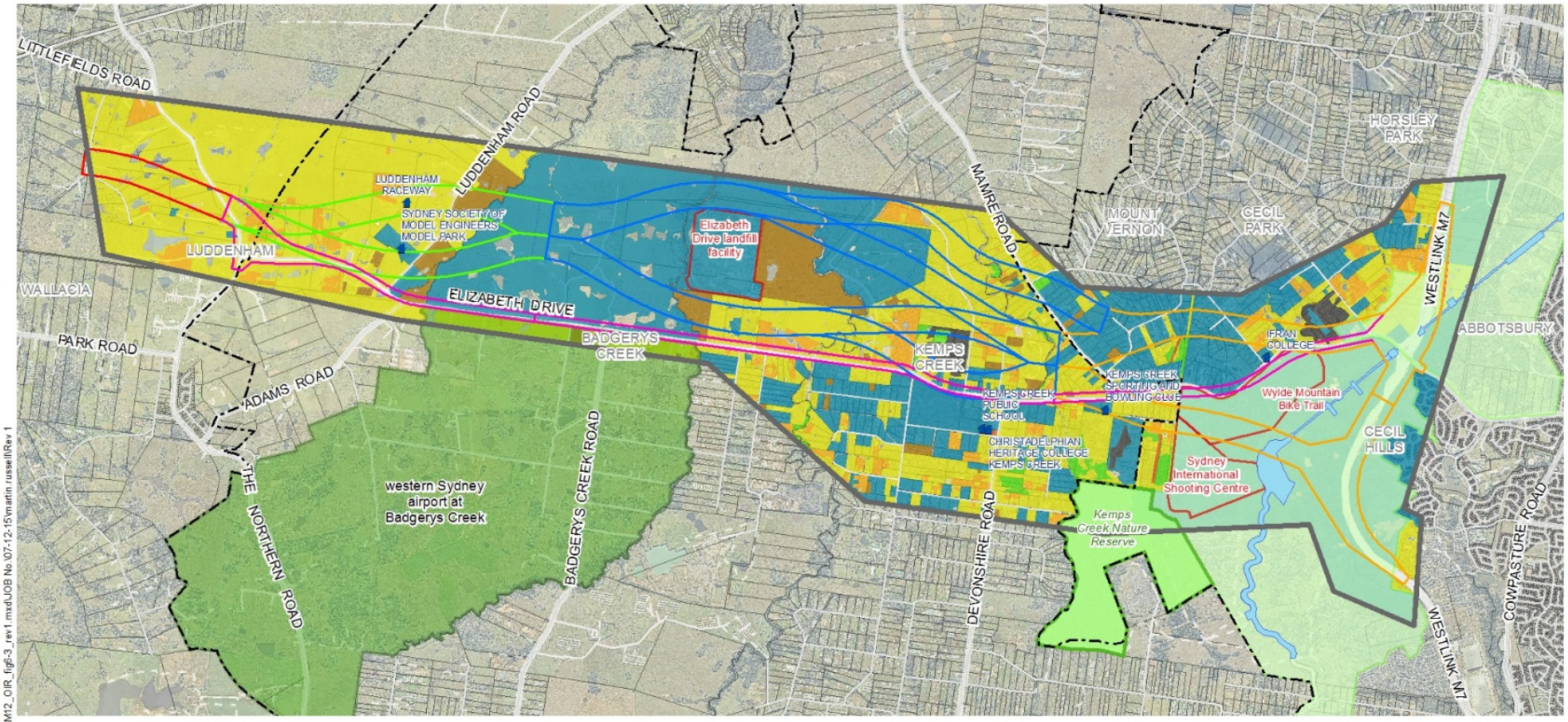
Zone B passes through the Western Sydney Priority Growth Area. The corridor options through this Zone have been designed to consider the operations of the future western Sydney airport.

Corridor option B0

Corridor option B0 includes the following land use zones: RU4 Rural small holdings, E2 Environmental living (around creek lines), RU2 Rural landscapes, and RE1 Public recreation. The corridor option contains:

- Part of the village of Kemps Creek along the northern side of Elizabeth Drive, where there are commercial properties, including the Kemps Creek village shops. This corridor option could result in the removal of these retail outlets
- A number of rural-residential properties
- Large agricultural and rural properties to the west
- Five farm dams.

Relative to the other options in Zone B, this corridor option would have a higher effect on land use.



Legend

- M12 study area
- Western Sydney Priority Growth Area
- western Sydney airport at Badgerys Creek
- Upper canal system
- Noteable facilities
- Nature reserve
- Western Sydney Parklands

Land use

- Grazing and farmhouses
- Horticulture
- Intensive animal production
- Mining & quarrying
- Power generation
- Tree & shrub cover
- Urban

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Source: Nearmap, LPI, Aurecon

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Projection: GDA 1994 MGA Zone 56

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FIGURE 6.3: Land use within the corridor options

Corridor option B1

Corridor option B1 includes the following land use zones: RU4 Rural small holdings, E2 Environmental conservation (around creek lines), and RU2 Rural landscape. The corridor option contains:

- Land uses similar to corridor option B0 where it passes through the village of Kemps Creek
- Rural residential, cropping, cleared and farming land
- Parts of some larger rural residential properties
- The Andreasens Nursery and the quarry on Clifton Avenue
- Twenty-two farm dams.

Relative to the other options in Zone B, this corridor option would have a higher effect on land use.

Corridor option B2

Corridor option B2 includes the following land use zones: RU4 Rural small holdings, E2 Environmental conservation (around creek lines), and RU2 Rural landscape. The corridor option contains:

- Rural residential and commercial properties to the west of Mamre Road
- The quarry on Clifton Avenue
- The northern extent of Andreasens Nursery
- Similar land uses to corridor option B1 to the west of South Creek
- Twenty-four farm dams.

Relative to the other options in Zone B, this corridor option would have a lower effect on land use.

Corridor option B3

Corridor option B3 includes the following land use zones: RU4 Rural small holdings, E2 Environmental conservation (around creek lines), and RU2 Rural landscape. The corridor option contains:

- Rural residential, cropping, cleared and farming land which are mostly large properties
- More intensive rural residential land uses around Mamre Road
- Some commercial and industrial properties
- The northern extent of the Suez Environment landfill site
- The site for an approved mosque.

Relative to the other options in Zone B, this corridor option would have a moderate effect on land use.

Corridor option B4

Corridor option B4 includes the following land use zones: E4 Environmental living, RU4 Rural small holdings, E2 Environmental conservation (around creek lines), and RU2 Rural landscape. The corridor option contains:

- Land uses similar to corridor option B3, including mostly large rural residential,

cropping, cleared and farming properties

- More intensive rural residential, commercial and industrial properties fronting Mamre Road.

Relative to the other options in Zone B, this corridor option would have a moderate effect on land use.

6.3.3 Zone C

Zone C passes wholly in the Western Sydney Priority Growth Area and is situated to the north of the western Sydney airport.

Corridor option C0

Corridor option C0 is along the existing Elizabeth Drive road reserve and includes the following land use zones: RU2 Rural landscape and E2 Environmental conservation (along creek lines). The corridor option contains:

- Horticultural and agricultural properties
- A series of linked farm dams north of Elizabeth Drive. This corridor option would impact on 13 farm dams. If the properties that rely on these farm dams remain operational, an alternative water supply may need to be established.

Relative to the other options in Zone C, this corridor option would have a lower effect on land use.

Corridor option C1

Corridor option C1 includes the following land use zones: RU2 Rural landscape and E2 Environmental conservation (along creek lines). The corridor option contains:

- Land uses similar to corridor option C0; however, as it is located further north, away from Elizabeth Drive, it has the greater potential than corridor option C0 to change existing land use
- Commercial properties along Luddenham Road
- Sydney Society of Model Engineers Model Park
- A series of linked farm dams north of Elizabeth Drive. Overall, this corridor option contains 24 farm dams (more dams than other options in this zone). If the properties that rely on these farm dams remain operational, an alternative water supply may need to be established.

Relative to the other options in Zone C, this corridor option would have a moderate effect on land use.

Corridor option C2

Corridor option C2 includes the following land use zones: RU2 Rural landscape and E2 Environmental conservation (along creek lines). The corridor option contains:

- Rural, horticultural, agricultural and intensive animal farm land
- Luddenham Raceway
- A series of sixteen farm dams. If the properties that rely on these farm dams remain operational, an alternative water supply may need to be established.

Relative to the other options in Zone C, this corridor option would have a moderate to

higher effect on land use.

6.3.4 Zone D

Corridor option D1 includes the following land use zones: RU2 Rural landscaping. The corridor option contains:

- Rural and grazing land west of The Northern Road
- Several residential properties and some large rural residential farms
- Eleven farm dams.

6.4 Hydrology and flooding

6.4.1 Zone A

There are two creeklines in Zone A: Ropes Creek and Hinchinbrook Creek. Corridor options A0 and A2 pass through the lower reaches of Ropes Creek, while A1 crosses Hinchinbrook Creek. These options may require transverse drainage structures.

The corridor options also cross a number of other unnamed creek and drainage lines that may require transverse drainage structures or changes to drainage lines:

- Corridor option A0 crosses seven other drainage lines
- Corridor option A1 crosses 10 other drainage lines
- Corridor option A2 crosses six other drainage lines.

Only corridor option A0 touches the South Creek floodplain (over a length of 65 metres –refer to Figure 6-4). However, this would be along the Elizabeth Drive alignment and would require the duplication of the existing transverse drainage structure.

Corridor options A0 and A1 have a moderate potential to affect hydrology of the area and corridor option A2 has a lower potential.

6.4.2 Zone B

Zone B is in the South Creek sub-catchment (refer to Figure 6-4). In this zone, all options cross Badgerys Creek, South Creek and Kemps Creek. While corridor options B3 and B4 cross the creek lines perpendicular, corridor options B1 and B2 cross sections of South Creek that run parallel to the options. This crossing may require additional treatment to the creek line to ensure water flows under the motorway.

The corridor options also cross a number of other unnamed creek and drainage lines:

- Corridor option B0, B2, B3 and B4 all cross five other drainage lines
- Corridor option B1 crosses six other drainage lines.

The corridor options in this zone are in the floodplains of South Creek, Kemps Creek and Badgerys Creek. The length of the options in the different floodplains are as follows:

- Corridor option B0: Kemps Creek 285 metres, South Creek 740 metres, Badgerys Creek 290 metres
- Corridor option B1: Kemps Creek 355 metres, South Creek 705 metres, Badgerys Creek 285 metres
- Corridor option B2: Kemps Creek 520 metres, South Creek 740 metres, Badgerys Creek 285 metres

- Corridor option B3: Kemps Creek 520 metres, South Creek 785 metres, Badgerys Creek 215 metres
- Corridor option B4: Kemps Creek 225 metres, South Creek 490 metres, Badgerys Creek 215 metres.

Corridor options B1, B2 and B3 have a moderate potential to affect hydrology in the area, and corridor option B4 has a lower potential (mostly due to the reduced crossing of floodplains).

6.4.3 Zone C

Zone C is in the South Creek sub-catchment. Corridor options C0 and C1 cross Cosgrove Creek and Oaky Creek, while corridor option C2 crosses over Cosgrove Creek. Corridor option C1 crosses part of Cosgrove Creek that travels parallel to the option. Corridor option C2 may cross Cosgrove Creek at a skew (that is, not perpendicular). These crossings would require additional treatment and/or structures to maintain water flow under the motorway.

The corridor options also cross a number of other unnamed creek and drainage lines:

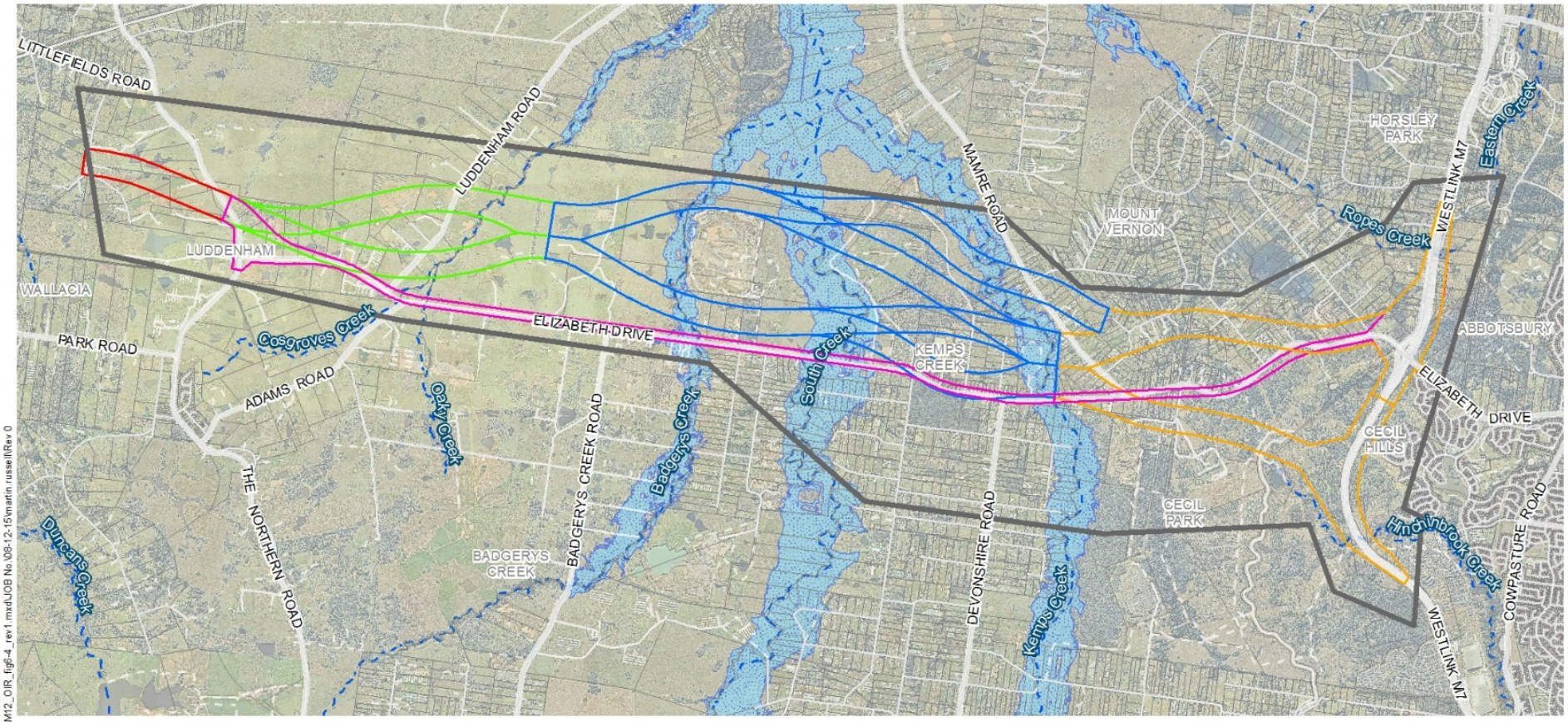
- Corridor option C0 crosses 12 other drainage lines
- Corridor option C1 crosses 23 other drainage lines
- Corridor option C2 crosses 15 other drainage lines.

These corridor options do not cross any floodplain area.

Corridor option C0 has a lower potential to affect hydrology in the area than corridor options C1 and C2, which have a moderate potential.

6.4.4 Zone D

There are no named creek crossings or floodplains in Zone D. However, corridor option D1 would cross eight unnamed creek or drainage lines.



Legend

- M12 study area
- 100 - year ARI flood extent
- Creek

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Source: Cardno, Nearmap, LPI, Aurecon

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Projection: GDA 1994 MGA Zone 56

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FIGURE 6.4: 100 - year ARI flood extents within the corridor options

6.5 Social

To compare the relative socio-economic attributes of the corridor options, four categories of socio-economic issues relevant to the study area have been identified:

- Community cohesion – The potential for a project to introduce a physical or psychological separation between different community areas or to reinforce an existing severance, or provide improved community interaction and cohesion from considering existing and future land uses
- Amenity effects – Positive and negative effects on the amenity or values of a place and is typically expressed through the key factors of noise impact, visual impact and air quality impact
- Access and movement patterns – The ease and safety with which members of the community can move both in their community and externally to it. This includes consideration of local vehicular, pedestrian and cyclist movements
- Property impact – This issue relates to the effects of full or partial property acquisition.

These categories are considered in the following sections.

6.5.1 Community cohesion

Zone A

Corridor option A0 would widen the road reserve next to Elizabeth Drive, which would minimise any segregation of communities. However, there is the potential of access changes/ traffic changes to the Ifrans School from Elizabeth Drive. This could result in a perceived adverse impact on the cohesion of the community. Relative to the other options in Zone A, corridor option A0 is likely to have a lower effect on community cohesion.

Corridor option A1 passes through a portion of Western Sydney Parklands, which is important for recreation, and encompasses part of the Kemps Creek Sporting and Bowling Club, which is a main social gathering spot for Kemps Creek and adjoining suburbs. Access to a number of recreational activities south of Elizabeth Drive including the Wylde Mountain Bike Trail and the Sydney International Shooting Centre may need to be modified. Relative to the other options in Zone A, corridor option A1 would likely have a moderate effect on community cohesion.

Corridor option A2 passes through the Mount Vernon residential community, and would be likely to segregate the community, with residential properties either side of the alignment. This options could also result in a perceived segregation of Mount Vernon residences to the north of the M12 Motorway alignment to services and facilities to the south along Elizabeth Drive.

This corridor option could also potentially alter access to a number of properties that are set back from Mount Vernon Road. This option is located just to the north of Irfan College and may alter access to the college from Duff Road from the north. Relative to the other options in Zone A, corridor option A2 is likely to have a higher effect on community cohesion.

Zone B

Corridor option B0 includes the widening of Elizabeth Drive road reserve to the north of the existing road, encompassing the Kemps Creek village shops. While the majority

of the upgrade would be in the existing road reserve, this section is used for access and informal parking (particularly by heavy vehicles) near commercial premises. Should the upgrade extend beyond this, it would encompass structures on the properties, resulting in changes to operation or closure. Relative to the other options in Zone B, corridor option B0 would likely have a high effect on community cohesion. However, outside of Kemps Creek, corridor option B0 would likely have a minimal effect to community cohesion.

Corridor option B1 would be similar to corridor option B0. However, as this would be a new corridor, there may be a greater direct effect that could increase the likelihood of changes to Kemps Creek village shops.

Relative to the other options in Zone B, corridor options B2, B3 and B4 would generally have a minimal effect on community cohesion due to their distance from community centres, services and facilities.

Zone C

Corridor option C0, by using the existing road pavement, would minimise community cohesion issues. However, widening the road corridor could result in a perceived distancing between those residences north of the corridor option and those to the south. This corridor option would also not provide an interchange at Luddenham Road, with access through the study area from Luddenham Road to be maintained by Elizabeth Drive. Relative to the other options in Zone C, this corridor option would likely have a higher effect on community cohesion.

Corridor option C1 crosses Luddenham Road, which would require alternative access to maintain traffic movements. The corridor option contains the Sydney Society of Model Engineers Model Park, which is a prominent recreational feature of the area. Relative to the other options in Zone C, this corridor option would likely result in a moderate effect on community cohesion.

There are few community services or communities that would be likely to be affected by corridor option C2. However, this corridor option does cross Luddenham Road, where alternative access would be required to maintain traffic movements. The option also contains the newly opened Luddenham Raceway. Relative to the other options in Zone C, this corridor option would have a moderate effect on community cohesion.

Zone D

There are few community facilities in Zone D. However, it contains a small residential community. Corridor option D1 would connect with the future Outer Sydney Orbital; however, the connection point is unknown at this stage. Corridor option D1 would have a minimal effect on community cohesion.

6.5.2 Amenity effects

Zone A

Corridor option A0, due to its nearness to Elizabeth Drive, would likely have minimal impact on amenity. In 600 metres of this option, there are 392 sensitive receivers (refer to Figure 6-5). However, most properties potentially affected would already be affected to some degree by existing road amenity issues (such as noise) from Elizabeth Drive, Mamre Road and the M7 Motorway.

Corridor option A1 would have a moderate effect on amenity as it passes through cleared or industrial land and Western Sydney Parklands. There are few receivers located near the option (in 100 metres). However, there are a number of receivers located further away (to the east of the M7 Motorway) that are in 600 metres of the corridor option (refer to Figure 6-5). As such, this corridor option has the greatest number of sensitive receivers (851) in Zone A. However, it is unlikely these receivers would experience changes in amenity (particularly noise) as they already experience amenity issues from the M7 Motorway.

Corridor option A2 would likely have the greatest effect on amenity. While it has a lower number of sensitive receivers (491) than corridor option A1, these sensitive receivers are generally located closer – and next to – the option (refer to Figure 6-5). This corridor option would likely result in properties being exposed to noise, visual and air quality impacts, particularly around Mount Vernon Road, where properties are currently separated from major road noise by topography.

Zone B

Corridor option B0 would likely have the greatest effect on amenity in Zone B, particularly at Kemps Creek, due to the widening of the existing corridor near a number of sensitive visual receivers. There are around 143 sensitive receivers in 600 metres of the option (refer to Figure 6-5). However, in terms of noise, many of the closer sensitive receivers are already affected by main road amenity issues. Outside of Kemps Creek, there would be a minor change to amenity.

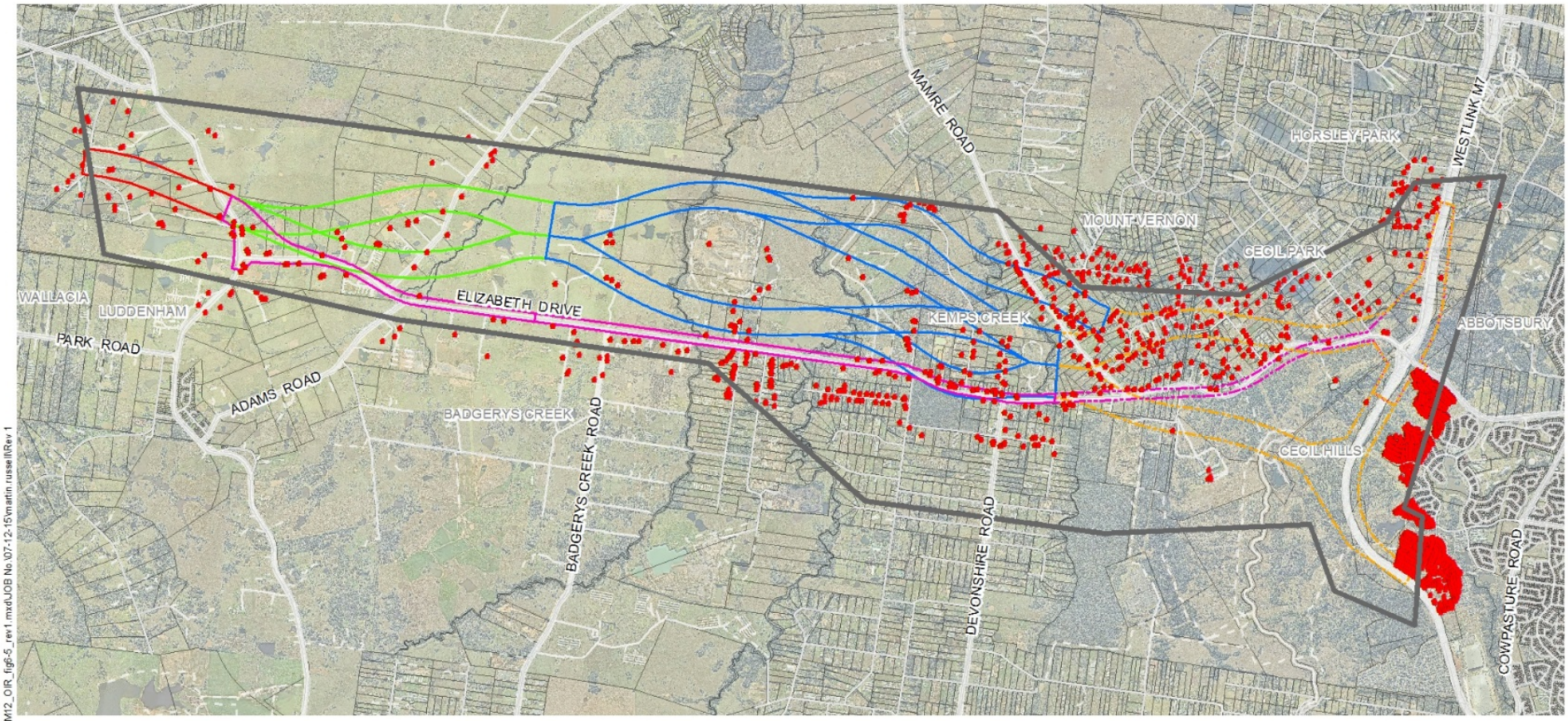
Corridor option B1 would likely have similar effects on amenity as corridor option B0. There are 123 sensitive receivers in 600 metres of the option.

Corridor options B2, B3 and B4 are further north away from Elizabeth Drive and would be located near fewer sensitive receivers (88, 56, 86 receivers respectively in 600 metres of the option) (refer to Figure 6-5). However, some sensitive receivers away from Elizabeth Drive (particularly around Mamre Road and Clifton Road) are not currently subject to main road amenity issues. There are no nearby sensitive receivers further west to these corridor options (west of the landfill site).

Zone C

Corridor option C0 would create a motorway along the existing road reserve. This would limit most amenity impacts on receivers that currently experience amenity impacts from the arterial roads of Elizabeth Drive and Luddenham Road. However, there are around 37 sensitive receivers along this stretch of road (refer to Figure 6-5).

Corridor option C1 would also likely have a minimal effect on the amenity of sensitive receivers due to the small number of receivers near the corridor (30).



Legend

- M12 study area
- Sensitive recievers

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Source: Nearmap, LPI, Aurecon

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Projection: GDA 1994 MGA Zone 56

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FIGURE 6.5: Sensitive receivers within the corridor options

These receivers are not exposed to current traffic noise, with the exception of receivers located near Luddenham Road and The Northern Road.

Corridor option C2 would have a similar impact on amenity as corridor option C1, as it is located further north with a similar number sensitive receivers in 600 metres (29) (refer to Figure 6-5). These receivers are not exposed to current traffic noise, with the exception of receivers located in proximity to Luddenham Road and The Northern Road.

Zone D

Corridor option D1 would adversely affect the amenity of a number of sensitive receivers west of The Northern Road around Queenshill Drive. These receivers are not currently subject to amenity issues from main roads (ie The Northern Road). There are 25 sensitive receivers in 600 metres of this option (refer to Figure 6-5). This corridor option would have a low effect on amenity.

6.5.3 Access and movement patterns

This section briefly discusses property access and movement patterns. However, no comparative assessment has been undertaken between the corridor options as only corridors have been identified at this stage and there is not sufficient information for an assessment at this stage.

Two criteria considered in this discussion were the need to provide property and local access where required, and to provide a shared path for walking and cycling as part of the project. However, an assessment of these criteria cannot be made at this stage. These will be considered in depth during the shortlisting and preferred options stages of the project.

Zone A

Relative to the other options in Zone A, corridor option A0 would result in the least amount of change to access and movement patterns as the connection to the M7 Motorway would not change. However, as a controlled access motorway, property accesses would not be allowed on the M12 Motorway. As such, a separate local access road would need to be constructed to maintain access to properties that front onto Elizabeth Drive. This would increase the overall footprint of the project.

Relative to the other options in Zone A, corridor option A1 would result in some changes to access and movement patterns. Access to the Sydney International Shooting Centre, Wylde Mountain Bike Trail and Brandown quarry and waste recovery and recycling centre may be affected with changed access. Access to some properties on Elizabeth Drive may be interrupted or changed.

Corridor option A2 would result in the greatest change to access and movement patterns. Access to the M7 Motorway would be at the same location as the existing Elizabeth Drive exit. The following roads may require changed or severed access:

- Kerrs Road (and therefore Mount Vernon Road) from Mamre Road
- Duff Road from Elizabeth Drive
- Cecil Road from Elizabeth Drive.

Zone B

Relative to the other options in Zone B, corridor option B0 would result in the greatest amount of change to access. However, as a controlled access motorway, property accesses would not be allowed on the M12 Motorway. As such, a separate local access road would need to be created to maintain access to properties that front onto Elizabeth Drive. This would increase the overall footprint of the project.

Corridor option B1 would also be located mostly next to the existing Elizabeth Drive and would result to some changes in property access, through either altered access, or the need to provide a property access road to Elizabeth Drive.

Relative to the other options in Zone B, corridor options B2, B3 and B4 would likely affect fewer local roads and fewer properties, resulting in fewer potential effects on access and movement patterns compared to corridor options B0 and B1.

Zone C

Corridor option C0 would result in minimal changes to access and movement. However, as a controlled access motorway, property accesses would not be allowed on the M12 Motorway. As such, a separate local access road would need to be created to maintain access to properties that front onto Elizabeth Drive. This would increase the overall footprint of the project. This option would not provide access to Luddenham Road or Adams Road, and access to these roads would be maintained from Elizabeth Drive.

Corridor option C1 would result in some access and movement changes as the option may sever local road access to a number of properties. Alternate access may be required as property access would not be permitted directly on or off the motorway. This could be achieved with an underpass structure or via an alternative local access road. This corridor option would not provide access to Luddenham Road and access would be maintained from Elizabeth Drive.

Corridor option C2 would only result in minimal changes with no property accesses likely to be severed. This corridor option would not provide access directly to Luddenham Road; access to Luddenham Road from the study area would be maintained from Elizabeth Drive.

Zone D

Corridor option D1 has potential to change access to properties via Queenshill Drive. However, this would depend on the Outer Sydney Orbital alignment, and would not be a direct result of the M12 Motorway project. Regardless, access would need to be maintained to these properties, via either an underpass or a local access road.

6.5.4 Property impacts

The M12 Motorway would require acquisition of a number of properties that would be either wholly or partially directly impacted by the motorway. This section presents the number of lots that are situated in each corridor option. Properties that are partially or wholly in each corridor option are listed in Table 6-18. All these properties may not be required to be acquired as the corridor is narrowed down to the actual road footprint.

Table 6-18 Lots in the corridor options

Corridor option	Number of lots	Approximate number of residences
Zone A		
A0	121	13
A1	42	12
A2	181	69
Zone B		
B0	68	9
B1	55	13
B2	36	11
B3	31	4
B4	57	17
Zone C		
C0	27	11
C1	24	5
C2	22	2
Zone D		
D1	18	4

In Zone A, corridor option A1 affects the least number of lots, while corridor option A2, which passes through the rural residential suburb of Mount Vernon, affects the highest number of lots, and contains the highest number of residences.

In Zone B, corridor option B0 affects the highest number of lots as it is along Elizabeth Drive, where there are smaller lots. Corridor option B4 affects the highest number of residences. However, corridor option B3 affects the second lowest number of residences and the lowest number of lots.

In Zone C, there is has little variation between the options. Corridor option C2 affects 22 lots and two residences, while corridor option C0 affects 27 lots and 11 residences.

Corridor option D1 affects the least number of lots out of all options (18) and affects four residences.

6.6 Urban design

The extensive rural nature of the environment will influence the likely urban design outcomes. In addition, the very low density of residential receivers in 100 metres of the option limits the number of viewers.

This discussion is based on a review of aerial photography, contours and a site visit.

Four landscape character zones have been defined which roughly align with the four zones (A to D). The landscape character zones are:

- Western Sydney Parklands (Zone A)
- Elevated residential parklands (Zone A – Corridor option A2)

- Low lying rural / commercial (Zone B)
- Undulating rural residential (Zone C and Zone D).

Figure 6-6 shows the landscape character zones in relation to the options.

6.6.1 Zone A

Zone A is characterised by the Western Sydney Parklands landscape character zone and the elevated residential/parklands landscape character zone.

Corridor option A0

Corridor option A0 would result in widening of the existing Elizabeth Drive road reserve to accommodate not only the M12 Motorway but also the upgrade of Elizabeth Drive. This would be a substantial visual change, which would be difficult to mitigate. Large fills would be required due to a steep change in topography to the east of Duff Road. This would make the formation of the road quite prominent in the landscape. There are a number of residential properties along the existing road reserve, and visibility of the road would mostly be confined to those properties with existing views of Elizabeth Drive.

Relative to the other options in this zone, corridor option A0 will have moderate visibility, with most views being transient views.

Corridor option A1

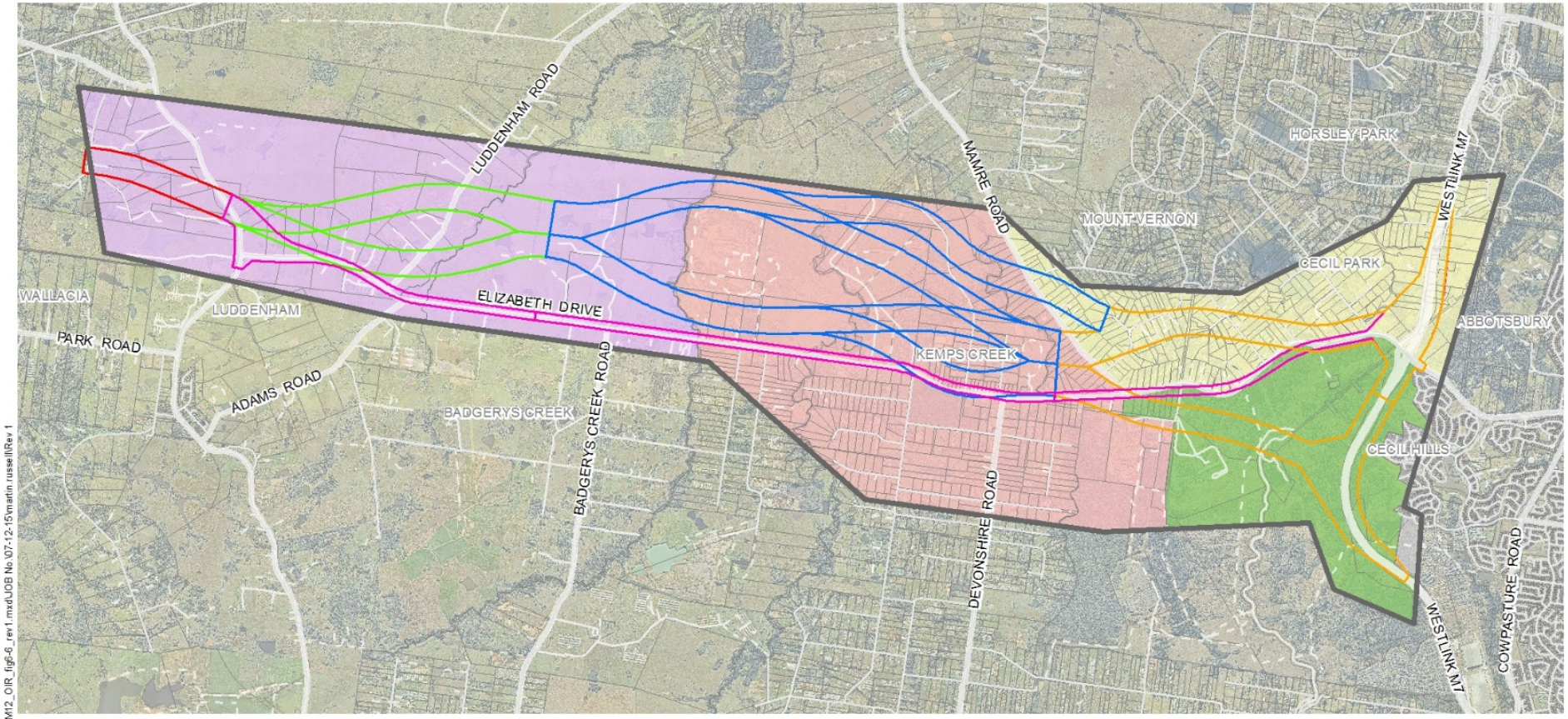
While the western part of corridor option A1 would widen the existing road reserve, further east it passes through undulating landscape into Western Sydney Parklands. It would be visible to users of the bike trail, but intermittent, due to the undulating landscape. Few receivers would be affected by this option. The main visually intrusive element would be the new interchange at the M7 Motorway, which would be visible from traffic on the M7 Motorway and the M12 Motorway, Elizabeth Drive and surrounding residences.

Relative to the other options in this zone, corridor option A1 will have the lowest visibility, with most views being transient, rather than permanent views.

Corridor option A2

Corridor option A2 would connect to the M7 Motorway in a location that would be highly visible to existing motorway users. The option passes over the Mount Vernon ridgeline, which would make it more visible to those receivers located downslope. A high density of receivers would be in its viewshed. A motorway in this corridor may require visually intrusive noise mitigation measures as well as prominent cut and fill. Existing topography would limit the long range visibility of this corridor option.

Relative to the other options in this zone, corridor option A2 will have the greatest visibility, with both permanent and transient views.



Legend

- M12 study area
- Urban areas

Landscape character zone

- Western Sydney Parklands
- Elevated residential/parklands
- Low lying rural/commercial
- Undulating rural/residential

Source: Nearmap, LPI, Aurecon

1:65,000

0 500 1000 m

Projection: GDA 1994 MGA Zone 56

M12 Strategic Route Options Analysis **Options Identification Report**

FIGURE 6.6: Landscape character zones within the corridor options

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6.6.2 Zone B

Corridor option B0

Corridor option B0 would result in widening of the existing Elizabeth Drive road reserve to accommodate not only the M12 Motorway but also the upgrade of Elizabeth Drive. The existing road reserve is lined by trees, which define the corridor. Augmentation of the road reserve may be visually prominent to road users and adjoining properties if these trees need to be cleared. In addition, the removal of some adjoining existing building structures would also increase the visibility of this option.

Relative to the other options in this zone, corridor option B0 would have a greater visibility.

Corridor option B1

Corridor option B1 follows the same road alignment as corridor option B0 through Kemps Creek. The existing road reserve is lined by trees, which define the corridor. Augmentation of the road reserve would be visually prominent to road users and adjoining properties. In addition, the removal of some adjoining existing building structures would also increase the visibility of this option.

West of Kemps Creek, the corridor passes through cleared land that is interspersed with riparian corridors and small rises that may block long views of the road corridor. Crossings of creeks and floodplains are a dominant feature in this landscape.

Relative to the other options in this zone, corridor option B1 would have a greater visibility.

Corridor option B2

Corridor option B2 passes through largely cleared agricultural land, which is interspersed with riparian corridors and small rises that may block long views of the road corridor. Crossings of creeks and floodplains are a dominant feature in this landscape. There are few residences in this area so few opportunities for permanent views.

Relative to the other options in this zone, corridor option B2 would have the least visibility.

Corridor options B3 and B4

Corridor options B3 and B4 pass through largely cleared agricultural land, which is interspersed with the riparian corridors and small rises that may block long views of the road corridor. West of south creek, corridor options B3 and B4 pass over a rise in topography, which would elevate the road and make it more visible in the landscape from a wider viewshed. Crossings of creeks and floodplains are a dominant feature in this landscape.

Relative to the other options in this zone, corridor options B3 and B4 would have a moderate visibility.

6.6.3 Zone C

Corridor option C0

Corridor option C0 would result in widening of the existing Elizabeth Drive road reserve to accommodate not only the M12 Motorway but also the upgrade of Elizabeth Drive. The existing road reserve is lined by trees, which define the corridor. Any widening of the road reserve through this area would be visually prominent to road users and adjoining properties. While there are few receivers affected by visual impacts, there will be mostly transient views from travellers along Elizabeth Drive and Luddenham Road.

Corridor options C1 and C2

Corridor options C1 and C2 pass through largely cleared agricultural land, which is interspersed with riparian corridors, Blackford Hill and small rises. These would tend to block long views of the road corridor. Few receivers would be affected by visual impacts.

The extensive rural nature of the environment will influence the likely urban design outcomes. In addition, the very low density of residential receivers in 100 metres of the option limits the number of viewers. There would be opportunity for transient views and long ranging views as the options would need to pass over Luddenham Road.

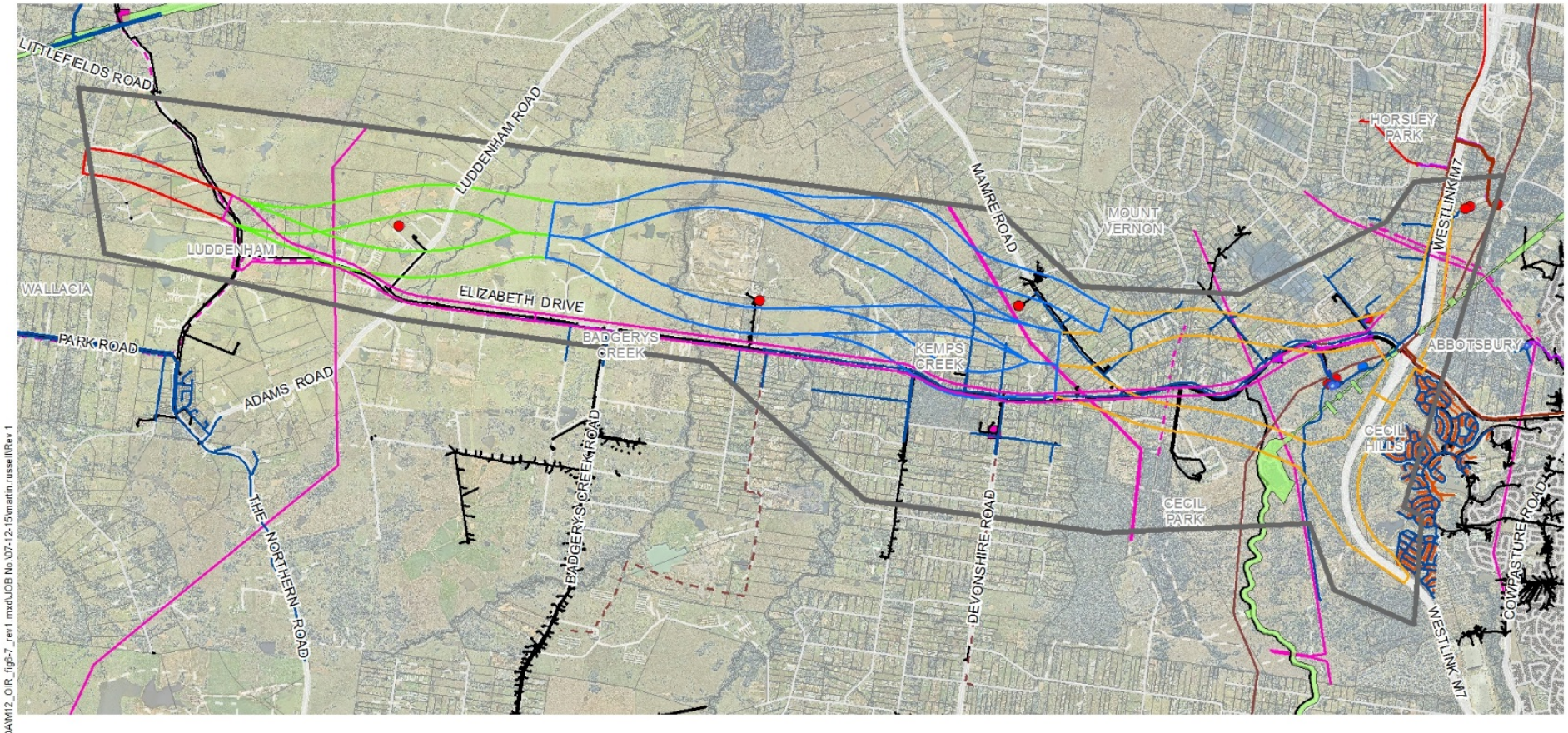
These corridor options are considered to have the same moderate visibility.

6.6.4 Zone D

Corridor option D1 passes through relatively flat land. West of The Northern Road, slopes to the west provide an outlook to the Blue Mountains. The interchange with The Northern Road would be a prominent feature in the landscape with potential long ranging views from the east. However, most views would be transient from road travellers.

6.7 Constructability and utilities

Figure 6-7 shows the constructability issues and utilities overlayed with the corridor options.



Legend

- M12 study area
- Water reservoir/structure
- Water main
- Water NSW (controlled area)
- Sewer main
- Gas main - central trunk (Wilton to Horsley Park)
- Gas main
- Uecomm fibre
- Optus fibre cable - aerial
- Optus fibre cable - ugrd
- Telstra fibre assets
- Radar site
- Mobile tower
- Exchange
- High voltage lines (Endeavour Energy)
- Transmission lines (Transgrid)
- Electrical substation

Source: Transgrid, Endeavour Energy, Telstra, Optus, Uecomm, Jemena, WaterNSW, Sydney Water, Nearmap, LPI, Aurecon

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0 500 1000 m

Projection: GDA 1994 MGA Zone 56

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FIGURE 6.7: Utilities within the corridor options

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6.7.1 Zone A

Corridor option A0

Corridor option A0 would present the following challenges during construction:

- It would traverse the existing road reserve
- It would require a moderate change to the current road level
- It would require substantial construction staging and temporary roadwork, including road closures, during construction
- It would require increased frequency of working under or near live traffic relative to the other options in Zone A, and therefore poses the most risk during construction out of all options in Zone A
- It would require extensive construction staging because the connection to the M7 Motorway is at the same location as the existing Elizabeth Drive interchange
- It would require alterations to all four existing service ramps to the M7 Motorway (bridges across the M7 may be launched)
- It would traverse an ex-quarry that now serves as a brick pit
- Crosses the Sydney Water upper canal, Telstra and Optus optical fibre assets, Sydney Water mains, Jemena 150 millimetre gas main, TransGrid 500 kilovolt (kV) overhead electricity line, Endeavour Energy 33 kV overhead electricity line and Endeavour Energy 132 kV overhead.

Corridor option A1

Corridor option A1 could be largely constructed ‘off line’ through Western Sydney Parklands. It would present the following challenges during construction:

- It would be built close to parkland users
- It would cross Elizabeth Drive at an acute angle and likely be constructed over this road to ensure the motorway remains flood free
- The M7 Motorway interchange would need to consider the closeness of the existing Elizabeth Drive interchange. However, the proposed interchange location is more manageable than corridor option A2)
- It would require a bridge crossing of the Sydney Water Canal with spill control
- Crosses the Sydney Water upper canal, Jemena gas main truck, Jemena 150 millimetre gas main, Telstra optical fibre assets, Sydney Water mains, TransGrid 500 kV overhead electricity line and Endeavour Energy 132 kV overhead electricity line.

Corridor option A2

Corridor option A2 would present the following challenges during construction:

- It would require extensive construction staging as the connection to the M7 would be at the same location as the existing Elizabeth Drive interchange. It is envisaged that any bridges across the M7 may be launched, but alterations would be required to all four existing service ramps
- In the remainder of the option, the motorway could be built ‘off line’ in moderate terrain next to small holdings. The one exception would be the crossing of Mamre Road, where the motorway is expected to be built over the road
- It would traverse an ex-quarry that now serves as a brick pit

- Crosses the Sydney Water upper canal, Telstra and Oputs optical fibre assets, Sydney Water mains, TransGrid 500 kV overhead electricity line and Endeavour Energy 132 kV overhead electricity line.

6.7.2 Zone B

Corridor option B0

Corridor option B0 would present the following challenges during construction:

- It would traverse the existing road reserve
- It would require a moderate change to the current levels to raise the road above the flood zones so significant construction staging and additional temporary roadwork along with closures would be required
- It would require increased frequency of working under or near live traffic relative to the other options in Zone B, and therefore poses the most risk during construction out of all options in Zone B
- Crosses Telstra optical fibre assets, Sydney Water mains, Endeavour Energy 33 kV overhead electricity line and Jemena 150 millimetre gas main.

Corridor option B1

Corridor option B1 runs reasonably close to Elizabeth Drive and threads through the village of Kemps Creek to the north of the small concentration of key businesses. The option largely traverses small rural holdings, and would require the least amount of construction access of all options in Zone B due to its proximity to Elizabeth Drive. This option would present the following challenge during construction:

- It would require a number of north–south roads to be crossed, including the access road to the Elizabeth Drive landfill facility
- Crosses Telstra optical fibre assets, Sydney Water mains, Endeavour Energy 33 kV overhead electricity line, TransGrid 500 kV and Jemena 150 millimetre gas main.

Corridor option B2

Corridor option B2 runs reasonably close to Elizabeth Drive and further north of the village of Kemps Creek than B1, thereby offering slightly more favourable constructability. The option largely traverses small rural holdings, and would require the least amount of construction access of all options in Zone B due to its proximity to Elizabeth Drive. It would present the following challenge during construction:

- It would require a number of north–south roads to be crossed, including the connection to the Elizabeth Drive landfill facility
- Crosses Telstra optical fibre assets, Sydney Water mains and TransGrid 500 kV overhead electricity line.

Corridor option B3

Corridor option B3 largely traverses small rural holdings located near Mamre Road but further away from Elizabeth Drive than other options. It would present the following challenges during construction:

- It would require a number of north–south roads to be crossed
- It would require the longest amount of construction access due to its locality further from Elizabeth Drive

- Crosses Sydney Water mains and TransGrid 500 kV overhead electricity line.

Corridor option B4

The eastern extent of corridor option B4 is to the east of Mamre Road and would pass through denser, small rural holdings. It would present the following challenges during construction:

- It would require a number of local roads to be crossed
- It would require a reasonable amount of construction access due to its isolation to the existing road network
- It would cross Mamre Road at an acute angle
- It would have the longest floodplain crossing of all options in Zone B
- Crosses Telstra optical fibre assets and TransGrid 500 kV overhead electricity line.

6.7.3 Zone C

Corridor option C0

Corridor option C0 would present the following challenges during construction:

- It would traverse the existing road reserve
- It would require additional construction staging and additional temporary roadwork along with closures
- It would require increased frequency of working under or near live traffic relative to the other options in Zone C, and therefore poses the most risk during construction out of all options in Zone C
- Crosses Telstra optical fibre assets, Sydney Water mains, Endeavour Energy 33 kV overhead electricity line and TransGrid 330 kV overhead electricity line.

Corridor option C1

Corridor option C1 runs reasonably close to Elizabeth Drive and a small concentration of businesses. The option largely traverses small rural holdings, and would require the least amount of construction access of all options in Zone C due to its proximity to Elizabeth Drive. It would present the following challenges during construction:

- It would require a number of north–south roads to be crossed, including Luddenham Road
- It would require a number of large dams to be crossed
- Crosses Telstra optical fibre assets, Endeavour Energy 33 kV overhead electricity line and TransGrid 330 kV overhead electricity line.

Corridor option C2

Corridor option C2 runs north of Blackford Hill and offers the same constructability issues as C1. The only noticeable variance is less interfacing with large dams and possible improvements in construction access.

This option crosses Telstra optical fibre assets, Endeavour Energy 33 kV overhead electricity line and TransGrid 330 kV overhead electricity line.

6.7.4 Zone D

Corridor option D1 has an interface with The Northern Road and is likely to be built underneath it, so significant temporary works would be required. To the west of The Northern Road, the option traverses rural holdings with significant dams and water features.

This option crosses Telstra optical fibre assets and Endeavour Energy 33kV overhead electricity line.

6.8 Project cost

The project has been costed using the input parameters in the Quantm software application. This has generated costing for all 15 route options and not on the corridor options. To help assess the route options, the cheapest option has been reported as the base cost at $X with the remaining options reported as X+Y per cent.

Due to the complexity of the interchange with the M7 Motorway, this was not modelled in Quantm. 12D designs have been developed and separate costings have been extrapolated for these interchanges using costing data for A1 and A2.

By not disclosing a dollar figure at this stage, the project team can focus on the relative costing associated with the base (cheapest) option.

The summary of relative route option costings is provided in Table 6-19.

Table 6-19: Project cost summary

Route option	Corridor option per zone				Cost
01	A0	B0	C0	D1	X + 41%
02	A1	B1	C1	D1	X = (base cost)
03	A1	B1	C2	D1	X + 7%
04	A1	B2	C1	D1	X + 3%
05	A1	B2	C2	D1	X + 13%
06	A1	B3	C1	D1	X + 11%
07	A1	B3	C2	D1	X + 5%
08	A2	B1	C1	D1	X + 11%
09	A2	B1	C2	D1	X + 49%
10	A2	B2	C1	D1	X + 18%
11	A2	B2	C2	D1	X + 22%
12	A2	B3	C1	D1	X + 20%
13	A2	B3	C2	D1	X + 34%
14	A2	B4	C1	D1	X + 13%
15	A2	B4	C2	D1	X + 13%

7 Next steps

Roads and Maritime will undertake a value management workshop to short list of route options. This workshop will gain stakeholder input into the relative benefits of each route option and the assessment of the options done to date.

Once a short list of route options is selected, Roads and Maritime will consult with the community about the selected route options. Roads and Maritime will also undertake additional investigations to consider a variety of community, environmental, social, economic and engineering criteria.

Roads and Maritime will consider these community consultation outcomes and additional investigations to select a preferred route. The selection would be undertaken once a Value Management workshop has been undertaken and stakeholders have had input into the shortlisted route options.

The preferred route, once selected will be made public to the community. The project will then be further refined and project approval sought from the NSW Government.

8 References

Reports/documents

- ABS Australia; Analysis of Population Census and Agriculture Census Data in Sydney Statistical Division; Canberra; 2010
- Department of Infrastructure and Regional Development; Western Sydney airport draft Environmental Impact Statement; Canberra; 2015
- Fox & Associates 1991 Heritage Study of the City of Penrith. Prepared on behalf of Penrith City Council (3 vols)
- Perumal Murphy 1990 The South Creek Valley Heritage Study. Prepared for the NSW Dept of Planning, Sydney
- Roads and Maritime; Western Sydney Infrastructure Plan Project Executive Committee, WSIP Project and Programme Objectives; Sydney; July 2015
- Parklands Plan of Management (to 2020) (Western Sydney Parklands Trust 2010)
- Worley Parsons; Updated South Creek Flood Study; Sydney; 2015

Legislation and government plans

- SEPP (Sydney Region Growth Centres) 2006
- *Threatened Species Conservation Act 1995*
- *Environment Protection and Biodiversity Conservation Act 1999*
- *Penrith Local Environmental Plan 2010*
- *Penrith Local Environmental Plan (Glenmore Park Stage 2) 2009*
- *Liverpool Local Environmental Plan 2008*
- *Fairfield Local Environmental Plan 2013*
- *Protection of the Environment Operations Act 1997*

Databases

- Office of Environment and Heritage (OEH); Atlas of NSW Wildlife database – searched in 2014
- OEH; Aboriginal Heritage Information Management System – searched on 29 July 2015
- NSW Environment Protection Authority (EPA) Contaminated Land records register was carried out on 11 August 2015
- Soils Landscapes Map (Penrith Sheet 9030)

Appendix A

Long list route options comparative assessment

Route option comparative assessment

Table A-1: Route 1 comparative assessment

ROUTE No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Zone A	A0	A1	A1	A1	A1	A1	A1	A2	A2	A2	A2	A2	A2	A2	A2
Zone B	B0	B1	B1	B2	B2	B3	B3	B1	B1	B2	B2	B3	B3	B4	B4
Zone C	C0	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
Zone D	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1
Land use															
Cadastral count (incl. partial lots)	234	139	137	120	118	115	113	278	276	259	257	254	252	280	278
Farm dams	32	66	58	68	60	52	44	72	64	74	66	58	50	57	49
Sensitive receivers (within corridor)	37	34	31	32	29	25	22	91	88	89	86	82	79	95	92
Social															
Sensitive noise receivers within 600m	597	1,029	1,028	994	993	962	961	669	668	634	633	602	601	632	631
Hydrology															
Floodplain length (m)	1,380	1,345	1,345	1,545	1,545	1,520	1,520	1,345	1,345	1,545	1,545	1,520	1,520	930	930
Floodplain area (m^2)	130,048	448,717	448,717	509,578	509,578	501,604	501,604	442,471	442,471	503,332	503,332	495,358	495,358	368,029	368,029
Creeks & major drainage lines crossed	19	25	23	24	22	24	22	21	19	20	18	20	18	20	18
Named creeks crossed	6	6	5	6	5	6	5	6	5	6	5	6	5	6	5
Biodiversity															

ROUTE No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Zone A	A0	A1	A1	A1	A1	A1	A1	A2	A2	A2	A2	A2	A2	A2	A2
Zone B	B0	B1	B1	B2	B2	B3	B3	B1	B1	B2	B2	B3	B3	B4	B4
Zone C	C0	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
Zone D	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1
Total area of threatened ecological communities (ha)	76	83	80	90	87	97	94	114	111	121	118	128	125	99	96
Threatened ecological communities in good condition (ha)	29	27	25	19	17	18	16	48	46	40	38	39	37	37	35
Threatened ecological communities potentially EPBC (ha)	64	62	62	69	69	73	73	95	95	102	102	106	106	80	80
Area of priority conservation lands (ha)	41	12	12	8	8	4	4	48	48	44	44	40	40	40	40
Number of regional biodiversity corridors crossed	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4
Area of regional biodiversity corridors (ha)	29	80	80	92	92	105	105	52	52	64	64	77	77	46	46
Area of bushland corridor in WSP (ha)	24	52	52	52	52	52	52	24	24	24	24	24	24	24	24

ROUTE No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Zone A	A0	A1	A1	A1	A1	A1	A1	A2	A2	A2	A2	A2	A2	A2	A2
Zone B	B0	B1	B1	B2	B2	B3	B3	B1	B1	B2	B2	B3	B3	B4	B4
Zone C	C0	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2	C1	C2
Zone D	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1	D1
Area of non-certified land (Sydney Region Growth Centres SEPP 2006)(ha)	35	134	134	134	134	134	134	26	26	26	26	26	26	26	26
Number of threatened flora species	1	3	1	3	1	2	0	3	1	3	1	2	0	2	0
Number of threatened fauna species	3	0	0	0	0	0	0	2	2	2	2	2	2	2	2
Heritage															
No of Aboriginal heritage sites	7	9	9	7	7	8	8	6	6	4	4	5	5	5	5
Area of Aboriginal sensitivity (km^2)	5.17	6.81	6.21	7.01	6.41	7.63	7.03	6.26	5.66	6.46	5.86	7.08	6.48	7.76	7.16
No of known or potential non-Aboriginal heritage sites	3	4	7	7	7	2	2	10	10	10	10	5	5	6	6
No of cultural landscapes	5	7	7	7	8	6	6	7	7	8	8	6	6	6	6
COST															
X+%	37%	0%	6%	3%	11%	10%	4%	10%	44%	16%	19%	18%	30%	11%	12%

rms.nsw.gov.au/projects/sydney-west/m12-motorway/index.html

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December 2015