

DELIVERING OUR TRANSPORT FUTURE NOW

# north-south corridor northern connector



## Glossary, Abbreviations, References and Appendices

Glossary  
Abbreviations  
References  
Appendices

## Project Impact Report Volume 2

An environmental, social and economic assessment



Government of South Australia  
Department for Transport,  
Energy and Infrastructure

## Glossary

'A' weighted	frequency filter applied to measured noise levels to represent how humans hear sounds
anti-directional	not the most direct route to take
aquifer storage and recovery	a means of introducing recycled water into underground aquifers (also known as managed aquifer recharge (MAR))
average recurrence interval	likelihood of a flood occurring in a given year (e.g. 100 year ARI occurs once every 100 years, on average)
base case	system that would exist without the introduction of changes proposed by the project
batter	the uniform side slopes of walls, banks and cuttings
batter swales	vegetated or grass-lined channel that receives and transports stormwater flow and is located within the road batter
benefit cost analysis	indicates whether the whole of South Australia is 'better off' by funding this project
biodiversity	the variety of all life forms (e.g. plants, animals, microorganisms)
brackish	slightly saline water
cluster effect	effect of buyers and sellers of a particular good or service congregating in a certain place, making other buyers and sellers relocate there
concept design	initial layout of the project
concept planning phase	phase to determine a definition of the scope; precedes environmental impact assessment and detailed design phase
dB(A)	'A' weighted overall sound pressure level in decibels
design speed	speed equal to or greater than the 85 <sup>th</sup> percentile speed (the speed at, or below, which 85% of cars travel under free flowing conditions)
diamond	4-ramp interchange that is often the design of choice for lower-traffic interchanges without special constraints
discount rate	interest rate used to find the present value of an amount to be paid or received in the future
environmental impact assessment phase	the phase in which this Project Impact Report, including all the specialist studies, is prepared
ephemeral wetlands	wetlands that hold water temporarily
fill	material placed to create an embankment
final route selection	the route that would be constructed; decided after community and stakeholders have provided input in the exhibition phase
freeboard	the height of a water storage device above a given level of water
grade	the slope of a road (i.e. 0% is flat)
grade separated	separation of road/rail at different elevation
habitat	type of environment in which an animal/plant normally occurs
heavy vehicles	vehicles with two or more axles; not cars

horticulture	intensive cultivation of flowers, fruits, vegetables or ornamental plants
hydro-seeding	high-pressure spray technique for applying seed, mulch and fertiliser in a water slurry over a seedbed
indirect effects	effects that a road/expressway in one area, has in another area
internal rate of return	indicator of the net benefits expected from a project over its lifetime, expressed as a percentage
interchange	a grade separation of two or more roads with one or more interconnecting carriageways
intelligent transport system	system that can monitor, collect, store, display, analyse, transmit or report information on the transport network
Kaurna people	Aboriginal group; traditional owners of the land in the project area
Land Use Scenario D+20%	defines the population and employment in the transport model
light-emitting diode	long-lasting illumination technology that requires very little power
Leq,T	equivalent continuous noise level measured over a time period T, often referred to as the 'ambient' noise level; represents an approximate average of the noise level over the period
L <sub>max</sub>	maximum measured noise level within a given time period
level mean emission	traffic noise level at 25 m calculated through the German RLS 90 method, used to express the basic source noise level of a road
level of service	a representative measure of the quality of traffic flows and ease with which traffic can move within the traffic stream
Metropolitan Adelaide Strategic Evaluation Model	the DTEI strategic transport model
minimum horizontal radius	the smallest/tightest curve to be designed on the expressway
Native title	rights and interests of Aboriginal people in land and waters, according to their traditional laws and customs, where they have maintained a continuous connection with their land or waters
net benefit	the indicator of whether South Australia is better off — the difference between the sum of benefits and the sum of all costs, expressed in present value dollars; calculated as the net present value (NPV) of the project
Northern Adelaide Plains	750 km <sup>2</sup> area centred 30 km north of Adelaide CBD
Northern Adelaide region	one of the seven planning regions, as identified in <i>The 30-Year Plan for Greater Adelaide</i> ; consists of Playford, Salisbury, Tea Tree Gully, Port Adelaide-Enfield (part) LGAs
Northern interchange	the interchange at the junction of the proposed Northern Connector, Northern Expressway and Port Wakefield Road
Plate F clearance	space available for rail cars of specific height and width
partial cloverleaf	four-ramp interchange that has loop ramps; functionally equivalent to a diamond, with two entrance ramps and two exit ramps; also referred to as 'parclo'
posted speed	enforced speed limit

Reference Concept	concept design that formed the basis for developing and comparing alternative route options
Sensitive receiver	Noise sensitive land use as defined by the DTEI <i>Road Traffic Noise Guidelines</i> including: existing dwellings in a zone where dwellings are contemplated as defined by the relevant development plan existing nursing homes caravan parks accommodating long-term residents parks and educational institutions (considered on a case by case basis)
stone mastic asphalt	asphalt with special grading and binders to produce a high level of resistance to road deformations
Southern interchange	interchange at the junction of proposed Northern Connector, South Road, Port River Expressway and Salisbury Highway
standard temperature and pressure	commonly used to define standard conditions for temperature and pressure; important for measurements and documentation of chemical and physical processes
superelevation	the slope by which the outside lane of a road curve is raised above the inside lane
the project	the new Northern Connector dual-use road and rail transport corridor
the Proponent	Department for Transport, Energy and Infrastructure
transshipment	transfer from one form of transport to another
transpiration	evaporation of water from plants
trumpet	three-way interchange that requires only one or two bridges
vertical crest curve	convex curve that connects sections of the road
vertical sag curve	concave curve that connects sections of the road



## Abbreviations

AADT	annual average daily traffic
AARD	Aboriginal Affairs and Reconciliation Division of the Department of the Premier and Cabinet
AHD	Australian height datum
AL	alluvial type
ARI	average recurrence interval
ARTC	Australian Rail Track Corporation
ASR	aquifer storage and recovery
ATC	Australian Transport Council
BCA	benefit cost analysis
BCR	benefit cost ratio
BoM	Bureau of Meteorology
CBD	central business district
CEMP	contractor's environmental management plan
CO	carbon monoxide
CO <sub>2</sub> -e	carbon dioxide equivalent
CPB	Coast Protection Board
dB(A)	'A' weighted overall sound pressure level in decibels
DECC	Department of Environment and Climate Change
DEEWR	Department of Education, Employment and Workplace Relations
DEH	Department for Environment and Heritage (South Australia)
DEWHA	Department of Environment, Water, Heritage and the Arts (Australian Government)
DOTARS	Australian Government Department of Transport and Regional Services
DPA	Development Plan Amendment
DTEI	Department for Transport, Energy and Infrastructure
EBS	Environmental and Biodiversity Services
EMS	Environmental Management System
EPA	Environment Protection Authority, South Australia
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPP	environment protection policy
ESD	ecologically sustainable development
FTE	full-time equivalent
GANRO	Draft Guidelines for the Assessment of Noise from Rail Operations
GGAT	Greenhouse Gas Assessment Tool
GHG	greenhouse gas

GPS	global positioning system
GWA	Genesee Wyoming Australia
HELSP	Housing and Employment Land Supply Program
IPCC	Intergovernmental Panel on Climate Change
K	rate of vertical curvature
km/hr	kilometres per hour
KPI	key performance indicator
$L_{eq,24h}$	equivalent continuous noise level measured over a 24 hour period; used for the assessment of rail noise
$L_{max}$	maximum measured noise level within a given time period
LGAs	local government areas
LME	level mean emission
LoS	level of service
MASTEM	Metropolitan Adelaide Strategic Evaluation Model
MDP	<i>Residential Metropolitan Development Program</i>
MNL	measured noise level data
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measures
NO <sub>2</sub>	nitrogen dioxide
Noise EPP	<i>Environmental Protection (Noise) Policy 2007</i>
NPI	National Pollutant Inventory
NPV	net present value
NPW Act	<i>National Parks and Wildlife Act 1972</i>
NRM	natural resources management
O <sub>3</sub>	ozone
OI 21.7	<i>DTEI Infrastructure Works at Night – Operational Instruction 21.7</i>
Pb	lead
PB	Parsons Brinckerhoff
PEMP	project environmental management plan
PM <sub>2.5</sub>	particulate matter of average aerodynamic diameter less than 2.5 micrometers (µm)
PM <sub>10</sub>	particulates with mean aerodynamic diameter < 10µm
PNL	predicted noise level data
Q100	design flow rate for a bridge or culvert to accommodate a 1 in 100 year event
RAAF	Royal Australian Air Force
RLS 90	German method that predicts the A-weighted traffic noise levels
SA	South Australia
SASP	South Australia's Strategic Plan

SD	statistical division
SEB	significant environmental benefit
SEDMP	soil erosion and drainage management plan
SO <sub>2</sub>	sulfur dioxide
STP	standard temperature and pressure
TAPM	The Air Pollution Model
	CSIRO developed prognostic meteorological model
vpd	vehicles per day
WEBs	wider economic benefits
WWTP	wastewater treatment plant





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## Appendix A. Project team

The project team for the planning study and their responsibilities are listed in Table A.1.

**Table A.1 Northern Connector project team**

<b>Responsibilities</b>	<b>Company</b>
Air quality and odour	Aurecon
Community and stakeholder engagement	DTEI
Concept design	DTEI and Aurecon
Project Impact Report	Preparation: DTEI, PB, Aurecon and InfraPlan Graphics: PB and DTEI Graphic design: Boylen Media Editing: PB and <i>in writing</i>
Economics	Ernst & Young Infraplan
Flora	Environmental & Biodiversity Services
Fauna	KBR
Geology, soils and contamination	Aurecon PB
Greenhouse, sustainability and climate change	PB and InfraPlan (Operational GHG)
Landuse, planning and zoning	Hassell and Infraplan
Noise and vibration	Aecom
Non-Aboriginal heritage	PB
Socioeconomic	PB and InfraPlan
Traffic and transportation	PB
Visual amenity and landscape	Hassell and DTEI
Water quality, drainage and flooding	PB



## Appendix B. Listed non-Aboriginal heritage places

**Table B.1 Heritage places listed in the Australian Heritage database**

Suburb	Heritage place	Location	List	Status
Dry Creek	Santiago Shipwreck	North Arm	Register of the National Estate	Registered
Gepps Cross	Administration Building	690–714 Main North Rd	Register of the National Estate	Indicative
Parafield Gardens	Angas home	92 Shepherdson Rd	Register of the National Estate	Indicative
	Wittbers Hop Monument	Victoria Rd	Register of the National Estate	Indicative
Bolivar	Penrice area	Near St Kilda	Register of the National Estate	Indicative
St. Kilda	Australian Electric Transport Museum	St Kilda Rd	Register of the National Estate	Rejected
	Penrice area*	Near St Kilda	Register of the National Estate	Indicative
Edinburgh	Salisbury Explosives Factory (former)	Commercial Road, Salisbury	Register of the National Estate; Commonwealth Heritage List	Registered Indicative
Virginia	Buckland Park Lake	Port Gawler Road, Two Wells	Register of the National Estate	Indicative
	Port Gawler Conservation Park	Port Gawler Road, Port Gawler	Register of the National Estate	Registered

\*in the vicinity of the Northern Connector project

**Table B.2 South Australian Heritage Places database search results**

Suburb	Heritage place	Location	List	Status <sup>1</sup>
Wingfield	None	-		
Dry Creek	Warehouse	79 Churchill Road	Port Adelaide Enfield Council Section 23 (Development Act 1993)	a,b,f
	Post office	1 High Street	Port Adelaide Enfield Council Council Section 23 (Development Act 1993)	a,c
	Southern abutment remains of 1857 North Arm Road Bridge	Old North Arm Road	Port Adelaide Enfield Council Section 16 (Heritage Places Act 1993)	REG a,c
	Warehouse	75–77 Churchill Road	Port Adelaide Enfield Council Section 23 (Development Act 1993)	a,b,f
	Dry Creek Explosives Magazine and Earth Mounds*	Magazine Road	Salisbury Council Section 16 (Heritage Places Act 1993)	REG a,e
Gepps Cross	Former house	714 Main North Road	Port Adelaide Enfield Council Section 23 (Development Act 1993)	e
Mawson Lakes	Former Levels Homestead	Lot 951 The Mews	Salisbury Council	REG
	Former Levels Homestead	15 Park Way	Salisbury Council	REG
Parafield Gardens	Salisbury City Church (former Angas Home for Aged and Infirm Deaf Mutes)	92 Shepherds on Road	Salisbury Council	REG
Paralowie	Hostel ('Paralowie House') and Gardens	94 Waterloo Corner Road	Salisbury Council	REG
	Dwelling	8 Settlers Court	Salisbury Council	REG

Suburb	Heritage place	Location	List	Status <sup>1</sup>
Edinburgh	DSTO (former Salisbury Explosives Factory) Site - Portion of the Industrial Explosives area (Former Bomb Filling Section) - Buildings 5, 7, 9, 11, 20 & 37 and associated bunding and lightning arresters	Explosives Road (Off)	Salisbury Council; Section 16 (Heritage Places Act 1993)	REG a,d,e,g
	DSTO (former Salisbury Explosives Factory) Site - Portion of the Contractor's Area (Former Shell filling Section) - Buildings 25, 26, 27, 30, 31, 32, 35, 36, 37, 51, 285 with associated bunding	Taranaki Road	Salisbury Council; Section 16 (Heritage Places Act 1993)	REG a,d,e,g
	DSTO (former Salisbury Explosives Factory) Site - Portion of the Base Repair Facility (Former TNT Section) - Buildings 1,6,7,8,10 and 14	10 Sturton Road	Salisbury Council; Section 16 (Heritage Places Act 1993)	REG a,d,g
	DSTO (former Salisbury Explosives Factory) Site - Portion of the Headquarters Area (Former Administration Section) - Buildings 1, 2, 3, 11, 12, 13, 14, 15, 27 and 28	The Crescent	Salisbury Council; Section 16 (Heritage Places Act 1993)	REG a,d,g



Suburb	Heritage place	Location	List	Status <sup>1</sup>
	DSTO (former Salisbury Explosives Factory) Site - Portion of the Headquarters Area (Former Administration Section) - Buildings 5, 6, 7 and 10	6-30 Woomera Avenue	Salisbury Council; Section 16 (Heritage Places Act 1993)	REG a,d,g
Virginia	House	Lot 6 Penfield Road	Playford Council Section 23 (Development Act 1993)	a,b,e
	House 'Almond Grove'	Lot 4 Robert Road	Playford Council Section 23 (Development Act 1993)	a,b,e
	Homestead 'Virginia Park'	Broster Road	Playford Council Section 23 (Development Act 1993)	a,b,d,e
	Virginia Oval	Lot 255 Old Port Wakefield Road	Playford Council Section 23 (Development Act 1993)	a,c,f
	Virginia Institute	Old Port Wakefield Road	Playford Council Section 23 (Development Act 1993)	a,c,f
	Our Lady of the Assumption Catholic Church	Lot 107 Penfield Road	Playford Council Section 23 (Development Act 1993)	a,b,c,d
	Former Railway Cottages	Lot 6 Leach Street	Playford Council Section 23 (Development Act 1993)	a,e
	Virginia Methodist Church (former Bible Christian Chapel)	Lot 202 Phineas Street	Playford Council Section 23 (Development Act 1993)	a,c
	Virginia Uniting Church (former Methodist Church)	Lot 203 Phineas Street	Playford Council Section 23 (Development Act 1993)	a,c
	Farmhouse	Lot 245 Johns Road	Playford Council Section 23 (Development Act 1993)	a,b,e
House 'Calvin Grove'	Lot 76 Taylors Road	Playford Council Section 23 (Development Act 1993)	a,b,e	

\* In project area

<sup>1</sup>REG - Confirmed as a State Heritage Place in the SA Heritage Register

Heritage Places Act 1993 section 16

- (a) It demonstrates important aspects of the evolution or pattern of the State's history; or
- (b) It has rare, uncommon or endangered qualities that are of cultural significance; or
- (c) It may yield information that will contribute to an understanding of the State's history, including its natural history; or
- (d) It is an outstanding representative of a particular class of places of cultural significance;
- (e) It demonstrates a high degree of creative, aesthetic or technical accomplishment or is an outstanding representative of particular construction techniques or design characteristics; or
- (f) It has strong cultural or spiritual associations for the community or a group within it; or
- (g) It has a special association with the life or work of a person or organisation or an event of historical importance.

Development Act 1993 section 23

- (a) It displays historical, economic or social themes that are of importance to the local area; or
- (b) It represents customs or ways of life that are characteristic of the local area; or
- (c) It has played an important part in the lives of local residents; or
- (d) It displays aesthetic merit, design characteristics or construction techniques of significance to the local area; or
- (e) It is associated with a notable local personality or event; or
- (f) It is a notable landmark in the area; or
- (g) In the case of a tree (without limiting a preceding paragraph)—it is of special historical or social significance or importance within the local area.



## Appendix C. Indicative plant list

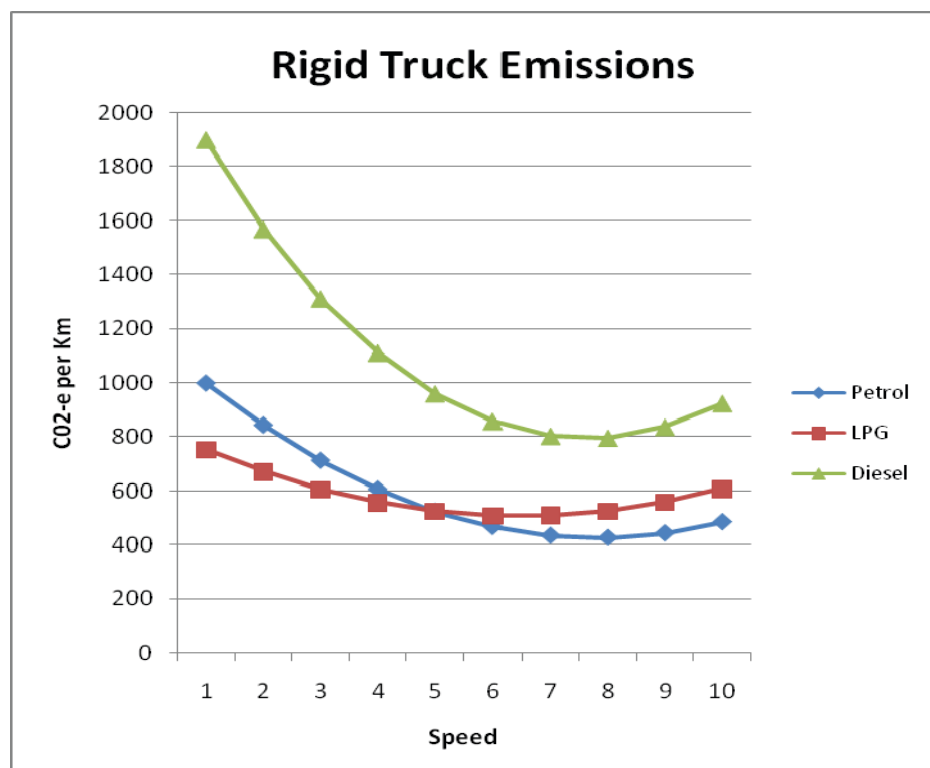
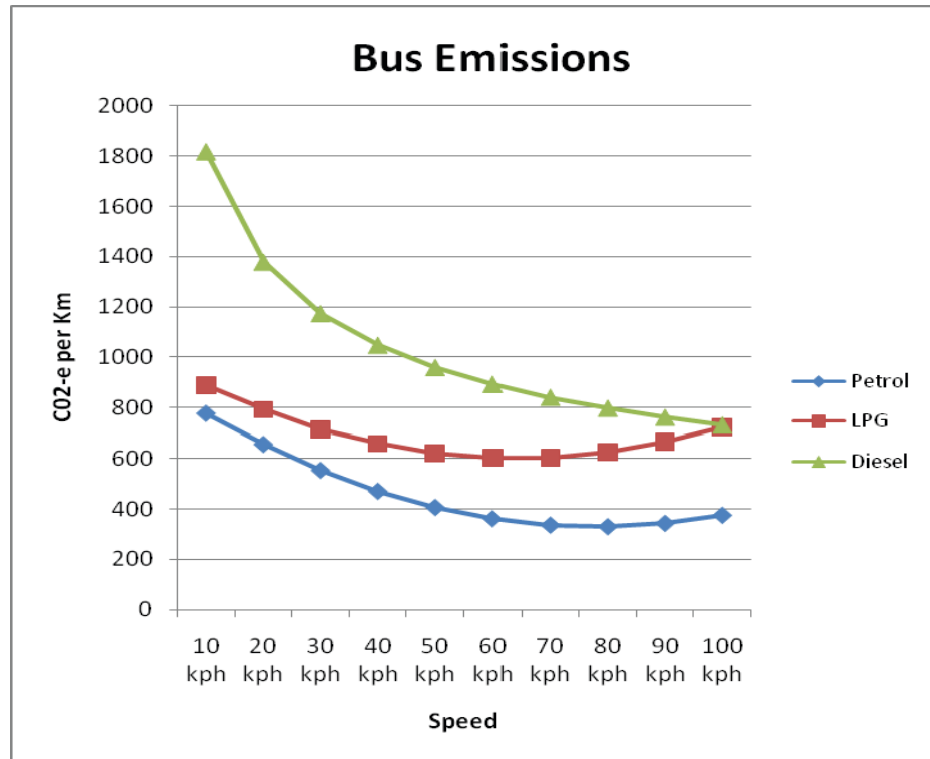
Table C.1 Indicative plant list

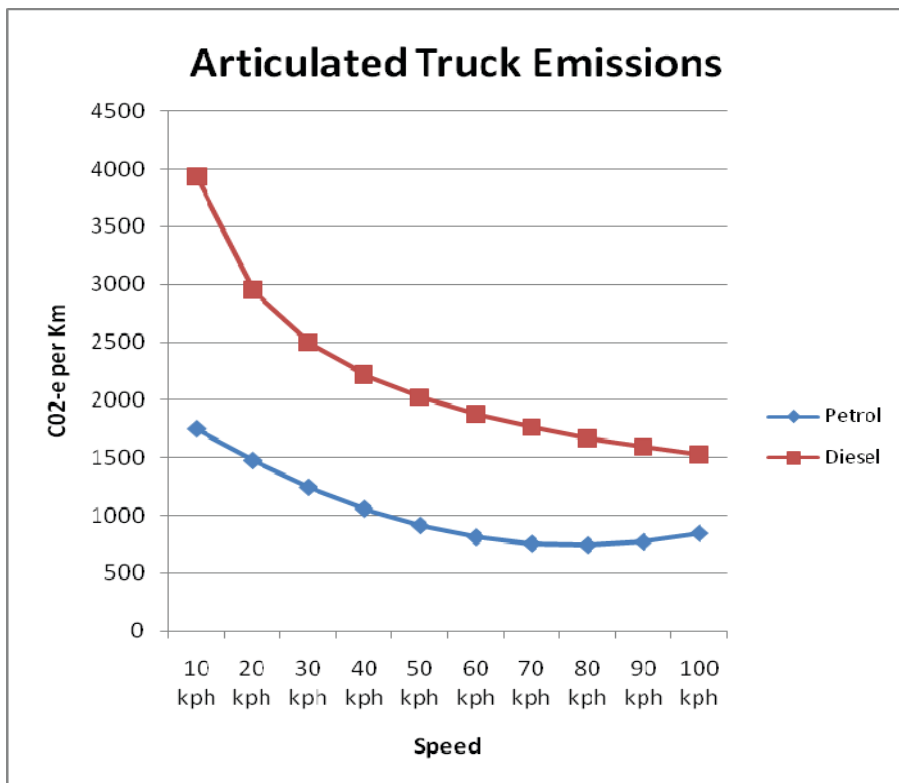
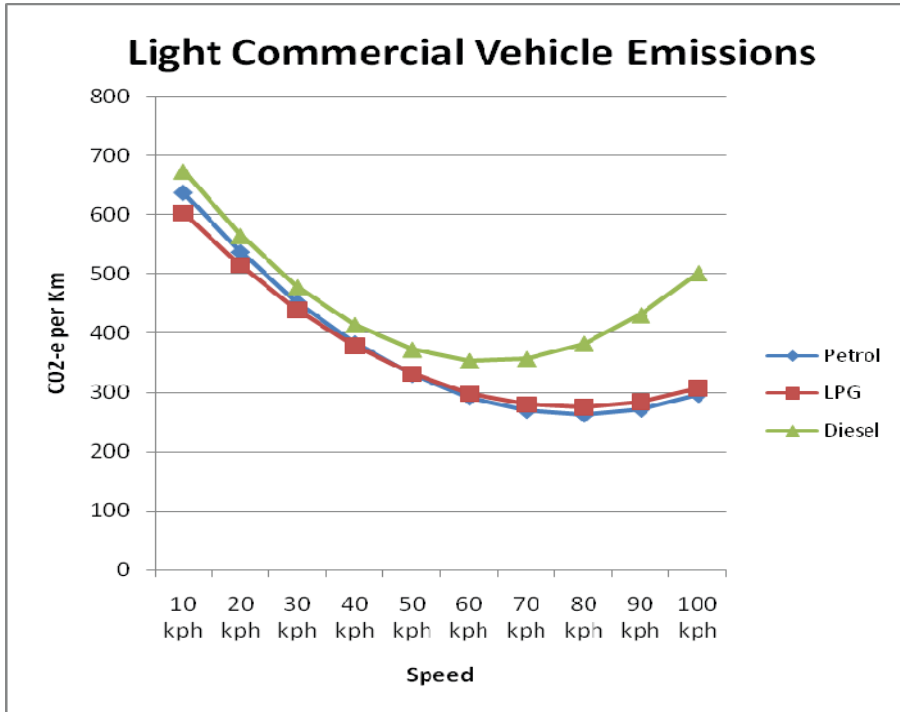
Species	Common name
<b>Trees</b>	
* <i>Acacia pycnantha</i>	Golden Wattle
* <i>Acacia retinoides</i>	Wirilda
* <i>Allocasuarina verticillata</i>	Drooping Sheoak
* <i>Avicennia marina</i> var. <i>resinifera</i>	Grey Mangrove
* <i>Callitris gracilis</i>	Native Pine
<i>Ceratonia siliqua</i>	Carob
<i>Cupaniopsis anacardioides</i>	Tuckeroo
<i>Dodonaea viscosa</i> ssp. <i>spathulata</i>	Hop Bush
* <i>Eucalyptus camaldulensis</i>	River Red Gum
<i>Eucalyptus lansdowneana</i>	Red Flowered Mallee Box
<i>Eucalyptus leucoxylon</i>	SA Blue Gum
<i>Eucalyptus leucoxylon</i> ssp. <i>megalocarpa</i>	Large Fruited SA Blue Gum
* <i>Eucalyptus macrocarpa</i>	Grey Box
* <i>Eucalyptus porosa</i>	Mallee Box
<i>Eucalyptus torquate</i>	Coral Gum
<i>Liriodendron tulipifera</i>	Tulip Tree
* <i>Pittosporum angustifolium</i>	Native Apricot
* <i>Melaleuca halmaturorum</i>	Swamp Paper-Bark
<b>Shrubs, grasses and groundcover</b>	
<i>Acacia pravissima</i> 'Little Nugget'	Little Nugget Acacia
* <i>Atriplex paludosa</i> ssp. <i>paludosa</i>	Marsh Saltbush
* <i>Atriplex semibaccata</i>	Berry Saltbush
* <i>Atriplex suberecta</i>	Lagoon Saltbush
<i>Banksia blechnifolia</i>	Blechnum Banksia
* <i>Bursaria spinosa</i>	Christmas Bush
* <i>Callistemon sieberi</i>	River Bottlebrush
<i>Calothamnus quadrifidus</i> fr. Dwarf	Dwarf Net Bush
* <i>Calytrix</i> sp.	Common Fringe-myrtle
<i>Correa glabra</i>	Rock Correa
* <i>Cyperus gymnocaulos</i>	Spiny Flat Sedge
<i>Dianella longifolia</i> var. <i>grandis</i>	Pale Flax-Lily
* <i>Dianella revoluta</i>	Black Anther Flax Lily
<i>Dianella revoluta</i> var. <i>revolute</i>	Black Anther Flax Lily

Species Common	name
* <i>Disphyma crassifolium</i> ssp. <i>clavellatum</i>	Round-leaf Pigface
* <i>Enchylaena tomentosa</i> var. <i>tomentose</i>	Ruby Saltbush
<i>Eremophila maculata</i> var. <i>brevifolia</i>	Lipstick Emu Bush
* <i>Eutaxia microphylla</i>	Mallee Bush-pea
* <i>Hardenbergia violacea</i>	Native Lilac
* <i>Isolepis nodosa</i>	Knobby Club Rush
* <i>Juncus pallidus</i>	Pale Rush
* <i>Kennedia prostrata</i>	Scarlet Runner
* <i>Lavatera plebeian</i>	Australian Hollyhock
* <i>Leptospermum continentale</i>	Prickly Tea-tree
<i>Leucophyta brownie</i>	Cushion Bush
* <i>Lomandra densiflora</i>	Soft Tussock Mat-rush
* <i>Lomandra multiflora</i> ssp. <i>dura</i>	Hard Mat-Rush
<i>Lotus australis</i>	Austral Trefoil
* <i>Maireana brevifolia</i>	Short-leaf Bluebush
* <i>Maireana decalvans</i>	Black Cotton-bush
* <i>Maireana oppositifolia</i>	Salt Bluebush
<i>Myoporum parvifolium</i>	Creeping Boobialla
* <i>Myoporum viscosum</i>	Sticky Boobialla
<i>Olearia ramulosa</i>	Twiggy Daisy-Bush
<i>Pimelea glauca</i>	Smooth Riceflower
* <i>Poa labillardieri</i> var. <i>labillardieri</i>	Common Tussock-grass
* <i>Pultenaea largiflorens</i>	Twiggy Bush-pea
* <i>Rhagodia candolleana</i> ssp. <i>candolleana</i>	Seaberry Saltbush
* <i>Sarcocornia blackiana</i>	Thick-head Samphire
* <i>Sarcocornia quinqueflora</i>	Beaded Samphire
* <i>Scaevola albida</i>	Pale Fanflower
* <i>Senecio lautus</i>	Variable Groundsel
* <i>Teucrium racemosum</i>	Grey Germander
* <i>Threlkeldia diffusa</i>	Coast Bonefruit
<i>Westringia fruticosa</i> cvs.	Native Rosemary

\*Endemic to area

## Appendix D. Greenhouse emission factors for vehicle types





## Appendix E. Northern Connector climate change risk assessment

A significant degree of climate change effects across Australia now seems inevitable. Changes in both average and extreme values for both precipitation and temperature are expected. Adaptation to a changing climate will be necessary to minimise costs, maximise benefits and ensure environmental sustainability.

Communities today have two major strategies to avoid or reduce the adverse effects of climate change: mitigation and adaptation. Mitigation measures aim to reduce or avoid greenhouse gas emissions and thereby help limit the rate and ultimate severity of future climate change. This is explained in further detail in Section 3.5 of this report.

On the other hand, adaptation aims to enhance society's resilience so that it is better able to cope with a degree of climate change that is now inevitable.

The creation of new transport infrastructure from first principles provides a unique opportunity to incorporate adaptation features throughout the proposal. The costs of designing new infrastructure to accommodate the effects of climate change will be much smaller than the costs and effort involved in adapting existing infrastructure in the future.

Early implementation of adaptation measures will reduce the risk of asset damage and the potential for loss in the future.

A preliminary risk assessment for the Northern Connector proposal based on the potential impacts of climate change listed above, identified, assessed and ranked the risks. Potential mitigation and adaptation measures to address identified risks are proposed.

The methodology and the adaptation measures proposed are based on materials presented in Climate Change Impacts and Risk Management, A Guide for Business and Government (DEH 2006); Climate Change Adaptation Actions for Local Government (DEWR 2007); Adapting to Climate Change, A Queensland Local Government Guide (LGAQ 2007) and Impacts of Climate Change on Settlements in the Western Port Region, Climate Change Risks and Adaptation (WPGA 2008).

The scale used to rate the likelihood of both singular events (occurring once-off) such as species loss, and recurring events, such as seasonal storm events, is shown in Table E.1.

**Table E.1 Climate change event likelihood**

Rating	Singular events	Recurrent events
Almost certain	More likely than not – probability greater than 50%.	Could occur several times per year.
Likely	As likely as not – 50/50 chance.	May arise about once per year.
Possible	Less likely than not, but still appreciable –	May arise once in ten



	Probability less than 50% but still quite high	years.
Unlikely	Unlikely but not negligible – probability low but noticeably greater than zero.	May arise once in ten years to 25 years.
Rare	Negligible – probability very small, close to zero.	Unlikely during the next 25 years.

Levels of risk priority associated with each combination of likelihood and consequence of these events are shown in Table E.2.

**Table E.2 Climate change risk priority levels**

Likelihood		Consequence				
		I Insignificant	MN Minor	MD Moderate	MJ Major	C Catastrophic
<b>A</b>	<b>Almost certain</b>	Moderate	Moderate	High	Extreme	Extreme
<b>L</b>	<b>Likely</b>	Low	Moderate	High	High	Extreme
<b>P</b>	<b>Possible</b>	Low	Moderate	Moderate	High	High
<b>U</b>	<b>Unlikely</b>	Low	Low	Moderate	Moderate	Moderate
<b>R</b>	<b>Rare</b>	Low	Low	Low	Low	Moderate

The interpretation of the levels of climate change risk priority is as follows:

- **Extreme risks** demand urgent attention at the most senior levels and cannot be simply accepted as a part of routine operations, without direct government response.
- **High risks** are the most severe that can be accepted as a part of routine operations without government response, but they will be the responsibility of senior operational management within government.
- **Moderate risks** can be expected to form part of routine operations but they will be explicitly assigned to relevant parties for action, maintained under review and may be reported to government.
- **Low risks** will be maintained under review but it is expected that existing controls will be sufficient and no further action will be required to treat them unless they become more severe.

The preliminary climate change risk assessment for the Northern Connector project is summarised in Table E.3.

**Table E.3 Climate change impacts and adaptation measures — related to Northern Connector (Adelaide)**

<b>Climate variable</b>	<b>Projected climate</b>	<b>Likely effects</b>	<b>Potential impacts on Northern Connector</b>	<b>Likelihood</b>	<b>Consequence</b>	<b>Overall risk</b>	<b>Adaptation measures</b>
Average rainfall	Decrease in annual totals	Reduced inflow to Adelaide's water storages	Reduced water supplies makes it difficult to water landscaping during droughts/ heat waves	A	MD	H	Use drought-tolerant native landscaping
		Less flow in streams	Lower flows and water levels in water bodies crossed by Connector	L	I	L	
		Reduced water quality in water bodies	Reduced amenity, ecological values and stormwater treatment in streams, lakes and wetlands crossed by Connector	L	MD	H	
		Changes in regional ground-water levels	Increase in soil dryness and stress on landscaping plantings; possible differential settlement due to drying of sub-grade	P	MN	M	Use drought-tolerant native landscaping
Temperature	Increase in extremes	Longer and more severe heat waves	Infrastructure damages from footing movements in dry soil	L	MD	H	Consider potential for footing/ foundation movement in infrastructure design
		Heat effects	Accelerated degradation of road pavements and buckling of railway lines	L	MD	H	Investigate and apply materials and design features to reduce heat impacts on roads and railways

Climatic variable	Projected climate	Likely effects	Potential impacts on Northern Connector	Likelihood	Consequence	Overall risk	Adaptation measures
Sea levels	Increases in level and surge	Increased storm surge	Increased coastal erosion and coastline accretion	U	MJ	L	Make provision for installing structural measures in future to protect Northern Connector from coastline accretion
			Damage/ loss of public infrastructure	U	MD	M	Locate critical infrastructure away from areas of likely inundation
		Sea level rise	Damage loss of ecological habitats	P	MD	M	Protect buffer vegetation in shore zones
			Saltwater intrusion into estuaries, wetlands and aquifers	P	MD	M	Facilitate change to more salt-tolerant plants
			Ecosystem migration. For example, mangroves in the area have been migrating inland at approximately 10m per year. This is subsequently causing the Samphire zones to shift.	A	MN	M	Liaise with environment agencies to monitor migration and develop local adaptation strategies
			Reduced capacity of wetlands to accommodate stormwater due to higher groundwater levels	P	MD	M	Investigate a stormwater capture and aquifer recharge scheme
			Ground water rising into areas of contaminated soils.	P	MJ	H	Develop and implement contaminated land rehabilitation plan and program
			Deterioration of infrastructure and/or reaction of materials with increased salt levels	P	MJ	H	Ensure infrastructure and all materials are selected and designed with consideration to minimise negative effects of salt exposure

Climatic variable	Projected climate	Likely effects	Potential impacts on Northern Connector	Likelihood	Consequence	Overall risk	Adaptation measures
Storms	Increased rainfall intensities	Heavier rainfalls	Reduced water quality in coastal rivers More frequent and severe flooding of bridges, culverts and longitudinal drainage along Northern Connector	P L	MN MD	M H	Ensure adequate tidal flushing by providing continual tidal movement Locate all roads and railways, including bridge decks, above design flood levels that allow for climate change to at least 2050 <sup>1</sup> . Size all waterways openings and drainage structures using design peak flows that allow for climate change to at least 2050 Consider making cost-justifiable provision for levels and drainage structures for climate change impacts beyond 2050 Plan road layout to avoid or minimise flooding disruption Develop and implement a floodplain risk management plan Investigate scheme to capture stormwater and store it for re-use. Ensure all excavated land and exposed stream banks are promptly stabilised to minimise sedimentation risks
			Increased sedimentation and erosion in streams	L	MD	H	Ensure all excavated land and exposed stream banks are promptly stabilised to minimise sedimentation risks
			Reduced dispersion of sediment and accumulation of silt behind likely flow control structures	L	MN	M	Allow for this in design of waterway crossings

<sup>1</sup> If found to be required after 2050, further upgrading of the infrastructure can be practically achieved to accommodate larger rainfall events. Land acquisition for the project has been set to accommodate the longer term 2100 requirements for the infrastructure works based on current estimates of climate change effects.

Climatic variable	Projected climate	Likely effects	Potential impacts on Northern Connector	Likelihood	Consequence	Overall risk	Adaptation measures
			More frequent sewer overflows	P	MD	M	Allow for increased rainfall intensities under climate change when designing new sewers or upgrading sewers
	Increased wind speeds	More severe wind storms and hail storms	Increased damage to street lighting and signage	P	MD	M	Revise design codes to cope with projected increased wind speeds and hail loads
	General	More frequent storms	Increased costs to maintain essential infrastructure	L	MN	M	Incorporate adaptation features in all new or refurbished infrastructure to minimise long term maintenance costs <sup>2</sup> .

Likelihood: R=Rare, U=unlikely, P=possible, L= likely, A=almost certain or NA -Not applicable in this situation  
Consequences: I=insignificant, MN=minor, MD=moderate, MJ=major, C=catastrophic or NA=Not applicable in this situation  
Overall Risks: L=Low – routine maintenance; M=Moderate – change standards or maintenance; H=High – detailed research or senior level planning; E=Extreme – needs immediate action or NA

<sup>2</sup> If found to be required after 2050, further upgrading of the infrastructure can be practically achieved to accommodate larger rainfall events. Land acquisition for the project has been set to accommodate the longer term 2100 requirements for the infrastructure works based on current estimates of climate change effects