

7 Risk assessment

The results of a preliminary risk assessment for the proposal are detailed in this chapter. The risk assessment details and classifies broad-scale environmental risks associated with the proposal.

The methodology used for this assessment is based on the requirements of AS/NZS 4360:2004, Risk Management. The assessment provides a risk assessment ranking for individual risks to the environment. It is expected that the assessment will be subject to continuous review and expansion at a later date by the contractor undertaking the project as part of the EMP.

The overall risk ranking for the project is low to moderate. All risks are manageable with minimal environmental impacts, provided that procedures and mitigation strategies are followed.

Table 7.1 details the likelihood and consequences of environmental impacts and Table 7.2 provides risk rankings. Project risks are assessed in Table 7.3.

Table 7.1 Likelihood and consequences of environmental impacts

Likelihood	Consequence
A Constant: The event is expected to occur throughout the life of the project	5 Catastrophic: Disaster with potential to lead to collapse of the project. Extreme long-term environmental consequences
B Frequent: The event will probably occur regularly throughout the project (e.g. weekly, monthly)	4 Major: A critical environmental event. With proper management the event will be controlled and remediated
C Likely: The event should occur at sometime during the project (i.e. more than once during the project)	3 Moderate: An environmental event that can be managed if project procedures are followed
D Unlikely: The event may occur at sometime during the project	2 Minor: Consequences are minor but management effort is still required to minimise impacts
E Rarely: The event may occur during the project as a result of extreme conditions	1 Insignificant: No immediate action is necessary. Event is easily controllable and manageable

Table 7.2 Risk ranking

Likelihood	Consequences				
	1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
A Constant	M	M	H	VH	E
B Frequent	L	M	M	H	VH
C Likely	N	L	M	M	H
D Unlikely	N	L	L	M	M
E Rare	N	N	N	L	M

Risk Assessment Rating: N—Negligible, L—Low, M—Moderate, VH—Very high, E—Extreme. Adapted from Comparative Environmental Risk Assessment Method, Australian National University.

PER Ref.	Impact/Event according to PER category	Consequences	Consequence and management rating	Likelihood rating	Environmental Risk (Risk Assessment Rating)	Mitigation measures
						programme. Auditing and surveillance will be by DPI and the relevant NT authority.
Chapter 8	Public involvement and consultation	Non-compliance with DPI policy and NT legislation	3	D	Low	A comprehensive programme has been undertaken. Additional involvement and consultation will be integral to the PER process.

Table 7.3 Risk matrix for determining the environmental significance of impacts of the proposal

PER Ref.	Impact/Event according to PER category	Consequences	Consequence and management rating	Likelihood rating	Environmental Risk (Risk Assessment Rating)	Mitigation measures
4.1	<i>Climate</i>					
4.2.2	Accelerated soil erosion due to heavy rainfall	Loss of topsoil and subsoil and associated seed bank, nutrients and soil fauna. Severe rilling and gullyng	3	C	Moderate	Most earthmoving will be undertaken in the dry season with specific erosion control measures addressed in the Contractor's EMP. Management of earthworks is a priority item and is emphasised in the DPI Specification as noted in Appendix B.
4.1	Disruption to construction due to heavy rainfall	Financial and time schedule losses due to delays; potential for disturbed areas to be susceptible to weed invasion, erosion, etc.	3	D	Low	A schedule of construction activities and timing will be developed by the contractor to avoid works coinciding with likely periods of heavy rainfall risk.
4.10	<i>Land tenure</i>					
	Disruption to daily activities of local residents, landowners and users	Inability to gain access into and out of sites adjacent to the road works	2	E	Negligible	DPI Specifications applicable and contractor to manage access issues.
4.2.1	<i>Geology & geomorphology</i>					
4.2.1 & 4.2.2	Accelerated soil erosion of cut & fill surfaces, especially fill batter slopes	Loss of soil, and potential destabilisation of surfaces and associated footslopes	3	C	Moderate	Requires particular attention. Could develop into higher risk issue if inadequately managed. Exposed earthwork faces (batter slopes and fill slopes) to be constructed to minimise the potential for erosion. This will include establishing a cut-off drain at the top of all cut slopes. Where appropriate, the drain will be lined with non-erosive materials. Fill batter slopes will be compacted progressively during construction. Additional erosion control devices and methods will also be required, especially timely and thorough revegetation.
4.2.2	Accelerated soil erosion of alluvial soils adjacent to the works	Loss of soil, and potential development of major erosion surfaces	3	D	Low	Surface water run-off and construction activities will be controlled and managed to prevent development of major erosional surfaces. Progressive management works will be undertaken
4.2.2	Exposed and disturbed surfaces	Dust generation	2	C	Low	All dry exposed surfaces will be watered regularly as part of the construction works to prevent dust generation.
4.4.4	Potential loss of habitat for flora and fauna (birds, small mammals and reptiles)	Loss of habitat, plus individuals of species	4	C	Moderate	Minimise disturbance impacts to areas known or expected to provide habitat for fauna of conservation significance. Investigate the use of compensatory and off-set habitat where required
4.1	Flooding of work sites during wet season	Limitations on types of construction activities that can be undertaken during wet season; potential delays to the construction works as a result of flooding	3	C	Moderate	A schedule of construction activities and timing and risk assessment will be developed by the Contractor to determine what activities can safely be undertaken during periods of high flood risk.
4.2.3	<i>Potential gravel borrow sources (riparian)</i>					
	Environmental impacts caused by extraction of gravel material from the Victoria River site (Site RG3)	Potential use of site may result in adverse impact on flow and riparian environment, including habitats	3	C	Moderate	Implement recommendations of Williams (2006) – refers to shaping of excavation and avoidance of riparian flora. Re-profile the site after extraction completed to avoid or minimise impacts on flow. Follow final recommendations of aquatic fauna survey (when available later in 2006). Avoid and protect archaeological sites by fencing.
4.3.2	<i>Flood events</i>					
4.2.2, 4.3.1 & 4.4.3	Transfer of weeds	Disturbed areas within the construction site are invaded by weeds. Increase in the amount of weed control activities previously expected may affect project schedule	3	D	Low	Part of DPI Specifications and EMP through the Weeds Management Plan
4.3.1	Transfer of mud	Mud may be transferred onto the road surface resulting in slippery conditions for Highway users	3	C	Moderate	Movement of vehicles and machinery offsite will be monitored to ensure that weeds and mud do not leave the area. Fixed, banded vehicle and machinery wash-down points will be established. These issues, including management of wastewater in detention basins, will be addressed in the contractor's EMP.
4.2.1	Soil erosion	Loss of topsoil and subsoil and associated seed bank, nutrients and soil fauna. Severe rilling and	3	C	Moderate	Part of DPI Specifications and EMP through the Erosion Management Plan

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4.3.2	Flooding of work sites during wet season	Limitations on types of construction activities that can be undertaken during wet season; potential delays as a result of flooding	4	C	Moderate	A schedule of construction activities and timing will be developed by the contractor to determine what activities can safely be undertaken during periods of high flood risk.
4.3.2	Flooding of work sites during wet season	Risk to sites and construction workers conducting activities near flooded areas. Ground may be unstable in some areas where heavy machinery is operating	4	D	Moderate	Part of HSP and EMP
4.3.2	Flooding of work sites during wet season	Risk to general public and landowners in the area. Areas that the public access may be unsafe/unstable.	4	D	Moderate	EMP will include activities to ensure that public access areas are safe at all times. Alternative access options in the event of flooding will be included. Emergency measures to be provided in the ERP.
4.2.3	RG3 (riparian gravel site)	Potential use of site may result in adverse impacts on flow. Areas that require inundation to support vegetation may suffer from altered flow	3	D	Low	Implement recommendations of Williams (2006). Re-profile the site after extraction completed to avoid or minimise impacts on flow
4.6	Release of substances that may cause contamination	Chemicals used during construction may enter the floodwaters unless stored correctly	3	D	Low	EMP will address the issue of chemicals (HAZMAT) management. All chemicals will be stored taking into account the potential for flooding.
2.4.3	Bridge construction	Floodwaters may disrupt bridge construction	3	D	Unlikely	Bridge construction can be undertaken during a flood. Safety measures will need to be addressed in relation to workers accessing the site and the safe storage of materials.
4.1 & 4.3.2	Loss of construction machinery and materials	Construction may be delayed due to the loss of materials and machinery as a result of floodwaters	4	D	Moderate	Lay-down areas will be out of the flood zone or in areas that are known to suffer only minimal impacts.
4.3.2	Damage to revegetation areas	Areas that have been revegetated may be damaged during flood events. Potential to impact the project schedule	3	D	Moderate	Revegetation to be carried out as soon as practicable after construction and far ahead as possible before the onset of the wet season. This may require watering of revegetation areas
4.3.2	Delay to construction schedules	Not all flood events can be planned for. In the event of significant flooding beyond the normal monsoonal rainfall, construction will be unavoidably delayed	3	D	Moderate	Activities will be rescheduled around floodwaters. There maybe some delay to the schedule resulting in re-scheduling of works.
4.3.1	Deposition of soil in 'choke points' of creeks and culverts and fauna habitat	Areas that have been disturbed may lead to accelerated erosion during a flood event	3	D	Moderate	Stabilisation, rehabilitation and revegetation of disturbed areas will be undertaken to ensure that accelerated erosion events are minimised in the wet season following construction.
4.2.4	<i>Fill borrow material (terrestrial)</i>					
	Existing and new borrow sites	Adverse impacts on elements of cultural heritage and biological environment	4	C	Moderate	Subject to current AAPA, archaeological and environment investigations. Areas identified as 'restricted sites' will not be entered. Management of access to sites will be in accordance with the DPI Specification. No extraction will occur in areas where studies have identified threatened flora and fauna species or heritage constraints without approval from the authorities.
	Clearance of vegetation and habitat	Loss of vegetation and fauna habitat	3	C	Moderate	Included in DPI Specification and EMP
	Borrow areas not rehabilitated	Rehabilitation and revegetation does not take place or is delayed	3	D	Low	Essential element that must be done by the contractor. Included in DPI Specification and EMP
4.3.1	<i>Hydrology</i>					
4.3.3	Loss and adverse impact on remnant pools	Loss of habitat and important water resources for fauna	4	C	Moderate	Remnant pools of water will not be used as a source of construction water. All construction water will be extracted in accordance with the permit requirements from NRETA—Natural Resources.
4.3.3	Impacts on groundwater	Drawdown on existing and new bores	2	C	Low	An assessment of existing bore quantity and quality will be carried out by NRETA—Natural Resources for all proposed bores as part of the Permit to Extract.
4.3.3	Impacts on groundwater	Environmental disturbance for establishment of new bores	3	D	Low	The contractor will consult and seek approval from Advisory and Regulatory Services Water, NRETA regarding extraction rates and conditions of extraction for sourcing construction water from underground water resources.

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4.4.1	<i>Vegetation</i>					
	Loss of vegetation communities that are significant	Direct reduction in the distribution of the vegetation associations; loss and fragmentation of habitat for fauna	3	C	Moderate	A survey of vegetation types will be conducted. The extent and level of disturbance will be limited to that necessary to complete the works. Significant vegetation will be avoided. Rehabilitation and revegetation works with local indigenous species similar to adjoining vegetation will be implemented during or directly after construction. Weeds will be controlled.
	Loss of up to 5 ha of cane grass grassland	Loss of habitat for fauna, especially threatened bird species, and subsequent loss of individuals	4	C	Moderate	Intrusion into and impacts on cane grass areas will be minimised, and undertaken only where necessary and approved. Specific management actions to be implemented to minimise access and to protect and extend other areas of cane grass habitat as an off-set measure.
	Presence of unrecorded communities and populations of threatened species	Populations not identified as part of flora survey works may be disturbed or destroyed during construction	1	C	Negligible	Completion of surveys of new borrow areas. Appointment of a project specific biologist to monitor and control activities with environmental risks.
	Vegetation clearance to enable access to gravel sources and for crushing and blending plant and equipment	Direct reduction in the distribution of the vegetation associations; loss of habitat for fauna	1	C	Negligible	Vegetation will only be cleared when absolutely necessary and for the minimum area allowed. Rehabilitation works with local indigenous species similar to adjoining vegetation will be implemented during or directly after construction works.
4.4.2	<i>Flora species and habitat of conservation significance</i>					
	Potential loss of individuals and whole populations of species of conservation significance	Reduction in biodiversity; reduction in species' distribution and abundance; increased pressure on remaining populations	1	E	Negligible	No threatened flora species are likely to be impacted, A survey of vegetation types will be conducted. The extent and level of disturbance will be limited to that necessary to complete the works. Significant vegetation will be avoided.
4.4.3	<i>Weeds</i>					
	Introduction and dispersal of declared and environmental weeds	Increased pressure on plant communities and plants and animals of significance (through competition and habitat changes)	3	D	Low	A weed management plan will be developed in consultation with staff from Weeds Branch NRETA and NTPWS, to assist in identifying best management practices for the control of weed species. Implement plan throughout the project at all relevant sites, especially prior to construction and on construction surfaces. Declared and environmental weeds included in control actions.
	Introduction and dispersal of weeds into Gregory National Park	Weeds maybe dispersed into Gregory National Park as a result of clearing activities and disturbance to weeds communities currently outside the park's boundaries	3	D	Moderate	The weed management plan will accord with the weed management priorities and actions developed for the Gregory National Park (PWCNT 2001).
	Changes to the local environment that result in the establishment of unfavourable habitat for native plants and animals	The spread of weeds may result in severe infestations and competition with native understorey species	3	D	Moderate	A weed management plan will be developed and implemented for construction as long as areas are operational and for one year post-construction for species and populations considered to be moderate to high risk issues.
4.4.4	<i>Fauna species & habitat (terrestrial)</i>					
	Loss of habitat. Maximum of about 110 ha for all of Highway sites and all borrow sites	Reduction in biodiversity; reduction in species' distribution and abundance; increased pressure on remaining populations	3	B	Moderate	Areas in construction precincts will be defined and no clearance will occur outside of these. Revegetation of all cleared and disturbed areas to be undertaken progressively throughout the project according to the Rehabilitation Plan and its schedule of works
4.4.4	<i>Fauna species & habitat (aquatic)</i>					
	Victoria River (RG3 and Victoria River Bridge)	Direct and indirect impacts on habitat and species	4	C	Moderate	Implement recommendations of Williams (2006)—refers to shaping of excavation and avoidance of riparian flora.). Re-profile the site after extraction completed to avoid or minimise impacts on flow. Investigate aquatic fauna during early dry season. Implement the recommendations of the survey's report
	Other riparian areas	Remnant pools	3	D	Low	Remnant pools of water will not be used as a source of construction water. All construction water will be extracted in accordance with the permit requirements from NRETA—Natural Resources.
4.4.5	<i>Conservation significant fauna</i>					
	Purple-crowned fairy-wren	Adverse impact on local populations of a nationally	43	C	Moderate	Risk varies according to the individual site. High to moderate risk at Victoria River and Lost Creek owing to the removal of habitat.

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		threatened species. Small direct impact due to removal of up to 5 ha of habitat. Potential for indirect adverse impacts.				Mitigation measures to be established include transplanting of cane grass; removal of cane grass and associated top soil and use of these materials in revegetation; collection of cane grass for propagation and use in revegetation works; fencing areas to improve quality of areas not currently used; avoid burning cane grass areas; and rehabilitation and revegetation of old road areas and road works areas to establish cane grass habitat. Low to moderate risk elsewhere. Low risk at Joe Creek, Sandy Creek and RG3 owing to avoiding cane grass areas. Specialist biologist to advise construction manager and audit management actions. Fairy-wren management to be part of the induction procedure for construction personnel.
	Aquatic species (sawfish species and whip ray)	Adverse impact on local populations of NT and nationally threatened species	3	C	Moderate	Likely to be a low risk at RG3. Moderate risk at Victoria River Bridge. Negligible risk at other bridge sites. If required, species relocation could be undertaken (under permit).
	Freshwater crocodile and turtles	Adverse impact on nest sites of local populations	2	D	Low	Dry season survey will identify any nesting sites at RG3 (if any). Avoidance areas will be established (if required).
4.4.6	<i>Pest animals</i>					
	Potential for construction activities to contribute to increases in pest fauna populations	Increased competition with native species for some food types and habitat resources. Predation of native species	4	C	Moderate	Construction management for pest animal species will be incorporated into the EMP to minimise the risk of construction activities increasing pest animal populations. NTPWS to be consulted for control actions.
	Increased population and distribution of black rat	Increased competition with native species for some food types and habitat resources. Predation of native species, especially purple-crowned fairy-wren	4	C	Moderate	Part of waste management plan. No food scraps on construction sites and all putrescible wastes to be securely binned and buried.
	Distribution of cane toad to west	Accelerated expansion of colonisation by the species	3	D	Low	Species is naturally spreading rapidly during each wet season due to movement along riparian areas and flooding. Minor controls available to contractor. Inspection of vehicles to avoid inadvertent transport of the species.
4.5	<i>Air quality, noise & vibration</i>					
	Point source and fugitive dust emissions at all bare earth construction areas	Impacts on road safety (road users and contractor personnel)	1	A	Moderate	Part of TMP (see Appendix B). Dry exposed surfaces will be watered regularly as part of the construction works to prevent dust generation. Health issues of respirable particles will be managed by contractor as part of the HSP.
	Green house gas emissions	Non-compliance with Australian and NT Strategy	1	A	Moderate	Vehicles and plant to be regularly maintained by contractor. No burning of cleared vegetation and top soil; this will be stockpiled and used during revegetation.
	Noise and vibration at bridge construction sites	OH&S issue and potential for impact on OFC. Few receptors along the area impacted	2	C	Low	Contractor OH&S plan to be established; PPE and safety requirements to be included. Telstra to monitor vibration impacts on OFC signal quality. Contractor to maintain a complaints register and satisfactorily manage all complaints.
4.6	<i>Waste management</i>					
	All contractor wastes	Pollution and contamination of environment and impacts on health of construction workforce. Inappropriate disposal	1	C	Negligible	Management to be through a specific plan established by the contractor. All wastes must be managed in compliance with NT requirements, including all public health requirements.
4.7	<i>Biting insects</i>					
	Environmental modifications due to construction activities could lead to increased biting insect populations	Construction activities could result in the establishment of new breeding sites for insects such as mosquitoes through the pooling of water	3	D	Low	Specific plan will be prepared as a component of the EMP. Also a component of the rehabilitation plan. All materials and areas such as borrow pits, culverts and culvert outflow sites where ponding of water is likely will be rendered free draining at the completion of works. Natural drainage lines will be maintained where possible or drainage devices used to prevent ponding of water.
	Induction of personnel	Warnings of risks from mosquito-borne diseases	3	C	Moderate	Part of contractor HSP. PPE to be advised. Insect repellents to be provided.
	Transport of interstate equipment, especially from Qld	Transfer of particular species, especially <i>Ochlerotatus</i> , to the region	4	E	Low	Part of contractor EMP and HSP, including deployment safeguards and induction procedures.
4.8	<i>Infrastructure & transport</i>					
	Disruption to trunk OFC infrastructure and services	Loss of national communication facilities and provision of services to the public	4	C	Moderate	The location of all OFC alignments in and adjacent to construction areas will be known and clearly marked in the field and on construction drawings. The construction workforce will be briefed about the importance of the OFC. Telstra monitoring of vibration impacts to be provided to contractor.
	Adverse impact on road users during construction. Significant	Inconvenience to road users	23	B	Moderate	Most works undertaken adjacent to the Highway, not in the existing alignment. Inconvenience and potential for delays associated with construction works will be managed using the TMP.

PER Ref.	Impact/Event according to PER category	Consequences	Consequence and management rating	Likelihood rating	Environmental Risk (Risk Assessment Rating)	Mitigation measures
	positive impact after construction upgrades the Highway					
	Motor vehicle accidents on or adjacent to sites affected by the road works	Potential for increased incidence of road accidents during construction without appropriate mitigation measures	3	D	Low	Mitigation measures include implementation of a TMP (see Appendix B), advertising and provision of information for road users and ongoing consultation with authorities, groups and land managers. ERP to include provision for management of emergencies.
4.9	<i>Fire</i>					
	OH&S impacts (personnel, property and materials) and natural vegetation	Injury and/or damage. Adverse impact on habitat	3	D	Low	Prepare detailed Fire Management Plan and ERP as part of EMP and HSP. Ensure consultation is ongoing with land managers of adjacent areas during the dry season.
	Burning of cleared vegetation	Vegetation burned when it should be stockpiled and used in revegetation works	32	C	Moderate	Prepare detailed Fire Management Plan and ERP as part of EMP. Burning-off will not be permitted without a permit. Fire breaks will be established.
	Greenhouse gas emissions	As above. Contrary to NT policy	2	D	Low	Part of Air Emissions Quality Management Plan.
4.10	<i>Socio-economic</i>					
	Adverse impacts on adjacent land holders and managers	Difficulty in accessing areas	2	D	Low	Consultation undertaken and unlikely to be significant impacts. Likely adverse impact on the car park and access area to the Escarpment Walk in Gregory National Park. To be addressed as a component of the TMP. Maintain consultation links.
	Economic and social benefits of project	Enhanced access, improved safety for road users and establishing required standard for this section of the Highway	4	B	High (positive)	Significant positive impact to all road users following completion of the project.
	Employment and training especially for Aborigines	Enhanced access to training, and immediate and future employment opportunities	4	B	High (positive)	Potentially important & training employment opportunity for local communities and landholders.
	Delays and inconvenience to road users during construction	Additional freight costs and inconvenience	2	B	Moderate	Minor delays will be experienced during construction. Additional costs considered to be negligible when compared with the entire road length and freight link. The TMP and ERP will control the safety management issues.
4.11	<i>Aboriginal, and, European heritage cultural heritage</i>					
	Traditional links to land	Disrupt access and activities	1	E	Negligible	There will not be an impact.
	Archaeological sites (Victoria Highway precinct)	Destruction of sites. Contrary to NT legislation	4	E	Negligible	Areas along the Highway have been cleared of significance for archaeological sites. Any additional sites found during construction will be protected in accordance with the Act.
	Archaeological impacts caused by extraction of gravel material from bed of Victoria River (Site RG3)	Site RG3 contains archaeological materials <i>in situ</i>	4	C	Moderate	Archaeological sites have been identified. Additional survey will define access areas to RG3. Sites will be protected by fencing. If required (unlikely), a Permit to disturb will be requested from the NT Environment and Heritage Minister. Alternative sites will be used where practical.
	Extraction of gravel and fill materials from terrestrial borrow areas	Potential for disturbance of Aboriginal, historic and cultural heritage sites	4	C	Moderate	Requires further investigation to assess and define areas. Can only be undertaken after AAPA and NLC have cleared areas for Sacred Sites and a Clearance Certificate issued. Areas identified as 'restricted' will not be entered.
4.12	<i>Combined & cumulative impacts</i>					
	Impacts as a result of other projects	Additional or enhanced adverse impacts. None known	1	E	Negligible	No other proposals known or recorded by the NT Government. Impacts of use of BFTA by Defence would not contribute to a combined or cumulative impact for this proposal.
4.13	<i>Sustainability</i>					
	Non-compliance with NT and DPI policies.	Adverse environmental impacts and no consultation, monitoring or environmental reporting	1	E	Negligible	Compliance with all policy requirements will be undertaken, especially the commitments to environmental protection.
Chapter 5	Environmental Management and EMP	EMP not established or implemented as required under the PER	3	D	Moderate	Compliance with DPI requirements must be undertaken by the contractor as part of its contractual obligations, as exemplified by the DPI documents in Appendix B. Auditing and surveillance will be by DPI.
Chapter 6	Health and Safety	Programmes established by the contractor is not comprehensive and/or not enforced	3	D	Low	Compliance with DPI requirements must be undertaken by the contractor as part of its contractual obligations, as exemplified by the DPI documents in Appendix B. The contractor must obtain all statutory and other approval requirements relating to the works