



Australian Government

BUILDING OUR FUTURE



M1 Pacific Motorway extension to Raymond Terrace

Environmental impact statement –
Chapter 25: Environmental risk analysis

Transport for NSW | July 2021



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25. Environmental risk analysis

This chapter outlines the environmental risk analysis process carried out for the project, and identifies key environmental risks associated with the project.

25.1 Assessment methodology

25.1.1 Identification of environmental risk categories

The assessment of environmental risk associated with the project included:

- Carrying out a preliminary environmental investigation (PEI) as part of the State significant infrastructure (SSI) scoping report (Roads and Maritime Services 2015b) to identify key environmental issues, support the SSI application for the project, and help to inform the project SEARs
- Assessing the key issues presented in the SEARs that were issued for the project (refer to **Appendix A** for a complete list of the SEARs and how they have been addressed within the EIS).

The identification and assessment of key issues has continued during the preparation of the EIS. Emphasis was placed on using the detailed information gathered during the assessment process to review the environmental aspects of the project. More specifically, the analysis identified:

- Environmental impacts, including environmental issues identified during design development, key environmental issues in the SEARs and by detailed environmental assessments
- Residual environmental impacts after design was developed and reviewed against the risk or issue, combined with the environmental management measures being implemented.

The environmental issues identified for the project and the associated environmental management measures to manage impacts are described in **Chapter 7** (traffic and transport) to **Chapter 22** (safety and risk). **Chapter 24** (summary of environmental management measures) presents a summary of the environmental management measures, while cumulative impacts associated with the project are assessed in **Chapter 23** (cumulative impacts). Environmental issues identified as negligible or minor were not considered further during the risk assessment process.

25.1.2 Likelihood and consequence analysis

An environmental risk analysis, including a likelihood and consequence analysis, was carried out for each environmental issue identified for the project in accordance with the principles of the Australian and New Zealand standard AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines.

The environmental risk analysis involved:

- Rating the risk of each identified potential impact by identifying the consequences of the impact and the likelihood of each impact occurring
- Considering the probable effectiveness of the project design and proposed environmental management measures to determine the likely residual risk of each impact.

Definitions of likelihood are provided in **Table 25-1** and the definitions of consequences are provided in **Table 25-2**. The risk rating was then determined by combining the consequence and identify the level of risk as shown in **Table 25-3**.

Table 25-1 Likelihood of environmental risks

| Likelihood level | Description |
|------------------|--|
| Certain | Expected to happen routinely during the project life |
| Likely | Could easily happen and has occurred on a previous similar project |
| Unlikely | Possible, but not anticipated |

Table 25-2 Consequence of environmental risks

| Consequence | Definition |
|-------------|--|
| Minor | <ul style="list-style-type: none"> Minor effects on biological, social, economic or physical environment, both built and natural Minor short to medium term damage to small area of limited significance, easily rectified. |
| Moderate | <ul style="list-style-type: none"> Moderate effects on biological, social, economic or physical environment, both built and natural Moderate short to medium term widespread impacts. More difficult to rectify. |
| Major | <ul style="list-style-type: none"> Serious effects on biological, social, economic or physical environment, both built and natural Relatively widespread medium to long term impacts. Rectification difficult or impossible. |

Table 25-3 Risk rating matrix

| Likelihood | Consequence | | |
|------------|-------------|----------|--------|
| | Minor | Moderate | Major |
| Certain | Medium | High | High |
| Likely | Low | Medium | High |
| Unlikely | Low | Low | Medium |

Residual environmental impacts have also been assessed through the risk analysis process. Residual risk ratings were identified after considering the environmental assessment carried out for each environmental issue and the implementation of management measures and safeguards incorporated into the construction methodology and project design described in **Chapter 5**.

25.2 Environmental risk analysis

Using the framework described above, the environmental risk analysis results for the project are presented in **Table 25-4**. The risk analysis identifies an initial risk rating for each of the environmental issues and the residual risk rating derived after the implementation of management measures developed and recommended by this environmental impact statement and the safeguards incorporated into the construction methodology and project design described in **Chapter 5**.

Table 25-4 Environmental risk analysis

| Environmental issue | Unmitigated consequence | Unmitigated likelihood | Unmitigated risk | Project response and environmental management measures | Residual consequences | Residual likelihood | Residual risk |
|--|-------------------------|------------------------|------------------|---|-----------------------|---------------------|---------------|
| Traffic and transport | | | | | | | |
| Construction traffic impacts on road network performance, including delays, increased travel times, road closures and detours, and parking impacts | Major | Certain | High | <ul style="list-style-type: none"> Construction methodology and project design described in Chapter 5 A Traffic Management Plan would be implemented during construction (TT01) Other measures as described in Chapter 7 (traffic and transport). | Moderate | Likely | Medium |
| Temporary disruptions to public transport, pedestrians and cyclists during construction | Moderate | Likely | Medium | | Minor | Likely | Low |
| Changes to access arrangements during construction and operation | Moderate | Certain | High | <ul style="list-style-type: none"> Property access would be maintained during construction in liaison with property owners (TT02) Permanent access changes developed in consultation with property owner as described in Chapter 5 Other measures as described in Chapter 7 (traffic and transport). | Minor | Certain | Medium |
| Temporary maritime traffic impacts during construction of bridge B05 over the Hunter River | Moderate | Likely | Medium | <ul style="list-style-type: none"> A navigational channel would be kept open during construction (TT06) Other measures as described in Chapter 7 (traffic and transport). | Minor | Likely | Low |
| Improved operational travel times, connectivity and accessibility in the Lower Hunter Region | Positive impact | | | | | | |
| Improved operational intersection and road network performance | Positive impact | | | | | | |

| Environmental issue | Unmitigated consequence | Unmitigated likelihood | Unmitigated risk | Project response and environmental management measures | Residual consequences | Residual likelihood | Residual risk |
|---|-------------------------|------------------------|------------------|---|-----------------------|---------------------|---------------|
| Improved operational freight network connectivity | Positive impact | | | | | | |
| Improved operational road safety | Positive impact | | | | | | |
| Provision of operational public and walking and cycling links | Positive impact | | | | | | |
| Noise and vibration | | | | | | | |
| Noise and vibration impacts at surrounding sensitive receivers from work during standard construction hours | Major | Certain | High | <ul style="list-style-type: none"> A Construction Noise and Vibration Management Plan would be prepared to mitigate and manage noise impacts during construction in (NV01) Requirements for further noise treatments, including quieter noise pavements, noise barriers and at-property treatments would be reviewed as part of the Operational Noise and Vibration Review (NV07) Where reasonable and feasible, implementation of operational noise mitigation would be carried out within 12 months of commencement of construction (NV02) Other measures as described in Chapter 8 (noise and vibration). | Moderate | Likely | Medium |
| Noise and vibration impacts at surrounding sensitive receivers from work outside of standard construction hours | Major | Certain | High | | Moderate | Likely | Medium |
| Increase in operational road traffic noise at surrounding sensitive receivers | Major | Likely | High | | Moderate | Likely | Medium |

| Environmental issue | Unmitigated consequence | Unmitigated likelihood | Unmitigated risk | Project response and environmental management measures | Residual consequences | Residual likelihood | Residual risk |
|---|-------------------------|------------------------|------------------|---|-----------------------|---------------------|---------------|
| Biodiversity | | | | | | | |
| Impacts to threatened flora, fauna habitat, wetlands & aquatic habitat and reduction of the footprint of endangered ecological communities beyond those assessed and offset in this EIS | Major | Certain | High | <ul style="list-style-type: none"> Avoidance and minimisation of impacts to sensitive environmental areas has been considered in the development of the preferred project as described in Chapter 4 and Chapter 5 A Flora and Fauna Management Plan will be prepared for construction activities (B01) Creek corridors will be revegetated with native riparian vegetation suitable for the local area (B05) Aquatic habitat protection measures will be implemented during construction (B07) Offset requirements have been quantified as biodiversity offset credit requirements. Refer to Chapter 9 (biodiversity) for the project's identified offset requirements Other measures as described in Chapter 9 (biodiversity). | Moderate | Likely | Medium |
| Fragmentation of native vegetation and habitat corridors | Major | Likely | High | <ul style="list-style-type: none"> Fragmentation has been minimised by design and alignment of the project as described in Chapter 4 and Chapter 5 Connectivity measures will be implemented (B08). | Moderate | Unlikely | Low |
| Invasion and spread of pests and weeds | Moderate | Likely | Medium | <ul style="list-style-type: none"> Weed species, pest species and pathogens will be managed (B11, B12). | Minor | Unlikely | Low |
| Indirect impacts on fauna from increased light and vibration during construction and operation | Moderate | Likely | Medium | <ul style="list-style-type: none"> The project design has minimised the need for lighting Artificial lighting will be minimised where feasible (B13). | Minor | Likely | Low |

| Environmental issue | Unmitigated consequence | Unmitigated likelihood | Unmitigated risk | Project response and environmental management measures | Residual consequences | Residual likelihood | Residual risk |
|---|-------------------------|------------------------|------------------|--|-----------------------|---------------------|---------------|
| Hydrology and flooding | | | | | | | |
| Adverse construction and operational hydrology and flooding impacts on surrounding land, infrastructure, property, business operations and future development due to increases in flood levels and changes to flood behaviour | Major | Likely | High | <ul style="list-style-type: none"> The project's 12 bridges and viaduct have been designed to pass over the Hunter River and its floodplain, minimising flood impacts Flood assessment has been carried out to assess the construction and operational impacts of the project on the existing flood impacts. A Flood Management Plan will be prepared to detail specific measures to reduce the potential for flooding impacts during construction (FH01) Transport will consult with landowners adversely impacted by flooding about reasonable and feasible management measures following the completion of additional flood modelling in detailed design (FH03) Other measures to be implemented during construction and operation of the project are described in Chapter 10 (hydrology and flooding). | Moderate | Likely | Medium |
| Operational flood hazards for road users and emergency services on the project | Moderate | Likely | Medium | | Moderate | Unlikely | Low |
| Groundwater drawdown impacts during construction | Moderate | Likely | Medium | | Moderate | Unlikely | Low |
| Operational scour impacts on creeks and minor drainage lines | Moderate | Likely | Medium | | Moderate | Unlikely | Low |
| Operational impacts to hydrology, water availability and flows | Moderate | Likely | Medium | | Moderate | Unlikely | Low |

| Environmental issue | Unmitigated consequence | Unmitigated likelihood | Unmitigated risk | Project response and environmental management measures | Residual consequences | Residual likelihood | Residual risk |
|---|-------------------------|------------------------|------------------|---|-----------------------|---------------------|---------------|
| Surface water and groundwater quality | | | | | | | |
| Surface water quality impacts during construction and operation | Major | Likely | High | <ul style="list-style-type: none"> Surface water quality measures including basins, have been included in design of the project as described in Chapter 5 Surface water and groundwater impacts will be managed with a Construction Soils and Water Management Plan (WQ01) A surface water and groundwater quality monitoring program will be implemented during construction operation (WQ06) Other measures to be implemented during construction and operation of the project are described in Chapter 11 (surface water and groundwater quality). | Moderate | Likely | Medium |
| Groundwater quality impacts during construction and operation | Moderate | Likely | Medium | | Moderate | Unlikely | Low |
| Aboriginal heritage | | | | | | | |
| Impact to Aboriginal archaeological heritage items during construction | Major | Certain | High | <ul style="list-style-type: none"> Extensive consultation and investigations have been completed with the Aboriginal community as described in Chapter 12 (Aboriginal cultural heritage) Environmental management measures, including a salvage program, are described in Chapter 9 of the Aboriginal Cultural Heritage Assessment Report (Appendix L). | Moderate | Likely | Medium |
| Construction impact to previously unidentified Aboriginal archaeological heritage items | Major | Likely | High | <ul style="list-style-type: none"> An Aboriginal Cultural Heritage Management Plan will be prepared for construction which will include an unexpected finds procedure (AH01). | Moderate | Unlikely | Low |

| Environmental issue | Unmitigated consequence | Unmitigated likelihood | Unmitigated risk | Project response and environmental management measures | Residual consequences | Residual likelihood | Residual risk |
|---|-------------------------|------------------------|------------------|---|-----------------------|---------------------|---------------|
| Socio-economic | | | | | | | |
| Temporary impacts to businesses during construction | Moderate | Likely | Medium | <ul style="list-style-type: none"> Access will be maintained to businesses during construction of the project (TT02) A Community Communication Strategy (CCS) will be prepared for the project to facilitate communication with the community and stakeholders including relevant Government agencies, Councils, adjoining affected landowners and businesses, residents, motorists and other relevant stakeholders that may be affected by the project. (SE01) | Minor | Likely | Low |
| Impacts to businesses during operation | Moderate | Likely | Medium | <ul style="list-style-type: none"> The project provides interchanges at four locations enabling access from the Motorway to existing businesses along the main alignment as described in Chapter 5. Signage will be provided to advise motorists of services in Beresfield and Heatherbrae. (SE02) | Minor | Likely | Low |
| Temporary impacts on social infrastructure and community values during construction | Moderate | Likely | Medium | <ul style="list-style-type: none"> Access will be maintained to properties (TT02) A range of environmental management measures as described in Chapter 7 (traffic and transport), Chapter 8 (noise and vibration), Chapter 14 (land use and property) and Chapter 15 (urban design, landscape and visual amenity) will be implemented to protect community values during construction. | Minor | Likely | Low |

| Environmental issue | Unmitigated consequence | Unmitigated likelihood | Unmitigated risk | Project response and environmental management measures | Residual consequences | Residual likelihood | Residual risk |
|---|-------------------------|------------------------|------------------|---|-----------------------|---------------------|---------------|
| Improved access and transport connections when operational | Positive impact | | | | | | |
| Reduced congestion and travel times when operational | Positive impact | | | | | | |
| Land use and property | | | | | | | |
| Temporary and permanent property acquisition, access and land use impacts | Moderate | Certain | High | <ul style="list-style-type: none"> • Consultation with all impacted property owners has occurred throughout development of the project. • All property adjustments will be carried out in accordance with the <i>Land Acquisition (Just Terms Compensation) Act 1991</i> and in consultation with landowners (LU01) • Property access will be maintained during construction (TT02) • Property adjustments will be completed in consultation with property owners / business managers (TT02) • Land subject to temporary use will be rehabilitated as soon as practicable to an appropriate land use in consultation with the land owner (LU03) • Other measures as described in Chapter 14 (land use and property). | Minor | Certain | Medium |

| Environmental issue | Unmitigated consequence | Unmitigated likelihood | Unmitigated risk | Project response and environmental management measures | Residual consequences | Residual likelihood | Residual risk |
|---|-------------------------|------------------------|------------------|---|-----------------------|---------------------|---------------|
| Urban design, landscape and visual amenity | | | | | | | |
| Landscape character and visual impacts from construction activities and construction support sites | Moderate | Likely | Medium | <ul style="list-style-type: none"> The Urban Design and Landscape Concept Plan (UDLP) will be updated to support the detail design of the project. (UD01). Construction elements such as fencing and hoardings will be designed to minimise impacts to landscape character and visual amenity where practicable (UD04) Other measures as described in Chapter 15 (urban design, landscape and visual amenity). | Minor | Likely | Low |
| Landscape character and visual impacts of operational roads, interchanges (including ramps), tie-ins, bridges (including the viaduct) | Moderate | Likely | Medium | | Minor | Likely | Low |
| Soils and contamination | | | | | | | |
| Soil erosion, impacts from acid sulfate soils and offsite sedimentation during construction | Major | Likely | High | <ul style="list-style-type: none"> A Construction Soils and Water Management Plan, including erosion and sediment controls, will be prepared for the project (WQ01) A Contaminated Land Management Plan, Salinity Management Plan and an Acid Sulfate Soils Management Plan will be prepared for the project (SC01, SC02, SC03) A Remediation Action Plan will be prepared and implemented for the former mineral sands processing facility. (SC04). | Moderate | Likely | Medium |
| Impacts resulting from contaminated material, including asbestos and the former mineral sands processing site at Tomago during construction | Major | Certain | High | | Moderate | Likely | Medium |

| Environmental issue | Unmitigated consequence | Unmitigated likelihood | Unmitigated risk | Project response and environmental management measures | Residual consequences | Residual likelihood | Residual risk |
|---|-------------------------|------------------------|------------------|--|-----------------------|---------------------|---------------|
| Non-Aboriginal heritage | | | | | | | |
| Impacts to known non-Aboriginal archaeological heritage items during construction | Major | Likely | High | <ul style="list-style-type: none"> A Non-Aboriginal Heritage Management Plan would be prepared detailing processes and procedures to ensure protection of known non-Aboriginal heritage items during construction (NA01) Transport's standard procedure will be followed in the event that any unexpected heritage items are encountered (NA01) Site specific requirements for non-Aboriginal heritage items that will be impacted during construction are identified in Chapter 17 (non-Aboriginal heritage). | Moderate | Likely | Medium |
| Impacts to previously unidentified non-Aboriginal archaeological heritage items during construction | Major | Likely | High | | Moderate | Unlikely | Low |
| Air quality | | | | | | | |
| Air quality impacts at surrounding sensitive receivers during construction | Moderate | Likely | Medium | <ul style="list-style-type: none"> An Air Quality Management Plan will be prepared identifying controls measures in relation to dust and odour during construction (AQ01) | Minor | Unlikely | Low |
| Odour impacts from acid sulphate soils and batching plants during construction | Moderate | Likely | Medium | | Minor | Unlikely | Low |
| Air quality impacts at surrounding sensitive receivers during operation due to vehicle movements | Moderate | Likely | Medium | | Minor | Unlikely | Low |

| Environmental issue | Unmitigated consequence | Unmitigated likelihood | Unmitigated risk | Project response and environmental management measures | Residual consequences | Residual likelihood | Residual risk |
|---|-------------------------|------------------------|------------------|--|-----------------------|---------------------|---------------|
| Waste | | | | | | | |
| Inappropriate handling, management or disposal of construction waste | Moderate | Likely | Medium | <ul style="list-style-type: none"> A Waste Management Plan will be prepared, to manage and minimise the generation of waste and encourage reuse of materials, including procedures to manage unexpected waste volume (WM01) Other measures as described in Chapter 19 (waste) and included in the project design in Chapter 5. | Minor | Unlikely | Low |
| Unexpected construction waste volumes | Moderate | Likely | Medium | | Minor | Unlikely | Low |
| Sustainability | | | | | | | |
| <p>A sustainability assessment was carried out for the project as detailed in Chapter 20 (sustainability). The assessment described how sustainability principles have been applied to the design, construction and operation of the project, including:</p> <ul style="list-style-type: none"> Application of the principles of ecologically sustainable development Legislation and policies relevant to the project The sustainability framework that has been developed for the project. <p>With the proposed environmental management measures in place there is a low residual risk of the principles of ecologically sustainable development, relevant legislation and policies, or the sustainability framework not being implemented across all elements of the project.</p> | | | | | | | |
| Climate change risk and greenhouse gas | | | | | | | |
| Increase in greenhouse gas emissions from construction | Moderate | Certain | High | <ul style="list-style-type: none"> If there are design changes during detailed design, further hydrological and hydraulic assessments would be carried out to consider climate change related flood impacts and risks (CC01) A Sustainability Management Plan (or similar framework) for the project will be developed and implemented during detailed design and construction, detailing measures to meet the project's sustainability objectives and targets. (SU01) | Minor | Certain | Medium |
| Impact of climate change on road operations and infrastructure | Moderate | Likely | Medium | | Minor | Likely | Low |

| Environmental issue | Unmitigated consequence | Unmitigated likelihood | Unmitigated risk | Project response and environmental management measures | Residual consequences | Residual likelihood | Residual risk |
|--|-------------------------|------------------------|------------------|--|-----------------------|---------------------|---------------|
| Safety and risk | | | | | | | |
| Increased exposure to bushfire risk during construction | Major | Likely | High | <ul style="list-style-type: none"> A Bushfire Management Plan will be prepared for the project (HS01). | Moderate | Likely | Medium |
| Mismanagement of incidents during construction | Moderate | Likely | Medium | <ul style="list-style-type: none"> Consultation with emergency services, including the NSW Police, RFS and Fire and Rescue NSW would be carried out during detailed design and construction to ensure emergency access is maintained during construction. | Minor | Likely | Low |
| Cumulative impacts | | | | | | | |
| Cumulative construction impacts | Moderate | Likely | Medium | <ul style="list-style-type: none"> The construction contractor will review traffic impacts before the start of construction and as required during construction. Any changes to manage cumulative traffic impacts will be included in the TMP (CI01). | Minor | Likely | Low |
| Cumulative operational traffic impacts associated with the Hexham Straight project | Positive impact | | | | | | |

25.3 Risk analysis outcomes

No potential impacts with a residual risk rating of 'high' were identified for the project.

A number of 'medium' level residual risks were identified. Through the detailed design of the project further review of the 'medium' residual risk level items would be carried out, and where necessary implement additional measures to ensure these risks are suitably managed. During further design development there would be further opportunity to:

- Resolve some of the residual impacts through detailed design refinement
- Develop effective construction methodologies and planning with the construction contractor to ensure that management and mitigation measures are effectively implemented
- Implement a process of review, correction and audit for the Construction Environmental Management Plan.

Other issues which have been identified as having a low residual risk would be adequately managed through the implementation of environmental management measures proposed in this environmental impact statement.