Dampier to Bunbury Natural Gas Pipeline Stage 5 Looping Expansion Project

Five-year Performance Review (2007-2012)

Prepared for
DBNGP (WA) Nominees Pty Ltd
by Strategen

August 2012

STRATEGEN
environmental consultants

Dampier to Bunbury Natural Gas Pipeline Stage 5 Looping Expansion Project

Five-year Performance Review (2007-2012)

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Client: DBNGP (WA) Nominees Pty Ltd

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1. Introduction

The Dampier to Bunbury Natural Gas Pipeline (DBNGP) Stage 5 Looping Expansion Project involves construction of eleven pipeline loops adjacent (and connected) to the existing DBNGP. Figure 1-1 shows the location of the individual loops. The Stage 4 Looping Expansion Project covered an aggregate length of about 220 km of the total pipeline length of 1489 km. Completion of the Stage 5 Looping Expansion project will result ultimately in completion of duplication of the pipeline from Dampier to Wagerup. The key characteristics of the Stage 5 Looping Expansion Project are presented in Table 1-1. The project, which continues from Stage 4 (completed in 2006), involves a total length of approximately 1270 km of pipeline.

The proposal for the Stage 5 Looping Expansion Project was approved for implementation under Part IV of the *Environmental Protection Act 1986* with issue of Statement No. 735 (the Statement) on 13 December 2006. DBNGP (WA) Nominees Pty Limited, trading as Dampier Bunbury Pipeline (DBP), is the Proponent of the DBNGP Stage 5 Expansion Project.

Implementation of the Stage 5 project commenced in February 2007 and is being undertaken in stages. The first stage (Stage 5A) was completed in March 2008. Stage 5B commenced in January 2009 and was effectively completed in early 2010, with the exception of the crossing of the Fortescue River. Construction of the Fortescue River Crossing section was undertaken during August to December 2011. WestNet Energy (previously Alinta Asset Management) was contracted by DBP to provide project management for Stages 5A and 5B of the DBNGP Looping Expansion Project. DBP undertook project management of the Fortescue River crossing. Planning for the remaining portion of Stage 5 was in a preliminary phase at the time of preparing this report.

Statement 735 requires the submission of a Performance Review report every five years after the start of construction of the DBNGP Stage 5 Looping Expansion project in accordance with the requirements of Condition 5–1 of the Statement. Construction of the proposal commenced in late February 2007. This report covers the five-year period to the end of February 2012.

1.1 Performance review requirements and report structure

Condition 5–1 of Statement 735 specifies: The proponent shall submit a Performance Review every five years after the start of construction to the Environmental Protection Authority, which addresses:

1. The major environmental issues associated with implementing the project; the environmental objectives for those issues, the methodologies used to achieve these; and the key indicators of environmental performance measured against those objectives.
2. The level of progress in the achievement of sound environmental performance, including industry benchmarking, and the use of best available technology where practicable.
3. Significant improvements gained in environmental management, including the use of external peer reviews.
4. Stakeholder and community consultation about environmental performance and the outcomes of that consultation, including a report on any on-going concerns being expressed.
5. The proposed environmental objectives over the next five years, including improvements in technology and management processes.

This review covers all aspects of the condition, as relevant to the specifics of the project as undertaken, and is structured as follows:

- Section 2 provides a summary of the compliance auditing findings over the reporting period
- Section 3 sets out the major environmental issues associated with implementing the project
- Section 4 sets out the level of progress in the achievement of sound environmental performance
- Section 5 sets out the significant improvements gained in environmental management
- Section 6 sets out the stakeholder and community consultation about environmental performance
- Section 7 sets out the proposed environmental objectives for the next five years.

Figure 1-1: Regional location of the DBNGP showing Stage 4 and Stage 5 Loops

Table 1-1: Key characteristics of the Stage 5 Looping Expansion

Aspect	Proposal			
Location	There will be eleven loops. The first loop starts at about 2 km south of Dampier. The last loop is south of compressor station 10, which starts at about 17 km southeast of Rockingham, and ends at Wagerup West (Main Line Valve 144).			
Proposed action	Construct eleven pipeline looping lengths of 660 mm in diameter, buried adjacent to the existing DBNGP. These pipeline lengths will be looped to the existing DBNGP to increase flow of natural gas.			
Total length of looping	Approximately 1270 km			
Characteristics of each loop	No.	Approx. length	Biogeographical region	Shires
	0	137.2 km	Pilbara	Shire of Roebourne
	1	123.3 km	Pilbara	Shire of Ashburton
	2	104.9 km	Carnarvon, Gascoyne	Shire of Ashburton
	3	113.0 km	Carnarvon, Gascoyne	Shire of Carnarvon
	4	112.9 km	Carnarvon	Shire of Carnarvon, Shire of Upper Gascoyne
	5	119.0 km	Carnarvon, Yalgoo	Shire of Shark Bay
	6	131.0 km	Yalgoo, Geraldton Sandplains	Shire of Northampton, Shire of Chapman Valley, Shire of Mullewa
	7	142.4 km	Geraldton Sandplains	Shire of Mullewa, Shire of Irwin, Shire of Carnamah
	8	96.8 km	Geraldton Sandplains, Swan Coastal Plain	Shire of Coorow, Shire of Dandaragan, Shire of Gingin
	9	127.7 km	Swan Coastal Plain	Shire of Gingin, Shire of Chittering, City of Swan, City of Belmont, Shire of Kalamunda, City of Gosnells, City of Armadale, City of Cockburn, Town of Kwinana
	10	61.5 km	Swan Coastal Plain	Shire of Serpentine–Jarrahdale, Shire of Murray, Shire of Waroona
Proposed tenure	The completed pipeline will be wholly within the existing DBNGP easement, which is gazetted under the Dampier to Bunbury Pipeline Act 1997 and the easement identified as Easement A as shown on the deposited plan numbered DP67493.			
DBNGP easement width	The existing DBNGP easement is 30 m wide. The area to be cleared and graded in the northern loops (Dampier to Muchea) will be approximately 30 m and south of Muchea, the area cleared will be 20 to 30 m. In environmentally sensitive areas, working widths will be 20 m. Additional easements may vary in width and all clearing will be subject to the conditions of the Ministerial Statement.			
Activities outside the DBNGP easement	Turnarounds, Campsites, Turkey nests*, Laydown areas, Water supply sources, Access roads, Works associated with watercourse and dune crossings			
Temporary area of disturbance within DBNGP easement	Approximately 3175 ha, all to be rehabilitated in consultation with landowners.			
Estimated area of vegetation clearing within DBNGP easement	Approximately 1264 ha, all to be rehabilitated in consultation with landowners.			
Temporary area of disturbance outside the DBNGP easement	Approximately 139 ha, all to be rehabilitated in consultation with landowners.			
Construction duration	The Stage 5 Expansion will be constructed in stages, with Stage 5A commencing in February 2007. The subsequent stages will be constructed to match the increasing demand in fuel gas, and full looping is expected to be substantially completed within five years of approval.			
Construction workforce	Up to 900 people			

* Turkey nests are artificially created water storages constructed by hollowing out an area of land and using the fill to build up its sides.

1.2 Construction status

The DBNGP Stage 5 Looping Expansion is being constructed in stages, the first of which was Stage 5A, which commenced in February 2007 and completed in March 2008. Stage 5B was commenced in January 2009 and construction was effectively completed (with the exception of the crossing of the Fortescue River) by the end of April 2010. The Fortescue River crossing was undertaken and completed to the point of commissioning during August – December 2011.

The statistics related to implementation of the proposal as at 13 December 2011 are summarised in Table 1-2. Of the total 1270 km of the Stage 5 proposal, 1011 km have now been constructed.

Table 1-2: Progress of DBNGP Stage 5 Looping Expansion Project

Loop	Stage 5	Stage 5A		Stage 5B		Stage 5
	Total Loop Length (km)	Loop Lengths (km)	Status of Loops	Loop Lengths (km)	Status of Loops	Residual (km)
Loop 0	137.2	No construction in Loop 0 undertaken in Stage 5A		114.9	Complete	22.3
Loop 1	123.3	74.0	Complete	32.9	Complete	16.4
Loop 2	104.9	57.8	Complete	31.9	Complete	15.2
Loop 3	113.0	60.3	Complete	34.6	Complete	18.1
Loop 4	112.9	61.9	Complete	33.6	Complete	17.4
Loop 5	119.0	63.7	Complete	34.0	Complete	21.3
Loop 6	131.0	70.5	Complete	35.8	Complete	24.7
Loop 7	142.4	60.4	Complete	44.0	Complete	38.0
Loop 8	96.8	55.3	Complete	21.8	Complete	19.7
Loop 9	127.7	52.0	Complete	23.4	Complete	52.3
Loop 10	61.5	15.1	Complete	33.3	Complete	13.1
TOTAL	1270	571.1		440.2		259

2. Environmental compliance

Four Annual Environmental Compliance Reports (AECR) have been submitted to the Chief Executive Officer (CEO) of the Department of Environment and Conservation (DEC) during the performance review period, as required by Conditions 4-1 to 4-4 of Statement 735. Copies are included in Appendix 1.

Table 2-1: Annual compliance audits

Stage 5 Compliance Reporting
2007 Annual Environmental Compliance Report (Statement No. 735)
2008 Annual Environmental Compliance Report (Statement No. 735)
2009 Annual Environmental Compliance Report (Statement No. 735)
2010 Annual Environmental Compliance Report (Statement No. 735)
2010 Annual Environmental Compliance Report (Statement No. 735)

Condition 6 of Statement No. 735 requires submission of a written compliance report within 30 days of the conclusion of the construction of each loop section[1]. Table 2-2 lists the end-of-loop compliance audit reports submitted to date. These are presented in Appendix 2 (Stage 5A) and Appendix 3 (Stage 5B).

Table 2-2: End-of-loop compliance audits

Loop	Stage 5A	Stage 5B
Loop 0	No construction in Loop 0 undertaken in Stage 5A	Stage 5B Loop 0 Compliance Audit
		Stage 5B Loop 0 Fortescue River Crossing Compliance Audit
Loop 1	Stage 5A Loop 1 Compliance Audit	Stage 5B Loop 1 Compliance Audit
Loop 2	Stage 5A Loop 2 Compliance Audit	Stage 5B Loop 2 Compliance Audit
Loop 3	Stage 5A Loop 3 Compliance Audit	Stage 5B Loop 3 Compliance Audit
Loop 4	Stage 5A Loop 4 Compliance Audit	Stage 5B Loop 4 Compliance Audit
Loop 5	Stage 5A Loop 5 Compliance Audit	Stage 5B Loop 5 Compliance Audit
Loop 6	Stage 5A Loop 6 Compliance Audit	Stage 5B Loop 6 Compliance Audit
Loop 7	Stage 5A Loop 7 Compliance Audit	Stage 5B Loop 7 Compliance Audit
Loop 8	Stage 5A Loop 8 Compliance Audit	Stage 5B Loop 8 Compliance Audit
Loop 9	Stage 5A Loop 9 Compliance Audit	Stage 5B Loop 9 Compliance Audit
Loop 10	Stage 5A Loop 10 Compliance Audit	Stage 5B Loop 10 Compliance Audit

Fifteen Potential Non-Compliances (or partial non-compliances)[2] and 12 Potential Non-Conformances[3] have been identified through the five Annual Environmental Compliance Reports submitted as required under the conditions of Statement 735. These are listed in Table 2-3 (potential non-compliances) and Table 2-4 (potential non-conformances). Details are provided in the relevant compliance reports presented in Appendix 1. Some further discussion is presented in Section 3.

A review of the outcomes of these potential non-compliances and non-conformances indicated that none appears to have resulted in any unexpected environmental impact or environmental harm.

[1] For audit purposes, conclusion of construction is deemed to be the date of handover of the completed loop section from the construction project team to the operations arm of DBP. This may be several months after commissioning of the loop section, and is dependent on the operations arm of DBP being satisfied that the work meets all operational requirements.

[2] A Potential Non-Compliance is considered to be a potential failure to meet requirements of a condition in the Statement.

[3] A Potential Non-Conformance is considered to be any potential deviation from the procedures, programs and/or management actions detailed within an Environmental Management Plan or similar document.

Table 2-3: Potential non-compliances identified through annual environmental compliance reporting

AECR	Condition No.	Factor	Comment
2007	9–2	Fauna	No evidence that any measurable or identifiable environmental harm resulted from the potential non-compliances.
	9–3		
	9–8		
	9–17		
	15–1	Acid sulphate soils	No environmental impact occurred as a consequence of the issue and demonstrated that the need to undertake field investigations prior to trenching is unjustified.
2008	N/A	None	No potential non compliances.
2009	8–2	Vegetation disturbance	No evidence that any measurable or identifiable environmental harm resulted from the potential non-compliances.
	8–3		
	9–2	Fauna	No evidence that any measurable or identifiable environmental harm resulted from the potential non-compliances.
	9–3		
	9–4		
	9–8		
	9–9		
	9–11		
	9–17		
2010	N/A	None	No potential non compliances.
2011	9–7	Fauna	No evidence that any measurable or identifiable environmental harm resulted from the potential non-compliances.
	9–15		

Table 2-4: Potential Non-Conformances identified through annual environmental compliance reporting

AECR	Key Action No.	Factor	Comment
2007	14	Fauna	The potential partial non-conformances, corrective and preventative actions and effectiveness were detailed in the Annual Environmental Compliance Report.
	16		
	21		
	36	Acid sulphate soils	The potential partial non-conformance, corrective and preventative action and its effectiveness were detailed in the Annual Environmental Compliance Report.
2008	N/A	None	Conformance with these management actions was found to be 'Not Applicable' as no construction occurred during the reporting period.
2009	5	Vegetation disturbance	No evidence of any measurable or identifiable environmental harm resulting from the potential non-conformances.
	7		
	13	Fauna	No evidence of any measurable or identifiable environmental harm resulting from the potential non-conformances.
	14		
	16		
	17		
	21		
	23		
2010	N/A	None	Conformance with these management actions was found to be 'Not Applicable' as no construction occurred during the reporting period.
2011	20	Fauna	No evidence of any measurable or identifiable environmental harm resulting from the potential non-conformances.

3. Major environmental issues associated with implementing the project

The key issues identified in the environmental impact assessment that formed the basis for approval of the Proposal were:

- clearing of vegetation and flora and subsequent rehabilitation
- management of fauna impacts from stress, injury or death associated with entrapment in open trenches
- disturbance of riparian vegetation associated with watercourse crossings and rehabilitation of disturbed beds and banks
- disturbance of wetlands where traversed by the construction
- dieback and weed management through introduction into uninfected areas or spread within infested areas
- management of acid sulphate soils
- rehabilitation of soil cover and vegetation.

Each of these issues is discussed in detail the following sections.

3.1 Clearing of vegetation and flora and rehabilitation

3.1.1 Environmental objectives

The environmental objectives for clearing of vegetation and flora as set out in the Flora and Vegetation Management Protocol within the Construction Environmental Management Plan (CEMP) (Strategen 2011b) are presented in Table 3-1.

Table 3-1: Environmental objectives for vegetation and flora

Issue	Environmental objective
Disturbance to vegetation	Minimise and manage disturbance to remnant vegetation.
Disturbance to Threatened Flora and Threatened Ecological Communities	To minimise the disturbance or clearing of Threatened Ecological Communities and Threatened Flora, including Declared Rare Flora and Priority Flora species listed under the *Wildlife Conservation Act 1950* and Threatened Flora and Ecological Communities listed under the *Environment Protection and Biodiversity Conservation Act 1999*.
Rehabilitation	To re-establish vegetation and associated habitat areas to the condition that it was in prior to disturbance or better.

3.1.2 Methodologies

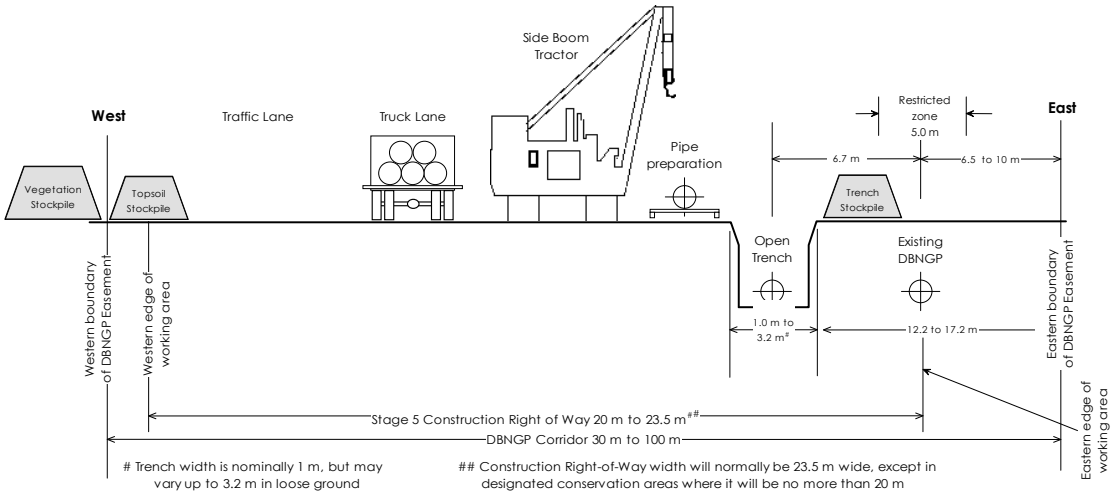
Minimisation of disturbance to vegetation was managed through a range of management actions, which included the following:

1. Staff induction programs included information regarding flora and vegetation management practices.
2. A construction survey was undertaken immediately prior to construction commencing on each loop section, with pegs to clearly delineate the construction right-of-way (CROW) and all areas of disturbance outside the CROW (see photographs of demarcation pegs in Plate 1). Construction activities were prohibited outside the delineated CROW and areas of disturbance.
3. Campsites, turkey nests, turnarounds for vehicles and other support infrastructure located within existing cleared areas where possible and the boundaries delineated (see Plate 2.
4. Vegetation to be retained was flagged (see photographs of trees marked for retention in Plate 3).

5. Trimming of branches on flagged vegetation overhanging the corridor was undertaken in preference to whole tree removal (see photographs of trimmed trees in Plate 4). All habitat trees flagged for either removal or branch trimming within DEC managed estate required signoff by the local DEC district representative.
6. Trimming overhanging branches was undertaken using the 'three-cut method' to prevent bark stripping (see photographs of trimmed trees in Plate 4).
7. No flora or vegetation outside approved areas was to be removed or disturbed.
8. Cleared vegetation and log debris was stockpiled along the CROW separately from topsoil (see photographs of vegetation stockpiles in Plate 5).
9. Vegetation and topsoil stockpiles were located adjacent to where vegetation has been cleared (see photographs of vegetation stockpiles in Plate 5 and topsoil stockpiles in Plate 6).
10. Stockpiled cleared or trimmed vegetation was respread evenly across the CROW and other work areas after completion of construction works (see photographs of respread vegetation across CROW in Plate 7).
11. Vegetative material including logs and leaf litter was respread to provide habitat (see Plate 7).

Figure 3-1 shows a typical CROW cross section, showing the location of the vegetation stockpile and topsoil and trench spoil stockpiles during the construction process.

Figure 3-1: Indicative cross section of construction right-of-way (diagrammatic – not to scale)



3.1.3 Key indicators and performance

The performance indicators for vegetation and flora as set out in the Flora and Vegetation Management Protocol and the Rehabilitation Protocol within the CEMP (Strategen 2011b) are presented in Table 3-2.

Table 3-2: Environmental performance indicators for vegetation and flora

Issue	Performance Indicator
Disturbance to vegetation	All construction activities undertaken within the CROW. All areas of remnant vegetation (habitat) avoided outside the CROW.
Disturbance to Threatened Flora and Threatened Ecological Communities	The width of the CROW reduced to prevent or minimise disturbance to Threatened Ecological Communities and Threatened Flora populations. No disturbance or clearing to Threatened Flora species other than that approved under licence to take.
Rehabilitation	Achievement of rehabilitation completion criteria set out in the CEMP.

Disturbance to vegetation

The CROW was delineated by pegs or flagging/bunting along its length in accordance with width limitations imposed under the Statement 735 (see Plate 1). No construction activities were undertaken outside the CROW that caused disturbance to native vegetation.

All remnant vegetation outside the CROW was avoided, together with several instances of avoidance of large trees within the CROW (see Plate 8). Where tree branches encroached over the CROW, pruning using the three-cut method was used where possible, to avid removal of the entire tree (see Plate 4).

Statement 735 provides for a temporary area of disturbance within the easement of not more than more than 1300 ha of vegetation and approximately 139 ha for activities outside the easement (turnaround bays, campsites, turkey nest dams, water supply sources and access roads). The total areas of disturbance to date are 529 ha within the easement and 90.359 ha for activities outside the easement. Of the 529 ha of disturbance within the easement, 414 ha occurred in areas of conservation value (conservation areas, wetland buffers, etc.) and 115 ha occurred outside conservation value areas.

The details of areas of disturbance within the easement over each of the Stages are presented in Table 3-3.

Table 3-3: Disturbance areas within pipeline easement

Stage	Areas of conservation value disturbed (ha)	Areas of vegetation outside areas of conservation value (ha)	Other areas of disturbance (ha)	Totals (ha)
Stage 5A	210.846	53.823	1025.915	1290.5840
Stage 5B	203.096	61.2298	826.5088	1090.8346
Totals	413.942	115.0528	1852.4238	2381.4186

Disturbance to Threatened Flora and Threatened Ecological Communities

The CROW width was reduced to 20 m within a 20 m buffer of all identified locations of Threatened Ecological Communities and Threatened Flora populations. The locations of these communities and populations were identified on the Environmental Line List (ELL), which specified the location boundaries of buffer zones for all such features. The ELL guided the surveyors in setting out the CROW demarcation pegging. These zones were signposted accordingly (see Plate 9).

Only one incidence of interaction with Threatened Flora species occurred. This involved the taking of a number of the Declared Rare Flora: *Synaphea stenoloba,* located on Loop 10 approximately 3 km northeast of Pinjarra, 490 m east of South Western Highway centred on 6390979N 396865E. This was undertaken accordance with *Wildlife Conservation Act 1950* Section 23F Permit to Take Declared Flora No. 89-0809. The area of occurrence of this species was identified on the ELL, and flagged and signposted in the field (see Plate 10). Areas of Threatened Ecological Communities, while close to the CROW, did not encroach on the CROW area, and taking of plants were taken as a consequence (see Plate 10).

Rehabilitation

Rehabilitation of vegetation was undertaken by the techniques involving:

- stripping and storing topsoil separately and adjacent to the source area (see topsoil stockpiles in Plate 6)
- storing removed vegetation adjacent to the source area (see vegetation stockpiles in Plate 5)
- respreading topsoil and vegetation across the CROW during reinstatement (see Plate 7).
- conducting 12 and 24 month surveys to confirm achievement of completion criteria set out in the CEMP.

The results of the completion criteria surveys are discussed in Section 3.7.2.

3.1.4 Environmental compliance

Environmental compliance audits identified potential non-compliances with conditions relating to management of impacts on vegetation and flora, as briefly described in Table 3-4.

Table 3-4: Environmental compliance for vegetation and flora

Environmental condition	Potential non-compliance	Remedial action taken
Condition 8–2: The proponent shall not cause disturbance of vegetation outside the delineated pipeline easement, or the delineated area of disturbance outside the easement, unless authorised by the Minister for the Environment.	Clearing external to a previously delineated campsite boundary was undertaken without Ministerial approval to provide an emergency firebreak because of a major fire. The firebreak clearing was approximately 0.75 ha in size, and its inclusion did not result in any exceedance of the total project area approved for clearing.	Future clearing plans for camps in fire risk areas will include a requirement for initial delineation of the proposed clearing area to make provision for firebreaks, which would not be cleared unless required.
Condition 8–3: The proponent shall not cause or allow disturbance of vegetation outside the 20 m wide easement located within environmentally sensitive areas, unless authorised by the Minister for the Environment.	Three locations along the construction right of way within an environmentally sensitive area were measured as having a width greater than 20 m. The CROW had been located immediately adjacent to an historical pre-cleared pipeline track, which was 3 – 4 m wide.	CROW widths are to be limited to 20 m in all environmentally sensitive areas irrespective of the presence of any pre-existing cleared areas such as maintenance tracks.

3.1.5 Environmental outcome for vegetation and flora

The environmental outcome for flora and vegetation was:

1. Minimum necessary disturbance of native vegetation, with the total area being limited to an area substantially within the approved area. Completion of the project will require additional clearing, however, the residual area available within the approved limit appears to be adequate for the anticipated requirements.
2. The impact on Threatened Flora and Threatened Ecological Communities was limited to:
    - a small area of Declared Rare Flora, which was managed in accordance with a *Wildlife Conservation Act 1950* Section 23F Permit to Take Declared Flora
    - CROWs were reduced to 20 m in several areas of Priority Flora and an area of Threatened Ecological Community (*Kingia Australis)*to limit impacts
    - CROWs were reduced to 20 m in all gazetted conservation areas and environmentally sensitive areas to limit impacts.
3. There was no evidence to suggest that environmental harm resulted as a consequence of the potential non-compliances/non-conformances identified in the compliance auditing process.

The environmental outcome with respect to rehabilitation of areas of cleared native vegetation is discussed in Section 3.7.4.

3.2 Management of fauna impacts

The environmental objectives for clearing of fauna as set out in the Fauna Interaction Protocol within the Construction Environmental Management Plan (CEMP) (Strategen 2011b) are presented in Table 3-5.

Table 3-5: Environmental objectives for fauna

Issue	Environmental objective
Fauna habitat	To minimise the temporary and permanent reduction or fragmentation of existing fauna habitat.
Direct fauna impacts	To minimise the direct impacts on fauna through impacts with vehicles, entrapment in construction works, or extraordinary exposure to predators.

3.2.1 Methodologies

Minimisation of impacts to fauna was managed through a range of management actions, which included the following:

1. Staff induction programs included information regarding fauna management practices.
2. Clearing was limited to authorised clearing areas.
3. Vehicle speeds were limited to no more than 40 km/h in the CROW (see photographs of CROW speed limit sign on Plate 11).
4. Habitat trees within or immediately adjacent to any construction areas were marked and the relevant Regional Office of DEC advised with opportunity to comment (see photographs of trees marked for retention in Plate 3).
5. Marked trees were not felled except where they materially interfered with construction of the pipeline, or are a safety concern (see photographs of retained trees in Plate 8).
6. Habitat trees overhanging construction areas were pruned, rather than removed, where practical (see photographs of trimmed trees in Plate 4).
7. Welded pipeline sections were capped at end of shifts to prevent fauna entry (see photographs of end caps in Plate 11).
8. Open trenching in Loops 0 to 2 was avoided between the months of November to March to minimise fauna stress or deaths during the summer months.
9. Fauna shelters/refuges (hessian bags) were placed in open trenches at intervals not exceeding 100 m (see Plate 12).
10. Trench plugs and fauna exit ramps were installed at both ends of trenches at intervals not exceeding 1200 m and ramp slopes did not exceed 45° (see photographs of exit ramps in Plate 12).
11. Open trenches were inspected daily and cleared by fauna handling teams by 4.5 hours after sunrise on Loops 0 to 7 and 5.0 hrs after sunrise on Loops 8 to 10 (see photographs of fauna clearing team in operation, and associated equipment in Plate 12).
12. Trench inspections procedures ensured inspection of the entire base of the trench, with attention to evidence of burrowing reptiles, and inspection of all shelters/refuges. Fauna teams comprised two persons to ensure full coverage of base of trench (see fauna clearing team in Plate 12).
13. Open trench lengths were not to exceed lengths capable of being practically inspected and cleared in accordance with the prescribed times by the available fauna teams at any time.
14. In all conservation areas and in vegetated bushland areas in Loops 8 – 10, trenches were not left open during construction breaks that exceeded three days duration.
15. No part of the trench, other than “bell holes”, was to be left open for more than 14 days unless approved by the CEO of the DEC.
16. In environmentally sensitive areas, no part of the trench was to remain open for more than 7 days unless approved by the CEO of the DEC.
17. In areas where trenches were permitted to remain open for longer than the prescribed period, an additional late afternoon fauna inspection was carried out.

18. The occurrence of water in trenches was managed by taking action to avoid the development of any individual water bodies longer than 100 m in length. Such actions could include the presence of floating islands as fauna refuges (see photographs of floating refuge in Plate 12).
19. Where a trench contains water and is not dewatered, the trench was not to remain open for longer than 7 days Plate 12).
20. Open trenches were required to be inspected by construction contractor immediately prior to lowering in and any entrapped fauna cleared by a fauna handler before lowering in was completed.
21. Open trenches were to be inspected by construction contractor half an hour prior to backfilling and any entrapped fauna cleared by a fauna handler before backfilling was completed.
22. All turkey nests and dams were fenced (see photograph of turkey nest fence in Plate 11).
23. Checks of Bureau of Meteorology flood forecasts were undertaken to avoid flooding of open trenches.
24. Vegetative material including logs and leaf litter was respread to provide habitat (see Plate 7).

3.2.2 Key indicators and performance

The performance indicators for fauna as set out in the Fauna Interaction Protocol and the Rehabilitation Protocol within the CEMP (Strategen 2011b) are presented in Table 3-6.

Table 3-6: Environmental performance indicators for fauna

Issue	Performance Indicator
Fauna habitat	No habitat trees, or parts of habitat trees, other than those in the direct line of the proposed pipeline or that materially interfere with construction of the pipeline to be removed. No vegetation clearing to be undertaken outside approved areas.
Direct fauna impacts	Vehicle speeds limited on unformed access tracks and construction worksite. Pipeline trenches to be open for a limited period of time. Achievement of fauna inspection and clearing requirements. Adherence to injured animal protocol.

Fauna habitat

Fauna habitat was preserved to the maximum extent possible by minimising clearing as discussed in Section 3.1. Plate 3, Plate 4 and Plate 8 provide examples that demonstrate how the impact on habitat trees was minimised. Plate 1, Plate 9 and Plate 10 provide examples of how vegetation clearing was limited to approved areas.

As outlined in Section 3.1.3 [*Disturbance to vegetation*], the total areas of vegetation disturbance to date are 529 ha within the easement and 90.359 ha for activities outside the easement, which are within the total areas approved for disturbance under Statement 735.

Direct fauna impacts

Achievement of the performance indicators for direct fauna as specified in Table 3-6 was achieved through implementation of the management measures set out in the Fauna Interaction Protocol.

3.2.3 Environmental compliance

Environmental compliance audits identified the potential non-compliances with conditions relating to management of impacts on fauna, as briefly described in Table 3-7.

Table 3-7: Environmental compliance for fauna

Environmental condition	Potential non-compliance	Remedial/preventative action taken
Condition 9-2: The clearing of open trenches by the fauna–clearing persons is to be completed each day by no later than 4.5 hours after sunrise for Loops 0 to 7 and no later than 5 hours after sunrise for Loops 8 to 10 and at least half an hour prior to the backfilling of pipeline trenches.	On occasions, for a variety of reasons, trenches were not inspected and cleared within the periods specified by this Condition.	Contractor addressed and reminded of contractual obligations to comply with conditions. Contractor committed to a number of actions to ensure compliance including increasing number of fauna clearing teams available for remainder of project.
Condition 9–3: Open trench lengths shall not exceed a length capable of being inspected and cleared by fauna clearing persons within the required times.	On occasions, fauna inspections were not completed as required because of not having sufficient fauna clearing persons engaged.	Closer monitoring of trench-open lengths initiated, together with employment of additional fauna clearing persons as necessary.
Condition 9.4: Significant habitat trees of sufficient age to form nesting hollows for hollow-nesting birds and mammals shall be marked, prior to construction, in consultation with the DEC.	A Pre-construction Environmental Survey identified a number of trees of habitat value on Stage 5B Loop 7. The survey report was provided to DEC after commencement of construction on this loop, and the Auditor considered this to be a potential non-compliance.	DBP believes that while the survey identified potential habitat trees in proximity to the easement, and all were marked, no trees of habitat value were found to be within the area actually proposed for clearing following survey of the easement boundaries. As it is understood that the intent of the condition relates to trees proposed to be removed, DBP believes there was no requirement to advise DEC prior to construction in this case. The survey report was provided to DEC as a courtesy only.
Condition 9–7: Where wet trenching is conducted, trenches shall not remain open for periods longer than 48 hours within wetlands and environmentally sensitive areas and 7 days for all other areas.	During construction of the Fortescue River crossing, the pipe trench was open longer than the prescribed 7 days caused by construction problems, during which the trench could not be safely backfilled and then safely re-trenched/excavated.	Exceedance of the time limit for wet trenching was the result of several construction and safety related factors. Corrective actions have been proposed by DBP to reduce the risk of future potential non-compliances and non-conformances. However, DBP is concerned that after practical experience with wet trenching, there is a strong possibility that other construction and safety issues may result in unavoidable potential non-compliances/non-conformances with wet trenching time limits during construction of the remaining portion of the project. DBP is consequently considering application for a change of conditions under s 46 of the EP Act.
Condition 9–8: The fauna clearing persons shall operate in teams of two with at least one fauna-clearing person experienced in specified DEC requirements.	On occasions, the team members did not have the required experience.	Fauna clearing tem member approvals required prior to engagement, through confirmation with DEC, or holding of an appropriate licence.
Condition 9.9: The proponent shall be responsible for ensuring that basic fauna handling training is provided to fauna clearing persons who do not possess the required skills and experience.	An Assistant Fauna Handler was not recorded as having been trained by a Senior Fauna Handler prior to employment in undertaking the fauna inspection and clearing task (having been trained by an Assistant Fauna Handler).	Contractors are being reminded of the requirement for training to be provided by a suitably experienced fauna handler, in accordance with the requirements of the approved training package.

Environmental condition	Potential non-compliance	Remedial/preventative action taken
Condition 9.11: No part of the trench shall remain open for more than 14 days except 'bell holes', unless authorised by the CEO.	One short portion of trench remained open for longer than the prescribed period. Pipe laid in trench had to be removed, and trench widened after it was realised that construction specifications had not been met with respect to saddle weighting of the pipe to prevent floating when groundwater levels rise in association with flows in the Fortescue River. Time taken to remove pipe, widen trench, and re-lay and backfill trench resulted in exceedance of prescribed time limit.	Pipe removal, relaying and trench backfilling was expedited to limit length of exceedance to as small a period as possible. There was no evidence of environmental harm having resulted. Incident was considered to be extraordinary and the time exceedance was consequently unavoidable.
Condition 9–15: The proponent shall implement the Fauna Management Plan.	Because the Fauna Management Plan specified the requirement to meet the time limits of Condition 9–7, and Condition 9–7 was potentially not complied with (see above), the plan was considered to not have been implemented.	See comments in response to condition 9–7.
Condition 9-17: Produce weekly performance monitoring reports on fauna management for each loop, to be provided to the DEC each week.	On occasions, the fauna reports were not submitted within the weekly time limit.	Procedures were put in place to ensure timely submission of reports.

3.2.4 Environmental outcome for fauna

The outcome for fauna management resulted in the handling of approximately 21 000 animals found entrapped in trenches, of which 918 (4.4%) were dead as a result of a range of causes, including cold, desiccation, predation and injury. The majority of fauna entrapped were rodents and reptiles, with the proportions varying between loops. Basic statistics of fauna interactions related to trench entrapment are presented in Table 3-8, Table 3-9 and Table 3-10 for Stages 5A, 5B and all Stage 5 respectively. Some of these statistics are presented graphically in Figure 3-2 (Fauna statistics), Figure 3-3 (Fauna mortality rates) and Figure 3-4 (Fauna removed per trench km).

The overall mortality rate for Stage 5A and 5B were almost identical (4.4%), however, there was some significant variation between the same loops, notably Stage 5A Loop 6 (8.8%) and Stage 5B Loop 3 (9.1%). Percentage mortality rates appear high on several other loops in the various stages; however, this is a result of the small sampling sizes, rather than high absolute mortality numbers. The apparent high mortality rate of 100% in Stage 5B Loop 10 only involved four animals.

The higher rate experienced on Stage 5A Loop 6 occurred over a two-week period when 210 out of 2139 fauna removed from the trench were dead, mainly as a result of desiccation, with some predation, and other unknown causes. In response, the Proponent investigated the possible causes, and concluded that the increase appears to be generally related to higher night-time temperatures with the onset of the summer period. A range of response measures was considered in consultation with DEC and management actions put in place that included:

1. Use of additional fauna teams to expedite inspections and clearing.
2. Supplementing the trench inspection and clearing program with afternoon inspections and spot checks (which returned very few fauna captures and mortalities).
3. Placing fauna shelters at 50 m intervals (compared with CEMP requirement of 100 m).
4. Revision of the contractor's site management protocols based on analysis of the situation – use of additional shelters in areas of conservation value or other vegetated areas in Loops 7, 8 and 9).
5. Increasing the number of lowering–in crews to expedite backfilling and reducing open trench lengths.
6. Delaying Loop 7 trenching to minimise open trench exposure times while Loop 6 is being completed, and also to keep trenching contained within one spread.

The results and actions taken were formally reported to the DEC.

The high rate of mortalities on Stage 5B Loop 3 involved much lower numbers than were experienced on Stage 5A Loop 6, i.e., there were eight mortalities from a total of 88 animal; entrapments, of which four were the result of predation. Of the eight mortalities, five occurred during one week of the six-week period of trenching, and again are probably the result of higher night–time temperatures occurring in mid-August.

Table 3-8: Fauna statistics – Stage 5A

Statistic/Loop No	0	1	2	3	4	5	6	7	8	9	10	Overall
Length of trench inspected (km)	0	847.645	516.52	407.90	379.50	410.50	790.66	512	169.3	370.5	46.3	4450.83
Total Fauna in Trench	0	3162	4077	870	748	585	2610	132	37	21	11	12253
Total Mortalities in Trench	0	82	139	18	30	33	232	3	3	0	1	541
% Mortalities in Trench	0.0%	2.6%	3.4%	2.1%	4.0%	5.6%	8.9%	2.3%	8.1%	0.0%	9.1%	4.4%
No Fauna in Trench/km	0.00	3.73	7.89	2.13	1.97	1.43	3.30	0.26	0.22	0.06	0.24	2.75

Table 3-9: Fauna statistics – Stage 5B

Statistic/Loop No	0	1	2	3	4	5	6	7	8	9	10	Overall
Length of trench inspected (km)	1446.45	332.95	266.85	213.01	253.10	94.60	109.30	199.1	32.3	38.97	59.0	3045.62
Total Fauna in Trench	2883	3471	1353	88	477	214	23	92	15	1	4	8621
Total Mortalities in Trench	135	147	59	8	20	3	0	1	0	0	4	377
% Mortalities in Trench	4.7%	4.2%	4.4%	9.1%	4.2%	1.4%	0.0%	1.1%	0.0%	0.0%	100.0%	4.4%
No Fauna in Trench/km	1.99	10.42	5.07	0.41	1.88	2.26	0.21	0.46	0.46	0.03	0.07	2.83

Table 3-10: Fauna statistics – Stage 5

Statistic/Loop No	0	1	2	3	4	5	6	7	8	9	10	Overall
Length of trench inspected (km)	1446.45	1180.595	783.37	620.91	632.60	505.10	899.96	711.1	201.6	409.47	105.3	7496.44
Total Fauna in Trench	2883	6633	5430	958	1225	799	2633	224	52	22	15	20874
Total Mortalities in Trench	135	229	198	26	50	36	232	4	3	0	5	918
% Mortalities in Trench	4.7%	3.5%	3.6%	2.7%	4.1%	4.5%	8.8%	1.8%	5.8%	0.0%	33.3%	4.4%
No Fauna in Trench/km	1.99	5.62	6.93	1.54	1.94	1.58	2.93	0.32	0.26	0.05	0.14	2.78

Figure 3-2: Fauna statistics

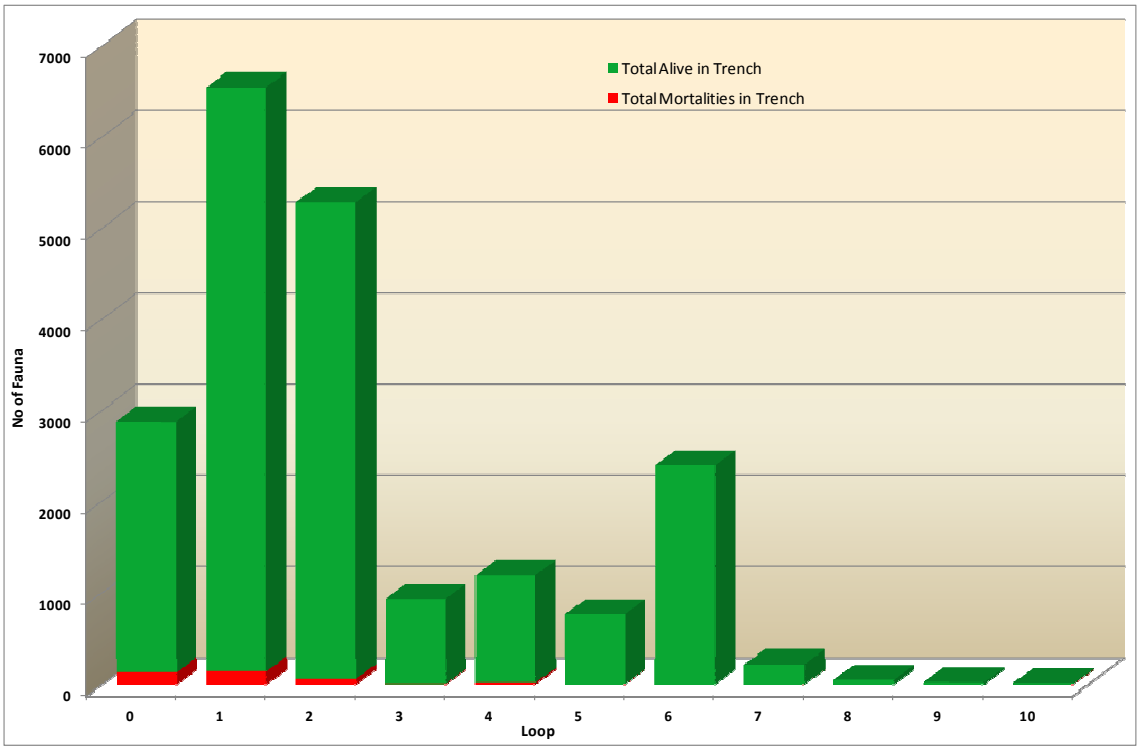


Figure 3-3: Fauna mortality rates

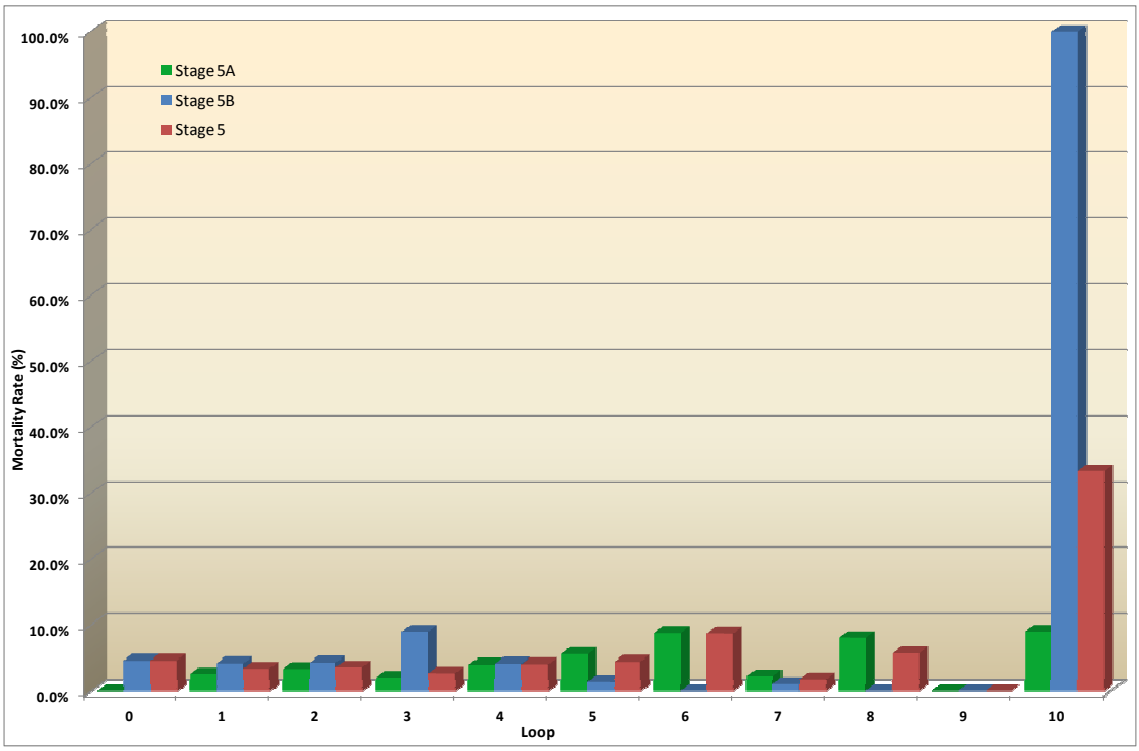
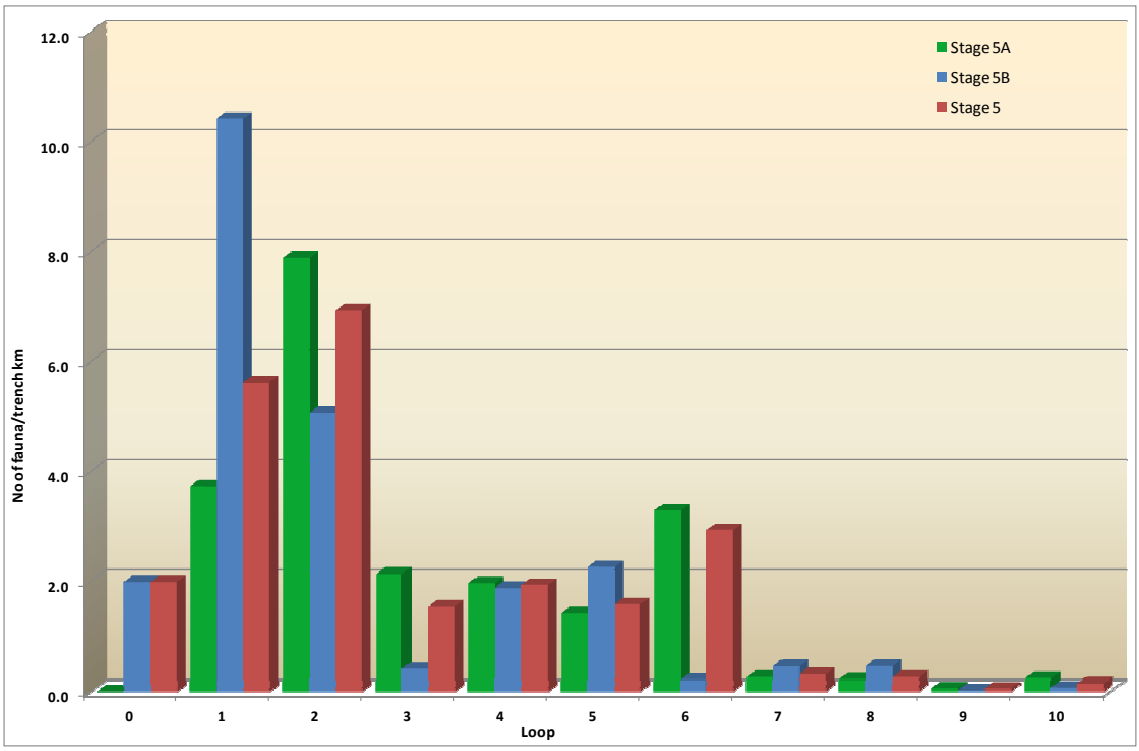


Figure 3-4: Fauna removed per trench km



The rate of fauna interactions per km of trench varied considerably between loops, with reasonable correlation between the two stages. Loops 1 and 2 had significantly higher rates than the other loops, being up to 10.42 interactions/km in Stage 5B Loop 1. With the highest rate for Stage 5A being 7.89 interactions/km in Loop 2, the data suggests that the area around the southern portion of Loop 1 and the northern portion of Loop 2 has the highest fauna density along the alignment. This area lies between the Robe and Yannerie rivers in the Pilbara region.

There was no evidence to suggest that environmental harm resulted as a consequence of the potential non-compliances/non-conformances identified in the compliance auditing process.

The fauna interaction rates in the cleared agricultural areas (Stage 5A Loops 7 to 10, and Stage 5B Loops 6 to 10) were an order of magnitude lower than the more northern areas, and significantly lower than the overall rate. The rates in Loops 9 and 10 (0.05 and 0.14 interactions/km respectively) largely involved vermin species (house mice) associated with remnant vegetation occurrences. This raises issues regarding the benefit of the significant effort involved in trench inspections/clearing in cleared agricultural or built-up urban areas. The majority of the remaining 52.3 km portion of Loop 9 (from Caversham to Rockingham) traverses established urban areas, with negligible potential for entrapment of native fauna. This section does include several areas of remnant native vegetation such as Hartfield Park, the Spectacles, and an area west of Forrestdale Lake, in which there is potential for native fauna entrapment.

The fauna interaction reports forwarded to DEC contained details of the location of every fauna interaction, including grid reference, date, time, category, family and species, whether alive or dead, and the cause of death where known. This data provides a substantial contribution to knowledge of numerous species distributions over a substantial area of Western Australia, traversing several bioregions.

3.3 Watercourse crossings

The environmental objectives for watercourse crossings as set out in the Watercourse Crossing Management Protocol within the Construction Environmental Management Plan (CEMP) (Strategen 2011b) are presented in Table 3-11

Table 3-11: Environmental objectives for watercourse crossings

Issue	Environmental objective
Disturbance to watercourses	Minimise and manage disturbance of watercourses.
Contamination of watercourses	Prevent contamination of watercourses from construction activities.

3.3.1 Methodologies

Minimisation of impacts to watercourse crossings was managed through a range of management actions, which included the following:

1. Staff induction programs included information regarding watercourse crossing management practices.
2. Watercourse crossings were scheduled during dry conditions or low flow periods. In particular, watercourse crossings in northern loops were avoided during the cyclone season (October to March) and in northern loops during the winter months (April to September).
3. Erosion control measures were installed as required to protect watercourses during ground disturbance where the CROW traversed such features (see Plate 13)
4. Riparian vegetation along watercourses was delineated on the ground and the relevant Regional Office of DEC advised (see photographs of delineated riparian vegetation in Plate 14).
5. Vehicular intrusion into the riparian zone and along stream banks was limited through fencing or flagging, and/or signage (see flagging of riparian vegetation zones in Plate 14).
6. Watercourses and riparian zones were only accessed along the CROW.
7. The areas of proposed disturbance associated with watercourse crossings were marked out with survey pegs and flagging so as to delineate the areas of construction activity (see photographs of delineated disturbance areas in Plate 14).
8. No storage of fuel or hydrocarbons was permitted within 200 m of a watercourse.
9. A no refuelling buffer zone extending 200 m from each bank of all watercourses was identified in the ELL along the CROW and flagged and signposted (see photographs of 'No Refuelling' signage in Plate 15). The requirements specifically applied to non-mobile plant. Refuelling of any non-mobile plant within 200 m of a watercourse was be undertaken in accordance with a Fuel and Chemical Storage, Spill and Emergency Response Protocol contained in the CEMP, which provided additional safeguards against spillage.
10. Cleared and pruned riparian vegetation was stockpiled on-site for later use in bank stabilisation and rehabilitation (see Plate 16).
11. When surface water was present, diversion berms or flumes were installed to divert water away from the construction area (see Plate 13).
12. Horizontal directional drilling (HDD) drill entry and exit points were located to avoid impact on riparian vegetation and heritage areas (see Plate 17).
13. HDD drill site, entry and exit points were located away from watercourse banks and riparian areas, as far as practicable (see Plate 17).
14. Only water-based drilling fluids were used and were contained in mud tanks or pits and de-sanded and recirculated during drilling.
15. Removal of riparian, bank and in-stream vegetation was minimised wherever possible, to reduce the risk of erosion and to assist in maintaining the stability of river beds and banks (see Plate 14).
16. Rehabilitation of watercourses was undertaken in accordance with a Department of Water approved plan.

17. As far as practicable, riverbeds and banks were landscaped to their former pre disturbance condition to ensure that watercourse crossings retained their form and function (see Plate 18).
18. Pre–construction equivalent stability, channel profile and bed composition was achieved wherever practicable (see Plate 18).
19. The banks were reinstated in the same manner as the original pipeline construction using hessian bags filled with a combination of sand and cement (see Plate 18). This methodology had proven very successful as the original stabilisation bags were found to still be present in most locations.
20. Particular care was taken with erosion and sediment control in waterway zones when implementing rehabilitation measures (see Plate 13).
21. Post-construction inspections during flow events were made to confirm effectiveness of bank stabilisation measures.

3.3.2 Key indicators and performance

The performance indicators for watercourse crossings as set out in the Watercourse Crossing Management Protocol within the Construction Environmental Management Plan (CEMP) (Strategen 2011b) are presented in Table 3-12.

Table 3-12: Environmental performance indicators for watercourse crossings

Issue	Performance Indicator
Disturbance to watercourses	No adverse impacts (for example to downstream ecology or land use) resulting from water body flow reductions or diversions as a result of pipeline construction activities. No change in water body flows. No erosion of the water body intersecting or adjacent to the pipeline CROW. Minimal disturbance of riparian vegetation.
Contamination of watercourses	No direct discharge of dewatering water to watercourses. No decrease in water quality attributable to construction activities. No significant (in excess of 80 litres near wetlands and rivers) spills or leaks of hydrocarbons during construction and rehabilitation operations outside of areas designated for maintenance, refuelling or storage.

Disturbance to watercourses

Watercourse crossing disturbance areas were minimised to the minimum practical level. The primary technique to minimise impact was timing of work to coincide with no-flow or low-flow periods. CROW widths at many of the larger watercourse crossings such as the Fortescue, Maitland, Wooramel and Yannerie river crossings were required to be substantially wider than the generally approved CROW width of 30 m. This was necessary to accommodate the excavation required to provide a safe working platform from which the trenching and pipe-laying activities could be carried out where the pipe had to be laid at depths of 5 m below the stable bed of the watercourse.

Diversions and flumes with silt traps were installed during construction to ensure no adverse impacts on water quality and downstream ecology.

Riparian zone vegetation was delineated and protected by bunting and flagging, unless it materially interfered with the construction requirements.

Erosion potential of rehabilitated watercourse banks was minimised by utilising sandbags filled with a cement and sand mix as the primary bank stabilisation mechanism. The is technique was proven to be effective in construction of the original pipeline, as the bags still exist in most areas where they were employed. Rock riprap was employed where adequate rock was available, and on steeper banks was secured by overlaying with anchored wire mesh (see Plate 18).

Contamination of watercourses

No contamination of watercourses occurred through employment of the techniques employed to minimise erosion/sedimentation during construction, and through the limitations and control measures on fuel storage and refuelling within the 200 m buffer zone of any watercourse. No decrease in water quality was observed as being attributable to the construction activities.

3.3.3 Environmental compliance

Environmental compliance audits did not identify any potential non-compliances with conditions relating to management of impacts on watercourses.

3.3.4 Environmental outcome for watercourses

The construction impacts on watercourses were temporary and fully rehabilitated, utilising proven techniques to minimise future erosion potential. Watercourse flows were managed to ensure no interruption to downstream ecological or anthropogenic uses. No observed or reported changes to water quality occurred outside the construction area.

3.4 Disturbance of wetlands

The environmental objectives for wetlands as set out in the Wetland Management Protocol within the Construction Environmental Management Plan (CEMP) (Strategen 2011b) are presented in Table 3-13.

Table 3-13: Environmental objectives for wetlands

Issue	Environmental objective
Disturbance to wetlands	To minimise and manage disturbance to wetlands and wetland buffer areas from construction activities.
Wetland water quality and water regimes	To prevent adverse changes to wetland water quality or hydrological regimes resulting from construction activities.

3.4.1 Methodologies

Minimisation of impacts to wetlands was managed through a range of management actions, which included the following:

1. Staff induction programs included information regarding wetland management practices.
2. All conservation category wetlands and wetlands protected under an Environmental Protection Policy within and immediately adjacent to the construction right-of-way were identified and recorded in the ELL.
3. All activities with potential to affect wetlands were scheduled to be undertaken during statistically dry periods.
4. All wetlands identified in the ELL were flagged in the field (see photographs prohibiting refuelling [Plate 15] and reduced CROW widths [Plate 9]).
5. Where vegetation within a wetland or its associated buffer area was required to be disturbed to enable construction, the width of the construction right-of-way was reduced to 20 m. Flagging and signage was used to delineate the reduced width (see photographs of marking reduced CROW widths [Plate 9]).
6. Buffer zones extending 200 m from each edge of wetlands identified in the ELL were flagged and signposted (see photographs prohibiting refuelling [Plate 15]).
7. A no refuelling buffer zone extending 200 m from wetland was identified in the ELL along the CROW and flagged and signposted (see photographs of 'No Refuelling' signage in Plate 15). The requirements applied to non-mobile plant.

8. Refuelling of any non-mobile plant within 200 m of a wetland was be undertaken in accordance with a Fuel and Chemical Storage, Spill and Emergency Response Protocol contained in the CEMP, which provided additional safeguards against t spillage.
9. All vehicle/plant service locations, including construction camps, fuel storage sites and infrastructure such as truck turnarounds and turkey nests were located at least 200 m from the nearest wetland. No storage of fuel or hydrocarbons was permitted within 200 m of a wetland.
10. Ground disturbing activities with potential to affect wetlands was not undertaken during periods of rainfall or when Bureau of Meteorology forecasts indicated rainfall may occur.
11. Stockpiles were not located in wetlands and associated buffer areas.
12. Wetland vegetation identified for retention in areas of conservation value was protected through use of fencing or flagging, and/or signage.
13. Dewatering of trenches in wetlands and associated buffer areas was avoided.
14. Hydro-test water[4] was not taken from or discharged into any wetlands.
15. All wetlands were reinstated as close as possible to their original profile and condition.

3.4.2 Key indicators and performance

The performance indicators for wetlands as set out in the Wetland Management Protocol and the Rehabilitation Protocol within the CEMP (Strategen 2011b) are presented in Table 3-14.

Table 3-14: Environmental performance indicators for wetlands

Issue	Performance Indicator
Disturbance to wetlands	No wetland dependent vegetation outside approved areas is cleared or destroyed.
Wetland water quality and water regimes	No permanent impact on wetland values during construction or following rehabilitation. No adverse change in the water quality of wetlands following rehabilitation. No change in wetland water level regimes following rehabilitation.

Disturbance to wetlands

Delineation of the wetland buffer areas and reduced CROW widths (20 m) ensured no wetland dependent vegetation outside the approved areas was cleared or destroyed.

Wetland water quality and water regimes

All wetlands were dry when construction took place, ensuring that the construction activity limited impacts on the water regime. No refuelling of mobile plant was undertaken within the wetland or the 200 m surrounding buffer zone to eliminate the potential for fuel spills from this activity. Refuelling of non-mobile plant was undertaken under strict controls to eliminate the possibility of fuel spills.

No discharges of hydrotest or dewatering water into wetlands occurred.

3.4.3 Environmental compliance

Environmental compliance audits did not identify any potential non-compliances with conditions relating to management of impacts on wetlands.

3.4.4 Environmental outcome for wetlands

The construction program and resulting pipe installation had no observable short-term impact on the wetland water level or water quality regimes, or any wetland ecological values.

[4] Hydro-test water is water used to pressure test pipeline segments, prior to acceptance for commissioning.

The expected long-term environmental outcome for wetlands is that no permanent effects would be experienced. Wetlands are highly productive areas. The condition of the wetlands after rehabilitation of the original pipeline has demonstrated that the construction and rehabilitation techniques have not resulted in any permanent impacts to the wetland values. Techniques employed during the Stage 5 project were significantly more rigorous than those employed during construction of the original pipeline.

3.5 Dieback and weed management

The environmental objectives for dieback and weed management as set out in the Weed, Pest and Dieback Management Protocol within the Construction Environmental Management Plan (CEMP) (Strategen 2011b) are presented in Table 3-15.

Table 3-15: Environmental objectives for dieback and weeds

Issue	Environmental objective
Introduction of new weeds and pests	To minimise the potential for new weeds and pests to be introduced into the DBNGP corridor from external sources.
Threat of spreading weeds and diseases	To minimise the risk of spreading existing weeds, pests and dieback along the corridor and to adjacent areas.

3.5.1 Methodologies

Minimisation of impacts of dieback and weeds was managed through a range of management actions, which included the following:

1. Staff induction programs included information regarding dieback and weed management practices.
2. Pre-construction field surveys of dieback risk areas were undertaken to identify the risk areas for dieback occurrence in Loops 8-10 and the results entered onto the ELL.
3. Field surveys to identify areas of significant populations of Declared Plants, as defined by the Department of Agriculture and Food (DAF), were undertaken and the results entered onto the ELL.
4. Construction areas containing native vegetation and displaying weed covers in excess of 50% were required to be treated with Glyphosate or cleared and the weeds disposed of to an appropriate landfill.
5. Bureau of Meteorology weather forecasts were used to schedule movements in dieback risk areas, with movement through dieback risk areas restricted during periods of wet weather.
6. All vehicles and machinery accessing the construction right-of-way were checked to ensure they were free from soil/organic matter prior to arrival on site (recorded as part of the mobilisation procedure) and marked accordingly (see vehicle cleaning facilities, washdown logs and green window stickers designating hygiene check in Plate 19).
7. Personnel were required to remain on designated roads and access tracks and not go outside approved access areas.
8. Vehicles that moved off the CROW but remained on bitumen or hard surfaces did not require clean down prior to entering areas of the corridor with the same risk rating.
9. Flagging and signage were used to identify areas of high risk for dieback and weeds (see Plate 19).
10. Corridor access hygiene points were identified on the ELL and construction alignment sheets.
11. Weed, pest and dieback hygiene stations were located at:
    - entry points for areas of conservation value
    - entry and exit points for areas identified as ‘high risk’ for dieback (loops 8 – 10 only)
    - entry and exit points for areas identified as ‘high risk’ for weeds.
12. Signage was erected outlining the hygiene management procedure at each station (see Plate 19 and Plate 20).
13. All construction machinery, including handheld tools, and vehicles were cleaned down at the hygiene management stations (see Plate 19).

14. Weed seeds and/or soil found attached to vehicles, footwear, clothing and/or equipment, were collected in a sealed container and disposed in accordance with the Waste Management Protocol (see Plate 20).
15. Construction materials (i.e. fencing, timber skids), brought onsite were required to be demonstrated as being disease, pest and weed free.
16. All topsoil within identified 'high risk' areas was stockpiled within that high risk area and not with topsoil from lower risk areas (see photographs of topsoil windrows located adjacent to source areas in Plate 6).
17. Stockpiles of weed and weed-free material and dieback and dieback free material, were kept separate (see photograph of signposted weed infested vegetation stockpile in Plate 20).
18. Drainage for dieback or weed infected areas was designed to prevent water draining into dieback or weed free areas.
19. Stockpiles of all soils and vegetation material were only respread back to their point of origin.

3.5.2 Key indicators and performance

The performance indicators for dieback and weed management as set out in the Weed, Pest and Dieback Management Protocol within the CEMP (Strategen 2011b) are presented in Table 3-16.

Table 3-16: Environmental performance indicators for dieback and weeds

Issue	Performance Indicator
Introduction of new weeds and pests	No new species of weeds or pests recorded in the pipeline corridor within one year of completion of construction activities.
Threat of spreading weeds and diseases	Hygiene management stations located at edges of areas of conservation value and high risk areas. No significant change to the extent and distribution of weeds, pests and dieback within one year of completion of construction activities compared to the extent and distribution of weeds, pests and dieback prior to construction.

Introduction of new weeds and disease

The 12 and 24 month rehabilitation surveys of the pipeline corridor conducted by Mattiske Consulting are discussed in Section 3.7.2. The key determinant for performance regarding this factor was adherence to the hygiene procedures.

Threat of spreading weeds and diseases

Hygiene management stations were installed at all potential locations where clean-down of plant and personnel was required to prevent the spread of dieback and/or weeds as described in Section 3.5.1, including all gazetted conservation areas such as the Toolonga and Melaleuca Park nature reserves. All hygiene activities were required to be recorded at the time, with brushes, and washdown facilities provided as required. All plant was required to be washed down before transfer between loops, and records kept of these actions.

The 12 and 24 month rehabilitation surveys of the pipeline corridor conducted by Mattiske Consulting are discussed in Section 3.7.2.

There were no recorded incidents relating to spread of weeds or disease. Given the extent of public access to the pipeline corridor, it will not be possible to attribute the cause of any future introduction of weeds or disease into the areas disturbed by the Stage 5 project. The key determinant for performance regarding this factor was adherence to the hygiene procedures.

3.5.3 Environmental compliance

Environmental compliance audits did not identify any potential non-compliances with conditions relating to management of impacts of dieback and weeds.

3.5.4 Environmental outcome for dieback and weeds

The environmental outcome for dieback and weeds, based on 12 and 24 month post construction surveys is discussed in Section 3.7.4.

3.6 Acid sulphate soils

The environmental objective for management of acid sulphate soils as set out in the Acid Sulphate Soils Protocol within the Construction Environmental Management Plan (CEMP) (Strategen 2011b) is presented in Table 3-17.

Table 3-17: Environmental objectives for acid sulphate soils

Issue	Environmental objective
Acidification and release of metals	To ensure that there are no adverse impacts to sensitive receptors as a result of the excavation and stockpiling of acid sulphate soils.

3.6.1 Methodologies

Minimisation of impacts from acid sulphate soils was managed through a range of management actions, which included the following:

1. A desktop identification of acid sulphate soil risk areas along the pipeline alignment was conducted prior to any ground disturbance activities on the project.
2. Pre-construction acid sulphate soil surveys were required to be undertaken in areas where there a HIGH or MEDIUM risk of the presence of acid sulphate soils was identified in the desktop survey. Results were included in the Environmental Line List (ELL) and specific management plans developed for handling soils in these areas, which were approved by DEC prior to implementation.
3. All acid sulphate soil risk areas were identified on the ELL, and signage erected to identify those areas on the ground (see Plate 21).
4. Soils in the MED-LOW risk areas with potential for excavation below the watertable were in-field tested prior to excavation for field pH (pH_F) and field pH after oxidation with hydrogen peroxide (pH_{FOX}).
5. Segments of the trench within the HIGH, MEDIUM, and MED-LOW acid sulphate soil risk areas were excavated in lengths that permitted opening and closing of the trench within a period not to exceed 48 hours to minimise the opportunity for the oxidation of soils.
6. Soils excavated from the MED-LOW area did not require active treatment or management unless in-field testing indicates that $pH_F<4$ and $pH_{FOX}<3$. If these criteria were exceeded then the soils were treated with neutralising agent.
7. Soils within the MEDIUM and HIGH risk areas confirmed to be potentially acid generating were treated with prescribed dosing rates of neutralising agent prior to excavation to ensure the excavated soils were neutralised (see Plate 21).

3.6.2 Key indicators and performance

The performance indicators for management of acid sulphate soils as set out in the Acid Sulphate Soils Management Protocol within the CEMP (Strategen 2011b) are presented in Table 3-18.

Table 3-18: Environmental performance indicators for acid sulphate soils

Issue	Performance Indicator
Acidification and release of metals	Groundwater and surface water quality near the pipeline is not degraded as a result of soil disturbance activities. No visual acid sulphate soil oxidation impacts result from the stockpiling of acid sulphate soils.

Acidification and release of metals

The acid sulphate surveys, development of site-specific treatment programs and neutralisation agent dosing rates ensured that no acidification of soils occurred along the pipeline alignment as a result of the construction works. This was evidenced by the groundwater monitoring results undertaken for three months following backfilling of trench excavations in acid sulphate soil risk areas. Longer-term monitoring was not necessary as any acidification would have occurred almost immediately after construction, i.e., as soon as the soils were exposed to oxygen.

3.6.3 Environmental compliance

Environmental compliance audits identified a potential non-compliance with conditions relating to management of acid sulphate soils, as briefly described in Table 3-19.

Table 3-19: Environmental compliance for acid sulphate soils

Environmental condition	Potential non-compliance	Remedial action taken
Condition 15–1: Prior to the commencement of soil disturbance or dewatering in an area, undertake field investigations within that area to clearly delineate areas of high, high to medium, medium to low risk acid sulphate soils.	Areas identified as having 'medium to low' risk (4 km in Stage 5A; Loop 10) were not subject to field investigation in an approach that was consistent with the DEC and agreed with that agency as being appropriate. The work also conformed to the EPA recommendations for environmental conditions contained in its assessment Bulletin.	The condition was believed to have included the requirement for testing in medium to low risk areas as an error and a s 46c request for a minor change of conditions was submitted, but was rejected by the Minster. All subsequent work in potential acid sulphate risk areas was preceded by the required investigations.

3.6.4 Environmental outcome for acid sulphate soils

As a result of the management actions applied, no adverse effects from the excavation of potential acid sulphate soils was observed.

It should be noted that no evidence of impacts from oxidation of acid sulphate soils was observed in the vicinity of the adjacent original Dampier to Bunbury Natural Gas Pipeline. No treatment methods were employed in the construction of those works, as little was known of the phenomenon at that time. This suggests that the treatment methods employed for the Stage 5 Looping Project ensured a conservative approach was taken with the issue.

Field monitoring of the trench stockpiles from the 'medium to low' risk areas in Stage 5A Loop 10 that were not field investigated demonstrated that no acid generation occurred such that approved pH trigger values required treatment to be implemented. That is, no environmental impact occurred as a consequent of the potential non-compliance issue and demonstrated that the need to undertake pre-construction field investigations in these lower risk areas was unjustified. Nonetheless, DBP will meet the conditions requirements in any future work in these identified risk areas.

3.7 Rehabilitation of soil cover and vegetation

The environmental objectives for soil cover and vegetation rehabilitation as set out in the Rehabilitation Protocol within the Construction Environmental Management Plan (CEMP) (Strategen 2011b) are presented in Table 3-20.

Table 3-20: Environmental objectives for soil and vegetation rehabilitation

Issue	Environmental objective
Vegetation	To re-establish vegetation and associated habitat areas to the condition that it was in prior to disturbance or better.
Soil	To control sediment and erosion.

3.7.1 Methodologies

Rehabilitation of soil cover and vegetation was managed through a range of management actions, which included the following:

1. Small amounts of rocks and stones generated by the construction process were distributed evenly over the construction right-of-way (see Plate 22). Where larger volumes of such material was produced, it was removed from site.
2. Areas subject to high traffic movements during construction to be rehabilitated were ripped to a depth of 30 cm, where necessary, prior to respreading topsoil.
3. Topsoil spreading was managed in accordance with the Soil Management Protocol of the CEMP and with the completion criteria completion criteria set out in the Rehabilitation Protocol of the CEMP.
4. Vegetation spreading was managed in accordance with the Flora and Vegetation Management Protocol of the CEMP and with the completion criteria set out in the Rehabilitation Protocol of the CEMP (see Plate 7).
5. Erosion was managed in accordance with the Soil Management Protocol (Section 16) and with the completion criteria set out in the Rehabilitation Protocol of the CEMP (see erosion berms in see Plate 22).
6. If the construction works resulted in subsequent erosion of watercourses, reasonable remedial action was to be taken if requested by the DoW. This would require that the erosion was demonstrably attributable to the construction work or an associated activity by DBP.
7. Rehabilitation of watercourse crossings was managed as described in Section 3.3.1.
8. Rehabilitation of mobile dune areas was managed in accordance with the Dune Crossing Protocol of the CEMP.
9. Rehabilitation of wetlands was managed as described in Section 3.4.1.
10. Weed and disease management was managed as described in Section 3.5.1.

3.7.2 Key indicators and performance

The performance indicators for soil and vegetation rehabilitation as set out in the Rehabilitation Protocol within the CEMP (Strategen 2011b) are presented in Table 3-21.

Table 3-21: Environmental performance indicators for soil and vegetation rehabilitation

Issue	Performance Indicator
Vegetation	Achievement of the completion criteria set out in the Rehabilitation Protocol of the CEMP.
Soil	Achievement of the completion criteria set out in the Rehabilitation Protocol of the CEMP.

The completion criteria set out in the Rehabilitation Protocol of the CEMP are presented in Table 3-22.

Table 3-22: Rehabilitation Completion Criteria

Aspect	Objective	Criteria	Assessment Method
Construction	To ensure that the key commitments implemented during the construction phase will assist in maximising the recovery of the native flora and vegetation on the pipeline construction right-of-way.	100% compliance with the weed hygiene protocol.	Audit during the operation.
		100% compliance with the dieback hygiene protocol (Loops 8 and 9 only).	Audit during the operation.
		Vegetation and topsoil is cleared and stored in compliance with CEMP.	Audit during the operation.
		Significant plant species are protected in accordance with the CEMP.	Audit during the operation.
Decommissioning	To ensure that all visual disturbances are removed by prompt remedial action to the greatest extent practicable.	All equipment, materials and litter are removed from the area of disturbance.	Visual inspection of the area of disturbance.
Erosion	To reinstate the land to provide suitable conditions for natural re-colonisation of native vegetation and support natural surface water movement.	Re-instatement of natural contours to pre-disturbance conditions.	Visual inspection of area of disturbance.
		No active erosion rills in excess of the surrounding land.	GPS record and physical measurement of any points of erosion.
		In erosion prone areas, within the 30 m wide construction right-of-way, individual bare patches must not exceed 10 m in length, and the cumulative sum of bare patches must not exceed 10% of the total area of each consecutive 100 m length of construction right-of-way after 12 and 24 months.	Visual assessment. Note this criterion does not apply in areas that were previously bare.
Weeds	To facilitate the establishment of native plant species, where native vegetation has been removed during the construction process.	Minimise the spread and intensification of weed infestations through vehicle hygiene protocols.	Visual inspection of the area of disturbance, with backing from photographs, baseline surveys and rehabilitation monitoring datasets.
		The foliage cover of declared and environmental weeds within disturbed areas should be similar to vegetation immediately adjacent to the area of disturbance after 12 and 24 months.	Visual inspection of the area of disturbance, with backing from photographs, baseline surveys and rehabilitation monitoring datasets.
Flora and Vegetation (where native vegetation has been removed during the construction process)	To facilitate the establishment of native plant species, where native vegetation has been removed during the construction process.	A minimum of 1 native plant per square metre when averaged over the entire area rehabilitated at 12 months. A minimum of 2 native plants per square metre when averaged over the entire area rehabilitated at 24 months.	Visual inspection of the area of disturbance, with backing from photographs, baseline surveys and rehabilitation monitoring datasets.
		Percentage foliage cover of native species indigenous to each plant community is greater than or equal to 40% of foliage cover in vegetation immediately adjacent to the area of disturbance after 24 months (excluding pipeline access track).	Visual inspection of the area of disturbance, with backing from photographs, baseline surveys and rehabilitation monitoring datasets.

Aspect	Objective	Criteria	Assessment Method
		Species Richness of greater than or equal to 50% (unless negotiated otherwise with DEC) in vegetation immediately adjacent to the area of disturbance after 24 months.	Visual inspection of the area of disturbance, with backing from photographs, baseline surveys and rehabilitation monitoring datasets.

Vegetation

Mattiske Consulting Pty Ltd undertook several post-construction surveys of the rehabilitated areas of Stage 5A and 5B with respect to native plant density, native plant foliage cover, native species richness, and foliage cover of introduced (weed) species in areas where native vegetation has been removed during the construction process. The surveys extended to up to 36 months after completion of construction in the areas of the Stage 5A loops.

The most recent published surveys of Stage 5A (Loops 0 to 6 [Mattiske 2012] and Loops 7 to 9[Mattiske 2010b]) found the following:

Native Plant Species Density (Loops 0 to 6)

On an average by Loop basis, the 24-month criterion was met by half of the six Loops. Loops 1, 2 and 6 failed to meet this criterion, with Loop 1 and Loop 6 having the lowest CROW average native plant densities of 0.90 ± 0.20 and 0.93 ± 0.12 plants/m^2. Neither of these two Loops had a site which met the minimum native plant density criterion. However, Loops 2 and 6 showed a higher average native plant density than their respective control plots.

Native Plant Species Density (Loops 7 to 9)

On average over the entire expansion area, this criterion was met in the CROW areas for all three Loops. However, several transects failed to meet the criteria, varying between largely bare ground or domination by the introduced species *Arctotheca calendula*.

Species Richness (Loops 0 to 6)

The 24-month completion criterion was met on average for all Loops, with the result being achieved for all sites of all Loops, with the exception of two sites on Loop 5.

Species Richness (Loops 7 to 9)

The 24-month completion criterion was met on average for Loop 7 and Loop 9, whereas Loop 8 did not meet this criterion. The control transects of Loop 8 had a higher species richness than those of Loops 7 and 9. The near bare rehabilitation of a Loop 6 had a very low native species richness relative to the control transect. Several transects on Loops 8 and 9 also had low native species richness relative to their respective controls. In the case of Loop 9, this was due to the dominance of one species: *Kunzea glabrescens*.

Native Plant Foliage Cover (Loops 0 to 6)

The 24-month criterion for foliage cover was met for all Loops. Loop 5 in particular, showed a consistently high native species foliage cover.

On average, the percentage of native plant foliage cover made up of perennial species as opposed to annual or biennial (short-lived) species is approaching that the Control plots for all Loops, with the exception of Loop 4.

Native Plant Foliage Cover (Loops 7 to 9)

The 24-month criterion for foliage cover was met on a loop average for Loop 7 only, while Loop 8 and Loop 9 failed to meet this with the majority of transects failing. The transects with the lowest Native Plant Foliage Cover were the same as those that failed the Native Plant Density criterion. The transects with the highest Native Plant Foliage Cover were dominated by *Jacksonia calcicola* and *Tecticornia indica subsp. bidens*.

Weeds (Loops 0 to 6)

The 24-month completion criterion for weeds was met for all Loops with the possible exception of Loop 3, which recorded a relatively high weed foliage cover in the CROW compared to the control. This was largely due to site MJ1, which showed a proliferation of *Cenchrus ciliaris* (Buffel grass). *C. ciliaris* was also responsible for the high introduced-species foliage cover in both the control and CROW plots at one site on Loop 1, and for the high weed foliage cover of a control plot on Loop 2.

Weeds (Loops 7 to 9)

The 24-month completion criterion was only met on only Loop 7, while the average for both rehabilitation and control plots was much higher for Loop 9 than Loop 8. Two transects on Loop 9 recorded weed covers of 77.21 ± 4.17% and 40.91 ± 6.75%, due largely to the proliferation of *Arctotheca calendula*. A rehabilitation transect on Loop 9 also had a high weed foliage cover of 12.83 ± 2.90% due to the presence of *Hypochaeris glabra, Avena barbata and Asteraceae sp.*. Another rehabilitation transect (15.64 ± 4.52%) and a control transect (52.25 ± 7.51%) on Loop 9 had large weed foliage covers due largely to introduced *Poaceae* species. Several transects on Loops 8 and recorded no introduced (exotic) species in the rehabilitation area.

Soil

Soil management primarily involved removal of the top 100–150 mm of topsoil from all areas to be disturbed and storing it in a windrow adjacent to the source area, with the exception of previously cleared agricultural land where the landholder requested that topsoil not be removed. Any removed topsoil was respread evenly over the CROW following backfilling of the trench, prior to respreading of removed vegetation.

The CEMP completion criteria in Table 3-22 relating to soil cover are listed under the Erosion aspect. Post-construction visual inspections confirmed that, with the exception of erosion prevention berms erected across the CROW, all construction areas were returned to pre-disturbance conditions. Inspections of the CROW immediately after backfilling and prior to topsoil re-spreading, confirmed that topsoil had not been used as backfill material (see Plate 23), indicating that the topsoil was returned to its source location over the CROW. Erosion berms were erected on sloping areas where removal of vegetation had resulted in an increased erosion risk. This was technique was predominantly used in areas adjacent to major watercourses where the pipeline alignment sloped downwards towards the watercourse, with consequent high potential for water to flow along the alignment, causing erosion before vegetation had the opportunity to re-establish.

Post-reinstatement surveys did not identify any active erosion rills in adjacent land that could be attributed to the project. These inspections confirmed that where individual bare patches in erosion prone areas within the CROW exceeded 10 m in length, erosion berms were constructed (see Plate 22).

3.7.3 Environmental compliance

Environmental compliance audits did not identify any potential non-compliances with conditions relating to management of soil cover and vegetation rehabilitation.

3.7.4 Environmental outcome for soil cover and vegetation

Soil

Soil management techniques employed on the project resulted in topsoil being retained and returned to the reinstated areas of disturbance along the alignment and in any areas where off-easement facilities were located. Erosion prevention berms constructed along the rehabilitated CROW were designed to eliminate soil erosion through overland flow occurring preferentially using the along the rehabilitated alignment, prior to reestablishment of vegetation cover. No evidence of soil erosion or sedimentation has been reported by any landholders, and the objectives for this factor can be considered to have been met.

Vegetation

Three of the four completion criteria were met overall in the 2011 monitoring (Mattiske 2012). The completion criteria of native species richness, native species foliage cover, and weed foliage cover were all met on average for all six Loops, despite a few sites being infested with *C. ciliaris* where water availability is elevated along creeklines and floodplains. The success in meeting these criteria can be attributed in part to the above average rainfall experienced over much of the area at some stage in the 6 months preceding the 2011 survey.

The native species density criterion of 2 plants/m^2 was met for Loops 3, 4 and 5. Loops 1, 2 and 6 failed, on averages) to meet this density criterion but all had on average a CROW native species density equal to or greater than that of their respective control plots. The control plots of each of these Loops, on average, had a native species density of less than 1 plant/m^2. While these Loops did not meet the native plant density criterion, the density obtained may be considered tolerable (Mattiske 2012).

The 2010 monitoring of Loops 7 to 9 (Mattiske 2010b) resulted in several instances of the completion criteria not being met, albeit variably within and between loops. Mattiske (2010b) makes recommendations for ripping and re-seeding programs in the near bare areas, and weed management in the infested areas.

At the time of writing this report, the results of the rehabilitation monitoring surveys were being discussed with officers of the DEC to determine what further actions should be taken, in accordance with the contingency actions set out in the CEMP.

3.8 Other factors

Key management techniques applied to factors other than those described in Sections 3.1 to 3.7 were:

1. Waste management including the following (some of which are illustrated in Plate 24):
    - covering of waste skips to prevent material blowing out in high winds
    - package wastewater treatment plants and ablution blocks at camp sites
    - waste storage areas with signage to differentiate the different types of waste
    - specific marked bins for recyclable materials
    - medical waste bins located adjacent to camp first aid stations
    - removal and disposal of collected wastes by licensed contractors.
2. Pollution prevention techniques including the following (some of which are illustrated in Plate 25):
    - hazardous material storage containers with signage
    - spill cleanup kits on fuel trucks
    - bunded storage of oils and other hydrocarbons
    - pollution control station located adjacent to the wastewater treatment plants, with spill kits
    - refuelling grates with spill kits and fire control measures at bulk fuel storage and refuelling points
    - bunded fuel tanks on plant (with spill kits where appropriate)
    - removal and disposal of collected hazardous waste materials by licensed contractors.

3. Other miscellaneous environmental management techniques, including the following (some of which are illustrated in Plate 26):
    - disposal of water dewatering discharge onto paddock through hay bales and sediment trap
    - fire extinguishers on all vehicles
    - dewatering discharge sediment traps
    - fire-fighting equipment on welding trucks
    - sediment trap for drainage discharges from campsite areas
    - fast attack fire control trailer available with all welding activities
    - recording of all environmental incidents in the project incident register, which included a process requiring investigation and close out of any incidents.

4. Level of progress in achieving sound environmental performance

Environmental performance of the project was achieved through implementation of a number of systems, procedures and techniques, which are briefly described in the following sections.

4.1 Construction Environmental Management Plan

The CEMP formed the primary basis for environmental management, and covered a range of topics, that included the key environmental factors discussed in Section 3 as well as others. The full list of CEMP protocols comprised the following:

- Environmental Incident Response Protocol
- Conservation Area Management Protocol
- Flora and Vegetation Management Protocol
- Weed, Pest and Dieback Management Protocol
- Wetland Management Protocol
- Dewatering and Water Disposal Management Protocol
- Acid Sulphate Soil Management Protocol
- Fauna Interaction Protocol
- Watercourse Crossing Management Protocol
- Dune Crossing Management Protocol
- Fire Management Protocol
- Dust Management Protocol
- Noise and Vibration Management Protocol
- Fuel and Chemical Storage, Spill and Emergency Response Protocol
- Waste Management Protocol
- Soil Management Protocol
- Aboriginal Heritage Site Management Protocol
- Rehabilitation Protocol
- Access and Safety Management Protocol.

Where relevant, the protocols were based directly on the conditions of approval set out in Statement 735; to ensure that implementation of the management measures set out in the CEMP would result in compliance with the Statement conditions. The primary management actions in the protocols related to the key environmental factors are presented in the *Methodologies* sections of Section 3.

A condition of the Stage 5A and 5B construction contracts required contractors to comply with the CEMP. Contractors were required to prepare a Construction Environmental Management Implementation Plan as a bridging document with the CEMP. The contractor was also required to prepare detailed procedures for implementation of each of the protocols within the CEMP, together with maintenance of induction, training, clearing, hygiene and incident registers, and daily logs of trenching progress and location.

Over the course of the project, as experience was gained with the practicality of implementing the prescribed management actions, the management protocols were progressively reviewed and modified in consultation with the relevant agencies, and approved as required. Approval of amendments was primarily through the Department of Mines and Petroleum (and predecessor agencies), as the CEMP requires approval under the *Petroleum Pipelines Act 1969*. In approving the CEMP, the Department of Mines and Petroleum consulted with other relevant agencies, and the latest version of the document was made public. Several of the protocols contain examples of industry best practice, as discussed in Section 5.

Any modifications to the CEMP were made on the basis of ensuring:

- no increase in environmental risk(s)
- improvement of the practicality and ease of implementation
- auditability of implementation
- improvement in the potential for achievement of environmental objectives.

On-site environmental officers were charged with the responsibility of ensuring compliance with the CEMP on a day-to-day basis.

4.2 Environmental audits

Implementation of the CEMP was audited under a range of processes:

1. Regular internal audits against all management actions set out in the CEMP as appropriate to the locality and stage of construction at the time of the audit, with follow up and close-out of any potential identified non-conformances.
2. Formal, independent audits of compliance with the Statement conditions, and conformance with key actions in the CEMP for each loop segment. These audits were reported to the Office of the Environmental Protection Authority as required by a Statement condition. To date, 26 such audits have been undertaken. The results of these audits are discussed in Section 2 and the audit reports are presented in Appendix 1, Appendix 2 and Appendix 3.
3. Formal audits of conformance with the CEMP by Department of Mines and Petroleum audit staff, with follow up and close-out of any potential identified non-conformances. Conformance with the CEMP is a requirement of licensing of the pipeline under the *Petroleum Pipeline Act 1969.* Five such audits were carried out, with several minor non-conformances, and recommendations for improvement, all of which were followed up and closed out.
4. Formal audits and reporting on compliance with conditions of approval given under the *Environment Protection and Biodiversity Conservation Act 1999*. Four such audits have been carried out to date, with no non-compliances identified.
5. Informal inspections by DEC staff of construction activities, particularly of weed/dieback hygiene and fauna management activities on DEC managed lands, such as the Cane River Conservation Park,, the Toolonga Nature Reserve and Melaleuca Park Nature Reserve. No significant issues were identified during those inspections.

5. Significant improvements gained in environmental management

The improvements gained in environmental management principally relate to the issues described in Sections 3 and 4. No peer reviews were undertaken, other than third party audits by the Department of Mines and Petroleum, field inspections by staff from the Department of Environment and Conservation and independent audits of compliance with the Statement conditions as described in Section 4.2.

The environmental management of gas pipeline construction is based on relatively low-level technologies, as the process and associated issues are simple and short-term. However, some methodology improvements were developed during the project, such as with fauna management, acid sulphate soil treatment techniques, and changes to other various management measures to improve the practicality of implementation, without adversely compromising environmental outcomes. The four key improvements are described in Sections 5.1 to 5.4. In addition, several audits revealed shortcomings in aspects of environmental management that were addressed by the Proponent to improve the overall standard of environmental management. These are described in Sections 5.5 and 5.6).

5.1 Fauna management

One of the most critical environmental factors associated with the project, was the management of fauna interactions; specifically, the potential for fauna to be entrapped in an open trench with consequential stress, injury or death. Prior to approval of the DBNGP Stage 5 Looping Project, conditions of approval on gas pipeline projects, notably the two components of the Stage 4 Looping Expansion (Southern Looping Project, Loop 10, South of Kwinana and Northern Looping Project, Loops 1 to 9, Karratha to Bullsbrook) were subject to conditions as discussed in the following sections. These conditions were modified for the Stage 5 project as discussed.

5.1.1 Limits on open trench length

Prior to DBNGP Stage 5 Looping Expansion approval

Prior to approval of the DBNGP Stage 5 Looping Expansion Project, environmental approval conditions limited lengths of open trench to maximum distances, with the length depending on the conservation value of the environment traversed by the trench sections. Provisions allowing for extra distances in areas of rock excavation were included. The open trench length limits appeared to be arbitrary, and not supported by scientific evaluation. For example, Statement 708 (DBNGP Southern Looping Project, Loop 10, South of Kwinana) issued in December 2005, required the trench length within the Leda Nature Reserve and Hymus Swamp to be limited to a maximum of 2.5 km at any time, with the limit extended to 7 km over the remaining 23 km length of the project. Statement 710 (DBNGP Northern Looping Project, Loops 1 to 9, Karratha to Bullsbrook) also issued in December 2005, limited the trench length in the Coomallo Nature Reserve to 2.5 km, in other areas of conservation value to a maximum length of 5 km and to 20 km in remaining areas with provision for an additional 10 km in rocky terrain.

DBNGP Stage 5 Looping Expansion approval

The stringent limitations on open trench lengths were manageable for the components of the Stage 4 Looping Expansion, with the project traversing a total length of only 217 km. However, such limitations on the 1270 km length of the Stage 5 Looping Expansion were anticipated as severely compromising the efficiency of the construction program, with an increase in environmental risk as a potential consequence. Limiting open trench lengths results in slower construction overall, an unjustifiable prohibition on running multiple construction spreads (i.e., working on several loop sections simultaneously), without any consequential reduction in environmental risk, assuming the fauna clearing actions are maintained.

Through the appeal processes available under the *Environmental Protection Act 1986*, it was successfully contended that the actual length of trench open at any one time would not affect the risks to fauna, provided that all open trench was subject to the required entrapped fauna clearing regime. This would only be limited by the availability of sufficient qualified personnel to undertake the required clearing regime. As a consequence, the trench length condition on the Stage 5 Looping Expansion limited trench lengths to not exceed a trench length capable of being inspected and cleared by fauna clearing persons within the required times as set out in the relevant conditions relating to clearing time limits. It is notable that this condition has been a standard condition applied to subsequent approvals for proposals involving trenching work.

The fauna mortality rate for Stages 5A and 5B were similar to those experienced under the previous approvals, demonstrating that there had been no increase in risk to fauna.

5.1.2 Time limits on trench fauna inspections

Prior to DBNGP Stage 5 Looping Expansion approval

Statement 708 (Southern Looping Project) required clearing of entrapped fauna from the trenches by 10 am each morning, and half an hour prior to backfilling the pipeline trench. This requirement was repeated in the fauna management plan approved for the Northern Looping Project. It is understood that this requirement was intended to ensure that entrapped fauna were not exposed to high daytime temperatures that had proven fatal in previous trenching projects in the north west of the State.

DBNGP Stage 5 Looping Expansion approval

The time limits on trench inspections for entrapped fauna created issues for components of the Stage 4 Looping Expansion, particularly during work in the northern sections during the winter time months, when late sunrises limited the time available to conduct the surveys. It was anticipated that this issue would be exacerbated with the 1270 km length of the Stage 5 Looping Expansion, and could result in imposing limits on the lengths of trench able to be open at any time because of limitations on the availability of trained fauna clearing personnel. It was successfully contended that the time available for clearing should be based on a period after sunrise during which the trench would not be significantly exposed to heat, rather than by a fixed time of day, independent of the locality and season.

The negotiations on conditions resulted in the condition applied to the Stage 5 Looping Expansion requiring inspections to be completed by 4.5 hours after sunrise for the northern loops (0 to 7) and by 5 hours after sunrise for the southern loops (8 to 10). In addition, fauna clearing was to be completed by 3 hours after sunrise or when temperatures were forecast to exceed 35℃ on Loops 0 to 2 during March to April. This outcome enabled more efficient use of the fauna handling resources available to the project. The fauna mortality rate for Stages 5A and 5B were similar to those experienced under the previous approvals, demonstrating that there had been no increase in risk to fauna.

5.2 Acid sulphate soil management

Acid sulphate soil is the common name for soil that contains iron sulphide or sulphide oxidation products. When acid sulphate soils are exposed to air and water, the iron sulphides can oxidise to produce sulphuric acid, iron precipitates and groundwater with elevated concentrations of dissolved metals such as aluminium, iron and arsenic. Although these materials are typically benign when undisturbed in their natural environment below the watertable, dewatering, excavation and/or stockpiling of acid sulphate soils that lie below the naturally occurring watertable may promote the occurrence of these adverse environmental impacts.

Construction of the DBNGP Stage 5 Looping Expansion Project involved the excavation and dewatering of potential acid sulphate soils that could potentially result in their oxidation and consequent environmental impacts in several areas along the pipeline alignment.

The accepted process to manage identified potential acid sulphate soils when removed from a trench was treatment of the trench spoil by mixing with a prescribed amount of neutralising agent with a known neutralisation capacity (such as crushed limestone). Determination of the amount of neutralising agent required is site specific and is based on soil testing to determine the acidification potential of the soil.

Prior to commencement of Stage 5, the method of treatment of acid sulphate soils associated with excavations such as trenches, involved placing the required amount of neutralising agent in three layers alternating with layers of trench spoil, during trench backfilling. This resulted in a 'layer cake' soil profile within the trench as a means of obtaining a neutralised soil mixture. The limited width of the CROW prevented premixing the neutralising agent with the trench spoil on the surface prior to backfilling because of the space required for such an operation. In implementing the Stage 4 Looping Expansion Project, the space limitations in some areas were such that the potentially acidic trench spoil was disposed of to an offsite facility, at substantial cost, as a more practical alternative to on-site treatment.

The Stage 5 alignment contained substantial areas of medium to high risk potential for acid sulphate soils, and off-site disposal costs would be costly, not only for the disposal, but in importing replacement soil for backfilling. Following a review of the treatment needs for Stage 5, a technique was developed, approved by the DEC and employed for Stages 5A and B that involved laying the prescribed amount of neutralising agent along the centreline of the pipe trench prior to excavation (see Plate 21). This material was then mixed with the trench spoil as a direct consequence of being excavated with the underlying trench spoil. Backfilling resulted in further mixing of the two components.

The advantages of this method are:

- it requires no additional workspace
- it results in the trench spoil stockpile containing neutralising agent, which prevented acidification prior to backfilling
- it results in substantially better mixing of the neutralising agent into the topsoil when returned to the trench
- it is simple and highly cost-efficient to implement.

There are no known disadvantages with the process. Overall, the methodology was demonstrably more efficient and effective than the previous technique, in terms of achieving the objective of neutralising potential acidification. It is expected that the methodology will continue to be used for the remaining sections of Stage 5.

5.3 Bulk refuelling station spill control

Several of the initiatives discussed in Section 3 are considered to represent improvements in industry best practice, not the least being the application of refuelling grates at bulk fuel storage refuelling points. Standard industry practice for addressing minor fuel spillages when refuelling at temporary refuelling stations is the placement of a thin rock (often limestone) apron in the refuelling area. This material is then excavated when the refuelling station is removed. However, the design of the rock apron and its infiltration characteristics are usually not subject to any regulation, and removal is often not monitored to ensure complete removal or appropriate disposal.

The Stage 5 Looping Expansion Project employed the placement of a steel grate and shallow steel tank in the refuelling area to catch any spills (see examples in Plate 25 and in Plate 27). A hole and pipe in the base of the shallow tank diverted the captured liquids to a nearby buried 200 L drum, which was periodically pumped out and the contaminated fluid disposed of by a licensed disposal contractor. The drum enabled prevention of overflow from the capture tank to the underlying soil in the event of rainfall filling the tank. This system ensured no spillage to ground, no residual soil contamination, and control of all contaminated fluids.

5.4 Refuelling proximate to watercourses and wetlands

The original versions of the Watercourse Crossing and Wetland Crossing Protocols in the CEMP prescribed a requirement for 200 m buffer zones around wetlands and watercourses in which refuelling was prohibited. Implementation of this requirement proved problematic in prohibiting refuelling of non self-propelled plant required to operate within or immediately adjacent to watercourses or wetlands. The main forms of non self-propelled plant utilised on the CROW are pumps, used for either dewatering or water supply. The need to limit pumping suction lifts on centrifugal pumps requires that they be placed as close as possible to the source water body. This invariably resulted in them needing to be within 200 m of the water body, and often within 50 m to ensure proximity to the water surface. Priming of pumps and maintaining the prime with intermittent pumping under these conditions was an additional issue. The two options to enable such a configuration to operate within the refuelling prohibition were:

1. Locate a fuel tank with the plant sufficiently large enough to eliminate the need to refuel during the course of operation of that plant at that location.
2. Remove the plant to a location outside the required buffer each time refuelling is required.

The increased risks in transporting and effectively storing large volumes of fuel within a watercourse indicated that the first option would be a less than desirable approach, unless substantial additional safeguards were put in place. The CEMP specifically prohibited storage of fuels, etc., within watercourses and their buffers.

Removing the plant for refuelling may not be possible when continual operation may be necessary (e.g., during dewatering), and transport of such plant in and out of their operating location carried additional spill risks which would be difficult to manage.

Approval to enable refuelling of non self-propelled plant within or adjacent to watercourses and wetlands was requested. To ensure that the risks of a fuel spill to ground while refuelling were adequately managed; substantial additional safeguards were proposed as follows:

1. Refuelling of non self-propelled plant proximate to or within wetlands or watercourses is to be carried out from a mobile tank no larger than 1000 L in capacity, towed to the location of the machines.
2. The refuelling crew will be one experienced fuel truck operator and one experienced off-sider as well as the operator of the individual machine if required.
3. The mobile tank unit may only be refilled in the field from bulk tanker within designated refuelling areas (and not within a 400 m or 50 m non-refuelling watercourse or wetland buffer applicable to self propelled plant).
4. The 1000 L mobile tank will travel between the designated refuelling locations and the non self-propelled plant within the field.
5. Refuelling procedures and safeguards otherwise apply as for designated refuelling areas.

Approval for this procedure was granted and the management protocols amended and implemented accordingly. No incidents of fuel spillage within any wetlands or watercourses were reported as having occurred under the amended procedure.

5.5 Environmental Improvement Plan

Early in the Stage 5A construction program, several potential non-compliances were identified by the auditing processes. In response, DBP prepared an Environmental Improvement Plan in 2007 for implementation by the construction contractor, intended to limit the potential for future occurrences. The plan identified the following key areas as requiring action to address the potential non–compliances and to improve overall environmental performance on the project:

1. Supervisor and staff awareness and training.
2. Trench management and fauna interactions to avoid future potential non–compliances.
3. Construction corridor management including:
    - restricted off–corridor access

- clearing restrictions
- soil stockpile management
- marking of environmental features
- vehicle hygiene.

4. Yard and campsite management (housekeeping and waste management).
5. Fuel, oil and hazardous chemical spill management.
6. Timely reporting and responses:
   - timely reporting of incidents and development of incident responses
   - timely implementation of incident responses and preventative measures
   - timely close–out of internal and external audit reports and associated issues
   - timely response to requests for information.

WestNet Energy implemented the EIP, which focused on three separate aspects as outlined in Table 5-1.

Table 5-1: Environmental Improvement Plan management approach

Aspect	Timing	Management Approach
Resources	Short–term applied immediately	Increasing WestNet Energy (WNE) on–site presence of environmental team. Raise priority of following issues in joint internal audit programs. Develop day–to–day links between on–site WNE environmental team, Health, Safety and Environment (HSE) team and Construction Manager and develop skills of HSE team in environmental matters. Train personnel to ensure that HSE tools e.g. JHA are used to consider environmental aspects of a job. Increasing involvement of on–site WNE HSE team in oversight/inspection of Right–of–Way (RoW) activities to detect potential and existing non–compliances/non–conformances. Increasing Head Office resources to monitor reporting and response actions on significant environmental issues not able to be immediately addressed on–site.
Communication	Short–term applied immediately or within weeks of implementation of the EIP.	Communicate shared values to all staff and project contractors through various means: staff meetings, pre–start briefings, toolbox meetings, etc. Develop communication system from the field and office environmental team through to the Owner's Representative to enable rapid high–level response to any incidents or potential issues. Daily interaction between on–site WNE and Contractor environmental teams and WNE Construction Manager to review potential for trench clearing issues on following day. Develop Environmental Issue Register to track all environmental issues raised at an off–site level to satisfactory close–out. Develop agreement between Owner's Representative and Contractor on process for addressing significant environmental issues, including close–out times. Status of all outstanding Environmental Register Issues to be an agenda item on weekly joint WNE/Contractor project meetings. Increasing Head Office environmental resources to monitor reporting and response actions on significant environmental issues not able to be immediately addressed on–site. Include environmental considerations as part of management team's site inspections.

Aspect	Timing	Management Approach
Culture	Long–term commitments to both development and implementation, and may take up to several years to fully implement.	Develop simple set of shared values (superordinate goals) for environmental aspects of all WNE activities. Develop an ongoing staff communication program to ensure shared values are understood, accepted and adopted by all WNE staff and major contractors. Review contractual arrangements relating to environmental management responsibilities to improve contractual leverage on good environmental management performance. Review the corporate Health, Safety and Environment Policy to clarify the relevant priority and profile of environmental performance with safety performance. Develop project induction packages to provide equal emphasis to environmental matters as to safety matters. Review the corporate Health, Safety and Environment Policy to clarify the relevant priority and profile of environmental performance with safety performance. Introduce a program to recognise good environmental behaviour. Ensure the mandate of HSE committees includes a focus on E to the same level as H & S. Ensure all future induction packages emphasise environmental performance on a par with safety performance.

The plan was implemented during the remaining construction work, with a consequent improvement in overall environmental performance.

5.6 Environmental audit outcomes

As outlined in the various end-of-loop compliance audit reports (Appendix 2 [Stage 5A] and Appendix 3 [Stage 5B]), where potential non-compliances and/or potential non-conformances were identified, specific responses were developed to limit the opportunity for repeat occurrences of future works These are detailed in the relevant audit reports and for brevity, are not repeated here. There was no evidence that any measurable or identifiable environmental harm resulted from any of the potential non-compliances or potential non-conformances.

The 2009 Annual Compliance Report (Strategen 2010) contained numerous instances of compliance with Ministerial conditions being unable to be assessed, as no verifiable evidence was available to support the audit. A key contribution to this outcome was the lack of understanding on the part of construction contractors to ensure the required evidence was collected. In response to this, DBP developed a specific list of audit evidence requirements to be met by construction contractors during further stages of construction. This evidence list was utilised during the Fortescue River crossing work undertaken during 2011, with the result that the number of ‘unable to be assessed’ findings was reduced from about 40 (as reported in the 2009 Annual Compliance Report) to two for the audit of the Fortescue River crossing (Strategen 2012).

6. Stakeholder and community consultation about environmental performance

Prior to implementation of the proposal, there was substantial stakeholder and community consultation about a range of aspects of the proposal, as was necessary to support an Assessment on Referral Information level of assessment. The key agencies were closely involved in consultation on preparation of the relevant management protocols forming the CEMP. There was also substantial consultation with landholders whose properties were traversed by the DBNGP and whose use of the land might be affected by the construction work. In these cases, individual landholder agreements were established, which considered a range of concerns, including use of the land, reinstatement and rehabilitation. The requirements of all landholder agreements were required to have been met prior to agreement with the contractor(s) regarding completion of the works having been achieved.

Other than several field inspections by Department of Environment and Conservation staff and audits by Department of Mines and Petroleum as described in Section 4, no specific stakeholder consultation was carried out with respect to environmental performance following the obtaining of approvals to implement the proposal. The environmental incident logs recorded no public complaints regarding any environmental aspects of the work. It is understood that there are no ongoing stakeholder concerns regarding environmental performance.

7. Proposed environmental objectives over the next five years

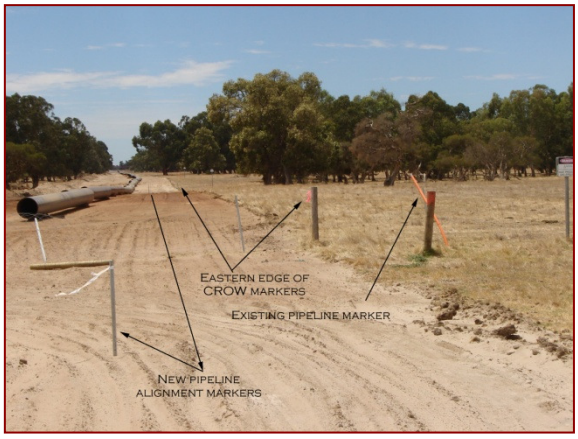
The review would propose that the current environmental objectives continue, and that literature relating to any available improvements in technology will be scanned and applied as appropriate. At the time of writing, there were no specific plans for further looping construction work, as the requirements for this are contingent upon additional gas demand contracts being put in place. However, about 259 km of the Stage 5 Looping Expansion Project remains incomplete, and it can be expected that this work will be implemented at some time in the foreseeable future.

In the meantime, DBP will continue to work on rehabilitation of construction areas to ensure achievement of the rehabilitation completion criteria set out in Table 3-22 (Section 3.7.2). In addition, DBP will be installing a GIS/GPS-based vehicle management system that will include all environmentally sensitive locations within the pipeline easement. An alarm will be activated on vehicle entry to any sensitive areas, with advice on what actions are required to be taken with respect to environmental management, such as vehicle hygiene. This system is expected to be in place prior to any future construction work, and will provide a permanent replacement for the previous temporary signposting system, that would also be relevant during the operational phase.

8. Plates

This section contains a series of sample photographs depicting typical management measures in place to achieve the designated environmental objectives for the relevant factors.

Plate 1: Delineation of CROW and facilities



CROW marking with marking of existing pipeline and alignment of Stage 5 duplication

Typical CROW edge demarcation peg

CROW edge demarcation with pegs and bunting

CROW edge demarcation peg

Turnaround bay demarcation netting

Vegetation storage area and limit demarcation peg (extreme right)

Plate 2: Support facilities located in previously cleared areas

Camp located in cleared farmland

Turkey nest dam located in cleared farmland

Turkey nest dam located in cleared farmland

Pipe laydown area located in cleared farmland

Turkey nest dam site on previously cleared farmland prior to installation

Material storage area in construction yard in cleared farmland

Plate 3: Marking of trees to be retained

Flagged potential habitat tree adjacent to CROW (denoted by yellow and black tape)

Flagged potential habitat tree adjacent to CROW (denoted by yellow and black tape)

Marked potential habitat tree adjacent to CROW (marked with "h" or "H")

Flagged potential habitat tree adjacent to CROW (denoted by yellow and black tape)

Flagged potential habitat tree in small watercourse adjacent to CROW (denoted by yellow paint)

Flagged potential habitat tree in small watercourse adjacent to CROW (denoted by yellow tape)

Plate 4: Employment of 'three cut method' for branch pruning

Typical tree pruning using three-cut method

Typical tree pruning using three-cut method

Typical tree pruning using three-cut method

Typical tree pruning using three-cut method

Typical tree pruning using three-cut method

Typical tree pruning using three-cut method

Plate 5: Vegetation stockpiles adjacent to CROW

Vegetation stockpile adjacent to CROW source area, separate from topsoil stockpile

Vegetation stockpile adjacent to CROW source area, separate from topsoil stockpile

Vegetation stockpile adjacent to CROW source area

Vegetation stockpile adjacent to CROW source area

Vegetation stockpile adjacent to CROW source area, separate from topsoil stockpile

Vegetation stockpile adjacent to CROW source area, separate from topsoil stockpile

Plate 6: Soil stockpiles adjacent to CROW

Topsoil stockpile adjacent to CROW source area (on left), separate from trench spoil stockpile (centre)

Topsoil stockpile adjacent to CROW source area

Topsoil stockpile adjacent to CROW source area

Topsoil stockpile adjacent to CROW source area

Topsoil stockpile adjacent to CROW source area, separate from vegetation stockpile

Topsoil stockpile adjacent to CROW source area with drainage slot to prevent water ponding

Plate 7: Vegetation respreading for rehabilitation

Spinifex respread on CROW

Vegetation respread on CROW

Vegetation respread on CROW

Vegetation respread on CROW

Vegetation respread on CROW

Vegetation respread on CROW

Plate 8: Avoidance of trees proximate to the CROW

Retained tree within CROW

Retained tree overhanging CROW

Retained tree within CROW

Retained tree within CROW

Flagging of habitat tree adjacent to CROW for retention

Retained habitat tree on edge of CROW

Plate 9: Reduced CROW widths in areas of environmental sensitivity

Reduced CROW width associated with wetland vegetation

Reduced CROW width associated with wetland vegetation

Reduced CROW width associated with TEC (Gingin Ironstone area)

Reduced CROW width associated with entry to wetland area

Reduced CROW width associated with entry to Bush Forever site

Reduced CROW width associated with entry to DRF area

Plate 10: Conservation significant flora

Survey of Declared Rare Flora: *Synaphea stenoloba*

Declared Rare Flora: *Synaphea stenoloba*

Fencing and demarcation of area of Declared Rare Flora

Fencing and demarcation of area of Declared Rare Flora

Retained TEC (*Kingia Australis*) adjacent to CROW

Retained TEC (*Kingia Australis*) adjacent to CROW

Plate 11: Fauna management techniques (other than in trenches)

End caps on welded pipe to prevent fauna entry and entrapment

Lidded waste bins in camp to prevent fauna entry

Fenced turkey nest dam

Speed limit sign on CROW

Floating fauna refuge in wet trench

Floating fauna refuge (close-up)

Plate 12: Fauna management methodologies (trenches)

Fauna clearing team removing entrapped fauna from trench

Snake jigger and hoop bag for fauna retrieval

Fauna exit ramps at 45° slope to trench plug

Hessian fauna refuge at base of trench

Fauna exit ramp and trench plug

Fauna exit ramp and trench plug

Plate 13: Watercourse crossing erosion and sediment controls

Watercourse crossing flumes to maintain downstream flow regime

Watercourse crossing flume to maintain downstream flow regime with erosion prevention blanket

Watercourse crossing flume with high flow sediment traps

Watercourse crossing flume to maintain downstream flow regime with erosion prevention blanket

Watercourse crossing sediment trap

Watercourse crossing flume with sediment trap

Plate 14: Watercourse crossing riparian vegetation marking and retention

Bunting demarcation of riparian vegetation area to be protected

Bunting demarcation of riparian vegetation area to be protected

Bunting demarcation of riparian vegetation area to be protected

Bunting demarcation of riparian vegetation area to be protected

Riparian vegetation marked for retention (denoted by yellow and black tape)

Riparian vegetation marked for retention (denoted by yellow tape)

Plate 15: No refuelling zones associated with wetlands and watercourse crossings

No refuelling signage adjacent to watercourse crossing

No refuelling signage adjacent to watercourse crossing

No refuelling signage adjacent to wetland crossing

No refuelling signage adjacent to wetland crossing

No refuelling signage adjacent to wetland crossing

No refuelling signage adjacent to watercourse crossing

Plate 16: Watercourse crossing soil and vegetation stockpiling

Riparian vegetation stockpiling and delineation of area

Watercourse soil stockpile located outside area of riparian vegetation

Watercourse soil stockpile located outside area of riparian vegetation

Watercourse soil stockpile located outside area of riparian vegetation

Plate 17: Horizontal directional drilling under watercourses

Horizontal directional drilling entry point at Murray River, approximately 200 m from river bank (in background)

Horizontal directional drilling entry point at Murray River looking away from river

Horizontal directional drilling exit point at Caren Caren Brook looking across watercourse

Horizontal drilling location at Caren Caren Brook looking across watercourse

Plate 18: Watercourse bank stabilisation

Sand and cement filled sandbags used for watercourse bank stabilisation, fenced to prevent stock damage

Sand and cement filled sandbags used for watercourse bank stabilisation, fenced to prevent stock damage

Rock armouring with mesh anchoring for watercourse bank stabilisation on long steep bank (Wooramel River)

Sand and cement filled sandbags used for watercourse bank stabilisation, fenced to prevent stock damage

Sand and cement filled sandbags bank stabilisation under construction with temporary silt fence

Sand and cement filled sandbags bank stabilisation under construction with temporary silt fence

Plate 19: Dieback and weed hygiene

Plant washdown prior to transfer to site

Green sticker denoting vehicle has been washed down

Limestone hardstand at property boundary to prevent affected soil transfer through adherence to vehicles

Vehicle washdown hygiene facility at entry to Bush Forever site

Clean-on-entry hygiene facility at entry to conservation area

Clean-on-entry hygiene facility at exit from dieback infested area

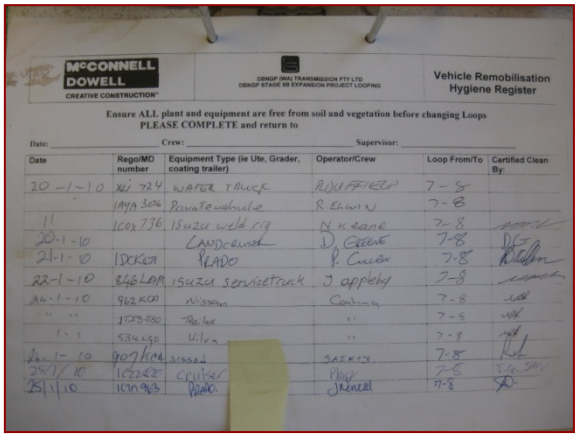
Plate 20: Weed seed removal locations and facilities

Clean-on-entry hygiene facility for removal of weed seeds from footwear (note jar for seed collection)

Clean-on-entry hygiene facility for removal of bindii seeds from footwear

Clean-on-entry hygiene facility for removal of bindii seeds from vehicles

Clean-on-entry hygiene facility for removal of bindii seeds from vehicles



Typical clean-on-entry hygiene facility log

Signposted weed infested vegetation stockpile

Signage designating weed infested area

Signage instructing where vegetation to be re-spread during rehabilitation

Plate 21: Acid sulphate soils management areas and treatment

Neutralising agent (aglime) laid on pipeline alignment prior to trench excavation

Automated pH correction plant for dewatering effluent from acid sulphate soil area prior to disposal

Neutralising agent (aglime) laid on pipeline alignment prior to trench excavation

Neutralising agent (aglime) stockpile and dosing laid on pipeline alignment prior to trench excavation

Neutralising agent (aglime) laid on pipeline alignment prior to trench excavation

Acid sulphate soils area demarcation signage

Plate 22: Rehabilitated areas

Small stones respread across rehabilitated CROW

Small stones respread across rehabilitated CROW

Erosion protection berm across rehabilitated CROW

Erosion protection berm across rehabilitated CROW

Rehabilitated campsite, with respread spinifex (clumped to provide habitat) on ripped ground

Respread spinifex in truck turnaround bay (clumped to provide habitat)

Plate 23: Topsoil windrows retained after backfilling, prior to respreading

Topsoil stockpile retained after backfilling, prior to respreading

Topsoil stockpile retained after backfilling, prior to respreading

Topsoil stockpile retained after backfilling, prior to respreading

Topsoil stockpile retained after backfilling, prior to respreading

Plate 24: Waste management techniques

Covered waste skips

Package wastewater treatment at camp sites

Ablution blocks at camp sites

Non-hazardous waste storage areas with signage and fencing to separate waste types

Lidded waste storage bin (marked as paper and cardboard only – for recycling)

Medical waste bins and signage

Plate 25: Pollution prevention techniques

Hazardous material storage container and signage

Spill cleanup kit on rear of fuel truck

Bunded storage of oils in fenced and signposted areas

Pollution control station with spill kits for package wastewater treatment plant

Refuelling grate, spill kits and fire control measures at bulk refuelling station

Bunded generator set fuel tank and spill kit

Plate 26: Miscellaneous environmental management techniques

Disposal of water dewatering discharge onto paddock through hay bales and sediment trap

Fire extinguisher on fuel truck

Dewatering discharge sediment trap

Fire-fighting equipment on welding truck

Sediment trap for surface drainage discharges from campsite area

Fast attack fire control trailer available with welding activities

Plate 27: Bulk fuel refuelling spill control

Fuel spill capture tank and grate beneath filling point (note captured liquid below grate)

Fuel spill capture tank and grate at bulk refuelling station (note fuel spill staining)

Fuel spill capture tank and grate at bulk refuelling station

Fuel spill capture tank and grate at bulk refuelling station

Multiple fuel spill capture tanks and grate at bulk refuelling station

Drain hole in base of fuel spill capture tank leading to 200 L recovery drum

9. References

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