

North-South Corridor Darlington Upgrade Project Project Assessment Report



Artist's impression of the Darlington Upgrade Project (surface roads and lowered road), view from south of Sturt Road looking north including the Flinders Link Project.

An environmental, social
and economic assessment



Australian Government
BUILDING OUR FUTURE



Government
of South Australia
Department of Planning,
Transport and Infrastructure

North-South Corridor Darlington Upgrade Project Project Assessment Report



The Darlington Upgrade Project is another important stage in the delivery of the North-South Corridor Project and the Project Assessment Report has been developed as part of the Environmental Impact Assessment process for the project. The Environmental Impact Assessment process evaluated the effects and opportunities of the proposed project so that decision making could take these effects into account and include appropriate mitigation or management measures.

The Project Assessment Report explains the need for the project, describes the project and summarises the environmental, social, economic and engineering assessments undertaken on the concept design. The report also describes the design development of the project and the modifications that have been made to the concept design.

Extensive community and stakeholder engagement has been undertaken for the Darlington Upgrade Project for the planning phase and has also informed the design development and decision making process for the project to date.

Intensive engagement commenced in 2010 with the release of the Darlington Transport Study Environmental Report in October 2010. Similar engagement was also undertaken in a broader context during the South Road Planning Study in 2013 - 2014.

Following announcement of the Darlington Upgrade Project in May 2014, a number of engagement initiatives were undertaken providing opportunities for stakeholders and the general community to provide input into the development of the concept design.

The detailed design phase of the project is underway and the design will further develop prior to construction commencing. Community and stakeholder engagement has been an important part of the design development process and will continue to be critical to its successful implementation and also during main construction activities.

The Project Assessment Report is available on the Darlington Upgrade Project website at: www.infrastructure.sa.gov.au/darlington.

Limited hardcopies are available from the Department of Planning, Transport and Infrastructure on request.

Please contact the project team on 1300 759 334 or via email at: dpti.darlington@sa.gov.au for further information.

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PART A

Project overview and development

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1 Introduction

1.1 Project background

Adelaide's North-South Corridor runs between Gawler and Old Noarlunga and connects the rapidly expanding industrial and residential growth areas in the north and the south, providing new opportunities for economic development. It is one of Adelaide's most important transport corridors and is the major route for north and south bound traffic (including freight vehicles) running between Gawler and Old Noarlunga at a distance of 78 kilometres.

The North-South Corridor is comprised of four road links:

1. Northern Expressway from Gawler to Port Wakefield Road
2. Northern Connector from Port Wakefield Road to Port River Expressway
3. North-South Motorway from Port River Expressway to Southern Expressway; and
4. Southern Expressway from Darlington to Old Noarlunga.

The Australian Government has announced its intention to upgrade the North-South Corridor and, together with the South Australian Government, has committed to construct the \$620 million Darlington Upgrade Project (the project) as part of this. The Australian Government has committed \$496 million and the South Australian Government's contribution will be \$124 million. The project is due for completion by the end of 2018.

The upgraded North-South Corridor will provide a series of strategic free-flowing road links to connect the expanding industrial and residential growth areas in the north and the south, providing new opportunities for economic development.

When completed, the North-South Corridor will:

- > Increase economic productivity
- > Improve connectivity
- > Improve road safety.

The current roadway is not capable of handling projected land use and transport growth and the number of vehicles that need to use the road or the size of freight carriers travelling along it. In response, the Australian and South Australian Governments have indicated their desire to expand the route by creating a dedicated 'non-stop' North-South Corridor.

To increase the capacity and efficient use of the roadway, the Australian and South Australian governments are creating a dedicated non-stop North-South Corridor, which will also eliminate the worst bottlenecks.

Currently 44 kilometres of non-stop motorway on the North-South Corridor is completed. New road links have been built between Gawler and Port Wakefield Road (Northern Expressway); Regency Road and the Port River Expressway (South Road Superway; and between Bedford Park and Old Noarlunga (Southern Expressway duplication). Traffic flow along and across this route has also been improved with the construction of the Gallipoli Underpass and the Glenelg Tram Overpass.

A funded program of works is already underway to eliminate the worst bottlenecks along the remaining 34 kilometres of the North-South corridor. This currently funded program of works comprises three distinct projects:

- > Torrens Road to River Torrens (to be completed by end of 2018)
- > Darlington Upgrade Project (to be completed by end of 2018); and
- > The Northern Connector (to be completed by end of 2019).

In 2013, the Department of Planning, Transport and Infrastructure (DPTI) began planning to enable non-stop travel between Anzac Highway and the Southern Expressway following funding from the Australian Government. DPTI identified that one of the highest priorities for upgrade in that section was between the Southern Expressway and Ayliffes Road and as this section is frequently congested for northbound vehicles in the morning peak period and south bound vehicles in the afternoon peak. During these times, vehicles are restricted to speeds lower than average for the metropolitan Adelaide area.

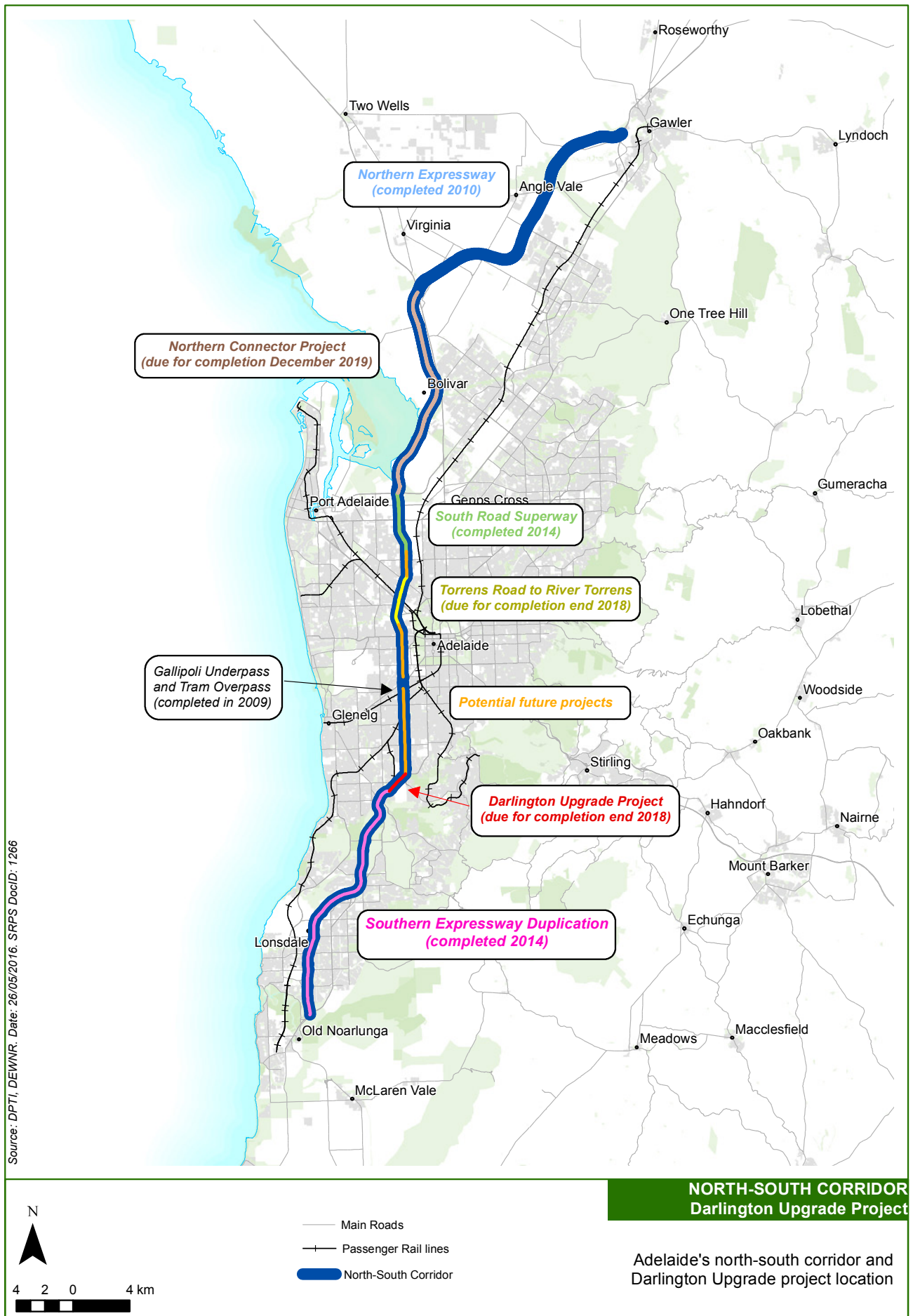


Figure 1 - Adelaide's North-South Corridor and Darlington Upgrade Project location

1.2 Project aims and outcomes

The project aims to:

- > Provide non-stop access between the Southern Expressway and just north of Tonsley Boulevard
- > Maintain and enhance local access to the area
- > Improve traffic efficiency and safety
- > Encourage and improve walking, cycling and public transport opportunities
- > Provide opportunities for urban, landscape and environmental improvements
- > Compliment the culture and unique character of the Darlington precinct
- > Help to achieve strategic policy outcomes and objectives for the Australian and South Australian governments.

The project is expected to:

- > Provide cost savings for industry and other users through reductions in travel times and vehicle operating costs
- > Reduce crash rates
- > Stimulate a net creation of economic activity and new activity by existing companies that would not otherwise occur
- > Improve access to the Darlington precinct
- > Improve road safety and connectivity for cyclists and pedestrians.

1.3 Key features of the project

The project will upgrade approximately 3.3 kilometres of the existing Main South Road in the suburbs of Darlington, Bedford Park, St Marys and Clovelly Park, including:

- > A non-stop motorway between the Southern Expressway and Tonsley Boulevard
- > A lowered, non-stop motorway passing underneath Flinders Drive, Sturt Road, Sutton Road/Mimosa Terrace and Tonsley Boulevard
- > Grade separation of the Main South Road/Ayliffes Road/Shepherds Hill Road intersection
- > Main South Road (at grade) service roads along both sides of the lowered motorway to provide connections to Flinders Drive, Sturt Road and most local roads; and
- > A full free flow interchange at the Southern Expressway/Main South Road with dedicated ramps providing direct access to the new motorway and Main South Road.

The design has taken into consideration the future needs of Adelaide and allows for future connection to the adjacent section stage of the North-South Corridor when it is upgraded in the future. Figure 2 provides an overview of the project.



Figure 2 - Darlington Upgrade Project – Concept design

1.4 Development of the project

1.4.1 Darlington Transport Study – 2010

In 2009-2010 a planning study was undertaken to investigate upgrades to road and rail infrastructure in the Darlington precinct. This included grade separation of Main South Road and Sturt Road, extension of the Tonsley rail line and the potential for a public transport interchange and transit orientated development.

1.4.2 Funding commitment – May 2014

In May 2014, the Australian and South Australian Governments announced a joint commitment of \$620 million towards the construction of the Darlington Upgrade Project. This followed a planning study to determine options for a North-South Corridor between Anzac Highway and the Southern Expressway, including the Darlington precinct.

1.4.3 Concept planning and assessment – 2014

The first phase of the Darlington Upgrade Project planning study investigated all possible options for a non-stop Main South Road between the Southern Expressway and Ayliffes Road. These options were designed to a level of detail that enabled high-level cost estimates to be developed for each option and a multi-criteria assessment to be undertaken.

In June 2014, an initial concept design for the Darlington precinct was released for community feedback. This design included:

- > A new lowered road on the western side of Main South Road that would allow non-stop flow of traffic from the Southern Expressway to the Ayliffes Road/South Road intersection
- > A parallel surface road along the current Main South Road alignment to provide arterial and local road connections
- > The extension of Flinders Drive from Main South Road to Sturt Road to enable more efficient public transport access to the Flinders Precinct, including the Flinders Medical Centre, Flinders Private Hospital and Flinders University.

1.4.4 – Revised concept – March 2015

Following further engagement with stakeholders and the community, and conducting additional traffic, environmental and social investigations, an alternative concept design was developed and released in March 2015 for further consultation.

The consultation resulted in some additional changes to the concept design which included:

- > The alternative scheme provided enhanced overall traffic performance through the addition of access to the non-stop motorway for north-bound traffic on Main South Road. It also removed signalised entry and exit points to the motorway.
- > Surface roads on either sides of the motorway.
- > Based on current traffic volumes, it was estimated that the alternative concept design would allow an additional 15 000 vehicles per day to access the non-stop motorway.

1.4.5 Flinders University Design – August 2015

Flinders University developed an alternative scheme for the Darlington Upgrade Project, with the lowered motorway on the outside of a central surface of Main South Road. The University's scheme was independently reviewed and it was found that the scheme would not provide sufficient capacity or satisfactory operation to fully accommodate the predicted 2031 traffic demands with the motorway delivering inadequate performance.

1.4.6 Scope extension – December 2015

On 20 December 2015, the Australian and South Australian Governments announced the extended scope design of the Darlington Upgrade Project. The changes to the concept design included:

- > Realignment of the Flinders Drive extension to connect to Birch Crescent. The junction of Birch Crescent and Sturt Road will be signalised to enable safe traffic movements in and out of Clovelly Park. This will also provide enhanced connectivity for pedestrians and cyclists between Tonsley/Clovelly Park and the Flinders precinct through a dedicated path and bicycle path along the Flinders Drive extension
- > Enhanced cycling and walking facilities through the provision of grade-separated, two-way cycling paths and dedicated footpaths
- > Inclusion of a bridge between Sutton Road and Mimosa Terrace to provide enhanced east-west connectivity
- > Realignment of the Sturt Road/Main South Road intersection to retain on-street parking in front of Sturt Road businesses, and remnant vegetation immediately west of this building
- > Removal of new road connection from Flinders Drive through the Francis Street Reserve
- > Extension of the non-stop motorway approximately one kilometre further north along Main South Road

- > Grade separating the Ayliffes Road/Shepherds Hill Road intersection and Tonsley Boulevard intersections
- > Left and right turn in and out of Brookside Road will be maintained on Main South Road at Darlington via a signalised intersection heading north.

Safety and travel efficiency on South Road will be significantly improved with the extension of the motorway.

1.4.7 Flinders Link Project

On 13 May 2016, the Australian and South Australian Governments announced funding for the \$85 million Flinders Link Project. While a separate project, this project will include extending the existing Tonsley rail line to Flinders Medical Centre, creating new connections to the health precinct and Flinders University. This is shown in Figure 3.

The project will include:

- > A 650 metre extension of the Tonsley rail line linking the Flinders Medical Centre and Flinders University to the rail network, including 520 metres of elevated single track over Sturt Road, Laffer's Triangle and Main South Road
- > A new station next to the Flinders Medical Centre
- > An integrated shared pedestrian/cycle path adjacent the rail line
- > Station review.

1.5 Ongoing design development

With the award of the design and construction to Gateway South (a joint venture between Fulton Hogan and Laing O'Rourke), the detailed design phase is underway and will further develop the design prior to construction, which is currently planned to begin in late-2016.

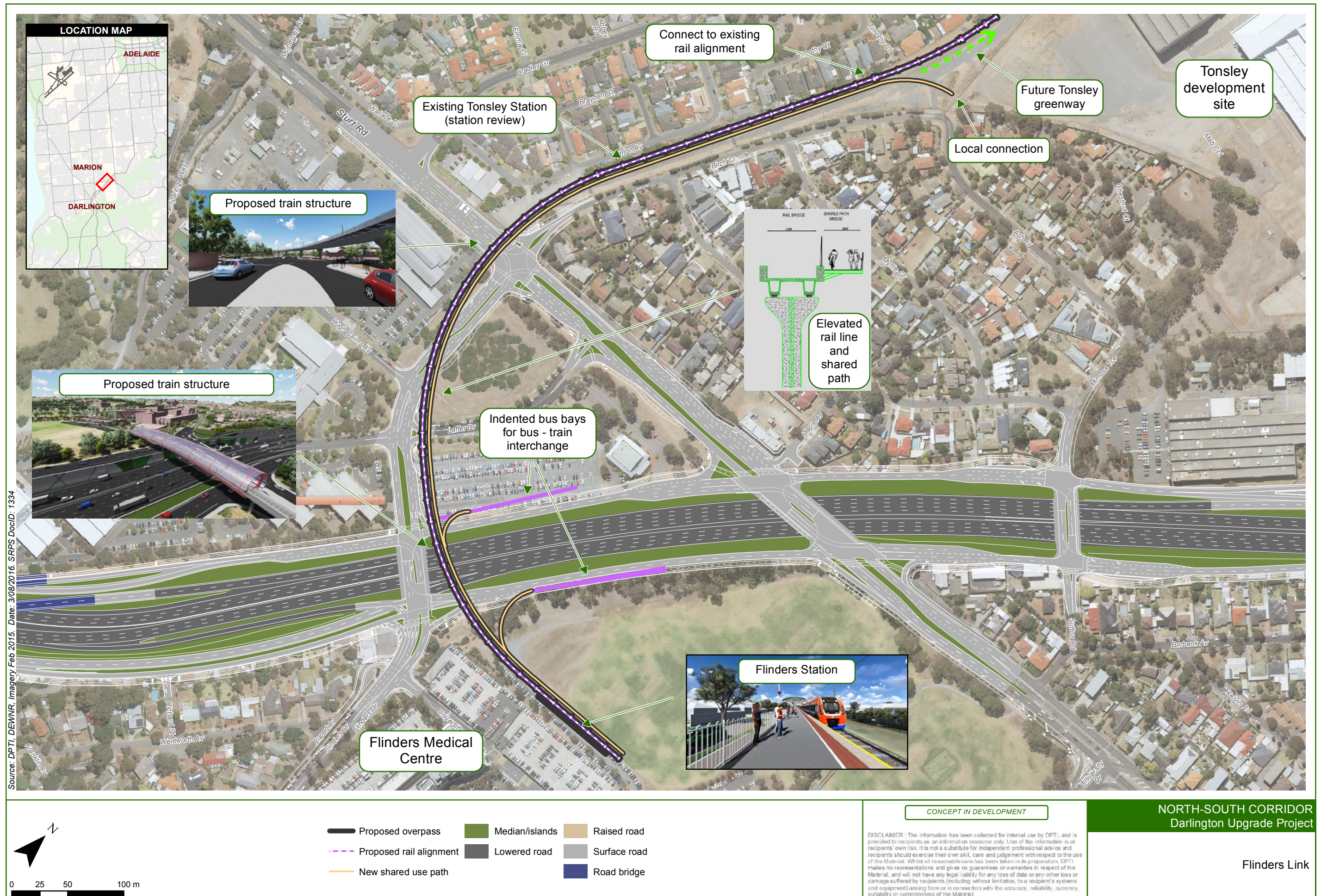


Figure 3 - Flinders Link proposal concept design

2 Project funding and timeframes

2.1 Project cost and funding

The total cost for the project is \$620 million. The Australian Government has committed \$496 million and the South Australian Government \$124 million.

A cost benefit analysis for the project has been undertaken, monetising the project's impacts on travel times, vehicle operating costs, road crashes and the environment. The analysis indicates that the project will produce positive net benefits for South Australians.

The project will also assist pedestrians, cyclists and residential/commercial development potential, but these were not monetised.

2.2 Project timeframes

Table 1 provides an overview of the various phases of the project and associated activities and timeframes.

Project phase	Activities	Time frame
Concept planning and investigations	<ul style="list-style-type: none"> > Development of possible road options > Stakeholder and community engagement > Preliminary field investigations > Initiate property acquisition 	December 2013 to October 2014
Pre-construction	<ul style="list-style-type: none"> > Ongoing property acquisition > Property demolition > Environmental and other approvals > Procurement (award Design and Construct Contract) > Early works – service relocations and local/arterial road and intersection upgrades on alternative/parallel routes > Ongoing community and stakeholder engagement > Preparation and release of the Project Assessment Report 	October 2014 to mid/late 2016
Construction	<ul style="list-style-type: none"> > Construction > Ongoing community and stakeholder engagement and other activities > Construction complete 	<p>Late 2016 to late 2018</p> <p>December 2018</p>
Post-construction	<ul style="list-style-type: none"> > Operation and maintenance 	2019 onwards

Table 1 - Indicative timeframes for the Darlington Upgrade Project

3 Project need and context

3.1 Overview

The need for a non-stop North–South Corridor in Adelaide, which includes the Darlington Upgrade Project, is driven by population growth and transport requirements for access to industrial/business precincts and Adelaide’s planned residential and employment areas.

Planning for the project identified three major problems associated with the current condition of South Road:

1. Economic – Issues of poor accessibility, increasing travel time, and reduced reliability for business through, and adjacent to, Main South Road is imposing additional costs on businesses and constraining current and future economic development in the State
2. Social – The Southern ‘Outer Adelaide’ area is characterised by few local industrial employment opportunities and limited access to wider recreational and social opportunities. Relative isolation and increasing congestion on key north-south transport routes will lead to further social disadvantage
3. Capacity – The current southern road network is at capacity and any disruption (such as crashes, breakdowns) has a widespread impact across the rest of the local network.

3.2 Traffic and transport drivers

The section of Main South Road between the Southern Expressway and the Ayliffes Road/Shepherds Hill Road intersection is Adelaide’s busiest section of road, carrying approximately 73 000 vehicles per day. It is a ‘squeeze point’ servicing vehicles from the south (Main South Road, Flagstaff Road and the Southern Expressway); to and from key destinations in the area (such as the Flinders Medical Centre, Flinders Private Hospital and Flinders University); and from the north (Main South Road and Ayliffes Road).

The Main South Road/Sturt Road intersection is one the busiest intersection in South Australia, with approximately 98 000 vehicles travelling through it each day.

As a result, this section of Main South Road is frequently congested for northbound vehicles in the morning peak period and southbound vehicles in the afternoon peak.

As a result, four of the current top ten busiest intersections within the State will be upgraded by the Darlington Upgrade Project.

3.3 Population growth

The Greater Adelaide area is home to eight out of ten South Australians. The 30-Year Plan for Greater Adelaide (released in 2010 and currently under review) foresees a steady population growth of an additional 560 000 people and construction of 258 000 additional homes. The plan focuses on identifying key locations for future growth and/or regeneration and proposes higher-density mixed-use development. This development is a fundamental part of meeting the South Australian Government’s infill targets of 70% in urban areas and 30% at the fringe by 2030. The Darlington Upgrade Project (forming part of Adelaide’s North–South Corridor) will play a vital role in efficiently connecting expanding employment and residential growth areas in the north and south (see Figure 4).

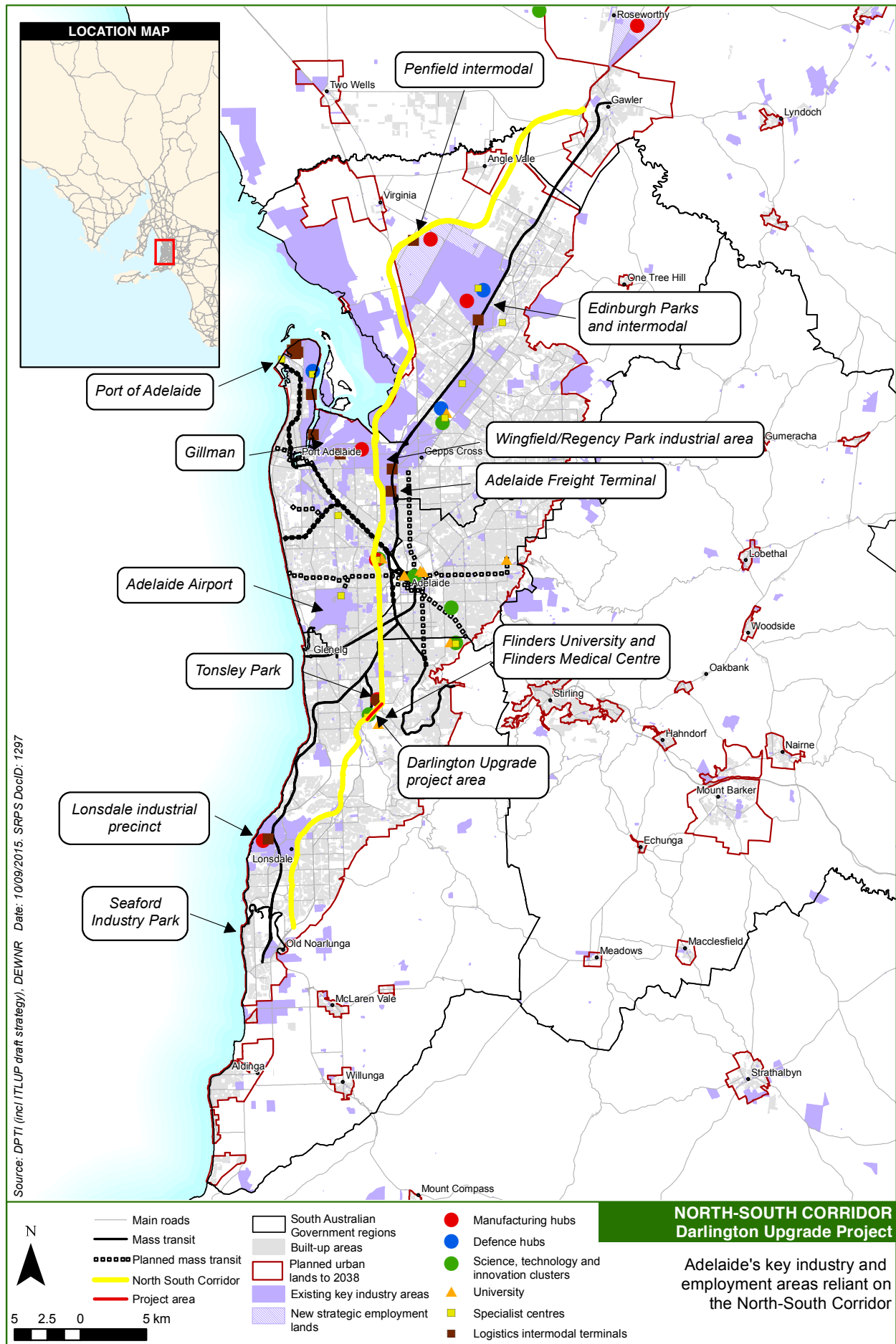


Figure 4 - Key industry and employment areas reliant on the North-South Corridor

3.4 National strategic policy context

3.4.1 Infrastructure Australia

Infrastructure Australia is committed to developing a long-term, national approach to infrastructure planning, and works with states and territories and other organisations. Infrastructure Australia identifies nationally significant infrastructure investment priorities and supports the development of infrastructure investment proposals using thorough evidence-based infrastructure planning processes.

In 2016, the Australian Infrastructure Plan (Plan) was released. The Plan sets out the infrastructure challenges and opportunities Australia faces over the next 15 years and the solutions required to drive productivity growth, maintain and enhance the standard of living, and ensure cities remain world class.

The Plan has four aspirations:

1. Productive Cities, Productive Regions
2. Efficient Infrastructure Markets
3. Sustainable and Equitable Infrastructure
4. Better Decisions and Better Delivery.

The Plan recognised Adelaide's North-South Corridor as addressing an underlying problem of congestion on the road network, specifically for North-South traffic in the corridor and east-west traffic which crosses the corridor. The North-South Corridor and the Darlington Upgrade Project contributes to Infrastructure Australia's aspirations (see Table 2).

3.4.2 National Land Transport Network

Adelaide's important North-South Corridor, including South Road from the Port River Expressway/Salisbury Highway to the Southern Expressway, forms part of the National Land Transport Network (see Figure 5).

The National Land Transport Network is a defined national network of important road and rail infrastructure links and their intermodal connections. The Network is determined by the Minister under the National Land Transport Act 2014.

The Australian Government promotes sustainable national and regional economic growth, development and connectivity by contributing to the development of an integrated National Network which:

- > Improves national and inter-regional connectivity for people, communities, regions and industry.
- > Improves national, inter-regional and international logistics and trade.
- > Enhances health, safety and security.
- > Is consistent with the obligation to current and future generations to sustain the environment.
- > Is consistent with viable, long-term economic and social outcomes.
- > Is linked effectively to the broader transport network.

The North-South Corridor and the Darlington Upgrade Project contribute to the goals of the National Land Transport Network.

Aspiration	Contribution by North-South Corridor and Darlington Upgrade Project
Productive Cities, Productive Regions: improving productivity, population and connectivity	Improved connections for southern industries and businesses to the national intermodal hubs and international gateways (Port of Adelaide and Adelaide International Airport). The North-South Corridor and Darlington Upgrade Project will provide improved connections to public transport services for those within the Darlington precinct. Efficient access to adjacent land use will create greater diversity of employment and housing that will reduce the need for people to travel long distances on a daily basis and will therefore reduce road congestion.
Sustainable and Equitable Infrastructure: improving efficiency and sustainability	Reducing road congestion (particularly the reduction in stop-start travel along arterial signalised road networks) reduces transport greenhouse gas emissions. The Darlington Upgrade Project removes four of Adelaide's top ten busiest intersections.

Table 2 - Infrastructure Australia aspirations addressed by a non-stop North-South Corridor

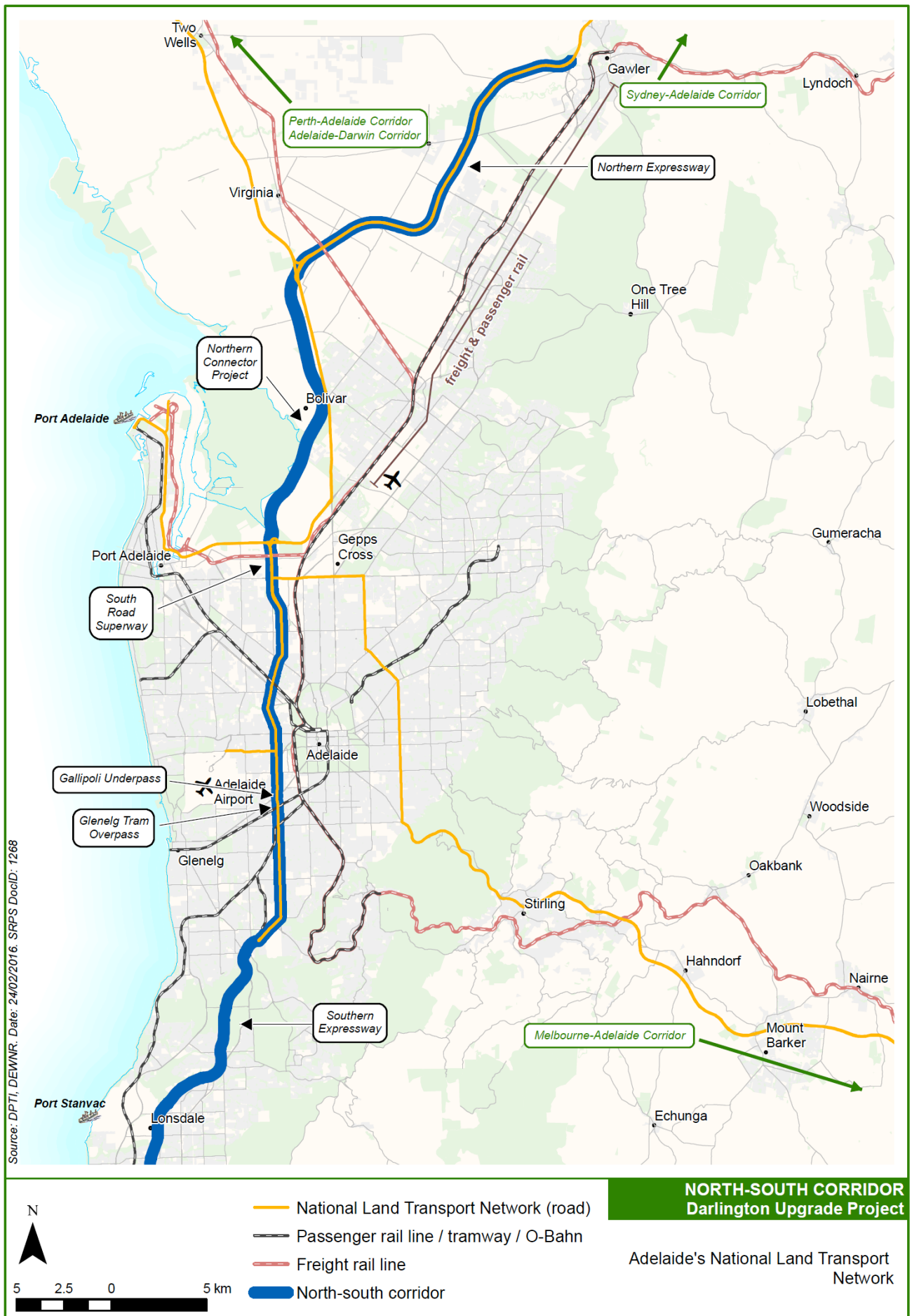


Figure 5 - Adelaide's National Land Transport Network

3.4.3 Australian Government Infrastructure Investment Programme

The Infrastructure Investment Programme funded by the Australian Government assists national, regional economic and social development by the provision of funding aimed at improving the performance of land transport infrastructures.

The programme incorporates:

- > A defined national network of important road infrastructure links
- > The National Land Transport Plan which outlines the Australian Government's approach to improving and integrating the National Network and the investments it will make
- > A single funding regime for the National Network
- > Funding for local and regional transport improvements including 'Roads to Recovery' and the 'Black Spot' program.

The Darlington Upgrade Project would positively contribute to the Infrastructure Investment Programme by:

- > Moving freight: increasing the productivity of interstate freight, local freight and heavy vehicles
- > Connecting people: addressing urban living issues and reducing pinch points
- > Safety: improving and upgrading the network
- > Innovation: using smart infrastructure.

3.4.4 Our Cities – Building a Productive, Sustainable and Liveable Future

Following the release of the *State of Australian Cities 2010 Report* (Infrastructure Australia 2010), the Australian Government released the discussion paper, *Our cities – building a productive, sustainable and liveable future, 2010* outlines aspirations under the themes of productivity, sustainability and liveability, and proposes possible directions for our cities.

Several of these themes link to the delivery of a non-stop South Road:

- > Productivity: investing in quality, efficient infrastructure
- > Sustainability: investing in infrastructure that delivers services and goods to businesses and communities more sustainably
- > Strengthening our governance frameworks: improving metropolitan planning and infrastructure delivery.

3.4.5 COAG Reform Council Capital City Strategic Planning Systems

The Council of Australian Governments has established a Reform Council, which has made recommendations to improve capital city strategic planning and build shared best practice planning approaches, including nine criteria for future strategic planning. Four of these criteria apply to the delivery of a non-stop North–South Corridor:

- > Provide nationally significant infrastructure including new and upgraded works for transport corridors, intermodal connections and international gateways
- > Address nationally significant policy issues including efficient development and use of existing and new infrastructure, connectivity of people to jobs and businesses to markets and development of major urban corridors
- > Consider and strengthen the networks between capital cities and major regional centres, and other important domestic and international connections
- > Clearly identify priorities for investment and policy effort by governments.

3.4.6 National Road Safety Strategy (2011–2020)

The National Road Safety Strategy 2011–2020 is a 10-year plan with a vision for safe roads, safe speeds, safe vehicles and safe people and a target to reduce fatalities and serious injuries from road accidents by 30%. The strategy sets out a range of high-level directions and priority actions to drive national road safety performance to the end of 2020. It also lays the groundwork for longer-term goals and aspirations. A non-stop North–South Corridor can contribute to several safe roads 'first step' priorities including:

- > Road project design by ensuring all new road projects are designed and built to reduce the risk of crashes
- > Treat accident cause by improving the road network to current safety standards to minimise head on, run off road and intersection crashes
- > Road improvements for all users including motorcyclists, cyclists, pedestrians, older users and users of public transport.

3.5 State strategic policy context

3.5.1 South Australia's Strategic Plan

South Australia's Strategic Plan (SASP) guides individuals, community organisations, governments and businesses to secure the wellbeing of all South Australians.

SASP contains the community's visions and goals; its 100 measurable targets reflect the priorities. SASP identifies priorities for South Australia. In addition to the SASP, the 7 Strategic Priorities and the 10 Economic Priorities form part of South Australia's strategic framework and their relevance to this initiative are described below in Table 3.

SASP targets	Contribution by North-South Corridor and Darlington Upgrade Project
Target 22: Road Safety	Reduce road fatalities and serious injuries by at least 30% by 2020.
Target 35: Economic Growth	Providing efficient and reliable movement across Adelaide for business. The Darlington Upgrade Project will provide new road connections to provide efficient and reliable movement and access along Adelaide's North-South Corridor.
Target 47: Jobs	Increase employment by 2% each year from 2010 to 2016. The project will support approximately 370 jobs per year during construction of the project. The Darlington Upgrade Project will provide new road connections to provide efficient and reliable movement and access to activate business and job opportunities.
Target 56: Strategic infrastructure	Ensure the provision of key economic and social infrastructure accommodates population growth. Contribute to investment in important infrastructure for South Australia.
Target 63: Use of public transport	Increase the use of public transport to 10% of metropolitan weekly passenger vehicle kilometres travelled by 2018. Improved access to public transport via road, cycling and walking links.
Target 68: Urban development	Investments in transport infrastructure will also improve connections to metropolitan Adelaide.
Target 82 and 83: Healthy weight, sport and recreation	More active travel via more public transport use, cycling and walking. Enhanced pedestrian and cycling facilities will be provided throughout the project area. Two-way cycling facilities separate to the traffic lanes and with separate footpaths will be provided on both sides of the road corridor.
7 Strategic Priorities	Contribution by North-South Corridor and Darlington Upgrade Project
Priority 4: Growing advanced manufacturing	Tonsley Innovation District. The transformation of the former Mitsubishi Plant at Tonsley into a purpose-built precinct will bring high-value manufacturing and technology-based businesses together with the education and research sectors. Tonsley represents a new future for innovation and manufacturing in the state. The Darlington Upgrade Project will provide direct access to and from Tonsley Park.
Priority 5: Safe communities, healthy neighbourhoods	Reduction in road crashes. Enhanced pedestrian and cycling facilities will be provided throughout the project area.
10 Economic Priorities	Contribution by North-South Corridor and Darlington Upgrade Project
Priority 4: The knowledge state	Improving access to Flinders University and surrounding suburbs as a place of study and residence for international tertiary students.
Priority 6: Growth through innovation	Tonsley Innovation District. The Darlington Upgrade Project will provide direct access to and from Tonsley Park.
Priority 7: South Australia - the best place to do business, through access to skilled workforce and high quality infrastructure	Providing efficient and reliable movement across Adelaide for business. The Darlington Upgrade Project will provide new road connections to provide efficient and reliable movement and access along Adelaide's North-South Corridor and will assist to activate development opportunities in Laffer's Triangle and in Bedford Park and other adjacent areas.

Table 3 - Project contribution to South Australia's Strategic Plan

3.5.2 Integrated Transport and Land Use Plan

The Integrated Transport and Land Use Plan (ITLUP) identifies a number of key transport challenges and sets goals, objectives and priorities for the state. The North-South Corridor is a critical aspect of delivering on the challenges, goals and objectives of the Plan. The project specifically supports the goals and associated objectives of the Plan (see Table 4).

3.5.3 The 30-Year Plan for Greater Adelaide

The 30-Year Plan for Greater Adelaide (2010) contains policies, targets and directions and governance arrangements that will guide development of Adelaide and its surrounds over a 30-year period by creating new transit corridors, growth areas and transit-oriented developments, and revitalising activity centres.

On 30 August 2016, a draft update to *The 30-Year Plan for Greater Adelaide* was released for consultation. The update builds on the strong foundations of the 2010

Plan and updates its vision to ensure the development of Greater Adelaide continues to respond to emerging challenges and opportunities. The draft update develops upon the Plan's existing principles and recognises the significant reforms introduced in the *Planning, Development and Infrastructure Act 2016*. The transport policies contained within the draft have also been updated.

The 30-Year Plan for Greater Adelaide (2010) can be found at:

https://livingadelaide.sa.gov.au/content/uploads/2016/08/The_30-Year_Plan_for_Greater_Adelaide_compressed.pdf.

The 2016 draft update to *The 30-Year Plan for Greater Adelaide* can be found at <https://livingadelaide.sa.gov.au/>.

The 30-Year Plan highlights the importance of the project as part of the North-South Corridor in Table 5.

ITLUP goal	ITLUP objective	Project contribution
1. Healthy, safe, affordable and connected communities	<p>Liveability</p> <ul style="list-style-type: none"> > Connected, vibrant, safe and attractive places throughout South Australia > A land use and transport system in Greater Adelaide that delivers connectivity, safety and choice of travel for people at a level that maintains Adelaide as one of the world's most liveable cities while increasing densities in central Adelaide to support the knowledge and services economy > Public transport, walking and cycling become a desired choice of travel for many of South Australians, reducing reliance on cars 	<p>The project will:</p> <ul style="list-style-type: none"> > reduce vehicle crashes by providing a non-stop corridor, grade separation of traffic streams, fewer intersections and improved pedestrian and cyclist network to minimise the risk of differing user conflicts > deliver an expressway standard road offering higher levels of safety, incident management and control > improve cycling and pedestrian facilities > divert traffic volumes from parallel and adjacent routes, improving traffic flow on these roads and allowing for better use, e.g. public transport priority
2. A strong, diverse and growing economy	<p>Prosperity</p> <ul style="list-style-type: none"> > A transport network which connects people and businesses to jobs, markets and services in a safe, reliable and timely manner > An efficient and effective freight transport system that adds to the competitiveness of South Australia 	<p>The project will:</p> <ul style="list-style-type: none"> > deliver more efficient and reliable links to industrial areas and Adelaide Airport > improve performance of east-west movements across the corridor
3. Thriving, natural and built environment	<p>Sustainability</p> <ul style="list-style-type: none"> > Significant reduction in transport emissions, including greenhouse gases and other harmful emissions 	<p>The project will:</p> <ul style="list-style-type: none"> > allow non-stop travel at a more efficient speed which is likely to reduce greenhouse gas emissions from the existing situation

Table 4 - Project contribution to the Integrated Transport and Land Use Plan

Reference to The 30-Year Plan for Greater Adelaide (2010)	Project contribution
Transport Policy 2 Designate and protect strategic freight corridors as identified on Map D15 (refer to page 117 of The 30-Year Plan for Greater Adelaide (2010))	North-south and east-west freight routes identified in the plan can ease congestion, minimise delays and improve travel time reliability
Transport Policy 15 Provide for non-stop travel along the North-South Corridor, linking the Northern Expressway, Northern Connector, Port River Expressway, non-stop South Road Corridor and Southern Expressway	Reduced travel times along the North-South Corridor would provide reliable travel options for business and social travel in Adelaide over the next 30 years
Reference to the 2016 draft update to The 30-Year Plan for Greater Adelaide	Project contribution
Draft policy 77 Protect current and future road and rail for strategic requirements, such as ensuring adequate access to ports and other major facilities' (refer to Page 82 of the 2016 draft update to The 30-Year Plan for Greater Adelaide).	Deliver a more connected and accessible greater Adelaide

Table 5 – Project contribution to The 30-Year Plan for Greater Adelaide

3.5.4 Strategic Infrastructure Plan for South Australia

The Strategic Infrastructure Plan for South Australia 2005/06 – 2014/15, (2005) identifies infrastructure priorities over 5 year and 10 year time frames. The purpose of the plan is to guide new infrastructure investment by government and the private sector, and improve the management and use of South Australia's existing infrastructure assets.

In October 2010 a discussion paper for the update of the Strategic Infrastructure Plan was released as the first step towards developing a new plan to map out the state's infrastructure priorities for the next 10 to 15 years. The paper identified a broadened scope of Adelaide's North–South Corridor to deliver the outcomes of the 30-Year Plan. The project will help contribute to the following Strategic Infrastructure Plan priorities:

- > Invest in transport infrastructure
- > Improve Adelaide's North–South Corridor
- > Develop reliable and efficient transport links for the North–South Corridor through Adelaide undertaking further improvements to South Road traffic flow.

3.5.5 Tackling Climate Change: South Australia's Greenhouse Strategy

The Tackling climate change: South Australia's greenhouse strategy, (2007) proposes three directions:

1. Reducing greenhouse gas emissions
2. Adapting to climate change
3. Innovating in markets, technologies, institutions and the way we live.

Directions are framed into goals and objectives for the community, industry, energy, transport and planning, buildings, and natural resources. The transport and planning goal aims to reduce transport related greenhouse gas emissions while maintaining accessibility and economic development. Lower congestion levels, achieved by minimising stop–start traffic along South Road on a non-stop North–South Corridor, will contribute to fewer total greenhouse gas emissions attributed to the north–south transportation of people and goods.

3.5.6 Towards Zero Together – South Australia's Road Safety Strategy 2020

South Australia's Road Safety Strategy 'Toward Zero Together' sets the direction for reducing serious casualty trauma by at least 30% by 2020. Targets include:

- > Less than 80 fatalities per year by 2020
- > Less than 800 serious injuries by 2020.

Strategies for Safer Roads include:

- > Integrate safety into all stages of urban/rural and transport/corridor planning processes
- > Form stronger partnerships between state and local government to apply safe system principles to South Australia's road network
- > Target infrastructure safety investment with the most effective safe system treatments at locations with the highest volumes or greatest risk of crashes.

The project will contribute to the Road Safety Strategy through improved safety design of intersections, roadways and the construction of shared use paths and cycle paths.

3.5.7 Industry Participation Policy

South Australia's Industry Participation Policy assists in delivering greater economic contribution to South Australia from government procurement.

The Darlington Upgrade Project will be delivered in line with the South Australian Government's Industry Participation Policy and in accordance with the South Australian's Government's policy for workforce participation. The State Government is committed to ensuring local South Australian businesses and workers benefit from construction projects.

Further details about the Industry Participation Policy can be found at the Office for Industry Advocate website at <http://www.dpc.sa.gov.au/office-industry-advocate>.

4 Community and Stakeholder Engagement

4.1 Overview

4.1.1 Background

Community and stakeholder engagement has formed an important part of the design development process for the Darlington Upgrade Project and will continue to be critical to its successful implementation.

4.1.2 Aims

Community and stakeholder engagement for the project aims to:

- > Raise awareness of the project and its contribution to the strategic transport objectives for South Australia
- > Build positive relationships with the community and stakeholders
- > Identify key stakeholder and community issues and opportunities
- > Provide and promote a range of opportunities for engagement at each project stage
- > Enable stakeholders and community to contribute to the identification of management strategies to address potential project impacts.

4.2 Engagement undertaken to date

Intensive engagement has been undertaken over the life of the project, commencing in 2010 with the release of the Darlington Transport Study in October 2010. Similar engagement was also undertaken in a broader context during the South Road Planning Study in 2013-2014.

Following the announcement of the project in May 2014, a number of engagement initiatives were implemented, which provided opportunities for stakeholders and the general community to have input into the development of the concept design over the past two years. These are summarised below and were undertaken at three key stages:

- > Initial release of the concept design in June 2014
- > Release of the revised concept design in March 2015
- > Extension of scope design in December 2015.

In September 2014, a Community Liaison Group was established to provide a forum for local residents and businesses to discuss and exchange information about the Darlington Upgrade Project. The group meets monthly and represents various organisations and interests including the Cities of Marion, Mitcham and Onkaparinga, local businesses and residents.

In addition to the Community Liaison Group, a Stakeholder Reference Group was established to provide a formal mechanism for major institutional stakeholders within the project catchment area to discuss common issues and coordinate multiple projects and strategic directions in the Darlington area. Members of the Group include representatives of the Cities of Marion, Mitcham and Onkaparinga, Flinders Medical Centre, Flinders Private Hospital, Flinders University, BT Financial and Westpac, Department of State Development, South Australia Police (SAPOL), SA Ambulance Service (SAAS), South Australian Metropolitan Fire Service (MFS) and Renewal SA.

The information received via the monthly meetings of these groups has been considered and integrated into the concept and design development process.

A project information line, email, website and drop in centre was set up in the early phases of the project and will continue into the construction phase. Emails, phone calls and web form comments received from stakeholders and the general community have been integrated into the design process.

Project brochures and letters were released to over 6 000 stakeholders and community members located around the project site at each of the three key stages of the concept design development phase. Feedback forms were distributed at the initial release of the concept design and again at the release of the revised concept design.

A number of briefings, workshops and information days were held at key phases of the project and included:

- > Eight community information days:
 - At the initial release of the concept design held on 2, 6 and 8 July 2014
 - At the release of the revised concept design held on 1, 9 and 11 April 2015
 - At the appointment of a contractor and project scope extension held on 3 and 6 March 2016
- > A display at Flinders University during O-Week in late July 2014

- > Meetings, presentations and workshops at key phases of the project to:
- State and Federal Members of Parliament
 - South Australian Government agency representatives
 - Local government staff, Mayors and Elected Members
 - Business owners along the corridor
 - Flinders Medical Centre and Flinders Private Hospital
 - Flinders University
 - Tenneco
 - Emergency services

- RAA, SA Road Transport Association, SA Freight Council and the SA Heavy Vehicle Industry Forum
- Utility service providers
- Community groups.

4.3 Outcomes of engagement

The key issues and opportunities raised by the community and key stakeholders during the design development phase focused on a number of areas of interest and were integral to ongoing refinement. Figure 6 shows the breakdown of issues by level of interest as recorded from feedback forms and information sessions over the concept design development phase between April 2015 and May 2016.

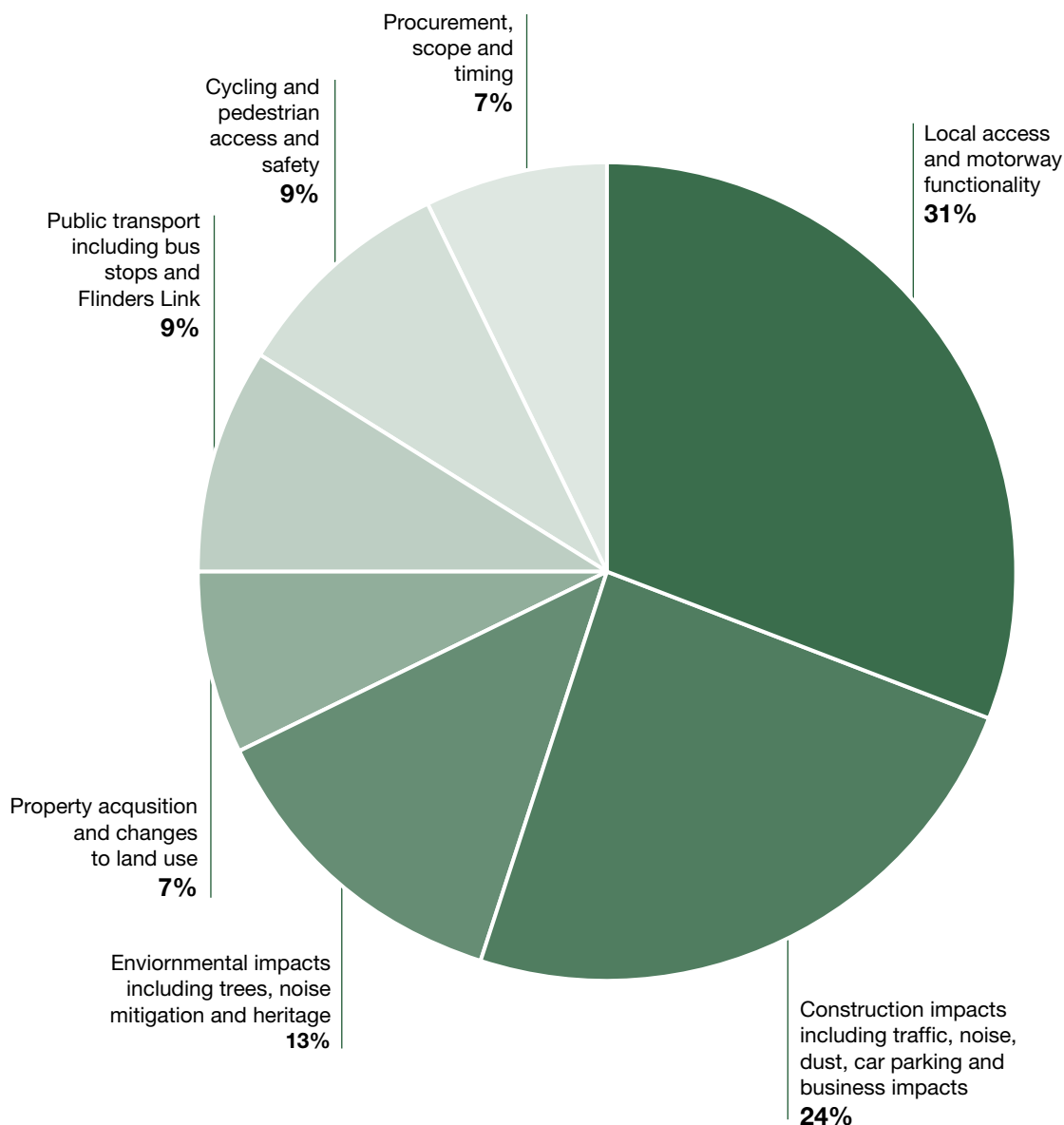


Figure 6 - Issues raised during concept design development from information sessions and feedback forms, April 2015 to May 2016

4.3.1 Local access and motorway functionality

Local access and motorway functionality was the most significant issue raised by the community. In particular, local access issues focused on access in and out of Bedford Park (south), Darlington, Clovelly Park, Flinders Medical Centre, and St Marys, including:

- > Access to and from Bedford Park and Darlington to Main South Road, including a right-hand turn out and additional access onto Flinders Drive
- > Improved access from Oak and Maple Avenues to Sturt Road and from Myrtle Grove to Main South Road from Mimosa Terrace
- > Left hand turn access from Shepherds Hill Road to Main South Road and right turn from Sturt Road to Main South Road
- > The provision of a U turn facility to facilitate access at Flinders Drive and Brookside Avenue
- > Access in and out of St Marys, especially for right hand turns in and out for both residents and businesses
- > Main South Road and Ayliffes Road intersection improvements and access to the motorway
- > The operation and capacity of Flinders Drive, including issues with current traffic volumes
- > Emergency access, particularly in relation to emergencies, access during construction and access to hospitals, police station and ambulance station

Comments in relation to the design of the motorway and functionality related to connections to the lowered motorway and surface road from Main South Road, access through the Sturt Triangle, improved access to the lowered motorway and minimising the number of signalised intersections for improved traffic flow on Sturt Road and the Main South Road surface roads.

4.3.2 Construction impacts including traffic, noise, dust, car parking and business impacts

Commuters, residents and employees alike raised construction impacts that included the impact on travel times and traffic flow during construction, concerns about traffic using side streets during construction to avoid delays and potential to stage construction works to minimise disruption. There were also a number of comments about the need to manage the cumulative impacts of other major projects on traffic flow and access.

Car parking was raised consistently during the design development phase and related to the existing lack of parking in the area and potential exacerbation during construction, car parking restrictions in adjoining suburbs and protection of staff car parking for Flinders Medical Centre and Flinders Private Hospital staff.

The management of construction noise and dust impacts were raised by both residents and employees within the area, the majority of which were queries about potential impacts as well as how dust and noise would be managed.

Business impact comments received during the design development phase and included concerns over maintaining visibility and passing trade and the need to maintain access and manage noise and dust during construction to minimise impacts on trade.

4.3.3 Environmental impacts including trees, noise mitigation and heritage

Comments relating to the long term management of traffic noise focused on noise mitigation options such as noise walls and house treatments, especially for residents newly exposed to Main South Road as a result of building demolitions. There was general support for early installation of noise walls to assist in mitigating the impacts of construction noise as well as long term operational noise. The impact of noise on the Warriparinga area was also raised.

Comments raised in relation to vegetation and significant trees related predominantly to concerns about loss of significant trees, particularly around the oval. Many comments included requests for more information about potential removals, desires to minimise impacts on trees, especially river red gums and opportunities for landscaping.

Comments raised in relation to environmental issues focused predominantly on minimising the impact on Warriparinga, including possible encroachment and noise impacts. Consideration of Water Sensitive Urban Design was also raised.

4.3.4 Property acquisition, demolition and changes to land use

The majority of property-related concerns raised related to acquisition requirements and the potential impact on properties newly exposed to Main South Road by the demolition of buildings, and changes to land use resulting from the loss of commercial and retail uses. These comments were received during the design development phase. The potential impact on property values and securing and maintaining leases was also raised.

4.3.5 Public transport including bus stops and Flinders Link Project

A large number of comments focused on the extension of the Tonsley Rail Line including funding for the Flinders Link Project. Comments related to support for the extension of the Tonsley Rail Line to Flinders Medical Centre, and details of the concept including the location of stations and the provision of supporting facilities such as car parking.

Public transport issues focused on safety and access to public transport facilities, public transport to Flinders Medical Centre generally, integration with pedestrian and cycle facilities, supporting facilities at stations such as car parking, and safe access to bus stops during construction. Public transport issues raised during the design development phase were also received.

4.3.6 Pedestrians and cyclists

Issues relating to pedestrian and cyclist access focused primarily on the provision of safe and convenient facilities along the road corridor as well as connections across the corridor and to nearby walking and cycling routes. Specific issues raised included:

- > Potential to improve cyclist and pedestrian access, facilities and safety during design
- > Improved and safer crossing facilities over the lowered motorway for pedestrians and cyclists including access into Flinders Drive

- > Pedestrian and cycling crossing facilities at Sutton Road/Mimosa Terrace
- > Safety for night workers particularly nurses accessing vehicles during construction
- > Minimal stoppages through intersections for cyclists
- > Safety measures for bridges where pedestrian access is permitted
- > Potential for improved pedestrian access over South Road at the Sturt River
- > Improvements to walking and cycling connections to adjacent Greenways including Tonsley, Sturt River Linear Park, Patrick Jonker Veloway and major local facilities such as the Flinders University and Medical Centre.

4.3.7 Procurement, scope and timing of the project

Questions about the scope of the project, who would be awarded the project construction, the procurement process generally, construction starting and completion dates, and asset management and ownership post construction were received.

4.4 Ongoing engagement

Engaging with the community and key stakeholders is a fundamental component of the Darlington Upgrade Project and a Stakeholder and Community Engagement Management Plan will be prepared to determine and define a process for engagement throughout the detailed design and construction of the project.

Various mechanisms and opportunities for involvement will be provided through each stage of the project including, but not limited to: project enquiry line, project mailbox, website, community open days, project displays, presentations, community drop-in facility at project office, meetings and direct engagement with stakeholders and affected property owners.

North-South Corridor Darlington Upgrade Project Project Assessment Report



Part B

Project description

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5 Detailed project description

5.1 Key project features

The project will upgrade approximately 3.3 kilometres of the existing Main South Road in the suburbs of Darlington, Bedford Park, St Marys and Clovelly Park, including:

- > A non-stop motorway between the Southern Expressway and Tonsley Boulevard
- > A lowered, non-stop motorway passing underneath Flinders Drive, Sturt Road, Sutton Road/Mimosa Terrace and Tonsley Boulevard
- > Grade separation of the Main South Road/Ayliffes Road/Shepherds Hill Road intersection
- > Main South Road (at grade) service roads along both sides of the lowered motorway to provide connections to Flinders Drive, Sturt Road and most local roads
- > Full free flow interchange at the Southern Expressway/Main South Road with dedicated ramps providing direct access to the new motorway and Main South Road.
- > Ground-level connections between Shepherds Hill Road and Ayliffes Road and the Main South Road surface roads, to provide access to hills residents travelling north and east
- > The extension of Flinders Drive through the Laffers Triangle to Sturt Road, connecting with Birch Crescent via a signalised intersection
- > Overall improved performance due to the provision of access to the non-stop dedicated, two-way cycling paths and footpaths along both sides of the road where possible, connecting with the existing pedestrian and cyclist network
- > Pedestrian and cyclist paths located on bridge connections over the lowered motorway to improve ease of access and connectivity between key land uses
- > Enhanced motorway for north-bound traffic on Main South Road
- > Implementation of Intelligent Transport Systems to assist with traffic management and inform road users of travel conditions
- > Left and right turn in and out of Brookside Road will be maintained on Main South Road at Darlington via a signalised intersection heading north.

Figures 7 to 9 show the sections of the Darlington Upgrade Project.

It should be noted that this project description provides an overview of key design elements at the concept planning stage and are all subject to detailed design. For this reason, design details contained in the following sections are subject to change.

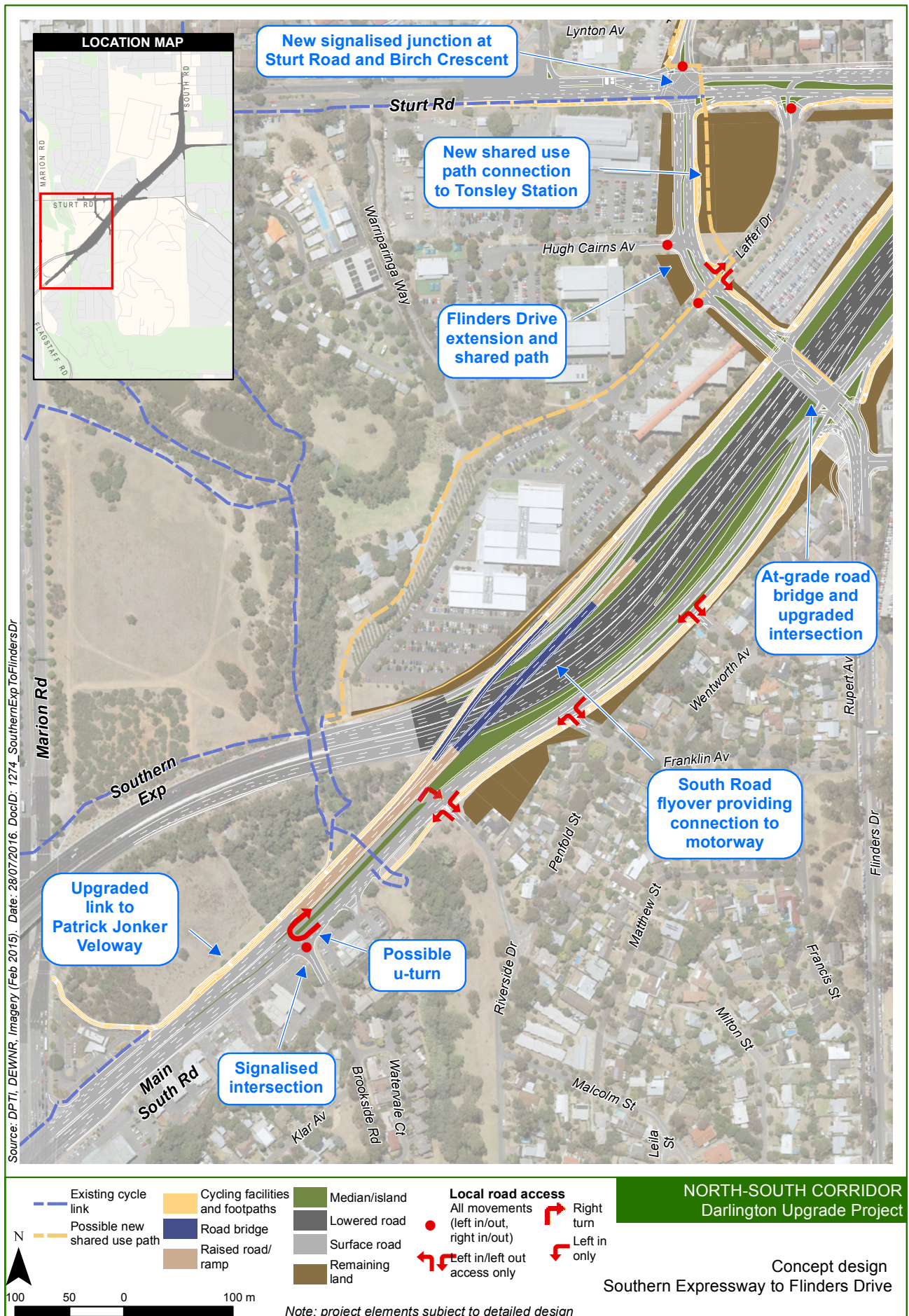


Figure 7 - Darlington Upgrade Project – Southern Expressway to Flinders Drive

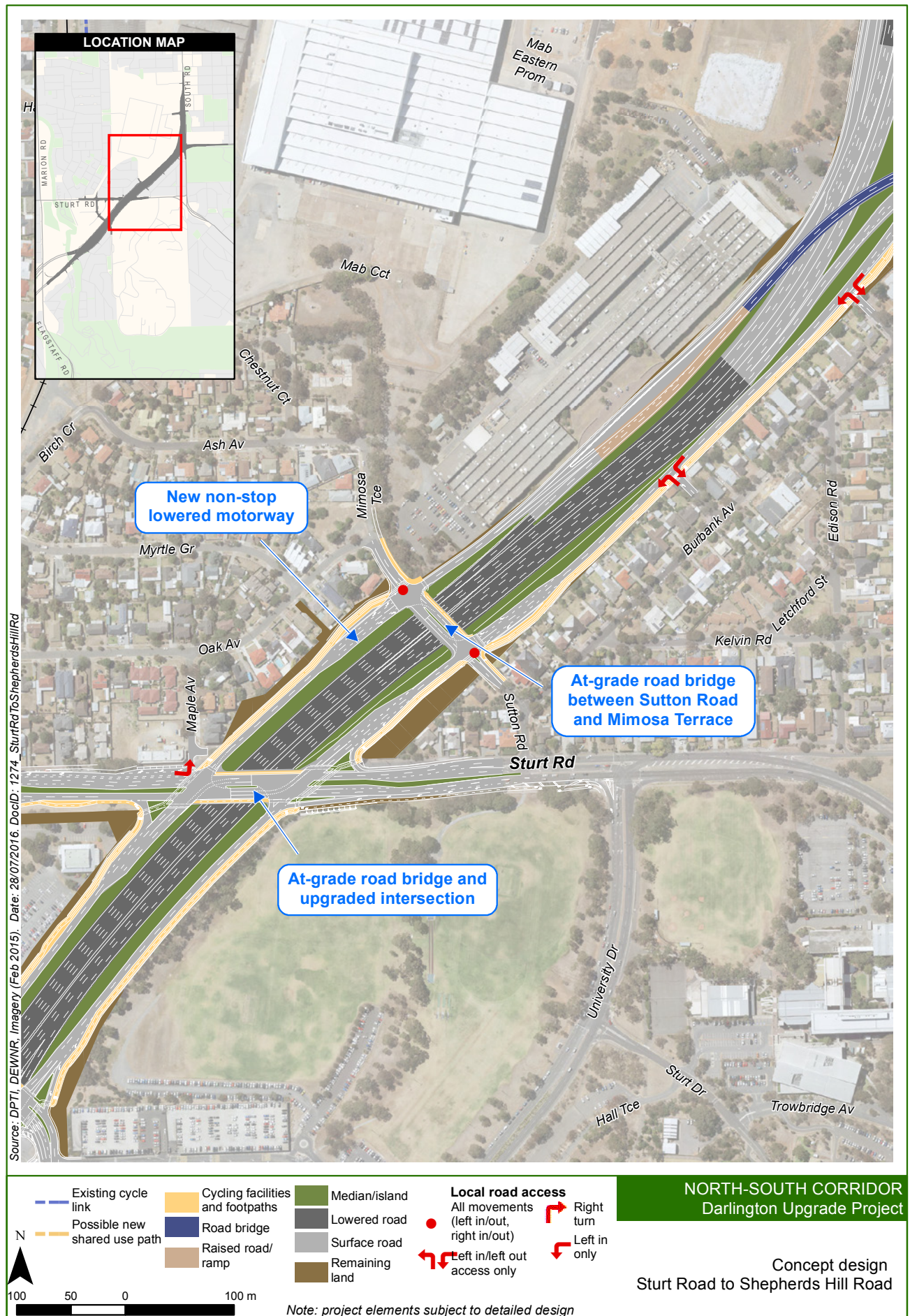


Figure 8 - Darlington Upgrade Project – Sturt Road to Shepherds Hill Road

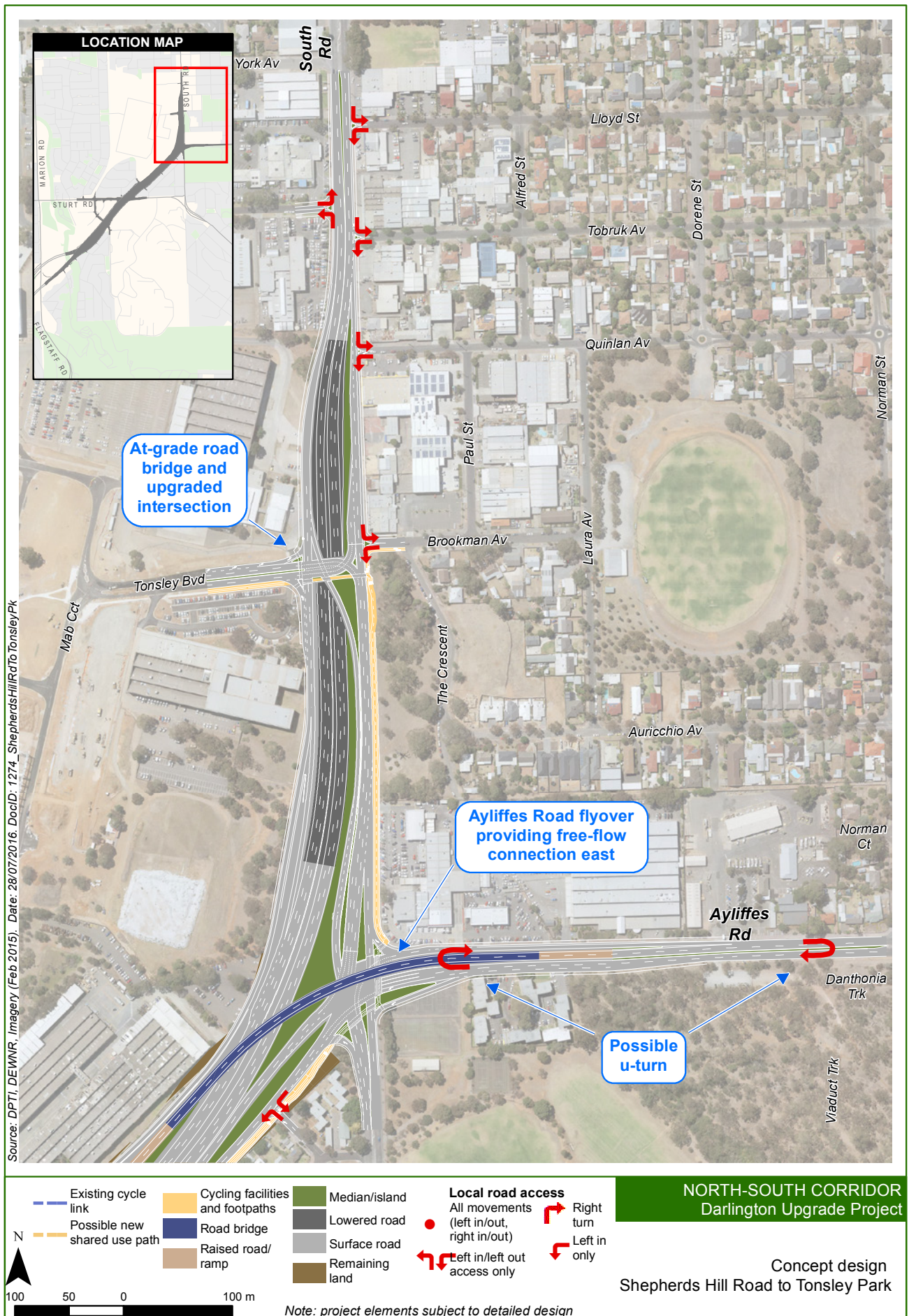


Figure 9 - Darlington Upgrade Project – Shepherds Hill Road to Tonsley Park

5.2 Non-stop motorway

The non-stop motorway will extend 3.3 kilometres and provide non-stop access between the Southern Expressway and just north of Tonsley Boulevard. The motorway will connect to the existing southern end of the Southern Expressway via a free-flow interchange underneath Main South Road. At the northern end, the motorway will connect into the existing Main South Road between Tonsley Boulevard and York Avenue, Clovelly Park.

The majority of the motorway will be lowered in a cutting with a maximum depth of approximately eight metres under the bridge structures along its length. At the connection with the existing intersection of the Southern Expressway and Main South Road, the motorway will start to descend below ground level and continue underneath the Main South Road bridge, Flinders Drive bridge, Sturt Road bridge, and the Sutton Road/Mimosa Terrace bridge before rising to ground level again opposite the Monroe site.

The motorway will then continue at ground level to north of the Ayliffes Road intersection opposite the Adrian Brien car dealership where it will descend again to go underneath the intersection of Tonsley Boulevard. The motorway will then rise to ground level once more to connect with the existing Main South Road pavement around Quinlan Avenue. Retaining walls will be provided next to the lowered road sections in the cut.

Once complete, the non-stop motorway will:

- > Provide non-stop travel through this section of road
- > Avoid five sets of traffic lights southbound and four sets of traffic lights northbound on the North-South Corridor
- > Allow non-stop access via the motorway for the majority of traffic wanting to pass through the local area
- > Enable local traffic to use the Main South Road surface roads.

Although subject to change through the detailed design process, Figure 10 shows an artist's impression of the non-stop motorway, including the Flinders Link Project.



Figure 10 - Artist's impression of the non-stop motorway including the Flinders Link Project

5.3 Surface Roads and local access

5.3.1 Surface roads

Surface roads will be provided on both sides of the lowered motorway to provide connections to the local road network and surrounding land uses and the speed limit will be posted at 60 km/h. Typical surface roads will extend the full length of the project between the existing intersection of Main South Road and the Southern Expressway to Quinlan Avenue, St Marys. At this point, the motorway will match into the existing Main South Road. The surface roads will generally be two lanes in width at ground level to provide an accessible and human-scale street environment.

A surface road will also extend along Ayliffes Road either side of a flyover connecting the northbound surface lane to Ayliffes Road, thus providing non-stop access between Main South Road and Ayliffes Road heading north and east. The Main South Road surface roads on each side of the non-stop motorway will provide the main access for the local community via side roads and access to the lowered motorway at a number of locations. The northbound surface lane will provide access to Clovelly Park and Sturt Triangle, whilst the southbound surface lane provides access to Darlington, Bedford Park and St Marys.

5.3.2 Local access

Darlington

At Darlington, left and right turns in and out of Brookside Road will be maintained on Main South Road via a signalised intersection, and u-turn movements for Bedford Park (south) motorists travelling north. Pedestrians crossing Main South Road will need to do so at the Sturt River underpass.

Bedford Park (south)

At Bedford Park (south), 'left in, left out' access off the Main South Road southbound surface road will be provided at Franklin Avenue and Riverside Drive and possibly Richard Street. An additional 'right in' turn will be available into Riverside Drive from Main South Road coming from the south (refer Figure 7).

The City of Mitcham is working on the proposed new exit point from Wentworth Avenue to Flinders Drive, to allow northbound access from Bedford Park (south). Traffic modelling is being undertaken to better understand the impacts of the proposal and determine the best traffic solution for the area.

Bedford Park (north)

At Bedford Park (north), 'left in, left out' access will be provided to Lincoln Road and Maidstone Road onto the southbound Main South Road surface road. Access via Sutton Road will be provided to Mimosa Terrace via a bridge over the lowered motorway. This will provide for all movements onto and off the surface roads (refer Figure 8).

Clovelly Park

At Clovelly Park, 'left in, left out' access will be provided at Selgar Avenue and 'left in' at Maple Avenue. At Tonsley Boulevard, a full range of traffic movements will be provided with traffic lights to allow access into the Tonsley Park development from the Main South Road surface roads and the motorway. At Mimosa Terrace, vehicles will be able to turn into Clovelly Park from the Main South Road surface roads and Sutton Road (refer Figure 9). This is subject to further design development.

St Marys

At St Marys, the southbound Main South Road surface lane will provide access via 'left in, left out' arrangements at Lloyd Street, Tobruk Avenue, Quinlan Avenue and Brookman Avenue. From the extension of the surface roads to Ayliffes Road, 'left in, left out' access will be provided to the car dealership and adjoining offices and the residential flat buildings on the south side of Ayliffes Road (refer Figure 9). This is subject to further design development.

5.4 Flinders Drive extension

Flinders Drive will be extended over the lowered motorway into the Sturt Triangle and connect to Sturt Road next to the Sturt Police Station. This will provide improved access from Clovelly Park and Mitchell Park to the hospitals and university. The extended road will form a signalised intersection with Birch Crescent and will incorporate paths along its length for pedestrians and cyclists.

5.5 Main intersections and bridges

5.5.1 Tonsley Boulevard

Tonsley Boulevard will provide the main entry and exit to the Tonsley Park redevelopment and a signalised intersection will provide access to the Main South Road surface roads with “left in”, “right in”, “left out”, and “right out” turns (see Figure 9).

5.5.2 Shepherds Hill Road/Main South Road/Ayliffes Road

The intersection of Shepherds Hill Road, Ayliffes Road and the Main South Road southbound surface road will be provided at ground level and separated from the lowered motorway. Access from Shepherds Hill Road will be provided to Ayliffes Road via a right hand turn lane under the Ayliffes Road flyover. Access will also be provided from Shepherds Hill Road to the Main South Road surface roads and the motorway via the intersection at Flinders Drive.

Access from Ayliffes Road to Shepherds Hill Road and the Main South Road southbound surface road will be provided. Access from the Main South Road northbound surface lane and the motorway to Ayliffes Road from the south will be provided via a flyover elevated above the motorway and the intersection of Main South Road and Shepherds Hill Road (see Figure 9).

5.5.3 Sutton Road/Mimosa Terrace

A ground level bridge will be constructed over the lowered motorway to provide a more direct connection for motorists, pedestrians and cyclists between Clovelly Park and Bedford Park (north) and facilitate better future connections between Flinders University and the Tonsley Park redevelopment. The bridge will also provide access to the northbound and southbound Main South Road surface roads (see Figure 8).

5.5.4 Sturt Road

The Sturt Road intersection with Main South Road will incorporate a bridge at ground level over the lowered motorway with connections to both the southbound and northbound Main South Road surface roads. The intersection will be aligned to retain on-street parking in front of Sturt Road businesses and a left turn into Maple Avenue. Figure 11 gives an impression of the Sturt Road intersection and bridge.

5.5.5 Flinders Drive

At the intersection of Flinders Drive and Main South Road, access will be provided to the northbound and southbound Main South Road surface roads from Flinders Drive. Access to the lowered motorway will be provided from Flinders Drive to head south, and access from the lowered motorway onto Flinders Drive will be provided from the north. Figure 12 gives an impression of the Flinders Drive intersection and bridge.



Figure 11 - Artist's impression of Sturt Road intersection and bridge



Figure 12 - Artist's impression of Flinders Drive intersection and bridge



Figure 13 - Artist's impression of Main South Road bridge over the Southern Expressway

5.5.6 Southern Expressway and Main South Road connection

The connection to the Southern Expressway will be free flowing from the non-stop motorway connecting to the existing pavement just south of the existing intersection of Main South Road and the Southern Expressway.

Main South Road will connect to the non-stop motorway via a bridge, which will pass over the lowered motorway before descending to match into the northbound lanes of the motorway. A second bridge will connect Main South Road and will pass over the non-stop motorway before descending to match in with the northbound Main South Road surface road. Figure 13 gives an artists impression of the Main South Road bridge over the Southern Expressway.

5.5.7 Sturt River

The Sturt River currently passes under Main South Road and the Southern Expressway. These underpasses also provide pedestrian and cyclist access between Darlington and Bedford Park (south), and Warriparinga.

The bridges that pass over the Southern Expressway and connect to Main South Road will start to elevate just south of Sturt River which will require the reconstruction

of one of the bridges over the river in the form of a new culvert under the northbound lanes. The existing bridge structure under the southbound lanes will remain.

5.6 Marion Road and Sturt Road intersection

As part of the project, the intersection of Marion Road and Sturt Road (see Figure 14) has been upgraded to manage the anticipated redistribution of traffic during construction. The improvements have been undertaken within the existing road corridor and consist of:

- > An additional right turn lane on the eastern approach of Sturt Road and extending the existing right turn lanes
- > Changes to the lane layout on the western approach of Sturt Road to include two right-turn lanes, two through lanes and one left turn lane
- > Extending the left and right turn lanes on the southern approach of Marion Road
- > Relocating bus stop 29A (north) on the eastern approach of Sturt Road approximately 170 metres to the east.

These changes have reduced the delays for all traffic at the intersection and have boosted its capacity.



Figure 14 – Upgraded intersection of Marion Road and Sturt Road

5.7 Pedestrian and cycling facilities

A separated, two-way cycling path and dedicated footpaths will be provided along both sides of the corridor where space allows, enhancing linkages for pedestrians and cyclists accessing services, facilities and public transport as well as providing for cyclist commuters travelling through the area. The dedicated cyclist paths will connect to the Patrick Jonker Veloway and provide for connection to the proposed Greenway adjacent to the Tonsley Rail line.

The extension of Flinders Drive will also incorporate a dedicated pedestrian and bicycle path linking Clovelly Park and Mitchell Park to the hospitals and university at Bedford Park. In addition, the new connection at Mimosa Terrace and Sutton Road will incorporate new cyclist and pedestrian paths on the bridge to improve connections between the Tonsley Park development and the hospitals and university at Bedford Park.

The safety of pedestrians and cyclists crossing the lowered motorway will be enhanced by the provision of dedicated paths at the intersections of Flinders Drive, Sturt Road, Sutton Road/Mimosa Terrace and Tonsley Boulevard.

The details of shared use paths, footpaths and dedicated cyclist links will be refined during the detailed design phase taking into account desired lines of travel, required links between services and facilities and access to public transport.

5.8 Urban design and landscaping

5.8.1 Landscape and urban design framework

Landscape and urban design is an integral part of the development of the project design and aims to recognise not only those using the road network but also those who live within its vicinity.

The landscape and urban design framework for the project aligns with the wider North-South Corridor Urban Design framework and considers:

- > Landscape character and the enhancement of the unique natural qualities of the surrounding environment
- > Minimisation of disturbance to areas of high conservation value, and protection and enhancement of biodiversity

- > Integrating existing and new pedestrian/shared use paths with the landscape
- > Retention of views and incorporation of crime prevention through design principles
- > Incorporation of natural features and low maintenance treatments to improve the amenity of the local environment along the corridor.

The landscape and urban design for the project will seek to create a complementary and engaging experience for both road users and the adjacent community. The design will provide consistent, adaptable and distinctive themes working together to generate an integrated and holistic design solution. This will be further developed during the detailed design phase of the project.

5.8.2 Urban design elements

Every element of the project will be designed to ensure consistency with the urban design principles. The architectural character and detailing of structural elements such as bridge parapets and abutments, retaining walls, noise barriers, visual screens and fencing will all be considered. Street furniture including gantries, light poles, railings and safety barriers will be designed where possible to provide an integrated design solution.

Figures 15 and 16, Southern Expressway Flyover and Flinders Drive Bridge, show examples of these treatments.

A palette of materials, colours and surface finishes will be developed to provide an integrated aesthetic appearance and to ensure that this project complements the urban design elements of projects that have already been completed along the North-South Corridor. The finishes and materials will also be selected based on ease of access and ongoing maintenance liabilities, their durability and their resistance to vandalism.

The palette of materials will incorporate:

- > A range of hard materials including paving and concrete effects for paths and other surfaces
- > A mixture of indigenous and non-indigenous trees to provide colour, visual impact and shade
- > A variety of shrubs and groundcovers
- > Groundcovers for batter slopes and erosion control.



Figure 15 – Artist's impression of Southern Expressway Flyover. (Vegetation shown at maturity)



Figure 16 – Artist's impression of Flinders Drive Bridge. (Vegetation shown at maturity)

5.8.3 Landscape design elements

Planting along the road verge will include a mix of indigenous, native and non-native trees, shrubs, groundcovers and grasses with a consistent planting palette along the length of the corridor to maintain a cohesive, continuous environment. Unless specified otherwise, the landscape will generally be designed to be low maintenance and meet crime prevention standards through environmental design principles. The Darlington precinct contains some impressive open space assets that contribute greatly to the character of the precinct. Design of the landscape will seek to preserve and build upon this legacy by retention of mature trees where possible, and development of a planting scheme that is complementary to existing open space assets. (See Figure 17.)

In some of the land remaining on completion of the project, small parks may be established along the corridor, creating open space for the community. Further discussions are required with the local councils to determine potential opportunities for the design, location and custodianship of these parks.

The principle of linkage and connectivity will drive the landscape design process. The use of roadside vegetation and the potential development of vegetated bio-retention planters will be investigated to allow for the open space areas in both the north and south to be linked by vegetated corridors both at the ground level and canopy level over time. The design will investigate the creation of vegetated “green” edges that serve a multitude of purposes and provide for greater vegetative biodiversity along the corridor, in turn creating habitat linkages for native fauna, providing for a habitat corridor at both the ground level and canopy level for native fauna to move along thereby increasing both habitat area and biodiversity. Landscaping will also focus on reducing the heat island effect of hard infrastructure, addressing solar access and microclimate effects and applying Water Sensitive Urban Design principles to manage run off and improve water quality.

5.8.4 Fencing, lighting, screens and walls

The project will incorporate fencing, lighting, screens and walls in specific locations for security, access control and safety. Proposed locations include the top of embankments and on structures, including throw screens and crash barriers. Noise attenuation walls next to residential properties adjoining the road environment will also be considered where necessary.

The design of these features, including colour, material selection, heights and placement will be carefully considered and incorporated into the detailed design phase of the project.

5.9 Stormwater, drainage and water quality

The project will incorporate various stormwater, drainage and water quality elements to ensure that it does not adversely impact on the capacity of adjoining stormwater systems and the quality of water entering the Sturt River.

Drainage elements will be subject to detailed design and may potentially include:

- > A gravity drain through the lowered motorway to discharge to the Sturt River
- > Maintenance of existing stormwater infrastructure along Sturt Road with minor extensions to the existing pipe network
- > Minor drainage improvements along the Main South Road surface road, Flinders Drive, Flinders Drive extension and other local roads.



Figure 17 - Landscape artist's impression looking south. (Vegetation shown at maturity)

6 Employment, industry and workforce participation

The estimate of direct full-time equivalent jobs supported by the Darlington Upgrade Project is approximately 370 per year during major construction. The size and composition of the construction workforce will vary depending on the location and construction activities at any given time and is likely to include:

- > project managers
- > designers
- > construction management staff
- > equipment and plant operators
- > formworkers
- > steel fixers
- > concreters
- > labourers
- > tradespersons
- > truck drivers.

6.1 Industry Participation Policy

The State Government's Industry Participation Advocate works to generate as much economic benefit to the state as possible from infrastructure projects, and DPTI, with assistance from the Office of the Industry Advocate, is committed to ensuring local businesses are given full, fair and reasonable opportunity to be considered for major works being undertaken in South Australia. This commitment is outlined in the South Australian Industry Participation Policy (SAIPP). DPTI's commitment against the SAIPP is monitored by the Industry Participation Advocate who oversees to ensure that our projects deliver on their targets. This includes:

- > Assisting tenderers to develop South Australian Industry Participation Plans by providing information about local supplier capability
- > Providing assistance to responsible government agencies where required to determine compliance with the Industry Participation Policy and, when relevant, to assist in the evaluation and scoring of Industry Participation Plans
- > Providing industry capability information to responsible government agencies, tenderers and contractors
- > Promoting awareness of the Industry Participation Policy to government agencies and private sector proponents
- > Annually reporting to Cabinet on Industry Participation Policy outcomes.

Given the Darlington Upgrade Project has a contract value of over \$50 million (\$620 million), the mandatory completion of a tailored Industry Participation Plan will:

- > Promote economic contribution to the state including for employment outcomes and economic growth
- > Provide full, fair and reasonable opportunity to identify products and capabilities of local small and medium enterprises
- > Include a level of capital investment
- > Commit to work with the Office of the Industry Advocate throughout delivery of the project to maximise local industry participation
- > Identify any additional business undertakings that promote South Australian economic growth, such as value added research, training programs and skills transfer; and an increased level of commitment to a South Australian business presence.

Further details about the Industry Participation Policy can be found at the Office for Industry Advocate website at <http://www.dpc.sa.gov.au/office-industry-advocate>.

6.2 Workforce participation in government construction procurement

All project procurement will be in accordance with the South Australian Government's Management Framework and will comply with the Australian and South Australian governments' joint guidelines for the application of the National Code of Practice with the construction industry for construction projects on the national network.

The project will be delivered in accordance with the South Australian Government's policy for workforce participation, which ensures increased employment opportunities for Aboriginal and Torres Strait Islander peoples, trainees, apprentices, local persons with barriers to employment and the up-skilling of people involved in civil construction contracts in South Australia.

The State Government is committed to ensuring local South Australian businesses benefit from the construction of the project.

In summary, the code requires government agencies to:

- > Inform tenderers and contractors for building and civil works over the relevant thresholds of the requirement to allocate 15% of labour hours to the employment and up-skilling of target groups
- > Place information about the policy in all tender documentation and a binding set of clauses from the Workforce Participation in Government Construction Procurement Guidelines in the contract documentation, for contracts covered by the code
- > Monitor contractor performance against the 15% target
- > Assist contractors if non-compliance becomes evident.

The code requires contractors to:

- > Agree to meet the 15% target within the relevant tiers
- > Provide a Workforce Participation and Skills Development Plan (Tier 1) or Strategy (Tier 2)
- > Provide information on the number of hours worked on-site by workers from the target groups at quarterly intervals throughout the contract and on completion of the contract
- > Nominate a person responsible for the coordination of employment and training required under this policy in the case of Tier 2 contracts.

6.3 Industry Participation Management Plan

Gateway South is committed to meeting its targets in the South Australian Industry Participation Policy and will provide full, fair and reasonable opportunities for industry to participate in the Darlington Upgrade Project and ensure the project supports and maximises economic and employment outcomes for South Australia. Some of the key strategies that will feature in the Industry Participation Management Plan will include:

- > Ensuring local supply-chain 'friendly' design with package sizes tailored where possible to maximise accessibility for local suppliers
- > Investigating locally available solutions to non-standard design requirements
- > Using performance specifications rather than brand names to enable the local supply chain to offer compliant options and alternatives
- > Maintaining industry awareness via the Industry Capability Network (ICN) web portal
- > Understanding local supply chain construction and manufacturing capability
- > Providing support and feedback to unsuccessful tenderers.

7 Construction approach and activities

7.1 Construction and traffic management approach

A feature of Gateway South's approach to construction management is to minimise the impacts to the community and manage the entire project with the least number of traffic changes.

This will enable a high degree of certainty and reliability for road users throughout construction, which in turn will improve safety and maximise road performance.

A goal of the staging plan is the minimisation of impacts on travel times during construction, ensuring that the existing travel times for the 73 000 vehicles per day travelling through the project work site are maintained wherever possible. This will ensure that impacts on traffic is minimised during construction.

The considerations for the management of traffic during construction are to:

- > Maintain four through lanes in each direction of Main South Road where the existing intersections are not grade separated during peak periods
- > Maintain a minimum of two lanes on either Main South Road or Southern Expressway where traffic is free flowing
- > Maintain unimpeded access 24 hours, 7 days per week to the Flinders Medical Centre for emergency services as well as for the general public
- > Maintain the existing number of lanes on northbound Southern Expressway (4 lanes), and southbound Southern Expressway (3 lanes), until the intersection is grade separated
- > Maintain the existing number of through lanes on the cross roads until the intersections are grade separated
- > Maintain the existing storage lengths for turn movements at intersections until intersections are grade separated.

Emergency service access will be maintained at all times to the Flinders Medical Centre. Liaison with emergency services will be part of the detailed design and will be maintained throughout construction to minimise the potential for disruptions and delays. Additionally, during some construction stages, changes to existing bus routes and stops may be necessary. Gateway South will prepare a Traffic Management Plan to ensure:

- > Minimal traffic delays and traffic issues
- > The safety of road users and construction traffic

- > Active monitoring of traffic impacts related to the construction works
- > Provision of access to adjoining properties throughout the works
- > Vehicular, cyclist and pedestrian traffic safety.

The primary objective of the Traffic Management Plan throughout the design and construct phase of the works is to promote the continuous, safe and efficient movement of people and goods through the project corridor. The Traffic Management Plan and sub-plans to be developed will:

- > Ensure the project establishes and maintains best practice to manage traffic, including cyclists and pedestrians during the design and construction phase of the project
- > Ensure that a safe environment for road users, local residents and adjacent businesses and construction personnel is maintained at all times
- > Ensure that road users experience minimal disruptions during the construction period
- > Provide a mechanism for communicating potential disruptions to the public and other stakeholders, in a timely, accurate and credible manner
- > Minimise impacts on directly adjacent and nearby businesses and ensure safe and efficient access for workers, customers and deliveries
- > Avoid traffic congestion, delays or disruptions to public transport, and cyclist and pedestrian paths through diligent planning and construction of proposed works to ensure the existing level of service requirements are satisfied
- > Actively monitor traffic impacts related to the construction works
- > Maximise the value and outcomes of traffic monitoring activities so that the information can be applied to the planning and implementation of traffic control plans
- > Ensure compliance with relevant specifications.

7.2 Construction scheduling

7.2.1 Overview of construction schedule

Construction of the project is anticipated to be completed by the end of 2018. Detailed construction methodology and staging information is being finalised as part of the final design phase of the project by Gateway South in consultation with DPTI. This information will consider all elements of the project including the design, local access requirements, traffic management, construction staging and utility service relocation. The different components of construction and associated indicative timeframes are provided in Table 6.

Gateway South will prepare a detailed construction staging plan prior to the commencement of construction. It is anticipated that the staging plan will incorporate several stages within five geographical zones as outlined in Table 7.

Works will also be undertaken across the length of the project as well as on the Southern Expressway to implement Intelligent Transportation System works including cabling, cameras and signs. In addition, finishing works will complete the project including landscaping, final asphalt surface, permanent linemarking and signage as well as the construction and installation of urban design elements.

Component	Activity
Late 2015-early 2016	
Pre-construction	<ul style="list-style-type: none"> > Complete investigations, planning and design works > Procurement > Establish construction contracts > Develop Environmental Management Plans > Obtain licences and approvals > Undertake network upgrades to surrounding roads / intersections > Undergo property acquisition and property adjustments
Site establishment	<ul style="list-style-type: none"> > Site set out > Set up site compounds/storage sites > Establish environmental controls
Early-mid 2016	
Relocate Utility Services	<ul style="list-style-type: none"> > Telstra > Water and sewer mains > Gas mains > SA Power Networks (underground and overhead power) > Other communication services
Site preparation & early works	<ul style="list-style-type: none"> > Clearing and grubbing > Demolition > Stripping of topsoil, spoil and unsuitable material > Construction access > Commencement of early utility services works
End of 2016 - End 2018	
Temporary works for construction - traffic management	<ul style="list-style-type: none"> > Earthworks > Road pavements > Line marking > Lighting > Traffic signals > Road barriers
Structures	<ul style="list-style-type: none"> > Retaining walls and bridge / underpass structures > Piling > Superstructure (beams) > Barriers
Bulk earthworks	<ul style="list-style-type: none"> > Excavation of lowered road sections
Drainage	<ul style="list-style-type: none"> > Swales > Stormwater culverts, pits and pipes > Permanent detention basins
Other works	<ul style="list-style-type: none"> > Pavement construction > Noise walls/treatments > Safety barriers > Street lighting > Traffic signals > Line marking and signs > Landscaping
Finishing works	<ul style="list-style-type: none"> > Remove temporary works > Remove site compounds/storage sites > Restore and landscape temporary sites

Table 6 - Construction overview. (May be subject to change)

Zone	Stages
Zone 1: South of Flinders Drive	<ul style="list-style-type: none"> > Construct temporary pavement on the eastern and western boundaries of the existing Main South Road carriageway, between Flinders Drive and the Southern Expressway > Realign traffic onto temporary pavement/existing surface road > Construct retaining wall embankments and Sturt River culvert > Construct southbound entry and exit ramps along the eastern boundary > Construct Main South Road structures over Southern Expressway and embankments > Excavate lowered motorway and construct drainage and pavement
Zone 2: Flinders Drive to Sturt Road	<ul style="list-style-type: none"> > Construct northbound surface road (western boundary) > Realign traffic to northbound surface road and then realign the southbound traffic onto the existing northbound carriageway > Construct temporary signalised roundabout at Sturt Road to allow for construction of bridge > Construct northern section of Flinders Drive bridge > Move Flinders Drive traffic to the north to allow construction of southern section of Flinders Drive bridge > Construct Sturt Road bridge > Excavate lowered motorway and construct drainage and pavement > Remove temporary pavements
Zone 3: Sturt Road to Ayliffes Road	<ul style="list-style-type: none"> > Construct northbound surface road (western boundary) and southbound surface road (eastern boundary) including temporary widening to accommodate traffic volumes during construction > Realign traffic onto northbound and southbound surface roads > Temporarily widen Ayliffes Road to accommodate traffic volumes during construction > Excavate lowered motorway and construct drainage and pavement > Construct Ayliffes Road flyover and embankment > Construct bridge at Sutton Road/Mimosa Terrace > Remove temporary widenings on Ayliffes Road and any other temporary works and reinstate
Zone 4: Ayliffes Road to Tonsley Boulevard	<ul style="list-style-type: none"> > Construct northbound surface road (western boundary) and southbound surface road (eastern boundary) including temporary widening to facilitate access to Tonsley during bridge construction > Construct drainage works and modifications > Realign traffic to surface road along the eastern and western boundaries > Construct Tonsley Boulevard bridge > Excavate lowered motorway and construct drainage and pavement

Table 7 - Indicative stages by zone subject to detailed design

7.3 Utility service relocations

Utility services will be impacted in numerous locations along the extent of the project site. Services to be impacted include:

- > SA Power Networks: relocation of overhead and underground 11 kV and low voltage lines
- > SA Water: relocation of large diameter water mains and sewer infrastructure
- > Telstra: relocation of transmission and distribution feeds into the adjacent local roads and in common service trenches along South Road, and crossing where necessary
- > Gas: relocation of transmission and distribution pipes into the adjacent local roads and in common service trenches along South Road
- > Relocation of various other communication services

Site investigation works, including over 2 000 depthing pot-holes were completed in mid-2015. The data will be used to develop a 3D model to be used as part of the design process to protect against service strike during construction and service design interface with structures/roads.

DPTI has been working closely with service authorities to develop the design for relocation works and onsite works started in late 2015 and will progress into 2016. Where possible utility services will be relocated to local roads as early works to facilitate the timely construction of the new non-stop motorway.

Approximately 4.8 kilometres of existing trunk water mains located under South Road will be relocated to the eastern extent of the project site, including under the surface arterial road adjacent Flinders Oval, between Sturt Road and Flinders Drive. Works to 'cut-over' the water supply to the new water mains will be undertaken in collaboration with SA Water during the winter months to ensure the work does not disrupt services during peak demand periods.

Early and enabling works to assist with utility service relocations, traffic management and access during construction will include:

- > Property demolition
- > Vegetation removal
- > Temporary fencing works
- > Local access modifications.

DPTI is co-ordinating the works of multiple separate contractors and service authorities.

The Darlington Upgrade Project team will continue to work closely with service authorities delivering essential utility services to surrounding community facilities to ensure appropriate design and construction management is put in place to avoid any disturbance.

7.4 Site compounds

Gateway South has established a site compound to accommodate the construction workforce for the project and ensure the safety and security of offices, amenities, cars, workshops, storage of material, plant and equipment, and facilities to service and repair vehicles and equipment. The compound is located on the corner of Laffer Drive and Sturt Road adjacent the Sturt Police Station. Several smaller compounds along the length of the project will also be required as the project progresses. Each compound will be fenced, lit at night and monitored by security services. Locations of additional site compounds will be identified as construction progresses as required.

7.5 Anticipated plant and equipment

The plant and equipment likely to be used during construction will be subject to refinement during the detailed design phase but is anticipated to include the equipment set out in Table 8.

7.6 Construction hours

Construction hours for large infrastructure projects are typically Monday to Saturday during daylight hours but may include night works depending on the activities involved. Night works and weekend works, which may also include Sundays, may be used during periods of lower traffic volumes.

Any night works will be undertaken in accordance with *DPTI's Operational Instruction 21.7: Management of Noise and Vibration: Construction and Maintenance Activities*, through the development of a night works management plan to minimise disturbance to the local community.

Advance community notification will be provided prior to any night works commencing.

7.7 Health and safety

Gateway South will prepare a Work, Health and Safety Management Plan to ensure the project conforms to all statutory and contractual requirements. Gateway South's Work, Health and Safety Framework will use a number of approaches to identify hazards and manage risks including:

- > The development of a 'Safety in Design' plan
- > The use of digital engineering models to identify and demonstrate key risks areas

- > The development of a risk management plan that will clearly define roles and accountabilities across all levels of the project.

The implementation of the Work, Health and Safety Management Plan will clearly define the process and controls necessary to manage risk during construction and operation. Some of the key risks applicable to stakeholders will be:

- > Fencing and security measures for no-go zones, hazardous areas, Vegetation Protection Zones, work areas and access points, storage areas and site compounds
- > Signage to indicate changed road conditions and location of emergency facilities
- > Fencing, hoardings, barriers or bunting around the work site as necessary
- > Clear advertising of emergency contact numbers
- > Clear delineation of work areas in the vicinity of where public or pedestrian access is likely
- > Provision of privacy screens to minimise motorist distraction
- > Provision of safe pedestrian access around the construction areas including the establishment and maintenance of appropriate foot and bicycle surfaces
- > Education of the public regarding the works and potential hazards.

Activities	Plant and equipment	
Construction work sites	Light vehicles	Bulldozers
Services relocation	Fuel storage tanks	Scrapers
Structures	Concrete and asphalt batch plants	Graders
Earthworks	Crushing plants	Water carts
Structural pavement	Trucks, cranes and excavators	Vibratory rollers
Other road works	Elevated platform vehicle	Drilling equipment
	Backhoes	Piling rigs
	Trenchers	Concrete pavers
	Small equipment	Concrete curing equipment
	Piling rigs	Concrete saws
	Concrete pumps	Asphalt pavers
	Bitumen sprayers	Rubber-tyred rollers

Table 8 - Anticipated plant and equipment to undertake the Darlington Upgrade Project

8 Infrastructure sustainability

8.1 Departmental commitment to sustainability

The Planning Strategy for South Australia provides the framework for land use development across the state. The Planning Strategy comprises *The 30-Year Plan for Greater Adelaide* and several regional volumes. The 30-Year Plan has a vision of creating a more compact city in the future to fulfil the overlapping objectives of liveability, competitiveness, sustainability and climate change resilience.

To demonstrate commitment to economic, social and environmental sustainability, DPTI is adopting the principles of the Infrastructure Sustainability Council of Australia (ISCA) and its Infrastructure Sustainability rating tool for projects undertaken within the North-South Corridor.

The Darlington Upgrade Project will use the Infrastructure Sustainability Council of Australia's (ISCA) Infrastructure Sustainability rating tool to set objectives and measure sustainability outcomes. This will be done in the context of DPTI's commitment to delivering more sustainable design, construction and operation of infrastructure across Adelaide and South Australia. DPTI's objectives for sustainability for the project are to:

- > Provide leadership and commitment in environmental management and sustainability
- > Consider environmental, social and economic aspects in the procurement process
- > Minimise energy consumption to reduce greenhouse gas emissions across the infrastructure lifecycle
- > Apply the principles of water conservation across the project's lifecycle
- > Minimise greenhouse gas emissions associated with the use of materials across the infrastructure lifecycle (including the use of sustainable alternatives where approved)
- > Protect water quality through incorporation of Water Sensitive Road Design elements and prevent pollution of surface, ground and marine waters
- > Protect noise sensitive receivers from rail and road traffic noise through incorporation of appropriate mitigation measures
- > Minimise the effect of vibration on sensitive structures and sensitive receivers
- > Minimise air quality emissions
- > Avoid mobilisation of contaminants and, where feasible, remediate contaminated land on the site
- > Apply the principles of the waste hierarchy (avoid, reduce, reuse and recycle) to maximise diversion of waste from landfill
- > Minimise the destruction and disturbance of regulated/significant trees and other amenity vegetation
- > Maintain and preserve existing areas of vegetation and protect fauna habitat
- > Enhance the amenity of the road corridor and surrounding areas with urban design and landscaping
- > Prevent disturbance to known Aboriginal heritage sites
- > Protect and conserve non-Aboriginal cultural heritage sites
- > Implement a community engagement strategy that proactively engages key stakeholders and the local community about the project and monitor their acceptance
- > Provide a quality urban design outcome that achieves a high standard of environmental sustainability
- > Ensure compliance with environmental legislation, regulations and approvals.

8.2 The Infrastructure Sustainability rating tool

The ISCA is a member-based industry association committed to the delivery of more sustainable outcomes from the design, construction and operation of Australia's infrastructure. The Infrastructure Sustainability rating scheme for infrastructure has been developed and is administered by the Infrastructure Sustainability Council of Australia. It is a comprehensive rating system for evaluating sustainability across planning, design, construction and operation of infrastructure.

The Infrastructure Sustainability rating scheme uses a rating tool that incorporates:

- > Infrastructure Sustainability rating tool scorecard
- > Infrastructure Sustainability Materials Calculator
- > Infrastructure Sustainability Technical Manual.

The Infrastructure Sustainability rating scheme covers the sustainability themes and categories shown in Table 9.

Themes	Categories
Management and governance	Management systems Procurement and purchasing Climate change adaptation
Using resources	Energy and carbon Water Materials
Emissions, pollution and waste	Discharges to air, land and water Land Waste
Ecology	Ecology
People and place	Community health, well-being and safety Heritage Stakeholder participation Urban and landscape design
Innovation	Innovation

Table 9 - Infrastructure Sustainability rating scheme themes and categories

8.3 Sustainability Management Plan

A Sustainability Management Plan will be prepared for the design and construction of the Darlington Upgrade Project to demonstrate how sustainability objectives will be implemented, provide details on how the Infrastructure Sustainability rating tool will be applied to the project and describe methods for managing and improving sustainability across the design and construction phases.

8.4 Infrastructure Sustainability rating process

Across the infrastructure lifecycle, there are a number of ways that the Infrastructure Sustainability rating scheme can be applied:

Infrastructure projects or assets can use the Infrastructure Sustainability rating tool as a performance management tool to integrate sustainability through registering, assessing and then verifying and certifying a rating through ISCA. Projects can be currently certified for Design, As Built and Operation ratings

ISCA encourages the use of the Infrastructure Sustainability rating tool to improve the sustainability of planning, design, construction and operation of all infrastructure projects and assets. Infrastructure Sustainability can be applied to assess the sustainability of all projects without registering and seeking verification

The Infrastructure Sustainability rating tool is also used as a sustainability framework and decision support tool for projects at the various stages of infrastructure planning to assist with integrating applied sustainability from business to case to project procurement stages.

8.5 Climate change adaptability

In 2015, DPTI adopted a Climate Change Adaptation Strategy, which commits the department to assessing and responding to future climate risks. DPTI's Climate Change Adaptation Planning Guidelines assists the implementation of the strategy by providing a process for incorporating adaptation into decision making and managing risks from climate change impacts to government infrastructure, including transport infrastructure.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) researches and monitors projected climate change across Australia, including Adelaide and publicises findings on the Climate Change in Australia website. Climate change projections for southern South Australia indicate that:

- > Average temperatures will continue to increase in all seasons with - high confidence
- > More hot days and warm spells are projected - very high confidence
- > Fewer frosts are projected - high confidence
- > A continuation of the trend of decreasing winter rainfall is projected - high confidence

- > Spring rainfall decreases are projected - high confidence
- > Rainfall changes in summer and autumn are unclear, although downscaling results suggest a continuation of the observed Autumn declines
- > Increased intensity of extreme rainfall events - high confidence.
- > Mean sea level will continue to rise and height of extreme sea-level events will also increase - very high confidence
- > A harsher fire-weather climate in the future - high confidence
- > On an annual and decadal basis, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years.

The projected changes to climate have been considered and incorporated into the design to maximise adaptation objectives over the life of the project. Table 10 summarises possible effects of climate change, and how they have been addressed in the design phase of the project.

Climate change impact	Potential planning and design-related considerations
Drier soil conditions as a result of increased temperatures, decreased rainfall and increased evaporation	Potential impacts of drier soil conditions on the design and retaining walls in particular will be considered during the detailed design phase Impacts of drier conditions on landscaping and in particular water sensitive urban design elements need to be considered during detailed design phase to ensure that they can function as designed
Increased peak flows for 100-year average recurrence interval (ARI) events as a result of increased intensity of extreme precipitation	Drainage design modelling will ensure that design caters for future 100-year flow events
Increased temperatures and more frequent heat waves	Incorporation of street trees and landscaping into the design to shade shared use paths will be considered as part of the landscaping plan during the detailed design phase

Table 10 - Possible effects of climate change and project response

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Part C

Effects and opportunities of the project

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9 Land use, visual amenity and landscape

9.1 Context

9.1.1 Assessment methodology

An assessment of the project's effects on land use, visual amenity and landscape has been undertaken using the following methodology:

- > A review of existing land ownership, governance, use and zoning
- > A visual and landscape assessment
- > Site surveys and investigations.

9.1.2 Relevant legislation, strategies and policies

The assessment has been undertaken in the context of several items of national and state legislation, strategies and policies including:

- > *National Urban Design Protocol, 2014*
- > *Development Act 1993*
- > *Marion (City) Development Plan consolidated 13 March 2014*
- > *Mitcham (City) Development Plan consolidated 13 February 2014*
- > *Onkaparinga (City) Development Plan consolidated 14 August 2014*
- > *Highways Act 1926*
- > *Land Acquisition Act 1969*
- > *Integrated Transport and Landuse Plan July 2015.*

9.2 Existing conditions

9.2.1 Land use and zoning

The study area extends into three local government areas: the Cities of Marion, Mitcham and Onkaparinga, and the suburbs of St Marys, Clovelly Park, Bedford Park and Darlington. Land uses within the precinct vary considerably and include residential areas and health, education, commercial, industrial and retail land uses located on both sides of Main South Road. The non-residential land uses are located predominantly along Main South Road and in the significant precincts of:

Flinders Precinct, including Flinders Medical Centre and Flinders Private Hospital, Flinders University and a number of supporting health services

Sturt Triangle, including the Warriparinga wetlands, significant cultural sites, Kaurna Living Cultural Centre, Sturt Police Station, Marion Holiday Park, Science Park business precinct, and car parking

The Tonsley Park area including the university and TAFE campuses, and a developing industrial, business and residential precinct. A land use plan is provided in Figure 18.

The zoning pattern for the precinct is also diverse and incorporates Industrial, Residential, Neighbourhood Centre, Urban Employment, Commercial, Special Uses, Institutional, Hills Face and Open Space zones and is shown in Figure 19.

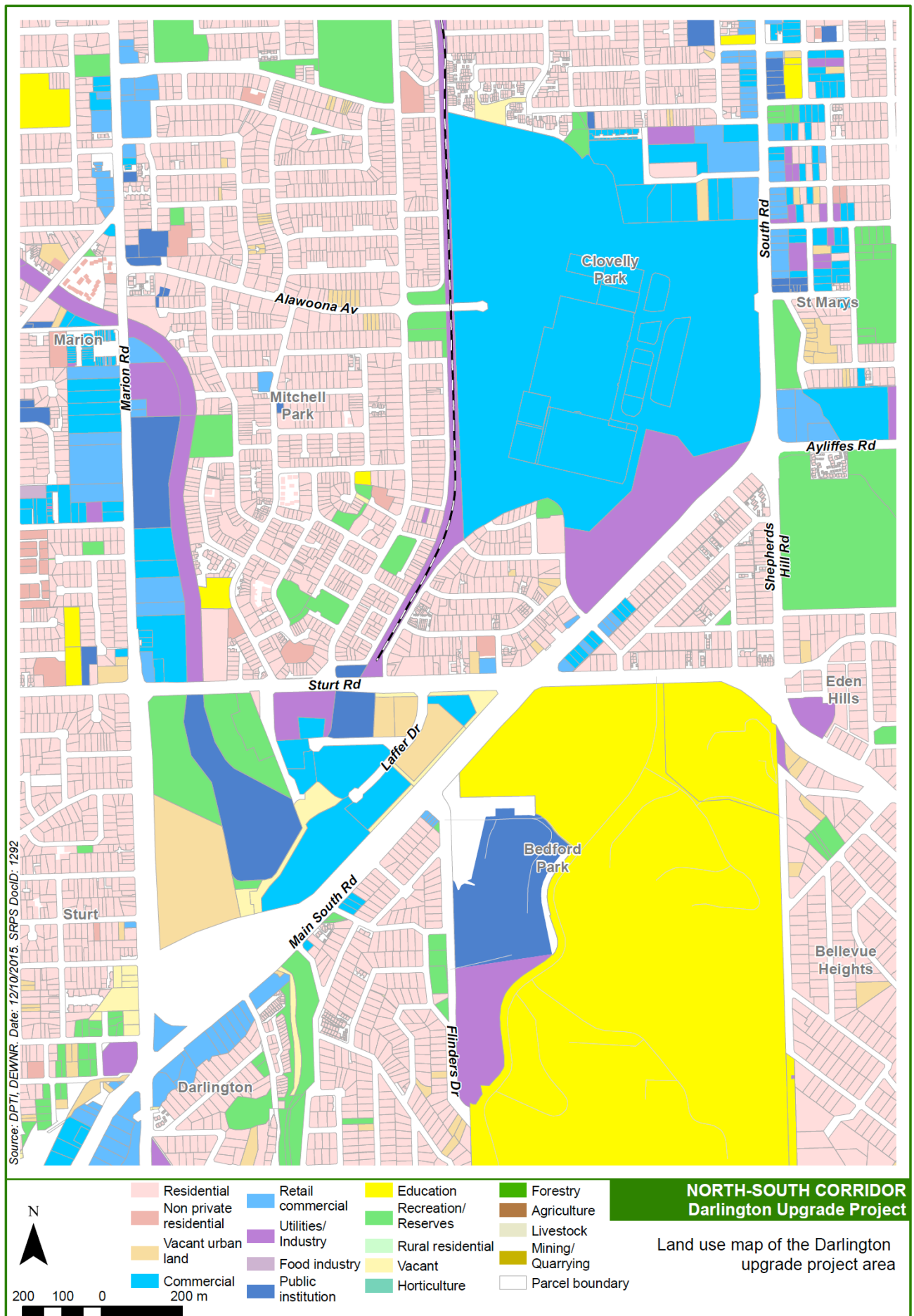


Figure 18 - Land use map of the Darlington Upgrade Project area

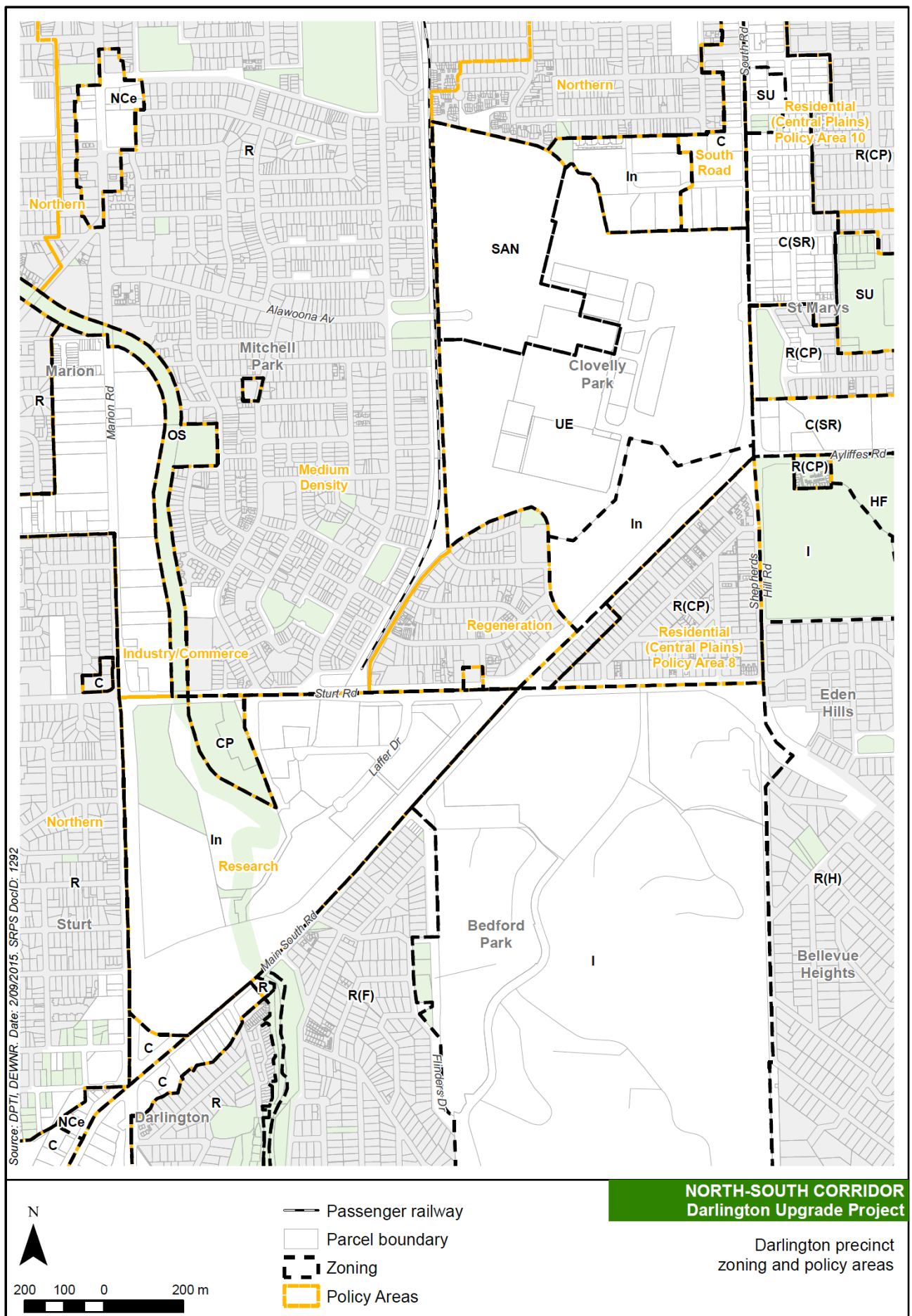


Figure 19 - Darlington precinct zoning and policy areas

9.2.2 Visual amenity and landscape

Visual context

The landscape and urban character through Darlington along the Main South Road alignment is extremely diverse, inconsistent and disjointed. When someone enters the precinct from the Southern Expressway, they pass through large areas of open space, comprising both tree lined avenues with areas of large scattered trees and open grassland. The crossing of the Sturt River with its mature River Red Gums provides a 'sense of arrival' onto the Adelaide Plains and the southern metropolitan areas.

Moving northward the wide roadway is a dominant feature, but is framed with semi-mature plane trees and includes central median planting of plane and eucalypt trees and grass as well as two large eucalypts in the median south of Flinders Drive. All power is undergrounded. On the western side there are three large free-standing commercial buildings within the 'Science Park' development, surrounded by large car parking areas behind the tree lined western side of South Road.

On the eastern side the residential area of Bedford Park rises up away from South Road. North of Flinders Drive lies the very large complexes of the Flinders Medical Precinct, with the land to the north providing several large playing fields associated with Flinders University (which are on elevated land built up above South Road and incorporating an attractive treed buffer along South Road and Sturt Road).

South Road north of Sturt Road continues as a wide roadway, and again semi-mature plane trees line both sides of the road and provide an attractive frame. South Road passes through residential areas on the eastern side (Bedford Park), which also includes a commercial strip in the area closest to Sturt Road. On the western side the residential areas (Clovelly Park) give way to the large industrial complex of Monroe, with the roadway again framed by large eucalypt and plane trees before reaching the large open intersection of Main South Road, Ayliffes Road and Shepherds Hill Road, which is also framed by large eucalypt trees at the edges of the road and within the centre median.

Main South Road 'splits' at this intersection, with traffic heading east down Ayliffes Road, which is characterised by a large car dealership on the north eastern corner, and a residential flat building surrounded by parklands, native vegetation and recreation facilities at the south eastern corner. Traffic heading north from Ayliffes Road, Shepherds Hill Road and Main South Road converge next to the Tonsley redevelopment to the west, which provides views of a wide, open area of grass studded with large eucalypt trees. Eucalypt trees planted in the median at this location and the Ragless Reserve in St Marys serve to provide an attractive and elevated tree lined avenue.

Landscapes and Areas of Visual Significance

The landscape character is the physical appearance and cultural context of a geographical area that gives it a distinct identity and sense of place. These elements include the landform, location, vegetation, land use and views to and from the area. Landscape character can also be informed by the social and cultural context that contributes to a unique sense of place. This section of the report describes the existing landscape character, considers the impact that development would have on the existing character, and visual amenity by selecting prominent areas of high visual sensitivity. Figure 20 depicts the existing landscape character areas adjacent the site.

The following are recognised as areas of visual sensitivity:

- > Residential precincts:
 - Immediate vicinity of the project
 - St Marys
 - Bedford Park (north and south)
 - Clovelly Park
 - Darlington.
- > Wider project area:
 - Bellevue Heights;
 - Sturt (opposite the wetlands)
 - Mitchell Park.
- > Flinders Precinct, hospitals and University, including recreation ovals
- > Mixed Use, Retail/Commercial and Light Industry land uses
- > Places of Indigenous significance:
 - The Warriparinga wetlands (including the Living Kurna Cultural Centre)
 - Sturt River.
- > State and local heritage places:
 - Fairford House and grounds in the Sturt Triangle
 - Women's memorial playing fields
 - St Marys Park in St Marys.
- > Tonsley rail corridor
- > Tonsley Park redevelopment site.

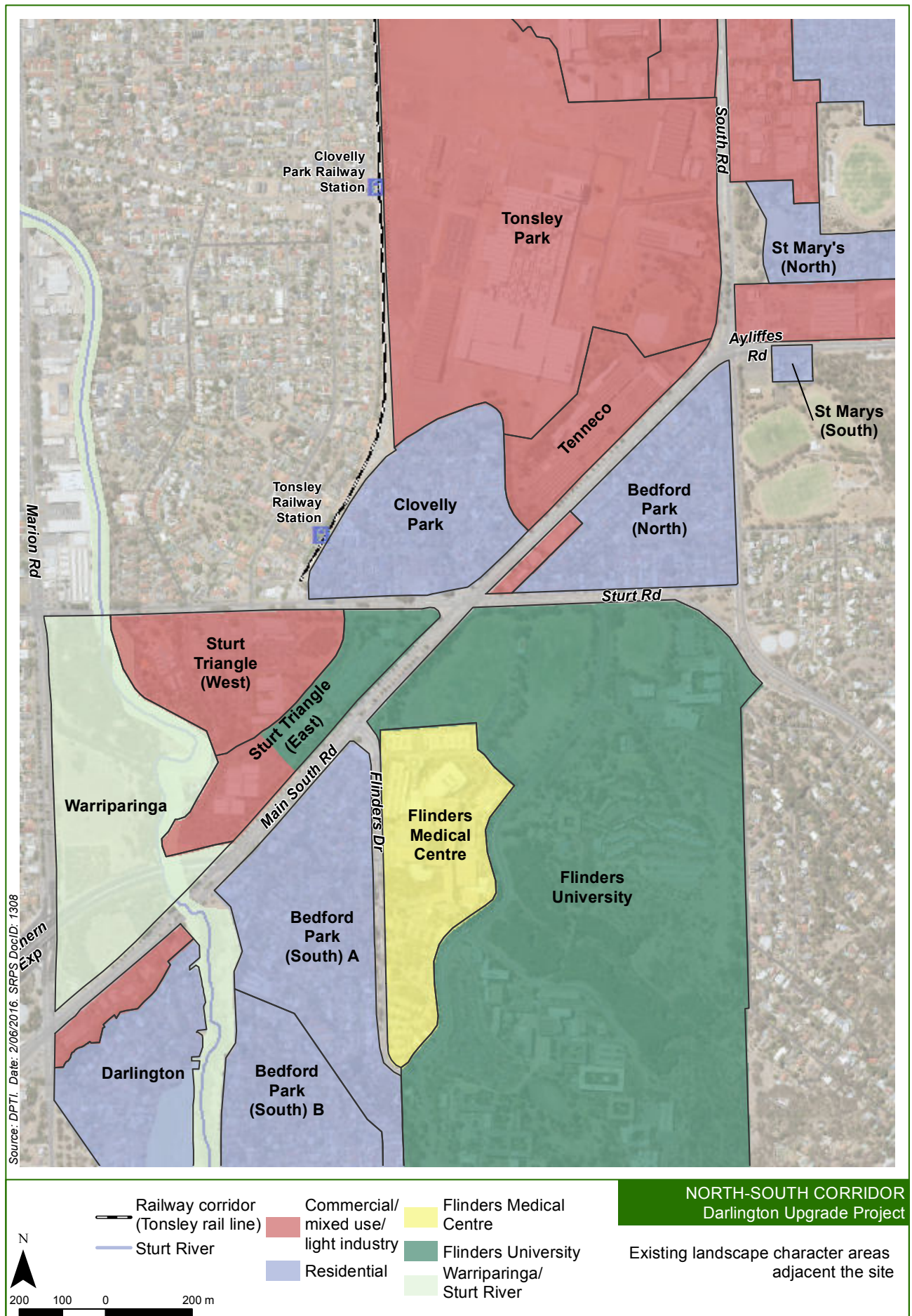


Figure 20 - Existing landscape character areas adjacent the site

9.2.3 Residential character

Darlington

Darlington is located in the City of Onkaparinga and lies between the Sturt River to the east, South Road to the north and Flagstaff Road to the west. The precinct itself lies slightly south of immediate exposure to project works. The land use is mostly residential and is set back from the South Road corridor by a service road and a cluster of regional scale franchise businesses at the South Road interface. The area is also somewhat screened by established plane trees on South Road. The topography in the area is predominantly flat with some undulating areas toward the hills face. Views to South Road are limited for the majority of residents.

Clovelly Park

Clovelly Park is bound by South and Sturt Road to the south, the Tonsley Rail Line to the west and the Tonsley Redevelopment to the east. The housing was predominantly built during the 1950s-80s and is characterised by separate houses and semi-detached or townhouses. The housing is well-maintained. There are signs of new development in the area. There is minimal to no streetscaping affecting the pedestrian experience. The landscaping in the area consists of small, immature street trees which are spread between larger groups of established eucalypt/plane trees. The topography in the area is predominantly flat with some undulating areas. Views to South Road are limited for the majority of residents. Properties located on South Road experience the lowest visual amenity.

Bedford Park (south)

Bedford Park (south) is bound by Flinders Drive to the east, South Road to the west and the Sturt River to the south. The mostly residential precinct is set back from South Road by service roads and somewhat screened by vegetation on both Flinders Drive and South Road. The housing typology in the area is varied with a mix of architectural styles mostly built during the 1950s-80s. There are mainly two-storey separate houses in the area which utilise the topography of the site. Some residents experience views overlooking the Sturt River catchment, South Road and towards the ocean. Most trees in the area are semi-mature to mature native trees which add to the visual amenity and character of the area. The visual quality is moderate to high looking up to the hills and over the Sturt River.

Bedford Park (north)

Bedford Park is bound by Sturt Road to the south, Main South Road to the west and Shepherds Hill Road to the east. The housing typology in the area was built during the 1950s-80s and consists of mostly separate houses and two-storey block flats, units or apartments. There is minimal streetscaping, undermining the pedestrian experience. The properties directly abutting South Road experience the lowest visual amenity, while other residents may experience minimal or no views through to the main arterial road. Properties abutting Sturt Road have higher quality views as they look up to the hills over the Flinders University Recreation Ovals. The ovals are lined with established plane trees that contribute to the visual amenity.

St Marys

St Marys is bound by Daws Road to the north, Main South Road to the west and Cashel Street to the east, incorporating the Women's Memorial Playing Fields to the south of Ayliffes Road. A strip of mixed industrial and commercial development exists along Main South Road and ranges from one to two blocks deep into the suburb. The strip consists of a mix of bulky goods retail, warehousing, car repairers and sales, commercial, and sports and entertainment facilities. The housing typology in the area consists of mostly separate houses, with some newer separate and maisonette dwellings and a group of residential flat buildings located on the southern side of Ayliffes Road. There is a wide variety of streetscaping and an inconsistent mix of planting species. Most residential areas are protected from Main South Road by industrial and commercial premises with the exception of the two-storey residential flat buildings on Ayliffes Road, which directly overlook the intersection of Ayliffes Road, Main South Road and Shepherds Hill Road. A new subdivision 'The Crescent' also has direct views over Main South Road and the Tonsley Park development, albeit over a local grassed reserve with scattered trees, which contribute to the visual amenity of the new housing development.

9.2.4 Flinders precinct character

Flinders Medical Centre, Flinders Private Hospital and Flinders University

This precinct includes the Flinders Medical Centre, Flinders Private Hospital and Flinders University. The development in this area is organised, the campus buildings, hospitals and overall grounds are well kept and areas of mature vegetation provide pleasant park environments for staff and students. All of the buildings within the precinct are set-back from South Road. The steep topography of the precinct provides some views overlooking South Road. However, the recreation ovals are lined with mature eucalypt/plane trees along their east and west perimeters, providing valuable screening to South Road.

This precinct is characterised by its functionality as an education, recreation and medical services precinct. The scenic quality of this area is considered to be moderate to high with a moderate sensitivity to visual change.

Recreation ovals

The ovals provide the area with visual relief from the otherwise built areas along South Road. This landscape area is surrounded by mature eucalypt/plane trees along Sturt and South Roads, which provide a high level of screening to South Road. Views from Flinders University are disrupted by the dense tree canopies.

9.2.5 Mixed use, retail, commercial and industry precinct character

The mixed use/commercial/light industry area is characterised by groups of small row shopfronts, fast-food restaurants, local medical centres/services, car yards, mechanical workshops and the Monroe automotive manufacturer.

The scenic quality of this area is considered to be low to moderate. Although the area is used for industrial/commercial purposes, the existing landscape is of moderate visual quality with large street tree plantings and some areas of landscaped open space.

Many of these areas are located along South Road and are characterised by groups of small shop fronts to large scale buildings, such as Monroe. The Monroe building façade is a dominant feature along South Road, with large panes of glass broken by red brick walls and company advertising. The trees in front of Monroe are immature and do not offer much screening of the large building for residents adjacent.

The Laffer Triangle is characterised by a mix of large scale education, commercial and public services buildings.

The combination of the sloping topography and vegetation along South Road's western side provides a high level of screening from South Road. This area also provides considerable parking for the Flinders University staff and students, particularly those within the medical centre and Mark Oliphant Building.

At St Mary's, the Adrian Brien car dealership consists of a large site with a number of commercial buildings located in a visually prominent location on the north eastern corner of Main South Road and Ayliffes Road. A single mature eucalypt is a dominant feature located immediately in front of the dealership's main building.

9.2.6 Places of indigenous and cultural significance

Warriparinga and Living Kurna Cultural Centre

This precinct is characterised by established native trees and vegetation, the river and wetlands, public open spaces and rich cultural history. This precinct is considered to have a very high level of scenic quality.

The wetlands and cultural centre provide the area with cultural, historical and environmental importance dating back thousands of years. The wetlands within the Sturt Triangle provide the local area with an enhanced regional sense of place and identity. The area is characterised by cultural elements such as artwork reflecting the cultural significance of the area, the Living Kurna Cultural Centre, and mature and well-maintained native vegetation. Shared paths riddle the area, providing local residents and visitors the opportunity to immerse in nature. The precinct is bound by established vegetation and trees which provide it shelter from the main arterial roads that surround it and the South Road corridor. This precinct is enclosed by the Southern Expressway to the south, Marion Road to the west and Sturt Road to the north.

Sturt River

The Sturt River catchment runs down the hill from Bedford Park (south), under South Road to the Warriparinga wetlands continuing north of Sturt Road. It provides scenic backdrop for the Marion Holiday Park tourists and residents. This area forms another significant corridor with environmental value through the Darlington area. This precinct is characterised by the river, shared off-road paths, public open spaces and groups of established native trees and vegetation.

Fairford House, Coach House and Grounds

Located entirely within the Sturt Triangle, these places provide the local area with an enhanced sense of place and identity, offering cultural insight in to the early European settlement of the area. This precinct is enclosed by the Southern Expressway to the south, Marion Road to the west and Sturt Road to the north. Shared paths are located throughout the area, enabling local residents and visitors the opportunity to pass the grounds and appreciate the historic importance of the places.

The two heritage listed buildings are confined to the heritage listed grounds, which are visually characterised by established fruit trees, vineyards and rolling lawns against the backdrop of the adjacent Warriparinga wetlands. The rural origins and nature of these places, particularly those within the Sturt Triangle are considered to have a very high level of scenic quality.

Women's Memorial Playing Fields

The recreational grounds are located at the corner of Ayliffes Road and Shepherds Hill Road at the northern end of the project area. It includes derelict tennis courts and clubrooms immediately adjacent the road corridor, which have a poor visual amenity due to vandalism and an advanced state of disrepair.

St Marys Park

St Marys Park is located within the suburb of St Marys and was the home of the South Adelaide Football Club prior to its relocation to Noarlunga. The park is characterised by an oval, turfed playing field and surrounded by open unirrigated grassed areas with scattered trees. The precinct is surrounded by residential development to the north, east and south and a mixture of industrial/commercial and residential development to the west which effectively blocks all views to Main South Road, except for a narrow vista down Brookman Avenue.

Refer to Figure 29 for location of non-Aboriginal heritage listings in the project area.

9.2.7 Tonsley development

Tonsley is Australia's first innovation district connecting businesses with the best and brightest. It is driving change in a tight, focused, vibrant and dynamic environment in one of the world's most liveable cities – Adelaide.

The Tonsley redevelopment is purposely designed to attract investment and create a thriving jobs precinct that includes residential and community living.

9.3 Potential effects and opportunities of the Project

9.3.1 Planning and design

Land use

The Darlington Upgrade Project will impact on land use due to the property acquisition required for the road infrastructure component of the project. In particular, this will require the removal of a number of bulky goods retailing, commercial, car servicing, health services and food retailing currently located along Main South Road.

The project also has the potential to enable redevelopment and revitalisation as a result of residual land and reconfigured access arrangements, in particular, land within the Laffer Triangle.

Visual impact

Susceptibility to visual impacts is likely to be most significant in areas that are directly adjacent to, or within, the immediate vicinity of the project footprint. This is particularly relevant for residential land uses, valued and significant places, and open space.

Given the rising topography of land to the east of the corridor, views can encompass the project site, metropolitan Adelaide 'plains' and Gulf St Vincent. Due to the scale of the project, visual amenity will be impacted to varying degrees at land parcels and roadways from this aspect. It is considered that the areas most sensitive to visual impact relate predominantly to the removal of screening vegetation and include:

- > Residences located on South Road or within close proximity to the project, particularly those exposed by the demolition of housing, which would normally provide a buffer
- > The Flinders precinct and ovals, due to the steep topography of the precinct which provides views overlooking South Road that will be opened up by the removal of trees
- > The Women's Memorial Playing Fields disused tennis courts, which has a direct outlook to the Ayliffes flyover with the potential for visual impact depending on the scale and final design
- > The Sturt River, Darlington and Bedford Park (south) areas in relation to the visual impact of the elevated bridges connecting the Southern Expressway to the new non-stop motorway.

9.3.2 Construction

During construction, visual amenity will be impacted predominantly due to views of the construction activities, machinery and the general worksite. In some locations this will be exacerbated by the removal of screening vegetation and their elevation. Again, sensitive areas will include residents living close to the project and areas with an elevated position above the worksite.

9.4 Management and Mitigation

9.4.1 Planning and Design

Urban design framework

It is the aim of the urban design framework to mitigate potential impacts by integrating the Darlington upgrade into the local landscape and the overall North-South Corridor vision enhancing the surrounding environment. This will assist in maintaining a sense of identity for the area as well as creating a vital section of the Adelaide's continuous non-stop North-South Corridor. The landscape and urban design framework has considered:

- > Context: understanding the landscape and urban design protocols, strategies and standards
- > Landscape character: enhancing the unique natural qualities of the surrounding environment
- > Environment: minimising disturbance to areas of high conservation value, and protecting and enhancing biodiversity
- > Access: integrating existing pedestrian/shared use paths with the landscape.
- > Amenity: retaining views and natural features; and using crime prevention through design principles and low maintenance treatments to improve amenity of local environment.

Land use and urban design

There are a number of land use and urban design opportunities and mitigations that will be considered to manage the visual impact and effects of the project on the character of the area including:

- > Creating a new Southern Gateway to the city at Darlington through integrated urban art referencing Aboriginal culture, Sturt River and Warriparinga
- > Defining a non-stop corridor that reduces the 'perceived' width of roadway through the Darlington section of Main South Road
- > Including streetscape improvements to Main South Road and adjoining roads
- > Providing corridor connections and alignments that maximise the long term development potential on adjacent land, including land within the Laffer Triangle
- > Designing the road corridor to allow for the establishment of street tree planting to reduce the extent of exposed hard surfaces and replanting of residual land
- > Reinforcing the presence of Sturt River and Warriparinga Wetlands through extending green space where possible
- > Maximising amenity beneath any elevated structures along South Road
- > Providing suitable landscape and other urban design elements to help separate the at-grade arterial road with any at-grade non-stop corridor element
- > Minimising the visual impact of elevated structures through:
 - Careful detailing of columns and soffits that minimise bulk and exposed services
 - Ensuring there is not too much height
 - Providing screen tree planting adjacent where possible
 - Using consistent, quality architectural design to ensure a clean, uncluttered appearance.

9.4.2 Construction

Opportunities to reduce visual impact during construction could include:

- > The use of hoardings and visual barriers to screen visual impacts from residential and other sensitive areas,
- > Potential viewing areas for people interested in the project

9.5 Conclusion

The Darlington Upgrade Project will impact on the existing land use, character and visual amenity of the area predominantly due to the project footprint and the acquisition of a number of residential, commercial and retail properties along Main South Road. In addition, the removal of vegetation along the road will contribute to visual impact, particularly when seen from sensitive areas such as residences located close to the project and elevated areas to the south east. The project has been designed to avoid impacts on the sensitive area of Warriparinga.

Significant opportunities exist for the project to provide an enhanced visual amenity for the area via the implementation of the North-South Corridor Urban Design Framework, which will include urban design, landscaping, planting and artistic elements.

10 Socioeconomic

10.1 Context

10.1.1 Assessment methodology

A socioeconomic assessment of the project has been undertaken by:

- > A review and analysis of relevant Commonwealth and State legislation and planning strategies, as well as regional and local planning and community strategies
- > A review of literature on similar activities nationally and internationally
- > Collation and analysis of baseline data from the 2011 Census of Population and Housing
- > Analysis of existing land uses along and in close proximity to the existing South Road corridor
- > Site visits and surveys, including a business survey as part of the South Road Planning Study
- > Consideration of the potential impacts of the project and mitigation strategies.

10.1.2 Relevant legislation, strategies and policies

The following national, state and local documents have been considered in the socioeconomic assessment:

- > *Development Act 1993*
- > *Local Government Act 1999*
- > *Integrated Transport and Land Use Plan, 2015*
- > *South Australia's Strategic Plan, 2011*
- > *South Australia's Planning Strategy: The 30-Year Plan for Greater Adelaide, 2010*
- > *Housing and Employment Land Supply Program, 2010*
- > *Housing Plan for South Australia, 2005*
- > *Tonsley Park Redevelopment Masterplan*
- > *National Cycling Strategy, 2011-2016*
- > *National Road Safety Strategy, 2011-2020*
- > *Seven Strategic Priorities*
- > *10 Economic Priorities*

10.2 Existing conditions

10.2.1 Resident profile

Residential precincts

Seven key residential precincts are located within the Darlington Upgrade Project area. These are highlighted on Figure 21 and have been used as the basis for the resident profile. The seven areas are:

- > Darlington, bounded by Main South Road, Sturt River, the Hills Face Zone and Flagstaff Road
- > Bedford Park (south) A, bounded by Main South Road, Flinders Drive, Sturt River and Malcolm Street
- > Bedford Park (south) B, bounded by Sturt River, Malcolm Street and the Hills Face Zone
- > Clovelly Park, bounded by Sturt Road, Main South Road, the Tonsley rail line and the Tonsley Park redevelopment
- > Bedford Park (north), bounded by Main South Road, Sturt Road and Shepherds Hill Road
- > St Marys (south), bounded by Ayliffes Road, Cashel Street, Auricchio Avenue and Main South Road and including the residential flat building on the southern side of Ayliffes Road
- > St Marys (north), bounded by Main South Road, Auricchio Avenue, Cashel Street and Quinlan Ave/St Mary's Park.

Demographic characteristics

Each of the seven residential precincts has been analysed for key population and housing characteristics (see Table 11). Compared with Greater Adelaide as a whole, the areas are characterised by:

- > Lower household incomes in some areas significantly lower than the Greater Adelaide average
- > Younger median ages in all but the Bedford Park (south) B precinct, with precincts located close to the university having significantly younger median ages
- > Generally similar or higher average number of people per household
- > Low levels of car ownership in all but the Bedford Park (south) B precinct
- > Significantly higher proportions of rental households, with the exception of Bedford Park (south) B

Precinct	Popn.	Median weekly house-hold income	Median age	English not spoken well or not at all	Private dwellings	Rented dwellings	Group house-holds	Lone person house-holds
St Marys (Quinlan)	369	\$987	34	2.7%	168	30.8%	8.3%	27.1%
St Marys (Ayliffes)	431	\$896	33	10.2%	185	55.4%	6.0%	29.8%
Bedford Park (north)	558	\$860	29	10.8%	235	54.2%	13.3%	28.1%
Clovelly Park	404	\$660	36	2.4%	201	64.2%	12.8%	44.5%
Bedford Park (south) A	479	\$923	31	3.1%	220	42.1%	15.2%	30.4%
Bedford Park (south) B	308	\$1,048	41	2.9%	125	20.5%	4.2%	19.3%
Darlington	341	\$1,210	34	3.5%	150	40.8%	8.4%	22.1%

Table 11 - Key demographic characteristics, Census of Population and Housing 2011. (Australian Bureau of Statistics)

- > Higher proportions of group households, particularly in Bedford Park (north), Bedford Park (south) A and Clovelly Park
- > Similar proportions of lone person households, except in Clovelly Park where the proportion of lone person households is significantly higher, and in Bedford Park (south) B where it is lower
- > Very high level of cultural diversity, particularly in St Marys (south) and Bedford Park (north) which is high, as indicated by the large number of international students at Flinders University and the popularity of local international restaurants
- > High proportion of people who do not speak English well or at all, particularly in St Marys (south) and Bedford Park (north).

Education and employment

In relation to education and employment of the 2011 key employment and education statistics, some precincts have higher than average proportions of students, especially tertiary students, compared with South Australia generally. Bedford Park (north) and Bedford Park (south) in particular had 28.2% and 29.6% respectively of their population engaged in tertiary education at the time of the census. This is reflective of these precincts' proximity to Flinders University.

Unemployment rates varied from 4.5% in St Marys (north) to 15.6% in Bedford Park (south) A. Of significance is the importance of the hospital industry as an employment base for the local area. Other top industries of employment common across the areas included the café/restaurant industry, building cleaning/pest control/gardening service industry, tertiary and secondary education, and food retail services.

Top occupations included professionals, labourers, technicians and trade workers, personal service workers, clerical and administration workers, and community and personal service workers. Key employment and education statistics are detailed in Table 12.

Precinct	% of population students	Unemployment rate
St Marys (north)	28.2% (9.8% tertiary)	4.5%
St Marys (south)	41.1% (19.0% tertiary)	13.7%
Bedford Park (north)	47.5% (29.6% tertiary)	14.2%
Clovelly Park	37.1% (13.1% tertiary)	10.6%
Bedford Park (south) A	43.4% (28.2% tertiary)	15.6%
Bedford Park (south) B	35.1% (15.6% tertiary)	9.8%
Darlington	32.3% (% tertiary)	7.3%

Table 12 - Key employment and education statistics, 2011. (Australian Bureau of Statistics)

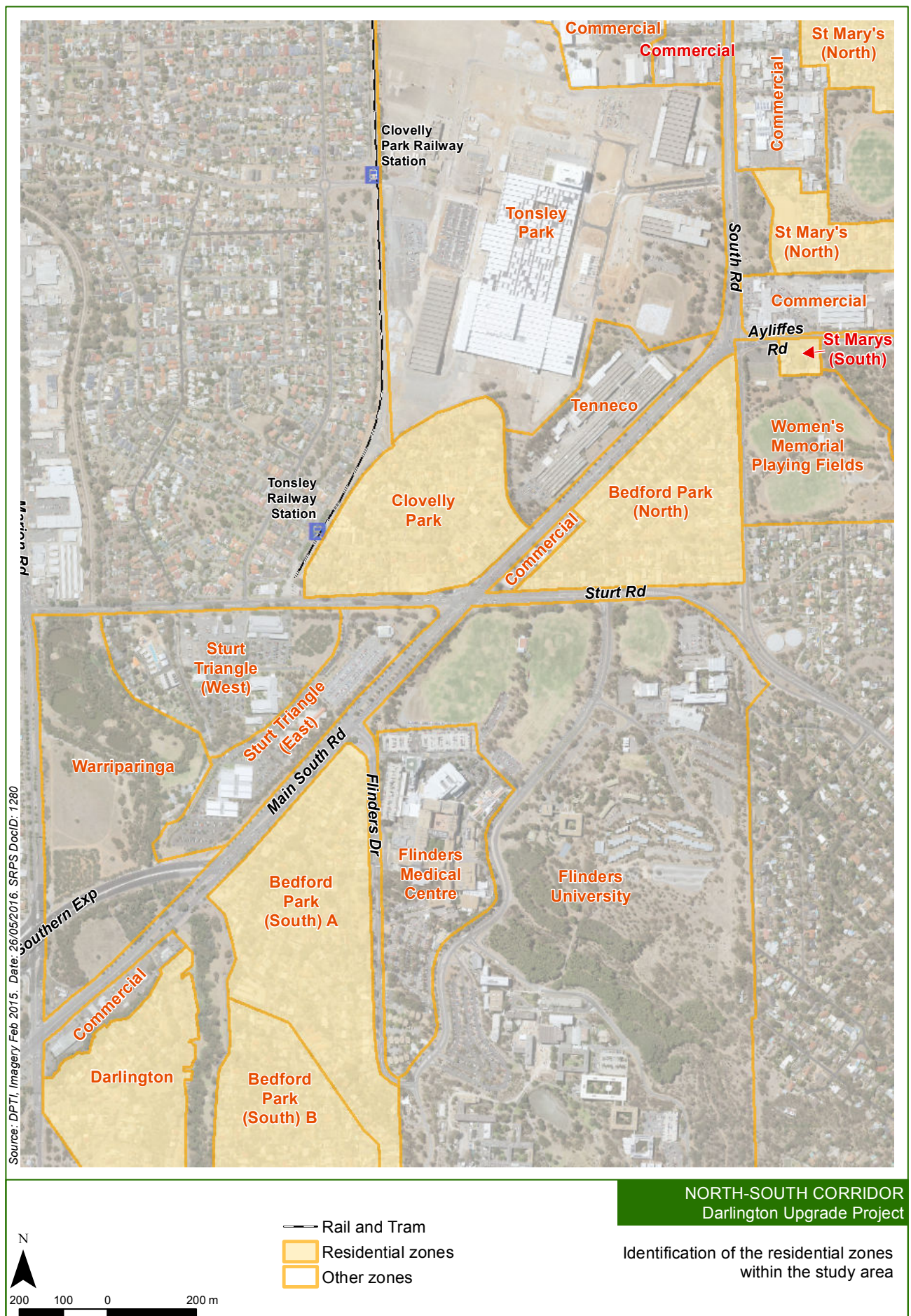


Figure 21 - Identification of the residential zones within the study area

Transport and travel

The transport and travel characteristics of the local population, specifically the method used to travel to work are useful measures. They can indicate the comparative level of importance of movement networks and the levels of interest when communicating with the community about issues such as detours, impacts on access, and incorporation of walking, cycling and public transport access. Statistics in Table 13 show that the area has:

- > High levels of public transport use in some areas
- > Lower levels of car ownership and use, and higher levels of walking or cycling. In Bedford Park (Flinders) and Bedford Park (Shepherds Hill) in particular, 18.6% and 11.0% respectively either walked or cycled to work on the day of the census.

This is a high proportion of households without a car within the St Marys (Ayliffes), Mitchell Park (Rail) and Bedford Park (Shepherds Hill) areas. This places a relatively high importance on access to public transport and walking/cycling facilities during and post construction, with between a fifth and a quarter of households in these areas not having access to a car.

Other areas within the Darlington Upgrade Project area that are not predominantly residential in nature but nevertheless are home to small numbers of residents include:

- > Flinders University and Flinders Medical Centre, which was home to 287 students at the time of the 2011 Census of Population and Housing with a young median age of 21 years, and a low median income
- > The Sturt Triangle bounded by Marion Road, Main South Road and Sturt Road, which was home to 60 people at the time of the 2011 Census of Population and Housing with an older median age of 63 years, and a low median income, most likely living in the Marion Holiday Park.

Population Growth

The Darlington Upgrade Project is located across four Statistical Local Areas used by the Australian Bureau of Statistics for the purpose of statistical analysis and comparisons including Marion Central, Mitcham Hills, Mitcham West and Onkaparinga Reservoir. Population projections at the Statistical Local Area level were prepared by the South Australian Government in 2011 with medium series growth projections indicating a growth in population across the four areas of 10 836 people, or 8.8% between 2011 and 2026.

In addition, the Tonsley Park redevelopment project anticipates that the Tonsley area will be home to an additional 1200 residents, with housing proposed and approved as part of the master plan. There are also preliminary plans from Flinders University to increase student accommodation within its land over the coming years.

10.2.2 Community services

A number of community services exist in the area as shown in Figure 22.

Education

Flinders University is a significantly large tertiary education institution with over 24 000 students and is located in Bedford Park on a large site that extends up to the Hills Face Zone. Recently, a campus has also been set up within the Tonsley area to provide for the newly created computer science, engineering and mathematics faculty. There is also a TAFE facility located at Tonsley providing a range of courses.

In addition to tertiary education, a number of public and private secondary, primary and pre-schools service the area.

Area	Public transport use (travel to work)	Private car use (travel to work)	Walk/cycle (travel to work)	Ave cars per dwelling	Households without a car
St Marys (Quinlan)	11.6%	69.1%	1.8%	1.5	6.1%
St Marys (Ayliffes)	19.0%	55.0%	2.2%	1.2	19.9%
Bedford Park (Shepherds Hill)	14.5%	53.6%	11.0%	1.3	21.5%
Mitchell Park (Rail)	14.2%	62.7%	7.8%	1	24.1%
Bedford Park (Flinders)	10.3%	45.9%	18.6%	1.5	10.3%
Bedford Park (Riverside)	7.2%	56.1%	4.3%	2	5.9%
Darlington	8.4%	55.7%	2.4%	1.6	11.6%

Table 13 - Key Travel Statistics, Census of Population and Housing 2011. (Australian Bureau of Statistics)

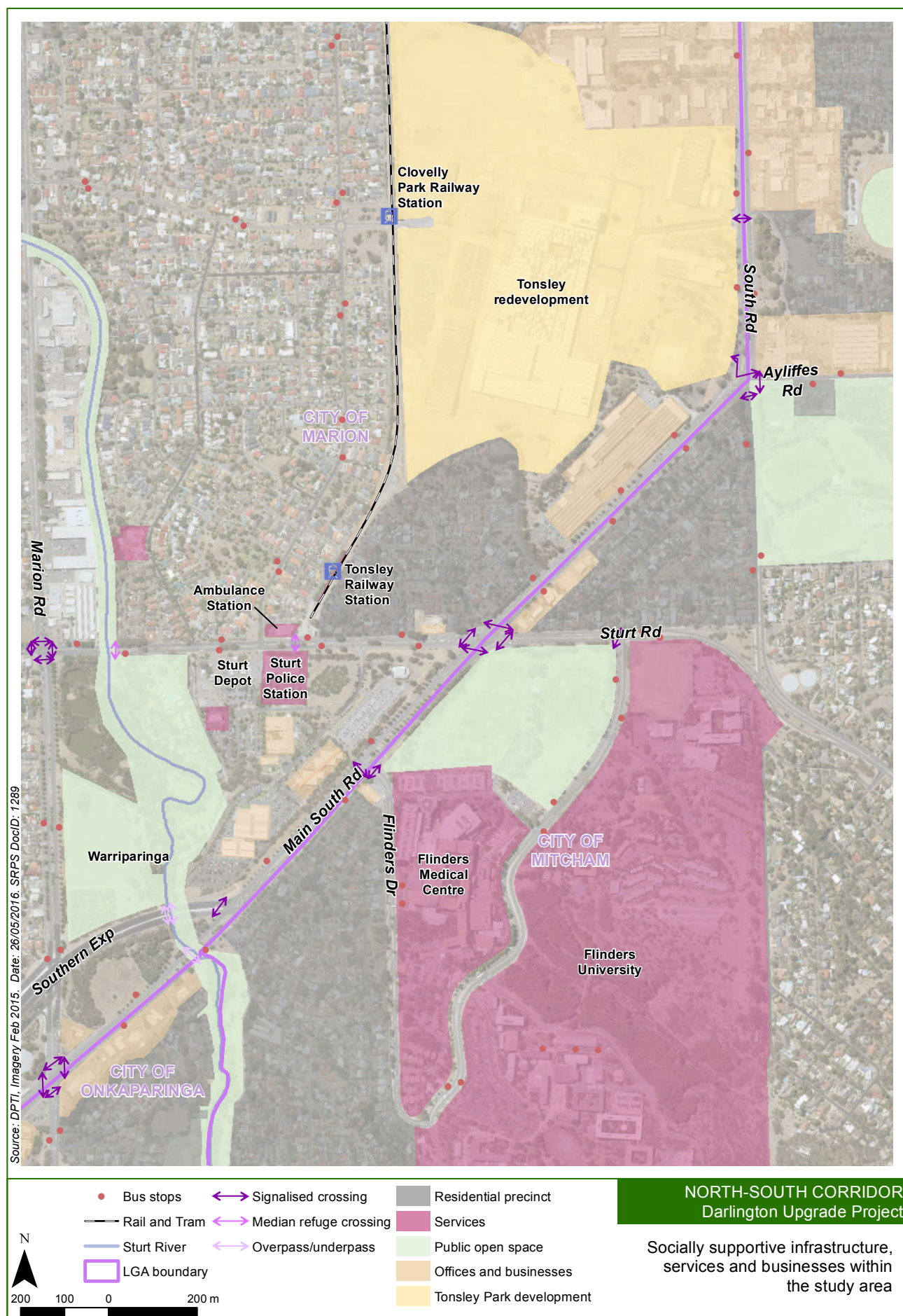


Figure 22 - Socially supportive infrastructure, services and businesses within the study area

Health

The precinct has a significant focus for health services, with the location of Flinders Medical Centre servicing southern Adelaide and providing 24/7 emergency services. Flinders Medical Centre is currently being expanded to accommodate additional facilities for rehabilitation, geriatric mental health, post traumatic stress disorders, and the relocation of services arising from the closure of the Repatriation General Hospital. Adjacent to the Flinders Medical Centre is the Flinders Private Hospital and numerous private specialists and services.

Community facilities and support services

In addition to these significant health services, a number of community support services exist in the area including:

- > Recreational facilities, sports fields, open spaces and clubs
- > Sturt River and Marion Holiday Park
- > Walking and cycling trails
- > The Kaurua Living Cultural Centre
- > Red Cross, MarionLIFE, Novita Children's Services and NDIS services
- > The Cooinda Neighbourhood Centre
- > Various support services provided through Flinders University and Flinders Medical Centre.

Emergency services

Local emergency services have a particularly strong presence in the Darlington Upgrade Project area and include:

- > The Marion Ambulance Station located on Sturt Road
- > The Sturt Police Station located on Sturt Road
- > Flinders Medical Centre all hours emergency department
- > St Marys Metropolitan Fire Service
- > O'Halloran Hill Metropolitan Fire Service
- > Eden Hills Country Fire Service (CFS)
- > Sturt Unit CFS
- > Metro South State Emergency Service (SES)
- > SA Ambulance Service head office.

10.2.3 Business profile

State economic drivers and growth

Southern Adelaide is one of South Australia's traditional heavy manufacturing heartlands but is undergoing significant restructuring. The closure of the Mitsubishi car plants at Tonsley Park and Lonsdale and the oil refinery at Port Stanvac led to significant regional job losses and slowed the rate of employment growth in those sectors. Manufacturing remains a significant industry to southern Adelaide in terms of its economic output, but there has been a transition over the past decade towards a more diverse industry structure with employment growth particularly strong in service based industries.

Tonsley redevelopment

Tonsley is the centrepiece of the South Australian Government's strategy for transforming the state's manufacturing industry into more advanced and clean technologies. The redevelopment of Tonsley covers 61 hectares of the former Mitsubishi Motors manufacturing site to create a new precinct that integrates industry, commercial office, education including TAFE SA's new Sustainable Industries Education Centre and Flinders University research, residential accommodation and community amenities. The redevelopment is being led by Renewal SA in partnership with the Department for State Development.

The vision for Tonsley Park mirrors key principles within *The 30-Year Plan for Greater Adelaide*, which include: attracting investment, creating employment opportunities and promoting competitiveness. It is also a key part of driving high-value manufacturing in South Australia. A master plan has been developed for the site (refer to <http://www.tonsley.com/>) and the redevelopment is expected to take 20 years to complete.

Local business

Figure 23 shows that the Darlington Upgrade Project area is home to a large number of local businesses including retail, commercial and industrial uses. Outside of the Tonsley Park precinct, these businesses are predominantly located on Main South Road and include:

- > Bulky goods retailing, car retailing, commercial and offices, showrooms, shops and trade supplies located on Main South Road and Ayliffes Road in St Marys and Clovelly Park
- > The Monroe manufacturing site and small car retailer located on Main South Road, Clovelly Park to the south of Tonsley Park
- > Car retailing, commercial and retail businesses located on Main South Road, Bedford Park (north)
- > The international food retail hub, deli and dentist at the corner of Flinders Drive and Main South Road servicing employees and local residents
- > The Sturt Road shopping centre providing takeaway pizza, floristry, hair boutique, deli and other local retail services
- > The Science Park area accommodating a range of offices including Westpac call centre, BT Finance, health research, and SAAS administration
- > Dentist and medical centre on Main South Road Bedford Park (south)
- > Bulky goods warehousing, petrol retailing, restaurants and fast food outlets on Main South Road, Darlington.

10.3 Effects and opportunities of the project

10.3.1 Planning and design

The impact of the footprint of the Darlington Upgrade Project has necessitated a large number of property acquisitions, particularly on the eastern side of Main South Road.

Access to services

In relation to the acquisition and demolition of non-residential properties, the socioeconomic impact resulting from the immediate loss of local services to an area has the potential to cause community stress.

In addition, the impact of loss of services on the extensive working, learning and visiting population of the area may also lead to frustration, inability to access essential or support services, and additional pressure on local road networks as people seek alternatives further afield. Particular areas of consideration include:

- > The medical, dentist and other community or essential services that play an important role in maintaining the social and physical health of the local community
- > Food retailers, particularly given the need to acquire most of the food retail premises in Bedford Park.

Social connectivity and wellbeing

For residents, visitors and employees of the precinct, connectivity between land uses on both sides of the road such as between university campuses, health services and retail will be especially important to ensure that the road is not a barrier to accessibility, either real or perceived. This is particularly important for vulnerable people such as the elderly, hospital visitors, those requiring access to the emergency department, those who are ill or recovering from surgery, and people seeking to access public transport or car parking facilities.

Visual amenity, urban design and heritage are also important factors in the social health and wellbeing of the local community, particularly in relation to residents and culturally important areas such as Warriparinga. Potential effects and opportunities in relation to these factors are discussed in greater detail elsewhere in this report but will have a significant impact on the planning and design phase of the project.

The Flinders Link Project represents an opportunity to enhance connectivity and wellbeing by improving access across Main South Road and to rail services. The Flinders Link Project will be integrated into the planning and design process of the Darlington Upgrade Project.

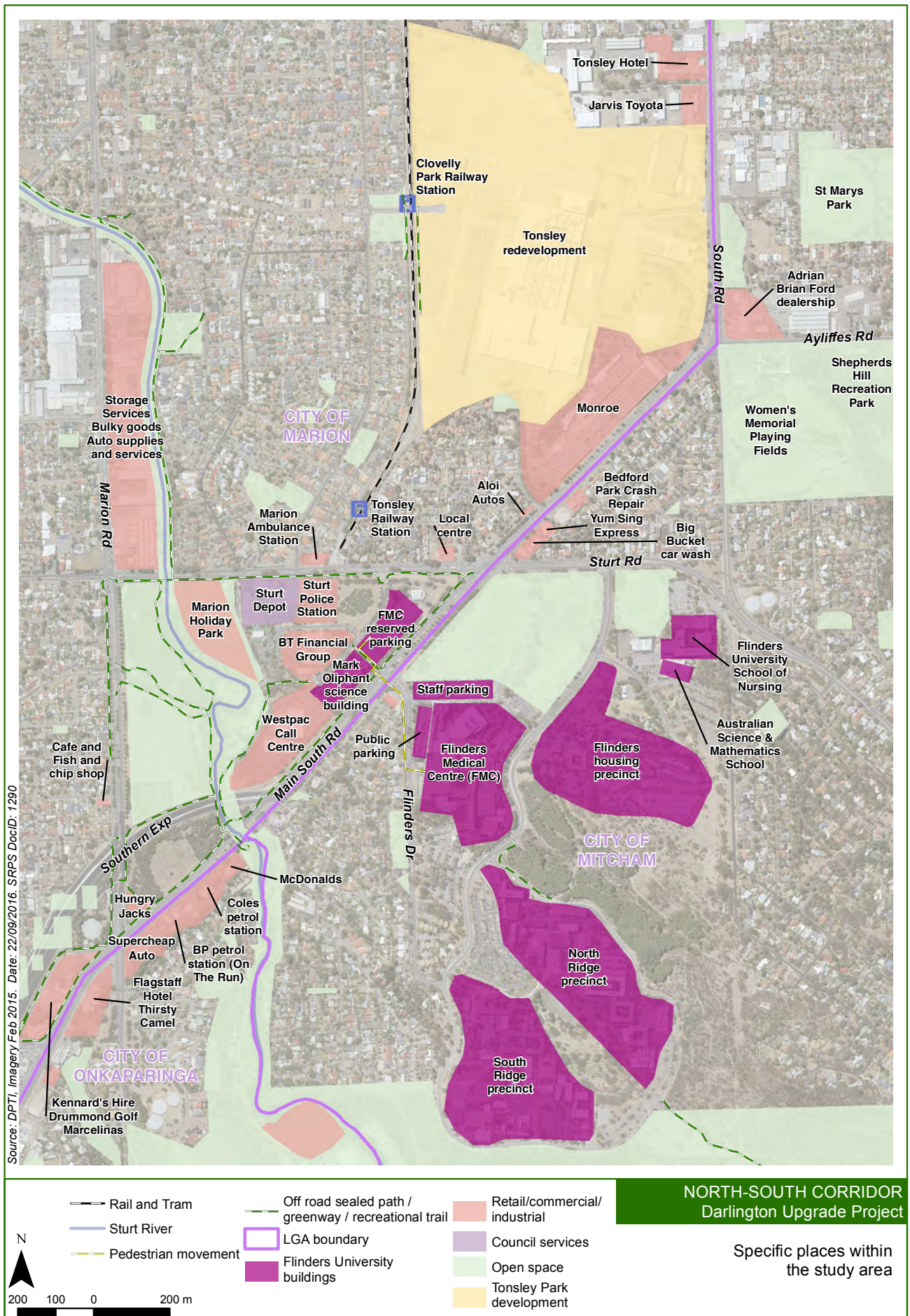


Figure 23 - Specific places within the study area

Local business health

The relocation of businesses also has the potential to impact on the socioeconomic health of the local business sector, which often includes family businesses and locally grown business. Particular areas of susceptibility include:

- > The medical centre and dentist, particularly given industry protocols around catchment areas and client bases
- > Small businesses that may not have the skills, resources and/or business experience to relocate and set up elsewhere.

Impact on business operations

For businesses remaining within the area, the planning and design phase of the project may have the potential to impact on their operations, especially where small amounts of land may be needed, where visual impacts may change business exposure; or where the design impacts on access arrangements. For the Darlington Upgrade Precinct, these impacts are most likely to occur at:

- > Retailing, commercial and hotel/club facilities on Main South Road at the northern end of the project, where efficient access and business exposure is important to ongoing competitiveness
- > The corner of Ayliffes Road and Main South Road, currently home to a large car dealership and Novita Children's Services. Depending on design, the project has the potential to affect business exposure and physical access
- > The Darlington area, where efficient access to restaurants, bulky goods retailing and petrol retailing is essential to business operations
- > The Monroe site, in relation to its long term access arrangements
- > Businesses within Science Park where car parking is potentially impacted by the footprint
- > Sturt Road shops.

The project as an enabler of future socioeconomic growth

A key opportunity for the Darlington Upgrade Project is as an enabler of future growth. During planning and design it will be essential to ensure that the project does not preclude future options of realising the area's full potential. To this end, the planning process incorporates an extensive collaborative engagement program with key stakeholders to plan for future opportunities including:

- > Opportunities for residential redevelopment particularly where there are good links to public transport facilities
- > Provision for the Flinders Link rail line extension to the hospital (announced)
- > Opportunities for additional retail opportunities, including food retail to replace acquired businesses and to service the growing population of residents, employees, students and visitors to the area
- > Opportunities to improve connectivity between Tonsley Park, Science Park and the Flinders Precinct to help facilitate growth.

10.3.2 Construction

The construction of the Darlington Upgrade Project has the potential to impact on socioeconomic considerations for residents, employees, business owners and operators and local community services. Such impacts, if not properly managed, could be:

- > The effect of construction impacts such as noise, vibration and dust
- > Traffic management impacts and temporary changes to access arrangements
- > Accessibility across Main South Road to access residential areas, services, facilities and businesses
- > Car parking impacts during construction in an area already experiencing significant undersupply of car parking for students, hospital visitors and employees
- > Safety and security of the large number of employees, visitors and students travelling to and around the area
- > Visual amenity and the effects of construction on the liveability of residential areas during construction.

10.3.3 Operational

Operational impacts and opportunities of the Darlington Upgrade Project relate primarily to the long term ability for it to leave a legacy and have a positive impact on the socioeconomic health of the area. Much of this will be associated with the role of the project as a driver or enabler of growth, particularly in relation to integrating community benefit opportunities into the design process.

10.4 Management and mitigation

10.4.1 Planning and design

The potential socioeconomic effects of the Darlington Upgrade Project during planning and design predominantly relate to the impact of the project footprint on both residential areas and social services and businesses. In order to address these impacts, the following mitigation actions are envisaged:

- > Minimising the project footprint
- > Providing opportunities for community engagement including consultation on, and involvement in, negotiable aspects of the design
- > Designing noise mitigation in consultation with affected residents where appropriate
- > Investigation of landscaping and urban design opportunities focusing on enhancements to the local area
- > Specifically addressing opportunities to improve connectivity across Main South Road in consultation with the community, particularly for pedestrians at Flinders Drive and between the university campuses
- > Providing support to businesses required to relocate
- > Investigating opportunities to support businesses to return following construction if possible and where it fits within the wider planning objectives of the precinct
- > Investigating development opportunities as part of the planning process in collaboration with stakeholders to ensure the project's role as an enabler of growth.

10.4.2 Construction

The potential socioeconomic effects of the Darlington Upgrade Project during construction predominantly relate to impacts such as dust, vibration, noise, traffic and access, pedestrian connectivity, safety, and visual amenity. In order to address these impacts, the following mitigation actions are envisaged:

- > Supporting businesses through construction via the implementation of 'business as usual' strategies and regular provision of information on scheduling

- > Investigating opportunities to provide temporary food retail premises during construction
- > Implementing a suite of management plans to help minimise impacts on residents, services and businesses including the Contractor's Environmental Management Plan, Stakeholder and Community Engagement Management Plan, and Traffic Management Plan
- > Communicating with the community and stakeholders to increase awareness of the project and to manage potential impacts
- > Considering value-add community opportunities and projects to enhance community wellbeing and belonging such as environmental enhancement and cultural awareness
- > Investigating educational opportunities in partnership with local schools, the university and other community groups to increase awareness of, and involvement in, the project during construction.

10.4.3 Operational

Proposed operational mitigation strategies for the Darlington Upgrade Project relate primarily to the area's ongoing development following construction of the project. It is therefore proposed to integrate long term operational objectives into the design and planning process to ensure that the project plays an enabling role in the ongoing growth of the precinct and does not eliminate any future opportunities.

10.5 Conclusion

The Darlington Upgrade Project has the potential to impact on the socioeconomic environment of the area predominantly via the planning and design process. The potential for the project to enable and in some cases, drive socioeconomic enhancements will be optimised and these will include economic growth and community support opportunities, enhancements to visual amenity, noise mitigation and urban design, and integration of project elements with good outcomes for community connectivity, particularly across Main South Road.

The construction process will focus on minimising impacts to local residents and businesses, community awareness and education, supporting businesses through the construction phase, and investigating opportunities for temporary community services displaced by the project footprint.

11 Access and movement

11.1 Context

11.1.1 Assessment methodology

The assessment of access and movement effects has been undertaken using the following methodology:

- > Catchment and travel demand analysis
- > Review of existing infrastructure and its capacity
- > Analysis of cycling and walking demand
- > Review of the effects of the project
- > Development of mitigation strategies and opportunities.

11.1.2 Relevant legislation, strategies and policies

The following legislation, strategies and policies have been reviewed and considered as part of the assessment of access and movement effects:

- > *Highways Act 1926*
- > *Road Traffic Act 1961*
- > *Disability Discrimination Act 1992*
- > *A Functional Hierarchy for South Australia's Land Transport Network, 2013*
- > *Austroads National Performance Indicators*
- > *Integrated Transport and Land Use Plan, 2015*
- > *National Cycling Strategy, 2011-2016*
- > *National Road Safety Strategy, 2011-2020*
- > *Seven Strategic Priorities*
- > *10 Economic Priorities*

11.2 Existing conditions

11.2.1 Road network

Travel demand analysis

The project area comprises a road network with links administered at the national, state and local government level. The arterial road network in the Darlington Upgrade Project area is critical to the movement of traffic between the outer southern suburbs and the rest of the Adelaide metropolitan area. The precinct acts as a 'squeeze point' for traffic converging at this location from:

- > Main South Road
- > Flagstaff Road
- > The Southern Expressway
- > Shepherds Hill Road
- > Ayliffes Road.

The convergence of the Southern Expressway, Main South Road and Flagstaff Road into Main South Road and Marion Road represents one of just three road transport corridors that carry traffic over the southern hills escarpment, the others being Lonsdale Road/Brighton Road, and Main Road through Coromandel Valley. The corridor is therefore heavily used by private vehicles, heavy vehicles, public transport, cyclists and pedestrians.

The precinct also encompasses major regional destinations that include the Flinders Medical Centre, Flinders Private Hospital, Flinders University and Tonsley redevelopment.

An analysis of traffic patterns in the project area identified that:

- > Approximately 70% of traffic passes through the area with an origin or destination outside the precinct, and
- > The remaining 30% of traffic has an origin or destination within the precinct, including local residents, visitors, employees or people accessing services and facilities such as the hospitals or university.

Traffic volumes

Traffic volume estimates in and around the Darlington precinct for 2015 are shown in Figure 24. The Ayliffes Road to Sturt Road and Sturt Road to Southern Expressway of Main South Road carry average daily traffic volumes of 72 700 and 70 600 vehicles per day respectively. These are the two busiest road sections in the South Australian road network, which results in a number of transport efficiency and safety concerns.

There are only seven other road sections in the state with volumes greater than 60 000 vehicles per day. In comparison, some of the other major roads in the Adelaide metropolitan network cater for significantly lower traffic volumes as follows:

- > Port River Expressway – 62 000 vehicles per day
- > Anzac Highway, at South Road – 50 000 vehicles per day
- > Port Road (at South Road) – 45 000 vehicles per day
- > Main North Road – 45 000 vehicles per day
- > South Eastern Freeway – 46 600 vehicles per day.

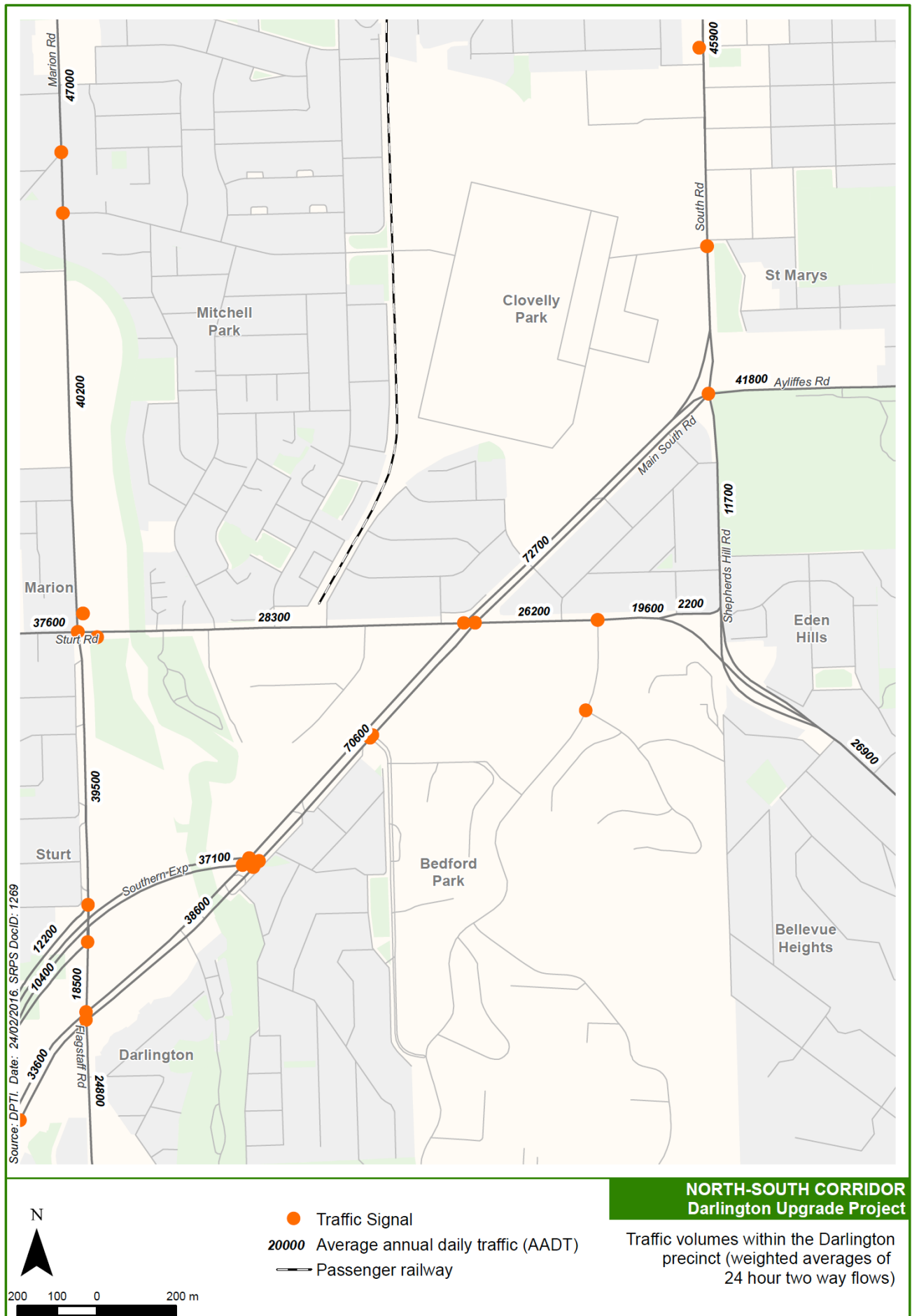


Figure 24 - Traffic volumes within the Darlington precinct

The Main South Road/Sturt Road intersection is currently the busiest at-grade intersection in South Australia, with an exposure of 98 400 vehicles per day travelling through it, split approximately 70/30 % between Main South Road and Sturt Road. Only the intersection of Port Wakefield Road and Salisbury Highway is busier at 113 500 vehicles per day and this intersection is grade separated by an overpass.

Travel speed

Travel speed is commonly used to assess the performance of a section of the road network. Main South Road in the Darlington precinct has a current posted speed limit of 70 km/h, and Sturt Road is posted at 60 km/h. Table 14 shows results of travel speed monitoring and highlights that there are significant impediments to travel speeds in peak hours, with most sections being near or below the Austroads National Performance Indicator.

Intersection delay

Intersection delay is closely associated with travel speed and road network performance. The intersections of South Road with the Southern Expressway and Sturt Road experience high levels of delay for passenger and commercial vehicles. Figure 25 identifies the delays at these intersections compared with other intersections along Main South Road. Delays at these locations are due to the intersection of arterial roads with high peak traffic and the impact of east-west movements on north-south movements.

Accidents

An analysis of crash statistics for the period from 2010-2014 revealed that rear end crashes represented around 68% of all crashes between Ayliffes Road and the Southern Expressway, which is indicative of high congestion and higher speed limits along this section of road. Traffic is regularly forced to stop at the signalised intersections, which increases the potential for rear end crashes. There is also a high level of uncontrolled left hand turning traffic in mid-block road sections as well as at intersections, which contributes to these types of crashes. Figure 26 shows crash history 2010-2014.

The crash history of South Road within the Darlington precinct is comparable to that of similar major arterial roads across the state. Each of the signalised intersections from Ayliffes Road to the Southern Expressway inclusive could be classified as a 'Black Spot' as they all meet the current program requirements of at least two casualty crashes in the last five years. Approximately 85% of the casualty crashes within the project area between 2010-2014 occurred during daylight hours, and 90% occurred in dry conditions. These figures are typical for the current major arterial road environment and conditions and do not indicate a significant issue with lighting or slippery road surfaces.

The intersection of Main South Road and Sturt Road had the 18th highest rate of casualty crashes of any intersection in South Australia over the five year period ending December 2014, including 32 casualty crashes and 76 crashes resulting in property damage only.

South Road link (intersection with)	Average speed (km/h)					
	Morning peak (7am-9am)		Business hours (10am-3pm)		Afternoon peak (4pm-6pm)	
	North - bound	South - bound	North - bound	South - bound	North - bound	South - bound
Ayliffes Road to Sturt Road (0.8km)	54.6	46.6	59.0	42.5	55.5	35.9
Sturt Road to Marion Road (1.4km)	27.0	35.4	38.6	41.4	37.0	41.6
Sturt Road (1.3km)	28.4	23.8	33.1	28.1	20.8	17.4
Austrroads National Performance Indicator for 2011-12	33.1		42.4		36.6	

Table 14 - Average speed for Main South Road links in the Darlington Precinct

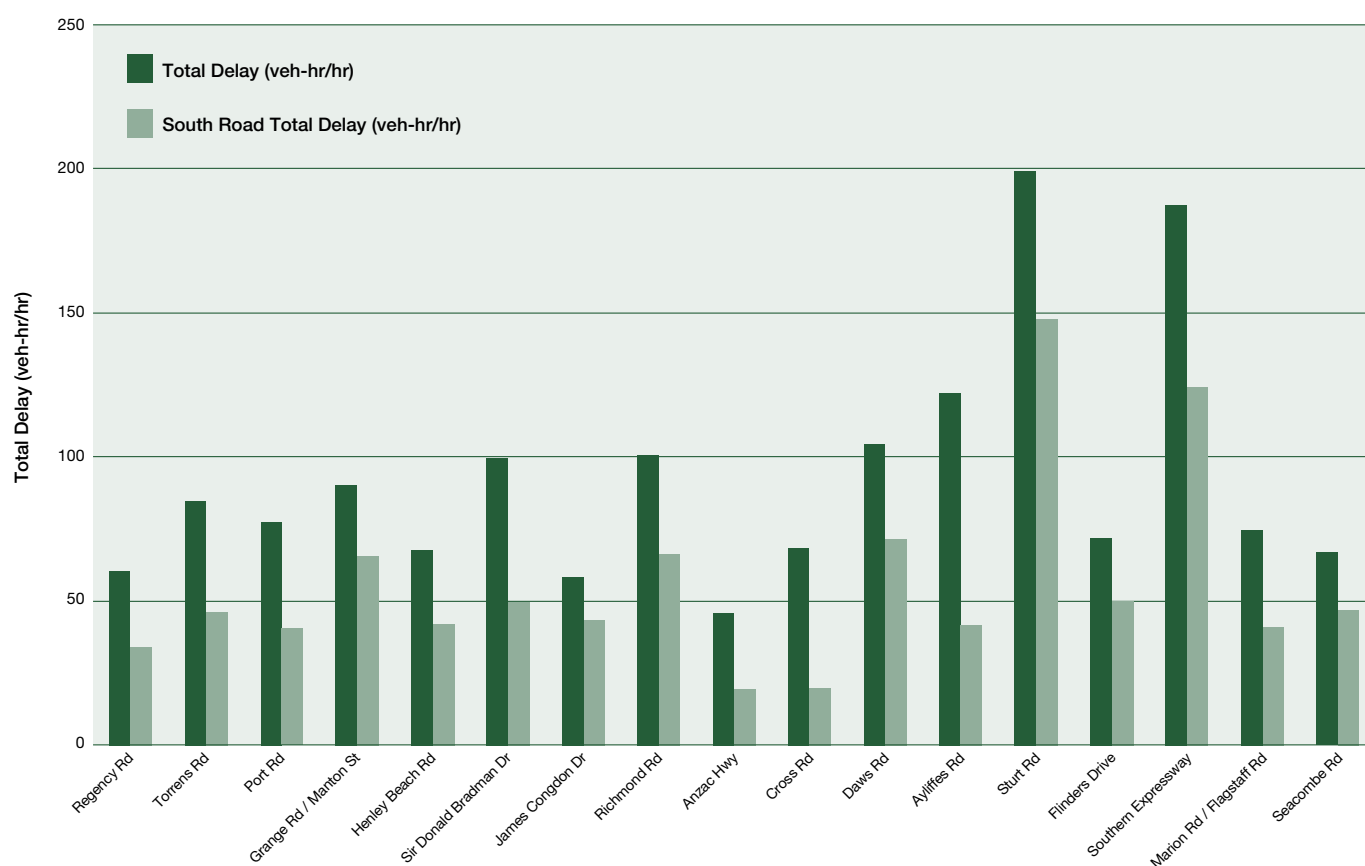


Figure 25 - Main South Road intersection performance

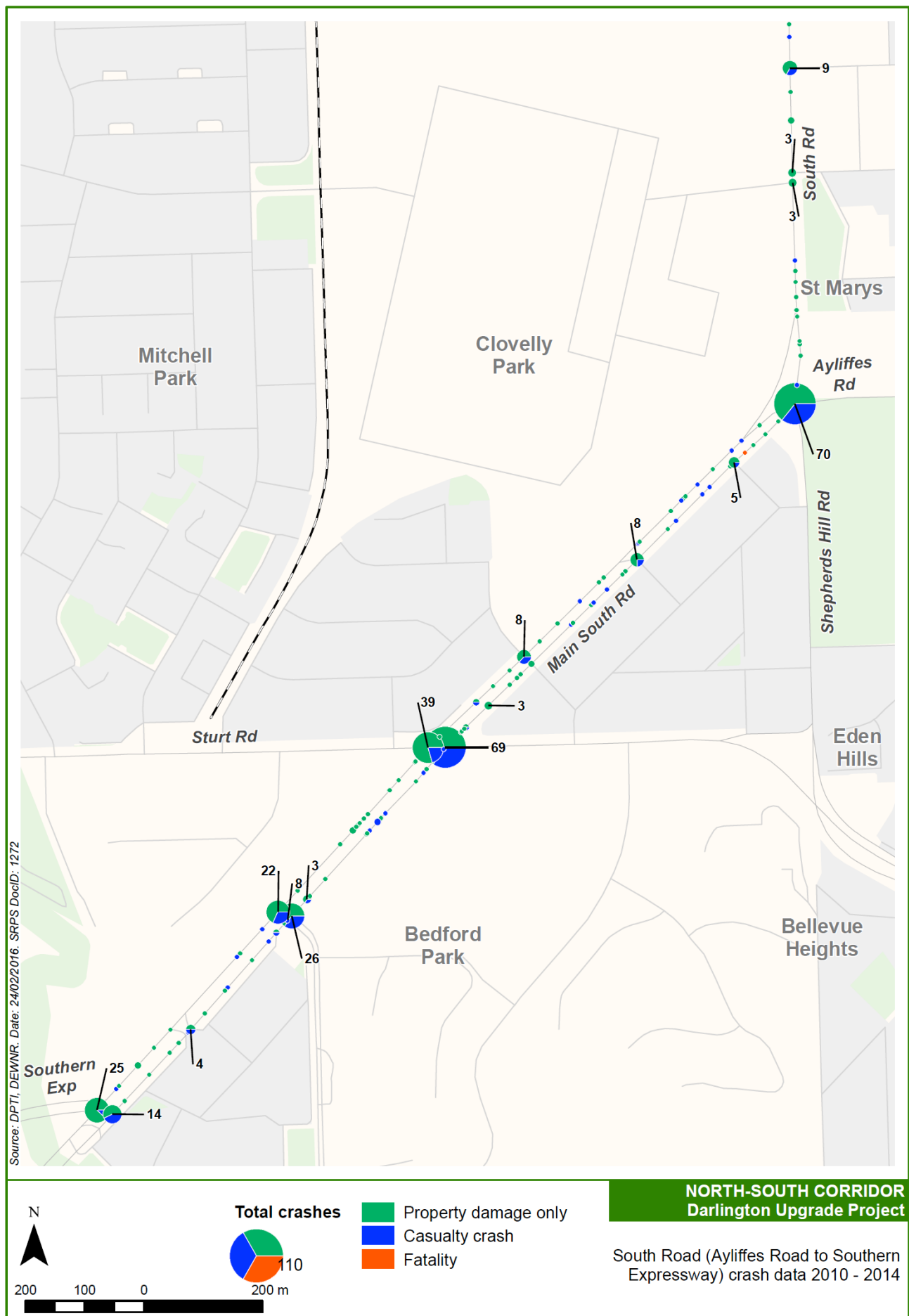


Figure 26 - South Road, Ayliffes Road to Southern Expressway crash data, 2010-2014

Local road network

The local road network in the Darlington Upgrade Project area links the arterial road network with surrounding communities, including St Marys, Clovelly Park, Bedford Park and Darlington. These local roads generally permit left in and left out movements to and from Main South Road and the local road network. Some right-turn in and out movements between Main South Road and local roads are restricted due to the high volumes of conflicting movements.

Separate right turn lanes exist in those sections of Main South Road where a central median is provided. These provide a safe opportunity to turn right into selected local roads using a protected turn lane.

Flinders Drive connects directly into Main South Road on the eastern edge for access to Flinders Medical Centre and Flinders University at a signalised intersection allowing for full traffic movements.

Other local access roads that interface with the project include:

- > Lloyd Street, St Marys
- > Tobruk Avenue, St Marys
- > Quinlan Avenue, St Marys
- > Brookman Avenue, St Marys
- > Selgar Avenue, Clovelly Park
- > Tonsley Boulevard, Clovelly Park
- > Maidstone Road, Bedford Park (north)
- > Lincoln Road, Bedford Park (north)
- > Sutton Road, Bedford Park (north)
- > Mimosa Terrace, Clovelly Park
- > Maple Avenue, Clovelly Park
- > Laffer Drive, Clovelly Park
- > Birch Crescent, Clovelly Park
- > Richard Street, Bedford Park (south)
- > Franklin Avenue, Bedford Park (south)
- > Riverside Drive, Bedford Park (south)
- > Brookside Road, Darlington.

11.2.2 Freight network

Important freight routes are identified in *A Functional Hierarchy for South Australia's Land Transport Network, 2013*, which highlights Main South Road as the strategic freight route through the western sector for north-south travel. Main South Road is currently the only continuous north-south freight route for heavy vehicles on the western side of Adelaide, with Marion Road, Sturt Road,

Shepherds Hill Road and the Southern Expressway also providing heavy vehicle access in the southern metropolitan area. Main South Road south of Seacombe Road and Diagonal Road are general oversize and over-mass routes.

Large volumes of freight move through metropolitan Adelaide along designated major road and rail corridors that link major freight nodes, including Port Adelaide, industrial centres, Adelaide Airport, rail and road freight terminals and inter-modal facilities. Heavy vehicle traffic estimates are shown in Figure 27.

For the Darlington section of South Road between Ayliffes Road and the Southern Expressway, heavy vehicle traffic, defined as two axle trucks or buses or larger, constitutes approximately 5% of the total traffic estimates. The proportion of heavy vehicle traffic on the surrounding roads varies from 3% on Ayliffes Road and Shepherds Hill Road to 6% on the Southern Expressway. These figures indicate that there is currently significant interaction between heavy and light vehicles throughout the Darlington precinct. The presence of signalised intersections at key arterial roads, including Sturt Road, Flinders Drive and the Southern Expressway, is a key contributor to the efficiency and safety issues on South Road.

11.2.3 Emergency vehicle access

Throughout the planning phase, the project team has been working with Flinders Medical Centre, Flinders Private Hospital and other emergency services to understand their current requirements in the precinct. This includes matters relating to access, the function of Flinders Drive and other access points to the Flinders precinct. The project team will continue to work with these institutions.

Emergency vehicle access is an important aspect of the Darlington precinct, and is particularly relevant to the South Australia Police, South Australian Metropolitan Fire Service and South Australian Ambulance Service given the location of the following facilities within the Project area:

- > A 24/7 emergency department at Flinders Medical Centre, Bedford Park
- > Marion Ambulance Station on Sturt Road, Mitchell Park
- > Sturt Police Station on Sturt Road, Clovelly Park.

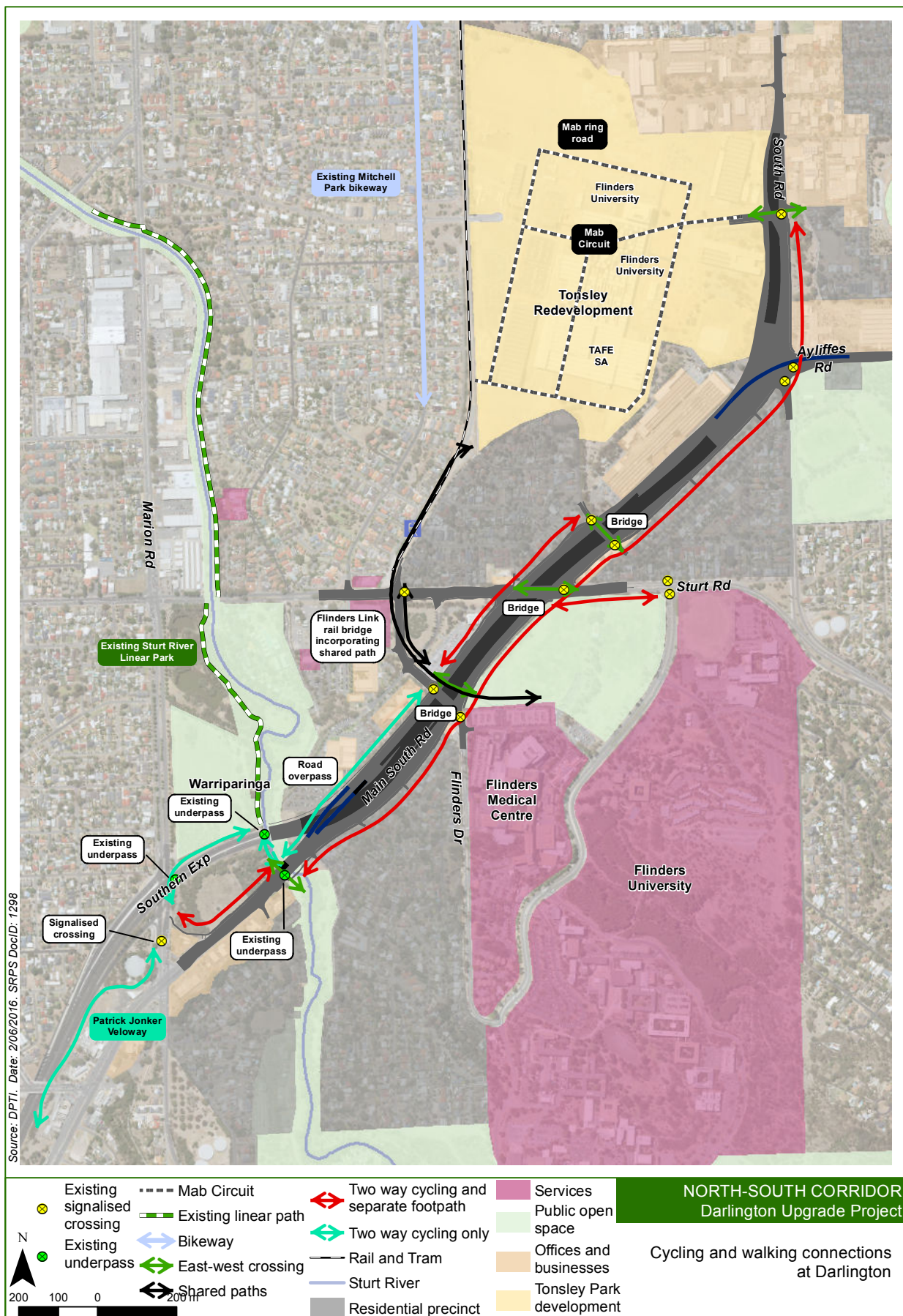


Figure 27 - Heavy vehicle traffic estimates

11.2.4 Parking

On-street car parking

Due to the role and function of Main South Road, parking is not permitted along the length between Marion Road and Sturt Road. Some on-road parking is permitted on the eastern side of Main South Road between Sturt Road and Ayliffes Road to service the adjacent commercial and residential land uses.

On-street car parking on local roads is managed by the Cities of Marion, Mitcham and Onkaparinga and is generally permitted on local streets in all residential areas, with parking restrictions in place at selected locations in response to cars generated by visitors, staff and students of the adjacent Flinders Medical Centre and Flinders University.

Off-street parking

Due to a lack of on-site parking availability, the Flinders Medical Centre lease a car parking area within the Sturt Triangle owned by the State Government. Flinders University parking on campus is available to all staff, students and visitors at a minimal cost. Parks are located around the campus and Sturt precinct. During the first term of semester one, when parking demand is high, there is overflow parking available for University staff and students on the main lower oval, opposite Flinders Private Hospital.

11.2.5 Public transport

Rail services

The Seaford Line travels 10 kilometres from the Adelaide Railway Station to Ascot Park Station, where the Tonsley Line continues south for a further 3.2 kilometres terminating at the Tonsley Station near Sturt Road (Mitchell Park). It is single track for its entire length from the junction near Ascot Park to the terminus at Tonsley, with two intermediate stations.

Tonsley train line terminates at Sturt Road approximately 310 metres north west of the South Road intersection with Flinders Drive. Currently the terminus of the Tonsley train line is not connected with any other public transport services.

Services for the Tonsley railway line operates hourly on weekdays, with more frequent services during peak periods. No services operate between 7pm and 7am on weekends.

The Flinders Link rail extension project, will extend the Tonsley spur line across Main South Road to Bedford Park.

The Flinders Link rail extension will incorporate a new station adjacent the Flinders Medical Centre and service workers, residents and visitors to the University and hospital facilities located in this precinct.

Bus services

Existing bus services run along all arterial roads in the precinct including South Road, Southern Expressway, Sturt Road, Marion Road, Shepherds Hill Road and Ayliffes Road as well as key local roads such as Bradley Grove, Flinders Drive and University Drive. These bus services connect Adelaide City and Metro south regions via local hubs including the Darlington precinct.

South Road and Sturt Road are key public transport corridors through the Darlington precinct. Currently 774 buses pass through the South Road intersection with Flinders Drive on a weekday. In October 2014, these buses were recorded as carrying 12 938 passengers on average per day.

In the Darlington Upgrade Project area, there are bus interchanges located at Flinders Medical Centre and Flinders University. The majority of existing buses service either or both of these bus interchanges except for express services.

11.2.6 Cycling and walking

Existing walking facilities

Footpaths are provided along most roads within the study area. Alongside arterial roads, these are typically wider than the standard minimum of 1.2 metres and adjacent to the kerb. Due to the high traffic volumes, lack of shade and numerous driveways, Main South Road does not provide a particularly comfortable walking environment.

The major arterial road intersections typically provide pedestrian crossings as part of traffic signal control, including audio-tactile pedestrian buttons. However, due to the sizes of the intersections, crossing is often conducted in stages and may not be provided on all legs of the intersection. Vehicle slip lanes create another stage in intersection crossings, although only multi-lane slip lanes tend to have signal control.

Formal pedestrian crossings over Main South Road are located at:

- > Tonsley Boulevard
- > Ayliffes Road/Shepherds Hill Road
- > Sturt Road
- > Flinders Drive.

The footpath and shared path along South Road also link to Flinders Drive and hence to the Flinders Medical Centre, Flinders Private Hospital and University via a staged pedestrian crossing at the traffic signals. This crossing point is well patronised as Flinders Medical Centre currently leases around 468 car park spaces in the Sturt Triangle and makes these available to staff via permits.

An underpass of Main South Road at Sturt River is the only designated grade-separated crossing of Main South Road within the Darlington Upgrade Project area, and services bus stops either side of the road.

Existing cycling facilities

In Warriparinga, a network of paths connects the Patrick Jonker Veloway, and the paths leading under the bridges over the Sturt River at the Southern Expressway and Main South Road. The Patrick Jonker Veloway starts at Marion Road and follows the Southern Expressway on a route that ultimately reaches Willunga via the Sea to Vines Trail, in the southern suburbs. The Sturt River Linear Park provides an important pedestrian and cycle link through the project area and the staged implementation of a concept plan by the Cities of Onkaparinga and Mitcham seeks to progressively invest in facilities.

Shared paths of low standard along Sturt Road, Marion Road and Main South Road form a recreational route as well as linkage between the Patrick Jonker Veloway, Sturt River Linear Path and the Main South Road underpass. A section of shared use path links the pedestrian crossing at the Flinders Drive signals to Laffer Drive.

Arterial roads provide important cycle access and Main South Road, Shepherds Hill Road, Flagstaff Hill Road, Marion Road and Sturt Road west of Marion Road, all have exclusive cycle lanes, but these are not necessarily continuous nor operate full-time. There are also bike lanes and a shared use path on Ring Road within the Flinders University.

There are also numerous cyclist and pedestrian generators along South Road or within close proximity to South Road. Both Marion Road and Goodwood Road provide direct north-south routes as an alternative to South Road. The lack of cycle lanes and high traffic volumes on South Road are likely to deter cyclists, reflected by the low total cyclist volumes on this route.

Projected future demand for pedestrian and cyclist facilities

The Tonsley redevelopment and proposed Flinders Link extension to the Tonsley rail line, will likely lead to an increased demand in non-motorised transport between these facilities and the hospitals and university at Bedford Park. Similarly, the extension to the Flinders Medical Centre as part of the Transforming Health Project, and any future redevelopment proposals at Flinders University will impact on projected demand for pedestrian and cyclist facilities. Figure 28 shows predicted future pedestrian movements in the precinct.

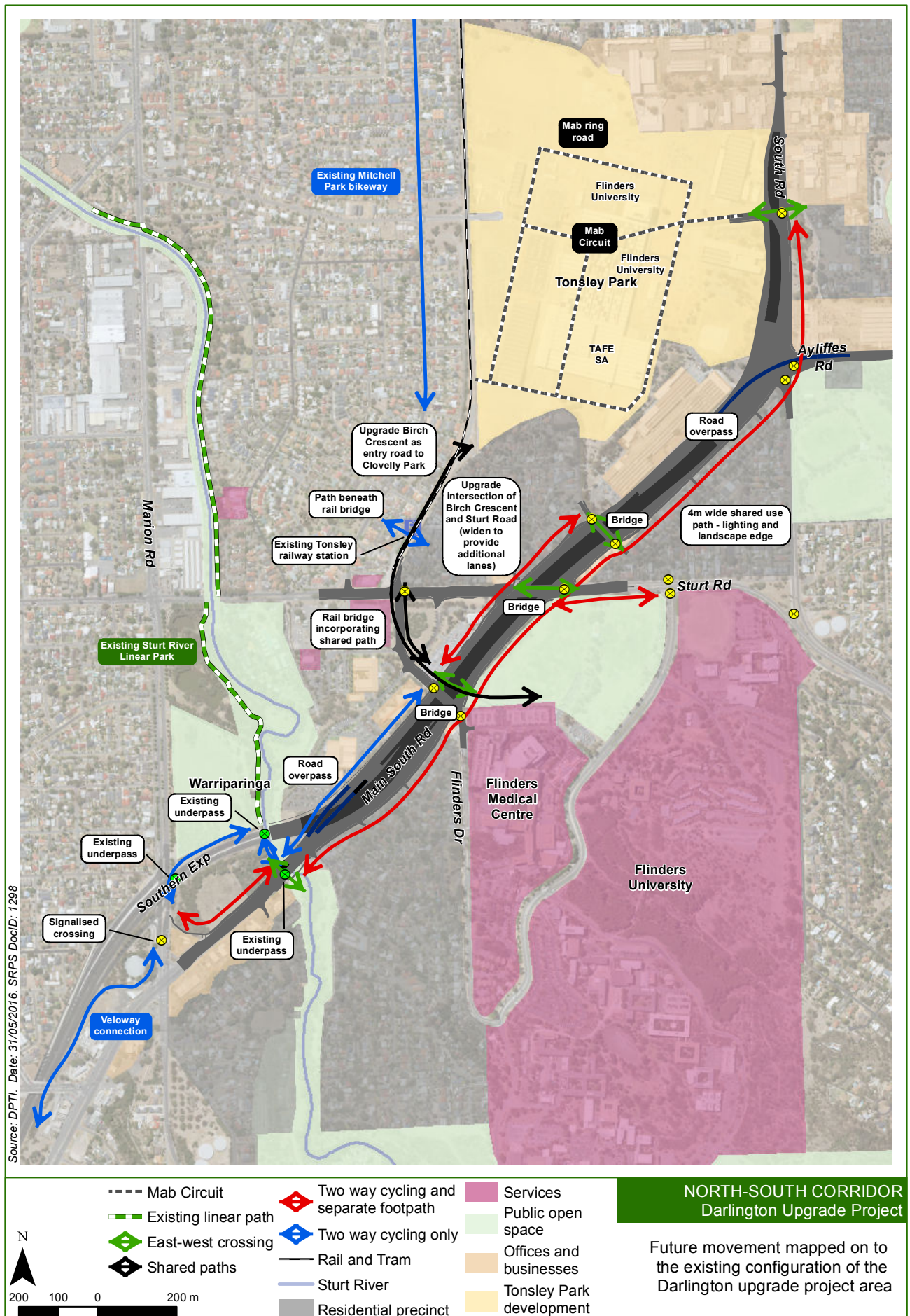


Figure 28 - Predicted future pedestrian and cyclist movements

11.3 Potential effects and opportunities of the project

11.3.1 Planning and design

The planning and design phase of the project represents the greatest opportunity to respond to future projected access and movement requirements. A detailed design process will be undertaken in the context of projected travel demands. In particular, it is expected that the project will:

- > Provide non-stop access between the Southern Expressway and the intersection of Ayliffes Road and just north of Tonsley Boulevard to meet projected travel demands
- > Allow commuters to bypass a series of signalised intersections through the precinct, from the Southern Expressway to just north of Tonsley Boulevard
- > Maintain and enhance local access to the area, particularly in relation to essential services
- > Improve access and connectivity via the provision of a road bridge and paths between Sutton Road and Mimosa Terrace
- > Improve traffic efficiency and safety both through and to/from the precinct
- > Encourage and improve walking and cycling opportunities by incorporating new and upgraded pedestrian and cyclist facilities
- > Improve access to public transport opportunities, particularly rail and bus services
- > Provide opportunities for urban, landscape, revegetation offsets and environmental improvements where possible
- > Compliment the culture and unique character of the precinct.

11.3.2 Construction

The staging, construction and methodology adopted is expected to manage the impacts of construction on existing access and movement arrangements in relation to the following potential effects:

- > Travel times, particularly in peak hours for commuter traffic passing through the site and particularly for those travelling from the hills and the southern suburbs
- > Travel times and ease of access to essential services for employees, students, visitors and users of services associated with the Flinders Medical Centre, Flinders Private Hospital, university, offices, retail, commercial and other land uses located within and adjacent to the precinct

- > Ease of access for residents within the suburbs of St Marys, Clovelly Park, Bedford Park and Darlington
- > Changes to public transport services including bus stop relocations
- > Changes to pedestrian and cyclist routes, including temporary diversions
- > Travel times and congestion related to the diversion of traffic to other main roads within the road network
- > Construction traffic using the road network
- > Further car parking demand created by the construction workforce in an area already impacted by car parking issues
- > Connectivity for pedestrians and cyclists, particularly in relation to crossing the Main South Road corridor.

11.3.3 Operational

- > From an operational perspective, the Darlington Upgrade Project is expected to deliver significant improvements in the following areas:
- > Reducing the number of rear end crashes along the non-stop corridor by grade separating intersecting roads
- > Improving safety by allowing more turning movements to be controlled as well as freeing up more 'green light' for minor movements due to the reduced congestion
- > Improving travel times for the 70% of traffic passing through the precinct by providing a non-stop motorway that avoids a number of sets of traffic lights
- > Reducing traffic volumes on the surface roads by separating through traffic, improving levels of service to the local area
- > Improving access to public transport facilities via improved pedestrian and cyclist facilities
- > Improving travel times and access for motorists travelling over the corridor at Sturt Road
- > Improving travel times and reliability for freight, reducing transport costs
- > Improving travel times and reliability for public transport via the non-stop motorway for express services and less traffic affecting local bus services on the Main South Road surface roads
- > Improving cyclist commuter facilities via dedicated two-way cycling paths and connections to the remainder of the cycling network
- > Improving pedestrian connectivity across the road corridor due to the provision of walking paths and upgraded footpaths.

11.4 Management and mitigation

11.4.1 Construction

A detailed Construction Management Plan has been prepared to manage the potential effects of the project on access and movement arrangements. In particular, construction will be staged in such a way to minimise impacts on the flow of traffic, particularly during peak times. In this regard, the project will be staged to construct the surface roads first to accommodate traffic flows during construction, including temporary pavements where required to manage peak flows.

The Construction Management Plan incorporates a Traffic Management Plan that will detail management strategies in relation to:

- > Ensuring access to Flinders Medical Centre for emergency services at all times
- > Changing access arrangements for properties and the local road network
- > Speed restrictions around the work zone as required
- > Temporary traffic arrangements to retain local access
- > Maintenance of access to properties and the local road network, including temporary access if required.

In addition, a Stakeholder and Community Engagement Management Plan will address the communication of impacts on access and movement, providing advance warning of programmed changes and details of alternative arrangements. Communication mechanisms will include notifications, variable message signs, the use of newsletters and door knocking where required.

Parking for the construction workforce during construction of the Darlington Upgrade Project will be provided to ensure that the project does not adversely impact on the existing issues relating to car parking. DPTI will work closely with the Flinders Medical Centre to manage the impact of the project on the land currently leased from DPTI for staff car parking and an equivalent number of spaces will be protected for use by the Flinders Medical Centre for the duration of the project.

11.4.2 Operational

Operational impacts of the project on access and movement will predominantly be positive, with additional opportunities for enhancements gained via the detailed design process, particularly in relation to the design of pedestrian and cyclist connections and local access arrangements.

11.5 Conclusion

It is anticipated that the Darlington Upgrade Project will deliver a number of significant improvements to the access and movement arrangements in and around the area including free-flow access via the non-stop motorway for the 70% of traffic that passes through the precinct on a daily basis. Vehicular access to key services, commercial, retail and institutional land uses will be enhanced via the provision of service roads and upgraded intersections, and a new connection between Sutton Road and Mimosa Terrace. Pedestrian and cyclist access and connectivity across the road corridor will be enhanced via the provision and upgrade of dedicated cycling and walking paths. The safety of motorists, pedestrians and cyclists passing through and accessing the precinct is also expected to improve, particularly in relation to rear end crashes and safer turning movements.

The impacts of constructing the Project on access and movement will be carefully managed via a staging program that will facilitate existing traffic flows and movements wherever possible through the use of measures such as temporary pavements and traffic management. This will minimise impacts on travel times and ensure that access to essential services, residential and other land uses is maintained.

12 Non-indigenous heritage

12.1 Context

12.1.1 Assessment methodology

Identifying the key heritage issues and options to mitigate the impacts of the Darlington Upgrade Project on heritage places and historic areas included:

- > A review of relevant legislation and policy
- > A desktop review of existing conditions including summarising the history of the area
- > Identification of national, state and local heritage items
- > Identification of potential impacts and management and mitigation activities.

Relevant legislation

The assessment of non-indigenous heritage effects has been undertaken in the context of several items of national and state legislation including:

- > *Australian Environment Protection and Biodiversity Conservation Act 1999*
- > *South Australian Heritage Places Act 1993*
- > *South Australian Development Act 1993*
- > *South Australian Highways Act 1926.*

12.2 Existing Conditions

12.2.1 Statutory heritage listings

No places within the Darlington Upgrade Project area are entered in the Commonwealth Heritage List established under the *Australian Environment Protection and Biodiversity Conservation Act 1999* and no heritage sites of national significance are present in or adjacent to the project site.

One state and two local heritage places have been identified within the wider project area, namely the state-listed Fairford House, and the locally listed Women's Memorial Playing Fields and St Marys Park. Heritage listings are detailed in Table 15 and their location is shown in Figure 29.

Fairford House

Fairford House has a long association with a single family. Horticultural activities began in 1839 on the land when it was originally granted to George Fife Angas. When Henry Laffer purchased the land in 1876 he extended the single roomed cottage into a bungalow. The property remained in the Laffer family for 112 years. The land was used for a variety of activities including vineyards, orchards and cow paddocks. By 1960 the eldest son, Albert, increased the vineyards and sold wine grapes to different wineries including Byard, Goode, Penfolds and Hamilton. Fairford House was occupied and maintained until 1989.

The coach house was constructed in the 1860s as a winemaking storage facility but later used as a fruit packing shed - the large timber packing benches are still in place. During World War II, Italian prisoners of war worked as grape pickers and slept in the loft of the coach house.

The surviving orchards on the property are important as remnants of an industry which was central to the early European development of Sturt River and the Marion region. Research indicates that the garden surrounding Fairford House was created in the 1870s and the present layout established in the 1920s (City of Marion, 2010).

Women's Memorial Playing Fields

The Women's Memorial Playing Fields on Ayliffes Road were established in 1953 when the Hon Sir Thomas Playford set aside 20 acres of reserve for a centre for womens' sport. Between 1953 and 1955 the fields prospered and in 1956 a memorial drinking fountain was erected and the grounds as a whole dedicated to the South Australian servicewomen who served during World Wars I and II (Office for Recreation and Sport, 2014).

St Marys Park

St Marys Park was opened in 1929 as the South Road Recreation Ground. Swag men camped here in a shed during the Great Depression of the 1930s. The South Adelaide Football Club (The Panthers), established in 1875 as South Australia's second oldest club, made this park its home ground in 1969. In 1997, the reserve was renamed St Marys Park as the South Adelaide Football Club had moved to Noarlunga in 1995. (City of Mitcham, 2014).

Place	Address	Status (criteria)	Distance from Project footprint
Fairford House, coach house (former winery) and grounds	Sturt Triangle Sturt	State	70 metres (approximately)
Women's Memorial Playing Fields	Ayliffes Road St Marys	Local criteria a: displays historical, economic or social themes that are of importance to the local area criteria e: associated with a notable local personality or event	Within footprint (derelict tennis courts)
St Marys Park	21-23 Laura Avenue St Marys	Local criteria e: associated with a notable local personality or event criteria f: a notable landmark in the area	200 metres (approximately)

Table 15 - State and Local Heritage places in the wider project area

12.3 Potential effects and opportunities of the project

12.3.1 Planning and design effects

The key potential planning and design effects on non-indigenous heritage places relate to the direct impact of the footprint affecting the integrity of any of the three heritage places located within the wider project area. Given the distance of Fairford House and St Marys Park from the boundary, the project is not expected to impact on either of these heritage places.

In relation to the Women's Memorial Playing Fields, the footprint of the project is expected to extend into the currently derelict and unused tennis courts located on the corner of Ayliffes Road and Main South Road, impacting on approximately one-third of the court area.

12.3.2 Construction effects

The key potential construction effect on non-indigenous heritage places is the impact of vibration on the structural integrity of buildings. Given the distance of the state heritage listed Fairford House and the locally listed St Marys Park from the project footprint, it is considered highly unlikely that vibration from construction will affect any heritage listed structures. Refer to the Noise and Vibration Chapter of this report for more details on the vibration assessment.

Apart from the land acquisition requirements associated with the need to extend into the currently derelict and unused tennis courts located on the corner of Ayliffes Road and Main South Road, further construction-related impacts on the Women's Memorial Playing Fields are not anticipated.

12.3.3 Operational effects

The key potential operational effect on non-indigenous heritage places is the impact of vibration on the structural integrity of buildings. Given the distance of structural elements within the heritage places from the project footprint, it is considered highly unlikely that vibration from operation will affect any heritage listed structures. (Refer to the Noise and Vibration chapter 17 of this report for more details on the vibration assessment.)



Figure 29 - Location of non-Aboriginal heritage listings in the project area

12.4 Management and mitigation

12.4.1 Planning and design

The footprint of the project has been managed to avoid impacts on heritage places where possible. A minor encroachment on the tennis courts located at the corner of Ayliffes Road and Main South Road at the Women's Memorial Playing Fields may require approval in parallel with the detailed design process.

Any changes to the proposed footprint will be assessed to determine the resultant proximity of construction activities to the identified heritage places. If the footprint comes within 50 metres of a heritage place, specialist heritage advice will be obtained.

12.4.2 Construction phase

Should any heritage items be uncovered during construction, all works in the vicinity of the find will cease until specialist heritage advice is obtained. These measures will be included in the Contractor's Environmental Management Plan.

12.4.3 Mitigation during operation

No mitigation measures are proposed for the identified heritage listed places as no adverse effects are expected during operation.

12.5 Conclusion

One state heritage place and two local heritage places were identified within the wider project area. Whilst the assessment indicates that there are not likely to be any effects on these places that are associated with construction or operation of the project, its planning and design are likely to impact on a small portion of the Women's Memorial Playing Fields in a small area of the currently unused and derelict tennis courts at the corner of Ayliffes Road and Main South Road.

13 Aboriginal heritage and native title

13.1 Context

13.1.1 Assessment methodology

The assessment of the Darlington Upgrade Project's effects on Aboriginal heritage and Native Title has focused on the protection or minimisation of any impact on Aboriginal sites and cultural heritage values and has been undertaken via:

- > A desktop study and research of relevant documents and databases including heritage register searches
- > Identification of State and Commonwealth legislative requirements relating to Aboriginal heritage and Native Title
- > Field surveys including inspections of geotechnical cores
- > Consultation with Aboriginal cultural groups with traditional cultural interests in the vicinity of the project, and their representation and interest with respect to Aboriginal heritage
- > Identification of potential effects and documentation of recommendations in relation to risks and mitigation of any Aboriginal heritage issues.

13.1.2 Relevant legislation

Aboriginal cultural heritage is protected under a number of Commonwealth and State Acts including:

- > *Australian Native Title Act 1993*
- > *Australian Environment Protection and Biodiversity Conservation Act 1999*
- > *Australian Aboriginal and Torres Strait Islander Heritage Protection Act 1984*
- > *South Australian Aboriginal Heritage Act 1988*.

13.2 Existing conditions

13.2.1 Archaeological and anthropological background

The Darlington Upgrade Project is located within an area identified as being culturally sensitive to the Kaurna and Ramindjeri Aboriginal groups.

In pre-colonial times there were more than 20 Kaurna local clans along the plains from Crystal Brook in the north to Cape Jervis in the south.

There were large-scale summer gatherings and ceremonial progressions along the coastline, fishing, meeting and trading with visitors from other tribes, and following and celebrating the journeys of creation by Ancestral Beings of the Dreaming such as Tjilbruke. During winter, the Kaurna moved inland to more sheltered locations in the Mount Lofty Ranges foothills and along the coastal streams (Wood, 1995).

13.2.2 Native title

The land is within the area of the Kaurna Native Title claim lodged in July 2001. A search has identified that Native Title has been extinguished over the entire area of the Darlington Upgrade Project.

13.2.3 Warriparinga/Sturt Triangle

Warriparinga meaning 'windy place by the river' is of particular significance to the Kaurna peoples through its connection to the Tjilbruke Dreaming (Tindale, 1987). Warriparinga is linked through the dreaming story to the spring located at Kingston Park and to other sites on the Dreaming Track along the south coast and in the southern Mount Lofty Ranges. Contemporary Kaurna people consider the Tjilbruke Dreaming to be one of the most important elements of their cultural heritage and identity (Warriparinga Consultant Team, 1995; Wood, 1995).

Warriparinga has a tangible link to Kaurna ancestors which is enhanced by the remaining scarred trees and burials known to have existed along Sturt River. The Kaurna people recognise the area as an important resource for the education of their own people as well as the rest of the community and have previously requested that no earthworks in Sturt Triangle, which is bounded by Sturt Road, Marion Road and Main South Road, be conducted without their knowledge (Warriparinga Consultant Team, 1995; Wood, 1995).

13.2.4 Assessment and survey outcomes

Aboriginal subsurface deposits have been encountered throughout the Adelaide region where soils are being disturbed for the first time. The Central Archive, administered by the Department of State Development, Aboriginal Affairs and Reconciliation, was searched to identify any additional previously recorded Aboriginal heritage sites in the vicinity of the project area. Four sites were identified including three culturally modified trees and an artefact scatter.

No new cultural heritage sites, as defined by the *South Australian Aboriginal Heritage Act 1988*, were recorded as a result of additional surveys undertaken in 2015.

However, the area is known to be of high cultural significance for Aboriginal people through its association with a number of dreaming stories, most notably with the story of Tjilbruke. Although the area has been subject to heavy construction and modern infrastructure, the close recorded proximity of a variety of sites including artefact scatters, culturally modified trees and burials, indicates a high likelihood for further sites to be encountered in areas not previously disturbed or minimally disturbed by modern impacts.

13.3 Potential effects and opportunities of the project

13.3.1 Planning and design

The assessment found that the Darlington Upgrade Project has the potential to impact on the known ethnographic and archaeological heritage values of Warriparinga and the wider Sturt Triangle, depending on the footprint and design. Whilst the project footprint will not impact on any registered cultural heritage site, the key impact of the planning and design phase relates to the proximity of the footprint to Warriparinga.

The project footprint is likely to extend into the area of land bounded by the Southern Expressway, Marion Road and Main South Road, and the corner of Main South Road and Sturt Road, both of which have been identified as high risk areas due primarily to their relatively undisturbed nature.

13.3.2 Construction

There exists a likelihood of encountering sub-surface Aboriginal archaeological deposits at the Sturt Triangle and surroundings. As the project area is located in a highly urbanised environment, the level of risk will depend on the degree to which the ground level has been modified historically and the level to which it will be impacted by the Darlington Upgrade Project construction activities.

The key impacts during construction relate to the uncovering of subsurface archaeological materials during topsoil stripping and excavation activities in the high risk locations identified by the assessment and in particular three key areas:

- > Roadworks at the corner of Main South Road and Sturt Road including intersection works
- > Roadworks on the northern side of Main South Road in proximity to the Sturt River riparian area and on land bounded by the Southern Expressway, Marion Road and Main South Road
- > A proposed site compound located at the corner of Sturt Road and Laffer Drive.

13.3.3 Operational

Potential impacts associated with the operation of the Darlington Upgrade Project on Aboriginal heritage and Native Title relate primarily to the ongoing protection of Aboriginal cultural heritage sites following construction.

13.4 Management and mitigation

13.4.1 Planning and design

In the Darlington Upgrade Project route selection and planning phase, desktop research and review of previous Aboriginal investigations were undertaken to identify any previously recorded Aboriginal sites in the study area footprint. Given the particular significance of Warriparinga, the project has been planned to minimise impacts on this site.

Awareness of Indigenous cultural heritage issues will be raised with all staff to ensure Aboriginal heritage issues are considered during the detailed design phase, particularly in relation to areas identified as particularly sensitive such as the Sturt River riparian area, Warriparinga and the Sturt Triangle bounded by Marion Road, Sturt Road and Main South Road.

13.4.2 Construction

To minimise impacts to cultural heritage during construction a Cultural Heritage Management Plan will be prepared and implemented and will include:

- > Development of the Contractor's Environment Management Plan and associated Site Environmental Plans to manage scattered artefacts and Aboriginal heritage sites
- > The continuation of consultation and liaison with relevant Aboriginal heritage group representatives during pre-construction and construction phases
- > Inductions for all construction and site staff to inform them of their legal obligations should they uncover any Aboriginal cultural material as well as cultural awareness and management of known sites
- > Pre-start and toolbox meetings including contingency measures for discovering Aboriginal cultural heritage material when excavation is due to begin
- > Clear identification of areas that must not be disturbed
- > The engagement of relevant Aboriginal heritage group representatives and archaeological specialists to monitor earthworks in high risk locations
- > Management of discovery protocols in accordance with approvals under Section 23 of the *South Australian Aboriginal Heritage Act 1988*.

If a suspected archaeological site or remains of human origin are discovered during earthworks, works will temporarily cease in the immediate area, advice will be sought from a qualified archaeologist on consultation with the relevant Aboriginal heritage group. Management measures will be implemented in accordance with DPTI procedures and the *South Australian Aboriginal Heritage Act 1988*.

Where sites are confirmed, the Department of State Development Aboriginal Affairs and Reconciliation representatives will be advised.

13.4.3 Operational

Aboriginal cultural heritage management requirements will be included in the maintenance contract to ensure Aboriginal cultural heritage sites are protected following construction.

13.5 Conclusion

The Darlington Upgrade Project has been planned and designed to minimise impacts on Warriparinga, which is of particular significance for Aboriginal cultural heritage. There is however potential for the project to impact on other sensitive areas such as the Sturt River riparian area and the wider Sturt Triangle area on the corner of Sturt Road and Main South Road and the corner of Sturt Road and Laffer Drive.

Relevant Aboriginal heritage group representatives and archaeological specialists will be engaged to monitor earthworks in high risk locations in accordance with approvals under Section 23 of the *South Australian Aboriginal Heritage Act 1988*. Additional management and mitigation actions will be put in place as part of the Contractor's Environment Management Plan.

14 Flora and fauna

14.1 Context

14.1.1 Assessment methodology

A flora and fauna assessment has been undertaken via:

- > A literature review
- > A search of state agencies and local governments databases
- > Flora and fauna surveys
- > Recording of the vegetation association, dominant flora species, habitat value, the extent of weeds, fauna observations, and the presence of significant/regulated trees
- > Identification of potential impacts and management and mitigation activities.

14.1.2 Relevant legislation, strategies and policies

The assessment of flora and fauna effects has been undertaken in the context of several items of national and state legislation including:

- > *Australian Environment Protection and Biodiversity Conservation Act 1999*
- > *South Australian National Parks and Wildlife Act 1972*
- > *South Australian Native Vegetation Act 1991*
- > *South Australian Natural Resources Management Act 2004*
- > *South Australian Development Act 1993*
- > *Local Government Act 1999.*

It should be noted that the *Native Vegetation Act 1991* applies only to that part of the project area within the City of Onkaparinga, i.e. south of the centre line of the Sturt River, and the Hills Face areas of the City of Mitcham, including the Shepherds Hill Recreation Park. Most of the project area is excluded from the *Native Vegetation Act, 1991*. The assessment area is shown in Figure 30.

Several state and local policies have been reviewed and considered as part of the assessment of the Darlington Upgrade Project's effects and opportunities associated with flora and fauna including state and local government strategies, policies, guidelines and operational instructions. A full list of these is contained in the references section of this report.

14.2 Existing Conditions

14.2.1 Historical context

Kraehenbuehl, 1996 provides a historical account of the vegetation in the Adelaide region before European settlement, which is mapped by the Atlas of South Australia as a broad-scale interpretation of the pre-European settlement vegetation. The three main vegetation communities that likely existed in the Darlington Upgrade Project area before European settlement were:

Eucalyptus camaldulensis var. *camaldulensis* (River Red Gum) *E. leucoxylon* (Blue Gum) woodland along the banks, margins and floodplains of the Sturt River and other drainage lines and on adjacent areas of higher ground

Eucalyptus porosa (Mallee Box) woodland and mallee across small sections of 'dryland' sites of the project area, possibly including smaller areas of *Allocasuarina verticillata* (Drooping Sheoak)

Native tussock grassland dominated by winter growing species such as *Austrodanthonia* spp. (wallaby grasses) and *Austrostipa* spp. (spear grasses) and summer growing species, such as *Bothriochloa macra* (Red-leg Grass), *Chloris truncata* (Windmill Grass), *Enteropogon acicularis* (Umbrella Grass), *Setaria* spp. and *Themeda triandra* (Kangaroo Grass) as an understorey to mallee and woodlands and probably as a specific community dominant across large portions of the project area.

Kraehenbuehl indicates that less than 4% of the natural vegetation communities remain across the Adelaide Plains, and that where remnants do exist they are usually small, isolated and often degraded. In 2002, the Alma Environmental Association estimated the Hundreds of Adelaide and Noarlunga retain less than 3% of their original native vegetation cover.

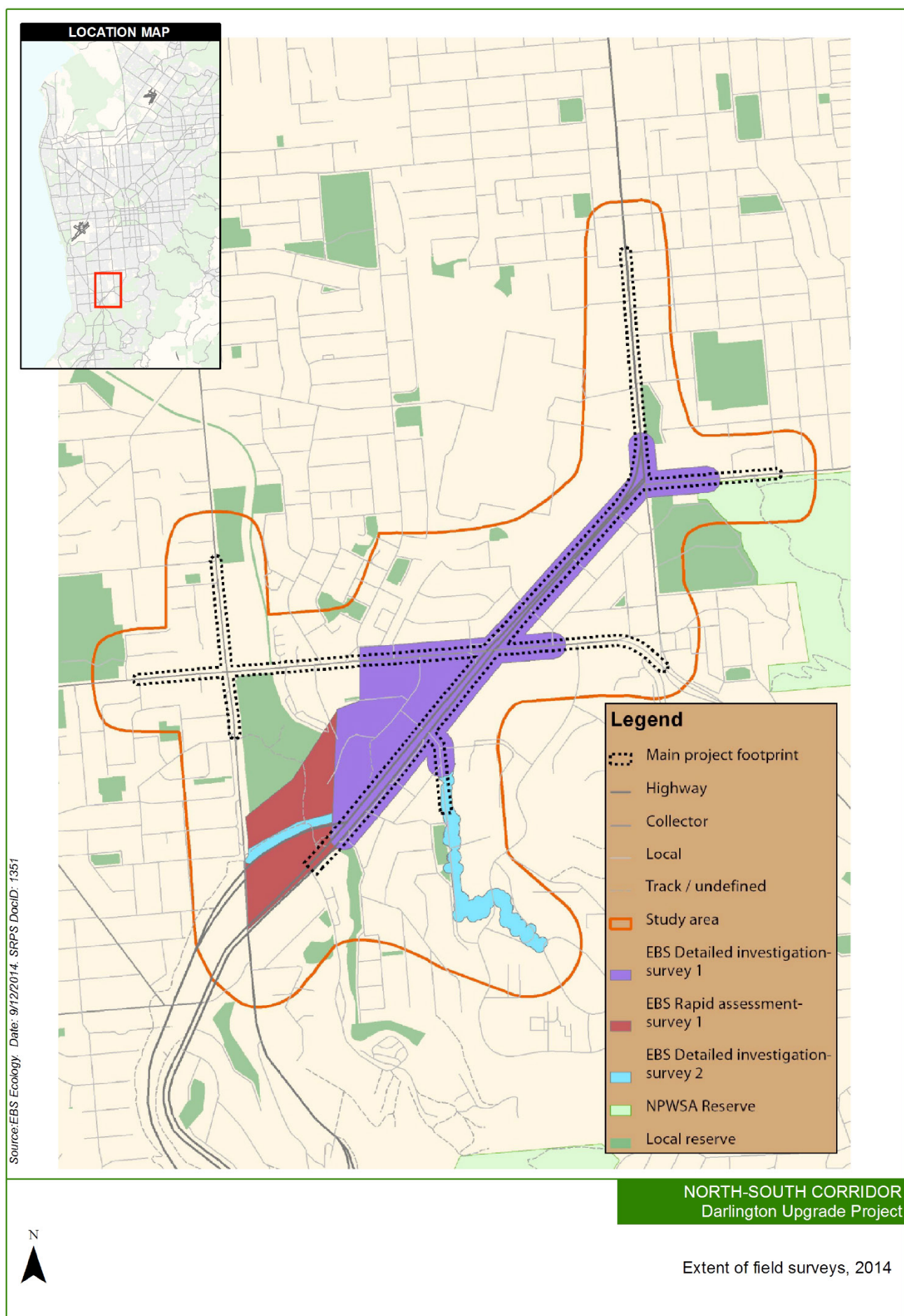


Figure 30 - Extent of field surveys, 2014

14.2.2 Current associations

Eight vegetation associations were observed in the Darlington Upgrade Project area during the field surveys as identified in Figure 31.

As the project is located within a highly urbanised area with over 180 years of European occupation, biodiversity has been considerably impacted and modified, with very limited native indigenous flora species remaining. Non-indigenous native and exotic plantings are dominant on side streets and major arterials, as well as local reserves and private residences. Some of these non-indigenous native and exotic trees are significant and/or regulated in size.

Scattered individuals of River Red Gum (*Eucalyptus camaldulensis*) and Sugar Gum (*Eucalyptus cladocalyx*) provide useful habitat in an urban context notwithstanding the low native species diversity. These scattered individuals co-occur with a range of mixed exotic tree species and modified understorey dominated by exotic species in a few locations along Main South Road, Sturt Road and within Warriparinga.

Located just outside the project area, the Shepherds Hill Recreation Park is a highly significant vegetation remnant that supports habitat for a number of threatened flora and fauna species. The next closest native remnants in the region are within Sturt Gorge Recreation Park to the south and the O'Halloran Hill Recreation Park to the south west of the project area.

14.2.3 Warriparinga

Warriparinga is located on land bounded by Sturt Road, Marion Road and South Road/Southern Expressway. Warriparinga includes the riparian zone around the Sturt River and supports the area's greatest patch of native vegetation, both remnant and planted and provides important habitat to terrestrial and aquatic fauna species. One of the intentions of Warriparinga wetlands is to create a self-sustaining ecosystem that supports a wide range of native plants and wildlife. Native trees, shrubs and understorey species have been planted to complement the existing Sturt River vegetation, as well as varieties of reeds and aquatic plants. The majority of plants are indigenous species that have been propagated from local seed stock.

Warriparinga contains mixed woodland plantings that also provide suitable habitat conditions for a number of native bird species and the habitat value of these plantings is likely to increase as this vegetation matures. Numerous large *Eucalyptus camaldulensis* of very high habitat and amenity value are present at Warriparinga.

14.2.4 Regulated and/or significant trees

The flora and fauna assessment identified the regulated and/or regulated significant trees within the survey area, which mainly comprises the following nine species:

- > River Red Gum (*Eucalyptus camaldulensis*)
- > Sugar Gum (*Eucalyptus cladocalyx*)
- > Tasmanian Blue Gum (*Eucalyptus globulus*)
- > South Australian Blue Gum (*Eucalyptus leucoxylon*)
- > Bracelet Honey-myrtle (*Melaleuca armillaris*)
- > White Cedar (*Melia azedarach*)
- > Spruce (*Picea sp.*)
- > Poplar (*Populus sp.*)
- > Black Locust (*Robinia psuedocacia*).

These trees have a minimum trunk circumference of two metres and are controlled by the *Development Act 1993*. They are identified in Figure 31.

14.2.5 Declared and environmental weeds and disease

Declared weeds (as declared under the *Natural Resources Management Act 2004*) and environmental weeds, listed on DPTI's Environmental Weeds List, were recorded during the field survey. A total of seven declared weeds and 20 dominant environmental weed species were recorded within the project area.

Given the highly modified condition of the project area, the understorey is mostly dominated by exotic grasses and herbaceous weeds. Blackberry (*Rubus fruticosus*) is present along parts of the Sturt River and is a Weed of National Significance. There has been some effort on the part of the City of Marion and volunteers to control weeds such as Blackberry and to replant with local understorey plant species around Warriparinga.

Olive trees (*Olea europaea*) are a declared species under the *Natural Resources Management Act 2004*, with significant potential to invade natural bushland. There are two groves of established olive trees within the project area and there are scattered self-seeded olive saplings in various locations, likely sourced from established groves, which will be an ongoing source of seed assisting their spread.

The Darlington Upgrade Project is located in a low Phytophthora area and no indications of its presence were noted at the time of the survey.

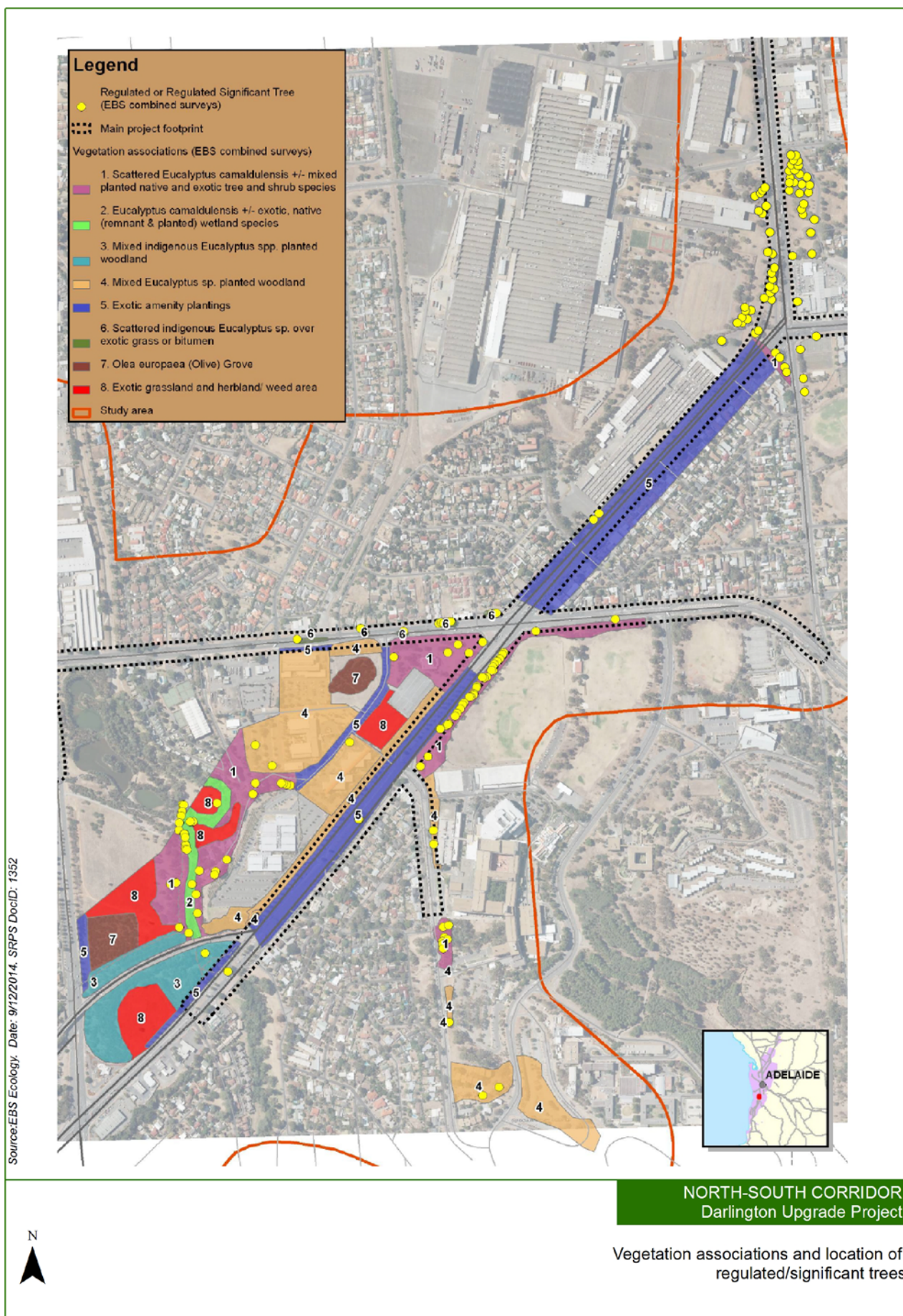


Figure 31 - Vegetation associations and location of regulated/significant trees

14.2.6 Flora assessment and survey outcomes

A search of the Protected Matters database and an assessment of likelihood of occurrence highlighted only one nationally threatened vegetation community as being likely to occur in or near the project area, namely the Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia. However, it is considered highly unlikely that this community would occur outside the Shepherds Hill Recreation Park on the periphery of the project area, and the Hills Face Zone more generally. Other flora species identified via the Protected Matters search were considered highly unlikely to occur within the area given the lack of supporting habitat and the area's urbanised nature.

A search of the Biological Databases of South Australia revealed four species of state conservation significance that have either been recorded in the region or their occurrence within the project area is considered possible as identified in Table 16.

During the broad survey, which focused on dominant species, a number of exotic and native, but not necessarily indigenous flora species were recorded. The Small Scurf-pea (*Cullen parvum*), rated vulnerable in South Australia was noted in the Warriparinga riparian precinct during the survey and is believed to be planted.

The Flinders Ranges Wattle (*Acacia iteaphylla*) was a common midstorey planting and, whilst rare in South Australia, is not native to the area and is therefore out of context. A single Pink Gum (*Eucalyptus fasciculosa*), rated rare in South Australia, was recorded in the South Road road reserve.

14.2.7 Fauna assessment and survey outcomes

A search of the Protected Matters database and an assessment of the likelihood of their occurrence identified two nationally threatened fauna species as possibly occurring within the project area. These two species are the Latham's Snipe (*Gallinago hardwickii*) and the Australian Painted Snipe (*Rostratula australis/Rostratula benghalensis s. lat*), which are migratory wetland birds that could potentially use the Warriparinga wetlands. Neither of these species was observed during the field survey.

A search of the Biological Database of South Australia found nine rare species and one vulnerable species of state conservation significance that are considered likely or possible to occur, mainly due to the presence of Warriparinga wetlands. The Yellow-tailed Black Cockatoo is known to commonly use the Flinders University grounds. It is also highly likely that the Common Brush-tail Possum uses trees within the area.

Species	Status	Within project boundary
Austral Rush (<i>Juncus australis</i>)	Rare (possible - wetland)	No
Red-leg Grass (<i>Bothriochloa macra</i>)	Rare (possible)	No
Pink Gum (<i>Eucalyptus fasciculosa</i>)	Rare (one specimen identified)	No

Table 16 - Flora species of state conservation significance possibly occurring

Species	Status
Australasian Darter (<i>Anhinga novaehollandiae</i>)	Rare (possible - wetland)
Australasian Shoveler (<i>Anas rhynchos</i>)	Rare (possible - wetland)
Blue-billed Duck (<i>Oxyura australis</i>)	Rare (possible - wetland)
Brown Toadlet (<i>Pseudophryne bibroni</i>)	Rare (possible - wetland)
Common Brushtail Possum (<i>Trichosurus vulpecula</i>)	Rare (likely)
Great Crested Grebe (<i>Podiceps cristatus</i>)	Rare (possible – wetland)
Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	Rare (likely – potentially seasonal)
Latham's Snipe (<i>Gallinago hardwickii</i>)	Rare (possible – wetland)
Musk Duck (<i>Biziura lobata</i>)	Rare (possible – wetland)
Yellow-tailed Black Cockatoo (<i>Calyptorhynchus funereus</i>)	Vulnerable (likely)

Table 17 - Fauna species of state conservation significance possibly occurring

The rare Grey-headed Flying-fox is considered as potentially occurring within the project area, with recent records from Dover Gardens, Eden Hills and South Brighton, where they were recorded in 2014 by the Department of Environment Water and Natural Resources as feeding on fig trees and *Corymbia maculata*. Potential feeding and roosting habitat exists in the form of established and fruiting trees within the project area. Fauna species of state conservation significance possibly occurring in the project area are identified in Table 17.

In addition to those potential species identified as being of state conservation significance, a number of the regionally threatened bird species are considered as having the potential to be present within the Darlington Upgrade Project area, such as the Brown Thornbill (*Acanthiza pusilla*), Silvereye (*Zosterops lateralis*) and the Pacific Black Duck (*Anas superciliosa*).

A total of 27 bird species, one mammal species (Koala, *phascolarctos cinereus*) and one reptile species (Eastern Water Skink, *Eulamprus quoyii*) were sighted during the survey. The Eastern Water Skink is considered vulnerable within the Adelaide Mount Lofty Ranges Region and four individuals were observed around the Sturt River during the survey. Whilst not observed, the Yellow-tailed Black-Cockatoo (*Calyptorhynchus funereus*), which is rated vulnerable is known to use the area and more than 30 types of birds are reported to visit Warriparinga.

14.3 Potential effects and opportunities of the project

14.3.1 Planning and design effects

Places of environmental significance

Of particular importance is the potential impact on vegetation within Warriparinga and Sturt River riparian area, these being the three main areas of habitat significance within the Darlington Upgrade Project area. The current design has been developed to eliminate the need to encroach on the Shepherds Hill Recreation Reserve, which is located within the boundaries of the *Native Vegetation Act, 1991* and where there is likely to be Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia, listed as nationally endangered, as well as threatened woodland birds. The project has also been designed to minimise encroachment on Warriparinga.

The design will necessitate alterations to utility services and bridges over the Sturt River between the Southern Expressway and Main South Road. This area of mixed woodland plantings has been identified as potentially providing conditions suitable for a number of native birds, with the habitat value increasing as vegetation matures.

The impact on this area however is expected to be manageable given the highly modified environment and the current existence of bridges and footpaths requiring modification and/or replacement. Beyond this, the project is not expected to have an impact upon the Sturt River riparian environment, the southern side of which is protected under the *Native Vegetation Act 1991*.

Vegetation removals

Due to the required footprint of the Darlington Upgrade Project, some vegetation removal will be required, including a number of non-indigenous amenity plantings and Regulated and Significant trees. Whilst the removal of amenity plantings such as street trees and shrubs are not controlled by legislation, the removal of Regulated and Significant trees will be subject to an approvals process under the *Development Act 1993*. The removal of vegetation will be restricted to only necessary removals by controlling the footprint of the project wherever possible via the design process. All vegetation removed as part of the Darlington Upgrade Project will be offset with new plantings incorporated into landscape and urban design plans developed in conjunction with relevant Councils.

Fauna and habitat

Aside from the significant areas of Shepherds Hill Recreation Reserve, Warriparinga and Sturt River riparian area, the project is located in a highly urban area with a fragmented and modified habitat with a low diversity. The fauna species with potential to occur within in the project area are predominantly due to the presence of the Warriparinga Wetlands, which will not be impacted by the project.

The majority of the vegetation within the project area is non-native amenity plantings, although there are scattered native trees that provide some important habitat in an urban context. Where removal of these scattered trees are required, there is potential for the project to have an adverse impact on habitats for local fauna, particularly birds, bats, small reptiles and the Common Brushtailed Possum, although it is likely that displaced local fauna will find alternative habitats close to the Darlington Upgrade Project area.

14.3.2 Construction effects

Vegetation and habitat

Construction of the Darlington Upgrade Project has the potential to impact on vegetation within the project site. Without adequate controls in place, activities such as soil compaction, excavation and the proximity of machinery and vehicles all have the potential to damage sensitive vegetation.

Construction activities will be undertaken close to and in some cases within the Sturt River riparian area, particularly in relation to utility service relocations and improvements to pedestrian and cycle facilities.

Without controls, impacts potentially include sedimentation of the river, erosion of banks and other impacts that may affect flora and fauna within the riparian environment.

Construction of the Darlington Upgrade Project has the potential to impact on roosting, nesting and feeding resources for birds, mammals and reptile species in the short term until redistribution to nearby food sources takes place. The removal of hollow-bearing mature trees in particular may result in immediate loss of shelter and nesting sites and cause disturbance to birds and animals, particularly if fauna inspections are not undertaken prior to removal.

Weeds and disease

Without appropriate management controls, the construction activities associated with the Darlington Upgrade Project have the potential to increase the spread of weeds and disease, particularly given the extent of weed species present in the area. Higher risk activities include the disturbance of soils and stockpiling, and the transfer of machinery and vehicles between various site locations and from outside the site. The location of the project within a low risk phytophthora area however means that the risk of spread of disease is low.

14.3.3 Operational effects

The impact of operation and maintenance of the Darlington Upgrade Project is likely to be limited to the need for ongoing pruning to maintain sight and clearance distances and the management of weeds. There will also be an establishment period for landscaping and revegetation works, which will require consideration of longer term responsibilities for maintenance to ensure the effective implementation of revegetation programs to enhance the flora and fauna.

14.4 Management and mitigation

14.4.1 Planning and design

The following management and mitigation measures have been identified to minimise impacts to flora and fauna as part of the planning and design phases:

- > Minimise project footprint to reduce impact on flora and fauna
- > Limit removal and disturbance/pruning of regulated and/or regulated significant trees
- > Design project to minimise impact on the Sturt River riparian environment

- > Develop landscape and revegetation plans to enhance flora and fauna outcomes
- > Offset vegetation removals in accordance with the DPTI's Vegetation Offset Guidelines
- > Integration of landscape maintenance considerations into the design phase.

14.4.2 Construction Phase

To minimise impacts to flora and fauna species during construction, a Construction Environmental Management Plan will be prepared and implemented, including the following measures:

- > All significant and/or regulated trees that require removal or pruning will be clearly identified in the Contractor's Environmental Management Plan
- > Remaining significant and/or regulated trees and other significant vegetation will be protected during construction using Tree Protection Zones
- > All site personnel will be inducted to ensure they are aware of potential construction impacts and mitigation measures
- > Construction areas contractor activity zones and 'no go zones' will be clearly identified to minimise the risk of accidental damage to vegetation and/or habitat
- > Soil erosion and drainage management plans will be developed
- > Weed and disease management strategies will be included in the Contractor's Environmental Management Plan
- > Earthmoving equipment, site machinery and vehicles will be cleaned where required to prevent accidental introductions of weeds and disease
- > Regular weed monitoring requirements will be documented in the Contractor's Environmental Management Plan
- > Qualified fauna consultants will inspect vegetation and habitat prior to removal
- > Designated people will remove and release any fauna species trapped as a consequence of the project.

14.4.3 Landscape design and revegetation

There are significant opportunities associated with the project in relation to landscape design and revegetation, including implementation of the DPTI's offset program. The department will work closely with local environmental groups and the community to investigate landscape and revegetation opportunities that enhance visual amenity, local biodiversity and habitat, including opportunities for community education and involvement.

14.4.4 Operation

Operation and maintenance phase management and mitigation measures will include:

- > Documentation of regular weed monitoring, establishment and maintenance requirements and responsibilities
- > Identification of the extent of maintenance activity zones
- > Handover of reserves and landscaping to Local Councils for ongoing maintenance.

14.5 Conclusion

All aspects of the project have been reviewed and it is considered that the Darlington Upgrade Project is not likely to have a significant impact on a Matter of National Environmental Significance, therefore no referral under the *Environmental Protection and Biodiversity Conservation Act* will be made. In addition, no approvals are required under the *South Australian National Parks and Wildlife Act 1972* for activities that are likely to interfere with listed species and their habitat.

Whilst some vegetation removals will be required, including amenity plantings and scattered significant and/or regulated trees with some habitat value, the area affected by the project is heavily urbanised with low biodiversity. Sensitive areas such as Shepherds Hill Recreation Reserve and established areas of Warriparinga will not be affected and impacts elsewhere will be minimised via:

- > Environmental controls around construction activities, particularly where close to the Sturt River, via the Contractor's Environmental Management Plan
- > Minimisation of the project's footprint to avoid impacts on flora and fauna where possible
- > Significant revegetation and rehabilitation opportunities associated with offset requirements and community education and planting
- > Implementation of a landscape plan for planting within the road reserve for amenity and biodiversity.

15 Water quality, drainage and flooding

15.1 Context

15.1.1 Assessment methodology

An assessment of water quality, drainage and flooding has been undertaken using the following methodology:

- > Review of relevant legislation, strategies, policies, guidelines and codes of practice
- > Analysis of existing catchment and the capacity of drainage systems
- > Review of flooding characteristics
- > Identification of current groundwater levels at existing bores
- > Analysis of available water quality data
- > Review of potential effects of the project
- > Identification of mitigation measures.
- > Relevant legislation, strategies and policies

The following legislation, strategies and policies have been considered as part of the assessment for water quality, drainage and flooding:

- > *ANZECC Guidelines for Fresh and Marine Water Quality 2000*
- > *Environment Protection Act 1993*
- > *Environment Protection (Water Quality) Policy 2003*
- > *Stormwater Pollution Code of Practice for Local, State and Australian Government, 1998*
- > *Natural Resources Management Act 2004*
- > *Natural Resources Management Plan for the Adelaide and Mount Lofty Ranges Region, volume D, 2008*
- > *Water Quality Monitoring for Construction Sites – Manual and Instructions, 2012*
- > *Protecting Waterways Manual, 2012*
- > *Code of Practice for Construction – road, rail and marine facilities, 2008*
- > *Water Affecting Activities Permits Standard Operating Procedure, 2012*
- > *Contractors Environmental Management Plan Guidelines for Construction – road, rail and marine facilities, 2009*
- > *Project Environmental Management Plan Guidelines for Construction – road, rail and marine facilities, 2009*

15.2 Existing conditions

15.2.1 Stormwater drainage

Catchment

The Darlington Upgrade Project area is entirely within the catchment of Sturt River, which drains an area of approximately 120 square kilometres. The catchment is the largest of six drainage systems in the broader Patawalonga catchment, which discharges to Gulf St Vincent through the Patawalonga Basin. The upper part of Sturt River catchment comprises the steep western slopes of the Adelaide Hills to the south-east of the city which include significant areas of native vegetation, as well as large and expanding areas of urban development. This area drains approximately 73 square kilometres and is fed by two major systems, Minno and Chambers creeks.

Overall, the existing Sturt River catchment network upstream of the Warriparinga wetlands is substantially rural or semi-urbanised with steep gradients. Grades are generally more than 2% for the road networks with steeper grades for upper rural areas. In the semi-urbanised areas, major and minor road systems drain into local road drainage; in the rural areas drainage is through creeks.

The lower part of the catchment, downstream of the Warriparinga wetlands is predominantly urbanised and drains through major and minor road systems into Sturt River which extends to Patawalonga Basin.

The Sturt River catchment in the study area can be further separated into four drainage systems:

- > Sturt Road trunk main, which connects downstream of Warriparinga Wetland into Sturt River
- > Franklin Avenue–South Road trunk main, which connects to Sturt River before Warriparinga Wetland
- > Sturt Triangle minor drainage systems, which connect to Sturt River before Warriparinga Wetland
- > Drainage systems around St Marys connecting between the Shepherds Hill Recreation Park and Ragless Reserve.

Figure 32 shows these drainage systems and indicates existing surface water drainage lines. Sturt Road and Franklin Avenue drainage systems are approximately one square kilometre and 1.4 square kilometres, respectively, and Sturt Triangle system is much smaller at 0.2 square kilometres. In addition, the Southern Expressway catchment bounded by the Southern Expressway, Main South Road and Marion Road, also enters Sturt River before the Warriparinga wetlands.

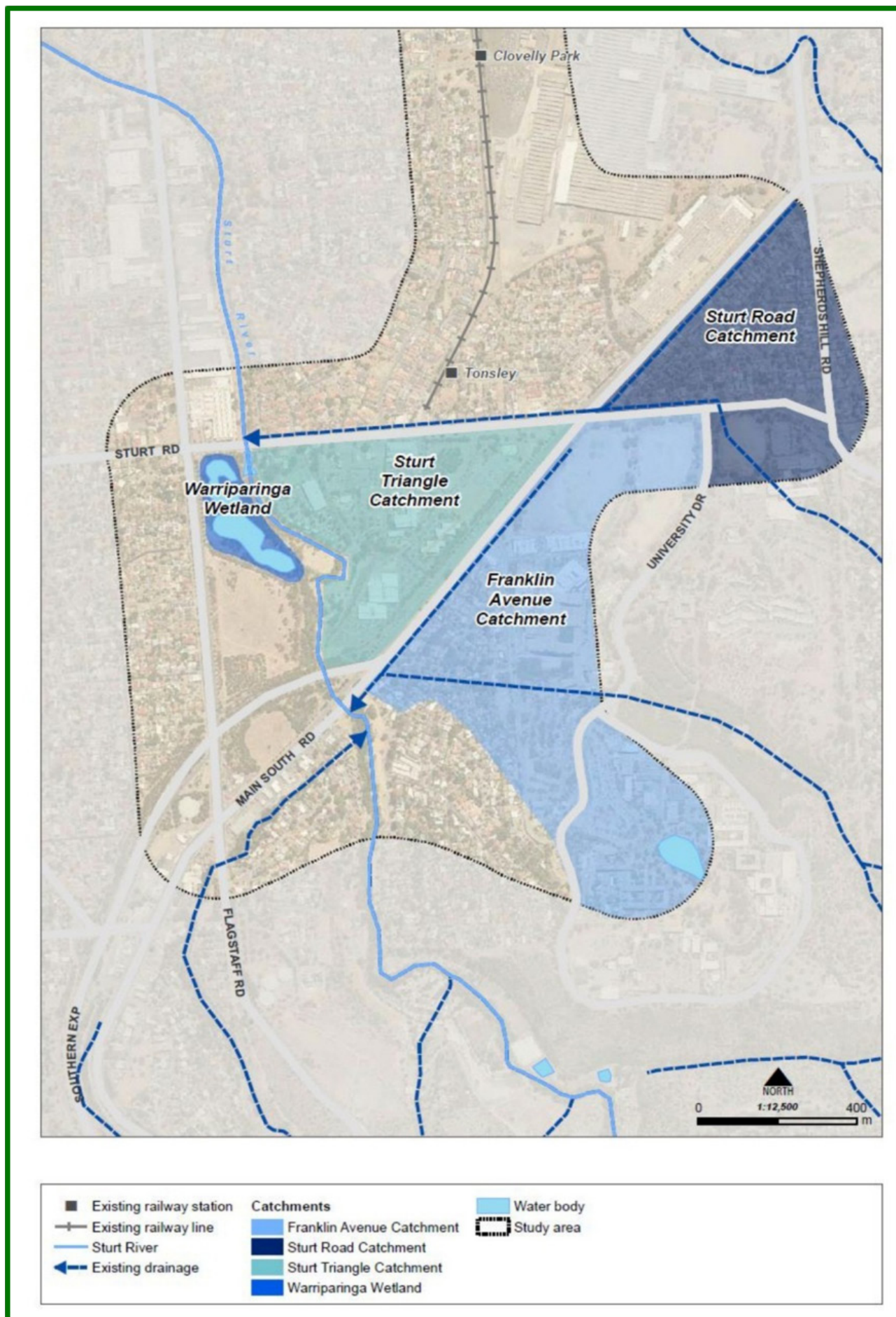


Figure 32 - Indicative catchments and major drainage systems relevant to the study area

At present, approximately 60% of all stormwater systems in the study area, including catchments from the Franklin Avenue trunk main and Sturt Triangle minor drainage systems, drain to Sturt River and then into the Warriparinga wetlands before discharging to Gulf St Vincent. The remaining 40% of stormwater flows along Sturt Road trunk and into Sturt River north of Sturt Road, bypassing the Warriparinga wetlands.

The Warriparinga wetlands

The Warriparinga wetlands are artificial wetlands that were developed in 1998 to improve the water quality of Sturt River and make an attractive open space for recreation, education and the re-establishment of native plants and animals. The wetlands have a capacity of 23 million litres and filter pollutants from stormwater through sedimentation. The still and slow flowing nature of wetlands allows pollutants to settle out, sink and become trapped in the clay and sediment. The taking of nutrients by wetland water plants can reduce the occurrence of algal blooms and ultra-violet rays from the sun kill harmful pathogens such as bacteria and fungi. The roots of water-loving plants help to provide an oxygenated environment to aggressively break down contaminants.

In the Warriparinga wetlands a fallen log acts as an inlet weir, diverting water into the wetlands. Gross pollutant traps have been installed at the end of the inlet to capture floating debris and litter. Gabion weirs (wire cages filled with rocks) ensure even flow, separating a system of four interconnecting clay-lined ponds. An outlet weir in the form of a rock riffle, or shallow area, diverts back flow to the river. After leaving the wetlands, water re-enters a concrete lined open river channel, the continuation of Sturt River. The channel has a large drainage capacity and runoff from the remaining 40% of stormwater not drained into the Warriparinga wetlands discharges directly into this channel via the stormwater network without any form of detention or treatment.

Drainage capacity and flooding characteristics

The drainage network in the study area has been constructed over a number of years by local councils or DPTI, predominantly to a 5-year Average Recurrence Interval (ARI) design standard. Generally no account has been taken of flows in excess of the pipe system capacity.

Based on the topography of the area, any stormwater runoff beyond the capacity of the underground drainage system, or having a higher ARI than 1 in 5 years, will flow in a westerly direction as surface water runoff towards the coast. Surface water runoff may potentially get caught along Main South Road before it reaches a point where it is able to flow off Main South Road and continue in a westerly direction. There is a history of flooding at the entrance to the Southern Expressway from Main South Road.

Flood mapping of Sturt River confirms that its floodplain is confined to the Sturt River channel through the study area and the 100 year Average Recurrence Interval flood in the river does not cross Main South Road or the Southern Expressway.

Groundwater levels

The construction activities associated with the Darlington Upgrade Project have the potential to interact with groundwater. A total of 11 boreholes, ranging in depth between approximately 11 and 26 metres, were investigated across the site to gauge standing water levels.

From the information obtained from the boreholes, the groundwater level along the section of Main South Road between Tonsley Boulevard and the Sturt River may be inferred to about 15 metres below existing surface level.

15.2.2 Water quality

Water quality in Sturt River

While the Sturt catchment is generally rural to semi-urbanised, the water quality in Sturt River is more typical of an urbanised catchment. Its high nutrient concentration indicates a high organic content and sediment influx from surrounding catchments. In addition, salinity levels in Sturt River are higher than expected for fresh water. Catchment inflows usually occur during the high rainfall winter months and the water quality is therefore expected to vary over the year.

Existing risks to water quality in Sturt River and receiving waters are from the use of local roads and the Southern Expressway in addition to runoff from upstream farms. These water quality risks are predominantly focused on:

- > pollutants emitted from vehicles during fuel combustion
- > accidental spills of pollutants from vehicle accidents
- > farm runoff containing fertiliser, manure, animal waste, leaf litter and lawn clippings
- > road runoff containing cigarette butts, litter and debris, heavy metals such as lead and copper, and oil.

Erosion upstream of the Warriparinga wetlands has previously raised concern about the condition of Sturt River. Results of water quality monitoring, conducted by the Adelaide and Mount Lofty Ranges Natural Resources Management Board in 2009, at a testing site located immediately upstream of the Warriparinga wetlands inlet, are summarised in Table 18.

	Salinity – total dissolved solids (mg/L)	Turbidity (NTU)	Nitrogen (mg/L)	Phosphorus (mg/L)	pH
Average	1,881	13	0.42	0.84	7.67
Limit	< 10% variation	20	0.5^	0.5^	6.5–9
EPA Classification	Moderate	Good	Moderate^	Poor^	Good

Table 18 - Summary of water quality data for Sturt River upstream of Warriparinga

Sturt River - Salinity

Salinity is a measure of the dissolved salts in water and can be measured as total dissolved solids. As water evaporates, salts are left behind, leading to an increase in salinity. Therefore salinity is highest when there are minimal flows and/or high temperatures. Freshwater salinity levels are generally less than 400 milligrams per litre. At 1881 milligrams per litre, Sturt River falls within the range for brackish water, which is 1000–3000 milligrams per litre and is classified as ‘moderate’ by the Environment Protection Authority (EPA). Potential sources of dissolved salts in Sturt River include urban and rural runoff containing salt, fertilisers and organic matter and land use issues related to runoff containing dissolved solids from industry, agriculture and stormwater. Water containing a total dissolved solids level of over 500 milligrams per litre is intolerable to some plants and animals and can cause stress or even death.

Sturt River - Turbidity

Turbidity is a measure of the ability of light to pass through water, that is, the murkiness of the water. Measuring turbidity gives an estimate of suspended solids in the water and is measured in nephelometric turbidity units. Suspended solids usually enter the water as a result of soil erosion from disturbed land and turbidity measurements also take into account algae and plankton present in the water. Turbidity in Sturt River, recorded as 13 nephelometric turbidity units, was classified by the EPA as ‘good’.

Sturt River - Nitrogen

In Adelaide and Mount Lofty Ranges Natural Resources Management Board monitoring, nitrogen was measured as nitrite or oxidised nitrogen. Nitrites are produced naturally as part of the nitrogen cycle in which bacteria break down toxic ammonia wastes to nitrite and then nitrates. Nitrites are relatively short-lived because they are quickly converted to nitrates. Nitrite levels below 0.5 milligrams per litre have no effect on aquatic plants and animals; however, above this value nitrites can start to affect aquatic animals. High levels of nitrogen can also result in algal blooms and excessive growth of water-plants that can cause fluctuations in dissolved oxygen levels and place stress on fauna. In addition, excessive levels of nitrogen can increase the total organic load to produce odours and reduce aesthetic quality.

Nitrogen levels in Sturt River at 0.42 milligrams per litre were classified as moderate by the EPA as they are relatively close to the *Environment Protection (Water Quality) Policy* limit. The likely sources of nitrites in Sturt River are stormwater runoff containing fertiliser and manure from farms upstream, leaf litter, lawn clippings and discharges from car exhausts.

Sturt River - Phosphorus

High levels of phosphorus can lead to many of the adverse effects discussed for nitrogen. The EPA limit for phosphorus is 0.5 milligrams per litre, thus the value of 0.84 milligrams per litre recorded for Sturt River is very high and has been classified as poor by the EPA. Potential sources of phosphorus in Sturt River are detergents or fertilisers that have been washed down drains, run off from properties upstream due to poor land management practices, or sediments from rocks and soil. Many sources of nitrogen are also sources of phosphorus.

Sturt River - pH

The acidity or alkalinity of water is measured as pH. A pH range of 6.5 to 8 is optimal for freshwater. Low pH values are classified as acidic and can be characteristic of acid sulfate soils. With a pH of 7.67, Sturt River is close to neutral and classified as ‘good’ by the EPA.

Water quality of the Warriparinga wetlands

Wetlands are areas that are permanently or regularly inundated with freshwater to slow and detain stormwater flows and improve water quality. The Warriparinga wetlands are an artificial wetland developed to improve the water quality of Sturt River and its goal is to reduce annual loads of pollutants entering Patawalonga Basin (City of Marion, 2010), in particular:

- > 8% of the phosphate
- > 20% of suspended solids
- > 25% of bacteria.

Approximately 60% of all stormwater systems in the area drain to Sturt River and then into Warriparinga wetlands before discharging to Gulf St Vincent. The remaining 40% is released into Gulf St Vincent without being treated and consequently contains more pollutants and is generally of lower water quality.

Groundwater quality

The South Australian Department of Environment, Water and Natural Resources maintains a network of observation bores across the state to monitor trends in groundwater and/or salinity levels. All data can be accessed from the Obswell online database (Primary Industries and Resources South Australia, 2011). A review of the records for the Adelaide metropolitan salinity monitoring network identified 39 current salinity monitoring bores in tertiary aquifers and highly variable salinity levels.

This data is consistent with findings in the *State of the environment report for South Australia* (Environment Protection Authority, 2013), which states that groundwater quality of the Adelaide Plains is variable depending on the nature of the aquifer and the source of the groundwater. In general, the tertiary aquifers (the source of most extractions) are rated 'good' for nutrients but 'poor' for salinity (Environment Protection Authority, 2013).

The monitoring networks focus on the economically important tertiary aquifers, but it is the shallow quaternary aquifers that are generally most at risk from pollution. Shallow groundwater can be contaminated by point sources such as landfills or localised chemical spills or diffuse sources such as urban runoff. Potential pollutants (National Water Commission, 2011) include:

- > microbiological contaminants from sewage and effluent
- > heavy metals
- > petroleum fuels
- > industrial solvents
- > excessive nutrients
- > detergents
- > pesticides.

15.3 Potential effects and opportunities of the project

The potential effects of the project on water resources have been assessed for the three, project phases – planning and design, construction and ongoing operations. Water resources related effects can be broadly categorised into:

- > hydrological – impacts on the volume and timing of flows
- > physical – impacts on the landforms and drainage pathways
- > water quality – impacts on both surface water and groundwater sources, either positively or otherwise.

15.3.1 Planning and design

Effects on existing stormwater systems

The effects of the Darlington Upgrade Project on peak flood levels and the ARI of the drainage system after construction will depend on the final location of drainage lines and be the subject of more detailed investigations before construction. The detailed design of the Darlington Upgrade Project will be undertaken in the context of the capacity of existing stormwater systems.

Water quality effects

The project area is at the terminal end of a 73 square kilometres continually urbanising catchment. Any detrimental water quality impacts from outside the study area will be transported to the Darlington region. Runoff from the section of South Road in the project area is currently not subject to any water quality treatment before discharge into the Sturt River. Construction of the new road may provide opportunities to incorporate water quality treatment for low flows into the design and improve the quality of water runoff.

The water quality criteria as stipulated in the Environment Protection Water Quality Policy do not apply to the ultimate discharge of stormwater from a public stormwater disposal system into any waters by a government or public authority responsible for the system. However, the intention is to meet the relevant water quality criteria wherever possible during the planning and design phase.

Effects on groundwater

Groundwater levels in the project area vary along the length of the project area but it is considered that groundwater levels are unlikely to be significantly affected by the project. However, the interception of shallow groundwater may impact on design elements such as footings. Project effects in relation to design and groundwater are discussed further in the geology, soils and contamination chapter of this report.

15.3.2 Construction

Potential effects to water during construction would be associated with maintaining existing stormwater systems, overland flow paths and water quality impacts. Potential construction related effects include:

- > Flooding of the construction site, with subsequent drainage and water quality impacts
- > Interruptions to drainage and existing stormwater systems during construction of Project elements and/or relocation of services
- > Potential impacts on the water quality of surface or groundwater due to erosion and general construction activities
- > The management of major flows during the construction period before final stormwater systems are in place, and
- > Potential need to dewater sites in the event of encountering groundwater.

The potential to introduce contamination to surface or groundwater during construction is discussed further in the soils and contamination chapter of this report.

15.3.3 Operational effects

The potential effects of ongoing operations of the completed project have been addressed in the planning and design phase. Early identification of potential effects allows for mitigation measures to be incorporated into the design.

Increased traffic volumes and impervious areas may generate increased pollutant loads which could affect the water quality of receiving waters. However, the project area is in a highly developed catchment where untreated runoff from South Road, both pre and post-project constitutes only a small percentage of the total flow volumes draining to the Gulf St Vincent from the Adelaide plains. On this basis, the net impact of the project on the water quality of receiving waters is considered to be negligible.

15.4 Management and Mitigation

15.4.1 Planning and design

The greatest potential to manage and mitigate potential effects, and maximise opportunities, occurs at the planning and design phase. The stormwater design for the project considers both stormwater pipes and overland flow systems. A primary objective of the stormwater design is to minimise the impact of the project on the existing stormwater network by maintaining stormwater systems, restricting post-project peak flow rates to pre-project rates, and providing overland flow paths across the lowered sections of road.

All stormwater systems that cross South Road will retain connectivity. Pipes will be conveyed across the lowered road sections attached to the underside of structures, or where it is not possible to provide sufficient clearance, the pipes will be realigned to maintain the existing drainage service. Detailed hydraulic modelling during the design phase will be undertaken to confirm that any realignments do not negatively affect the capacity of the system.

Overland flow paths along the project area have been identified by reviewing relevant local rainfall and contours. Provision to maintain flow paths or, where necessary, provide alternative flow paths, has been incorporated into the project design. This information will be reviewed during detailed design.

Opportunities to improve the water quality of runoff from the Darlington Upgrade Project, and apply the principles of water sensitive urban design will be considered during detailed design. Subject to available space within the corridor, these may include:

- > Grates for stormwater inlets within the lowered road
- > Gross pollutant traps
- > Detention basin(s)
- > Rain gardens alongside the Main South Road surface roads
- > Bio-retention systems, and
- > Avoidance of disturbance to the Warriparinga wetlands.

The potential impacts on groundwater quality are discussed further in the soils and contamination chapter of this report.

15.4.2 Construction

Measures for managing and mitigating water impacts during the construction phase will be incorporated in the Contractor's Environmental Management Plan. The extent of measures required during construction will be determined once the detailed design and construction methodology have been completed via development of a Soil Erosion and Drainage Management Plan. This may include:

- > Maintenance of existing flow paths and stormwater systems through a combination of construction scheduling and temporary works to manage off-site and on-site water-related issues during construction
- > Ongoing monitoring of groundwater during the construction phase
- > Provision for the management of groundwater, including dewatering
- > Management of potential stormwater pollutants, particularly suspended sediment and associated attached pollutants
- > Management of runoff from disturbed areas via sediment controls prior to discharging into existing stormwater systems
- > Measures to limit the movement of sediment from the construction site onto adjacent roads
- > Management of spills to minimise impacts on water quality through measures such as isolating vehicle maintenance and refuelling to a designated area away from drainage lines, storing all chemicals in a sealed, bunded surface away from drainage lines, and minimising on-site storage and use of chemicals.

15.4.3 Operations and maintenance

The water quality, hydrology and hydraulics in the project area will be managed in the long term mostly by implementing the measures identified during the planning and design phase. The design aims to minimise the effect of the project on the hydrology and hydraulics of the area, while seeking opportunities to improve water quality.

The project will maintain connectivity of existing stormwater systems, control peak flows from the project area and consider provision of major drainage paths. Ongoing maintenance of drainage systems will be necessary to ensure that they continue to act as designed.

15.5 Conclusion

The majority of potential impacts of the project on water quality, flooding and drainage will be managed through the detailed design phase. This phase will focus on the design of drainage systems, minimising the impact on the existing stormwater system capacity, retaining stormwater connectivity across the project site and opportunities to improve water quality via measures such as gross pollutant traps. The principles of water sensitive urban design will also be applied.

A more comprehensive water quality risk assessment will be undertaken during detailed design and the Contractor's Environmental Management Plan will address potential construction-related effects such as the management of runoff from construction sites.

16 Geology, soils and contamination

16.1 Context

16.1.1 Assessment methodology

The methodology for assessing geology, soils and site contamination was based on:

- > A desktop review of existing information on regional geology and soils to identify site characteristics, current and historical land uses, Development Plan zoning and aerial photographs
- > A review of previous geotechnical reports relevant to the project area
- > Results of preliminary geotechnical investigations
- > Assessment of potentially contaminating activities across the project areas based on the results of the desktop analysis and site inspection
- > Application of a preliminary contamination risk rating to properties in and immediately adjacent to the project area
- > Field investigations and testing.

16.1.2 Relevant legislation, guidelines and policies

Several measures relate to site contamination assessment however no specific legislation applies to the geotechnical assessment, although the general environmental duty provisions of the *Environment Protection Act, 1993* and a number of Australian Standards are relevant. Relevant legislation and measures reviewed as part of this assessment include:

- > *National Environment Protection (Assessment of Site Contamination) Measure, 1999*
- > *Environment Protection Act 1993*
- > *Site contamination – Guidelines for the Assessment and Remediation of Groundwater Contamination, 2009*
- > *EPA Guidelines for Environmental Management of On-Site Remediation, 2008*
- > *Standard for the Production and Use of Waste Derived Fill, 2010*
- > *Recycled Fill Materials for Transport Infrastructure – Operational Instruction 21.6, 2006*
- > *DPTI Policy: Guide for the Re-Use or Disposal of Asphaltic Concrete Planings, 2012.*

16.2 Existing conditions

16.2.1 Geology and soils

Topography

The topography of the Darlington Upgrade Project area is particularly important given the construction activities associated with the Darlington Upgrade Project and their location across the transition between areas of low and high slope. The study area is located on the Sturt River fan, a fan-shaped deposit formed where Sturt River slows and spreads on to a flatter plain. The Sturt River fan is located on the upper outwash plain, an area of high relief bounded by the sea towards the west and Hills Face Zone towards the south-eastern landward side.

The section of Main South Road between Ayliffes Road and Sturt Road is almost level. On the south-eastern side of Main South Road, the Hills Face Zone rises at a gradient of approximately 9% with the slopes currently occupied by Flinders Medical Centre and Flinders University. The land to the north-west of Main South Road between Sturt River and Sturt Road slopes to the west at a gradient of approximately 3%. North of Sturt Road the gradient is about 2% to the north-west. The ground levels along Main South Road vary from about 56 metres Australian Height Datum at the intersection with Sturt Road to about 40 metres Australian Height Datum at Sturt River bridge on Main South Road/Southern Expressway, an average gradient of about 2%.

Geology

Given the construction activities associated with the Darlington Upgrade Project, consideration needs to be given to the underlying geology of the study area. Although the majority of the Adelaide metropolitan area is underlain by fairly stiff and stable sediments, the project is situated on the Eden-Burnside Fault Zone, a zone of complex fracture associated with a fault plane. This fault zone has controlled formation of the Lower Hills Face Zone and sedimentary and erosional landscape features. The bedrock of the Hills Face Zone overlooking the study area consists of bouldery sandy siltstone, siltstone, quartzite (Pre-Cambrian Sturt tillite) overlain by a thin cover of less than one metre of residual soil, which is predominantly skeletal soil developed from the tillite. Outcrops of bedrock are also common on the Hills Face Zone.

Boreholes adjacent to the intersection of Main South Road and Sturt Road drilled to depths of up to 11.5 metres did not encounter rock. The depth to tertiary bedrock is at least 50 metres in the area to the north-west of the Eden-Burnside Fault Zone. The bedrock under Main South Road may thus be assumed to be shallower but still more than 12 metres below the surface. The soils under Main South Road and the area immediately to the north-west are mainly Pooraka Formation over Pleistocene-aged Hindmarsh clay. The geological profile at Sturt River Bridge consists of alluvium in the river terraces and floodplains (Waldeila Formation) over Pre-Cambrian siltstone bedrock at a level of about 25.5 metres Australian Height Datum, or 15 metres below bridge level.

Soils

Three district soil profiles exist in the study area:

- > Soils on the Upper Outwash Plain on the north-western side of Main South Road are generally stiff to hard and characterised mainly by red brown earth profiles in addition to alluvium, black earth and intergraded soils to a depth of about two to three metres. These soils overlie Hindmarsh clay
- > The soils on the steeper slopes of the Hills Face Zone grade from red brown earth soils at the base of the slope to the thin soils over shallow bedrock
- > The soils along Sturt River are layered stream alluvium and the texture of the sediments ranges from boulders and gravels to sands, silts and silty clays. The alluvium downstream from the bridge is underlain by Hindmarsh clay.

Acid sulfate soils

Acid sulfate soils are naturally occurring sediments containing iron sulfides that when disturbed can produce sulfuric acid. The ground levels and the likely depth of excavations in the project area are however well above the levels of acid sulphate soils that would trigger incidences. Existing boreholes in the area did not identify acid sulfate soils and the landforms and soil types are generally not indicative of their likelihood. Although a remote possibility, the greatest potential for acid sulfate soils is considered to be along Sturt River on the southern side of Main South Road.

16.2.2 Site contamination

Bedford Park

The area north of Sturt Road to Maidstone Road is primarily residential, with the majority of properties presenting a low risk of site contamination.

Several industrial and commercial properties were located on the eastern side of Main South Road, including mechanical workshops, crash repairers and a car yard, which represent a moderately high risk of site contamination from the potential leakage or spillages of fuels, oils, solvents and/or other chemicals.

The portion of the road alignment between Sturt Road and Flinders Drive is bound by Flinders University's playing fields on the south-eastern side. The eastern side of Main South Road – between Flinders Drive and Sturt River – primarily consists of residential properties, although commercial properties, including restaurants, are located at the corner of Flinders Drive and Main South Road. These areas are considered to have a low risk of site contamination.

Clovelly Park

The north-western side of Main South Road west of Mimosa Terrace is primarily residential. However, a car yard located on the corner of Main South Road near Mimosa Terrace represents a medium risk of site contamination.

A major industrial manufacturing facility is located east of Mimosa Terrace, which represents a high risk of site contamination. It is understood that this site contains existing ground water contamination and extensive contamination investigations to define risks and treatment options for this site have been undertaken, including delineation of contamination in the affected areas.

Mitchell Park

The northern side of Sturt Road adjacent to Mitchell Park is currently bound by residential properties and an ambulance depot located near the terminus of Tonsley Passenger Rail Line. Existing activities in these properties pose a low risk of site contamination. Former horticultural activities throughout this area may have a low to medium risk of contamination from agricultural chemicals.

Sturt Triangle

Land in Sturt Triangle, bounded by Marion Road, Sturt Road and Main South Road, was formerly used for intensive horticulture and consequently there is a low to medium risk of contamination from agricultural chemicals. In addition, this area used to be low lying, therefore imported fill of unknown quality may have been used to raise site levels for development.

Activities in existing properties in Sturt Triangle, including commercial properties, Sturt Police Station, Marion Holiday Park and the Warriparinga wetlands, present a relatively low risk of site contamination.

16.3 Potential effects and opportunities of the project

16.3.1 Planning and Design

Soils and geology

The existing soils and geology of the project area will influence the planning and design of the project particularly in relation to slope stability, erodibility, landforms, foundation type, retaining wall requirements, settlement and groundwater.

Given the relatively flat slope of the project area, it is considered unlikely that it will affect slope stability. The design however will require near-vertical cuts in soils due to the lowered motorway. Most soils likely to be encountered will be clays and sands, susceptible to erosion from rainfall and concentrated stormwater flows, particularly on steeper slopes, impacting on the design of the project. Whilst soils of the Lower Outwash Plains are capable of supporting lightly loaded shallow footings, changes in moisture content will impact on shrink-swell soil movements of the clay soils and have a potential impact on footings, retaining and pavement design. Excessive settlements of soils are not anticipated.

Unsaturated clay soils above groundwater level should be suitable for most types of conventional retaining walls such as anchored/soil nailed, cantilever, gravity and reinforced earth walls. Shallow perched groundwater could occur in sandier layers, particularly where such sands are underlain by relatively impermeable clay. The depth and quality of this groundwater may also affect structural design elements, including drainage structures and concrete durability.

Site contamination

The project has the potential to expose soil and/or groundwater contamination where historical activities in and adjacent to the road corridor have been identified as having the potential for contamination issues. Potential contamination risks have assisted in identifying the project footprint and will be taken into account during the detailed design process.

16.3.2 Construction

Soils and geology

Existing soils and geology in the Darlington Upgrade Project area will influence construction methodologies. Considerations include the constructability of the detailed design, suitability of materials for reuse, the balance between cut and fill, the source and type of fill, and opportunities for surplus fill material disposal. The detailed design process will incorporate a detailed analysis of soil conditions.

Site contamination

The existing extent of site contamination in both soils and groundwater in and adjacent to the Darlington Upgrade Project area has the potential to influence construction methodology. The project may expose soil and/or groundwater contamination during construction likely as a result of historical activities in and adjacent to the road corridor. Without environmental management measures, surface water runoff or erosion has the potential to mobilise contaminated soils if encountered during excavation. If present, any contamination of groundwater could also migrate, depending on rate of groundwater flow and nature of the specific contaminants. Contaminated groundwater originating from a site outside the project area has the potential to migrate beneath the corridor unless suitable protection measures are considered.

16.3.3 Operational

Given that the clay soils along the alignment have a moderate to high potential for shrink-swell movements in response to changes in soil moisture content, they have the potential to lose strength when wetted. Therefore maintaining soil moisture content close to the long-term equilibrium will be an important long-term maintenance requirement to protect against undesirable distortion of pavements, retaining walls or lightly loaded footings.

The ability and ease of maintaining elements such as retaining walls in the context of moderate to high potential for shrink-swell soil movement is influenced by the constraints of the road corridor and proximity to traffic. It is likely therefore that the project may impact on maintenance regimes, particularly in relation to retaining walls and the potential for the corrosion of soil nails.

16.4 Management and mitigation

16.4.1 Planning and design

The design process has taken risk assessment and likely contamination risks into account in planning for the project footprint and design of project elements. The detailed design process will focus on:

- > Designing retaining structures to support cuttings and ensure stability in the context of the soils, which are susceptible to erosion from rainfall and concentrated stormwater flows
- > The use of sealed surfaces and conventional drainage infrastructure where required to prevent soil erosion where water flows are concentrated
- > Consideration of the potential for shrink-swell soil movements for lightly loaded footings
- > Consideration of the potential for shrink-swell soil movements in the design of pavements to reduce the risk of cracking and distortion
- > The consideration of piled footings for heavier loads and supporting soil during pile construction where they extend below groundwater level
- > Giving consideration to the potential presence of cobbles and boulders in the alluvium close to groundwater level. Suitable piling techniques could include driven, driven-cast-in-situ and continuous flight auger.

In relation to site contamination, the planning and design phase has considered:

- > Sampling and analysis of soil requiring excavation in line with relevant Australian Standards and EPA standard for reuse of waste-derived fill to determine if it is suitable for reuse on site or requires disposal at an EPA licensed waste/recycling facility
- > Delineation of the extent of contamination (lateral and vertical) if excavation through potential or confirmed contaminated soils cannot be avoided
- > Assessment of contaminant concentrations of the soil to be classified for disposal at a licensed landfill or potential reuse
- > Consideration of groundwater depth and quality in structural design, including for drainage and concrete durability
- > Additional on-site testing to confirm groundwater levels throughout the corridor.

16.4.2 Construction

A Contractor's Environmental Management Plan will be prepared to identify areas of risk, management of spoil and erosion, protection of groundwater and surface water, management of dust and odour, and the safety of workers and the community. The plan will incorporate:

- > Measures to protect groundwater and surface water during excavations to ensure that any contaminated soils encountered during excavation are not mobilised by surface runoff/erosion
- > Requirements for management of contaminated materials on site, transportation and off-site disposal
- > Controls for impacted soils/groundwater, not previously identified, that are encountered during excavation
- > Measures for the off-site disposal of surplus spoil via an EPA waste/recycling licensed facility
- > Opportunities for the reuse of surplus spoil managed in accordance with the requirements of the EPA standard for reuse of waste derived fill
- > Measures for the collection and disposal of potentially contaminated groundwater if dewatering is required during construction
- > Identification of safe work methods for construction workers handling potentially contaminated soils, and for storage and use of chemicals on site
- > Controls throughout the construction period to avoid potential exposure of human or environmental receptors to pre-existing contaminants or dust pollution.

16.4.3 Operational

The potential impact of soils with high potential for shrink-swell movements on pavements, retaining walls, or lightly loaded footings in response to changes in soil moisture content, can be managed by:

- > Ensuring a program of planned inspections and maintenance to protect against corrosion of the soil nails where steel reinforced soil nails are used to support retaining walls
- > Ensuring the durability of soil nails given space constraints of the road corridor and likely difficulty of their replacement, especially where they are likely to be in contact with oxygen and water
- > Maintaining subsoil drains and the stormwater collection system in good working order
- > Giving careful consideration to the proximity of trees and soil moisture changes caused by tree root moisture extraction close to infrastructure
- > Promptly sealing any cracks that develop in pavement, shoulder or footpath areas.

16.5 Conclusion

Assessment of existing geology and soil conditions, including soil, groundwater and acid sulfate soils, has identified potential impacts off and on the project and the management approaches needed for detailed design and construction. The medium to high risk of shrink-swell soil movements in the soils identified during this assessment will be considered in the detailed design of structures, footings, retaining walls and pavements to reduce the potential for cracking and distortion due to soil movement.

Further geotechnical and environmental testing will be carried out during the detailed design phase to confirm the geotechnical properties of the soil and locate areas of rock. The soil is generally strong and conventional piling should be suitable. Rock is not expected to be encountered under the Main South Road depressed carriageway.

The groundwater is expected to be below the lowered section of the roadway. Testing during the detailed design phase would reveal any necessary management approaches to be incorporated into the construction and operational phases. A Contractor's Environmental Management Plan will be prepared to address issues relating to soil, geology and contamination during construction of the Darlington Upgrade Project.

17 Noise and vibration

17.1 Context

17.1.1 Assessment methodology

A noise and vibration assessment was undertaken using the following methodology:

- > Review of relevant legislation, policies and guidelines
- > Noise monitoring at sensitive receiver locations adjacent the project
- > Noise modelling undertaken for the years 2021 and 2031 to project expected noise and vibration impacts
- > Identification of the need for noise mitigation measures where noise levels at noise-sensitive receivers are predicted to be above target noise criteria and are identified as eligible for noise mitigation
- > Determination of project construction and operation noise and vibration assessment criteria
- > Prediction of construction noise exposure at dwellings along the existing corridor based on existing traffic flow and composition data for South Road
- > Comparison of predicted noise levels with relevant environmental noise criteria
- > Measurement of vibrations to confirm that ground vibration at the anticipated setback of dwellings meets the project criteria
- > Identification of options for the treatment of construction noise and vibration where required.

17.1.2 Relevant legislation, policies and guidelines

A number of relevant pieces of legislation, policies and guidelines have been reviewed as part of the noise and vibration assessment including:

- > *The Environment Protection Act 1993*
- > *Environment Protection (Noise) Policy, 2007*
- > *The Department of Planning, Transport and Infrastructure Road Traffic Noise Guidelines, 2014*
- > *Australian and New Zealand Standard AS/NZS2107:2000*
- > *Australian Standard AS 2670.2-1990: Evaluation of Human Exposure to Whole-Body Vibration German Standard DIN 4150-3 Effects of Vibration on Structures New Zealand Standard NZS 6803:1999 Acoustics – Construction Noise*
- > *Minister's Specification SA 78B established under the Development Act 1993.*

Although Section 22 of the *Environmental Protection (Noise) Policy 2007* specifically excludes road, rail and public infrastructure construction work from Division 1 of the policy (which deals with construction noise), the department and its contractors still have responsibility under Section 25 of the *Environment Protection Act 1993* to have a “duty of care” to not pollute the environment through noisy activities.

17.2 Existing conditions

17.2.1 Noise

Operational noise criteria

Outdoor target noise levels for noise sensitive land uses have been adopted for the Darlington Upgrade Project and used to assess its noise impacts. Sensitive land uses include dwellings in a residential type zone, aged care facilities, hospital wards and caravan parks that accommodate long-term residents. The target noise criteria adopted for the project is based on DPTI's Road Traffic Noise Guidelines, 2014. Outdoor target noise levels for noise sensitive land uses as adopted for the Darlington Upgrade Project are provided in Table 19.

Operational Noise Criteria (decibels)	Day	Night
Existing receivers affected by noise from a redeveloped road	60	55
Existing receivers affected by noise from a redeveloped road and where demolition of building structures or noise walls results in receivers previously shielded from traffic noise becoming exposed	57	52

Table 19 - Operational noise criteria for noise sensitive land uses

Construction noise targets

In relation to construction noise, the Darlington Upgrade Project has adopted a set of targets based on the Environment Protection (Noise) Policy, 2007. These are outlined in Table 20.

For commercial premises, a noise level of 70 decibels averaged over an hour between 7.30am and 6.00pm and 75 decibels over an hour between 6.00pm and 7.30am has been adopted for all days of the week. This is based on a review of New Zealand Standard NZS 6803:1999 Acoustics – Construction Noise.

Day of the week	Time period	Duration of impact					
		Short term works up to 2 nights		Medium term works 3-14 nights		Long term works over 14 nights	
		Average over 15 mins	Max	Average over 15 mins	Max	Average over 15 mins	Max
Weekdays	6am–7am	65	75	60	75	55	75
	7am–7pm	Reasonable and practicable measures to minimise noise					
	7pm–10pm	75	90	70	85	65	80
	10pm–6am	45	75	45	75	45	75
Saturday	Midnight–7am	45	75	45	75	45	75
	7am–7pm	Reasonable and practicable measures to minimise noise					
	7pm–midnight	45	75	45	75	45	75
Sunday and public holidays	Midnight–9am	45	75	45	75	45	75
	9am–7pm	Reasonable and practicable measures to minimise noise					
	7pm–midnight	45	75	45	75	45	75

Table 20 - Construction noise targets for construction activities, plant and equipment

Outcomes of noise monitoring

Noise monitoring was undertaken in May 2014 and again in May 2015 to allow for data collection over a seven day monitoring period and to gather updated baseline noise data following the opening of the Southern Expressway Duplication in August 2014. A total of 10 locations were monitored ranging from road reserves adjacent Main South Road, to the back yards of houses. Outcomes of monitoring indicated that day time noise levels, averaged over 15 hours, ranged between 54.3 and 68.0 decibels. Night time noise levels, averaged over nine hours, ranged from 49.3 to 64.9 decibels.

17.2.2 Vibration

Target construction vibration levels – human comfort

Generally, vibration levels that may be perceived by building occupants are significantly more rigorous than the vibration levels at which any structural damage might occur. Vibration criteria for human annoyance are based on human exposure and have been derived by the *Australian Standard AS 2670.2-1990: Evaluation of Human Exposure to Whole-Body Vibration*. They are provided in Table 21.

Receiver type	Peak particle velocity vibration target
Residential – day and shoulder	0.3–0.6 mm/s
Residential - night	0.2 mm/s
Office	0.6 mm/s
Workshop	1.2 mm/s

Table 21 - Adopted construction vibration criteria for human comfort

Target construction vibration levels – to avoid building damage

The vibration criteria for structural damage have been derived from the *German Standard DIN 4150-3 Effects of Vibration on Structures*, a common reference in the absence of a specific Australian Standard for structural building damage and are provided in Table 22.

Structure type	Peak particle velocity vibration target
Commercial, industrial and similar buildings	20 mm/s
Residential dwellings and buildings of similar design and/or use (excluding heritage listed structures)	5 mm/s
Structures sensitive to vibration and that have intrinsic value such as heritage listed structures without modern foundations	3 mm/s

Table 22 - Target vibration levels to avoid building damage

If it is not possible in practice to achieve these targets as a result of construction activities, *German Standard DIN 4150-3 Effects of Vibration on Structures* provides alternative methodologies for identifying vibration targets based on frequency of the vibration source.

17.3 Potential effects and opportunities of the project

17.3.1 Planning and design

Traffic noise modelling outcomes

Noise monitoring and an analysis of existing and predicted traffic levels and speeds were used to determine potential noise effects with noise mitigation likely being required at the following immediate interfaces with Main South Road:

- > Clovelly Park between Sturt Road and the Monroe site
- > Bedford Park (north) between Sturt Road and Shepherds Hill Road
- > Bedford Park (south)/Darlington between Flinders Drive and Brookside Road.

It should be noted that the extent of noise modelling required will depend greatly upon the detailed design process. Definitive noise modelling will therefore not be undertaken until the detailed design is closer to completion to ensure accuracy. Noise modelling will also be undertaken for the St Marys area given the recent extension of the project to incorporate Main South Road between Ayliffes Road and the intersection of Tonsley Boulevard.

17.3.2 Construction

Construction vibration

The highest levels of vibration during construction are typically generated by compactors, vibratory rollers and pile drivers. The vibration assessment for the study indicates that in most cases, the generated vibration levels are too low in magnitude to cause structural damage to buildings located more than 25 metres from the construction activity. The assessment also indicates that residences within 50 metres of construction activities – such as compacting and piling – may experience some vibration effects on building contents.

Heritage listed buildings are considered at potential risk of structural damage within 50 metres of construction activity due to their significance and potential sensitivity. A policy or objective specific to vibration criteria does not exist in South Australia. However, the general environmental duty of the EPA can be interpreted to apply to vibration and there are accepted standards that

are usually referenced for projects where vibration might be an issue.

A number of construction activities have the potential to have an effect on levels of ground vibration and have been assessed for typical levels of vibration and distance required to avoid damage to structures. These include:

- > Vibratory rollers
- > Hydraulic rock breakers
- > Compactors
- > Excavators
- > Truck traffic over irregular surfaces
- > Impact pile driving/removal
- > Continuous flight auger piling
- > Bored piling
- > Bulldozers
- > Air track drills
- > Jackhammers.

A number of facilities in the vicinity of the Darlington Upgrade Project will have equipment sensitive to vibration. Vibration criteria that are applicable to vibration sensitive equipment should be determined based on advice from the equipment supplier or manufacturer. These include:

- > Monroe – the site contains old underground oil containers, and the facility uses calibration equipment that is sensitive to vibration
- > Flinders Medical Centre and Flinders Private Hospital – these have sensitive equipment such as medical imaging and scanners, and the specialist spaces such as operating theatres will also be more sensitive to vibration than the general medical areas
- > The various campus sections of Flinders University within the project area, which may also have vibration-sensitive equipment.

It is also likely that construction activities will occur in close vicinity to existing and planned underground pipework and services along the roadway that may require monitoring for vibration effects.

17.4 Management and mitigation

17.4.1 Planning and design

It is likely that the final detailed design for the Darlington Upgrade Project will incorporate a mixture of design methods and treatments including designing the motorway to reduce the impact of noise by treatment close to the source, treatment via noise barriers, and treatment of buildings.

Designing the motorway to control noise

The Darlington Upgrade Project incorporates a non-stop motorway that is lowered below ground level for most of the 3.3 kilometre distance and this is a key design approach to reducing the transmission of noise. Locating the road away from potential sensitive receivers wherever possible, using buffers to create distance between the road and receivers, and using mounding are additional design techniques that will be investigated at the detailed design phase. It should be noted however that the constrained and built up urban environment may limit the use of these techniques considerably.

The detailed design phase will also incorporate the selection of materials and the design of pavements that minimise noise from the interaction between road and vehicle tyres. This is considered especially effective for higher speed non-stop roads such as those forming part of the Darlington Upgrade Project. The use of a 'low road noise' asphalt surface will be investigated during detailed design.

Noise walls

The use of noise walls at the edge of the road reserve and adjacent to sensitive receivers where property boundaries face the road corridor will be investigated as an option (if required) for managing noise through the planning and design phase. Depending on their design, noise walls can both reflect and absorb noise. The ultimate height of noise barriers will be determined during the detailed design phase and will be balanced with urban design and other community objectives. Walls will be acoustically designed using materials that prevent noise transmitting through the barrier either via absorption or reflection.

Building treatments

Individual dwelling acoustic treatments are likely to be required to treat residual noise impacts following the installation of noise barriers, particularly where the use of tall noise barriers are considered undesirable from an urban design or community perspective. Approaches to the acoustic treatment of buildings will depend on expected noise levels and eligibility for treatment but would include double glazing, acoustic seals and insulation, sometimes combined with artificial ventilation.

Eligibility for noise mitigation

Eligibility for noise mitigation is based on the predicted change in noise levels at the project opening year, without noise barriers in place. In order for a receiver to be eligible for noise mitigation, one of the following must be satisfied:

- > The project predicted noise level is more than 2 decibels above the existing predicted noise level for the same year and above the noise criteria
- or
- > The predicted noise level is greater than or equal to 5 decibels above the noise criteria.

Once a receiver is deemed eligible, the mitigation measures are designed to ensure that predicted noise levels for 10 years after the project's opening satisfy the noise criteria, where reasonable and practicable.

Noise catchment areas will be defined during the detailed design phase once the preferred noise wall height and locations have been finalised. Catchment areas will be determined based on areas where noise-sensitive receivers are eligible for similar noise mitigation treatments to ensure a consistent, reasonable and practicable approach to noise mitigation.

17.4.2 Construction

Vibration management during construction

Prior to construction starting, pre-construction dilapidation surveys will be undertaken in buildings that may be more at risk of potential damage from construction vibration. A Construction Noise and Vibration Management Plan developed as part of the Contractor's Environment Management Plan will be used as the key tool for managing the impacts of vibration and this will be prepared before construction starts.

The Management Plan will incorporate:

- > The scheduling of construction to ensure that activities likely to generate high levels of vibration are undertaken during periods where the potential for disturbance of human occupants are lowest
- > Coordinating activities with the operation of vibration sensitive facilities such as Monroe and the medical centre
- > Ensuring equipment is well maintained and balanced
- > Using lower vibration plant and equipment
- > Avoiding vehicle movements along uneven surfaces and restricting vehicle speed where this is unavoidable

- > Modifying existing equipment to reduce vibration power levels
- > Operating equipment at the lowest vibrating settings possible for the task at hand having regard to effective time and output parameters
- > Mounting high-speed vibrating plant on rubber or other vibration-isolating mounts where feasible
- > Balancing variable-speed vibrating plant and equipment and operating at speeds that do not produce resonances
- > Avoiding impact piling where practicable and setting the piling hammer drop distance as low as possible where piling is necessary.

During the development of the Construction Noise and Vibration Management Plan, facilities with sensitive equipment such as the Monroe site and Flinders Medical Centre will need to be consulted, and vibration criteria specific to the relevant items of equipment established if required.

Vibration monitoring

Construction vibration monitoring will be undertaken where:

- > Vibratory compaction works are to occur within 40 metres of heritage listed structures and 25 metres of residences
- > Where impact piling is to occur within 120 metres of heritage listed structures and 90 metres of residences
- > Responding to a complaint, where this represents an appropriate response in accordance with the complaints handling process.

In addition, continuous vibration monitoring will be undertaken with automated exceedance notifications during major construction works near the following sensitive locations:

- > Fairford House and Coach House, for the duration of the project
- > Monroe
- > Medical facilities where vibration-sensitive equipment is discovered during development of the Construction Noise and Vibration Management Plan
- > Representative residential properties adjacent to where vibration intensive works are occurring.

Management of noise during construction

Prior to construction starting, the Construction Noise and Vibration Management Plan will be developed as part of the Contractor's Environment Management Plan as the key tool for managing the impacts of noise. The Management Plan will incorporate:

- > The programming of construction works to minimise the impact of noise
- > The use of quieter equipment and operating methods
- > The maintenance of equipment in good working order
- > Avoidance of noisy activities close to sensitive receivers where possible
- > The use of communications to inform residents about noisy construction works
- > Location of site access and noisy equipment as far away from sensitive receivers where possible
- > Shielding of noisy activities
- > The minimisation of the use of warning devices and radios
- > Education of staff on noise sensitive issues.

The installation of noise barriers early in the life of the project will be investigated, with the timely establishment of permanent noise walls if required. Alternatively, the installation of temporary acoustic screens next to noisy activities will be investigated.

Noise monitoring

The process of construction noise monitoring will be detailed in the Construction Noise and Vibration Management Plan and may include:

- > Monitoring of significant noise generating plant and equipment at the commencement of construction activities
- > Monitoring of any alternative equipment or processes proposed which are expected to be significantly louder than those assumed in the Construction Noise and Vibration Management Plan
- > Monitoring of night time works next to noise-sensitive receivers which are expected to result in noise levels above the construction noise targets.

Works outside of normal working hours

It is expected that some construction works may need to be undertaken outside of normal working hours, including at night, due to the need to maintain an operable road network for the duration of the project. Justification of works during these time periods is necessary to address the increased potential impact of construction noise and vibration during these times.

Communication and complaints management

A key aspect of the Construction Noise and Vibration Management Plan is the establishment of a communications plan and complaints management system that incorporates the notification of vibration or noise-sensitive properties prior to the start of high-vibration and noisy activities. Communication activities will be detailed in the Stakeholder and Community Engagement Management Plan.

17.4.3 Operational

Road traffic vibration levels are estimated to be below the human annoyance criteria (and therefore below the typical threshold of perception) at all locations in future operating scenarios. The smooth road surface installed in the project would not require any mitigation or management measures.

With the application of mitigation measures identified in the planning and design phase, the impact of operational noise is expected to be within the adopted noise criteria for the Project.

17.5 Conclusion

Noise and vibration modelling has been undertaken based on the concept scheme using noise monitoring, analysis of predicted traffic levels and modelling of likely noise impacts for existing conditions in 2021 and 2031. The results of the modelling suggest that noise mitigation will be required, particularly where the demolition of buildings exposes housing to the effects of road noise. More detailed noise modelling will be undertaken once the detailed designs are progressed and details can be used to determine the level and type of noise mitigation options. Mitigation options are likely to include a mixture of noise barriers, treatment of noise at the source, and the treatment of houses and areas likely to require consideration for noise mitigation. These include the immediate interfaces with Main South Road at Darlington, Bedford Park (south), Clovelly Park, Bedford Park (north) and potentially St Marys.

During construction, noise and vibration will be managed principally via the Construction Noise and Vibration Management Plan, which will identify and implement measures that minimise impacts via the scheduling of activities, monitoring, the use of construction methods and the selection and maintenance of plant and machinery.

18 Air quality and greenhouse gas emissions

18.1 Context

18.1.1 Assessment methodology

An air quality assessment was undertaken to determine the potential effects of air quality on sensitive land uses adjacent to the corridor and includes the following methodology:

- > Review of relevant legislation, measures, policies and guidelines
- > Identification and adoption of project air quality goals
- > Air dispersion modelling
- > Greenhouse gas impact assessment

18.1.2 Assessment of likely effects of the project on air quality.

The potential effects associated with exposure to road traffic pollutants generated after completion of the project were modelled using a base case as well as comparisons with year of opening (2021) and 10 years after opening (2031). The modelling incorporated:

- > A count of traffic volumes
- > Review of traffic types
- > An inventory of fleet emissions
- > Review of atmospheric chemistry

18.1.3 Relevant legislation, strategies and policies

A number of relevant pieces of legislation, strategies and policies have been considered in undertaking the air quality assessment, particularly National Environment Protection Measures, which outline agreed national objectives and targets for protecting or managing certain aspects of the environment. Relevant legislation, strategies and policies reviewed include:

- > *National Environment Protection (Ambient Air Quality) 2003*
- > *South Australian Environment Protection Act 1993*
- > *Environment Protection (Air Quality) Policy 1994*
- > *National Environment Protection Council Act 1994*
- > *Climate Change and Greenhouse Gas Emissions Reduction Act 2007*
- > *Tackling Climate Change – South Australia's Greenhouse Gas Strategy 2007-2020*
- > *Australian Government's Direct Action Plan – Emissions Reduction Fund.*

18.2 Existing conditions

18.2.1 Project-specific air quality goals

Project-specific air quality goals were taken from the South Australian EPA Guidelines, and supplemented by the National Environment Protection Measures and the New South Wales EPA where criteria are not provided by the South Australian EPA Guidelines. Table 23 provides the adopted air quality goals for the pollutants relevant to this assessment.

18.2.2 Existing air quality

Meteorology and air dispersion

Meteorology in the area surrounding the Darlington Upgrade Project is affected by several factors such as terrain and land use. Wind speed and direction are largely affected by topography at the small scale, while factors such as synoptic scale winds affect wind speed and direction on the larger scale. Wind speed and direction are important variables in assessing potential air quality impacts as they dictate the direction and distance air pollutant plumes travel.

In the dispersion modelling undertaken, atmospheric stability describes the rate at which a plume will disperse, represented by typically six classes: A to F, that is, unstable through to very stable conditions. The most common stability class for the project area was determined to be D class, occurring 63% of the time, which suggests that the dispersion conditions are such that air emissions will disperse rapidly for a significant proportion of the time.

Ambient air quality

The South Australian EPA operates an ambient air quality monitoring program in metropolitan Adelaide and selected country regions. Four monitoring stations are located in metropolitan Adelaide within 20 kilometres of the project. The closest operating EPA monitoring site to the study area is at Netley approximately eight kilometres to the north and has been used in the assessment. Volatile organic compounds, polycyclic aromatic hydrocarbons and carbon monoxide are not monitored by the EPA. However, the background concentrations of these pollutants are expected to be very low in the Adelaide area. A summary of data from the Netley monitoring station is provided in Table 24.

Pollutant	Concentration		Averaging period
	ppm	µg/m ³	
Carbon Monoxide (CO)	25	29,000	1 hour
	9	10,000	8 hours
Nitrogen dioxide (NO ₂)	0.0625	113	1 hour
	-	62	Annual
Coarse Particulate Matter (2.5 to 10 micrometres in diameter) (PM ₁₀)	-	50	24 hour
	-	30	Annual
Fine Particulate Matter (2.5 micrometres in diameter or smaller) (PM _{2.5})	-	25	24 hour
	-	8	Annual
Volatile Organic Compounds	0.017	53	3-minute (as benzene)
Polycyclic aromatic hydrocarbons	-	0.73	3-minute (as benzo(a)pyrene)

Table 23 - Ambient air quality goals adapted from National Environment Protection Measures

Pollutant	Level	Micrograms/ cubic metre
Nitrogen dioxide - (NO ₂) over a 1 hour averaging period	Maximum	86.2
	90th percentile	37.0
	70th percentile	17.9
	Average	14.3
	1 hour average criterion	113.0
	Annual average criterion	620
Coarse Particulate Matter (2.5 to 10 micrometres in diameter) - (PM ₁₀) over a 24 hour averaging period	Maximum	56.4
	90th percentile	23.0
	70th percentile	18.2
	Average	15.9
	1 hour average criterion	50.0
	Annual average criterion	30.0
Fine Particulate Matter (2.5 micrometres in diameter or smaller) - (PM _{2.5}) over a 24 hour averaging period	Maximum	17.0
	90th percentile	10.2
	70th percentile	8.2
	Average	7.4
	1 hour average criterion	25.0
	Annual average criterion	8.0

Table 24 - Existing ambient air quality, Netley 2014, EPA

Historic trends in air quality

Trends in air quality between 1979 and 2014 suggest that generally air quality concentrations in Adelaide are decreasing over time for carbon monoxide and nitrogen dioxide. No major changes in the concentration of coarse particulate matter have been observed. Key air quality observations show:

- > Carbon monoxide values measured at Adelaide and Elizabeth monitoring locations were well below the National Environment Protection Measure values, having trended downwards between 1988 and 2008 and plateaued since 2008
- > Nitrogen dioxide values measured across Adelaide showed a continued low concentration of nitrogen dioxide. One area of note was the lack of nitrogen dioxide exceedances noted at the Netley monitoring location in 2014, which indicates improved performance than noted historically for Netley
- > Concentrations of coarse particulate matter is noted as exceeding the South Australian EPA criterion on one day in 2014, which is similar to typical observations of between one and five exceedances per year
- > Concentrations of fine particulate matter in 2014 show a similar trend to that observed in 2008 with average values close to the annual average criterion and the 24 hour maximum concentration close to the short term criterion.

Given the lack of any clear trend in pollution increase and general decreases in background pollutant concentration, it was considered that the use of the 2014 data extrapolated for the years 2021 and 2031 is a reasonable approach for the predictive modelling. In addition, as air quality over this length of time has the potential to change, a conservative approach was used applying use of the 90th percentile to ensure the predictions are conservative for all modelling scenarios in this assessment.

18.2.3 Greenhouse gas emissions

In 2009, the Bureau of Infrastructure, Transport and Regional Economics undertook detailed modelling and forecasting of greenhouse gas emissions for the Australian transport sector, including consideration of likely future trends in travel behaviour, vehicle technology and greenhouse gas emissions abatement measures. The Bureau estimated that by 2020, road transportation would be accountable for emissions totalling 90 million carbon dioxide equivalent, representing an increase of 65% above the 1990 baseline period.

In recent years, increases in traffic volumes in metropolitan Adelaide have increased traffic congestion which, in turn, can lead to greater production of greenhouse gas emissions through increased traffic idling and stop-start traffic movements.

18.3 Potential effects and opportunities of the project

18.3.1 Planning and design

A more efficient road design that incorporates higher average vehicle speeds with fewer stop-starts has the potential to minimise vehicle emissions and this is one of the key objectives driving the design process. The design focuses on providing a non-stop lowered motorway for the length of the Darlington Upgrade Project from the Southern Expressway to just north of Tonsley Boulevard. It can also be anticipated that vehicle engine emissions technology will continue to be improved and implemented in South Australia, which has the potential to further minimise transport related emissions over time.

18.3.2 Construction

Dust emission sources include both the processes of excavation work and static sources such as those from exposed surfaces, unsealed surfaces and stockpiles. The key air quality issue associated with construction of the Darlington Upgrade Project is the management of dust, largely as coarse particulate matter and total suspended particles. The main sources of dust from construction are likely to be:

- > Removal of vegetation
- > Top soil stripping
- > Heavy excavation works
- > Heavy vehicular movement on unsealed surfaces
- > Stockpiles.

The level of dust will depend upon the intensity of excavation, extent of exposed soil surfaces, prevailing winds and time of year.

18.3.3 Operational

Air quality

Air quality at sensitive receptor locations depends on their proximity to roads and industry. For receptors close to main roads, vehicle emissions will be the dominant source of air pollution during peak hours with the remaining pollution from other non-road sources, both natural and man-made. Air quality at locations more than 500 metres from existing roads will be dominated by a mix of regional air pollutant sources.

The determination of the existing air quality is important to ensure predicted concentrations from a source such as a road are considered cumulatively and in view of background concentrations.

The air quality assessment modelled the potential effects on air quality associated with the project for the existing road configuration in 2015, opening year in 2021 and 10 years after opening in 2031. The assessment focused on emissions associated with the existing and operational phase of the project from traffic using an air dispersion model. Indications are that the operation of the project is not expected to result in pollutant concentrations that exceed the adopted criteria for the existing road, opening year and 10 years after opening. Furthermore, the contribution from the project to cumulative concentrations was generally minor. The year 2021 was chosen for the modelling as it is the closest traffic modelling available to the project's anticipated opening (i.e. 2018).

Greenhouse gas emissions

Modelling of traffic across the Adelaide metropolitan network indicates that construction of a non-stop corridor along the length of Main South Road is likely to increase the number of vehicle kilometres travelled when compared with a no-build scenario. However, the associated increase in average vehicle speed will improve fuel efficiency and thus bring an overall reduction in traffic-related greenhouse gas emissions.

The upgraded North-South Corridor, including the Darlington Upgrade Project, is predicted to result in greenhouse gas emissions savings of 1 977 kilotonnes of carbon dioxide equivalent over a 30-year period when compared to not upgrading the road. In 2021, the annual average saving is predicted to be eight kilotonnes of carbon dioxide equivalent, increasing to 63 by 2031 due to the expected increase in traffic volumes.

18.4 Management and mitigation

18.4.1 Construction

As part of the project's Contractor's Environmental Management Plan, Gateway South will manage air quality during construction. Potential management and mitigation measures to be considered in the development of the plan area include:

- > Creation of a Construction Traffic Management Plan to advise all truck drivers, contractors and vehicular machinery operators of designated vehicle access routes
- > Haulage routes positioned with heavy traffic away from sensitive receivers as far as practicable

- > Restriction of vehicle speeds on unsealed access routes to minimise wheel-generated dust
- > Minimisation of engine idle times and queuing by construction vehicles
- > Installation of truck tyre cleaning stations such as rumble pads at site boundaries for earth moving vehicles to minimise dust emissions or sediment drag out onto surrounding roads
- > Truck loads with a potential for dust emissions covered during transport
- > Frequently water exposed surfaces, including exposed stockpiles and unsealed roadways
- > Use of chemical dust suppressants or sealing of high use access tracks to suppress dust generation
- > Location and/or covering of stockpiles away from sensitive receivers
- > Restriction of activities with high dust generating potential, including heavy excavations and drilling, during periods when strong winds are present
- > Monitoring of ambient air quality in accordance with Australian Standard 2922-1987 with additional mitigation measures implemented where necessary
- > Removal of asbestos in accordance with the provisions of the *Work Health and Safety Act 2012* and Chapter 8 of the *Work Health and Safety Regulations 2012*, and the relevant Codes of Practice and Australian Standards
- > Engagement of the affected community through a project telephone information line answered by the project team, responding to queries on construction and to complaints/concerns from the community
- > Providing regular updates to the community to inform them of upcoming construction.

18.4.2 Operation

The operational air quality impact assessment based on the concept design has demonstrated that Ambient Air National Environment Protection Measures will be met within the project area and the operation of the Darlington Upgrade Project is not expected to adversely affect air quality in its vicinity and the completion of the upgraded non-stop road corridor, including the Darlington Upgrade Project, is predicted to result in greenhouse gas emissions savings.

18.5 Conclusion

Air quality assessments undertaken indicate that the Darlington Upgrade Project is not expected to adversely affect air quality in its vicinity.

During construction, the key potential impacts of the project relate to dust due to excavation works and the use of machinery as well as emissions from heavy machinery and vehicles themselves. A Contractor's Environment Management Plan will be prepared to manage potential air quality effects relating to construction.

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