Damper-Bunbury Natural Gas Pipeline Stage 5 Expansion

Environmental Impact Assessment

Prepared for
Alinta Asset Management
by Strategen

September 2006

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Environmental Impact Assessment

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Client: Alinta Asset Management

Report	Version	Prepared by	Reviewed by	Submitted to Client	
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DAMPER-BUNBURY NATURAL GAS PIPELINE STAGE 5 EXPANSION

ENVIRONMENTAL IMPACT ASSESSMENT

EXECUTIVE SUMMARY

INTRODUCTION, THE PROPOSAL AND ENVIRONMENTAL FACTORS

INTRODUCTION

The Dampier to Bunbury Natural Gas Pipeline (DBNGP) extends almost 1600 km from the Pilbara region to the South-West of Western Australia (WA). It is one of the longest and largest capacity natural gas pipelines in Australia supplying natural gas to industrial, commercial and residential customers in Perth and major regional centres along the pipeline route.

Background

DBNGP (WA) Nominees Pty Limited is proposing to construct a number of loops adjacent (and connected) to the existing underground gas transmission pipeline within the pre-existing DBNGP corridor to will raise the capacity of the system from 627 TJ/d (post Stage 4 capacity) to approximately 937 TJ/d. The proposed Stage 5 comprises a total length of approximately 1270 km. The loops will generally be constructed within a previously cleared corridor associated with the construction of the original DBNGP. The corridor is typically covered by pasture or 24 year-old regrowth native vegetation.

The proponent

The proponent is Dampier Bunbury Pipeline (DBP). DBP is the trading name of DBNGP (WA) Nominees Pty Limited - the group of companies ultimately owned by the consortium that purchased the Dampier to Bunbury Natural Gas Pipeline in October 2004.

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Alinta Asset Management (Alinta) has been contracted by the Proponent to conduct the construction, operation and maintenance of the DBNGP.

This report provides information to support the environmental referral by assessing the key environmental issues associated with the project and outlining the environmental management measures that will be utilised to minimise any impacts on the environment.

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

PROPOSAL DESCRIPTION

The DBNGP traverses the State from Dampier in the North-West to Wagerup in the South-West, passing through the pastoral (Loops 0 to 6 inclusive), agricultural (Loops 7 and 8) and Swan Coastal Plain (Loops 9 and 10) regions of the State (Map 1). At the landscape scale, the DBNGP traverses six biogeographical regions: Pilbara, Carnarvon, Gascoyne, Yalgoo, Geraldton Sandplains and Swan Coastal Plain. The Stage 5 loops vary between 61.5 km (Loop 10) and 142.4 km (Loop 7) in length, with a total of 1270 km of pipeline to be constructed.

The looping pipeline sections will be constructed adjacent to the existing DBNGP within the existing corridor established in the early 1980s and gazetted under the *Dampier to Bunbury Pipeline Act 1997* prior to the privatisation of the pipeline. DBP is the owner of the existing DBNGP. In some sections, the construction activity will extend outside of the existing corridor (e.g. for vehicle turnarounds, campsites). Access to these locations will be negotiated directly with the individual landowners. The tenure in these sections is typically Crown Leases and freehold land for agricultural purposes.

The key characteristics of the project are shown in the table below.

Key characteristics of the Stage 5 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 south-east 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.	Approximate length	Biogeographical region	Shire
	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*.			

Aspect	Proposal
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. Reduced working widths will be implemented as far as practicable in areas of conservation value.
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 January 2007 (Chapter 1, Section 2.5). 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

Key: km kilometre
m meter
mm millimetre
ha hectare
DBNGP Dampier to Bunbury Natural Gas Pipeline
***** Turkey nests are artificially created water storages constructed by hollowing out an area of land and using the fill to build up its sides.

For pipeline construction works in the northern loops (from the Dampier Loop to Muchea), construction will typically be carried out within a 30 m wide construction corridor using a production line approach. A reduced corridor width will be implemented, where practicable, in areas of conservation value. In the area south of Muchea, a 20 to 30 m construction corridor will be utilised with a slightly reduced corridor width in areas of conservation value, where practicable.

Scheduling

The Stage 5 Expansion will be constructed in stages, with Stage 5A commencing in January 2007. Subsequent stages will be constructed to match the increasing demand in fuel gas, and are expected to be substantially completed within five years. The scope and timing of each stage to provide the progressive upgrade of the pipeline system in looping length will be matched to the incremental increasing gas flow requirements. Precise scheduling and definition of the individual stages proposed to be constructed subsequent to Stage 5A have not been finalised at this time.

RELEVANT ENVIRONMENTAL FACTORS

Scoping of relevant factors

The scoping process for the Stage 5 Expansion involved preliminary identification of proposal aspects and associated key environmental issues and factors. The scoping process utilised Environmental Protection Authority (EPA) guidelines and stakeholder consultation to confirm factors and those key aspects that affect environmental factors. A preliminary assessment of the environmental aspects and associated environmental factors relating to the proposal is shown in the following table.

Environmental aspects of the proposal

Relevant factor	Proposal aspect	Potential impacts	Further assessment
Biophysical			
Vegetation and flora	Clear and grade	Loss of vegetation communities Weed infestation and disease spread Wildfire Damage by dust emissions	Key factor for all loops.
	Construction vehicular movement	Weed infestation and disease spread Damage by dust emissions Wildfire	
	Dewatering	Disturbance to groundwater dependent vegetation from drawdown and acid formation	
Wetlands	Clear and grade	Disturbance to wetland	Key factor for Loops 8 to 10.
	Dewatering	Loss of wetland attributes due to drawdown and acid formation	
	Fuel and chemical storage, handling and spills	Contamination of wetland	
Fauna	Clear and grade operations	Removal of habitat	Key factor for all loops.
	Dewatering	Alteration of habitat from drawdown	
	Trenching	Fatalities of trapped fauna	
	Construction vehicular movement	Road kills Wildfire	
	Noise emissions	Disturbance to nearby fauna	
Conservation areas	Clear and grade	Disturbance to conservation areas Weed infestation and disease spread	Key factor for all loops.
	Fuel and chemical storage, handling and spills	Contamination	
Soils and terrain	Clear and grade	Erosion (wind and rain) and sedimentation	Key factor for all loops.
	Construction vehicular movement	Soil compaction	
	Trenching and backfilling	Soil inversion	
	Dewatering	Soil contamination from acid formation	
	Fuel and chemical storage, handling and spills	Soil contamination	
	Test water disposal and waste generation	Soil contamination	
Groundwater	Dewatering	Water contamination from acid formation Altered groundwater regime	Key factor for Loops 8 - 10.
	Fuel and chemical storage, handling and spills	Water contamination	
	Test water disposal	Water contamination	
Water courses	River and stream crossings	Disturbance to river and stream channels and banks	Key factor for all loops.
	Clear and grade	Increased sediment load or turbidity	
	Dewatering	Migration of acid formation	
	Fuel and chemical storage, handling and spills	Water contamination	
	Test water disposal and waste generation	Water contamination	

Relevant factor	Proposal aspect	Potential impacts	Further assessment
Pollution management			
Noise and vibration	Noise emissions and vibration from construction equipment and blasting	Disturbance to amenity Property damage	Key factor for Loops 9 & 10. Minor factor for Loop 0 to 8
Air quality	Air emissions from vehicles	Negligible	Key factor for Loops 9 & 10. Minor factor for Loops 0 to 8
	Dust emissions from exposed surfaces and construction vehicular movement	Disturbance to amenity and property damage Damage to vegetation	
Social surrounds			
Heritage	Clear and grade	Disturbance to shallow artefacts and subsurface material Damage to significant natural features of ethnographic significance (trees, watercourses and landscape)	Key factor for all loops.
	Trenching	Disturbance to subsurface material	
Land usage and services	Construction access and vehicular movement	Temporary loss of land utilisation and property access Temporary disruption to stock movement and land management Loss of soil productivity Spread of weeds Wildfire Increased local road traffic Damage to infrastructure and property Disruption of services	Key factor for all loops.
	Site preparation	Temporary loss of land utilisation and property access Temporary disruption to stock movement and farm management Loss of soil productivity Spread of weeds Wildfire Damage to infrastructure and property Disruption of services	
	Backfilled trench	Loss of soil productivity Permanent restrictions on land usage	
Public safety and risk	Pipeline failure	Property damage Injuries or fatalities	Key factor for Loops 9 & 10 Minor factor for Loops 0 to 8

Key environmental factors addressed

Environmental factors requiring detailed assessment were identified through the scoping process. Other environmental factors not considered key relevant factors but requiring further consideration were also identified. Review of these factors has been arranged according to the three geographical regions the pipeline corridor traverses as follows:

1. Pastoral region (Loops 0 to 6)

Key environmental factors assessed:

- vegetation and flora
- fauna
- areas of conservation value
- soils and terrain
- water resources
- heritage
- land usage and services

Other environmental factors considered:

- noise and vibration
- air quality (dust)
- public safety and risk

2. Agricultural region (Loops 7 and 8)

Key environmental factors assessed:

- vegetation and flora
- fauna
- areas of conservation value
- soils and terrain
- water resources
- heritage
- land usage and services

Other environmental factors considered:

- noise and vibration
- air quality (dust)
- public safety and risk

3. Swan Coastal Plain region – (Loops 9 and 10)

Key environmental factors assessed:

- vegetation and flora
- fauna
- areas of conservation value
- wetlands
- water resources (other than wetlands)
- soils and terrain
- heritage
- land usage and services
- noise and vibration
- air quality (dust)
- public safety and risk

KEY STUDIES UNDERTAKEN

The following studies investigated key environmental factors:

- **Terrestrial vegetation and flora studies** to assess potential impacts on the conservation status of those species known or likely to occur along the pipeline corridor.
- **Terrestrial fauna studies** to assess the potential impacts on the conservation status of those species known or likely to occur along the pipeline corridor.
- **Acid sulphate soil and hydrogeologic studies** to predict the likelihood of encountering acid sulphate soils, shallow groundwater, wetlands and river systems along the Stage 5 Expansion loops and to develop an investigation strategy.
- **Aboriginal heritage studies** to investigate the presence and significance of Aboriginal heritage features along the pipeline corridor.

IMPACT MITIGATION

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

Under the *Petroleum Pipeline Act 1969*, the proponent is required to submit a Construction Environmental Management Plan (CEMP) for approval by DoIR prior to the commencement of construction. This plan will detail the prescriptive management measures considered necessary to mitigate the expected impacts of the proposal. The CEMP for the Stage 5 Expansion will contain the following information:

- assessment of environmental effects and risks
- environmental objectives and performance criteria
- management framework
- implementation strategy
- management, monitoring and contingency actions (see more detail below)
- auditing, review and reporting requirements.

The CEMP will describe activity specific environmental management measures, including monitoring and contingency actions, to be implemented during the pipeline construction process based on the following project activities:

- survey, fencing and service location
- clear and grade
- trenching and excavation
- drilling and boring
- pipe stringing and welding
- lowering-in and backfilling
- clean-up and rehabilitation
- testing and commissioning

The CEMP will also contain site/issue specific environmental management protocols. Measures described for each project activity will indicate when a particular site/issue specific protocol needs to be implemented. The Environmental Line List, being developed as part of the CEMP, will also indicate when and for what section of the pipeline corridor a site-specific protocol needs to be implemented. The following management protocols will be developed for the Stage 5 Expansion:

- Incident Response Protocol
- Conservation Area Management Protocol
- Vegetation Management Protocol
- Weed and Dieback Management Protocol
- Threatened Flora Management Protocol
- Wetland Management Protocol
- Dewatering 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 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

STAGE 5 EXPANSION ENVIRONMENTAL OBJECTIVES AND PERFORMANCE CRITERIA

The proponent has developed a number of environmental objectives for the Stage 5 Expansion (see Table below). These objectives have been developed to provide guidance for the management of environmental issues during the construction of the pipeline and will be incorporated into the CEMP.

Stage 5 Expansion environmental objectives and performance criteria

Issue	Objective	Performance Indicator
INCIDENT RESPONSE		
Environmental impact	To minimise and limit environmental impacts to the extent of the environmental approval.	Breaches of Ministerial Conditions.
Complaint	Investigate complaint and implement action to minimise future complaints.	Investigation completed. Remediation action undertaken. Complainant advised of outcomes.
Protocol	Protocols implemented to manage potential environmental impacts.	Protocol updated to minimise potential for future complaints.

Issue	Objective	Performance Indicator
CONSERVATION AREAS		
Disturbance to areas of conservation value	Minimise and manage disturbance to areas of conservation value.	No vegetation outside approved areas in areas of conservation value is cleared or destroyed. No vehicle or machinery movement outside of approved areas. Weeds and diseases managed consistent with the *Weed and Dieback Management Protocol*.
VEGETATION		
Weeds and diseases	Prevent the introduction and dispersal of weeds and pathogens and pest species.	The presence of weeds, pathogens and pest species on the construction corridor is consistent with or better than adjacent land.
Disturbance to vegetation	Minimise and manage disturbance to remnant vegetation Declared Rare Flora and Priority Flora populations.	All construction activities undertaken within the construction corridor. All areas of remnant vegetation (habitat) avoided outside the construction corridor, the width of the construction corridor reduced to prevent or minimise disturbance to the populations.
WEED AND DIEBACK		
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.	No new species of weeds or pests recorded in the pipeline corridor within one year of completion of construction activities.
Threat of spreading weeds, pests and diseases	To minimise the risk of spreading existing weeds, pests and dieback along the corridor and to adjacent areas.	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.
THREATENED FLORA		
Disturbance to Threatened Flora	To minimise the disturbance or clearing of Threatened Flora including Declared Rare Flora and Priority Flora species listed under the Wildlife Act.	No disturbance or clearing to Threatened Flora species other than that approved under license to take.
WETLANDS		
Disturbance to wetlands	To minimise and manage disturbance to wetlands and wetland buffer areas from construction activities.	No wetland dependent vegetation outside approved areas is cleared or destroyed.
Wetland water quality and water regimes	To prevent adverse changes to wetland water quality or hydrological regimes resulting from construction activities.	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.
DEWATERING AND WATER DISPOSAL		
Water Quantity	To ensure that dewatering activities do not extract excessive amounts of water that may be detrimental to the water resource.	No drawdown of the aquifer beyond the immediate proximity of the construction works from dewatering activities.
Water Quality	To ensure that dewatering activities do not degrade the beneficial use of the aquifer or compromise the ecological value of nearby surface receptors.	No long-term detrimental impact to the aquifer compared to pre-construction background water quality from dewatering activities. Groundwater returned to the aquifer will meet or exceed pre-construction groundwater quality components. No greater than a 10% variation of water quality in nearby ecological receptors from dewatering activities.

Issue	Objective	Performance Indicator
ACID SULPHATE SOIL		
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.	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.
FAUNA INTERACTION		
Fauna habitat	To minimise the temporary and permanent reduction or fragmentation of existing 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	To minimise the direct impacts on fauna through impacts with vehicles, entrapment in construction works, or extraordinary exposure to predators.	Vehicle speeds limited on unformed access tracks and construction worksite. Achievement of fauna inspection and clearing requirements. Adherence to injured animal protocol.
WATERCOURSE CROSSING		
Disturbance to watercourses	Minimise and manage disturbance of 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 construction corridor.
Contamination of watercourses	Prevent contamination of watercourses from construction activities.	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.
FIRE		
Prevent fires	To prevent fires occurring as a result of construction activities.	No pipeline construction related fires.
DUST		
Landholders	To minimise the temporary impact of dust emissions from construction activities, machinery and vehicles.	Few reasonable substantiated complaints. Accordance with relevant policies. Acceptable ambient dust levels down-wind of the construction site.
Vegetation	To minimise the impact of dust on surrounding vegetation so long-term existence is ensured.	Health of vegetation adjacent to the construction corridor remains the same post-construction as it was pre-construction.
NOISE		
Public/residents	To minimise the impact of noise and vibration emissions from construction activities, machinery and vehicles.	No reasonable landholder complaints. Compliance with Noise Regulations.

Issue	Objective	Performance Indicator
FUEL AND CHEMICAL STORAGE, SPILL AND EMERGENCY RESPONSE		
Contamination	Prevent contamination of groundwater, surface water and soil.	Chemicals and fuels stored and handled within designated areas. No significant spills or leaks of hydrocarbons (in excess of 80 litres near wetlands and rivers) during construction and rehabilitation operations outside of areas designated for maintenance, refuelling or storage. No significant spills or leaks of hydrocarbons (in excess of 500 litres) during construction and rehabilitation operations outside of areas designated for maintenance, refuelling or storage. No spills or measurable leaks of hydrocarbons within any Water Reserve.
WASTE		
Waste management	Minimise generation of waste during construction.	Minimise waste generation.
	Minimise pollution or environmental harm due to inappropriate disposal of waste.	No uncontained waste, rubbish or litter is found within construction corridor or at facilities during construction. No waste found within construction corridor or at facilities immediately following construction. A waste register is maintained during construction indicating waste categories, approximate volumes of waste, and location of disposal. Waste material is contained and disposed of in accordance with EP Act.
SOIL		
Topsoil	Minimise change to soil profile from excavation activities.	No evidence of subsoil on surface (as detected by colour and texture) within construction corridor following backfill. No visual evidence of soil compaction following backfill and rehabilitation (e.g. hard soil, local water pooling).
Erosion	Prevent occurrence of soil erosion during and following construction.	The extent of soil erosion within the construction corridor during and within two years following construction is consistent with surrounding land. No visible soil erosion from construction corridor during or within three years following construction.
ABORIGINAL SITES		
Known (recorded) Aboriginal heritage sites	To avoid disturbance to Aboriginal heritage sites identified for protection near the pipeline corridor.	No disturbance to Aboriginal heritage sites identified for protection.
New (unrecorded) Aboriginal heritage sites	To manage new Aboriginal heritage sites/artefacts uncovered or identified during construction in accordance with the requirements of the Aboriginal Heritage Act 1972.	All new Aboriginal heritage sites managed in accordance with the *Aboriginal Heritage Act 1972*.
REHABILITATION		
Vegetation	To re-establish vegetation and associated habitat areas to the condition that it was in prior to disturbance or better.	Achievement of the completion criteria set out in the *Rehabilitation Protocol.*
Soil	To control sediment and erosion.	Achievement of the completion criteria set out in the *Rehabilitation Protocol.*

ENVIRONMENTAL OUTCOMES

The following environmental outcomes are expected as a consequence of the proposed management measures.

VEGETATION AND FLORA

Around 2360 ha of disturbance is required within the pipeline corridor. As not all the corridor is vegetated, vegetation clearing requirements will be less than this and, on the basis of current estimates of already cleared areas, will be less than 1200 ha. A further 140 ha of disturbance is required outside the corridor for the establishment of infrastructure. This disturbance may require the clearing of Priority Flora, however, such species will be avoided wherever practicable and all areas disturbed will be promptly rehabilitated.

It is likely that any DRF and Priority Flora occurring within the pipeline corridor will be cleared, however efforts will be made to avoid or translocate species where practicable. Surrounding vegetation values could potentially be affected by the introduction of weeds, dust emissions, fire or altered water regimes, however the mitigation measures that will be implemented should ensure no long-term effects. Dieback is a potential issue in Loops 8 to 10 and hygiene measures will be implemented to reduce the risk of its introduction and/or spread into unaffected areas. It is expected that the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels will be maintained through the avoidance or management of adverse impacts, in accordance with the EPA objective.

Clearing will be minimised within all Bush Forever sites.

Vegetation clearing will be temporary, as the working width and all other disturbed areas will be rehabilitated as soon as practicable following construction. Infrastructure outside the pipeline corridor will be located on existing cleared or disturbed areas and will avoid any known populations of significant vegetation and flora as far as practicable. There is an increased risk of the spread of weeds, however this will be mitigated through weed control and hygiene procedures. There may also be a minor long-term reduction in species diversity, including trees and other deep-rooted species immediately over and adjacent to the pipeline trench. However, consistent with EPA objectives, the abundance, species diversity, geographic distribution and productivity of flora at species and ecosystem levels are expected to be maintained thereby conserving regional biological diversity.

FAUNA

As a result of disturbance during construction, there will be a short-term effect on the local abundance of fauna populations due to interruption to fauna behaviour, injury or death. Potential effects on fauna will be minimised through the implementation of the CEMP which will include specific measures for interactions with fauna. Given the relatively small area affected at any one time and the proposed rehabilitation, the long-term effects of the pipeline on the fauna values in the pastoral region are expected to be minimal. Consistent with EPA objectives, the abundance, species diversity, geographic distribution and productivity of fauna at species and ecosystem level are expected to be maintained conserving regional biological diversity.

AREAS OF CONSERVATION VALUE

There are a number of areas of conservation value that will be affected by the Stage 5 Expansion pipeline construction. All areas of disturbance will be rehabilitated and there is not expected to be any long-term consequences to the conservation values of these areas, ensuring the EPA objective for this factor will be met.

SOILS AND TERRAIN

Construction of the Stage 5 Expansion pipeline may lead to erosion and sedimentation, soil compaction and inversion, and contamination of soil resources, which can lead to on and off-site impacts and can limit the effectiveness of rehabilitation efforts. The implementation of the proposed mitigation measures will minimise the risk of impacts to soil and terrain occurring and will ensure the EPA objective for this factor is met.

WATER RESOURCES

Numerous watercourse crossings will be constructed within the Stage 5 Expansion using either open-cut or horizontal directional drilling techniques depending on site conditions. River beds, banks and riparian vegetation will be directly disturbed, which may result in temporary alteration to surface water flow and quality. The bed and banks will be appropriately stabilised and banks rehabilitated as soon as practicable following construction to minimise erosion risk. Mitigation measures will ensure potential sources of water contamination will be appropriately managed to reduce contamination risks. Should groundwater drawdown from dewatering occur, it is expected to be short in duration and is not anticipated to significantly affect the health of any groundwater dependent vegetation. Given the proposed management measures, impacts to watercourses will not be significant or long-term, therefore the EPA objective for this factor will be met.

HERITAGE

Construction of the Stage 5 Expansion will require the disturbance of Aboriginal heritage sites within the pipeline corridor and will not affect any known European heritage sites. Where these sites are covered by existing Section 18 consents, they will be managed in accordance with the consent conditions. Where these sites are not covered by existing Section 18 consents, they will be further researched and appropriate heritage management procedures developed and implemented. The proponent will avoid disturbance to sites outside the corridor identified for protection, and will minimise disturbance to landscape and environmental features that may be of heritage significance but not recognised as ‘sites’. The proponent will continue to consult with relevant Aboriginal groups and will ensure that, consistent with the EPA objective for this factor, Aboriginal heritage sites are managed in accordance with the Aboriginal Heritage Act.

LAND USAGE AND SERVICES

The Stage 5 Expansion is expected to cause minimal disruption to landowners and other third-party infrastructure in the pastoral and agricultural regions. This is because the duration of prohibition of public access to the pipeline corridor will be relatively short, land users will be able to resume previous land use activities on top of the pipeline (post construction and rehabilitation) except excavation activities, and infrastructure will be reinstated and landscaped following construction.

The proposal is expected to cause localised, temporary disruption to landowners and other third-party infrastructure along Loops 9 and 10. Construction activities may cause some traffic congestion problems in the Perth metropolitan area, however, this will be localised and of short duration.

NOISE AND VIBRATION

The Stage 5 Expansion will result in a temporary increase in noise emissions above ambient levels. However, given the remote nature and short duration of construction of the Stage 5 Expansion, it is anticipated that noise and vibration from construction activities will not have a significant impact on any noise sensitive premises or fauna values within the pastoral and agricultural regions.

Noise impacts within the southern loops in more dense residential areas will be short in duration and managed so that construction is in accordance with the Noise Regulations. Vibration is expected to be insignificant, resulting from ground compaction only. Therefore, in accordance with the EPA objective, there will be no long-term effect on the amenity of nearby residents from noise and vibration.

AIR QUALITY (DUST)

Significant long-term dust impacts are expected to be negligible given the low population density and small number of dust sensitive premises along Loops 0 to 8, the short-term and temporary nature of the construction work and the mitigation measures proposed. These measures will ensure dust emissions do not have any significant impact upon sensitive premises, vegetation or fauna in these areas.

Due to the high population density in the Perth metropolitan region (Loop 9), potential dust impacts are more likely to arise as a result of the proposal. Long-term dust impacts are expected to be negligible given the short-term and temporary nature of the construction work and the mitigation measures proposed by the proponent. These measures will ensure the EPA objective for this factor is met in that dust emissions do not have any significant impact upon sensitive premises, vegetation or fauna values.

PUBLIC SAFETY AND RISK

Pipelines are recognised as a safe and efficient means of transporting natural gas; however, there are risks to the public both during and after construction of the Stage 5 looping project. Proximity to public infrastructure, the requirement to transport equipment and machinery on public roads and post construction interference with the pipeline could potentially cause harm to the public. Construction, operation, maintenance and management of the pipeline will be undertaken in accordance with AS 2885 to ensure risks are minimised as far as practicable. The increase in traffic volumes will be temporary and within the current capacity of the public roads. Transportation of dangerous goods will be done in accordance with relevant legislation and standards. Through implementation of risk mitigation measures, potential risk to the public will be reduced as far as practicable to ensure the EPA objective for this factor is met.

There are few private residences near the Stage 5 Expansion pipeline alignment in the pastoral and agricultural regions, therefore reducing public safety risks associated with construction activities in these areas. Construction of the Stage 5 Expansion will result in an increase in general traffic volumes and freight movement (including some dangerous goods) on public transport routes in the project area. However, the increase in traffic volumes will be temporary and within the current capacity of the public roads. Transportation of dangerous goods will be done in accordance with relevant legislation and standards. Through implementation of risk mitigation measures, potential risk to the public will be reduced as far as practicable to ensure the EPA objective for this factor is met.

WETLANDS

Loops 9 and 10 of the Stage 5 Expansion traverse numerous wetlands, including wetlands of regional conservation significance, and are close to two Ramsar wetlands, Forrestdale Lake and the Peel-Harvey Estuary. Construction activities will directly disturb wetlands through the removal of fringing vegetation and may also temporarily alter surface and groundwater regimes and affect water quality.

Reduced working widths will be employed in wetlands of regional conservation significance and all disturbed areas will be promptly rehabilitated. Effects to water regimes and quality in wetland areas, should they occur, are expected to be of short duration and not result in any long-term affects. Dewatering of trenches will be avoided in wetland areas as far as practicable and no hydrotest water will be discharged to wetland areas.

The threatening processes identified for the Ramsar wetlands are not expected to be exacerbated by the construction of the pipeline. Given the proposed management measures and resilient nature of wetland systems, impacts to wetlands are not expected to be significant or long-term, therefore the EPA objective for this factor will be met.

STAKEHOLDER CONSULTATION

The proponent has undertaken a program to identify and consult stakeholders, including local residents and all landholders whose properties will be affected by the project, to inform them of the Stage 5 Expansion, the proposed schedule of construction works and the actions that will be undertaken to minimise potential impacts.

The proponent and its contractors will continue this consultation program to ensure stakeholders are kept informed on the project and to minimise disruption to the landowners affected by both pre-construction and construction activities. Many of the management actions, particularly those with the potential to affect neighbouring residences including measures relating to dust, noise and rehabilitation, require continued ongoing consultation with landowners.

As part of this consultation program, the proponent has also consulted and will continue to consult with a number of regulatory authorities, including:

- Department of Environment and Heritage (proposal has been formally referred as a “controlled action” under the *Environment Protection and Biodiversity Conservation Act 1999*)
- Department of Water (permits and licences required for river crossings and water supplies respectively under the *Rights in Water and Irrigation Act 1914*)
- Department of Environment and Conservation (development of protocols for activities regulated under the *Conservation and Land Management Act 1984* and the *Wildlife Conservation Act 1950)*
- Environmental Protection Authority Service Unit (proposal has been formally referred under the *Environment Protection Act 1986*)
- Department of Industry and Resources (approval of the Stage 5 Expansion CEMP under the pipeline licence issued under the *Petroleum Pipelines Act 1969*)
- Department of Planning and Infrastructure (land access)
- Department of Indigenous Affairs (*Aboriginal Heritage Act 1972*).

COMMITMENTS

The following environmental management commitments are made by the proponent for the proposed Stage 5 Expansion of the DBNGP.

Proponent environmental management commitments

No	Factors	Objective	Action	Timing	Advice From
1	All factors	To minimise environmental impacts and public risk during construction of the DBNGP Stage 5 Expansion.	Prepare a Construction Environmental Management Plan (CEMP) for the construction of the DBNGP Stage 5 Expansion that addresses the environmental management of the following issues: a) access and safety b) incident response c) conservation areas d) vegetation e) weed and dieback f) threatened flora g) wetlands h) dewatering and disposal of water i) acid sulphate soils j) fauna interactions k) watercourse crossings l) dune crossings m) fire n) dust o) noise p) fuel and chemical storage, spill and emergency response q) waste r) soil s) aboriginal heritage sites t) rehabilitation	Prior to ground disturbance	DoIR, DEC, DIA
2	All factors	To minimise environmental impacts and public risk during construction of the DBNGP Stage 5 Expansion.	Implement the CEMP prepared under Commitment 1.	During construction	DoIR, DEC, DIA
3	Acid sulphate soil	To ensure that there are no adverse impacts to sensitive receptors as a result of the excavation and stockpiling of acid sulphate soils	Undertake an acid sulphate soil field investigation to validate results from the acid sulphate soil and hydrogeological desktop study undertaken in June 2006. Manage acid sulphate soils in accordance with the CEMP.	Prior to ground disturbance within risk areas identified in the desktop study	DEC
4	Dieback	To minimise the introduction and/or spread of dieback along the corridor or to adjacent areas.	Undertake a dieback field survey of Loops 8 to 10 of the DBNGP Stage 5 Expansion, to identify and map low, medium and high dieback risk areas. Manage dieback areas in accordance with the CEMP.	Prior to ground disturbance in Loops 8 to 10	DEC

No	Factors	Objective	Action	Timing	Advice From
5	Threatened Flora	To minimise the disturbance or clearing of DRF and Priority Flora species listed under the *Wildlife Conservation Act 1950*.	Undertake a spring flora field survey of Loops 8 to 10 of the DBNGP Stage 5 Expansion, to identify and map the occurrence of DRF and Priority Flora. Manage DRF and Priority Flora in accordance with the CEMP.	Prior to ground disturbance in Loops 8 to 10	DEC
6	Aboriginal heritage	To comply with the *Aboriginal Heritage Act 1972*.	Undertake further research of Aboriginal heritage sites of the DBNGP Stage 5 Expansion that were identified in preliminary investigations in June 2006 as not being covered by existing *Aboriginal Heritage Act 1972* Section 18 consents. Based on research findings, develop and implement appropriate heritage management measures for these sites.	Prior to ground disturbance in each Loop	DIA

DAMPER-BUNBURY NATURAL GAS PIPELINE STAGE 5 EXPANSION

ENVIRONMENTAL IMPACT ASSESSMENT

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- Aboriginal heritage (AIC 2006).

Appendix 3 Wetlands of Loops 9 and 10 potentially affected by the Stage 5 Expansion

DAMPER-BUNBURY NATURAL GAS PIPELINE STAGE 5 EXPANSION

ENVIRONMENTAL IMPACT ASSESSMENT

Chapter 1 Introduction, the proposal and environmental factors

1 INTRODUCTION

The Dampier to Bunbury Natural Gas Pipeline (DBNGP) extends almost 1600 km from the Pilbara region to the South-West of Western Australia (WA). It is one of the longest and largest capacity natural gas pipelines in Australia supplying natural gas to industrial, commercial and residential customers in Perth and major regional centres along the pipeline route.

1.1 BACKGROUND

DBNGP (WA) Nominees Pty Limited is proposing to construct a number of loops adjacent (and connected) to the existing underground gas transmission pipeline within the pre-existing DBNGP corridor. There are eleven separate loops proposed from the Dampier natural gas facilities to Wagerup West (Main Line Valve 144). Each of the eleven loops will extend the loops being constructed under the Stage 4 expansion to result in complete duplication of the existing DBNGP pipeline from Dampier to Wagerup. Stage 5 will raise the capacity of the system from 627 TJ/d (post Stage 4 capacity) to approximately 937 TJ/d.

The proposed Stage 5 looping pipeline sections will be 660 mm (26") in diameter with a total length of approximately 1270 km.

The proposed pipeline sections will generally be constructed within a previously cleared corridor associated with the construction of the original DBNGP. The corridor is typically covered by pasture or 24 year-old regrowth native vegetation.

In 1981, the existing pipeline was constructed within a 30 m wide easement and is located approximately 6 m from the eastern boundary. Widening of the corridor occurred in 2001 to increase the easement to a width of 100 m, from Dampier to Bullsbrook. South of Bullsbrook the corridor remains 30 m wide. During future construction work, there will be a requirement to occasionally move out of the existing corridor to meet practical working conditions, e.g. truck turnarounds, campsites, excess spoil storage and materials and equipment storage. This 'construction corridor' will only be necessary during the construction period.

1.2 THE PROPONENT

The proponent is Dampier Bunbury Pipeline (DBP). DBP is the trading name of DBNGP (WA) Nominees Pty Limited - the group of companies ultimately owned by the consortium that purchased the Dampier to Bunbury Natural Gas Pipeline in October 2004. DBP is 60% owned by Diversified Utilities and Energy Trusts (DUET) with Alcoa and the proponent each owning 20%.

DBP performs corporate and regulatory services and a number of commercial and strategic functions in respect of the DBNGP, including business and asset management plan review, managing the financing arrangements for the company, negotiating and managing the shipping and system gas contractual relationships and managing business regulatory issues.

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Alinta Asset Management (Alinta) has been contracted by the Proponent to conduct the construction, operation and maintenance of the DBNGP. The proposal will effectively be implemented by Alinta, and in accordance with its corporate environmental policy (Appendix 1).

1.3 PURPOSE AND STRUCTURE OF THIS DOCUMENT

The purpose of this document is to provide information to support the environmental referral by assessing the key environmental issues associated with the project and outlining the environmental management measures that will be utilised to minimise any impacts on the environment. The document is divided into eight Chapters as follows:

- **Chapter 1:** Introduction, description of the proposal and identification of environmental factors.
- **Chapter 2:** Assessment and management of key environmental factors in the pastoral region (Loops 0 to 6 inclusive).
- **Chapter 3:** Assessment and management of key environmental factors in the agricultural region (Loops 7 and 8).
- **Chapter 4:** Assessment and management of key environmental factors in the Swan Coastal Plain region (Loops 9 and 10).
- **Chapter 5:** Impact mitigation for key environmental factors assessed.
- **Chapter 6:** Stakeholder consultation.
- **Chapter 7:** Conclusion and commitments.
- **Chapter 8:** References, abbreviations and construction corridor maps.

2 PROPOSAL DESCRIPTION

2.1 NEED FOR PROJECT

DBP has received requests from major industrial customers for approximately 375 TJ/day of new capacity for the period from late 2007 to 2009 to meet demand for gas for industrial growth in WA in the mining, manufacturing and domestic energy demand sectors. In order to meet this demand, the current Stage 4 expansion of the DBNGP will need to be followed by a Stage 5 Expansion that will increase the pipeline capacity by approximately 375 TJ/day of gas.

To meet this increasing demand DBP would need to construct approximately an additional 1270 km of new pipeline alongside the existing pipeline. Combined with the current Stage 4 expansion, the Stage 5 Expansion would effectively duplicate the entire length of the original DBNGP.

The Stage 5 Expansion will involve up to 900 construction jobs in activities including civil works, accommodation, catering, communications, transport, freight forwarding, warehousing and security. The local content is expected to be around 65-70% of the total project cost.

2.2 LOCATION

The DBNGP traverses the State from Dampier in the North-West to Wagerup in the South-West, passing through the pastoral (Loops 0 to 6 inclusive), agricultural (Loops 7 and 8) and Swan Coastal Plain (Loops 9 and 10) regions of the State (Figure 1.1). At the landscape scale, the DBNGP traverses six biogeographical regions[5]; Pilbara, Carnarvon, Gascoyne, Yalgoo, Geraldton Sandplains and Swan Coastal Plain (Figure 1.2). Detailed maps showing the landscape and significant environmental features along the pipeline route are depicted in a series of maps contained in Chapter 8, Section 3.

The Stage 5 loops vary between 61.5 km (Loop 10) and 142.4 km (Loop 7) in length (Table 1.1), with a total of 1270 km of pipeline to be constructed.

Stage 4 of the looping program for the DBNGP is currently nearing completion and Stage 5 will extend the loops from the southern ends of the Stage 4 loops (with the exception of Loop 0, which was not included in Stage 4).

[5] Around 80 biogeographical regions were first delineated across Australia in 1993-94 as part of the Interim Biogeographic Regionalisation for Australia (IBRA). IBRA was developed under the coordination of Environment Australia by the States and Territories to identify appropriate regions to assess and plan for the protection of biological diversity. Biogeographical regions, or IBRA regions, represent a landscape based approach to classifying the land surface and were delineated based on many variables including regional and continental scale data on climate, geomorphology, landform, lithology and characteristic flora and fauna (Environment Australia 2000).

Table 1.1 Loop location and length

Loop	Length (km)	Start		Finish	
		Longitude	Latitude	Longitude	Latitude
Dampier (Loop 0)	137.2	116.729450	-20.764171	116.076076	-21.274065
1	123.3	115.835981	-21.598429	115.260631	-22.446138
2	104.9	115.101676	-22.733181	115.113972	-23.574772
3	113.0	115.174306	-23.890139	115.296799	-24.817004
4	112.9	115.278964	-25.072856	115.244225	-25.792191
5	119.0	115.207055	-26.441847	115.190587	-26.441847
6	131.0	115.183050	-27.522753	115.133227	-28.618888
7	142.4	115.137399	-28.688793	115.316853	-29.622154
8	96.8	115.443301	-30.287908	115.769318	-31.092429
9	127.7	115.838740	-31.268694	116.019579	-32.669887
10	61.5	115.900806	-32.401526	115.823622	-32.905901

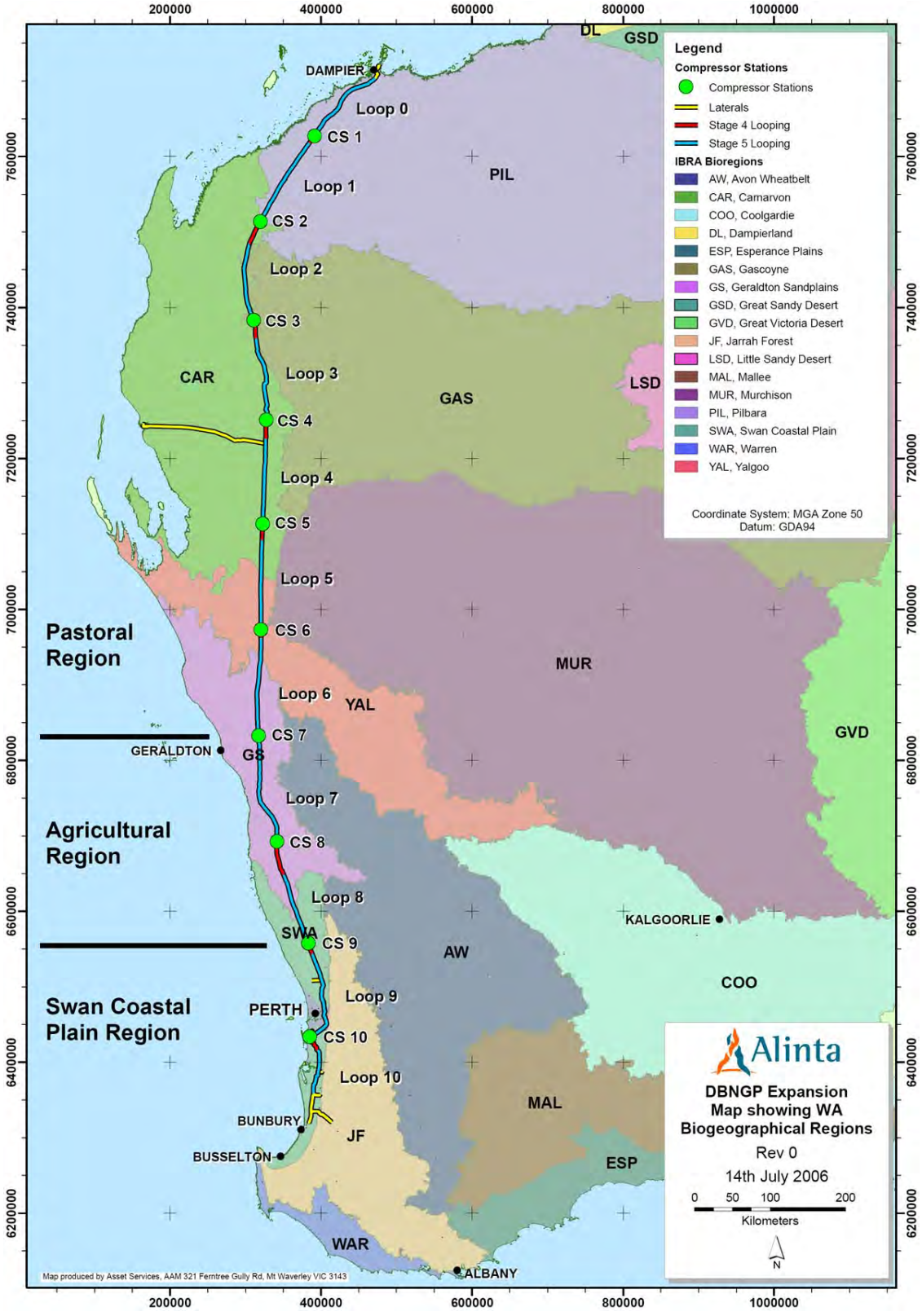
2.3 LAND TENURE

The looping pipeline sections will be constructed adjacent to the existing DBNGP within the existing corridor established in the early 1980s and gazetted under the *Dampier to Bunbury Pipeline Act 1997* prior to the privatisation of the pipeline. DBP is the owner of the existing DBNGP.

In some sections, the construction activity will extend outside of the existing corridor (e.g. for vehicle turnarounds, campsites). Access to these locations will be negotiated directly with the individual landowners. The tenure in these sections is typically Crown Leases and freehold land for agricultural purposes.

Figure 1.1 Regional location of the DBNGP showing Stage 4 and Stage 5 Loops

Figure 1.2 Biogeographical regions traversed by the DBNGP



2.4 PROPOSAL COMPONENTS

Looping is a process of duplicating a pipeline by installing a new pipeline parallel to the existing line in order to provide an additional flow path for the transported gas. This process enhances the volumetric capacity of the system and allows increased gas deliveries to customers. The details of the construction and operation activities are set out in the following sections (Sections 2.4.1 through 2.4.3).

The key characteristics of the project are shown in Table 1.2.

Table 1.2 Key characteristics of the Stage 5 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 south-east 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.	Approximate length	Biogeographical region	Shire
	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*.			
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. Reduced working widths will be implemented as far as practicable in areas of conservation value (Chapter 2, Section 3).			
Activities outside the DBNGP easement	Turnarounds Campsites Turkey nests* Laydown areas Water supply sources Access roads Works associated with watercourse and dune crossings			

Aspect	Proposal
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 January 2007 (Chapter 1, Section 2.5). 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

Key: km kilometre
m meter
mm millimetre
ha hectare
DBNGP Dampier to Bunbury Natural Gas Pipeline
***** Turkey nests are artificially created water storages constructed by hollowing out an area of land and using the fill to build up its sides.

2.4.1 Pipeline construction

For pipeline construction works in the northern loops (from the Dampier Loop to Muchea), construction will typically be carried out within a 30 m wide construction corridor using a production line approach. A reduced corridor width will be implemented, where practicable, in areas of conservation value. A description of areas of conservation value is provided in Chapter 2, Section 3.3. In the area south of Muchea, a 20 to 30 m construction corridor will be utilised with a slightly reduced corridor width in areas of conservation value, where practicable.

A number of specialised crews pass along the construction corridor, fabricating and installing the pipeline then backfilling and rehabilitating the corridor. The pipeline will be constructed and operated in accordance with the requirements of *AS2885 Pipelines — Gas and Liquid Petroleum* and the Australian Pipeline Industry Association (APIA) *Code of Environmental Practice (1998).* Typical construction activities expected for the pipeline are described in Table 1.3.

Table 1.3 Typical pipeline construction activities

Activity	Description
Detailed Survey	Engineering, environmental and cultural heritage surveys are used both in route selection and to determine if any special construction techniques or mitigation measures are required. Once the preferred pipeline route has been determined, the centreline is surveyed and engineering aspects are finalised. Markers (pegs) are placed to identify the pipeline route and corridor.
Fencing	Fences are severed and construction gates installed to allow access through property boundary and internal fences.
Clear and Grade	Graders and bulldozers are used to clear a 22 m wide area to provide for construction activities. This clearing will be within the construction corridor (30 m in northern sections, 20 to 30 m in southern sections, and appropriately reduced in areas of conservation value). The remaining 8 m wide area will be used to stockpile cleared vegetation. The cleared area may include excavations through sand dunes and riverbanks and beds to establish a construction corridor. For safety reasons, dependent on soil type (e.g. heavy sand), an additional 3 m may need to be cleared in limited areas to allow for trench and stockpile stability. Topsoil will typically be graded to a depth of 100 to 150 mm for a blade-width over the trench line, or the entire working side or the full construction corridor, depending on factors such as the soil type, terrain, construction requirements and weather conditions. Topsoil will be stockpiled separately. Overburden related to dune and river crossings will be stockpiled adjacent to the excavation, in areas with no, or limited vegetation cover, where practicable.

Activity	Description
Trenching	After the route is cleared, a trench (approximately 1.8 m deep) is dug for the pipeline by either a trenching machine or an excavator in accordance with pre-defined depths of burial. The required depths are determined by the AS2885.1 risk assessment process and recorded on construction alignment sheets. Trench spoil is stockpiled on the corridor, usually on the non-working side. Trench spoil is stockpiled separately to topsoil. The trench will be monitored daily for fauna entrapment and refuges (hessian bags or similar) placed in the trench to provide protection for fauna that temporarily occupy the trench. The trenches will be ramped at regular intervals to allow larger fauna to escape. The period that any part of a trench will be left open will be minimised. Trenches will be stopped and started at regular intervals with "plugs" between these sections to allow for unimpeded movement of livestock and fauna. Where possible, trenching will be delayed until completion of the welding and joint coating as part of ensuring that the trench will be open for the minimum amount of time.
Stringing	Steel pipe is trucked to the construction site and sections, each approximately 18 metres long, are laid end-to-end next to the trench. The sections are placed on sandbags and raised on blocks of wood (timber skids) to protect the pipe from corrosion and coating damage.
Bending	Where required, pipe sections are bent to match changes in either elevation or direction of the route.
Welding	Pipe sections are welded together.
Non-destructive weld testing	The pipe welds are inspected using x-ray or ultrasonic equipment as per AS 2885.2.
Joint Coating	The area around the weld is grit blasted and then coated with a protective coating to prevent corrosion
Padding	Where required, padding machines are used to sift excavated subsoil to remove coarse materials to prevent damage to the pipe coating. The remaining fine material is used to pad beneath and above the buried pipe. In some instances (e.g. rocky soil), imported sand or foam pillows are used for padding.
Lowering-in	Side booms (bulldozers with cranes) or excavators are used to lower the welded pipe into the trench.
Backfilling	Trench spoil is returned to the trench and material compacted to minimise the likelihood of subsidence of material over the pipe, in accordance with the *Soil Management Protocol* detailed in the Construction Environmental Management Plan.
Watercourse Crossings	The pipeline alignment crosses a number of watercourses of varying size, some of which are ephemeral. The ephemeral streams are expected to be dry during construction and crossings will be constructed using standard open cut (trenching) construction. Erosion and sediment control measures will be implemented to ensure there are no significant impacts at these crossings. The Swan, Canning and Murray Rivers are perennial, and construction by horizontal directional drilling is planned to be used under the riverbed to minimise disturbance. However, the specific methodology for crossing the individual watercourses will be determined by the Construction Contractor based on geotechnical survey information to be obtained prior to commencement of construction. This assessment considers both methods and is intended to provide for the choice of method to be made, subsequent to obtaining environmental approval. Permits will be obtained from the Department of Water where crossings involve any interference to bed or banks.
Pressure Testing	Pipeline integrity is verified using hydrostatic testing in accordance with AS 2885.5. During hydrostatic testing the pipeline is capped with test manifolds, filled with water and pressurised up to a minimum of 125% of design maximum operating pressure for a minimum of two hours. A minimum 24-hour duration leak test then follows. Providing it meets Department of Water water quality guidelines and has landholder approval, hydro-test water is discharged to the surrounding environment. Hydro-test water will be sourced from a variety of sources, including public water supply system standpipes, dams, local groundwater or streamflows, subject to licensing from the Department of Water. In general, it is expected that no chemicals will be added as the pipeline is internally coated. However, in some locations chemicals may need to be added if there is danger of aggressive water affecting the integrity of the internal coating of the pipeline. In these cases and where necessary, the water will be treated to neutralise alkaline elements to an appropriate standard before discharge to the environment. This discharge is a once-off discharge during commissioning of the pipeline and will be undertaken to the requirements of the Department of Environment and Conservation
Restoration and Rehabilitation	The easement is re-contoured to match surrounding landform, and erosion controls constructed where necessary. Separately stockpiled topsoil is then respread evenly across the easement and any stockpiled vegetation placed across the easement to assist in soil retention, provide seed stock and fauna shelter. Reseeding or revegetation of the easement with appropriate species (i.e. crops/pasture or indigenous native species of the right provenance), will be undertaken to restore vegetation cover.
Signage	Information signs on the presence of the buried pipeline are erected in line of sight along the easement as per AS 2885.1.

Watercourse crossings

There are a number of major watercourses that will be crossed by the pipeline. River crossings may be by open-cut methods or by horizontal directional drilling (HDD). Site specific geotechnical conditions will determine the methodology to be used in each case.

At the sites where HDD is undertaken, an area will be required to temporarily house the drill rig. The drill site area for the HDD from an operational and safety perspective is usually 50 m x 50 m and incorporates an area for the positioning of the drilling rig, an area for the management of the drilling mud (i.e. mud pits) and a safe truck turnaround/manoeuvring area. The same topsoil removal and preservation methods used on the general construction corridor will be used when clearing the HDD Pads.

HDD involves drilling beneath the river, minimising disturbance to the bed, banks and riparian vegetation, and to surface water flow, but may require a larger disturbance area than open-cut methods, mainly to accommodate drilling activities (e.g. drill rig pads, drilling fluids pits).

The HDD drilling mud disposal requirements include the construction of evaporation dams at the HDD entry and exit locations where the mud will be stored until such time as it is dry. At this point, the mud will then be loaded into tip trucks and disposed of at a suitable approved land fill/waste disposal site. The HDD pad will be rehabilitated.

Open-cut methods will require excavation through the banks and riverbed, deep enough to achieve the required 2 m cover below the stable river bed. This will ensure flow events do not expose the pipeline, ensuring pipeline integrity. There will also be the need to extend this excavation through the riverbank profile for some distance away from the river channel. This will result in the requirement for an increased working width across each bank of the river crossing to enable safe excavation of the construction corridor and installation of the pipeline.

Sand dune crossings

There are several areas along the pipeline route in Loops 0 and 6 that require the crossing of mobile sand dunes. This will require excavation through the dunes deep enough to be below the stable dune formation to ensure sand movement will not expose the pipeline in the future. An increased working width across the dune will be required in these areas to enable safe excavation of the trench and installation of the pipeline. Construction activities across mobile sand dunes will be managed in accordance with a *Dune Crossing Management Protocol* to be developed as part of the Construction Environmental Management Plan (CEMP)[6] for the Stage 5 Expansion.

[6] A Construction Environmental Management Plan is being prepared for the Stage 5 Expansion project, to the requirements of the Department of Industry and Resources, in accordance with the pipeline licence issued to DBP under the *Petroleum Pipelines Act 1969*.

Borrow pits

Borrow pits to win suitable fine soils to place around the pipeline are unlikely to be required for the project. Should a borrow pit be required, the nearest existing pit used during the initial construction of the DBNGP will be considered as the first option. Should no existing borrow pit be suitable, the establishment of a suitable borrow pit will be discussed with the Department of Environment and Conservation (DEC) and relevant local authorities on a case by case basis.

Pressure testing

Pressure testing of the pipeline involves pumping water into the pipeline and maintaining a set pressure for a period of time (hydrotesting). Hydrotesting will require water to be sourced and following testing, appropriately disposed of.

Numerous wells along the pipeline route are currently being tested to determine their suitability for the hydrotest program. Licences for abstraction of water will be obtained as required under the *Rights in Water and Irrigation Act 1914.*

The hydrotest water will be discharged into evaporation ponds, dams, turkey nests, water courses or areas of the corridor in accordance with an approved protocol described in the CEMP.

2.4.2 Other infrastructure requirements

Construction camps will be erected near the pipeline at various intervals to service Loops 1 to 8 (no camp is required for Loops 0, 9 and 10 due to proximity to either Karratha or the Perth Metropolitan area). The camps will consist of demountable buildings with individual sleeping quarters, toilet/showers, laundry, food mess, wet mess (bar) and recreation rooms. Caterers are contracted to cook and clean for the construction personnel.

Construction camps will, where possible, be located to minimise noise impacts on surrounding residences, and in areas that have been largely cleared. Sites will be located to minimise clearing of vegetation, and will not be located where there will be an impact on any areas of ecological significance. Final site selection will be influenced by the results of the flora and fauna studies, location of Aboriginal heritage sites, and the practical requirements of the Construction Contractor.

Water will be required for potable uses (at accommodation camps), and dust suppression and hydrotesting (construction site). Water will be sourced from local groundwater, surface water dams, or public water supply standpipes along the construction route. The required licences will be sought from the Department of Water (DoW) prior to commencement of construction in any area.

2.4.3 Pipeline operation

Given that the pipeline will be underground, land users will be able to resume previous land use activities on top of the pipeline provided activities do not include excavation. All areas disturbed during construction will be rehabilitated to their pre-construction condition.

Typical operation activities expected for the pipeline are described in Table 1.4.

Table 1.4 Typical pipeline operation activities

Activity	Description
General Operations	Routine operation and maintenance programs including integrity monitoring surveys, ground and aerial patrols, repair or replacement of damaged pipe or other equipment, pigging and cleaning of the pipeline, corrosion monitoring and remediation, easement and lease area maintenance, including access roads, and line of sight requirements under the pipeline licence.
Gas Metering	All gas flows will be metered with high accuracy metering. This information will be checked against the volume of gas within the pipeline and any significant imbalance will be immediately checked and rectified if required.
Prevention of Pipeline Damage	Prevention of damage due to third party activity is achieved through depth of cover, signposting of the pipeline, one call "Dial Before You Dig" programs, regular inspection of the pipeline corridor to detect any construction or earthmoving activities in the area, and third party education on the potential dangers of carrying out activities near the pipeline. In some areas, such as crossings, marker tape and concrete slabs will be buried above the pipeline to reduce the risk of third party interference. Security fencing, gates and locks will be provided around all major above ground facilities (namely mainline valves or offtake sites) to inhibit accidental or unauthorised tampering.
Cathodic Protection	Pipeline corrosion is prevented by the protective external coating and cathodic protection systems. The cathodic protection system is checked regularly to ensure that the protection voltages are within limits, and to monitor any likely areas of corrosion activity. Any voltage irregularities and corrosion will be rectified as required. The cathodic protection system and external coating system work independently to protect the pipeline from corrosion. Either system, operating satisfactorily on its own, would be sufficient to prevent corrosion of the pipeline.

2.5 SCHEDULING

The Stage 5 Expansion will be constructed in stages, with Stage 5A commencing in January 2007. Subsequent stages will be constructed to match the increasing demand in fuel gas, and are expected to be substantially completed within five years. The scope and timing of each stage to provide the progressive upgrade of the pipeline system in looping length will be matched to the incremental increasing gas flow requirements. Precise scheduling and definition of the individual stages proposed to be constructed subsequent to Stage 5A have not been finalised at this time.

The details of the Stage 5A loops are set out in Table 1.5.

Table 1.5 DBNGP Stage 5A Expansion loop lengths and locations

Loop	Length (km)	DBNGP KP	Easting	Northing	Longitude	Latitude
0	7	21.990	471,847.16	7,703,972.70	116.73	-20.7638
		29.002	466,207.54	7,699,879.59	116.675	-20.8007
1	72.1	149.120	384,337.03	7,618,158.76	115.883	-21.5356
		221.212	344,092.19	7,558,586.26	115.489	-22.0706
2	57	304.345	305,283.90	7,485,451.55	115.104	-22.727
		361.342	299,819.41	7,429,597.57	115.044	-23.2307
3	59	434.236	313,898.39	7,359,004.07	115.172	-23.8696
		493.236	327,619.33	7,302,751.25	115.3	-24.379
4	59	571.820	326,553.70	7,226,566.57	115.28	-25.0667
		630.850	324,634.52	7,167,673.35	115.254	-25.5981
5	63	706.640	321,753.57	7,091,959.94	115.215	-26.2811
		769.634	320,166.53	7,028,982.36	115.19	-26.8492
6	65	835.900	320,514.26	6,962,713.01	115.184	-27.4473
		900.900	316,014.09	6,897,988.95	115.128	-28.0307
7	71	972.261	317,866.69	6,827,112.53	115.136	-28.6704
		1,043.290	317,509.41	6,756,314.28	115.121	-29.309
8	54	1,160.160	350,252.33	6,648,381.40	115.443	-30.287
		1,214.210	367,705.45	6,597,590.15	115.618	-30.7473
9	52	1,271.940	387,949.01	6,543,785.37	115.823	-31.2347
		1,323.965	400,926.11	6,494,883.58	115.955	-31.6771
10	15.1	1,421.410	394,738.88	6,416,147.45	115.881	-32.3867
		1,436.500	397,771.32	6,402,154.20	115.912	-32.5132
Total:	**574.2**					

2.6 INPUTS

2.6.1 Water supply

Up to approximately 513.1 ML of water will be required for construction purposes, campsites and hydrotesting of the pipeline (Table 1.6). Water will be reused where practicable, which will reduce water supply requirements.

Water will be sourced from local groundwater, surface water dams, or public water supply standpipes along the construction route. Temporary dams may need to be constructed to store such water during the works. The required licences will be sought from the DoW prior to commencement of construction in any area.

Table 1.6 DBNGP Stage 5 Expansion water supply requirements

Loop	Hydrotesting (ML)	Construction (ML)	Potable water (ML)	Total water supply required* (ML)
0	32.22	5.6	2.2	40.0
1	42.62	7.4	3.0	53.0
2	33.61	5.8	2.3	41.8
3	38.81	6.7	2.7	48.2
4	34.30	5.9	2.4	42.6
5	40.54	7.0	2.8	50.4
6	45.39	7.9	3.1	56.4
7	41.23	7.1	2.9	51.2
8	33.26	5.8	2.3	41.3
9	34.65	30.0	12.0	76.7
10	5.20	4.5	1.8	11.5
TOTAL	381.8	93.7	37.5	513.1

* Water supply assumptions:

- hydrotesting requires 330 m^3 of water/km of pipeline
- pipeline constructed at a rate of 3 km/day for Loops 0 to 8 and 0.5 km/day for Loops 9 and 10
- construction water required is approximately 150 m^3/day under normal conditions
- potable water supply required is approximately 200 L/day per person (assuming 400 people/camp/loop).

2.7 OUTPUTS

2.7.1 Air (dust) emissions

Dust from soil disturbance will be the main component of air emissions during the construction phase of the pipeline, principally from clearing and grading, trenching, backfill and vehicle movement. There are few sensitive premises near the pipeline corridor in the pastoral and agricultural areas. More sensitive premises are close to pipeline route as it traverses the more densely populated area of the Perth metropolitan area and outer urban areas. This impact is expected to be of short duration and intensity and will be managed in accordance with a *Dust Management Protocol* to be developed as part of a CEMP for the Stage 5 Expansion.

2.7.2 Noise and vibration

Pipeline construction activity will result in a temporary increase in noise and vibration levels within the immediate vicinity of the alignment. There are few sensitive premises near the pipeline corridor in the pastoral and agricultural areas. More sensitive premises are close to pipeline route as it traverses the more densely populated area of the Perth metropolitan area and outer urban areas. This impact is expected to be of short duration and intensity and will be managed in accordance with a *Noise Management Protocol* to be developed as part of a CEMP for the Stage 5 Expansion.

2.7.3 Waste water

Pipeline integrity is verified using hydrostatic testing in accordance with AS 2885.5. Providing it meets water quality guidelines and has landholder approval, hydro-test water is discharged to the surrounding environment. In general, it is expected that no chemicals will be added as the pipeline is internally coated. However, in some locations chemicals may need to be added if there is danger of the water affecting the integrity of the coating or the bare steel at the joints where the pipe lengths are welded together. In these cases and where necessary, the water will be treated to an appropriate standard before discharge to the environment. This discharge is a once-off discharge during commissioning of the pipeline and will be managed in accordance with a *Dewatering and Water Disposal Management Protocol* to be developed as part of a CEMP for the Stage 5 Expansion. This protocol covers the management of disposal of water as well as dewatering.

Dewatering may be required in locations of shallow groundwater (e.g. river basins, wetlands and areas on the Swan Coastal Plain). Disposal of dewater product is not expected to have a detrimental effect on the receiving environment and will be managed in accordance with a *Dewatering and Water Disposal Management Protocol* to be developed as part of a CEMP for the Stage 5 Expansion.

Sewage will be generated at campsites. Disposal at each site will be undertaken by treatment in a package wastewater treatment plant, and the treated effluent disposed of via infiltration ponds in locations that will not cause pollution of the receiving environment.

2.7.4 Solid waste

Small amounts of domestic and industrial solid waste will be generated during construction and operation of the pipeline. The waste will be disposed of in accordance with a *Waste Management Protocol* to be developed as part of a CEMP for the Stage 5 Expansion, which will be consistent with the relevant local authority requirements.

3 RELEVANT ENVIRONMENTAL FACTORS

3.1 SCOPING OF RELEVANT FACTORS

The scoping process for the Stage 5 Expansion involved preliminary identification of proposal aspects and associated key environmental issues and factors. The scoping process utilised Environmental Protection Authority (EPA) guidelines and stakeholder consultation to confirm factors and those key aspects that affect environmental factors. A preliminary assessment of the environmental aspects and associated environmental factors relating to the proposal is shown in Table 1.7.

Table 1.7 Environmental aspects of the proposal

Relevant factor	Proposal aspect	Potential impacts	Further assessment
Biophysical			
Vegetation and flora	Clear and grade	Loss of vegetation communities Weed infestation and disease spread Wildfire Damage by dust emissions	Key factor for all loops.
	Construction vehicular movement	Weed infestation and disease spread Damage by dust emissions Wildfire	
	Dewatering	Disturbance to groundwater dependent vegetation from drawdown and acid formation	
Wetlands	Clear and grade	Disturbance to wetland	Key factor for Loops 8 to 10.
	Dewatering	Loss of wetland attributes due to drawdown and acid formation	
	Fuel and chemical storage, handling and spills	Contamination of wetland	
Fauna	Clear and grade operations	Removal of habitat	Key factor for all loops.
	Dewatering	Alteration of habitat from drawdown	
	Trenching	Fatalities of trapped fauna	
	Construction vehicular movement	Road kills Wildfire	
	Noise emissions	Disturbance to nearby fauna	
Conservation areas	Clear and grade	Disturbance to conservation areas Weed infestation and disease spread	Key factor for all loops.
	Fuel and chemical storage, handling and spills	Contamination	
Soils and terrain	Clear and grade	Erosion (wind and rain) and sedimentation	Key factor for all loops.
	Construction vehicular movement	Soil compaction	
	Trenching and backfilling	Soil inversion	
	Dewatering	Soil contamination from acid formation	
	Fuel and chemical storage, handling and spills	Soil contamination	
	Test water disposal and waste generation	Soil contamination	
Groundwater	Dewatering	Water contamination from acid formation Altered groundwater regime	Key factor for Loops 8 - 10.
	Fuel and chemical storage, handling and spills	Water contamination	
	Test water disposal	Water contamination	

Relevant factor	Proposal aspect	Potential impacts	Further assessment
Water courses	River and stream crossings	Disturbance to river and stream channels and banks	Key factor for all loops.
	Clear and grade	Increased sediment load or turbidity	
	Dewatering	Migration of acid formation	
	Fuel and chemical storage, handling and spills	Water contamination	
	Test water disposal and waste generation	Water contamination	
Pollution management			
Noise and vibration	Noise emissions and vibration from construction equipment and blasting	Disturbance to amenity Property damage	Key factor for Loops 9 & 10. Minor factor for Loop 0 to 8
Air quality	Air emissions from vehicles	Negligible	Key factor for Loops 9 & 10. Minor factor for Loops 0 to 8
	Dust emissions from exposed surfaces and construction vehicular movement	Disturbance to amenity and property damage Damage to vegetation	
Social surrounds			
Heritage	Clear and grade	Disturbance to shallow artefacts and subsurface material Damage to significant natural features of ethnographic significance (trees, watercourses and landscape)	Key factor for all loops.
	Trenching	Disturbance to subsurface material	
Land usage and services	Construction access and vehicular movement	Temporary loss of land utilisation and property access Temporary disruption to stock movement and land management Loss of soil productivity Spread of weeds Wildfire Increased local road traffic Damage to infrastructure and property Disruption of services	Key factor for all loops.
	Site preparation	Temporary loss of land utilisation and property access Temporary disruption to stock movement and farm management Loss of soil productivity Spread of weeds Wildfire Damage to infrastructure and property Disruption of services	
	Backfilled trench	Loss of soil productivity Permanent restrictions on land usage	
Public safety and risk	Pipeline failure	Property damage Injuries or fatalities	Key factor for Loops 9 & 10 Minor factor for Loops 0 to 8

3.2 KEY ENVIRONMENTAL FACTORS ADDRESSED

Environmental factors requiring detailed assessment were identified through the scoping process. Other environmental factors not considered key relevant factors but requiring further consideration were also identified. Review of these factors has been arranged according to the three geographical regions the pipeline corridor traverses as follows:

4. Pastoral region (Loops 0 to 6) – Chapter 2

Key environmental factors assessed:

- vegetation and flora
- fauna
- areas of conservation value
- soils and terrain
- water resources
- heritage
- land usage and services

Other environmental factors considered:

- noise and vibration
- air quality (dust)
- public safety and risk

5. Agricultural region (Loops 7 and 8) – Chapter 3

Key environmental factors assessed:

- vegetation and flora
- fauna
- areas of conservation value
- soils and terrain
- water resources
- heritage
- land usage and services

Other environmental factors considered:

- noise and vibration
- air quality (dust)
- public safety and risk

6. Swan Coastal Plain region – (Loops 9 and 10) – Chapter 4

Key environmental factors assessed:

- vegetation and flora
- fauna
- areas of conservation value
- wetlands
- water resources (other than wetlands)
- soils and terrain
- heritage
- land usage and services
- noise and vibration
- air quality (dust)
- public safety and risk

The key environmental factors associated with the proposal are discussed in this review document in the following format:

- overview of factor

- assessment of potential impact and mitigation measures
- monitoring and assessment of performance
- predicted outcome.

3.3 KEY STUDIES UNDERTAKEN

The following studies investigated key environmental factors:

- **Terrestrial vegetation and flora studies** to assess potential impacts on the conservation status of those species known or likely to occur along the pipeline corridor.

  A detailed vegetation and flora survey was undertaken for Loops 0 to 7 (inclusive) of the Stage 5 Expansion during the summer/autumn of 2006 (Mattiske 2006).

  Detailed vegetation and flora surveys were previously undertaken along the entire lengths of Loops 9 and 10; these studies were considered relevant for this assessment (Mattiske 2003a, 2003b). Spring flora surveys will be undertaken in 2006 along Loops 9 and 10 to identify and map locations of Priority and Declared Rare Flora species (prior to construction).

  A detailed vegetation and flora survey has not been undertaken for Loop 8 of the Stage 5 Expansion (a survey was undertaken for the Stage 4 expansion section of Loop 8). Threatened Flora and Ecological Communities datasets were obtained from DEC for consideration of vegetation and flora values along all loops including Loop 8 in this assessment. A spring flora and vegetation survey will be undertaken along Loop 8 (prior to construction).

- **Terrestrial fauna studies** to assess the potential impacts on the conservation status of those species known or likely to occur along the pipeline corridor.

  A review of fauna interactions during some of the Stage 4 expansion construction works was undertaken to refine fauna interaction procedures for the Stage 5 Expansion (Bancroft and Bamford 2006a).

  A review of relevant fauna datasets and publications was undertaken (including reconnaissance survey) to identify conservation significant fauna and fauna habitats that may be affected by the Stage 5 Expansion (Bancroft and Bamford 2006b).

- **Acid sulphate soil and hydrogeologic studies** to predict the likelihood of encountering acid sulphate soils, shallow groundwater, wetlands and river systems along the Stage 5 Expansion loops and to develop an investigation strategy (Parsons Brinckerhoff 2006).
- **Aboriginal heritage studies** to investigate the presence and significance of Aboriginal heritage features along the pipeline corridor (Australian Interaction Consultants [AIC] 2006).

These studies are contained in Appendix 2.

Chapter 2 Assessment and management of key environmental factors in the pastoral region (Loops 0 to 6)

This Chapter contains the assessment of environmental factors identified for the pastoral region loops of the DBNGP. The pastoral region covers the length of the pipeline from Dampier to Geraldton, or Loops 0 to 6 inclusive (Figure 1.1 and Figure 1.2). The Stage 5 section of the pipeline corridor within Loops 0 to 6 is approximately 841 km in length.

The key environmental factors addressed in this Chapter are:

- vegetation and flora
- fauna
- conservation areas
- soils and terrain
- water resources
- heritage
- land usage and services.

Other environmental factors considered in this Chapter, but not identified as key environmental factors, are:

- noise and vibration
- air quality (dust)
- public safety and risk.

1 VEGETATION AND FLORA

1.1 EPA OBJECTIVE

To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

1.2 LEGISLATIVE AND POLICY CONTEXT

National Strategy for Conservation of Australian Biodiversity

The State and Commonwealth Governments have endorsed the National Strategy for Conservation of Australia Biodiversity and the National Strategy for Ecologically Sustainable Development that protects biodiversity. The strategies address the conservation of Australia's biological diversity by defining guiding principles.

EPA Position Statement No. 2

EPA Position Statement No. 2, "*Environmental Protection of Native Vegetation in Western Australia*", provides an overview of the EPA position on the clearing of native vegetation in Western Australia. Principles and related objectives and actions have been adopted from the above mentioned national strategies in the formation of this Position Statement. In assessing a proposal, the EPA consideration of biological diversity will include the following basic elements:

- comparison of development scenarios or options of biodiversity at the species and ecosystems level
- no known species of plant or animal is caused to become extinct as a consequence of the development and the risks to threatened species are considered to be acceptable
- no association or community of indigenous plants or animals ceases to exist as a result of the proposal
- there is a comprehensive, adequate and secure representation of scarce or endangered habitats within the project area and/or in areas which are biologically comparable to the project area, protected in secure reserves
- if the project is large (in the order of 10 ha to 100 ha or more, depending on where in the State) the project area itself should include a comprehensive and adequate network of conservation areas and linking corridors whose integrity and biodiversity are secure and protected
- the on-site and off-site impacts of the project are identified and the proponent demonstrates that these impacts can be managed.

EPA Position Statement No. 3

EPA Position Statement No. 3, "*Terrestrial Biological Surveys as an Element of Biodiversity Protection*", discusses the principles which the EPA would apply when assessing proposals which may affect biodiversity values in Western Australia. The outcomes sought by this Position Statement are intended to:

- promote and encourage all proponents and their consultants to focus their attention on the significance of biodiversity and therefore the need to develop and implement best practice in terrestrial biological surveys
- enable greater certainty for proponents in the EIA process by defining the principles the EPA will use when assessing proposals which may affect biodiversity values.

EPA Guidance Statement No. 51

EPA Guidance Statement No. 51, "*Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*", provides guidance on standards and protocols for terrestrial flora and vegetation surveys, particularly those undertaken for the environmental impact assessment of proposals.

Significance of vegetation

Vegetation is considered significant by the EPA (Guidance for the Assessment of Environmental Factors Draft February 2003) for a range of reasons including:

- scarcity
- unusual species
- novel combination of species
- a role as a refuge
- a role as a key habitat for threatened species, or large populations representing a significant proportion of the local to regional total population of a species
- being representative of the range of a unit
- a restricted distribution.

Threatened Ecological Communities (TECs), as listed by DEC and under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are of high significance.

Significant flora

The preservation and conservation of flora is covered primarily by the following statutes:

- *Wildlife Conservation Act 1950*
- *Conservation and Land Management Act 1984*
- *Environmental Protection Act 1986*
- *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth).

Recorded conservation flora will either be Declared Rare Flora (DRF) for which, under the *Wildlife Protection Act 1950* (Wildlife Act), it is illegal to remove or damage flora defined as Priority Flora.

DRF are specifically scheduled for protection under the Wildlife Act and are species that have been adequately searched for and are deemed either rare, in danger of extinction, or otherwise in need of special protection.

Priority species are those listed as potentially threatened by DEC. They range from Priority one to four species, as follows:

- **Priority 1:** *Poorly Known Taxa*. Taxa, which are known from one or a few (generally <5) populations, which are under threat.
- **Priority 2:** *Poorly Known Taxa*. Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat.
- **Priority 3:** *Poorly Known Taxa*. Taxa which are known from several populations, at least some of which are not believed to be under immediate threat.
- **Priority 4:** *Rare Taxa*. Taxa which are considered to have been adequately surveyed and which whilst being rare, are not currently threatened by any identifiable factors.

Clearing of vegetation

All clearing of vegetation in WA is regulated by the Environmental Protection (Clearing of Native Vegetation) Regulations 2004.

1.3 VEGETATION AND FLORA OVERVIEW

Mattiske Consulting Pty Ltd (Mattiske) undertook a vegetation and flora survey of the Stage 5 Expansion pastoral region loops consistent with EPA Guidance Statement No. 51 (Mattiske 2006). An overview of the findings is provided below.

Vegetation

The vegetation of Loops 0 to 6 is described below in broad terms according to the five biogeographical regions that the loops traverse:

1. Pilbara (Loops 0 & 1): Located within the Fortescue Botanical District of the Eremaean Botanical Province as defined by Beard (1975). The vegetation is characterised by tree and shrub-steppe communities. Dominant genera of the area are *Eucalyptus*, *Acacia* and *Triodia*.

2. Carnarvon (Loops 2, 3, 4 & 5): Classified as the Carnarvon Botanical District as defined by Beard (1975). Dominant genera are *Acacia* and *Triodia* with occurrences of species from the *Chenopodiaceae* (Chenopods) family such as *Halosarcia*, *Atriplex* and *Maireana* on flats and claypans. The vegetation of the area is varied and is dominated by *Acacia* in the south and changes to *Triodia* dominated in the north.

3. Gascoyne (Loops 2 & 3): Classified as the Ashburton Botanical District as defined by Beard (1975). Different forms of *Acacia aneura* (mulga) with other *Acacia sp*. as shrubs on hills and woodlands on flats. Other dominant species include *Eremophila* and *Senna*. The mulga woodlands/shrublands may be continuous or interrupted with bare patches. Perennial grasses such as *Triodia* species (Spinifex) are usually confined to patches of sandy soil, where sands tend to occur in low, raised banks. Annual grasses and daises are common in spring and late winter or occur opportunistically after significant rainfall events.

4. Yalgoo (Loops 5 & 6): Dominated by *Acacia* shrublands, *Acacia* forests and woodlands, hummock grasslands and smaller areas of eucalypt woodlands and cheopod and samphire shrublands.

5. Geraldton Sandplains (Loop 6): Located in the Irwin Botanical District of the Southwest Botanical Province as defined by Beard (1976). Dominant plant families include Proteaceae, Myrtaceae, Mimosaceae, Casuarinaceae, Asteraceae, Chenopodiaceae and Poaceae. Scrub heath and *Acacia* – *Casuarina* thickets with occasional areas of *Acacia* scrub with scattered *Eucalyptus* trees are main characteristics.

Mapping and descriptions of the vegetation communities along Loops 0 to 6 are contained in Mattiske (2006). No TECs listed under the Commonwealth EPBC Act or by DEC were recorded (Mattiske 2006).

The river crossings supported a range of species and communities that are able to tolerate both high and low energy flows. There is a range of significant habitat trees near some of these river crossings, however only a few occur within the proposed alignment.

The condition of the vegetation was very variable from completely degraded in areas which have been subjected to heavy grazing pressures, to excellent condition in areas subjected to above annual rainfall in the northern loops near Dampier and Karratha. The introduced and weed species were scattered throughout the pastoral areas, with a greater concentration of weeds in the major valley systems.

Flora

A total of 501 taxa of native terrestrial vascular flora were recorded from along Loops 0 to 6. Twelve different Priority Flora species were recorded by Mattiske (2006) along Loops 0 to 6 (Table 2.1). No DRF was recorded. Eleven introduced species were recorded. The dominant weeds included *Cenchrus ciliaris* (Buffel Grass) (Loops 0 to 4), *Cenchrus setigerus* (Birdwood Grass) (Loops 2 and 4), *Malvastrum americanum* (Spiked Malvastrum) (Loops 0 and 3), and *Amaranthus mitchellii* (Boggabri Weed) (Loops 1 and 3).

Table 2.1 Priority Flora recorded along Loops 0 to 6

Loop	Species name	Conservation status
0	*Hibiscus brachysiphonius*	P3
1	*Goodenia pascua*	P3
2	*Olearia fluvialis*	P2
3	*Frankenia glomerate*	P3
4	*Grevillea stenostachya*	P3
	Scaevola chrysopogon	P2
5	*Dicrastylis linearifolia*	P3
	Eremophila physocalyx	P3
	Grevillea stenostachya	P3
6	*Acanthocarpus parviflorus*	P3
	Dicrastylis incana	P2
	Dicrastylis linearifolia	P3
	Grevillea stenostachya	P3
	Microcorys tenuifolia	P3
	Philotheca kalbarriensis	P2

Source: Mattiske (2006).

The DEC database has also been searched for the locations of DRF and Priority Flora occurring within or immediately adjacent (within 5 km either side) to the corridor. The field studies in Loops 0 to 6 concentrated on the areas within 30 to 100 m of the pipeline corridor. This list of species is provided in Mattiske (2006).

1.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Project activities requiring vegetation clearing (e.g. clear and grade) have the potential to affect vegetation and flora values. Potential direct impacts that may result primarily from clearing activities include:

- change in the abundance, species diversity, geographic distribution and productivity of vegetation communities
- disturbance of DRF and Priority Flora species
- disturbance of species with significant range extensions.

Potential indirect impacts that may result from vegetation clearing and other construction activities, such as trenching and excavation, dewatering, hydro-testing, and stringing, welding and x-raying, include:

- smothering of vegetation by dust
- introduction or spread of weeds
- bushfire risk (associated with metal cutting, welding and grinding activities)
- alteration of groundwater and surface drainage regimes.

Vegetation clearing

The total area of disturbance within the pipeline corridor required for construction of Loops 0 to 6 is around 2100 ha[7] (Table 2.2). As not all the corridor is vegetated, vegetation clearing requirements will be less than this 2100 ha and, on the basis of current estimates of already cleared areas, will be less than 1000 ha. There will also be a requirement to clear around 100 ha outside of the pipeline corridor for infrastructure such as construction camps, turkey nests and turnarounds (Table 2.2). Existing turkey nests, construction camp sites and cleared and/or disturbed areas will be used where practicable in preference to disturbing new sites.

The vegetation that exists within the DBNGP corridor is vegetation that has established subsequent to clearing of the corridor when the original pipeline was installed 24 years earlier. Vegetation removal and subsequent rehabilitation within the pipeline corridor will occur sequentially as each individual pipeline section is constructed; only the relevant length of the pipeline corridor will be cleared for each construction period. No TECs as defined under that EPBC Act or by DEC were defined in the pipeline corridor.

[7] Based on a working width of 25 m and does not take into account reduced working width areas in areas of conservation value.

Of interest were several communities that supported a range of Priority species or species which occur as outliers from their main occurrence. In these areas the communities could be considered locally significant. As indicated in Mattiske (2006), the river crossings also supported significant habitat trees either within or near the pipeline corridor.

Table 2.2 Area of disturbance in Loops 0 to 6

Loop	Estimated total area of disturbance within pipeline corridor (ha)*	Estimated area of disturbance outside pipeline corridor (ha)
0	343	6
1	308	16
2	262	15
3	283	15
4	282	15
5	298	16
6	328	16
TOTAL	**2104 ha**	**99 ha**

* Based on a working width of 25 m. Not taking into account reduced working widths in areas of conservation value.

Twelve Priority Flora species are known to occur within or adjacent to the pipeline corridor (Table 2.1). Occurrences of these species within the pipeline corridor will most likely be cleared, however, there may be opportunities to avoid flora (e.g. through reducing corridor working width in nominated areas of rare or endangered flora), translocate flora to adjacent vegetation or use biological material from flora for propagation of plants for rehabilitation. Disturbance to occurrences of these species outside of the pipeline corridor (e.g. for construction camps, turnarounds etc.) will be avoided, where practicable. In the event that DRF cannot be avoided, an application to take DRF will be prepared and submitted to DEC for approval by the Minister for the Environment in accordance with the Wildlife Act.

The loss of Threatened Flora through disturbance from the project is not expected to affect the conservation status of these species, as none of the threatened (Priority) species are restricted to the pipeline corridor.

Weeds

Movement of vehicles and other vectors, such as the presence of cattle, has the potential to introduce weeds and/or spread existing populations of weeds. This may be compounded by many weed seeds remaining dormant in soil until the area is disturbed (APIA 1998). Areas that are particularly vulnerable to weed infestation include watercourses, where higher moisture levels may encourage rapid infestations, and areas where species competition is limited and soil disturbance high (e.g. stock grazing areas). The latter is reflected in the dominance of Buffel Grass in some of the creek and river crossings in Loops 1 to 4.

The proponent will prepare and implement a *Weed and Dieback Management Protocol* within the CEMP, which will reduce the potential for the introduction and spread of weeds.

Dust

Construction activities; such as clearing and grading, trenching, backfill and rehabilitation, and general vehicle movement along the corridor are likely to increase the risk of atmospheric dust emissions. These emissions may result in off-site environmental impacts and public concern, particularly when activities are undertaken close to residences.

The risk of activities resulting in off-site dust emissions is generally dependant on:

- the frequency at which a dust generating activity takes place
- meteorological conditions, such as wind speed
- composition of dust, including particle size distribution, particle density and moisture content
- the condition of the source.

The majority of the airborne particles associated with dust emissions from construction activities are likely to be larger than PM_{10} and are associated with nuisance rather than public health problems. Further, the larger particles tend to settle back to the ground within a short range (<300 m) from the source reducing the potential impact of the operations.

Long term accumulation of dust may have physical effects on plants such as blockage and damage to stomata, shading, abrasion of leaf surface or cuticle and cumulative effects (e.g. drought stress on already stressed species). Vegetation adjacent to the pipeline corridor, or located close to access tracks and other sources of dust (e.g. stockpiles), is more likely to be subject to such impacts. In the pastoral region, areas of clay substrate have the potential to generate large amounts of dust from even light vehicle movement. However, due to the short term nature of the construction activities, the risk of dust smothering vegetation is not expected to be significant.

The proponent will minimise the area of ground disturbance, including the number of access tracks, to reduce adverse impacts resulting from dust and erosion. The proponent will prepare and implement a *Dust Management Protocol* within the CEMP, which will reduce the potential for the impact of dust on the environment.

Fire

The potential for a bushfire to occur is associated with a number of construction activities including metal cutting, welding and grinding activities, as well as by the operation of equipment or vehicles in high risk areas/conditions. Clearing of the pipeline easement will provide some separation between construction activities and surrounding vegetation and flora. Additionally, a *Fire Management Protocol* will be prepared and implemented within the CEMP, to reduce the likelihood of a bushfire.

Altered water regimes

Groundwater is typically at depth in Loops 0 to 6, except in river basins where groundwater levels can be relatively shallow (Chapter 2, Section 5.3). Therefore, trenching would typically be above the water table and would have no affect on groundwater regimes, except where dewatering may be needed at river crossings. It is also likely groundwater will be used as the main construction water source along Loops 0 to 6. Potential effects of altered groundwater regimes on vegetation and flora values is expected to be limited to areas near the watercourses and for limited times during construction activities. As many of these systems are perennial or intermittent, many of the plant species are able to tolerate extremes in soil moisture availability.

The presence of linear stockpiles of topsoil and excavation spoil and modification to surface contours during construction may temporarily alter surface drainage patterns, which may affect vegetation dependent on such drainage systems. These communities are largely dominated by *Eucalyptus camaldulensis, E. victrix* and a range of *Melaleuca* and *Acacia* species. All of these larger tree and shrub species are dependent on intermittent groundwater levels and are generally adapted to massive water table fluctuations, providing they are not too extreme. Construction on the northern loops will be undertaken in the winter, as far as practicable, when surface drainage will be minimal. Any disruption to surface flows will be temporary as all stockpiles will be removed and post construction earthworks will restore the pre-existing landform and drainage patterns.

Mitigation

A Construction Environmental Management Plan (CEMP) will be prepared for the proponent's environmental management of the Stage 5 Expansion construction activities. The CEMP will include management measures to be implemented during the various construction stages, including:

- minimising area to be cleared outside of pipeline corridor
- reducing working widths to avoid Threatened Flora
- avoiding as far as practicable disturbance of significant vegetation types and Threatened Flora outside of the pipeline corridor (should they be present)
- avoidance or translocation of Threatened Flora occurring within the corridor
- rehabilitating disturbed areas with minimal delay
- implementing hygiene measures for vehicles and machinery to prevent introduction and spread of weeds
- undertaking weed control where required.

The CEMP will also include site/issue specific management measures in the form of management protocols (e.g. *Threatened Flora Protocol*, and *Weed and Dieback Management Protocol*). An Environmental Line List will indicate the location and length along the pipeline corridor to which a particular site/issue specific management protocol(s) needs to be applied.

The CEMP, vegetation and flora specific management protocols and other impact mitigation measures are described in more detail in Chapter 5.

1.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of flora and vegetation parameters to assess the effectiveness of flora and vegetation management measures described in the CEMP.

1.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for vegetation and flora management during construction of the pipeline, which will include specific measures for:

- threatened vegetation communities and flora
- weeds

- bushfire.

This commitment is consolidated in Table 7.1.

1.7 ENVIRONMENTAL OUTCOME

Around 2100 ha of disturbance is required within the pipeline corridor of Loops 0 to 6 of the Stage 5 Expansion. As not all the corridor is vegetated, vegetation clearing requirements will be less than this 2100 ha and, on the basis of current estimates of already cleared areas, will be less than 1000 ha. A further 100 ha of disturbance is required outside the corridor for the establishment of infrastructure. This disturbance may require the clearing of Priority Flora, however, such species will be avoided wherever practicable and all areas disturbed will be promptly rehabilitated. No TECs or DRF were recorded in Loops 0 to 6.

Vegetation clearing will be temporary, as the working width and all other disturbed areas will be rehabilitated as soon as practicable following construction. Infrastructure outside the pipeline corridor will be located on existing cleared or disturbed areas and will avoid any known populations of significant vegetation and flora as far as practicable. There is an increased risk of the spread of weeds; however this will be mitigated through weed control and hygiene procedures. There may also be a minor long-term reduction in species diversity, including trees and other deep-rooted species immediately over and adjacent to the pipeline trench. However, consistent with EPA objectives, the abundance, species diversity, geographic distribution and productivity of flora at species and ecosystem levels are expected to be maintained thereby conserving regional biological diversity.

2 FAUNA

2.1 EPA OBJECTIVE

To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

2.2 LEGISLATIVE AND POLICY CONTEXT

EPA Position Statement No. 3

EPA Position Statement No. 3, "*Terrestrial Biological Surveys as an Element of Biodiversity Protection*", discusses the principles that the EPA would apply when assessing proposals that may have an impact on biodiversity values in Western Australia. The Position Statement intends to provide the following outcomes:

- promote and encourage all proponents and their consultants to focus their attention on the significance of biodiversity and therefore the need to develop and implement best practice in terrestrial biological surveys
- enable greater certainty for proponents in the environmental impact assessment process by defining the principles the EPA will use when assessing proposals which may have an impact on biodiversity values.

EPA Guidance Statement No. 56

As described in the EPA Position Statement No. 3, the EPA determined that a series of guidance statements were warranted to provide an easy-to-use decision-making guide to the level of biological survey required. EPA Guidance Statement No. 56 "*Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*", provides guidance on standards and protocols for terrestrial fauna surveys, particularly those undertaken for the environmental impact assessment of proposals.

State protection

In a legislative context, the preservation and conservation of fauna is covered primarily by the following Western Australian legislation:

- *Wildlife Conservation Act 1950*
- *Conservation and Land Management Act 1984.*

In WA, rare or endangered species are protected by the Wildlife Conservation (Specially Protected Fauna) Notice 2005, under the Wildlife Act. Schedules 1 and 4 in this notice are relevant to this assessment, providing a listing of those species protected by this Notice.

DEC Priority Fauna List also nominates conservation species from priority one to four. It is expected that the potential impacts from a proposal on these priority listed species should be managed so that the species do not meet the International Union for Conservation of Nature and Natural Resources (IUCN) criteria for threatened species.

Commonwealth protection

The Commonwealth EPBC Act protects species listed under Schedule 1 of the Act. In 1974, Australia signed the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). As a result, an official list of endangered species was prepared and is regularly updated. This listing is administered through the EPBC Act. The current list differs from the various State lists; however some species are common to both.

International agreements

Australia is party to the Japan-Australia (JAMBA) and China-Australia (CAMBA) Migratory Bird Agreements. Most of the birds listed in these agreements are associated with saline wetlands or coastal shorelines and have little relevance to the proposed area. However, some migratory birds not associated with water are also listed on these international treaties.

Conservation significance of fauna

Based on the above discussion relating to mechanisms for the protection of fauna, three levels of conservation significance, developed by Bancroft and Bamford (2006b), are recognised in this assessment:

- *Conservation significance level 1* (CS1): species listed under State or Commonwealth Acts
- *Conservation significance level 2* (CS2): species not listed under State or Commonwealth Acts, but listed in publications on Threatened Fauna or as Priority species by DEC.
- *Conservation significance level 3* (CS3)[8]: species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

2.3 FAUNA OVERVIEW

Bancroft and Bamford (2006a), consulting ecologists, undertook a review of fauna interactions during some of the Stage 4 expansion construction works to refine fauna interaction procedures for the Stage 5 Expansion. They also undertook a Level 1 fauna survey of the entire pipeline corridor in accordance with EPA Position Statement No. 3 (Bancroft and Bamford 2006b). These studies are contained in Appendix 2. An overview for the Stage 5 Expansion pastoral region loops is provided below.

Fauna habitat

The habitats found along the pastoral region loops are known to support a range of fauna species, including species that are listed for protection under State and Federal conservation legislation. It is likely that there will be areas along each of the pastoral region loops of relatively high value to fauna, particularly when compared with other areas within the region. Examples of these include:

- National Parks, Conservation Parks, Nature Reserves and Conservation Reserves: areas that have been previously recognised as of high value for flora or fauna, or that have been set aside for conservation purposes (e.g. Cane River Conservation Park).

[8] These species have not been investigated in detail in Bancroft and Bamford (2006b) because loop-specific vegetation mapping is required to assist this process and such mapping was not completed at the time of the fauna study.

- Drainage lines: in the arid and semi-arid regions, rivers, creeks and drainage lines often support higher quality, or more diverse, vegetation and this may concentrate fauna in these areas (e.g. Maitland, Robe, Cane and Lyons Rivers).

  Kendrick and Stanley (2003) list the permanent pools (within 40 km of the coast) of coastal rivers (Maitland, Fortescue) as wetlands of subregional significance. These pools may be significant for large fish, waterbirds and invertebrates.

  Desmond and Chant (2003) list the Minilya, Gascoyne and Wooramel Rivers as wetlands of subregional significance. Pools along these drainage lines may be important regional biological refugia.

- Rare or unusual habitats: uncommon or unusual habitats (e.g. those driven by geological or hydrological factors such as freshwater springs or outlying hills) may support uncommon or outlying fauna populations, or may support a high degree of fauna endemism.

Fauna species

Fifty-one species were assessed as being of CS1 or CS2 (Table 2.3). See Bancroft and Bamford (2006b) in Appendix 2 for a description of each conservation significant species, including their conservation status, the reason for their significance, aspects of their ecology and potential threatening processes.

Table 2.3 Fauna of conservation significance potentially occurring along Loops 0 to 6

Species	Loop species likely to occur along	Species	Loop species likely to occur along
CS1 Species		**CS2 Species**	
Gilled Slender Blue-tongue*	6	Fortescue Grunter*	0, 1, 2
Western Spiny-tailed Skink*^	2, 3, 4, 5, 6	*Lerista lineata**	2, 3, 4, 5
Woma*	2, 3, 4, 5, 6	*Lerista planiventralis maryani**	0, 1
Pilbara Olive Python*	0, 1, 2	*Lerista yuna**	6
Carpet Python*	6	Grey Falcon	0, 1, 2, 3, 4, 5
Malleefowl^	2, 3, 4, 5, 6	Australian Bustard	All
Great Egret	All	Bush Stone-curlew	All
Glossy Ibis	All	Barking Owl	6
White-bellied Sea-Eagle^	All	Thick-billed Grasswren	2, 3, 4, 5
Peregrine Falcon	All	Rufous Fieldwren	6
Little Curlew^	0, 1, 2	Slender-billed Thornbill^	2, 3, 4, 5, 6
Common Greenshank^	All	White-browed Babbler	6
Wood Sandpiper	All	Crested Bellbird	6
Common Sandpiper	All	Spectacled Hare-wallaby	0, 1
Red-necked Stint	All	Tammar	6
Sharp-tailed Sandpiper	All	Ghost Bat	0, 1, 2
Curlew Sandpiper	All	Short-tailed Mouse*	0, 1
Oriental Plover^	0, 1, 2, 3, 4, 5	Western Pebble-mound Mouse*	0, 1, 2
Oriental Pratincole^	0, 1, 2		
Caspian Tern	All		
White-winged Black Tern	All		

Species	Loop species likely to occur along	Species	Loop species likely to occur along
Carnaby's Cockatoo	5, 6		
Major Mitchell's Cockatoo	5, 6		
Night Parrot	0, 1		
Fork-tailed Swift	All		
Rainbow Bee-eater*	All		
Star Finch	0, 1, 2, 3, 4, 5		
Barn Swallow^	0, 1		
Mulgara^	0, 1, 2, 3, 4, 5		
Northern Quoll*^	0, 1		
Bilby*	2		
Black-footed Rock-wallaby*	0, 1, 2, 6		
Orange Leaf-nosed Bat	0, 1, 2		

Source: Bancroft and Bamford (2006b).

* Indicate species that, if present near the pipeline route, are at greatest risk of impact due to trench construction. While generally at lower risk of significant impact, the remaining species may still be directly or indirectly disturbed and, hence, affected by the construction process.

^ EPBC Act listed species (Threatened Fauna and Migratory Species).

2.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Construction of the Stage 5 Expansion requires clearing and grading, excavation, pipe-laying, backfilling, hydrotesting, rehabilitation and commissioning activities to be undertaken. There will be a requirement for construction camps, stockpile sites, small worksites, access roads and water storage facilities (turkey nests) associated with these works. Construction activities could potentially affect indigenous and feral fauna in a number of ways, including:

- death/injury of fauna from impact with vehicles
- spread of weeds and feral fauna along cleared line
- fragmentation of habitat (temporary)
- loss of habitat (generally temporary, however, the necessary removal of large habitat trees may result in some permanent habitat loss)
- increase in indigenous and feral fauna due to provision of water in “turkey nests” (temporary)
- entrapment in trenches excavated to receive the pipeline (temporary)
- disturbance of fauna in nearby areas from light, noise and even personnel feeding selected species (temporary).

The existing cleared line over the pipeline will be retained for maintenance purposes.

Habitat disturbance and fragmentation

Around 2200 ha will be required to be disturbed for the construction of Loops 0 to 6 of the Stage 5 Expansion (Chapter 2, Section 1.4).

The removal or displacement of single trees has the potential to decrease faunal breeding and foraging grounds. Large trees may provide nesting hollows or shelter for animals. The corridor may also create a temporary barrier between nesting and foraging grounds or for fauna movement in general. For example, mammals and reptiles generally prefer not to cross large expanses of cleared land, where they are more vulnerable to predation.

Corridors of native vegetation, such as those that exist along rivers/streams, can also be important for dispersal of species in otherwise cleared landscapes. The pipeline corridor has the potential to fragment these riverine corridors at several locations, also impacting ephemeral wetland vegetation (Chapter 2, Section 5.3).

For species specific impacts see Bancroft and Bamford (2006b) in Appendix 2.

The proponent will minimise clearing requirements by reducing working widths in areas of conservation value, will avoid the clearing of habitat trees where practicable (pruning rather than removing), and will rehabilitate all disturbed areas to their pre-disturbance condition.

Injury or death of fauna

Conservation species descriptions that provide basic information, including the potential for the Stage 5 Expansion to affect these species, are presented in Bancroft and Bamford (2006b) contained in Appendix 2. Species vary in their likelihood of occurrence and sensitivity to impacts from the Stage 5 Expansion. The most susceptible species have also been highlighted in Table 2.3. It is predominantly ground-dwelling reptiles and mammals that are most at risk during the pipeline expansion.

The information gained from the Stage 4 works to date has indicated some of the susceptible species or groups. These are (Bancroft and Bamford 2006b):

- Frogs: a group that travels along the ground surface and, therefore, is highly susceptible to falling into trenches. The group may occur in high to extreme densities in some localities or seasons, and is extremely susceptible to heat stress or desiccation if trapped in the trench.
- Geckoes: a group that has many predominantly terrestrial members and, therefore, is highly susceptible to falling into trenches. Geckoes may occur in high densities in some localities or seasons and are very highly susceptible to heat stress or desiccation if trapped in the trench.
- Dragons: a group that has many predominantly terrestrial members that move quickly across the ground surface, hence are likely to encounter trenches. Dragons may occur in high densities in some localities or seasons and may be susceptible to heat stress or desiccation if trapped in the trench in some seasons.
- Emus: a species that has a moderately high likelihood of injury if it falls into trench.
- Nesting birds: a group that may occur in high densities in some localities or seasons and may be susceptible to disturbance or habitat clearing (e.g. waterbirds, honeyeaters).
- Macropods (kangaroos, wallabies): species that have a moderate likelihood of injury if they fall into the trench.

The proponent will implement a *Fauna Interaction Protocol* to the requirements of the DEC which will include requirements for fauna handlers to inspect and clear trenches daily. In developing the protocol, a key issue is the risk presented by the trench. This risk has two key components in considering management:

- animals making their way into the trench, not being able to escape with the resultant stress (potentially to the point of death), and risk of predation by other native and introduced animals
- animals being injured by falling into the trench (applies largely to larger mammals and marsupials)
- cumulative impacts of fauna stress or mortality as a result of repeated entrapment and translocation of particular individuals
- cumulative impacts of exposure/predation related mortality of a high number of individuals over time.

Entrapped fauna

Management of entrapped fauna is related to the ability to inspect and clear trenches on a regular basis, to limit the time of entrapment, of exposure to high temperatures in the trench, and to increased opportunity for predation . This aspect is managed through fauna handling teams inspecting the trench daily, generally in the morning, before trench temperatures become unreasonably high. This approach caters for most animals, with only those that fall into the trench in the few hours immediately following the inspections being at risk.

Clearing of the trenches by 4.5 hours after sunrise in the northern sections of the project (Loops 0 to 7) would ensure clearing by 10:00 am in those areas in the peak summer time (consistent with the requirements of Stage 4). Cooler summer temperatures in the southern loops (Loops 8 to 10) justify clearing by 5.0 hours after sunrise (which also corresponds to clearing by 10:00 am in summer in those loops). Maintaining the same clearing times after sunrise into the winter months means that trenches would be cleared by 11:15 am at the latest in the northern sections and by 12:20 pm in the south.

Trench inspections and clearing could, on average, be expected to progress at walking pace (≈3 km/hr). Based on the 4.5 hour clearing period in the northern sections, trench lengths of about 13.5 km can be managed per fauna team. In the southern sections, trench lengths of about 15 km/team can be managed during the 5 hour clearing period. Based on this, limitations on the lengths of trench permitted to be open at any one time can be related directly to the number of fauna teams available.

Injuries to fauna by falling into trench

The potential for injuries by falling into the trench relates directly to the period of time a trench is left open. To ensure efficient progress of construction, trenches often need to be left open up to a maximum of 14 days before backfilling. This allows for the construction process following trenching to proceed.

To minimise these risks in conservation areas, the contractor will not be permitted to leave the trench open for longer than seven days. It is in the interests of the construction contractor to progress the pipe-laying as quickly as possible because of the logistical constraints of operating from campsites, etc. However, in the northern sections, it is usual for construction teams to operate on a working regime of 28 days straight, with a nine day break. This increases the potential for trenches to be left open for extended periods during construction breaks. To minimise the risks associated with trenches being open during such breaks, the contractor will not be permitted to leave the trench open during breaks that exceed three days in conservation areas and other bushland areas with potential for high densities of fauna.

The limitations on trench open times will also minimise the potential for cumulative fauna stress.

Open trenching will not be undertaken in the Pilbara (Loop 0 to Loop 2) during the summer months November to March, to avoid heat stress on any animals entrapped in the trench.

The requirements for trench inspections/fauna clearing and time limitations on trench opening will be included in the CEMP.

Interruption to fauna behaviour

The effect of artificial light on fauna is not considered to be an issue as the majority of construction activities will be undertaken during daylight hours. A small amount of external lighting will be used at the temporary construction camps but any potential impact will be short term.

Construction activity may result in temporary, short-term disturbances to fauna from noise emissions (e.g. noise may discourage critical lifecycle stages such as breeding or nesting). However, due to the short duration of construction activities, noise emissions are not expected to have any prolonged effect on fauna.

Open artificial water sites associated with construction activities will include temporary 'turkey nest' dams that will be constructed at water source points (i.e. bores). There is the potential for fauna to become trapped in these dams and as such they will be regularly inspected in accordance with the *Fauna Interaction Protocol*.

Feral animals and bushfire

The Stage 5 Expansion may affect the movement of feral animals near the pipeline due to the presence of a cleared corridor and artificial watering sites. However, due to the temporary nature of disturbance it is unlikely that pipeline construction in these areas will cause any long-term changes to feral animal populations.

The risk of fire is increased due to construction activities. Fire has the potential to cause injury and death to fauna as well as removing habitat. A *Fire Management Protocol* will be implemented by the proponent to ensure fire risks are reduced to as low as practicable.

Mitigation

A CEMP will be prepared for the proponent's environmental management of the Stage 5 Expansion construction activities. The CEMP will include specific management protocols for managing fauna during the construction of Stage 5 Expansion in Loops 9 and 10. This protocol (*Fauna Interaction Protocol*) will include:

- limit on vehicle speeds in the construction corridor
- significant habitat trees to be identified prior to clearing; these trees are to be protected from clearing where practicable
- habitat trees that overhang construction areas are to be pruned and trimmed rather than removed where practical
- prompt rehabilitation of vegetation within areas of conservation value
- fauna shelters or refuges are to be placed in open trenches
- trench plugs and fauna exit ramps are to be installed in trenches

- open trenches will be inspected and cleared by fauna handling teams and open trench lengths will not exceed lengths capable of being practically inspected and cleared
- limitations on leaving trenches open for extended periods, particularly in designated conservation and bushland areas.

The CEMP will also include other site/issue specific management protocols (e.g. *Fire Management Protocol*). An Environmental Line List will indicate the location and length along the pipeline corridor to which a particular site/issue specific management protocol(s) needs to be applied.

The CEMP, the *Fauna Interaction Protocol* and other impact mitigation measures are described in more detail in Chapter 5.

2.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of fauna parameters to assess the effectiveness of fauna management measures described in the CEMP.

2.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for fauna management during construction of the pipeline, which will include specific measures for interactions with fauna.

This commitment is consolidated in Table 7.1.

2.7 ENVIRONMENTAL OUTCOME

Around 2200 ha will be progressively disturbed and rehabilitated for the Stage 5 Expansion in the pastoral region. As a result there will be a short-term effect on the local abundance of fauna populations due to interruption to fauna behaviour, injury or death. Potential effects on fauna will be minimised through the implementation of the CEMP which will include specific measures for interactions with fauna. Given the relatively small area affected at any one time and the proposed rehabilitation, the long-term effects of the pipeline on the fauna values in the pastoral region are expected to be minimal. Consistent with EPA objectives, the abundance, species diversity, geographic distribution and productivity of fauna at species and ecosystem level are expected to be maintained conserving regional biological diversity.

3 AREAS OF CONSERVATION VALUE

3.1 EPA OBJECTIVE

To protect the environmental values of areas identified as having significant environmental attributes.

3.2 LEGISLATIVE AND POLICY CONTEXT

State

Parks and reserves

Parks and reserves are protected areas of land, reserved for the purpose of preservation and management of unique or valuable landform, flora or fauna associations, and encompass national parks, conservation parks, nature reserves, State forest and timber reserves. The DBNGP corridor has been either excised from the reserves or the corridor land has been set aside for the purpose of the gas transmission pipelines within the areas.

Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are defined in Regulation 6(1) of the *Environmental Protection Act 1986*. ESAs include World Heritage property, areas registered on the Register of the National Estate, defined wetlands, rare flora, TECs and Bush Forever sites.

Commonwealth

The Australian Heritage Council is the principal adviser to the Australian Government on Australian heritage matters. The Council assesses nominations for the National Heritage List and the Commonwealth Heritage List and compiles the Register of the National Estate.

The Australian Heritage Database is maintained by the Council and contains a listing of natural, historic and Indigenous places listed in the World Heritage List, National Heritage List, Commonwealth Heritage List and the Register of the National Estate, where:

- The World Heritage List contains sites that are important to all the peoples of the world, irrespective of the territory in which they are located.
- The National Heritage List is Australia's list of places or groups of places with outstanding heritage value to the nation - whether natural, Indigenous or historic or a combination of these. Places on this list are protected to the full extent of Federal government powers.
- The Commonwealth Heritage List comprises natural, Indigenous and historic heritage places owned or controlled by the Commonwealth. These include places connected to defence, communications, customs and other government activities that also reflect Australia's development as a nation.
- The Register of the National Estate is Australia's national inventory of natural and cultural heritage places which are worth keeping for the future.

3.3 AREAS OF CONSERVATION VALUE OVERVIEW

The pipeline corridor traverses or is adjacent to several areas designated to be of conservation significance. For the purpose of this review, areas of conservation value are defined as including:

- nature and conservation reserves
- places listed on the Australian Heritage Database
- Environmentally Sensitive Areas (ESAs)
- those areas supporting DRF, Priority Flora or TECs
- conservation category wetlands, resource enhancement wetlands and wetlands gazetted under the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 (EPP Lakes).

It should be noted that the DBNGP corridor from Dampier to Bullsbrook has been excised from the conservation estate (A Class reserves and Conservation Parks) as an easement by Parliament in 2003. Reserves that were not afforded "A" class status but were still reserved for Conservation of Flora and Fauna were referred to the Minister for Environment and consent was obtained to exclude these areas from such reserves. Although the pipeline corridor is so excised, such areas will be classified as "areas of conservation value" for the purpose of managing construction activities.

Mapping of conservation category wetlands, resource enhancement wetlands and EPP Lakes does not extend to the pastoral region, therefore, this category of areas of conservation value does not apply to Loops 0 to 6 of the Stage 5 Expansion. No DRF or TECs were recorded along Loops 0 to 6 and discussion relating to Priority Flora along Loops 0 to 6 is contained in Chapter 2, Section 1.3.

Two conservation reserves (DEC estate) and one place listed on the Register of the National Estate occur along Loops 0 to 6 (

Table 2.4). These sites are also recognised as ESAs. There were also several areas of conservation value at distance from the pipeline corridor. Areas of conservation value are depicted in the series of landscape and environmental features maps contained in Chapter 8, Section 3.

The pipeline corridor also traverses a proposed conservation reserve in Loop 0. This comprises part of the Karratha and Mardie stations, which will be excluded from the pastoral leases when they expire in 2015 and included in the formal conservation reserve system. In addition, Cane River Station (Loop 1;

Table 2.4) is bordered to the north and south by formal pastoral leasehold land (ex-Mt Minnie and ex-part Nanutarra), which are currently managed by DEC under Section 33(2) of the *Conservation and Land Management Act 1984*. This land is proposed for addition to the Cane River Station reserve.

In addition to the conservation values, these areas may also be of recreational value.

Table 2.4 Areas of conservation value present along Loops 0 to 6

Loop	Name and description of area	Pipeline location in conservation area	Location (chainage)	Reserve	Australian heritage	ESA
0	Coastal margin Cape Preston to Cape Keraudren Area: ~60,000 ha	Passes through area	0.12-14.978	-	Register of the National Estate (indicative place*)	Yes
1	Cane River Station This reserve is a de-stocked station that is currently held as a pastoral lease by DEC. The station is representative of the Pilbara pastoral areas and is a proposed addition to the State's National Parks. The Cane River flows through the reserve. Area: ~148,000 ha	Excised corridor passes through reserve	208.455-213.700 230.667-249.222	C Class Reserve	Not listed	Yes
5	Toolonga Nature Reserve This is the largest reserve representing the rangelands of the Carnarvon Basin. It was originally set aside for the conservation of flora and fauna of the region. The vegetation is typical of the Toolonga Plateau. Area: ~405,424 ha	Excised corridor passes through reserve	746.512-817.47	C Class Reserve	Not listed	Yes

* Data provided to or obtained by the DEH has been entered into the database. However, a formal nomination has not been made and the Australian Heritage Council has not received the data for assessment.

3.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Project activities requiring vegetation/habitat clearing, trenching and vehicle/equipment movements have the potential to affect the environmental values (e.g. vegetation and flora, and fauna values) of areas of conservation value. The potential impacts on vegetation and flora, and fauna values have been described and discussed in Chapter 2, Sections 1.4 and 2.4 respectively and an overview of clearing requirements and recreational impacts is provided below.

Environmental and recreational values

Around 83 ha[9] of disturbance will occur within the pipeline corridor where the excised corridor traverses the areas of conservation value of Cane River Station and Toolonga Reserve (Table 2.5). A further 31 ha will be disturbed within the pipeline corridor where it traverses the indicative place listed on the Register of the National Estate (Coastal Margin Cape Preston to Cape Keraudren). The vegetation that exists within the pipeline corridor is vegetation that has established subsequent to the

[9] Based on a reduced working width of 20 m and allowing for truck turnarounds every 2 km. The pipeline easement has been excised from the CALM estate where it passes through Cane River Station and Toolonga Nature Reserve. Just over 1 ha of disturbance will be required for truck turnarounds outside of the pipeline corridor within Cane River Station and Toolonga Nature Reserve. Does not include disturbance in areas proposed for inclusion in conservation reserves.

clearing of the corridor for the installation of the original pipeline 24 years earlier. All areas disturbed during construction will be rehabilitated to their pre-construction condition.

Table 2.5 Area of conservation value that will be disturbed in Loops 0 to 6

Loop	Name	Approximate area of disturbance within pipeline corridor (ha)*
0	Coastal Margin Cape Preston to Cape Keraudren	30.6
1	Cane River Station	48.3
5	Toolonga Nature Reserve	35.0

* Based on a reduced working width of 20 m and allowing for truck turnarounds every 2 km. The pipeline easement has been excised from DEC estate where it passes through Cane River Station and Toolonga Nature Reserve. Just over 1 ha of disturbance will be required for truck turnarounds outside of the pipeline corridor within Cane River Station and Toolonga Nature Reserve. Does not include disturbance in areas proposed for inclusion in conservation reserves.

Thirteen Priority Flora species are known to occur within or adjacent to the pipeline corridor (Chapter 2, Sections 1.3).

It is expected that there will be no long-term consequences for the values of the areas of conservation value due to the relatively small area of mostly regrowth vegetation disturbance required, and the prompt rehabilitation of all disturbed areas.

Recreational use, should it be actively pursued in the conservation areas identified, is unlikely to be restricted by the pipeline corridor, although the aesthetic value may be compromised by vegetation clearance (temporary) and signage.

Mitigation

A CEMP will be prepared for the proponent's environmental management of the Stage 5 Expansion construction activities. The CEMP will include management measures to be implemented during the various construction stages. Measures to be implemented within areas of conservation value, in addition to those outlined for vegetation and flora (Chapter 2, Section 1.4) and fauna (Chapter 2, Section 2.4), include:

- reducing pipeline corridor working width in areas of conservation value
- locating sites of temporary disturbance (e.g. turnarounds) outside areas of conservation value as far as practicable.

These measures will also apply to those areas that are proposed for inclusion in conservation reserves.

The CEMP will also include site/issue specific management measures in the form of management protocols (e.g. *Conservation Area Management Protocol*). An Environmental Line List will indicate the location and length along the pipeline corridor to which a particular site/issue specific management protocol(s) needs to be applied.

The CEMP, conservation area specific management protocols and other impact mitigation measures are described in more detail in Chapter 5.

3.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of parameters associated with conservation areas to assess the effectiveness of conservation area management measures described in the CEMP.

3.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of conservation areas during construction of the pipeline, which will include:

- reducing the working width to 20 m or less within areas of conservation value.

This commitment is consolidated in Table 7.1.

3.7 ENVIRONMENTAL OUTCOME

There are three areas of conservation value (excluding areas that support Priority Flora) that will be affected by the Stage 5 Expansion pipeline construction in the pastoral region, however the pipeline corridor is excised from DEC estate. Around 115 ha of disturbance will occur within the pipeline corridor in these areas. All areas of disturbance will be rehabilitated and there is not expected to be any long-term consequences to the conservation values of these areas, ensuring the EPA objective for this factor will be met.

4 SOILS AND TERRAIN

4.1 EPA OBJECTIVE

To maintain the integrity, ecological functions and environmental values of the soil and landform.

4.2 LEGISLATIVE AND POLICY CONTEXT

EPA Position Statement No. 5

EPA Position Statement No. 5, "*Environmental Protection and Ecological Sustainability of the Rangelands in Western Australia*", outlines the environmental attributes and values of rangelands, their pressures and environmental condition, management issues, principles and objectives for the environmental protection and ecological sustainability of the rangelands and management responses required. This Position Statement identifies grazing, horticulture (in the floodplains), fire, feral animals and weeds, mining and climate change as pressures on the rangeland environment.

EPA Guidance Statement No. 4

EPA Guidance Statement No. 4, "*Rehabilitation of Terrestrial Ecosystems*", recognises that a key aim of rehabilitation is to ensure the long-term stability of soils, landforms, and hydrology required for the sustainability of sites. When discussing abiotic factors, the Guidance Statement describes the maintenance of soil properties as being a key aspect of rehabilitation to ensure vegetation establishment and resistance to erosion. It also states that effective topsoil and subsoil management is essential to ensure adequate plant growth and normal root distribution patterns.

Planning Bulletin No. 64

The Western Australian Planning Commission Planning Bulletin No. 64, "*Acid Sulphate Soils*", provides advice on matters that should be taken into account in the development of land that contain acid sulphate soils. The Bulletin provides planning guidelines for acid sulphate soils and refers proponents to the Acid Sulphate Soils Guidelines Series, prepared by the Department of Environment (now DEC), which assist developers and individuals to manage development in areas where acid sulphate soils may or will be affected.

4.3 SOILS AND TERRAIN OVERVIEW

The pipeline corridor passes through a range of soil and terrain conditions in the pastoral region and these are broadly described below in relation to the five biogeographical regions that Loops 0 to 6 traverse.

1. Pilbara (Loops 0 & 1): The surface geology of the pipeline in the Pilbara region is dominated by largely unconsolidated Quaternary alluvial, colluvial, eluvial and aeolian deposits of sand, gravel, silt and clay. Outcrops of rock are rare, although the undulating topography indicates that rock lies at a relatively shallow depth. The soils closely reflect the origins and mineralogy nature of the underlying geology. Soils vary along the route and include cracking clays, hard alkaline red soils, ironstone gravels and loamy soils developed on calcrete (Dames and Moore 2000).

2. Carnarvon (Loops 2, 3, 4 & 5): The Carnarvon region lies entirely within the Carnarvon Basin, a large sedimentary basin whose superficial expression is dominated by Quaternary eluvium, alluvium, colluvium and sheet-flood deposits that overlie Permian to Cretaceous sedimentary rocks. In the northern Carnarvon region along the pipeline corridor, outcrops of granite occur together with Cretaceous shale, siltstone and laterite. The southern Carnarvon region is dominated by Permian siltstone, sandstone, shale and calcareous rocks. Shallow rock and outcrops also occur in the southern part of the region. The soils vary from hard red sandy soils in the north of the region to earthy sands in the south, with fixed dunes becoming common (Dames and Moore 2000).

3. Gascoyne (Loops 2 & 3): The pipeline corridor traverses the western extreme of the Gascoyne region, an area with extensive occurrences of Proterozoic sedimentary, metamorphic and granitic rocks. Unconsolidated Quaternary sheet-flood colluvium and alluvium occupy low lying areas between the basement rocks. Shallow rock occurs along most of the corridor in this region. Soils vary between red and yellow earth soils, which are often underlain by laterite, to the north and hard red duplex soils, which set hard when dry, to the south (Dames and Moore 2000).

4. Yalgoo (Loops 5 & 6): The region is characterised by sand and alluvial plains, lateritic breakaways, low ranges and salt lakes. Broad alluvial valleys separate the breakaways and low ranges (Land and Water Australia 2001).

5. Geraldton Sandplains (Loop 6): The region is located entirely within the Perth basin, a deep linear trough of sedimentary rocks. The geology of the trough in Loop 6 is dominated by a late Carboniferous to Permian sequence of shallow marine and fluvial siliclastic rocks such as sandstone, siltstone and shale. The upper surface of the sediments has been weathered to form the Victoria Plateau, a gently undulating surface covered almost entirely by a lateritic duricrust overlain by Quaternary aeolian sand. The presence of small rock outcrops indicates that the laterite is typically shallow. The soils are dominated by earthy sands which are commonly underlain by ironstone gravels, laterite or an indurates mottled or pallid zone (Dames and Moore 2000).

Acid sulphate soils

Parsons Brinckerhoff undertook a desktop assessment to predict the likelihood of encountering acid sulphate soils along the DBNGP Stage 5 Expansion loops. This report (Parson Brinckerhoff 2006) is contained in Appendix 2 and an overview of the key findings provided below.

The potential for occurrence of acid sulphate soils occurring within the proposed excavation footprint was assessed through the use of key indicators such as geology, wetlands, depth to groundwater, and vegetation and classified as high (almost certain), medium (likely), medium to low (possible is isolated circumstances), and low (unlikely). Results are contained in Table 2.6.

Table 2.6 Summary of potential for occurrence of acid sulphate soils in Loops 0 to 6

Loop	Acid sulphate soil risk ranking (no. of km's along pipeline)			
	Low	Medium to low	Medium	High
0	70	1	30	15
1	110	15	0	0
2	106	1	0	0
3	111	3	0	0
4	110	5	0	0
5	119	1	0	0
6	132	0.5	0	0

Approximately 15 km of high risk soils were identified at the northern end of Loop 0 in association with cracking clays (marine sediments) and a depth to groundwater less than five metres below ground level (mbgl). An additional 30 km of medium risk soils were identified in association with cracking clays where the depth to groundwater is predicted to be greater than 5 mbgl.

Medium to low risk soils were identified generally in association with hard setting loamy soils, red yellow earths, hard red duplex soils or earthy sands in areas intercepting or near water bodies and rivers where groundwater was predicted to be generally shallow (e.g. 5-10 mbgl).

Where acidic soils occur above the natural watertable, excavation and backfilling of these soils is not expected to increase the risk of further acidification or release of metals. The protective trilaminate coating on the pipeline is acid resistant and the presence of acidic soils does not pose any threat to the integrity of the pipeline.

4.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Project activities that result in disturbance of the landscape surface and sub-surface soil profiles have the potential to affect soil and terrain values. Such activities include clearing and grading, trenching and excavation, and vehicle movement in general. Potential impacts that may result from these ground disturbance activities include:

- erosion (wind and rain) of the corridor and subsequent transport of material offsite
- soil compaction
- soil inversion whereby the topsoil is 'lost' through burial or mixing with other trench soil
- contamination of the soil from spills, disposal of hydrotest water and acid generating soils.

Erosion and sedimentation

Erosion and sedimentation are key potential impacts associated with the construction of the pipeline as construction activities will result in the removal of surface cover and disturbance to soil profiles. During rainfall events the cleared and open surfaces may be subject to erosion by water and the subsequent transportation and deposition of this sediment off the corridor. Erosion may also result from wind action on soils where prolonged exposure occurs following clearing. Through implementation of drainage controls, erosion control devices, appropriate topsoil/spoil stockpile management, and effective rehabilitation, significant erosion and sedimentation impacts will be minimised.

Soil compaction

In addition to the requirement for compaction of the backfilled trench (to prevent subsidence), general vehicle movement on the construction corridor can lead to soil compaction, particularly in areas where heavy machinery and equipment frequently traverse. Soil compaction could change local drainage patterns and prevent effective plant growth. Soil compaction activities will be temporary and any compaction will be alleviated through the ripping or scarification of the soil prior to rehabilitation.

Soil inversion

Topsoil may be 'lost' during the construction process through burial beneath (or mixing with) trench spoil during stockpiling or through return of topsoil and spoil to the trench in a sequence different to original profiles. The loss of topsoil can reduce the effectiveness of rehabilitation efforts. Through the implementation of topsoil handling procedures, soil inversion and the loss of topsoil is not expected to occur.

Soil contamination

Construction of the pipeline will involve relatively small quantities of chemicals and likely volumes of spills are extremely low. The storage and handling of fuel on-site will be required which could result in leaks or spills, however, spill prevention measures will be implemented at all times and spill contingency actions developed. The hydrotest water discharge may contain trace chemicals however the quantity of such chemicals is likely to be extremely low and poses no significant risk to the contamination of soil and/or water resources.

Only a small area along the pipeline in Loops 0 to 6 was identified as having soils of high or medium acid generating risk (Table 2.6). The generation of acid soils can affect soil quality, water quality and land use. In areas of high or medium risk soils, an investigation strategy will be developed to validate the desktop assessment and will include soil and groundwater sampling and analysis. These investigations will enable the preparation of acid sulphate soil and dewatering management protocols to be included in the CEMP.

Areas of medium to low risk acid sulphate soils along Loops 0 to 6 were typically areas of high elevation and where the river intercepts the pipeline, and flows are seasonal and high. Therefore, the likelihood of deposition of sulphides is considered low (Parsons Brinckerhoff 2006).

Mitigation

A CEMP will be prepared for the proponent's environmental management of the Stage 5 Expansion construction activities. The CEMP will include a *Soil Management Protocol* to be implemented during the various construction stages, including:

- installing erosion and sedimentation control structures
- stockpiling topsoil separately to other trench material
- restricting vehicle movement to designated access tracks
- ripping or scarifying compacted areas where necessary to alleviate compaction
- treating acid sulphate soils
- reducing trench open times in areas of acid sulphate soils.

The CEMP will also include site/issue specific management measures in the form of management protocols (e.g. *Acid Sulphate Management Protocol, Dewatering and Water Disposal Protocol*). Environmental Line Lists will indicate the location and length along the pipeline corridor to which a particular site/issue specific management protocol(s) needs to be applied.

The CEMP, acid sulphate soil, dewatering and other impact mitigation measures are described in more detail in Chapter 5.

4.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of soil and terrain parameters to assess the effectiveness of soil and terrain management measures described in the CEMP.

4.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of soils and terrain during construction of the pipeline, which will include specific measures for:

- potential acid sulphate soils
- dewatering and disposal of dewater product
- fuel and chemical storage, handling and spill response.

2. Undertake field investigations for the length of the Stage 5 Expansion to validate results from the acid sulphate soil and hydrogeological desktop study.

These commitments are consolidated in Table 7.1.

4.7 ENVIRONMENTAL OUTCOME

Construction of the Stage 5 Expansion pipeline may lead to erosion and sedimentation, soil compaction and inversion, and contamination of soil resources, which can lead to on and off-site impacts and can limit the effectiveness of rehabilitation efforts. The implementation of the proposed mitigation measures will minimise the risk of impacts to soil and terrain occurring and will ensure the EPA objective for this factor is met.

5 WATER RESOURCES

5.1 EPA OBJECTIVES

To maintain the integrity, ecological functions and environmental values of watercourses.

To maintain the integrity, ecological functions and environmental values of wetlands.

To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.

To ensure that emissions do not adversely affect environment values of the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

5.2 LEGISLATIVE AND POLICY CONTEXT

Regulatory framework

The abstraction of groundwater is subject to a licence issued by the Department of Water under the *Rights in Water and Irrigation Act 1914* that specifies the maximum abstraction rate and includes conditions for monitoring.

Surface water discharges and potentially polluting activities are managed under a licence issued under the *Environmental Protection Act 1986* (EP Act).

Water resource strategies and guidelines

The Government of Western Australia developed the State Water Quality Management Strategy with the objective 'to achieve sustainable use of the Nation's water resource by protecting and enhancing their quality while maintaining economic and social development'.

ANZECC/ARMCANZ Guidelines

In 1996, the Australian and New Zealand Environment and Conservation Council (ANZECC) together with the Agricultural and Resource Management Council of Australia and New Zealand (ARMCANZ) developed the National Principles for the Provision of Water for Ecosystems (1996). These national principles aimed to improve the approach to water resource allocation and management, and to incorporate the needs of the environment in the water allocation process. The overriding goal of the principles is to provide water for the environment to sustain, and where necessary restore, ecological processes and biodiversity of water dependent ecosystems.

ANZECC and ARMCANZ have also released a set of water quality guidelines for the protection of marine and freshwater ecosystems (ANZECC/ARMCANZ 2000). The ANZECC/ARMCANZ guidelines provide a comprehensive list of recommended low-risk trigger values for physical and chemical stressors in water bodies, broken down into five geographical regions across Australia and New Zealand.

5.3 WATER RESOURCES OVERVIEW

Rivers and streams

The pastoral region loops will involve the crossing of many watercourses, several of which are major rivers (Table 2.7). No major watercourses will be crossed in Loop 5. In addition to major watercourses, there were a number of small watercourses, floodways and drainage gullies which will be crossed by the pipeline corridor and that do not have an identifiable name. Watercourses are depicted in the series of landscape and environmental features maps contained in Chapter 8, Section 3.

Rivers in the north of the State are generally broad, shallow, ephemeral drainage lines that support riverine woodlands of eucalypts such as *Eucalyptus camaldulensis* (River Red Gum) and other species such as *Melaleuca argentea* (Cadjeput). Due to the low rainfall and high evapotranspiration, runoff is very low and for most of the time, there is no flow in these rivers. Streamflow is dominated by irregular summer rainfall resulting in variable flows; a situation of no flow may persist for long periods. However, pools sustained by groundwater may persist for significant periods of time (Dames and Moore 2000).

Table 2.7 Major watercourses that will be crossed in Loops 0 to 6

Loop	Name	Location of crossing (chainage)
0	Maitland River	37.612, 37.627, 37.661, 37.677
	Melford Creek	45.647
	Yanyare River	47.411
	Devil Creek	57.748, 58.095, 58.234
	Du Boulay Creek	98.602
	Fortescue River	108.696
	Trevarton Creek	127.656
1	Robe River	152.611, 153.061
	Warramboo Creek	166.479
	Peedamulla Creek	183.376
	Cane River	209.471
	Peepingee Creek	264.522
2	Yannarie River	337.291
	Lyndon River	400.528
	Monkey Creek	405.554, 406.086
3	Minilya River South	449.136
	Newman Creek	495.059
	Lyons River	534.897, 534.962, 535.140, 535.192, 535.219
4	Jacobs Gully	597.267
	Wooramel River	650.411
6	Murchison River	845.881
	Greenough River	962.370

Ephemeral wetlands

There are a number of ephemeral wetlands and claypans which occur near the pipeline corridor in the pastoral region. These are typically associated with the floodplains of major rivers (Table 2.8). Most of the ephemeral wetlands are claypans that contain water only after substantial rainfall (Dames and Moore 2000).

Table 2.8 Ephemeral wetlands located along Loops 0-6

Loop	Name	Classification	Location (KP/chainage)
0	Roebourne Plains	Wetlands	22-60 (KP)
1	South of Peepingee Creek	Ephemeral claypan wetlands	266.519-270.489 (Chainage)
3	Minilya River area	Ephemeral wetlands	434-460 (KP)
6	North of Murchison River	Ephemeral claypan wetlands	843.717-845.881 (Chainage)

Groundwater

Groundwater is generally deep (e.g. 10 to 140 mbgl) for most of the loops in the pastoral region, therefore, excavation will occur mainly above the water table. The exceptions to this being river basins where groundwater is predicted to be shallow, 0-10 mbgl (Parsons Brinckerhoff 2006). Groundwater is also likely to be the main construction water source for Loops 0 to 6. Up to 332 ML of water is expected to be abstracted from existing groundwater wells or from installing caissons in river beds for Loops 0 to 6, however, water will be reused where practicable, reducing water abstraction requirements. The majority of this water is required for hydrotesting (approximately 268 ML) with smaller quantities required for construction activities and potable water supply (approximately 46 ML and 18 ML respectively).

Some pastoral region flora species are thought to have potential for groundwater dependence. These communities are largely dominated by *Eucalyptus camaldulensis, E. victrix* and a range of *Melaleuca* and *Acacia* species. All of these larger trees and shrub species are dependent on intermittent groundwater levels and generally are adapted to massive water table fluctuations, providing they are not too extreme (Mattiske 2006). For example, *M. argentea* is often associated with shallow water tables and as such, this species is often referred to as a true phreatophyte[10] due to its apparent high dependency on groundwater (Muir Environmental 1995, Weston & Trudgen 1995) and *E. camaldulensis* is described as a vadophyte[11] that can also function as a phreatophyte when water is readily available (Muir Environmental 1995). These species are typically associated with the riparian zone of watercourses where depth to groundwater is shallow compared to upland areas. These species were recorded in Loops 0 to 6 (Mattiske 2006).

[10] Those species that rely on access to the water table or on a ready supply of surface water.

[11] Those species that primarily utilise water held in the vadose zone (e.g. the unsaturated zone above the water table) and not necessarily dependent on the water table.

5.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Project activities, such as excavation, trenching, and hydrostatic testing have the potential to affect watercourses and associated ephemeral wetlands. Potential impacts that may result from these activities include:

- physical disturbance to watercourses/ephemeral wetlands, banks and riparian vegetation
- alteration to surface water flow regimes
- deterioration in surface and groundwater quality
- groundwater drawdown.

The degree of impact pipeline construction may have on a watercourse is dependent upon various factors, including the volume of water carried by the river or stream during the construction period, the construction methods used and the stability of the watercourse beds and banks.

Physical disturbance to watercourses and ephemeral wetlands

There are a number of major watercourses that are required to be crossed by the pipeline in the pastoral region. River crossings may be by open-cut excavation methods or by HDD. Site specific geotechnical conditions will determine the methodology to be used in each case.

At the sites where HDD is undertaken, an area will be required to temporarily house the drill rig. The drill site area for the HDD from an operational and safety perspective is usually 50 m x 50 m in area and incorporates an area for the positioning of the drilling rig, an area for the management of the drilling mud (i.e. mud pits) and a safe truck turnaround/manoeuvring area. The same topsoil removal and preservation methods used on the general construction corridor will be used when clearing the HDD pads.

HDD involves drilling beneath the river, minimising disturbance to the bed, banks and riparian vegetation, and to surface water flow, but may require approximately 3000 m^2 of disturbance adjacent to the banks, mainly to accommodate drilling activities (e.g. drill rig pads, drilling fluids pits).

The HDD drilling mud disposal requirements include the construction of evaporation dams at the HDD entry and exit locations where the mud will be stored until the mud is dry. At this point, the mud will be loaded into tip trucks and disposed of at a suitable approved land fill/waste disposal site. The HDD pad will be rehabilitated.

Open-cut methods will require excavation through the banks and riverbed, deep enough to achieve the required 2 m cover below the stable river bed. This will ensure flow events do not expose the pipeline, ensuring pipeline integrity. The excavation will extend through the riverbank profile for some distance away from the river channel and require an increased working width across each bank of the river crossing to enable safe excavation and installation of the pipeline.

The installation of caissons in river beds for sourcing water will also result in the physical disturbance of river beds.

Post construction, there is potential for erosion of creek and riverbanks along the pipeline and access track alignments. The extent of sedimentation from erosion processes is determined by factors such as soil type, slope, run-off volume and velocity and vegetation cover. Appropriate stabilisation techniques (e.g. geotextile and gabions) will be employed to ensure the integrity of riverbanks are maintained and, as with all sections of the pipeline corridor, crossings will be rehabilitated as soon as practicable after construction. Although large riparian trees will not be allowed to re-establish over the pipeline due to the risk of pipeline damage from tree roots, the extent of clearing prior to construction will be carefully planned to minimise the number of large riparian trees which need to be removed (e.g. overhanging trees will be pruned rather that cleared).

Construction through wetlands, including claypans, will be based on applying a reduced working width to minimise impacts on vegetation, where present.

Alteration to surface flow regimes

Construction of the northern loops will be undertaken in the dry season (e.g. winter), as far as practicable, to avoid wet conditions and river flow events. However, there may be the need to temporarily dam rivers upstream of trenching activities should flow persist at time of construction. Alteration to stream flow will be for the duration of construction only, which may be up to several weeks for the large river crossings, as any damming structures will be removed after installation of the pipeline.

The disposal of water from dewatering and hydrostatic testing activities to watercourses will alter hydrological regimes through the potential introduction of large volumes of water. Disposal of such waters will be managed to avoid flooding and/or scouring. Water from these activities may also carry large volumes of sediment (see below).

The presence of linear stockpiles of topsoil and excavation spoil and modification to surface contours during construction may temporarily alter surface drainage patterns, which may temporarily affect the hydrological regimes of ephemeral wetlands. This is described and discussed in Chapter 2, Section 1.4.

Deterioration in water quality

Deterioration in surface and groundwater quality may affect the integrity and functions of watercourses and the future use of groundwater resources. Sediments entering watercourses from erosional processes or disposal of water from dewatering may cause a temporary reduction in water quality. Other potential sources of surface and groundwater contamination are minor spills of hazardous material (e.g. hydrocarbons), disposal of saline groundwater from dewatering, leachate from acid sulphate soils (Chapter 2, Section 4.3) and discharged hydrotest water (which may contain trace quantities of chemicals). Effects on water quality from these sources of contamination, should they occur, are expected to be temporary and not result in any long-term surface or groundwater quality impacts. Disposal of dewater product and hydrotest water will be undertaken in compliance with the DoW guidelines for dewatering (DoW 2006) to avoid contamination of any receiving waters.

Groundwater drawdown

Within the pastoral region, phreatophytic (groundwater dependent) vegetation is typically restricted to the major creek systems (e.g. riparian zone). Drawdown of groundwater levels near the riparian zone as a result of dewatering (should it be required) or groundwater abstraction could affect some riparian tree species if they are accessing groundwater.

The nature of the impact depends on the:

- presence of phreatophytic vegetation
- location, depth and extent of any drawdown cone
- rate of drawdown
- period of the drawdown.

Should groundwater drawdown occur from dewatering or groundwater abstraction, it is expected to be localised, of short duration and is not anticipated to result in any significant impact to vegetation and flora values. Pre-construction groundwater levels are expected to re-establish after dewatering ceases. See also Chapter 2, Section 1.4.

Groundwater abstraction is not expected to have any affect on the long-term viability of the resource, due to the short timeframe of abstraction and the relatively small quantities of groundwater abstracted. Water will be reused where possible.

Mitigation

A CEMP will be prepared for the proponent's environmental management of the Stage 5 Expansion construction activities. The CEMP will include management measures to be implemented during the various construction stages, including:

- scheduling creek-crossing construction activities to coincide with dry conditions or low creek flow periods, where practicable
- installing erosion control measures, such as geotextile, gabions and sandbags.

The CEMP will also include site/issue specific management measures in the form of management protocols (e.g. *Watercourse Crossing Protocol, Dewatering and Water Disposal Protocol*). Environmental Line Lists will indicate the location and length along the pipeline corridor to which a particular site/issue specific management protocol(s) needs to be applied. The CEMP and other impact mitigation measures are described in more detail in Chapter 5.

5.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of parameters associated with water resources to assess the effectiveness of water resource management measures described in the CEMP.

5.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of water resources during construction of the pipeline, which will include specific measures for:

- watercourse crossings
- dewatering and disposal of dewater product
- potential acid sulphate soils
- fuel and chemical storage, handling and spill response.

This commitment is consolidated in Table 7.1.

5.7 ENVIRONMENTAL OUTCOME

A number of major watercourse crossings will be required along the pastoral region Stage 5 Expansion pipeline sections using the preferred technique of open-cut construction. This will require direct disturbance of river beds, banks and riparian vegetation, and may result in the temporary alteration to stream flow (should flow be persistent at the time of construction) and some localised deterioration of water quality. The bed and banks will be appropriately stabilised and banks rehabilitated as soon as practicable following construction to minimise erosion risk.

Flows will be reinstated subsequent to construction and mitigation measures will ensure potential sources of water contamination will be appropriately managed to reduce contamination risks. Should groundwater drawdown from dewatering or groundwater abstraction occur, it is expected to be short in duration and is not anticipated to significantly affect the health of any groundwater dependent vegetation. Given the proposed management measures, impacts to watercourses will not be significant or long-term; therefore, the EPA objective for this factor will be met.

6 HERITAGE

6.1 EPA OBJECTIVE

To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.

6.2 LEGISLATIVE AND POLICY CONTEXT

Aboriginal heritage

State legislation

The Minister for Indigenous Affairs is responsible for the administration of the *Aboriginal Heritage Act 1972*. Under section 17 of the Aboriginal Heritage Act, it is an offence to disturb any Aboriginal site without consent under section 18 of that Act.

The Minister considers recommendations from the Aboriginal Cultural Material Committee and the general interests of the community when making a decision on disturbance to a site and may also impose conditions on the approval.

The Registrar of Aboriginal Sites is responsible for maintaining the Register of Places and Objects. The Department of Indigenous Affairs (DIA) has a database of all recorded sites.

EPA Guidance Statement No 41

EPA Guidance Statement No. 41, "*Assessment of Aboriginal Heritage*", provides guidance on the process for the assessment of Aboriginal heritage as an environmental factor. This guidance statement also details those actions that may be pertinent to the factor of Aboriginal heritage, including:

- consultation with DIA staff and desktop review of sites
- undertaking an Aboriginal heritage and/or archaeological survey in consultation with relevant Aboriginal representatives
- inform relevant Aboriginal people of the proposal and conduct appropriate consultation
- demonstrate that any concerns raised by the Aboriginal people have been considered in the environmental management of the factor and that this is made known to the relevant Aboriginal people.

Native title

Native title, or indigenous land rights, is a concept in the law of Australia that recognises the continued ownership of land by local Australian Aborigines or Torres Strait Islanders. The colonisation of Australia was conducted under the false assumption that the land was unoccupied (*terra nullius*) and could therefore be claimed for the Crown and distributed to colonists by the Government. The legal concept of Native Title as it applies in Australia was recognised by the judicial system in 1992, and the Keating government later enacted the *Native Title Act 1993* (Cwlth) to clarify the legal position of landholders and the processes that must be followed for Native Title to be claimed, protected and recognised through the courts.

European heritage

State legislation

The Heritage Council of WA operates under the *Heritage of Western Australia Act 1990* (Heritage Act). The Heritage Council of WA maintains the State Register, which provides official recognition of a place's cultural heritage significance to WA. Heritage places may include places, buildings or sites. The State Register also legally protects a place's cultural heritage significance by ensuring that any proposed demolition, relocation, subdivision, amalgamation, alteration, addition or new development is in harmony with its cultural heritage values. Protection is achieved through the requirement under the Heritage Act that all development proposals regarding a registered place be referred to the Heritage Council for advice.

Local government authorities are required under Section 45 of the Heritage Act to prepare municipal inventories. A municipal inventory is a list of buildings which in the opinion of the local government are, or may become, of local cultural heritage significance.

Commonwealth legislation

See Chapter 2, Section 3.2.

6.3 HERITAGE OVERVIEW

Aboriginal heritage

Australian Interaction Consultants (AIC) undertook an Aboriginal heritage assessment of the Stage 5 Expansion. This report (AIC 2006) is contained in Appendix 2 and an overview of Loops 0 to 6 provided below.

Searches of the Register of Aboriginal Sites, which is maintained by the DIA, indicated that over 200 archaeological and ethnographic sites have been recorded along or within 100 m either side of the pipeline corridor. These sites are comprised mostly of artefacts/scatters, which refers to locations where a range of activities has occurred such as the manufacture and maintenance of tools and the processing of foods. A small number of sites consisted of grinding patches/grooves, quarries, modified trees, and man-made structures.

Most of the registered sites are covered by existing Section 18 consents with conditions relating to them.

Native title

Yamatji Marlpa Barna Baba Maaja Aboriginal Corporation (YMBBMAC) is the native title representative body for native title claims in the Pilbara, Murchison and Gascoyne areas of Western Australia. The organisation has two divisions: Pilbara Native Title Service and Yamatji Land and Sea Council. At present YMBBMAC acts for over 10 registered native title claims near Loops 0 to 6 (Table 2.9).

Table 2.9 Native Title Claims near Loops 0 to 6

Loop	Native Title Claim
0	Kuruma Mardhudunera, Yaburara and Coastal Mardhudunera, Wong-goo-tt-oo
1	Thalanyji
2	Gnulli, Thalanyji, Budina
3	Thudgari, Gnulli
4	Gnulli, Malgana Shark Bay People's
5	Malgana Shark Bay People's, Nanda
6	Nanda, Wajarri Yamatji, Mullewa Wadjari, Naaguja Peoples, Amangu

European heritage

No European heritage sites are listed by the Heritage Council of Western Australia, Australian Heritage Commission or the National Trust of Australia as occurring within the pipeline corridor for Loops 0 to 6 (Dames and Moore 2000). In addition, no sites listed on municipal heritage inventories maintained by the separate local government authorities occur in the pipeline corridor[12]. The Shire of Ashburton municipal inventory listed homesteads as occurring near the pipeline but at sufficient distance to ensure no impacts will result from pipeline construction. Lonely graves may occur on some pastoral stations traversed by the corridor but specific locations have not been recorded in municipal inventories (Dames and Moore 2000).

6.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Project activities requiring ground disturbance (e.g. clear and grade, trenching and excavation) have the potential to disturb archaeological material and effect ethnographic values, should they be present. Potential impacts include:

- disturbance to known heritage sites and previously undiscovered sites
- disturbance to significant features of the landscape/environment (e.g. modified/scarred trees).

No European heritage sites will be affected by the Stage 5 Expansion.

[12] This was confirmed through correspondence with all local government authorities along the Stage 5 expansion pipeline route in June 2006.

Disturbance to land surface

Sites covered by existing Section 18 consents will be managed in accordance with the conditions applied to those consents. These conditions include avoidance of sites outside of the corridor (which may include flagging and/or fencing sites), salvaging and recording sites prior to disturbance, monitoring of ground disturbance activities by qualified archaeologists near some sites and undertaking additional archaeological investigations prior to disturbance.

Sites not covered by existing Section 18 consents will be further researched. This research will include detailed analysis of site records and may require some in-field investigations. From the results of these investigations, appropriate heritage management procedures will be implemented for these sites (e.g. submitting Section 18 applications, identifying sites for protection etc.).

Land disturbance activities during construction may uncover previously unrecorded heritage sites (e.g., sub-surface artefact scatters and skeletal material may be present). In hard ground formations, the potential for uncovering such material is low compared to more sandy formations. In areas where the potential for uncovering such material is high, qualified heritage consultants will be present during ground disturbance activities.

Where a heritage site cannot be avoided, the proponent will seek a Section 18 consent, in consultation with relevant Aboriginal groups. The proponent will undertake disturbance in accordance with the conditions of the Section 18 consent, and will consult and involve relevant Aboriginal groups in mitigative heritage work prior to disturbance of the site.

Disturbance to significant features

Significant landscape or environmental features, such as trees and watercourses, may be of heritage or ethnographic importance, but not recognised as 'sites' *per se*. The pipeline corridor will require the removal or displacement from within the pipeline corridor and in some areas outside the pipeline corridor, and will cross several watercourses, which will require disturbance to the bed and banks. Concern has also been expressed in the course of past heritage surveys about the possible loss of plants used by Aboriginal people as food and medicine (AIC 2006).

Clearing outside the corridor will avoid significant trees and other features where practicable. Pruning of large trees will also be undertaken in preference to removal where practicable. All disturbed areas will be rehabilitated to their pre-construction condition. Where required, the proponent will consult with relevant Aboriginal groups to implement watercourse crossings.

Mitigation

A CEMP will be prepared for the proponent's environmental management of the Stage 5 Expansion construction activities. The CEMP will include management measures to be implemented during the various construction stages, including:

- flagging and/or fencing known heritage sites identified for protection
- onsite heritage monitors and archaeologist to be present during ground disturbance activities in areas where heritage material has the potential to be present
- contingency actions to be implemented in the event of unearthing potential heritage material.

The CEMP will also include site/issue specific management measures in the form of management protocols (e.g. *Aboriginal Heritage Management Protocol*). An Environmental Line List will indicate the location and length along the pipeline corridor to which a particular site/issue specific management protocol(s) needs to be applied.

The CEMP, the *Aboriginal Heritage Management Protocol* and other impact mitigation measures are described in more detail in Chapter 5.

6.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of Aboriginal heritage parameters to assess the effectiveness of heritage management measures described in the CEMP.

6.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of Aboriginal heritage during construction of the pipeline, which will include specific measures for:

- avoidance of disturbance to sites identified for protection
- discovery of new heritage sites or material.

2. Undertake further research of Aboriginal heritage sites along the pipeline that were identified as not being covered by existing Section 18 consents and, based on research findings, develop and implement appropriate heritage management measures for these sites.

These commitments are consolidated in Table 7.1.

6.7 ENVIRONMENTAL OUTCOME

Construction of the Stage 5 Expansion will require the disturbance of Aboriginal heritage sites within the pipeline corridor along Loops 0 to 6 and will not affect any known European heritage sites. Where these sites are covered by existing Section 18 consents, they will be managed in accordance with the consent conditions. Where these sites are not covered by existing Section 18 consents, they will be further researched and appropriate heritage management procedures developed and implemented. The proponent will avoid disturbance to sites outside the corridor identified for protection, and will minimise disturbance to landscape and environmental features that may be of heritage significance but not recognised as 'sites'. The proponent will continue to consult with relevant Aboriginal groups and will ensure that, consistent with the EPA objective for this factor, Aboriginal heritage sites are managed in accordance with the Aboriginal Heritage Act.

7 LAND USAGE AND SERVICES

7.1 OBJECTIVE

Minimise disturbance to third party infrastructure, landholders and land use.

7.2 LAND USAGE AND SERVICES OVERVIEW

Loops 0 to 6 are located in the Pilbara, Gascoyne and Midwest Regions as defined by the State Planning Strategy (WAPC 1997). The Loops traverse the Shires of Roebourne, Ashburton, Carnarvon, Upper Gascoyne, Shark Bay, North Hampton, Chapman Valley and Mullewa (Table 2.10).

The current land use within Loops 0 to 6 is varied due to the expansive length traversed by the pipeline (Table 2.10). The loops are located primarily within Crown Leases (pastoral) and an area within Loop 4 is used for cattle and tourism. Smaller proportions of the land are freehold, Crown Reserve and Crown Land. Loops 0 to 6 also traverse exploration and other tenements associated mainly with extractive industries such as iron ore, and oil and gas.

Loops 0 to 6 pass primarily through sparsely populated areas. The start of Loop 0 is approximately 2 km from the township of Dampier. There are no other townships near the pipeline corridor. Several homesteads, other buildings (e.g. sheds) and other third-party pastoral infrastructure (e.g. fencing, stock yards) are close to the pipeline corridor (Table 2.10).

Other third-party infrastructure near the pipeline corridor includes roads (major roads crossed being North West Coastal Highway, Onslow Road and Carnarvon Mullewa) and utility services (e.g. power transmission lines). The pipeline corridor also crosses the vermin proof fence to the east of Kalbarri (Table 2.10).

Table 2.10 Local government authorities and land use along Loops 0 to 6

Loop	Local government authority	Description of land use*
0	Shire of Roebourne	Comprises mining activities, pastoral stations. There are no premises within 660 m of the pipeline easement.
1	Shire of Ashburton	Land use consists of conservation reserves, Aboriginal lands, mining properties and crown land. There are no premises within 660 m of the pipeline easement.
2	Shire of Ashburton	Predominant land use is pastoral stations. There are no premises within 660 m of the pipeline easement.
3	Shire of Carnarvon	Predominant land use is pastoral stations. There are no premises within 660 m of the pipeline easement.
4	Shire of Carnarvon, Shire of Upper Gascoyne	Land use includes pastoral stations and Aboriginal communities. There are no premises within 660 m of the pipeline easement.
5	Shire of Shark Bay	Comprises nature/conservation reserves and leased pastoral lands. There are no premises within 660 m of the pipeline easement.
6	Shire of Northampton, Shire of Chapman Valley, Shire of Mullewa	Land use includes numerous pastoral stations and crown land. Six sensitive premises were identified in this loop, the closest being within 165 m of the pipeline easement.

*Sensitive premises identified during the Risk Assessment undertaken, incorporating areas within 660m of the pipeline.

7.3 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

During the construction of the pipeline, access to and use of land on the corridor by landowners and the public will be strictly prohibited. Construction activities will also require the crossing of roads, fences and other infrastructure, and may also contribute to ongoing land use issues. Potential impacts that may result from construction activities include:

- temporary loss of land for utilisation in pastoral activities
- temporary impediment to property access and stock movement
- increased risk of wildfire and the introduction of weeds
- possible long-term loss in soil productivity
- disruption or damage to infrastructure, services and third party property.

Access to and utilisation of land

Prohibition of access to and use of the pipeline corridor land will be temporary and will cease once the construction phase of the project has been completed and the corridor rehabilitated. Furthermore, as the pipeline is buried, existing land uses will be able to resume post-construction and rehabilitation. Existing land uses will generally not be restricted over the pipeline except those that will potentially cause harm to the pipeline or the public (e.g. deep ripping, fence installations and the planting of deep rooted plants). The construction phase and subsequent land use restrictions are not anticipated to significantly affect pastoral activities during and post-construction in Loops 0 to 6.

Soil productivity

Soil productivity, in terms of erosion, compaction, inversion and contamination, is discussed in Chapter 2, Section 4.4.

Weeds and wildfire

The introduction and/or the spread of weeds along the pipeline corridor can affect the productivity of the land, should this land be used for grazing or other pastoral activities, as too can fire incidences. Chapter 2, Section 1.4 discusses weeds and wildfire, including management measures.

Infrastructure, services and third-party infrastructure

Construction activities will not result in significant impacts to public infrastructure and services. All public utilities (services) will be identified prior to construction by the Stage 5 Expansion Land Management Team to enable protection and avoidance during construction. Construction near these utilities will be undertaken in accordance with relevant utility standards and guidelines.

Public infrastructure, such as roads, may require some level of disturbance. For example, road crossings will be undertaken using either open-cut or directional boring methods, and heavy vehicle and equipment movement on public roads may result in localised damage to road integrity.

Private property impacts will be necessary as part of the normal construction process and will be communicated and discussed with the landowner by the Land Management team prior to construction commencing. All public and private infrastructure will be restored to its pre-construction condition in accordance with agreements made between the proponent and landowners.

Mitigation

A Stage 5 Expansion Land Management Strategy will be developed that will outline:

- land management processes, such as the notification of landowners and facilitation of land owner agreements
- land management activities, such as determining construction access to the pipeline corridor
- rehabilitation requirements.

A Stage 5 Land Management Team will be responsible for communicating with landowners along the pipeline route advising them of all aspects of the construction activities that are likely to affect them. The aim is to deliver the project with minimum disruption to the landowners affected by both pre-construction and construction activities.

A CEMP will also be prepared for the proponent's environmental management of the Stage 5 Expansion project construction activities. The CEMP will include management measures to be implemented during the various construction stages, which will include measures that will address land usage and services issues, such as:

- weed management
- soil management
- fire management
- rehabilitation.

The CEMP will also include site/issue specific management measures in the form of management protocols (e.g. *Fire Management Protocol* and *Weeds, Pests and Dieback Management Protocol*). Environmental Line Lists will indicate the location and length along the pipeline corridor to which a particular site/issue specific management protocol(s) needs to be applied.

The Land Management Strategy, CEMP and other impact mitigation measures are described in more detail in Chapter 5.

7.4 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of parameters associated with land usage and services to assess the effectiveness of management measures described in the CEMP (Chapter 5).

7.5 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of land usage and services during construction of the pipeline, which will include specific measures for:

- weed, soil and fire management
- rehabilitation
- access and safety management (primarily addressed through the Land Management Strategy).

This commitment is consolidated in Table 7.1.

7.6 ENVIRONMENTAL OUTCOME

The Stage 5 Expansion is expected to cause minimal disruption to landowners and other third-party infrastructure in the pastoral region. This is because the duration of prohibition of public access to the pipeline corridor will be relatively short, land users will be able to resume previous land use activities on top of the pipeline (post construction and rehabilitation) except excavation activities, and infrastructure will be reinstated and landscaped following construction.

8 OTHER ENVIRONMENTAL FACTORS

A number of environmental factors have not been addressed in detail for the pastoral region of the Stage 5 Expansion as they were considered to be minor factors given the remoteness of the pipeline location. These factors are noise and vibration, air quality (dust), and public safety and risk. They are addressed briefly below in Sections 8.1 to 8.3.

8.1 NOISE AND VIBRATION

EPA objective

To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring noise levels meet statutory requirements and acceptable standards.

Legislative and policy context

The legislative framework for managing noise impacts is the EP Act, specifically sections 51, 62(4), 65 and 74(3)/50, 51 and 75. The noise limits cited by the Act are prescribed in the Environmental Protection (Noise) Regulations 1997 (Noise Regulations) and are provided in Table 2.11.

Table 2.11 Prescribed noise limits

Type of premises receiving noise	Time of day	Assigned level (dB)		
		LA 10	LA 1	LA max
Noise sensitive premises within 15 m of a building directly associated with a noise sensitive use	0700 to 1900 hours Monday to Saturday	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	35 + influencing factor	45 + influencing factor	55 + influencing factor
Noise sensitive premises further than 15 m from a building directly associated with a noise sensitive use	All hours	60	75	80
Commercial premises	All hours	60	75	80
Industrial and utility premises	All hours	65	80	90

Whilst these noise limits are prescribed in the regulations, construction sites are exempt from these as detailed in Part 2 Regulation 13 of the Noise Regulations:

> *Regulation 7 does not apply to noise emitted from a construction site as a result of construction work carried out between 0700 hours and 1900 hours on any day which is not a Sunday or a public holiday if the occupier of the premises or public place, shows that –*

(a) the construction work was carried out in accordance with control of environmental noise practices set out in section 6 of AS 2436-1981 Guide to Noise Control on Construction , Maintenance and Demolition Sites;

(b) the equipment used on the premises was the quietest reasonably available; and

(c) if the occupier was requested to prepare a noise management plan under sub regulation (4) in respect of the construction site-

(i) the noise management plan was prepared and given in accordance with the requirement, 7 days prior to construction commencement, and approved by the Chief Executive Officer; and

(ii) the construction work was carried out in accordance with the management plan.

Therefore, the noise limits outlined in Table 2.11 do not apply for the construction work being undertaken as part of the Stage 5 Expansion between the hours of 0700 and 1900 from Monday to Saturday, however any work conducted out of these hours or during Sunday and public holidays will need to comply with the standards.

Air-blast levels prescribed by the Noise Regulations are shown in Table 2.12. Blasting will also comply with the requirements of the Department of Industry and Resources (DoIR) and specifically with the *Explosives and Dangerous Goods Act 1961* and the *Mining Act 1978*.

Table 2.12 Air blast criteria

Day	Time	Maximum level*	Level	Compliance frequency
Days other than Sundays and public holidays	7am – 6pm	125 dB $L_{linear, peak}$	120 dB $L_{linear, peak}$	For nine in any 10 consecutive blasts, regardless of the interval between blasts
Sundays and public holidays	7am – 6pm	120 dB $L_{linear, peak}$	115 dB $L_{linear, peak}$	For nine in any 10 consecutive blasts, regardless of the interval between blasts
All other times	6pm – 7am	90 dB $L_{linear, peak}$	-	-

*Applies to all blasts.

Blast vibration criteria for structures are set by Australian Standard 2187.2 (1993) Part 2. Table 2.13 indicates the levels of peak particle velocity required before there is damage to a typical residential structure.

Table 2.13 Potential for damage and limits for ground vibration of structures

Peak particle velocity (mm/sec)	Level of damage	Structure
<5	No damage	
5-10	Damage unlikely	
10-20	Potential minor damage (plaster cracks)	Houses and low rise residential structures may be damaged above 10 mm/sec
20-30	Minor damage (plaster cracks)	Commercial and industrial structures may be damaged above 25 mm/sec
30-50	Minor structural damage (concrete cracks)	
>50	Potential major damage	

The DEC applies criteria in environmental licences for vibration caused by blasting. The selection of the standard used is based on avoidance of human annoyance rather than structural damage, as follows:

- peak particle velocity is not to exceed 5 mm/sec for 90% of all blasts
- peak particle velocity is not to exceed 10 mm/sec for 100% of all blasts.

Noise and vibration overview

The predominant land use along the pipeline corridor in the pastoral region is pastoral grazing; consequently, there are few potential noise sensitive premises near the pipeline corridor. These premises comprise mainly homesteads on pastoral properties. An overview of surrounding land use, including nearby residences, is contained in Table 2.10.

Table 2.14 provides an estimate of noise emissions from equipment that will be used during the construction of the pipeline.

Table 2.14 Noise emission characteristics of all construction phases

Machinery/equipment generating noise	Level of noise expected (dB)
Excavators 100 kW – 200 kW	112
Tractors track 100 – 200 kW	118
Compressors 7 m^3/m partly silenced	100
Graders > 100 kW	120
Hand tools: grinder breaker	106
Hand tools chipping hammer	119
Trucks 20 T	108
Rock breaker: breaker hydraulic	119
Ditching machine: approx	112
Padding machine: approx	115
Dewatering pump	108
Generator	112

Source: AS 2436-1981

Assessment and mitigation of potential impacts

Noise and vibration will be generated during the construction of the pipeline. Vibration and ambient noise levels near the construction corridor will increase as a result of the project, however due to the remoteness and short duration of the construction operations in one location, noise and vibration impacts will primarily be restricted to health and safety of the construction workforce.

Noise emissions from the construction corridor will vary depending on the aspect of the project being undertaken (e.g. blasting, clearing and grading), the resultant tonality of the noise emission, and the duration of the emission. Some noise emissions from the construction operations with varying tones could be considered intrusive (e.g. vehicle reversing beacon or blasting activities), whilst other noise emissions with a continuous tone could be considered less intrusive (e.g. running vehicle engine). The progressive movement of the active construction area will limit the duration of noise emissions from one particular location.

Noise emissions from the construction of the pipeline will cause localised temporary disruption to fauna in areas adjacent to the corridor; however, it is unlikely that the behaviour of fauna will be disrupted by noise emissions in the long term (Chapter 2, Section 2.4).

The proponent will minimise noise emissions through mitigation measures described in Chapter 5. These measures include ensuring noise and vibration from construction of the pipeline complies with the requirements of the Noise Regulations and DoIR requirements for mine safety and health.

Monitoring and assessment of performance

The CEMP will include provisions for the monitoring of noise and vibration parameters to assess the effectiveness of management measures described in the CEMP (Chapter 5).

Proponent commitments

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of noise and vibration emissions during construction of the pipeline, which will include:

- scheduling construction during daylight hours to avoid impacts on nocturnal fauna
- maintaining vehicle speed limits
- compliance with Noise Regulations.

This commitment is consolidated in Table 7.1.

Environmental outcome

Given the remote nature and short duration of construction of the Stage 5 Expansion, it is anticipated that noise and vibration from construction activities will not have a significant impact on any noise sensitive premises or fauna values within the pastoral region. Therefore, the EPA objective for this factor will be met.

8.2 AIR QUALITY (DUST)

EPA objective

To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

Legislative and policy context

In June 1998, a National Environmental Protection Measure (NEPM) for Ambient Air Quality was endorsed by the National Environment Protection Council (NEPC). The desired environmental outcome of this Measure is ambient air quality that allows for the adequate protection of human health and well being (NEPC 1998). The measure included standards for air quality, including for particulates as PM_{10}. In 2003, the National Environmental Protection Measure was amended to include advisory reporting standards for particles as $PM_{2.5}$ (NEPC 2003).

The National Environmental Protection Measure standards and goals for particulates are shown in Table 2.15.

Table 2.15 National Environmental Protection Measure for ambient air quality

Pollutant	Averaging period	Maximum concentration	Maximum allowable exceedances
Standards and goal for pollutants other than particulates as $PM_{2.5}$			
Particles as PM_{10}	1 day	50 µg/m^3	5 days a year
Advisory reporting standards and goal for particulates as $PM_{2.5}$			
Particles as $PM_{2.5}$	1 day	25 µg/m^3	Goal is to gather sufficient data nationally to facilitate a review of Advisory Reporting Standards
	1 year	8 µg/m^3	

Overview of air quality (dust)

Dust from soil disturbance will be the main component of air emissions during the construction phase of the proposed development. However, no dust emissions are likely once the pipeline is in operation.

In the assessment of environmental impacts, dust is more conventionally referred to as 'particulates' or 'airborne particulates'. Airborne particles can be generated during construction activities mainly by mechanical disturbances, such as blasting, earthmoving and road traffic on unsealed surfaces. In dry windy conditions, particles can be lifted from open or disturbed areas, resulting in visible dust emissions. Most airborne particles that originate from these sources are larger than PM_{10} and are more associated with nuisance than public health problems. The larger particles tend to settle back to the ground within a short range (<300 m) from the source. However, it is increasingly considered that it is the $PM_{2.5}$ fraction of the PM_{10} that is most responsible for health effects.

The generation of airborne dust from construction operations will depend on:

- the frequency at which a dust generating activity takes place
- meteorological conditions, such as wind speed
- composition of dust, including particle size distribution, particle density and moisture content
- the condition of the source.

There are few potential dust sensitive premises near the pipeline corridor along Loops 0 to 6. An overview of surrounding land use, including nearby residences, is contained in Table 2.10.

Assessment and mitigation of potential impacts

Dust emissions generated from construction of the pipeline may result from vehicle movements, ground disturbance activities, wind action on stockpiles and bare areas, and blasting activities. Dust emissions have the potential to create a short-term nuisance to nearby sensitive residents and may reduce visual amenity, be of general nuisance and cause health problems in susceptible individuals. The effects of dust on vegetation and flora, and fauna were described in Chapter 2, Sections 1.4 and 2.4 respectively.

The proponent will minimise the emission of dust through mitigation measures described in Chapter 5. These measures include:

- minimising the area being cleared
- rehabilitating and/or stabilising areas as soon as possible after disturbance
- avoiding unnecessary movement of vehicles and machinery.

Monitoring and assessment of performance

The CEMP will include provisions for the monitoring of dust parameters to assess the effectiveness of dust management measures described in the CEMP.

Proponent commitments

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of dust emissions during construction of the pipeline, which will include specific measures for:

- stabilising disturbed surfaces and/or stockpiles
- watering
- rehabilitation.

This commitment is consolidated in Table 7.1.

Environmental outcome

Significant long-term dust impacts are expected to be negligible given the low population density along Loops 0 to 6, the short-term and temporary nature of the construction work and the mitigation measures proposed by the proponent for the Stage 5 Expansion. These measures will ensure dust emissions do not have any significant impact upon sensitive premises, and vegetation and fauna values, and that the EPA objective for this factor will be met.

8.3 PUBLIC SAFETY AND RISK

EPA objective

To ensure that risk from the proposal is as low as reasonably achievable and complies with acceptable standards and EPA criteria.

Legislative and policy context

State legislation

The transportation of dangerous goods in Western Australia is managed in accordance with the *Explosives and Dangerous Goods Act 1961* and associated regulations and the *Dangerous Goods (Transport) Act 1998* and associated regulations (expected to be replaced by *Dangerous Goods Safety Act 2004* by late 2006). These Acts and Regulations aim to protect the community by minimising risks associated with the storage, transport and handling of dangerous goods.

The Resources Safety Division of the Department of Consumer and Employment Protection is responsible for administering the above mentioned legislation and associated regulations, through licensing, assessment, inspection and advisory functions.

Australian standards

Various Australian standards also apply to the transport of dangerous goods, namely procedures for dealing with emergencies involving specific dangerous goods.

Overview of public safety and risk

Pipelines are recognised as a safe and efficient means of transporting natural gas. However, all developments present some level of risk during construction and operation. There are several aspects of the Stage 5 Expansion that could potentially pose an off-site risk to the safety of the general public, not including pipeline construction personnel. These include:

Construction

- proximity of construction activities to private residences and public roads
- the requirement for transportation of equipment, hydrocarbons and chemicals on public roads
- the increase in traffic volumes on public roads.

Operation

- interference with the pipeline.

Assessment and mitigation of potential impacts

The pastoral region is remote and thus the proportion of the public likely to be affected by the construction risks identified above is reduced in comparison to highly populated areas. A Stage 5 Expansion Land Management Strategy will be developed, and will address public safety and access to the corridor during construction and management of land use activities within the pipeline corridor post-construction (Chapter 5).

The transport of potentially hazardous material (e.g. hydrocarbons and chemicals) will be managed in accordance with relevant State legislation and Australian standards to ensure risks to the public are minimised as far as practicable. Requirements of this legislation and standards include, amongst others, vehicle and driver licensing and vehicle placarding. The storage and handling of fuels and chemicals and response to spills will also be managed in accordance with specific management measures to be detailed in the CEMP (Chapter 5).

Construction of the Stage 5 Expansion will result in a small increase above current levels in general traffic and freight movement along the major transport routes in the project area. Anticipated traffic increases will be within the current capacity of the public roads and are not expected to pose a significant risk to other road users.

The Stage 5 pipeline will be constructed in accordance with Australian Standard 2885 to meet appropriate safety standards. This includes physical and procedural measures, such as burying the pipeline and installing signs, amongst others. These measures will reduce the likelihood of post-construction interference.

Monitoring and assessment of performance

The CEMP will include provisions for the monitoring of parameters associated with fuels and chemicals, and access and safety, to assess the effectiveness of management measures described in the CEMP.

Proponent commitments

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of parameters associated with public safety during construction of the pipeline, which will include specific measures for:

- fuel and chemical storage, handling and spills response
- access and safety.

This commitment is consolidated in Table 7.1.

Environmental outcome

There are few private residences near the Stage 5 Expansion pipeline alignment in the pastoral region, therefore reducing public safety risks associated with construction activities. Construction of the Stage 5 Expansion will result in an increase in general traffic volumes and freight movement (including some dangerous goods) on public transport routes in the project area. However, the increase in traffic volumes will be temporary and within the current capacity of the public roads. Transportation of dangerous goods will be done in accordance with relevant legislation and standards. Through implementation of risk mitigation measures, potential risk to the public will be reduced as far as practicable to ensure the EPA objective for this factor is met.

Chapter 3 Assessment and management of key environmental factors in the agricultural region (Loops 7 & 8)

This Chapter contains the assessment of environmental factors identified for the agricultural region loops of the DBNGP. The agricultural region covers the length of the pipeline from Geraldton to Gingin, or Loops 7 and 8 (Figure 1.1 and Figure 1.2). The Stage 5 section of the pipeline corridor within Loops 7 and 8 is approximately 239 km in length.

The key environmental factors addressed in this Chapter are:

- vegetation and flora
- fauna
- areas of conservation value
- soils and terrain
- water resources
- heritage
- land usage and services.

Other environmental factors considered in this Chapter, but not identified as key environmental factors, are:

- noise and vibration
- air quality (dust)
- public safety and risk.

1 VEGETATION AND FLORA

1.1 EPA OBJECTIVE

To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

1.2 LEGISLATIVE AND POLICY CONTEXT

See Chapter 2, Section 1.2.

1.3 VEGETATION AND FLORA OVERVIEW

Mattiske Consulting Pty Ltd (Mattiske) undertook a vegetation and flora survey of Loop 7 of the Stage 5 Expansion (Mattiske 2006). An overview of the findings is provided below.

A survey of Loop 8 is planned for the spring of 2006. A list of Threatened Flora and TECs that have been recorded near Loop 8 has been compiled from DEC datasets and an overview provided below.

Vegetation

The vegetation of Loops 7 and 8 are broadly described below in regards to the two biogeographical regions traversed by the loops:

- Geraldton Sandplains (Loops 7 & 8): Located in the Irwin Botanical District of the Southwest Botanical Province as defined by Beard (1976). Dominant plant families include Proteaceae, Myrtaceae, Mimosaceae, Casuarinaceae, Asteraceae, Chenopodiaceae and Poaceae. Scrub heath and *Acacia – Casuarina* thickets with occasional areas of *Acacia* scrub with scattered *Eucalyptus* trees are main characteristics.
- Swan Coastal Plain (Loop 8): Part of the Southwest Botanical province as defined by Beard (1981). Characterised by *Banksia* low woodland on leached sands with *Melaleuca* swamps in less drained areas.

The majority of Loop 7 has been cleared and modified by agricultural activities. Consequently, only localised remnants occur near the pipeline corridor. The values within these remnants are locally significant as so little is left of the original plant communities in the area.

A search of the DEC TEC database revealed that there is currently no known TEC located within Loops 7 and 8 (Woodman 2006). However, as noted by Woodman (2006), there is an occurrence of the priority ecological community known as '*Petrophile chrysantha* low heath on Lesueur dissected uplands' in the area. There are also occurrences of the Critically Endangered TEC 'Lesueur-Coomallo Floristic Community (species rich low heath dominated by *Allocasuarina microstachya*)' and occurrences of the priority communities 'Ferricrete floristic community (Rocky Springs type)' and 'Lesueur-Coomallo Floristic Community (*Melaleuca preissiana* woodland)' within 20 km of the pipeline corridor looping sections.

Flora

A total of 58 taxa of native terrestrial vascular flora were recorded from along Loop 7. No DRF or Priority Flora species were located during the survey. Three introduced species were recorded. These were *Avena barbata, Bromus* sp. and *Mesembryanthemum nodiflorum.*

The DEC database has also been searched for DRF and Priority Flora occurring within or immediately adjacent (within 5 km either side of the alignment) to the corridor. This list of species is provided in Mattiske (2006).

A range of DRF species is known to occur near Loop 8 and this area will be inspected closely during the spring flora survey. In addition, there are another 124 Priority Flora species which may occur within the area (Woodman 2006).

1.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Project activities requiring vegetation clearing (e.g. clear and grade) have the potential to affect vegetation and flora values. Potential direct impacts that may result primarily from clearing activities include:

- change in the abundance, species diversity, geographic distribution and productivity of vegetation communities
- disturbance of Declared Rare and Priority Flora species.

Potential indirect impacts that may result from other construction activities, such as trenching and excavation, dewatering, hydro-testing, and stringing, welding and x-raying, include:

- smothering of vegetation by dust
- increased risk of introduction or spread of weeds and disease (e.g. dieback)
- increased bushfire risk (associated with metal cutting, welding and grinding activities)
- alteration of groundwater and surface drainage regimes.

Vegetation clearing

The total area of disturbance within the pipeline corridor required for construction of Loops 7 and 8 is around 600 ha[13]. Of this, approximately 120 ha in Loop 7 and 60 ha in Loop 8 is vegetated and will require clearing (Table 3.1). There will also be a requirement for infrastructure to be located outside of the pipeline corridor (e.g. turnarounds, turkey nests) (Table 3.1). Existing turkey nests, construction camp sites and cleared and/or disturbed areas will be used where practicable in preference to disturbing new sites.

[13] Based on a working width of 25 m and does not take into account reduced working widths in areas of conservation value.

Table 3.1 Area of disturbance in Loops 7 and 8

Loop	Estimated total area of disturbance within pipeline corridor (ha)*	Estimated vegetated area within corridor (ha)*	Estimated area of disturbance outside corridor (ha)
7	356	120	16
8	242	60	15
TOTAL	**598 ha**	**180 ha**	**31 ha**

* Based on a working width of 25 m. Not taking into account reduced working widths in areas of conservation value.

The vegetation that exists within the pipeline corridor is vegetation that has established subsequent to the clearing for installation of the original pipeline 24 years earlier. Vegetation removal and subsequent rehabilitation within the pipeline corridor will occur sequentially as each individual pipeline section is constructed; only the relevant length of the pipeline corridor will be cleared for each construction period. The extent of vegetation within Loop 7 is negligible in view of the extent of agricultural clearing activities. In contrast, sections of Loop 8 occur within areas supporting uncleared shrubland and heath communities which are locally and regionally significant as a result of the range of species, degree of endemism and previous clearing activities in the area.

No DRF or Priority Flora species were located in Loop 7. Occurrences of DRF or Priority Flora within the pipeline corridor, should they occur along Loop 8, will most likely be cleared, however, there may be opportunities to avoid flora (e.g. through reducing corridor working width), translocate flora to adjacent vegetation or use biological material from flora for propagation of plants for rehabilitation. Disturbance to occurrences of these species outside of the pipeline corridor (e.g. for construction camps, turnarounds etc.) will be avoided. In the event that DRF cannot be avoided, an application to take DRF will be prepared and submitted to DEC for approval by the Minister for the Environment in accordance with the Wildlife Act.

Based on currently available information, the loss of flora from disturbance during the project is not expected to affect the conservation status of these species. This will require further targeted work in the spring months of 2006.

Dieback

Dieback disease, caused by microscopic soil fungi of the genus *Phytophthora*[14], affects a wide range of native flora species throughout the South-West of Western Australia. The pathogen requires a minimum of 400 mm annual rainfall to survive and these conditions are met in Loop 8. Dieback may be spread by surface or subsurface water flow, but the major vector of infection is the transport of infected soil and plant material, whether in fill or mulch or adhering to vehicles and machinery.

Mapping for dieback has not been undertaken along Loop 8 but will be undertaken as part of spring flora surveys. The location of dieback infestations will be included on the Environmental Line List, being prepared as part of the CEMP, to indicate areas where dieback hygiene measures are to be implemented during construction. As construction will be occurring in predominantly dry seasons (where practicable), and a *Weed and Dieback Management Protocol* will be implemented, the risk of spreading dieback will be minimal.

[14] Currently up to nine *Phytophthora* species are causing infestation in the South-West. This disease destroys the structure of native plant communities, reducing their floristic diversity, decimating primary productivity and destroying habitat for dependant native fauna (EPA 2000).

Weeds

Movement of vehicles has the potential to introduce weeds and/or spread existing populations of weeds within and adjacent to the pipeline corridor, as outlined in Chapter 2, Section 1.4.

A range of aggressive agricultural weeds occurs in Loops 7 and 8. These include species with a wide tolerance of sites or that tend to occur on the deeper sandy soils in these areas. These species include *Eragrostis curvula* (South African Love Grass), *Ergarta calyina* and *E. longiflora* (Veldt Grass), *Lupinus* species, and *Artotheca calendula* (Cape Weed).

Dust

Vegetation adjacent to the pipeline corridor may be affected physically by dust primarily through blockage and damage to stomata or shading. However, as the construction process is temporary and short-lived, this impact is not expected to be significant. A *Dust Management Protocol* will be prepared and implemented within the CEMP. This is discussed in Chapter 2, Section 1.4.

Fire

As described in Chapter 2, Section 1.4, the potential risk of a bushfire results from a number of construction activities (e.g. welding) and the operation of equipment and vehicles. The implementation of a *Fire Management Protocol* (to be prepared within the CEMP) will reduce the risk of such an occurrence.

Altered water regimes

Groundwater is typically at depth in Loops 7 and 8, except in river basins where groundwater levels can be relatively shallow (Chapter 3, Section 5.3). Therefore, excavation would typically be above the water table and would have no effect on groundwater regimes, except where dewatering may be needed at river crossings. It is also likely groundwater will be used as the main construction water source along Loops 7 and 8. Potential effects of groundwater drawdown on vegetation and flora values is discussed in Chapter 3, Section 5.4.

The presence of linear stockpiles of topsoil and excavation spoil and modification to surface contours during construction may temporarily alter surface drainage patterns. Construction of Loops 7 and 8 will be undertaken in the dry season, where practicable, when surface drainage will be minimal, however should there be any disruption to surface flows it will be temporary, as outlined in Chapter 2, Section 1.4.

Mitigation

A CEMP will be prepared for the proponent's environmental management of the Stage 5 Expansion project construction activities. The CEMP will include measures to be implemented during the various construction stages to address the management of vegetation and flora values, as described briefly in Chapter 2, Section 1.4.

The CEMP will also include site/issue specific management measures in the form of management protocols (e.g. *Threatened Flora Protocol*, and *Weeds and Dieback Management Protocol*). An Environmental Line List will indicate the location and length along the pipeline corridor to which a particular site/issue specific management protocol(s) needs to be applied.

The CEMP, vegetation and flora specific management protocols and other impact mitigation measures are described in more detail in Chapter 5.

1.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of flora and vegetation parameters to assess the effectiveness of flora and vegetation management measures described in the CEMP (Chapter 5).

1.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for vegetation and flora management during construction of the pipeline, which will include specific measures for:

- threatened vegetation communities and flora
- weeds and dieback
- bushfire.

2. Undertake a dieback survey of Loop 8, planned sufficiently in advance to enable surveys in appropriate seasonal conditions. The boundaries of potentially dieback-infested and dieback-free areas, as well as those areas where dieback status is uninterpretable, will be mapped and indicated on the Environmental Line List.

3. Undertake a spring flora and vegetation survey of Loop 8 to identify the occurrence of DRF and Priority Flora. Locations of such flora to be protected from disturbance will be mapped and indicated on the Environmental Line List.

These commitments are consolidated in Table 7.1.

1.7 ENVIRONMENTAL OUTCOME

Around 180 ha of vegetation will be cleared and rehabilitated within the pipeline corridor during construction of Loops 7 and 8 of the Stage 5 Expansion. Up to a further 31 ha will be cleared outside of the corridor for infrastructure requirements. It is likely that any DRF and Priority Flora occurring within the pipeline corridor will be cleared, however efforts will be made to avoid or translocate species where practicable. Surrounding vegetation values could potentially be affected by the introduction of weeds, dust emissions, fire or altered water regimes, however the mitigation measures that will be implemented should ensure no long-term effects. Dieback is a potential issue in Loop 8 and hygiene measures will be implemented to reduce the risk of its introduction and/or spread into unaffected areas. It is expected that the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels will be maintained through the avoidance or management of adverse impacts, in accordance with the EPA objective.

2 FAUNA

2.1 EPA OBJECTIVE

To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

2.2 LEGISLATIVE AND POLICY CONTEXT

See Chapter 2, Section 2.2.

2.3 FAUNA OVERVIEW

Bancroft and Bamford (2006b), consulting ecologists, undertook a review of fauna interactions during some of the Stage 4 expansion construction works to refine fauna interaction procedures for the Stage 5 Expansion (Bancroft and Bamford 2006a). They also undertook a Level 1 fauna survey of the entire pipeline corridor in accordance with EPA Position Statement No. 3 (Bancroft and Bamford 2006b). These studies are contained in Appendix 2. An overview for the Stage 5 Expansion for the agricultural region loops is provided below.

Fauna habitat

The habitats found along loops 7 and 8 are known to support a diversity of fauna species, including species listed for protection under State and Federal conservation legislation. It is likely that there will be areas along each of the agricultural region loops of relatively high value to fauna, particularly when compared with other areas within the region. Examples of these include:

- National Parks, Conservation Parks, Nature Reserves and Conservation Reserves: areas that have been previously recognised as of high value for flora or fauna, or that have been set aside for conservation purposes (e.g. Burma Road Nature Reserve).
- Bushland remnants or fragments in cleared, developed or degraded areas: in areas where land use has removed or degraded much of the native vegetation (e.g. the agricultural region) the remaining zones of native vegetation may be important refugia for fauna. Impacts in such refugia will be disproportionately high in a local context because surrounding habitats are of such low value for fauna.
- Drainage lines: in the arid and semi-arid regions, rivers, creeks and drainage lines often support higher quality, or more diverse, vegetation and this may concentrate fauna in these areas (e.g. Irwin and Moore Rivers).
- Rare or unusual habitats: uncommon or unusual habitats (e.g. those driven by geological or hydrological factors such as freshwater springs or outlying hills) may support uncommon or outlying fauna populations, or may support a high degree of fauna endemism.
- Threatened Ecological Communities: ecological communities that are recognised as environmentally significant under the EPBC Act. Desmond and Chant (2003) note two TECs as occurring within this region: *Acacia rostellifera* low forest with scattered *Eucalyptus camaldulensis* on Greenough River alluvial flats, and clay flat assemblages of the Irwin River. One other ecosystem at risk within the Geraldton Hills (GS1) subregion is the *Eucalyptus macrocarpa* over Proteaceous sandplain community. It is unlikely that these TECs occur within

Loop 7 due to this loop being largely cleared. Their occurrence within Loop 8 will be determined as part of the spring flora and vegetation survey planned.

Fauna species

Forty-seven species were assessed as being of CS1 or CS2 (Table 3.2). See Bancroft and Bamford (2006b) in Appendix 2 for a description of each conservation significant species, including their conservation status, the reason for their significance, aspects of their ecology and potential threatening processes.

Table 3.2 Fauna of conservation significance potentially occurring along Loops 7 and 8

Species	Loop species likely to occur along	Species	Loop species likely to occur along
CS1 Species		**CS2 Species**	
Western Swamp Tortoise	8	Jewelled Ctenotus*	7, 8
Gilled Slender Blue-tongue*	7	*Lerista lineata**	8
Western Spiny-tailed Skink*^	7, 8	*Lerista yuna**	7
Woma*	7, 8	Black-striped Snake*	7, 8
Carpet Python*	7, 8	Black Bittern	8
Malleefowl^	7, 8	Australasian Bittern	8
Great Egret	7, 8	Australian Bustard	7, 8
Cattle Egret	8	Bush Stone-curlew	7, 8
Glossy Ibis	7, 8	Barking Owl	7, 8
White-bellied Sea-Eagle^	7, 8	Shy Heathwren	7, 8
Peregrine Falcon	7, 8	Rufous Fieldwren	7, 8
Common Greenshank^	7, 8	Slender-billed Thornbill^	7
Wood Sandpiper	7, 8	White-browed Babbler	7, 8
Common Sandpiper	7, 8	Crested Bellbird	7, 8
Red-necked Stint	7, 8	Brush-tailed Phascogale	8
Sharp-tailed Sandpiper	7, 8	Quenda*	8
Curlew Sandpiper	7, 8	Tammar	7
Hooded Plover	7, 8	Brush Wallaby*	7, 8
Caspian Tern	7, 8	Water-rat*	8
White-winged Black Tern	7, 8		
Carnaby's Cockatoo^	7, 8		
Baudin's Cockatoo^	8		
Major Mitchell's Cockatoo	7, 8		
Fork-tailed Swift	7, 8		
Rainbow Bee-eater*	7, 8		
Chuditch*^	7, 8		
Black-footed Rock-wallaby*	7		
Western Ringtail Possum*	8		

Source: Bancroft and Bamford (2006b).

* Indicate species that, if present near the pipeline route, are at greatest risk of impact due to trench construction. While generally at lower risk of significant impact, the remaining species may still be directly or indirectly disturbed and, hence, affected by the construction process.

^ EPBC Act listed species (Threatened Fauna and Migratory Species).

2.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Construction of the Stage 5 Expansion requires clearing and grading, excavation, pipe-laying, backfilling, hydrotesting, rehabilitation and commissioning activities to be undertaken. There will be a requirement for construction camps, stockpile sites, small worksites, access roads and water storage facilities (turkey nests) associated with these works. Construction activities could potentially affect indigenous and feral fauna in a number of ways, including:

- death/injury of fauna from impact with vehicles
- spread of weeds and feral fauna along cleared line
- fragmentation of habitat (temporary)
- loss of habitat (generally temporary, however, the necessary removal of large habitat trees may result in some permanent habitat loss)
- increase in indigenous and feral fauna due to provision of water in "turkey nests" (temporary)
- entrapment in trenches excavated to receive the pipeline (temporary)
- disturbance of fauna in nearby areas from light, noise and even personnel feeding selected species (temporary).

The existing cleared line over the pipeline will be retained for maintenance purposes.

Habitat disturbance and fragmentation

Around 180 ha of vegetation clearing will be required in Loops 7 and 8 (Chapter 3, Section 1.4). See Chapter 2, Section 2.4 for a discussion of habitat disturbance and fragmentation and Bancroft and Bamford (2006b) in Appendix 2 for species specific impacts.

Injury or death of fauna

Chapter 2, Section 2.4 detailed causes of injury or death to fauna from the Stage 5 Expansion. There is the possibility for ground dwelling fauna to fall into open trenches becoming injured or perishing. Vehicle movements may also cause death to local fauna and bushfires could potentially harm fauna values (e.g. death or loss of habitat). A *Fauna Interaction Protocol* will be prepared within the CEMP and implemented by the proponent.

Interruption to fauna behaviour

Fauna behaviour could potentially be interrupted from artificial light, noise emissions and open artificial water sites, as outlined in Chapter 2, Section 2.4. Predation from feral animals and wildfires could also potentially affect local fauna populations.

Feral animals

As described in Chapter 2, Section 2.4, the Stage 5 Expansion may affect the movement of feral animals near the pipeline, however, due to the temporary nature of disturbance it is unlikely that pipeline construction in these areas will cause any long-term changes to feral animal populations.

Mitigation

A CEMP will be prepared for the proponent's environmental management of the Stage 5 Expansion construction activities. The CEMP will include management measures to be implemented during the various construction stages and for site/issue specific matters. These are described in Chapter 2, Section 2.4 and expanded on in Chapter 5.

2.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of fauna parameters to assess the effectiveness of fauna management measures described in the *Fauna Interaction Protocol* (Chapter 5).

2.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for fauna management during construction of the pipeline, which will include specific measures for interactions with fauna.

This commitment is consolidated in Table 7.1.

2.7 ENVIRONMENTAL OUTCOME

Around 180 ha of vegetation will be cleared within the pipeline corridor and up to a further 31 ha outside the corridor will be disturbed in the agricultural region of the Stage 5 Expansion, resulting in a temporary loss of habitat. There will also be a short-term effect on the local abundance of fauna populations due to interruption to fauna behaviour, injury or death. Potential effects on fauna will be minimised through the implementation of the CEMP which will include specific measures for interaction with fauna. Given the relatively small area affected at any one time and the proposed rehabilitation, the long-term effects of the pipeline on the fauna values in the pastoral region are expected to be minimal. Consistent with EPA objectives, the abundance, species diversity, geographic distribution and productivity of fauna at species and ecosystem level are expected to be maintained conserving regional biological diversity.

3 AREAS OF CONSERVATION VALUE

3.1 EPA OBJECTIVE

To protect the environmental values of areas identified as having significant environmental attributes.

3.2 LEGISLATIVE AND POLICY CONTEXT

See Chapter 2, Section 3.2.

3.3 AREAS OF CONSERVATION VALUE OVERVIEW

The pipeline corridor traverses or is adjacent to several areas designated to be of conservation significance[15]. There are four conservation reserves and one National Park that Loops 7 and 8 of DBNGP traverse or are adjacent to (Table 3.3). One reserve and the National Park are also listed on the Register of the National Estate. ESAs that occur within Loops 7 and 8 correspond to the conservation areas and the location of rare and threatened flora and ecological communities; the occurrence of DRF, Priority Flora and TECs along Loops 7 and 8 is described and discussed in Chapter 3, Section 1.3. There were also several areas of conservation value at distance from the pipeline corridor. Areas of conservation value are depicted in the series of landscape and environmental features maps contained in Chapter 8, Section 3.

In addition to the conservation value, these areas, such as the National Park, may also be of recreational value.

Table 3.3 Areas of conservation value present along Loops 7 and 8

Loop	Name and description of area	Pipeline location in conservation area	Location (chainage)	Reserve	Australian heritage	ESA
7	Burma Road Nature Reserve The reserve supports a wide variety of plant species and is dominated by a heath vegetation common to the Northern Sandplains. Area: ~6890 ha	Passes through eastern boundary	998.165-1006.67	A Class Nature Reserve	Register of the National Estate	Yes

[15] The DBNGP corridor from Dampier to Bullsbrook has been excised from the conservation estate (A Class reserves and Conservation Parks) as an easement by Parliament in 2003. Reserves that were not afforded "A" class status but were still reserved for Conservation of Flora and Fauna were referred to the Minister for Environment and consent was obtained to exclude these areas from such reserves. Although the pipeline corridor is so excised, such areas will be classified as "areas of conservation value" for the purpose of managing construction activities.

Mapping of conservation category wetlands, resource enhancement wetlands and EPP Lakes does not cover Loop 7 and most of Loop 8, therefore this category of designated conservation area does not apply to Loop 7 and most of Loop 8 of the Stage 5 Expansion.

Loop	Name and description of area	Pipeline location in conservation area	Location (chainage)	Reserve	Australian heritage	ESA
8	Hill River Nature Reserve The vegetation of the reserve is described as mostly comprising woodland dominated by *Corymbia calophylla* with stands of *Eucalyptus rudis* on the river banks. There are also areas of open woodland of *Acacia acuminata*, *Eucalyptus loxophleba* and *Melaleuca* species with pasture understorey. The sandy soils away from the river itself support a woodland of banksias and *Eucalyptus todtiana*, with a shrub understorey. Area: ~ 882 ha	Excised corridor passes through reserve	1165.54-1165.63	A Class Nature Reserve	Not listed	Yes
	Twyata Nature Reserve *Kwongan* vegetation, to the south of Hill River. Area: ~154 ha	Excised corridor passes through reserve	1166.12-1166.63	C Class Reserve	Not listed	Yes
	Badgingarra National Park The vegetation within the Park is high quality shrublands with *Hakea flabellifolia, H. recurva, Banksia incana, Dryandra shuttleworthiana, D. stricta, Jacksonia densiflora, Calothamnus sanguineus* and *Dasypogon obliquifolius*. Area: ~13,121 ha	Excised corridor passes through reserve north-east corner	1169.74-1174.12	National Park	Register of the National Estate	Yes
	Minyulo Nature Reserve The principal value of the Nature Reserve is as a feeding and breeding habitat for bush birds. Vegetation in the reserve is dominated by two distinct types. *Eucalyptus wandoo* woodland dominates the creek bed with species such as *Hakea ruscifolia* and *Acacia saligna*. The hillsides are generally dominated by a species-rich heath land with scattered *Eucalyptus todtiana* trees. Area: ~200 ha	Excised corridor passes through reserve	1201.92-1202.65	A Class Nature Reserve	Not listed	Yes

3.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Project activities requiring vegetation/habitat clearing, trenching and vehicle/equipment movements have the potential to affect the environmental values (e.g. vegetation and flora, and fauna values) of conservation areas. The potential impacts on vegetation and flora, and fauna values have been described and discussed in Chapter 3, Sections 1.4 and 2.4 respectively. An overview of clearing requirements and recreational impacts is provided below.

Environmental and recreational values

Around 30 ha[16] of clearing of vegetation will occur within the pipeline corridor where the excised corridor traverses the areas of conservation value (Table 3.4). The vegetation that exists within the pipeline corridor is regrowth vegetation that has established subsequent to the clearing of the corridor for installation of the original pipeline 24 years earlier. All areas disturbed during construction will be rehabilitated to their pre-construction condition.

DRF and Priority Flora species are known to occur near the pipeline corridor (Chapter 3, Section 1.3).

It is expected that there will be no long-term consequences to the values of the areas of conservation value due to the relatively small area of mostly regrowth vegetation disturbance required and the prompt rehabilitation of all disturbed areas.

Recreational use, should it be actively pursued in the conservation areas identified, is unlikely to be restricted by the pipeline corridor, although the aesthetic value may be compromised by vegetation clearance (temporary) and signage.

Table 3.4 Area of conservation value that will be cleared in the region from Geraldton to Perth

Loop	Name	Approximate area of disturbance within pipeline corridor (ha)
7	Burma Road Nature Reserve	17.3
8	Hill River Nature Reserve	0.2
	Twyata Nature Reserve	1.0
	Badgingarra National Park	8.9
	Minyulo Nature Reserve	1.5

* Based on a reduced working width of 20 m and allowing for truck turnarounds every 2 km.

Mitigation

A CEMP will be prepared for the proponent's environmental management of the Stage 5 Expansion construction activities. The CEMP will include management measures in a *Conservation Area Management Protocol* to be implemented in areas of conservation value during the various construction stages and for site/issue specific matters. These are briefly described in Chapter 2, Section 3.4 and expanded on in Chapter 5.

3.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of parameters associated with conservation areas to assess the effectiveness of conservation area management measures described in the CEMP.

[16] Based on a reduced working width of 20 m and allowing for truck turnarounds every 2 km.

3.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of conservation areas during construction of the pipeline, which will include:

- reducing the working width to 20 m within areas of conservation value
- reducing the working width to 10-12 m over distances of less than 150 m through areas of DRF and TECs, where the feature can be completely or almost avoided.

This commitment is consolidated in Table 7.1.

3.7 ENVIRONMENTAL OUTCOME

There are five areas of conservation value (excluding areas that support DRF, Priority Flora or TECs) that will be affected by the pipeline construction in the agricultural region; however, the pipeline corridor is excised from DEC estate. Around 30 ha of disturbance will occur within the pipeline corridor in these areas. All areas of disturbance will be rehabilitated and there are not expected to be any long-term consequences to the conservation values of these areas, ensuring the EPA objective for this factor will be met.

4 SOILS AND TERRAIN

4.1 EPA OBJECTIVE

To maintain the integrity, ecological functions and environmental values of the soil and landform.

4.2 LEGISLATIVE AND POLICY CONTEXT

See Chapter 2, Section 4.2.

4.3 SOILS AND TERRAIN OVERVIEW

Loop 7 and most of Loop 8 are within the Geraldton Sandplains biogeographical region. Some of Loop 8 also traverses the Swan Coastal Plain biogeographical region.

1. Geraldton Sandplains (Loops 7 & 8): The noticeable difference in the terrain of the Geraldton Sandplains bioregion within Loops 7 and 8, compared to the area of the region traversed by Loop 6 (Chapter 2, Section 4.3), is the erosion of the Victoria Plateau's upper surface to produce a dissected region of laterite capped hills and sand covered plains. The geology and soils of Loops 7 and 8 are essentially the same as that of Loop 6 (Chapter 2, Section 4.3), although the underlying weathered sedimentary rocks become increasingly exposed (Dames and Moore 2000).

2. Swan Coastal Plain (Loop 8): Like the adjoining Geraldton Sandplains bioregion, the Swan Coastal Plain bioregion is entirely within the Perth Basin. The end of Loop 8 traverses the gently undulating surface of the Dandaragan Plateau. Laterite occurs throughout the area and is commonly seen in outcrop. Soils in this area are typically laterite and ironstone gravels (Dames and Moore 2000).

Acid sulphate soils

Parsons Brinckerhoff undertook a desktop assessment to predict the likelihood of encountering acid sulphate soils along the DBNGP Stage 5 loops. This report (Parsons Brinckerhoff 2006) is contained in Appendix 2 and an overview of the key findings provided below.

The potential for occurrence of acid sulphate soils occurring within the proposed excavation footprint is contained in Table 3.5.

Less than 1 km of medium risk soils were identified along Loop 7 in association with an area of pipeline intercepting the Irwin River. The Irwin River coal measures are potentially exposed in this area. Coal measures contain sulphides that have the potential to generate acid sulphate soils. A 1 km interval of medium soils was identified in association with areas intercepting the Moore River in Loop 8.

Medium to low risk soils identified along Loop 7 were in association with an area within 500 m of an unnamed lake and Irwin River.

Table 3.5 Summary of potential for occurrence of acid sulphate soils in Loops 7 and 8

Loop	Acid sulphate soil risk ranking (no. of km's)			
	Low	Medium to low	Medium	High
7	140	3	0.3	0
8	98	0	1	0

Where acidic soils occur above the natural watertable, excavation and backfilling of these soils is not expected to increase the risk of further acidification or release of metals. The protective trilaminate coating on the pipeline is acid resistant and the presence of acidic soils does not pose any threat to the integrity of the pipeline.

4.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Project activities that result in disturbance to the landscape surface and sub-surface soil profiles have the potential to affect soil and terrain values. Such activities include clearing and grading, trenching and excavation, and vehicle movement in general. Potential impacts that may result from these ground disturbing activities are similar to those for the pastoral region and include:

- erosion (wind and rain) of the corridor and subsequent transport of material offsite
- soil compaction
- soil inversion whereby the topsoil is 'lost' through burial or mixing with other trench soil
- contamination of the soil from spills, disposal of hydrotest water and acid generating soils.

As potential impacts for Loops 7 and 8 are similar to those for Loops 0 to 6 (pastoral region), refer to Chapter 2, Section 4.4, for a discussion of possible implications of the potential impacts listed above.

Soil contamination

Only a small area of soils along the pipeline in Loops 7 and 8 were identified as being of medium or medium to low acid generating risk (Table 3.5). The generation of acid soils can affect soil quality, water quality and land use. In areas or high or medium risk soils, an investigation strategy will be developed to validate the desktop assessment and will include soil and groundwater sampling and analysis. These investigations will enable the preparation of acid sulphate soil and dewatering management plans.

Areas of medium to low risk acid sulphate soils along Loops 7 and 8 were typically areas of high elevation and where the river intercepts the pipeline, and flows are seasonal and high. Therefore, the likelihood of deposition of sulphides is considered low (Parsons Brinckerhoff 2006).

Mitigation

A CEMP will be prepared for the proponent's environmental management of the Stage 5 Expansion construction activities. The CEMP will include management measures to be implemented during the various construction stages and for site/issue specific matters. These are briefly described in Chapter 2, Section 4.4 and expanded on in Chapter 5.

4.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of soil and terrain parameters to assess the effectiveness of soil and terrain management measures described in the CEMP.

4.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of soils and terrain during construction of the pipeline, which will include specific measures for:

- potential acid sulphate soils
- dewatering
- fuel and chemical storage, handling and spill response.

2. Undertake field investigations for the length of the Stage 5 Expansion to validate results from the acid sulphate soil and hydrogeological desktop study.

These commitments are consolidated in Table 7.1.

4.7 ENVIRONMENTAL OUTCOME

Construction of the Stage 5 Expansion pipeline may lead to erosion and sedimentation, soil compaction and inversion, and contamination of soil resources, which can lead to on and off-site impacts and can limit the effectiveness of rehabilitation efforts. The implementation of the proposed mitigation measures will minimise the risk of impacts to soil and terrain occurring and will ensure the EPA objective for this factor is met.

5 WATER RESOURCES

5.1 EPA OBJECTIVE

To maintain the integrity, ecological functions and environmental values of watercourses.

To maintain the integrity, ecological functions and environmental values of wetlands.

To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.

To ensure that emissions do not adversely affect environment values of the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

5.2 LEGISLATIVE AND POLICY CONTEXT

See Chapter 2, Section 5.2.

In addition, as the pipeline traverses the Allanooka–Dongara Water Reserve, the provisions of the *Country Area Water Supply Act 1947* apply to activities with potential to pollute the groundwater resource used for public drinking water supplies. This is supported by the Western Australian Planning Commission *Statement of Planning Policy No. 2.7 – Public Drinking Water Source Policy 2003* and the *Water Quality Protection Note: Protecting Public Drinking Water Source Areas* (Department of Water – under revision).

5.3 WATER RESOURCES OVERVIEW

Rivers and streams

The agricultural region loops (Loops 7 and 8) will involve the crossing of several major watercourses and numerous minor watercourses (Table 3.6). In addition to the major watercourses, there were several small streams, gullies and drainage lines crossed by the pipeline corridor without identifiable names. Watercourses are depicted in the series of landscape and environmental features maps contained in Chapter 8, Section 3.

Rivers in this section of pipeline have similarities to rivers in both the arid and temperate zones. The Irwin River has broad sandy drainage lines supporting *Eucalyptus camaldulensis* (River Red Gum) characteristic of northern rivers. Further south, the watercourses in this region (e.g. Moore River) tend to be narrower, with steeper banks which are dominated by *Eucalyptus rudis* (Flooded Gum) and *Melaleuca* species.

Wetlands

There were no significant wetlands[17] in Loop 7 (Mattiske 2006), and only one wetland traversed by the Stage 5 Expansion pipeline in Loop 8. This was an unnamed palusplain wetland associated with the Moore River (chainage crossed was 1241.51-1241.19). The unnamed wetland was not listed under any State, National or International policies, agreements or conventions.

Table 3.6 Major rivers and streams that will be crossed by Loops 7 and 8

Loop	Name	Location of crossing (chainage)
7	Irwin River	1036.97
	Arrowsmith River	1080.87
	Donkey Creek	1086.69
	Eneabba Creek	1102.04
8	Boothendarra Creek	1164.48
	Hill River	1165.58
	Mullering Brook	1187.75
	Minyulo Brook north	1202.18
	Minyulo Brook south	1209.88
	Caren Caren Brook	1226.22
	Moore River	1241.44
	Red Gully	1254.27

Groundwater

Depth to groundwater along Loops 7 and 8 of the pipeline is generally predicted to be deep (e.g. greater than 20 mbgl), therefore excavation activities will occur mainly above the water table. The exception to this being river basins, where groundwater could be less than 10 mbgl (Parsons Brinckerhoff 2006). Groundwater is also likely to be the main construction water source for Loops 7 and 8. Up to 92.5 ML of water is expected to be abstracted from mainly existing groundwater wells with the possible use of caissons; however, water will be reused where practicable, reducing water abstraction requirements. The majority of this water is required for hydrotesting (approximately 74.5 ML) with smaller quantities required for construction activities and potable water supply (approximately 13 ML and 5 ML respectively).

Some flora species are thought to have potential for groundwater dependence, particularly riparian vegetation. See Chapter 2, Section 1.3 for discussion.

Public water supply sources

The pipeline easement traverses the Allanooka–Dongara Water Reserve which provides protection for the Water Corporation wellfield used to supply Geraldton and Dongara. The area is proclaimed under the *Country Area Water Supply Act 1947*, which requires that activities are managed so as not to compromise the quality of groundwater resources within the reserve.

[17] The definition of a wetland that has been adopted in the Wetland Conservation Policy for Western Australia (DWECP 1997) is 'an area of marsh, fen, peatland, or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres'.

5.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Project activities, such as excavation, trenching, and hydrostatic testing, have the potential to affect watercourses. Potential impacts that may result from these activities include:

- physical disturbance to watercourses/wetlands, banks and riparian vegetation
- alteration to surface water flow regimes
- deterioration in surface and groundwater quality
- groundwater drawdown.

The degree of impact pipeline construction may have on a watercourse is dependent upon various factors, including the volume of water carried by the river or stream during the construction period, the construction methods used and the stability of the watercourse beds and banks.

Physical disturbance to watercourses

There are several major watercourses that are required to be crossed by the pipeline in Loops 7 and 8 (Table 3.6). Two methods will be used for the pipeline installation at these crossings:

- open-cut
- horizontal directional drilling.

The open-cut technique is outlined in Chapter 2, Section 5.4, and is planned to be utilised for most of the crossings in Loops 7 and 8 as a preferred option. Open-cut construction will require the excavation of isolated sections on the banks, to achieve the required 2 m below the stable river bed. This will ensure flow events do not expose the pipeline, ensuring pipeline integrity. The excavation will extend through the riverbank profile for some distance away from the river channel and require an increased working width across each bank of the river crossing to enable safe excavation and installation of the pipeline.

Where geotechnical investigations indicate that HDD can be feasibly undertaken, the Construction Contractor may opt for this methodology to cross under watercourses, with less impact than if open-cut methods are used.

Post construction, there is potential for erosion of creek and riverbanks along the pipeline corridor, bank disturbance areas and access track alignments, as discussed in Chapter 2, Section 5.4. Appropriate stabilisation and rehabilitation of the watercourses will occur as soon as practicable after construction. All areas disturbed will be rehabilitated to pre-construction condition, although deep rooted vegetation will not be allowed to re-establish in the corridor.

Alteration to surface flow regimes

Construction of the agricultural region loops will be undertaken in summer, as far as practicable, so as to avoid wet conditions and river flow events. However, as described in Chapter 2, Section 5.4, watercourse and surface flow regimes may be temporarily altered due to the potential installation of dams, dewatering, discharge of hydrostatic testing water and positioning of linear stockpiles. Any alteration to surface flow regimes will be temporary.

The intersection of shallow groundwater by the open trench has the potential to create localised disturbance to flow patterns, especially close to the wetland area identified near the Moore River. The effects on local groundwater flow regimes is expected to be minimal due to the minor depth of the intrusion and the short period for which the trench is expected to be open.

Deterioration in water quality

Deterioration in surface and groundwater water quality may result from sedimentation, minor spills of hazardous material (e.g. hydrocarbons and chemicals), leachate from acid sulphate soils and discharged hydrotest water, as discussed in Chapter 2, Section 5.4. The potential for acid generating soils in Loops 7 and 8 was discussed in Chapter 3, Section 4.3. Effects on water quality from these sources of contamination, should they occur, are expected to be temporary and not result in any long-term water quality impacts. Disposal of dewater product and hydrotest water will be undertaken in compliance with the DoW guidelines for dewatering (DoW 2006) to avoid contamination of any receiving waters.

Activities within the Allanooka–Dongara Water Reserve will be undertaken to meet the requirements of the Department of Water regarding all activities with potential to pollute the groundwater resources.

Groundwater drawdown

Within the agricultural region, phreatophytic (groundwater dependent) vegetation is typically restricted to the major creek systems (e.g. riparian zone). Drawdown of groundwater levels close to the riparian zone as a result of dewatering (should it be required) or groundwater abstraction could affect some riparian tree species if they are accessing groundwater. Dewatering is also preferred where the watertable is close to the surface, as is generally the case for wetlands. This may cause localised disturbance of shallow groundwater flow patterns, which may affect the health and viability of wetland systems

However, should groundwater drawdown occur from dewatering or groundwater abstraction, it is expected to be localised, of short duration and is not anticipated to result in any significant impact to vegetation and flora, and wetland values. Pre-construction groundwater levels are expected to re-establish after dewatering ceases.

Groundwater abstraction is not expected to have any effect on the long-term viability of the resource, due to the short timeframe of abstraction and the relatively small quantities of groundwater abstracted. Water will be reused where possible.

Mitigation

A CEMP will be prepared for the proponent's environmental management of the Stage 5 Expansion construction activities. The CEMP will include management measures to be implemented during the various construction stages and for site/issue specific matters. These are briefly described in Chapter 2, Section 5.4 and expanded on in Chapter 5.

5.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of parameters associated with water resources to assess the effectiveness of water resource management measures described in the CEMP.

5.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of water resources during construction of the pipeline, which will include specific measures for:

- watercourse crossings
- dewatering and disposal of dewater product
- wetlands
- potential acid sulphate soils
- fuel and chemical storage, handling and spill response.

This commitment is consolidated in Table 7.1.

5.7 ENVIRONMENTAL OUTCOME

Numerous watercourse crossings will be constructed along Loops 7 and 8 of the Stage 5 Expansion using either open-cut or HDD depending on site conditions. Only one wetland associated with the Moore River will be traversed by the pipeline in Loop 8. River beds, banks and riparian vegetation will be directly disturbed, which may result in temporary alteration to surface water flow and quality. Mitigation measures will ensure potential sources of water contamination will be appropriately managed to reduce contamination risks. Should groundwater drawdown from dewatering occur, it is expected to be short in duration and is not anticipated to significantly affect the health of any groundwater dependent vegetation. Given the proposed management measures, impacts to watercourses will not be significant or long-term; therefore the EPA objective for this factor will be met.

6 HERITAGE

6.1 EPA OBJECTIVE

To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.

6.2 LEGISLATIVE AND POLICY CONTEXT

See Chapter 2, Section 6.2.

6.3 HERITAGE OVERVIEW

Aboriginal heritage

Australian Interaction Consultants (AIC) undertook an Aboriginal heritage assessment of the Stage 5 Expansion. This report (AIC 2006) is contained in Appendix 2 and an overview of Loops 7 and 8 is provided below.

Searches of the Register of Aboriginal Sites, which is maintained by the DIA, indicated that seven archaeological and ethnographic sites have been recorded along or within 100 m of the pipeline corridor in Loops 7 and 8. Some of these sites comprised of artefacts whilst others, mainly associated with watercourses, were of mythological significance.

Four of the seven sites have Section 18 consents and conditions associated with them.

Native Title

There are seven Native Title Claims near Loops 7 and 8:

- Naaguja Peoples and the Amangu (Loop 7)
- Mullewa Wadjari (Loop 7)
- Franks (Loop 7)
- Widi Mob (Loop 7)
- Taylor (Loop 7)
- Yued (Loop 8)
- Single Noongar Claim[18] (Loop 8).

[18] In September 2003, the Western Australian South West Aboriginal Land and Sea Council (SWALSC) lodged a 'Single Noongar Claim', which combined the six registered native title claims and a further 12 unregistered claims covering the south west of Western Australia (SWALSC 2006).

European heritage

No European Heritage sites listed by the Heritage Council of Western Australia, Australian Heritage Commission and the National Trust of Australia occur in the pipeline corridor in Loops 7 and 8 (Dames and Moore 2000). No sites listed on municipal heritage inventories maintained by the relevant local government authorities, occur in the pipeline corridor in Loops 7 and 8[19] (Dames and Moore 2000).

6.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Project activities requiring ground disturbance (e.g. clear and grade, trenching and excavation) have the potential to disturb archaeological material and effect ethnographic values, should they be present. Potential impacts include:

- disturbance to known heritage sites and previously undiscovered sites
- disturbance to significant features of the landscape/environment (e.g. modified/scarred trees).

No European heritage sites will be affected by the Stage 5 Expansion.

As potential impacts for Loops 7 and 8 are similar to those for Loops 0 to 6 (pastoral region), refer to Chapter 2, Section 6.4, for a discussion of possible implications of the potential impacts listed above.

Mitigation

A CEMP will be prepared for the proponent's environmental management of the Stage 5 Expansion construction activities. The CEMP will include management measures to be implemented during the various construction stages, including:

- flagging and/or fencing known heritage sites identified for protection
- onsite heritage monitors and archaeologist to be present during ground disturbance activities in areas where heritage material has the potential to be present
- contingency actions to be implemented in the event of unearthing potential heritage material.

The CEMP will also include site/issue specific management measures in the form of management protocols (e.g. *Aboriginal Heritage Management Protocol*). Environmental Line Lists will indicate the location and length along the pipeline corridor to which a particular site/issue specific management protocol(s) needs to be applied.

The CEMP, the *Aboriginal Heritage Management Protocol* and other impact mitigation measures are described in more detail in Chapter 5.

[19] This was confirmed through correspondence with all local government authorities along the Stage 5 expansion pipeline route in June 2006.

6.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of Aboriginal heritage parameters to assess the effectiveness of heritage management measures described in the CEMP.

6.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of Aboriginal heritage during construction of the pipeline, which will include specific measures for:

- protection of sites identified for protection
- discovery of new heritage sites or material.

2. Undertake further research of Aboriginal heritage sites along the pipeline that were identified as not being covered by existing Section 18 consents and, based on research findings, develop and implement appropriate heritage management measures for these sites.

These commitments are consolidated in Table 7.1.

6.7 ENVIRONMENTAL OUTCOME

Construction of the Stage 5 Expansion will require the disturbance of Aboriginal heritage sites within the pipeline corridor along Loops 7 and 8 and no known European heritage sites will be affected. Where these sites are covered by existing Section 18 consents, they will be managed in accordance with the consent conditions. Where these sites are not covered by existing Section 18 consents, they will be further researched and appropriate heritage management procedures developed and implemented. The proponent will avoid disturbance to sites outside the corridor identified for protection and will minimise disturbance to landscape and environmental features that may be of heritage significance but not recognised as 'sites'. The proponent will continue to consult with relevant Aboriginal groups and will ensure that, consistent with the EPA objective for this factor, Aboriginal heritage sites are managed in accordance with the *Aboriginal Heritage Act 1972*.

7 LAND USAGE AND SERVICES

7.1 OBJECTIVE

Minimise disturbance to third party infrastructure, landholders and land use.

7.2 LAND USAGE AND SERVICES OVERVIEW

Loops 7 and 8 are located in the Midwest Region and Coastal section of the Wheatbelt Region, as defined by the State Planning Strategy (WAPC 1997). A small end section of Loop 8 also traverses the Perth Metropolitan Area. The loops traverse the Shires of Mullewa, Irwin, Carnamah, Coorow, Dandaragan and Gingin (Table 3.7).

Loop 7 is primarily freehold. Smaller proportions of the land are Crown Reserve and Crown Land. Loop 8 is mostly freehold for the purpose of grazing and cropping with some Crown Reserve and Crown Land for conservation and other purposes (Table 3.7).

Population density is low along the corridor. The closest town is Badgingarra, which is located approximately 500 m east of the pipeline corridor.

Various third-party infrastructure is located near the pipeline including roads (e.g. Brand Highway), railways and public utilities (e.g. powerlines). A number of fences associated with agricultural properties are also crossed.

Table 3.7 Local government authorities and land usage along Loops 7 and 8

Loop	Local government authority	Description of main land uses*
7	Shire of Mullewa, Shire of Irwin, Shire of Carnamah	Loop comprises freehold and crown land, also containing Government reserves. There are four sensitive premises (all residences), the closest within 160 m.
8	Shire of Coorow, Shire of Dandaragan, Shire of Gingin	This loop contains a combination of freehold and crown land, including conservation reserves. Eleven sensitive premises were identified including residences, sporting complexes and road houses. The closest of these sensitive premises is within 112 m of the pipeline easement.

*Sensitive premises identified during the Risk Assessment undertaken, incorporating areas within 660 m of the pipeline.

7.3 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

During the construction of the pipeline, access to and use of land on the corridor by landowners and the public will be strictly prohibited. Construction activities will also require the crossing of roads, fences and other infrastructure and may also contribute to ongoing land use issues. Similar to the pastoral region, potential impacts that may result from construction activities include:

- temporary loss of land for utilisation in pastoral activities
- temporary impediment to property access and stock movement
- increased risk of wildfire and the introduction of weeds

- possible long-term loss in soil productivity
- disruption or damage to infrastructure, services and third party property.

As potential impacts for Loops 7 and 8 are similar to those for Loops 0 to 6 (pastoral region), refer to Chapter 2, Section 7.3, for a discussion of possible implications of the potential impacts listed above.

7.4 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of environmental parameters associated with land usage and services to assess the effectiveness of management measures described in the CEMP.

7.5 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of the environmental aspects of land usage and services during construction of the pipeline, which will include specific measures for:

- weed, soil and fire management
- rehabilitation
- access and safety management (primarily addressed through the Land Management Strategy).

This commitment is consolidated in Table 7.1.

7.6 ENVIRONMENTAL OUTCOME

The Stage 5 Expansion is expected to cause minimal disruption to landowners and other third-party infrastructure in the agricultural region. This is because the duration of prohibition of public access to the pipeline corridor will be relatively short, land users will be able to resume previous land use activities on top of the pipeline (post construction and rehabilitation) provided that it does not include excavation activities, and infrastructure will be reinstated and landscaped following construction.

8 OTHER ENVIRONMENTAL FACTORS

A number of environmental factors have not been addressed in detail for the agricultural region of the Stage 5 Expansion as they were considered to be minor factors given the remoteness of the pipeline location. These factors are noise and vibration, air quality (dust), and public safety and risk. These factors are addressed briefly below in Sections 8.1 to 8.3.

8.1 NOISE AND VIBRATION

EPA objective

To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring noise levels meet statutory requirements and acceptable standards.

Legislative and policy context

See Chapter 2, Section 8.

Noise and vibration overview

The predominant land use along the pipeline corridor in Loops 7 and 8 is agricultural and consequently there are only a small number of potential noise sensitive premises near the pipeline corridor. These premises comprise mainly rural residences. An overview of surrounding land use, including nearby residences, is contained in Table 3.7. Noise emission characteristics of all construction phases is contained in Table 2.14.

Assessment and mitigation of potential impacts

Noise and vibration will be generated during the construction of the pipeline. Sources and potential effects of noise and vibration were described in detail in Chapter 2, Section 8.1 and are expected to be similar for Loops 7 and 8.

The proponent will minimise noise emissions through mitigation measures described in Chapter 5, Section 2.11. These measures include ensuring noise and vibration from construction of the pipeline complies with the requirements of the Noise Regulations and DoIR requirements for mine safety and health.

Monitoring and assessment of performance

The CEMP will include provisions for the monitoring of noise and vibration parameters to assess the effectiveness of management measures described in the CEMP.

Proponent commitments

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of noise and vibration emissions during construction of the pipeline, which will include:

- scheduling construction during daylight hours to avoid impacts on nocturnal fauna
- maintaining vehicle speed limits
- compliance with the Noise Regulations.

This commitment is consolidated in Table 7.1.

Environmental outcome

Given the remote nature and short duration of construction of the Stage 5 Expansion, it is anticipated that noise and vibration from construction activities will not have a significant impact on any noise sensitive premises or fauna values within the pastoral region. Therefore, the EPA objective for this factor will be met.

8.2 AIR QUALITY (DUST)

EPA objective

To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

Legislative and policy context

See Chapter 2, Section 8.

Overview of air quality (dust)

Dust from soil disturbance will be the main component of air emissions during the construction phase of the proposed development. However, no dust emissions are likely once the pipeline is in operation. Dust is defined and described in Chapter 2, Section 8.2. An overview of surrounding land use, including nearby residences, is contained in Table 3.7.

Assessment and mitigation of potential impacts

There are few potential dust sensitive premises along Loops 7 and 8. Dust emissions generated from construction of the pipeline have the potential to create a short-term nuisance to nearby sensitive residents and may reduce visual amenity, be of general nuisance and cause health problems in susceptible individuals. The effects of dust on vegetation and flora, and fauna were described in Chapter 3, Sections 1.4 and 2.4 respectively.

The proponent will minimise the emission of dust through mitigation measures described in Chapter 5, Section 2.12. These measures include:

- minimising the area being cleared

- rehabilitating and/or stabilising areas as soon as possible after disturbance
- avoiding unnecessary movement of vehicles and machinery

Monitoring and assessment of performance

The CEMP will include provisions for the monitoring of dust parameters to assess the effectiveness of management measures described in the CEMP (Chapter 5).

Proponent commitments

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of dust emissions during construction of the pipeline, which will include specific measures for:

- stabilising disturbed surfaces and/or stockpiles
- watering
- rehabilitation.

This commitment is consolidated in Table 7.1.

Environmental outcome

Significant long-term dust impacts are expected to be negligible given the small number of dust sensitive premises, the short term and temporary nature of the construction work and the mitigation measures proposed by the proponent. These measures will ensure dust emissions do not have any significant impact upon sensitive premises, and vegetation and fauna values.

8.3 PUBLIC SAFETY AND RISK

EPA objective

To ensure that risk from the proposal is as low as reasonably achievable and complies with acceptable standards and EPA criteria.

Legislative and policy context

See Chapter 2, Section 8.

Overview of public safety and risk

Pipelines are recognised as a safe and efficient means of transporting natural gas. However, all developments present some level of risk.

There are several aspects of the project that could potentially pose an off-site risk to the safety of the general public, not including pipeline construction personnel. These were described in Chapter 2, Section 8.3 (pastoral region) and are expected to be similar for the agricultural region section of the pipeline.

Assessment and mitigation of potential impacts

Potential risks to public safety that will arise during the construction of the pipeline were described in detail in Chapter 2, Section 8.3 (pastoral region) and are expected to be similar for the agricultural region section of the pipeline.

The Stage 5 pipeline will be constructed in accordance with AS 2885, implementing a number of procedural and physical mitigation measures, which will reduce the potential risks associated with public safety.

Monitoring and assessment of performance

The CEMP will include provisions for the monitoring of parameters associated with fuels and chemicals, and access and safety, to assess the effectiveness of management measures described in the CEMP.

Proponent commitments

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of parameters associated with public safety during construction of the pipeline, which will include specific measures for:

- fuel and chemical storage, handling and spills response
- access and safety.

This commitment is consolidated in Table 7.1.

Environmental outcome

There are few private residences near the Stage 5 Expansion pipeline alignment in the agricultural region, therefore reducing public safety risks associated with construction activities. Construction of the Stage 5 Expansion will result in an increase in general traffic volumes and freight movement (including some dangerous goods) on public transport routes in the project area. However, the increase in traffic volumes will be temporary, within the current capacity of the public roads and transportation of dangerous goods will be done so in accordance with relevant legislation and standards. Through implementation of risk mitigation measures, potential risk to the public will be reduced as far as practicable to ensure the EPA objective for this factor is met.

Chapter 4 Assessment and management of key environmental factors in the Swan Coastal Plain region (Loops 9 & 10)

This Chapter contains the assessment of environmental factors identified for the Stage 5 Expansion of the DBNGP on the Swan Coastal Plain, or Loops 9 and 10 (Figure 1.1 and Figure 1.2). The Stage 5 section of the pipeline corridor within Loops 9 and 10 is approximately 189 km in length.

The key environmental factors addressed in this Chapter are:

- vegetation and flora (which incorporates areas of conservation value)
- fauna
- wetlands (which incorporates areas of conservation value)
- water resources (other than wetlands)
- soils and terrain
- heritage
- land usage and services
- noise and vibration
- air quality (dust)
- public safety and risk.

1 VEGETATION AND FLORA

The pipeline traverses a number of cleared and disturbed areas in Loops 9 and 10, as well as directly affecting some areas of established vegetation. Construction activities in the Loop 9 pipeline corridor, which traverses the Perth Metropolitan Region, will require the clearing of vegetation which has been identified in *Bush Forever*, the Government's key bushland conservation policy for the Perth Metropolitan Region.

Loop 10 includes areas within the metropolitan region and areas to the south of the Perth Metropolitan Region. However, Loop 10 does not require the clearing of any vegetation identified in *Bush Forever*.

As most of the vegetation on the Swan Coastal Plain affected by the Stage 5 Expansion in Loop 9 is within Bush Forever Sites, the environmental factor of vegetation and flora for Loops 9 and 10 has been considered in the context of areas of conservation value[20]. Areas of conservation value are depicted in the series of landscape and environmental features maps contained in Chapter 8, Section 3. It should be noted that the pipeline corridor easement has been recognised by the Western Australian Planning Commission as being a pre-existing use, and this use takes precedence over the *Bush Forever* policy position.

1.1 EPA OBJECTIVE

To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

To protect the environmental values of areas identified as having significant environmental attributes.

1.2 LEGISLATIVE AND POLICY CONTEXT

See Chapter 2, Section 1.2 – Vegetation and Flora.

See Chapter 2, Section 3.2 – Areas of conservation value.

[20] For the purpose of this review, areas of conservation value are defined as including:

- nature and conservation reserves
- Bush Forever Sites
- places listed on the Australian Heritage Database
- Environmentally Sensitive Areas (ESAs)
- those areas supporting DRF, Priority Flora or TECs
- conservation category wetlands, resource enhancement wetlands and wetlands gazetted under the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992.

Between 30 to 100 m has been excised from all DEC estate (e.g. nature and conservation reserves) for the purpose of the DBNGP corridor. Although the pipeline corridor is excised from DEC estate, such areas will be classified as areas of conservation value for the purpose of managing construction activities.

Bush Forever

In 2000, the Government of Western Australia released *Bush Forever*, a report that identifies areas of regional significance for conservation within the Swan Coastal Plain portion of the Perth Metropolitan Region (Government of Western Australia 2000a, 2000b). The *Bush Forever* policy aims to protect a target of at least 10% of each ecological community (based on mapped vegetation complexes) on the Swan Coastal Plain portion of the Perth Metropolitan Region.

The selection of regionally significant bushland for inclusion in *Bush Forever* was based on criteria relating to its conservation value. However *Bush Forever* has inevitably identified some lands previously designated for public infrastructure, service requirements and other broader community needs. In these constrained areas, *Bush Forever* recognises the need to balance social and economic benefits with environmental outcomes (Government of Western Australia 2000a). Establishment of the DBNGP easement by the Government has defined the primary purpose of this land as being for a pipeline corridor.

1.3 LOOP 9 – AREAS OF CONSERVATION VALUE OVERVIEW

Most of the natural areas (including wetlands) with higher conservation values that are affected by the DBNGP in Loop 9 have been identified within Bush Forever Sites. The pipeline corridor traverses through 15 Bush Forever Sites and runs adjacent to a number of other Sites (Table 4.1). Several natural places listed on the Register of the National Estate correspond to or are places that are part of Bush Forever Sites. These include:

- Melaleuca Park (part of Bush Forever Site 399)
- Ellenbrook National Estate Area (part of Bush Forever Site 399)
- Munday Swamp and Bushland (part of Bush Forever Site 386)
- Forrestfield Bushland (part of Bush Forever Site 386)
- Beeliar Regional Park (part of Bush Forever Site 269).

As the corridor was cleared approximately 20 years previously, some areas within the Bush Forever Sites remain disturbed and devoid of native vegetation (e.g. some areas parts of the corridor are used as an informal track). In other areas however, particularly where access has been controlled, vegetation has re-established well in the pipeline corridor.

Wetland values along Loop 9 are described in Chapter 4, Section 3.3 and Threatened Flora and TECs are described in Chapter 4, Section 1.5.

Table 4.1 Loop 9 sections identified in *Bush Forever*

Site no.	Bush Forever Site name	Bush Forever policy coverage	Location (chainage)
97	Kirby Road Bushland, Bullsbrook	Pipeline corridor within Bush Forever policy area Within 200 m	1318.15-1320.53 1321.28-1321.41 1320.98-1321.28
6	Cooper Road Water Reserve and Adjacent Bushland, Bullsbrook	Within 50m	1325.06-1326.06

Site no.	Bush Forever Site name	Bush Forever policy coverage	Location (chainage)
399	Melaleuca Park and Adjacent Bushland, Bullsbrook/Lexia	Pipeline corridor within Bush Forever policy area Within 50 m	1324.62-1328.72 1329.09-1335.15 1328.72-1329.09
192	Wetherell Road Bushland, Lexia/Ellenbrook	Pipeline corridor within Bush Forever policy area on eastern side Within 200 m	1335.38-1335.49 1335.17-1335.38
200	Caversham Airbase Bushland, West Swan/Whiteman	Pipeline corridor within Bush Forever policy area Abuts	1341.92-1343.42 1343.41-1343.52
305	Bennett Brook, Eden Hill to West Swan	Pipeline corridor within Bush Forever policy area	1348.29-1348.37
386	Perth Airport and Adjacent Bushland	Pipeline corridor within Bush Forever policy area on eastern side Within 200 m	1353.50-1354.09 1357.16-1357.43 1358.52-1358.65 1358.79-1359.08 1351.98-1352.22 1356.99-1357.16 1357.43-1357.80
319	Dundas Road Bushland, Forrestfield	Abuts Pipeline corridor within Bush Forever policy area	1359.56-1359.77 1359.77-1360.10
320	Hartfield Park Bushland, Forrestfield	Pipeline corridor within Bush Forever policy area	1361.45-1363.02
387	Greater Brixton Street Wetlands, Kenwick	Within 200 m	1363.02-1363.46
53	Clifford Street Bushland, Maddington	Within 200 m	1365.15-1365.57
246	Canning and Southern Rivers, Beckenham to Martin/Kelmscott	Pipeline corridor within Bush Forever policy area	1371.62-1371.89
255	Dallen Road Bushland, Southern River/ Gosnells	Pipeline corridor within Bush Forever policy area Within 50 m	1376.53-1376.58 1376.47-1376.72
260	Southern River and Adjoining Bushland, Westfield	Within 200 m	1376.56-1376.66
342	Anstey/Keane Dampland and Adjacent Bushland, Forrestdale	Pipeline corridor within Bush Forever policy area Within 200 m	1381.48-1381.53 1382.77-1383.05 1381.93-1382.77
345	Forrestdale Lake and Adjacent Bushland, Forrestdale	Pipeline corridor within Bush Forever policy area	1383.27-1384.18
344	Dennis De Young Reserve and Gibbs Road Swamp Bushland, Banjup/Forrestdale	Pipeline corridor within Bush Forever policy area	1385.34-1386.14 1386.25-1386.70 1386.96-1387.13
268	Mandogalup Road, Mandogalup	Pipeline corridor within Bush Forever policy area on eastern side	1393.78-1394.52
269	The Spectacles	Pipeline corridor within Bush Forever policy area on western side	1394.56-1396.38

1.4 LOOP 10 – AREAS OF CONSERVATION VALUE OVERVIEW

The pipeline corridor passes adjacent to only one designated conservation area in Loop 10 during Stage 5 construction activities. This reserve, the Buller Nature Reserve, is vested for the purpose of 'conservation of flora and fauna' and is managed by the DEC[21]. The pipeline runs adjacent to the western side of this reserve at the following chainage locations:

- 1478.62 – 1479.75 (within 50 m)
- 1479.74 – 1481.38 (within 200 m)

No vegetation within this reserve is required to be cleared for the purposes of Stage 5 construction.

The construction activities for Stage 5 do not affect any other areas of conservation value in or immediately adjacent (within 200 metres) to the pipeline corridor in Loop 10, other than those wetlands identified in Chapter 4, Section 3.3 and areas supporting TECs, which are described in Chapter 4, Section 1.5.

1.5 DESCRIPTION OF VEGETATION AND FLORA

Mattiske Consulting Pty Ltd (Mattiske) undertook vegetation and flora surveys of the pipeline route in 2003 (Mattiske 2003a, 2003b). These reports are contained in Appendix 2 and an overview provided below.

Vegetation

The survey area lies within the Darling Botanical District of the Southwest Botanical Province (Beard 1990) and thus exhibits characteristics of this province. Dominant plant families within the Drummond Botanical Sub-district of the Darling Botanical District include Proteaceae (*Grevillea*, *Banksia*), Myrtaceae (*Eucalyptus*, *Melaleuca*) and Mimosaceae (*Acacia*). The Drummond Botanical Sub-district is characterised by *Banksia* woodland on leached sands with *Melaleuca* swamps where ill-drained; woodland of tuart (*Eucalyptus gomphocephala*), jarrah (*Eucalyptus. marginata*) and marri (*Corymbia calophylla*) on less leached soils (Beard 1990).

Mattiske (2003a, 2003b) mapped and recorded the vegetation and flora occurring along the pipeline route on the Swan Coastal Plain at a detailed scale. A total of 27 vegetation communities were mapped within the Loop 9 corridor and 42 communities were mapped within the Loop 10 corridor. In Loop 9 and 10, the predominant plant communities were *Eucalyptus* woodlands over various other tree and shrub species. There were also many *Corymbia* woodlands, *Melaleuca* woodlands and *Banksia* woodlands, while less common were heaths and shrublands in Loop 9 and *Agonis* woodlands, *Kunzea* shrublands, heaths and sedgelands in Loop 10. The relatively high number of plant communities recorded in these loops reflects the large area surveyed and to some degree the diversity of landforms within the survey area.

[21] Between 30 to 100 m has been excised from all DEC estate (e.g. nature and conservation reserves) for the purpose of the DBNGP corridor. Therefore, construction disturbance undertaken within the pipeline corridor will not be within the DEC estate in these areas. Although the pipeline corridor is excised from DEC estate, such areas will be classified as areas of conservation value for the purpose of managing construction activities.

Many of the vegetation communities differ only slightly from one another and the contrasts are more than likely due to a loss of structure and diversity due to degradation from urban development (Loop 9) and intensive farming practises (Loop 10) (Mattiske 2003a, 2003b).

Threatened Ecological Communities

The survey by Mattiske (2003a) identified three occurrences of the TEC '*Corymbia calophylla – Kingia australis* woodlands on heavy soils of the Swan Coastal Plain' in Loop 9. All occurrences were within Bush Forever Site No. 320 (Hartfield Park, Forrestfield).

The condition of the vegetation of the two most northerly locations of this community was 'Good' to 'Very Good'. However, in the most southerly location, the community vegetation was recorded as being very degraded with only occasional *Corymbia calophylla* or *Kingia australis* plants present (Mattiske 2003a).

Mattiske (2003b) also identified five localised areas of this same TEC in Loop 10 centred at the following chainage locations:

- 1427.04 (recorded approximately 150 m from the pipeline corridor)
- 1432.6 (recorded approximately 100 m from the pipeline corridor)
- 1433.85 (recorded approximately 90 m from the pipeline corridor)
- 1438.06 (recorded within the pipeline corridor)
- 1438.25 (recorded within the pipeline corridor).

The community was very degraded and in most cases only the occasional *Corymbia calophylla* or *Kingia australis* plants were present (Mattiske 2003b). The occurrences of these communities were considered to be fragmented, small and largely disturbed.

The TEC '*Corymbia calophylla – Kingia australis* woodlands on heavy soils of the Swan Coastal Plain' is categorised as 'Endangered' and is listed under the EPBC Act.

No other TECs were recorded in Loop 9 and 10 during the surveys. However, the DEC database identifies two further TECs at locations north of Bullsbrook (within Loop 9) occurring within 500 m of the pipeline corridor (Table 4.2).

Table 4.2 TECs recorded on DEC database within 500 m of the pipeline corridor in Loop 9

TEC	Approximate location	Approximate distance from pipeline corridor (m)
Perth to Gingin ironstone association of the Swan Coastal Plain	East of the Pearce Flying Club	120
	3 km north of Timaru Road (approximately 10 km north of Muchea)	50
Communities of Tumulus Springs	South of Muchea (approximately 2 km south)	350
	West of Bullsbrook (near Neaves Road)	400
	West of Bullsbrook (near Neaves Road)	400

Vegetation condition

Mattiske (2003a, 2003b) rated the condition of each mapped vegetation community in Loops 9 and 10 according to the scale used for assessing Bush Forever Sites (Government of Western Australia 2000b). It ranged from Very Good[22] to Degraded and evidence of disturbance was largely associated with roads, railway lines, powerlines, housing developments and variable grazing pressures.

Flora

Mattiske (2003a, 2003b) recorded a total of 167 plant taxa (including varieties and subspecies) in Loop 9 and a total of 326 plant taxa in Loop 10 and determined that the low number of taxa recorded during surveys of such relatively large sizes, reflects the high degree of disturbance and the large area of cleared land. However, the reports also acknowledged that additional species would most likely be recorded if further survey work were undertaken during other seasons or in more favourable rainfall periods.

A high number of weeds were found within the proposed pipeline corridor. The abundance of weeds exceeded the diversity of weed species recorded in both Loops 9 and 10 (Mattiske 2003a, 2003b). Several of the introduced plants were planted in paddocks and rehabilitation areas along the route.

Over 30 introduced plant species were recorded in Loop 9; however, none of these was listed as Declared Plants under Section 37 of the *Agriculture and Related Resources Protection Act 1976.* For Loop 10, over 70 introduced plant species were recorded of which five were listed as Declared Plants under Section 37 of the *Agriculture and Related Resources Protection Act 1976*:

- Arum Lily (*Zantedeschia aethiopica*) (P1 and P4 control requirements)
- Blackberry (*Rubus fruticosus*) (P1 and P4 control requirements)
- Cotton Bush (*Gomphocarpus fruticosus*) (P1 and P4 control requirements)
- Paterson's Curse (*Echium plantagineum*) (P1 and P3 control requirements)
- Prickly Pear (*Opuntia* spp.) (Declared Plant).

Rare and Priority Flora

Mattiske (2003a) identified four plant species occurring in Loop 9 of the pipeline corridor as being restricted geographically or threatened by local processes (Table 4.3). One species of DRF (*Conospermum undulatum*) listed under the Wildlife Act, and three other species listed as Priority Flora were identified at Hartfield Park (Bush Forever Site 320) in Loop 9 (Table 4.3). *Conospermum undulatum* is also listed as Vulnerable under the EPBC Act.

[22] Very Good: Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure covers repeated fire, aggressive weeds, dieback, logging, grazing.

Good: Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure covers frequent fires, aggressive weeds at high density, partial clearing, dieback and grazing.

Degraded: Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure includes frequent fires, presence of very aggressive weeds, partial clearing, dieback and grazing.

Mattiske (2003b) did not identify any DRF or Priority Flora species within the pipeline corridor of Loop 10 that will be affected by the Stage 5 Expansion.

Table 4.3 DRF and Priority Flora species located in Loop 9

Location	Species Name	Conservation status
BFS 320 (Hartfield Park, Forrestfield)	*Conospermum undulatum*	DRF
	Isopogon drummondii	P3
	Jacksonia ?sericea	P3
	Lambertia multiflora var. darlingensis	P3

The DEC database has also been searched for the locations of DRF and Priority Flora occurring within or immediately adjacent (within 5 km either side of the alignment) to the corridor. This list of species is provided in Mattiske (2006).

1.6 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Project activities requiring vegetation clearing (e.g. clear and grade) have the potential to affect vegetation and flora values. Potential direct impacts that may result primarily from clearing activities include:

- clearing and disturbance to vegetation, (including vegetation that is considered to be regionally significant), that adversely affects the long term viability, condition and diversity of vegetation
- disturbance to TECs
- disturbance of DRF and Priority Flora species.

Potential indirect impacts that may result from other construction activities, such as trenching and excavation, dewatering, hydro-testing, and stringing, welding and x-raying, include:

- increased risk of introduction or spread of weeds and disease (e.g. dieback)
- increased bushfire risk (associated with metal cutting, welding and grinding activities, as well as by the operation of equipment or vehicles in high fire risk areas/conditions)
- alteration of groundwater and surface drainage regimes

Vegetation clearing

The total area of disturbance within the pipeline corridor required for construction of Loops 9 and 10 is around 473 ha[23]. Of this, approximately 75 ha[24] in Loop 9 and 8.5 ha[25] in Loop 10 is vegetated and will require clearing (Table 4.4). There will also be a requirement for infrastructure to be located outside of the pipeline corridor (e.g. truck turnarounds).

[23] Based on a working width of 25 m and does not take into account reduced working widths in areas of conservation value.

[24] Based on a 20 m working width in Bush Forever Sites and a 25 m working width outside of areas of conservation value (including Bush Forever Sites).

[25] Vegetated areas based on wetland areas and a reduced working width of 20 m.

Existing cleared and/or disturbed areas will be used where practicable. However, disturbance outside of the corridor could be around 9 ha for Loops 9 and 10 (Table 4.4).

Table 4.4 Area of disturbance in Loops 9 and 10

Loop	Total area of disturbance within pipeline corridor (ha)*	Estimated vegetated area within pipeline corridor (ha)**	Estimated area of disturbance outside of pipeline corridor (ha)
9	319	75	5
10	154	8.5	4
TOTAL	**473 ha**	**83.5 ha**	**9 ha**

* Based on a working width of 25 m. Not taking into account reduced working widths in areas of conservation value.
** Based on a working width of 20 m in Bush Forever Sites.

Of the vegetation to be cleared in Loop 9, approximately 55 ha[26] is covered by the Bush Forever policy. Vegetation within Bush Forever Sites outside of the pipeline corridor will not be cleared, where practicable. Infrastructure such as turnarounds will be located outside of Bush Forever Sites, or within previously cleared areas within Bush Forever sites, where necessary for practical construction reasons.

All of the vegetation requiring clearing within the pipeline corridor in Bush Forever Sites is considered to be regionally significant. Mattiske (2003a) identified a number of specific plant communities as significant as they support DRF and/or Priority Flora or may be recognised as a TEC. These plant communities are all found within Hartfield Park (Bush Forever Site 320) in Loop 9. There were a number of other Bush Forever Sites, although not specifically regarded as significant by Mattiske (2003a), that contained relatively intact and well established vegetation (generally the result of controlling access) within the pipeline corridor including:

- Dundas Road bushland (Bush Forever Site 319)
- Denis de Young Reserve and Gibbs Road Swamp bushland (Bush Forever Site 344).

The pipeline corridor in other Bush Forever Sites, such as The Spectacles (Bush Forever Site 269), although predominantly cleared of vegetation, does contain a number of mature trees at the edge of the corridor that are likely to have considerable habitat value. In most Bush Forever Sites, much of the vegetation within the pipeline corridor is considerably disturbed, partially cleared and/or the corridor appears to be used as an informal access track.

No vegetation within areas of conservation value will be cleared in Loop 10 other than disturbance to those wetlands identified in Chapter 4, Section 3.3 and degraded areas supporting a TEC, which are described in Chapter 4, Section 1.5. Construction activities for Stage 5 will be occurring immediately adjacent to one nature reserve (the Buller Nature Reserve) and may have the potential to indirectly affect the conservation values of this area through increased edge effects.

Construction of the Stage 5 Expansion pipeline within the corridor will most likely result in the direct impact on TECs in three separate locations in Loops 9 and 10:

- Loop 9, Muchea (TEC - Perth to Gingin ironstone formation on the Swan Coastal Plain)

[26] This figure has been calculated using information provided by the Department for Planning and Infrastructure. It was estimated using the 2001 native vegetation mapping dataset based on a working width of 25 m.

- Loop 9, Hartfield Park, Forrestfield (TEC – *Corymbia calophylla* over *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain)
- Loop 10, KP location 1438-1439 (TEC – *Corymbia calophylla* over *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain)[27]

In the locations where the TECs are mapped in Loop 9, a reduced width of the working corridor (maximum 20 m) will be undertaken.

One species of DRF and three species of Priority Flora were located by Mattiske (2003a) within the pipeline corridor in Loop 9 (Table 4.3). These have all been mapped at Hartfield Park (Bush Forever Site 320). Reduced width of the working corridor (maximum 20 m working width) will also be undertaken in these areas. Where disturbance to these populations is unavoidable, there may be opportunities to translocate flora to adjacent vegetation or use biological material from flora for propagation of plants for rehabilitation.

Weeds

Movement of vehicles has the potential to introduce weeds and/or spread existing populations of weeds within and adjacent to the pipeline corridor. However, a high number of weeds are already present within the proposed pipeline corridor. The proponent will implement a weed hygiene and control program which will reduce the potential for the introduction of new weeds and the spread of the existing weeds.

Fire

There is an increased risk of fire associated with a number of the construction activities within the pipeline corridor. Fire poses an additional risk to the conservation value of the vegetation and flora by providing potentially suitable conditions for weed invasion and through inappropriate fire regimes for native plant reproduction and survival.

Altered water regimes

Groundwater is typically shallow on the Swan Coastal Plain (Chapter 4, Section 4.3), however, Stage 5 Expansion construction will be timed for the summer months, where practicable, whereby the water table will be at its lower limits and seasonally inundated areas would be expected to be dry. The effect the Stage 5 Expansion may have on groundwater-dependent ecosystems is discussed in more detail in Chapter 4, Section 3.4.

The presence of linear stockpiles of topsoil and excavation spoil and modification to surface contours during construction may temporarily alter surface drainage patterns, which could temporarily affect vegetation dependent on such drainage. Construction on Stage 5 will be undertaken in the summer, where practicable, when surface drainage will be minimal. Any disruption to surface flows will be temporary as all stockpiles will be removed and post construction earthworks will restore the pre-existing landform and drainage patterns.

[27] Mattiske (2003b) recorded this community to be in a very degraded condition and to contain in most cases only the occasional presence of *Corymbia calophylla* or *Kingia australis* plants. Mattiske (2003a) regarded these communities to be so disturbed and fragmented (small) that they were unlikely to be sustainable and contain any value.

Dieback

The impact of *Phytophthora cinnamomi* presents a major threat to the ecology and conservation of susceptible vegetation communities in areas within Loops 9 and 10 of the pipeline corridor.

Mapping for dieback has not been undertaken along Loops 9 and 10; however, Mattiske (2003b) has identified low lying areas and wetlands of concern. Detailed mapping for dieback will be undertaken as part of spring flora surveys. The location of dieback infestations will be included on the Environmental Line List, being prepared as part of the CEMP, to indicate areas where dieback hygiene measures are to be implemented during construction. As construction will be occurring in predominantly dry seasons (where practicable), and a *Weed and Dieback Management Protocol* will be implemented, the risk of spreading dieback will be minimal.

Mitigation

Most of the bushland identified in Loop 9 that is affected by Stage 5 construction activities is of particular conservation significance due to its inclusion in *Bush Forever*. The environmental impacts of construction in the pipeline corridor within Bush Forever Sites will be carefully managed to achieve the best environmental outcomes. Stage 5 construction activities within Loop 10 are unlikely to adversely affect any bushland of recognised high conservation significance, other than disturbance to those wetlands identified in Chapter 4, Section 3.3 and degraded areas supporting a TEC, described in Chapter 4, Section 1.5. Mattiske (2003b) concluded that there is likely to be only minimal disturbance to remnant areas of native vegetation.

A CEMP will be prepared for the proponent's environmental management of the Stage 5 Expansion construction activities. The CEMP will include management measures to be implemented during the various construction stages, including the following general requirements:

- minimising the working area in areas of conservation value, which includes Bush Forever Sites
- avoiding disturbance of regionally significant vegetation in Bush Forever Sites outside the pipeline corridor
- avoiding clearing of mature trees in Bush Forever Sites where possible by trimming and pruning subject trees
- rehabilitating disturbed areas with minimal delay
- undertaking weed control
- implementing hygiene measures for vehicles and machinery to prevent the introduction and spread of weeds and diseases (e.g. dieback) in Bush Forever Sites
- liaising with officers from DEC regarding the nature of the construction activities and likely fire dangers within Bush Forever Sites

In addition to these general requirements, the CEMP will also include specific management measures for a number of Bush Forever Sites. The Environmental Line List will indicate the location and length along the pipeline corridor to which a particular site/issue specific management protocol(s) needs to be applied.

Although a detailed vegetation and flora survey has been undertaken relatively recently (Mattiske 2003a, 2003b), an additional survey will be undertaken during spring specifically to locate any DRF or Priority Flora not previously identified. This survey will focus on Bush Forever Sites. Should additional DRF or Priority Flora species be identified through this survey, specific management measures (e.g. the *Threatened Flora Protocol*) will be applied through the CEMP.

1.7 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of flora and vegetation parameters to assess the effectiveness of flora and vegetation management measures described in the CEMP.

1.8 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for vegetation and flora management during construction of the pipeline, which will include specific measures for:

- threatened vegetation communities and flora
- weeds and dieback
- bushfire.

2. Undertake a dieback survey of Loops 9 and 10, planned sufficiently in advance to enable surveys in appropriate seasonal conditions, prior to commencement of construction on those loops. The boundaries of potentially dieback-infested and dieback-free areas, as well as those areas where dieback status is uninterpretable, will be mapped and indicated on the Environmental Line List.

3. Undertake a spring flora survey of Loops 9 and 10 to identify the occurrence of DRF and Priority Flora. Locations of such flora will be mapped and indicated on the Environmental Line List.

These commitments are consolidated in Table 7.1.

1.9 ENVIRONMENTAL OUTCOME

Around 84 ha of vegetation will be cleared and rehabilitated within the pipeline corridor during construction of Loops 9 and 10 of the Stage 5 Expansion. Up to a further 9 ha will be disturbed outside the corridor for infrastructure requirements. It is likely that any DRF and Priority Flora occurring within the pipeline corridor will be cleared, however efforts will be made to avoid or translocate species where practicable. Surrounding vegetation values could potentially be affected by the introduction weeds, dust emissions, fire or altered water regimes, however the mitigation measures that will be implemented should ensure no long-term effects. Dieback is a potential issue in Loops 9 and 10 and hygiene measures will be implemented to reduce the risk of its introduction and/or spread into unaffected areas. It is expected that the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels will be maintained through the avoidance or management of adverse impacts, in accordance with the EPA objective. Clearing will be minimised within all Bush Forever sites.

2 FAUNA

2.1 EPA OBJECTIVE

To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

2.2 FAUNA OVERVIEW

Bancroft and Bamford (2006b), consulting ecologists, undertook a review of fauna interactions during some of the Stage 4 expansion construction works to refine fauna interaction procedures for the Stage 5 Expansion (Bancroft and Bamford 2006a). A Level 1 fauna survey was conducted of the entire pipeline corridor in accordance with EPA Position Statement No. 3 (Bancroft and Bamford 2006b). These studies are contained in Appendix 2. An overview of the Stage 5 Expansion for Loops 9 and 10 is provided below.

Fauna habitat

The habitats found along Loops 9 and 10 are known to support a range of fauna species, including several species that are listed for protection under State and Federal conservation legislation. It is likely that there will be areas along Loops 9 and 10 of relatively high value to fauna, particularly when compared with other areas within the region. Examples of these include:

- National Parks, Conservation Parks, Nature Reserves and Conservation Reserves: areas that have been previously recognised as of high value for flora or fauna, or that have been set aside for conservation purposes.
- Bushland remnants or fragments in cleared, developed or degraded areas: in areas where land use has removed or degraded much of the native vegetation (e.g. the agricultural region) the remaining zones of native vegetation may be important refugia for fauna. Impacts in such refugia will be disproportionately high in a local context because surrounding habitats are of such low value for fauna.
- Bush Forever sites: within the Perth Metropolitan Region there are a large number of native vegetation remnants that have been recognised as important because of their ecological importance (relative to surrounding areas of development).
- Wetlands: wetlands are often a concentration of resources (e.g. water, food and habitat) and are, therefore, of high value to fauna. In many cases the density of fauna is higher near wetlands compared with surrounding areas. Wetlands may also support of suite of species that are specialised to this habitat.
- Drainage lines: in the arid and semi-arid regions, rivers, creeks and drainage lines often support higher quality, or more diverse, vegetation and this may concentrate fauna in these areas (e.g. Swan and Canning Rivers).
- Rare or unusual habitats: uncommon or unusual habitats (e.g. those driven by geological or hydrological factors such as freshwater springs or outlying hills) may support uncommon or outlying fauna populations, or may support a high degree of fauna endemism.
- Threatened Ecological Communities: ecological communities that are recognised as environmentally significant under the EPBC Act.

Mitchell *et al.* (2003) note several TECs that occur on the Swan Coastal Plain, one of which will be affected by the DBNGP: *Eucalyptus calophylla - Kingia australis* woodlands on heavy soils, Swan Coastal Plain.

Fauna species

Forty species were assessed as being of CS1 or CS2 (Table 4.5). Bancroft and Bamford (2006b) in Appendix 2 provides a description of each conservation significant species, including their conservation status, the reason for their significance, aspects of their ecology and potential threatening processes.

Table 4.5 Fauna of conservation significance potentially occurring along Loops 9 and 10

Species	
CS1 Species	**CS2 Species**
Western Swamp Tortoise	Jewelled Ctenotus*
Woma*	Lerista lineata*
Carpet Python*	Black-striped Snake*
Malleefowl^	Black Bittern
Great Egret	Australasian Bittern
Cattle Egret	Australian Bustard
Glossy Ibis	Bush Stone-curlew
White-bellied Sea-Eagle^	Barking Owl
Peregrine Falcon	Rufous Fieldwren
Common Greenshank^	White-browed Babbler
Wood Sandpiper	Crested Bellbird
Common Sandpiper	Brush-tailed Phascogale
Red-necked Stint	Quenda*
Sharp-tailed Sandpiper	Brush Wallaby*
Curlew Sandpiper	Water-rat*
Hooded Plover	
Caspian Tern	
White-winged Black Tern	
Carnaby's Cockatoo^	
Baudin's Cockatoo^	
Major Mitchell's Cockatoo	
Fork-tailed Swift	
Rainbow Bee-eater*	
Chuditch*^	
Western Ringtail Possum*	

Source: Bancroft and Bamford (2006b).

* Indicate species that, if present near the pipeline route, are at greatest risk of impact due to trench construction. While generally at lower risk of significant impact, the remaining species may still be directly or indirectly disturbed and, hence, affected by the construction process.

^ EPBC Act listed species (Threatened Fauna and Migratory Species).

2.3 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Trenching, habitat disturbance and vehicle/equipment movements are the primary project activities with the potential to affect fauna values. Potential impacts that may result from these and other project activities include:

- loss of fauna habitat and habitat fragmentation (temporary, except in the case of habitat trees)
- injury or death through falling into and becoming trapped in open trenches or through accidental collisions with construction vehicles
- interruption to fauna behaviour from noise and light emissions and provision of artificial watering sites (temporary)
- increased predation from feral animals due to increased clearing and lack of cover, improved access for feral predators
- spread of weeds and bushfire risk.

Habitat disturbance and fragmentation

The most significant impact to fauna in Loops 9 and 10 will most likely result from the clearing of vegetation used as habitat. The Stage 5 Expansion pipeline route passes through and close to a number of bushland and vegetated wetland areas. A number of waterbird species (e.g. Australian Shelduck, Pacific Black Duck) nest in adjacent habitat and walk their young to the nearest wetland. Construction adjacent to wetlands may therefore create barriers to these species as well as potentially harming breeding areas through the removal of adjacent bushland.

Mammals and reptiles generally prefer not to cross large expanses of cleared land, where they are vulnerable to predation. Clearing a 30 m wide corridor may fragment potential habitats for these species and/or create barriers to these species' feeding and breeding ranges.

Bancroft and Bamford (2006b) in Appendix 2 provides a description of species specific impacts.

Injury or death of fauna

Mammals and reptiles are more likely to be affected by construction activities within the corridor, as they are less mobile than birds. They are mainly ground-dwelling creatures and are therefore more likely to become trapped in open trenches. There is some potential for injury and even death, particularly for the larger mammals, through entrapment within the trench and/or collisions with construction vehicles. Desiccation-prone species, such as frogs, may also be affected through lack of adequate cover, particularly as the construction activities are occurring in Loops 9 and 10 through the summer period.

See Chapter 2, Section 2.4, for additional discussion relating to susceptible species or groups. In addition to the species discussed in Chapter 2, Section 2.4, the Honey Possum is a species that may occur in high densities in some areas or seasons along Loops 9 and 10. This species regularly travels across the ground and may be trapped in the trench in large numbers.

Mitigation

The working width within all areas of conservation value, including wetlands and bushland areas, will be minimised and not exceed 20 m. This will minimise the area of fauna habitat removed during construction. Isolated trees in rural areas, that may potentially be used as habitat will be avoided where possible and habitat trees pruned and trimmed rather than removed in areas of conservation value. Construction activities will occur outside breeding periods wherever practicable to limit impacts to breeding fauna.

A CEMP will be prepared for the proponent's environmental management of the Stage 5 Expansion construction activities. The CEMP will include management measures to be implemented during the various construction stages and for site/issue specific matters, including a *Fauna Interaction Protocol*. These are described in Chapter 2, Section 2.4 and expanded on in Chapter 5.

2.4 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of fauna parameters to assess the effectiveness of fauna management measures described in the CEMP.

2.5 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for fauna management during construction of the pipeline, which will include specific measures for interactions with fauna.

This commitment is consolidated in Table 7.1.

2.6 ENVIRONMENTAL OUTCOME

Around 84 ha of vegetation will be progressively cleared and rehabilitated for the Stage 5 Expansion in Loops 9 and 10. As a result there will be a short-term effect on the local abundance of fauna populations due to interruption to fauna behaviour, injury or death. Potential effects on fauna will be minimised through the implementation of the CEMP which will include specific measures for interaction with fauna. Given the relatively small area affected at any one time, and the proposed rehabilitation, the long-term effects of the pipeline on the fauna values in Loops 9 and 10 are expected to be minimal. Consistent with EPA objectives, the abundance, species diversity, geographic distribution and productivity of fauna at species and ecosystem level are expected to be maintained conserving regional biological diversity.

3 WETLANDS

3.1 EPA OBJECTIVE

To maintain the integrity, ecological functions and environmental values of wetlands.

3.2 LEGISLATIVE AND POLICY CONTEXT

Wetland policies

Several environmental protection policies provide specifically for the protection of significant wetlands on the Swan Coastal Plain and the South-West region of the State:

- Environmental Protection of Wetlands Preliminary Position Statement (Position Statement No. 4)
- Wetlands Conservation Policy for Western Australia 1997.

The Statutory Environmental Protection Policy (EPP) is:

- Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 (EPP Lakes).

Specified open water wetlands on the coastal plain are also considered to be regionally significant and are protected by the EPP Lakes. This makes it an offence to fill, excavate, mine, deposit effluent into, or construct or alter any drainage works associated with any lakes to which the policy applies (EPA 1992).

The EPA has also previously reported on strategies for the protection and management of wetlands in several bulletins, including:

- Bulletin 685: *Strategy for the protection of lakes and wetlands of the Swan Coastal Plain*.
- Bulletin 686: *A guide to wetland management in the Perth and near Perth Swan Coastal Plain Area*.

In addition, the DEC position on buffer requirements for wetlands has been outlined in the *Wetlands Position Statement* (WRC 2001) and *Advisory Notes for Land Managers on Rivers and Wetland Restoration* (WRC 2000).

Wetland categories

Wetlands on the Swan Coastal Plain have been grouped into three management categories (Hill *et al.* 1996) according to their values:

- Conservation: for wetlands that support a high level of ecological attributes and functions.
- Resource enhancement: for wetlands which may have been partially modified but still support substantial ecological attributes and functions.
- Multiple use: for wetlands with few important ecological attributes and functions.

'Conservation' category wetlands (CCWs) are considered to be of regional significance (EPA 2003). In the Perth Metropolitan Region (i.e. Loop 9), CCWs have been included in Bush Forever Sites where they contain regionally significant bushland and/or form an integral part of a Site (Government of Western Australia 2000b). However, there are many CCWs outside of Bush Forever Sites.

Wetland buffers

As a general guide, the EPA normally recommends a minimum distance between intensive land uses and wetlands of 50 m from the point one metre higher in elevation than the furthest extent of the wetland vegetation (minimum dryland buffer).

The DEC *Wetland Position Statement* (WRC 2001) recommends buffer distances between various land uses and wetlands in absence of management to address potential threats. The buffer width recommended for a particular wetland is dependent upon the conservation significance of the wetland and the purpose of the buffer.

The Department for Planning and Infrastructure has also developed a *Land Use Planning Guideline for the Determination of Wetland Buffer Requirements* to assist land owners, developers and architects in identifying appropriate buffering between wetlands and existing or proposed land uses that will enhance or maintain the significant attributes and values of the wetland (Essential Environmental Services 2004; Welker Environmental Consultancy 2002).

Ramsar wetlands

The Convention on Wetlands (Ramsar, Iran, 1971), more commonly known as the *Ramsar Convention*, is an intergovernmental treaty dedicated to the conservation and "wise use" of wetlands. The Convention's mission is "*the conservation and wise use of wetlands by national action and international cooperation as a means to achieving sustainable development throughout the world"* (Ramsar Convention Bureau 2000). Australia was one of the first of 18 countries to become a signatory to the Convention in 1971.

3.3 WETLANDS OVERVIEW

The Stage 5 Expansion pipeline corridor in Loops 9 and 10 passes through over 100 mapped wetlands on the Swan Coastal Plain. This review focuses on those wetlands that are considered to be regionally significant.

A complete list of the wetlands affected, their location and management category is provided in Appendix 3. Wetlands are also depicted in the series of landscape and environmental features maps contained in Chapter 8, Section 3.

The pipeline passes through over 40 CCWs and 7 EPP Lakes mapped within Loop 9 and 10 CCWs and 10 EPP Lakes in Loop 10. All of these wetlands are considered to be of regional significance.

Loop 9 traverses within 200 m of Forrestdale Lake and Loop 10 runs north-south across the eastern side of the Swan Coastal Plain section of the catchment of the Peel-Harvey Estuary (the estuary is approximately 10 km away from the proposed route at its closest point). Forrestdale Lake and the Peel-Harvey Estuary are both part of Ramsar listed wetlands; 'Forrestdale and Thomsons Lakes' and the 'Peel-Yalgorup System' respectively.

Both Ramsar wetland systems are identified as wetlands of international importance, with Forrestdale and Thomsons Lakes meeting three Ramsar criteria (1a, 2b, 3c), and the Peel-Yalgorup System meeting four criteria (1a, 2c, 3a, 3c) (DEH 2003; 1998):

- **Criteria 1a:** It is a particularly good representative example of a natural or near-natural wetland, characteristic of the appropriate biogeographical region.

- **Criteria 2b:** It is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna.
- **Criteria 2c:** It is of special value as the habitat of plants or animals at a critical stage of their biological cycle.
- **Criteria 3a:** It regularly supports 20,000 waterfowl.
- **Criteria 3c:** Where data on populations are available, it regularly supports 1% of the individuals in a population of one species or subspecies of waterfowl.

3.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Project activities requiring vegetation clearing (e.g. clear and grade) and alteration to surface water or groundwater regimes (e.g. dewatering) have the potential to affect the conservation values of wetlands. The potential impacts that construction activities may have include:

- removal of wetland vegetation that may be regionally significant and/or fauna habitat (see also Chapter 4, Sections 1.6 and 2.3 for assessment of potential impacts relating to vegetation and flora and fauna respectively)
- changes to the hydrological regimes of wetlands
- deterioration of surface water quality in wetlands.

It should be noted that these wetlands were subject to the above impacts during construction of the existing DBNGP. The highly productive nature of these systems has resulted in a high level of rehabilitation, particularly when compared with areas of lower biological productivity.

Removal of wetland vegetation

The construction of the pipeline in Loops 9 and 10 passes through up to 70 wetlands of regional conservation significance (CCWs or EPP Lakes) and will result in the clearing and disturbance to vegetation associated with these wetlands. Wetlands of regional conservation significance are areas of conservation value and, as such, the working width of the corridor will be reduced to 20 m or less through all these areas.

Alteration to hydrological regimes

Species diversity and vegetation composition can potentially be affected if water regimes within wetland areas are altered over the long-term. Pipeline trenches have the potential to act as drainage lines and interfere with natural drainage by diverting water away from, or into wetland areas. The intersection of shallow groundwater by the open trench also has the potential to create localised disturbance to sub-surface flow patterns. However, due to the minor depth of the intrusion and the short period during which the trench is expected to be open, the effects on local drainage and groundwater flow regimes is expected to be minimal. Trench lengths in wetlands will be limited to ensure that the trench does not provide a direct connection between any two wetland water bodies.

Dewatering and groundwater abstraction for water supply (should groundwater be sourced along Loops 9 and 10) may have an effect on groundwater-dependent vegetation. Should groundwater drawdown occur from dewatering or groundwater abstraction, it is expected to be localised, of short duration and is not anticipated to result in any significant impact to vegetation and flora values. Pre-construction groundwater levels are expected to re-establish after dewatering or abstraction ceases.

Disposal of dewater product and hydrotest water can also affect hydrological regimes of wetlands. Pipelines will be laid in wet trenches through wetland areas where possible to minimise the impact dewatering may have on the hydrological regimes of nearby wetlands. Dewatering will only be undertaken if water in the trench is significantly restricting the ability to lay the pipe. Where dewatering is required, the time the trench is open will be minimised and the abstraction rates carefully monitored to reduce potential impacts on surrounding vegetation. Hydrotest water will not be discharged into wetland areas.

The presence of linear stockpiles of topsoil and excavation spoil and modification to surface contours during construction may temporarily alter surface drainage patterns around wetlands. Construction on Loops 9 and 10 will be undertaken in the summer where practicable when surface flows will be minimal. Any disruption to surface flows will be temporary as all stockpiles will be removed and post construction earthworks will restore the pre-existing landform and drainage patterns.

Water quality

There is the potential for contamination (e.g. fuel and chemical spills, acid generating soils) and sedimentation to occur, which could detrimentally affect the wetland system. These impacts were addressed in Chapter 2, Section 5.4.

The water quality may also be affected by the removal of any fringing wetland vegetation by reducing the capacity of the wetland to filter contaminants (including sediments and nutrients) in runoff. However, as the disturbed areas within the pipeline corridor area will be rehabilitated with minimal delay, it is expected that the long term effect of the loss of vegetation on the water quality will be minimal.

Ramsar wetlands

Factors adversely affecting the ecological character of Forrestdale and Thomsons Lakes Ramsar wetland included:

- inputs of nutrients
- use of chemicals to control chironomids
- increasing area *Typha* spp. invading fringing vegetation (DEH 1998).

The three threatening processes identified are not expected to be exacerbated by Stage 5 Expansion construction activities nor the ongoing operation of the pipeline. Construction activities will occur around 200 m from the Forrestdale Lake water body. No dewater product, should it be generated, nor hydrotest water, will be discharged to the wetland.

Threatening processes identified for the Peel-Yalgorup System included:

- inputs of nutrients
- urban development (particularly canal development) and associated increased recreational use (DEH 2003).

As the Stage 5 Expansion section of Loop 10 is some 10 km from the wetland at its closest point, construction of the pipeline is not expected to exacerbate the threatening processes identified for the Peel-Yalgorup System.

Mitigation

The working width within wetland areas of recognised regional conservation significance in Loops 9 and 10, (wetlands identified in *Bush Forever*, CCWs or wetlands identified in the Lakes EPP), will be minimised and will not exceed 20 m (corridor width normally 30 m).

The CEMP will include specific management protocols applicable to construction in wetland areas (i.e. *Wetland Management Protocol*). This protocol will include:

- minimising the working area of wetlands in areas of conservation value[28].
- avoiding dewatering as far as practicable in all wetland areas; if dewatering is required, minimising the length of the open trench so that lower dewatering rates can be applied to minimise the impacts on the surrounding vegetation
- where open water bodies are within 50 m radius of the trench, the water levels of the water bodies will be regularly monitored during any dewatering exercise
- trench lengths in wetlands will be limited to ensure that the trench does not provide a direct connection between any two wetland water bodies
- monitoring abstracted groundwater prior to discharge to ensure compatibility with surrounding water particularly if acid sulphate soils are encountered.

3.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of wetland parameters to assess the effectiveness of wetland management measures described in the CEMP.

3.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for wetland management during construction of the pipeline, which will include specific measures for:

- dewatering
- clearing widths
- trench construction.

[28] Areas of conservation value includes areas identified as CCWs and wetlands gazetted under the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 (Lakes EPP).

This commitment is consolidated in Table 7.1.

3.7 ENVIRONMENTAL OUTCOME

Loops 9 and 10 of the Stage 5 Expansion traverse numerous wetlands, including wetlands of regional conservation significance, and are close to two Ramsar wetlands, Forrestdale Lake and the Peel-Harvey Estuary. Construction activities will directly disturb wetlands through the removal of fringing vegetation and may also temporarily alter surface and groundwater regimes and affect water quality.

Reduced working widths will be employed in wetlands of regional conservation significance and all disturbed areas will be promptly rehabilitated. Effects to water regimes and quality in wetland areas, should they occur, are expected to be of short duration and not result in any long-term affects. Dewatering of trenches will be avoided in wetland areas as far as practicable and no hydrotest water will be discharged to wetland areas.

The threatening processes identified for the Ramsar wetlands are not expected to be exacerbated by the construction of the pipeline. Given the proposed management measures and resilient nature of wetland systems, impacts to wetlands are not expected to be significant or long-term, therefore the EPA objective for this factor will be met.

4 WATER RESOURCES (OTHER THAN WETLANDS)

4.1 EPA OBJECTIVE

To maintain the integrity, ecological functions and environmental values of wetlands.

To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.

To ensure that emissions do not adversely affect environment values of the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

4.2 LEGISLATIVE AND POLICY CONTEXT

See Chapter 2, Section 5.

In addition, as the pipeline traverses the Gnangara and Jandakot Water Reserves, the provisions of the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* apply to activities with potential to pollute the groundwater resource used for public drinking water supplies. This is supported by the Western Australian Planning Commission *Statement of Planning Policy No. 2.7 – Public Drinking Water Source Policy 2003* and the *Water Quality Protection Note: Protecting Public Drinking Water Source Areas* (Department of Water – under revision).

4.3 WATER RESOURCES (OTHER THAN WETLANDS) OVERVIEW

Rivers and streams

Several main rivers are crossed or near the Stage 5 Expansion pipeline section in Loops 9 and 10 (Table 4.6). There are also a number of small streams in the vicinity that are not named and cannot be identified. In addition, a network of artificial drains has been developed to reduce waterlogging in the agricultural areas of the coastal plain. The pipeline corridor passes a number of these main drains, as well as numerous unnamed drains and small gullies. Watercourses are depicted in the series of landscape and environmental features maps contained in Chapter 8, Section 3.

Table 4.6 Major watercourses that the pipeline crosses in Loops 9 and 10

Loop	Name	Location (chainage)
9	Gingin Brook	1286.51-1286.72
	Swan River	1348.32
	Helena River	1349.28
	Woodlupine Brook	1361.38
	Yule Brook	1362.87
	Bickley Brook	1366.55
	Ellis Brook	1369.03
	Canning River	~1371.83-1371.85
	Wungong River	1376.56
10	Dirk Brook	1426.8
	North Dandalup River	1439.43

Loop	Name	Location (chainage)
	South Dandalup River	1445.25
	Murray River	1457.18
	Harvey River	1482.36

Groundwater

Depth to groundwater along Loops 9 and 10 is generally predicted to be shallow (0 to 10 mbgl), excluding a few isolated areas where the pipeline crosses topographical highs (Parsons Brinckerhoff 2006). The inferred groundwater flow for Loop 9 is generally westerly towards the Indian Ocean; however, groundwater flow direction changes to flow towards major water courses (e.g. Swan and Canning Rivers) in areas near these water courses (Parsons Brinckerhoff 2006).

Public water supply sources

The pipeline easement traverses the Gnangara and Jandakot Water Reserves which provide protection for Water Corporation pubic water supply wellfields. The area is proclaimed under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909*, which requires that activities are managed so as not to compromise the quality of groundwater resources within the reserve.

Water supply

Up to 88 ML (76.7 ML for Loop 9 and 11.5 ML for Loop 10) of water is expected to be required for hydrotesting, construction and potable water supplies, however, water will be reused for hydrotesting where practicable, reducing water requirements. The majority of the water is required for hydrotesting (approximately 40 ML) and construction (mainly dust suppression) (approximately 34.5 ML) with smaller quantities required for potable water supply (approximately 14 ML).

This water is expected to be sourced from existing groundwater wells and possibly caissons in riverbeds in areas where groundwater is not readily available away from watercourses (e.g. northern section of Loop 9). Water supply is expected to be sourced from the public water supply in the Perth Metropolitan Area, however groundwater sources may be used in some locations.

4.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Project activities, such as excavation and trenching, and hydrostatic testing, have the potential to affect watercourses and groundwater resources. Potential impacts that may result from these activities include:

- physical disturbance to watercourses/wetlands, banks and riparian vegetation
- alteration to surface water flow regimes
- deterioration in surface water quality
- groundwater drawdown.

The degree of impact pipeline construction may have on a watercourse is dependent upon various factors, including the volume of water carried by the river or stream during the construction period, the construction methods used and the stability of the watercourse beds and banks.

Physical disturbance to rivers and streams

There are several major rivers and streams that are required to be crossed by the pipeline in Loops 9 and 10 (Table 4.6). The preferred option is to use the open-cut technique for these crossings. Open-cut techniques were described in Chapter 2, Section 5.4. The Swan, Canning and Murray Rivers are planned to be crossed using HDD techniques. This technique is described in Chapter 3, Section 5.4.

The installation of caissons in river beds for sourcing water, should they be used, will also result in the physical disturbance of river beds.

Post construction, there is potential for erosion of creek and riverbanks along the pipeline trench and access track alignments, as discussed in Chapter 2, Section 5.4. Appropriate stabilisation and rehabilitation of the watercourses will occur as soon as practicable after construction.

Alteration to flow regimes

Construction of Loops 9 and 10 will be undertaken in summer, as far as practicable, so as to avoid wet conditions and river flow events. However, as described in Chapter 2, Section 5.4, flow regimes may be temporarily altered due to the potential installation of dams, dewatering and discharge of hydrostatic testing water.

Effects on sub-surface flow regimes was discussed in Chapter 4, Section 3.4.

Deterioration in water quality

Deterioration in surface and groundwater quality may result from sedimentation, minor spills of hazardous material (e.g. fuel), leachate from acid sulphate soils and discharged hydrotest water, as outlined in Chapter 2, Section 5.4. The potential for acid generating soils in Loops 9 and 10 is discussed in Chapter 4, Section 5.4. Effects on water quality from these sources of contamination, should they occur, are expected to be temporary and not result in any long-term water quality impacts. Disposal of dewater product and hydrotest water will be undertaken in compliance with the DoW guidelines for dewatering (DoW 2006) to avoid contamination of any receiving waters.

Activities within the Gnangara and Jandakot Water Reserves will be undertaken to meet the requirements of the Department of Water regarding all activities with potential to pollute the groundwater resources.

Groundwater drawdown

Chapter 4, Section 3.4, provides discussion relating to groundwater dependent vegetation.

Should groundwater drawdown occur from dewatering or groundwater abstraction, it is expected to be localised, of short duration and pre-construction groundwater levels are expected to re-establish after dewatering/abstraction ceases. Groundwater abstraction is not expected to have any effect on the long-term viability of the resource, due to the short timeframe of abstraction and the relatively small quantities of groundwater abstracted. Water will be reused where possible.

Mitigation

A CEMP will be prepared for the proponent's environmental management of the Stage 5 Expansion construction activities. The CEMP will include management measures to be implemented during the various construction stages, as briefly described in Chapter 2, Section 5.4. The CEMP and other impact mitigation measures relating to watercourse management are described in more detail in Chapter 5.

4.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of parameters associated with water resources to assess the effectiveness of water resource management measures described in the CEMP.

4.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of water resources during construction of the pipeline, which will include specific measures for:

- watercourse crossings
- dewatering and disposal
- potential acid sulphate soils
- fuel and chemical storage, handling and spill response.

This commitment is consolidated in Table 7.1.

4.7 ENVIRONMENTAL OUTCOME

The pipeline crosses a number of rivers (five of which are considered major rivers), creeks and minor drainage lines. Watercourse crossings will be constructed using the open cut technique and HDD, the latter being used for major river crossings. Direct impacts will be borne by river beds, banks and riparian vegetation, with potential indirect impacts resulting from alterations to surface hydrology and contamination.

Pipeline construction is unlikely to have any long-term impacts on the surface water quality and hydrology, given the management measures proposed, and that pipelines will be buried at a safe margin below the scour channel. At completion, the original contours will be restored and the river channels stabilised to maintain the integrity, ecological functions and environmental values of the watercourses, in accordance with the EPA objective.

5 SOILS AND TERRAIN

5.1 EPA OBJECTIVE

To maintain the integrity, ecological functions and environmental values of the soil and landform.

5.2 LEGISLATIVE AND POLICY CONTEXT

See Chapter 2, Section 4.2.

5.3 SOILS AND TERRAIN OVERVIEW

Loops 9 and 10 traverse the Swan Coastal Plain biogeographical region. This section of the Swan Coastal Plain is a low-lying area dominated by fixed dunes of Quaternary sand with subordinate alluvium, peat and lacustrine deposits. Neither the Mesozoic basement sedimentary rocks nor the laterite occur within the near-surface profile, although occurrences of cemented sands ('coffee rock') are likely to be encountered occasionally depending on local conditions. The soils of the Swan Coastal Plain are dominated by sandy acidic yellow mottled soils with associated leached sands and clays.

Acid sulphate soils

Parsons Brinckerhoff undertook a desktop assessment of the risk of acid sulphate soils occurring in the pipeline corridor. Detailed field investigations will be undertaken prior to construction to identify areas where specific management measures will be implemented to manage the risks of acid generation and release of metals. This report is contained in Appendix 2 and an overview of the key findings provided below.

The potential for occurrence of acid sulphate soils occurring within the proposed excavation footprint is summarised in Table 4.7.

Table 4.7 Summary of potential for occurrence of acid sulphate soils in Loops 7 and 8

Loop	Acid sulphate soil risk ranking (km)			
	Low	Medium to low	Medium	High
9	20	26.5	69	11.5
10	0	18.5	40	3.5

Around 80 km along Loop 9 and 43 km along Loop 10 have been classified as medium or high risk due to the presence of high water tables and wetlands on or adjacent to the line. All other areas have been classified as low or medium to low.

Where acidic soils occur above the natural watertable, excavation and backfilling of these soils is not expected to increase the risk of further acidification or release of metals. The protective trilaminate coating on the pipeline is acid resistant and the presence of acidic soils does not pose any threat to the integrity of the pipeline.

5.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Project activities that result in disturbance of the landscape surface and sub-surface soil profiles have the potential to affect soil and terrain values. Such activities include clearing and grading, trenching and excavation, and vehicle movement in general. Potential impacts that may result from these ground disturbance activities are similar to those for the pastoral and agricultural regions and include:

- erosion (wind and rain) of the corridor and subsequent transport of material offsite
- soil compaction
- soil inversion whereby the topsoil is 'lost' through burial or mixing with other trench soil
- contamination of the soil from spills, disposal of hydrotest water and acid generating soils.

As potential impacts for Loops 9 and 10 are similar to those for the pastoral and agricultural regions, refer to Chapter 2, Section 4.4, for a discussion of possible implications of the potential impacts listed above.

Soils contamination

Over half the length of Loops 9 and 10 were identified as being of medium or high soil acid generating risk (Table 4.7). The generation of acid soils can affect soil and water quality, and land use. In areas or high or medium risk soils, an investigation strategy will be developed to validate the desktop assessment. It will include soil and groundwater sampling, and analysis. These investigations will enable the preparation of acid sulphate soil and dewatering management plans.

5.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of soil and terrain parameters to assess the effectiveness of soil and terrain management measures described in the CEMP.

5.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of soils and terrain during construction of the pipeline, which will include specific measures for:

- potential acid sulphate soils
- dewatering and disposal of water
- fuel and chemical storage, handling and spill response.

2. Undertake field investigations for the length of the Stage 5 Expansion to validate results from the acid sulphate soil and hydrogeological desktop study.

These commitments are consolidated in Table 7.1.

5.7 ENVIRONMENTAL OUTCOME

Construction of the Stage 5 Expansion pipeline may lead to erosion and sedimentation, soil compaction and inversion, and contamination of soil resources, which can lead to on and off-site impacts and can limit the effectiveness of rehabilitation efforts. The implementation of the proposed mitigation measures will minimise the risk of impacts to soil and terrain from occurring and will ensure the EPA objective for this factor is met.

6 HERITAGE

6.1 EPA OBJECTIVE

To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.

6.2 LEGISLATIVE AND POLICY CONTEXT

See Chapter 2, Section 6.2.

6.3 HERITAGE OVERVIEW

Aboriginal heritage

Australian Interaction Consultants (AIC) undertook an Aboriginal heritage assessment of the Stage 5 Expansion. This report (AIC 2006) is contained in Appendix 2 and an overview of Loops 9 and 10 is provided below.

Searches of the Register of Aboriginal Sites, which is maintained by the DIA, indicated that 54 archaeological and ethnographic sites have been recorded along or within 100 m of the pipeline corridor in Loops 9 and 10. Most of these sites comprised of artefacts whilst others were ceremonial and/or burial sites, scar trees or were of mythological significance.

Nine of the 54 sites have Section 18 consents and conditions associated with them.

Native Title

There are four Native Title Claims near Loops 9 and 10:

- Yued (Loop 9
- Single Noogar Claim – Area 1 (Loops 9 & 10)
- Ballaruks People (Loop 9)
- Gnaala Karla Booja (Loops 9 &10).

European heritage

All local government authorities along Loops 9 and 10 were contacted in June 2006 regarding municipal heritage inventory site listings within 1 km of the pipeline corridor. There were no listed sites within the corridor although several within 1 km of the pipeline along Loops 9 and 10. The City of Armadale noted two listed sites and one site under consideration for addition to the inventory within 1 km of Loop 9

- Forrestdale Lake (listed)
- 'Haydock's Existing Home Site'; located on Allen Road near Forrestdale Lake (listed)
- 'Taylor's Old Home Site', located on Commercial Road near Forrestdale Lake (under consideration).

6.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Project activities requiring ground disturbance (e.g. clear and grade, trenching and excavation) have the potential to disturb archaeological material and effect ethnographic values, should they be present. Potential impacts include:

Aboriginal heritage

- disturbance to known heritage sites and previously undiscovered sites
- disturbance to significant features of the landscape/environment (e.g. modified/scarred trees).

European heritage

- disturbance to known heritage sites.

As potential Aboriginal heritage impacts for Loops 9 and 10 are similar to those for the pastoral and agricultural regions, refer Chapter 2, Section 6.4, for a discussion of possible implications of the potential impacts listed above.

European heritage

The known European heritage sites are located over 150 m from the Loop 9 pipeline corridor and are not expected to be directly affected by the proposal. There is potential for indirect impacts, for example vibration.

Chapter 4, Section 3.4 provides a discussion of Forrestdale Lake and potential impacts.

Mitigation

A CEMP will be prepared for the proponent's environmental management of the Stage 5 Expansion construction activities. The CEMP will include management measures to be implemented during the various construction stages, including:

Aboriginal heritage

- flagging and/or fencing known heritage sites identified for protection
- onsite heritage monitors and archaeologist to be present during ground disturbance activities in areas where heritage material has the potential to be present
- contingency actions to be implemented in the event of unearthing potential heritage material.

The CEMP will also include site/issue specific management measures in the form of management protocols (e.g. *Aboriginal Heritage Management Protocol*). Environmental Line Lists will indicate the location and length along the pipeline corridor to which a particular site/issue specific management protocol(s) needs to be applied.

The CEMP, the *Aboriginal Heritage Management Protocol* and other impact mitigation measures are described in more detail in Chapter 5.

6.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of Aboriginal heritage parameters to assess the effectiveness of heritage management measures described in the CEMP.

6.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of Aboriginal heritage during construction of the pipeline, which will include specific measures for:

- protection of sites identified for protection
- discovery of new heritage sites or material.

2. Undertake further research of Aboriginal heritage sites along the pipeline that were identified as not being covered by existing Section 18 consents and, based on research findings, develop and implement appropriate heritage management measures for these sites.

These commitments are consolidated in Table 7.1.

6.7 ENVIRONMENTAL OUTCOME

Construction of the Stage 5 Expansion will require the disturbance of Aboriginal heritage sites within the pipeline corridor along Loops 9 and 10. Where these sites are covered by existing Section 18 consents, they will be managed in accordance with the consent conditions. Where these sites are not covered by existing Section 18 consents, they will be further researched and appropriate heritage management procedures developed and implemented. The proponent will avoid disturbance to sites outside the corridor identified for protection, and will minimise disturbance to landscape and environmental features that may be of heritage significance but not recognised as 'sites'. The proponent will continue to consult with relevant Aboriginal groups and will ensure that, consistent with the EPA objective for this factor, Aboriginal heritage sites are managed in accordance with the Aboriginal Heritage Act.

7 LAND USAGE AND SERVICES

7.1 OBJECTIVE

Minimise disturbance to third party infrastructure, landholders and land use.

7.2 LAND USAGE AND SERVICES OVERVIEW

Loops 9 and 10 are located in the Perth Metropolitan, Peel and South West Regions, as defined by the State Planning Strategy (WAPC 1997), and traverse numerous local government authorities, especially once the pipeline corridor enters the Perth Metropolitan Area (Table 4.8).

Loop 9, to the north of the city fringe, is mostly freehold for the purpose of grazing and cropping with some Crown Reserve and Crown Land for conservation and other purposes. This area has been experiencing increasingly intense land use pressures. Loop 9 also includes freehold agricultural land on the city fringe and public owned and freehold urban land and regional and public open space. Through the city, Loop 9 traverses a combination of vacant, rural, semi-rural and urban land, with private urban residences being within several metres of the corridor in some sections. Understandably, there is a high population density along the corridor within the city area (Table 4.8).

Loop 10 is mostly freehold land for grazing and cropping and it is not close to any towns it passes by (Pinjarra and North Dandalup are approximately 1.6 km and 5 km from the pipeline corridor respectively). Consequently, there is a low population density along the corridor (Table 4.8).

Table 4.8 Local government authorities and land use along Loops 9 and 10

Loop	Local government authority	Description of land use and closest residences
9	Shire of Gingin	Predominantly rural with some houses within 70 m of the corridor.
	Shire of Chittering	Primarily rural with large expanses of unoccupied land.
	City of Swan	A combination of rural and urban areas, abutting a number of residential areas. Various sensitive premises were located adjacent to or near the pipeline corridor including schools, sporting venues and mining areas.
	City of Belmont	Comprises vacant land and conservation areas associated with the Perth Airport.
	Shire of Kalamunda	Semi-rural and urban areas comprise this municipality with some residential areas abutting the pipeline corridor. A few sensitive areas, incorporating sporting venues, were near the pipeline corridor.
	City of Gosnells	Predominantly vacant land, with some conservation and urban residential areas. The pipeline corridor borders two sensitive residential estates and crosses a recreational park that is currently unused. It also passes through the Orange Grove primary school.
	City of Armadale	Primarily rural with some houses within 65 m of the pipeline corridor. There were a number of sensitive areas near to the corridor, including a sporting complex.
	City of Cockburn	Predominantly rural/semi-rural with some houses within 5 m of the pipeline corridor.
	Town of Kwinana	Primarily rural/semi-rural with some houses within 15 m of the pipeline corridor.
10	Shire of Serpentine-Jarrahdale	Predominantly rural with eleven sensitive premises identified*, the closest of which is approximately 70 m from the pipeline easement.

Loop	Local government authority	Description of land use and closest residences
	Shire of Murray	Primarily rural with eighteen sensitive premises identified*, the closest is within 20 m of the pipeline corridor.
	Shire of Waroona	Predominantly rural, including crown and freehold land, with one conservation reserve. One sensitive premises was identified within 12 m of the pipeline easement.

*Sensitive premises identified during the Risk Assessment undertaken, incorporating areas within 660 m of the pipeline.

A variety of infrastructure occurs near the pipeline corridor. Within the Perth Metropolitan Area the pipeline corridor crosses major transport corridors; including roads (Albany Highway, Roe Highway, Great Eastern Highway, Reid Highway) and railways (Perth urban passenger railway and freight railway); other infrastructure (e.g. power transmission); and private infrastructure (e.g. property fences).

7.3 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

During the construction of the pipeline, access to and use of land on the corridor by landowners and the public will be strictly prohibited. Construction activities will also require the crossing of roads, fences and other infrastructure and may also contribute to ongoing land use issues. Potential impacts that may result from construction activities include:

Rural areas (low population density)

- temporary loss of land for utilisation in agricultural activities
- temporary impediment to property access and stock movement
- increased risk of wildfire and the introduction of weeds
- possible long-term loss in soil productivity
- disruption or damage to infrastructure, services and third party property.

Residential areas (high population density)

- disruption or damage to infrastructure, services and third party property
- localised traffic congestion or disruptions.

As most potential impacts for Loops 9 and 10 are similar to those for the pastoral and agricultural regions, refer to Chapter 2, Section 7.3, for a discussion of possible implications of the potential impacts listed above.

Traffic interruptions

When pipeline construction is occurring in high-population density areas, particularly the Perth Metropolitan Region, there is the potential for traffic interruptions. These may be caused by transport of equipment or materials (e.g. trucks and the pipeline construction equipment), as well as regular vehicle movements associated with construction personnel commuting to and from the construction site. These effects would be localised, depending on the section of the pipeline being constructed, and temporary as pipeline construction progresses through the Perth metropolitan region. The intended construction hours of 7 am to 6 pm would result in construction personnel commuting outside of the normal peak traffic times and thus is unlikely to contribute further to peak traffic congestion.

Mitigation

A Stage 5 Expansion Land Management Strategy will be developed to be implemented by the Land Management Team, with the aim of delivering the project with minimum disruption to the landowners affected by both pre-construction and construction activities.

A CEMP will also be prepared for the proponent's environmental management of the Stage 5 Expansion project construction activities. The CEMP will include management measures to be implemented during the various construction stages, which will include measures that will address land usage and services issues, such as:

- weed management
- soil management
- fire management
- rehabilitation.

The CEMP will also include site/issue specific management measures in the form of management protocols (e.g. *Fire Management Protocol* and *Weeds and Dieback Management Protocol*). An Environmental Line List will indicate the location and length along the pipeline corridor to which a particular site/issue specific management protocol(s) needs to be applied.

The Land Management Strategy, CEMP and other impact mitigation measures are described in more detail in Chapter 5.

7.4 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of parameters associated with land usage and services to assess the effectiveness of management measures described in the CEMP.

7.5 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of land usage and services during construction of the pipeline, which will include specific measures for:

- weed, soil and fire management
- rehabilitation
- access and safety management (primarily addressed through the Land Management Strategy).

This commitment is consolidated in Table 7.1.

7.6 ENVIRONMENTAL OUTCOME

The Stage 5 Expansion is expected to cause localised, temporary disruption to landowners and other third-party infrastructure along Loops 9 and 10. This is because the duration of prohibition of public access to the pipeline corridor will be relatively short, land users will be able to resume previous land use activities on top of the pipeline (post construction and rehabilitation) with the exception of excavation activities, and infrastructure will be reinstated and landscaped following construction. Construction activities may cause some traffic congestion problems in the Perth metropolitan area, however, this will be localised and of short duration.

8 AIR QUALITY (DUST)

8.1 EPA OBJECTIVE

To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

8.2 LEGISLATIVE AND POLICY CONTEXT

See Chapter 2, Section 8.2.

8.3 AIR QUALITY (DUST) OVERVIEW

Dust was defined and described in Chapter 2, Section 8.2.

Dust from soil disturbance will be the main component of air emissions during the construction phase of the proposed development. However, no dust emissions are likely once the pipeline is rehabilitated and in operation.

Dust from construction activities is not likely to be a key public concern in areas remote from populated centres (e.g. most of the northern section of Loop 9 outside of the Perth Metropolitan Area and most of Loop 10). However, where construction is required near populated centres (e.g. some sections of Loop 9 where it traverses the Perth Metropolitan Area), dust has the potential to affect nearby residences. An overview of surrounding land use and proximity to residences was provided in Table 4.8.

8.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Dust can affect visual amenity, be of general nuisance, cause health problems in susceptible individuals and affect vegetation and fauna values. The effects of dust on vegetation and flora, and fauna were described in Chapter 2, Sections 1.4 and 2.4 respectively.

The potential impacts of dust are likely to be more prevalent in Loops 9 and 10, compared to the pastoral and agricultural areas, due to the increased population density, particularly in the Perth metropolitan region (Loop 9). Should dust emissions pose a significant risk to nearby residences in Loop 9, or substantiated public complaints are received, the proponent will implement additional dust suppression measures.

The proponent will minimise the emission of dust through mitigation measures described in Chapter 5, Section 2.12. These measures include:

Rural areas (low population density)

- minimising the area being cleared
- rehabilitating and/or stabilising areas as soon as possible after disturbance
- avoiding unnecessary movement of vehicles and machinery

Residential areas (high population density)

- measures as described above
- applying water or stabilisers via water trucks and sprayers
- covering vehicles with dust emitting loads (except when loading and unloading)
- using tarps or geo-textile materials to suppress dust from stockpiles.

8.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of dust parameters to assess the effectiveness of management measures described in the CEMP.

8.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of dust emissions during construction of the pipeline, which will include specific measures for:

- stabilising disturbed surfaces and/or stockpiles
- watering
- rehabilitation.

This commitment is consolidated in Table 7.1.

8.7 ENVIRONMENTAL OUTCOME

Due to the high population density in the Perth metropolitan region (Loop 9), potential dust impacts are more likely to arise as a result of construction of the Stage 5 Expansion. Significant long-term dust impacts are expected to be negligible given the short-term and temporary nature of the construction work and the mitigation measures proposed by the proponent. These measures will ensure the EPA objective for this factor is met in that dust emissions do not have any significant impact upon sensitive premises, and vegetation and fauna values.

9 NOISE AND VIBRATION

9.1 EPA OBJECTIVE

To protect the amenity of nearby residents from noise and vibration impacts resulting from activities associated with the proposal by ensuring the noise and vibration levels meet statutory requirements and acceptable standards.

9.2 LEGISLATIVE AND POLICY CONTEXT

See Chapter 2, Section 8.1.

9.3 NOISE AND VIBRATION OVERVIEW

Pipeline construction activity will result in a temporary increase in noise levels within the immediate vicinity of the corridor, associated with the operation of vehicles and equipment. Access to and from the relevant construction sites may also cause a temporary increase in local traffic noise levels. This impact is expected to be of short duration and intensity at any one location. There will not be a requirement for blasting to be carried out in Loops 9 and 10.

Loops 9 and 10 traverse areas of low, moderate and high density living. Within Loop 9, residential properties come within 5 m of the corridor in some places. Loop 10 traverses predominantly agricultural areas, with residences generally not within 100 m. An overview of surrounding land use and proximity to residences was provided in Table 4.8.

9.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential impacts

Vibration and ambient noise levels near the construction corridor will increase as a result of the operation of vehicles and equipment. Potential impacts that may result from these activities include:

- affect the amenity of nearby residences (noise and vibration)
- cause damage to property (vibration)
- interrupt fauna behaviour and movement (discussed in Chapter 2, Section 2.4).

Noise

Loop 9 traverses the Perth Metropolitan Area and consequently high density residential areas are near the pipeline corridor. Within Loop 10, the pipeline corridor is routed through predominantly agricultural areas with few residences.

Construction activities will generally cause a temporary increase in local noise levels above ambient levels. The progression of construction along the pipeline corridor will result in short lived noise impacts at any one location. The noise levels generated by the various construction activities will vary in intensity and tonal characteristics depending upon the combination of equipment in operation at any one time and the location and duration of the individual activities.

Construction traffic will cause minor increases in traffic noise on roads near the pipeline corridor. However this effect will be temporary and will be restricted to the construction phase of the pipeline. Blasting is not anticipated to be carried out in Loops 9 and 10.

Construction of the pipeline corridor will be in accordance with the Noise Regulations. It is anticipated the majority of construction will occur during normal working hours from Monday to Saturday. Where construction is required out of hours or on Sundays and/or public holidays, noise emissions will comply with the assigned levels provided in Regulation 7 of the Noise Regulations or construction will be undertaken in accordance with an approved Noise Management Plan.

Vibration

Vibration has the potential to affect adjacent residences, farm structures or historical sites and also the adjacent existing pipeline within the corridor. Blasting and rock breaking will not be required in Loops 9 and 10, however ground compaction will be required. The potential for vibration impacts from ground compaction on dwellings and structures are anticipated to be low.

Mitigation

A Construction Environmental Management Plan (CEMP) will be prepared for the proponent's environmental management of construction activities. The CEMP will include mitigation measures to be implemented during the various construction stages, as described in Chapter 5, Section 2.11. These measures include ensuring noise and vibration from construction of the pipeline comply with the requirements of the Noise Regulations.

9.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for the monitoring of noise parameters to assess the effectiveness of management measures described in the CEMP.

9.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of noise and vibration emissions during construction of the pipeline, which will include:

- scheduling construction during daylight hours to avoid impacts on nocturnal fauna
- complying with the Noise Regulations when working near residences
- maintaining vehicle speed limits.

This commitment is consolidated in Table 7.1.

9.7 ENVIRONMENTAL OUTCOME

The Stage 5 Expansion will result in a temporary increase in noise emissions above ambient levels. However, noise impacts will be short in duration and managed so that construction is in accordance with the Noise Regulations. Vibration is expected to be insignificant, resulting from ground compaction only. Therefore, in accordance with the EPA objective, there will be no long-term effect on the amenity of nearby residents from noise and vibration.

10 PUBLIC SAFETY AND RISK

10.1 EPA OBJECTIVE

To ensure that risk from the proposal is as low as reasonably achievable and complies with acceptable standards and EPA criteria.

10.2 LEGISLATIVE AND POLICY CONTEXT

See Chapter 2, Section 8.3.

10.3 PUBLIC SAFETY AND RISK OVERVIEW

There are several aspects of the Stage 5 Expansion that could potentially pose an off-site risk to the safety of the general public, not including pipeline construction personnel. These include risks during construction and operational phases.

Loops 9 and 10 traverse numerous local government authorities and their associated suburbs, crossing a number of major and minor roads and railway networks. There are also a number of public utilities occurring near the pipeline corridor (e.g. water, gas and electricity) that may be affected by the installation of the pipeline (Chapter 4, Section 7.2).

10.4 ASSESSMENT AND MITIGATION OF POTENTIALLY SIGNIFICANT IMPACTS

Potential sources of impacts

There are several aspects of the Stage 5 Expansion that could potentially pose an off-site risk to the safety of the general public, not including pipeline construction personnel. These include:

Construction

- proximity of construction activities to private residences and public roads
- proximity to other utilities
- the requirement for transportation of equipment, hydrocarbons and chemicals on public roads
- the increase in traffic volumes on public roads

Operation

- interference with the pipeline.

Proximity to the public during construction

A Stage 5 Expansion Land Management Strategy will be developed and will address public safety and access to the corridor during construction and management of land use activities within the pipeline corridor post-construction (Chapter 5).

There will also be a requirement for a variety of machinery/equipment and hazardous materials to be transported to the different locations of pipeline construction via public roads. The transport of potentially hazardous material (e.g. hydrocarbons and chemicals) will be managed in accordance with relevant State legislation and Australian standards to ensure risks to the public are minimised as far as practicable. The storage and handling of fuels and chemicals and response to spills will also be managed in accordance with specific management measures to be detailed in the CEMP.

Construction related traffic and the effects on local traffic volumes was discussed in Chapter 4, Section 7.3.

Pipeline interference post construction

The main threat to pipeline integrity, once installed, is external or mechanical interference. External interference usually involves the removal of the protective ground cover and contact with the pipe, which may or may not penetrate the pipe wall (APIA 1998).

The Stage 5 pipeline will be constructed in accordance with Australian Standard 2885 to meet appropriate safety standards. This includes physical and procedural measures, such as burying the pipeline and installing signs, amongst others. These measures will reduce the likelihood of post-construction interference.

Mitigation

A Construction Environmental Management Plan (CEMP) will be prepared for the proponent's environmental management of construction activities. The CEMP will include mitigation measures to be implemented during the various construction stages, as described in Chapter 5. These measures include ensuring compliance with Australian Standard 2885, from the pipeline construction stage to operation and maintenance. Measures to reduce the risk of post construction interference will also be described (e.g. erecting signs and fences where applicable).

10.5 MONITORING AND ASSESSMENT OF PERFORMANCE

The CEMP will include provisions for monitoring parameters associated with fuels and chemicals, and access and safety, to assess the effectiveness of management measures described in the CEMP.

10.6 PROPONENT COMMITMENT

The proponent will:

1. Prepare and implement a CEMP to include provisions for the management of parameters associated with public safety during construction of the pipeline, which will include specific measures for:

- fuel and chemical storage, handling and spills response
- access and safety.

This commitment is consolidated in Table 7.1.

10.7 ENVIRONMENTAL OUTCOME

Pipelines are recognised as a safe and efficient means of transporting natural gas; however, there are risks to the public both during and after construction of the Stage 5 looping project. Proximity to public infrastructure, the requirement to transport equipment and machinery on public roads and post construction interference with the pipeline could potentially cause harm to the public. Construction, operation, maintenance and management of the pipeline will be undertaken in accordance with AS 2885 to ensure risks are minimised as far as practicable. The increase in traffic volumes will be temporary and within the current capacity of the public roads. Transportation of dangerous goods will be done in accordance with relevant legislation and standards. Through implementation of risk mitigation measures, potential risk to the public will be reduced as far as practicable to ensure the EPA objective for this factor is met.

Chapter 5 Impact mitigation

1 INTRODUCTION

This chapter describes the DBNGP Stage 5 Expansion environmental impact mitigation measures that will be implemented by the proponent. It will also describe the mechanisms/tools that will be employed to implement those measures. All impact mitigation measures that will apply to the Stage 5 Expansion will be consistent with the Australian Pipeline Industry Association (APIA) impact mitigation measures as outlined in the APIA *Code of Environmental Practice.*

1.1 ENVIRONMENTAL MANAGEMENT SYSTEM

The proponent operates in accordance with its Environmental Management System (EMS) and maintains compliance with the international EMS standard, AS/NZ ISO 14001:1996. The purpose of the EMS is to ensure proactive planning, sustainable development and continuous environmental improvement.

The key elements of the proponent's EMS include a corporate environmental policy (Appendix 1), assessing environmental risk and identification of legal requirements, developing objectives and targets for improvement, training, operational control, communication, emergency response, corrective and preventative actions, audits and review.

1.2 STAGE 5 EXPANSION ENVIRONMENTAL MANAGEMENT PLANS

Construction Environmental Management Plan (CEMP)

Under the *Petroleum Pipeline Act 1969*, the proponent is required to submit a Construction Environmental Management Plan (CEMP) for approval by DoIR prior to the commencement of construction. The CEMP for the Stage 5 Expansion will contain the following information:

- assessment of environmental effects and risks
- environmental objectives and performance criteria
- management framework
- implementation strategy
- management, monitoring and contingency actions (see more detail below)
- auditing, review and reporting requirements.

The CEMP will describe activity specific environmental management measures, including monitoring and contingency actions, to be implemented during the pipeline construction process based on the following project activities:

- survey, fencing and service location
- clear and grade
- trenching and excavation
- drilling and boring

- pipe stringing and welding
- lowering-in and backfilling
- clean-up and rehabilitation
- testing and commissioning

The CEMP will also contain site/issue specific environmental management protocols. Measures described for each project activity will indicate when a particular site/issue specific protocol needs to be implemented. The Environmental Line List, being developed as part of the CEMP, will also indicate when and for what section of the pipeline corridor a site-specific protocol needs to be implemented. The following management protocols will be developed for the Stage 5 Expansion:

- Incident Response Protocol
- Conservation Area Management Protocol
- Vegetation Management Protocol
- Weed and Dieback Management Protocol
- Threatened Flora Management Protocol
- Wetland Management Protocol
- Dewatering 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 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

These management protocols are described in more detail in Chapter 5, Section 2.

Environmental Line List

All site specific environmental information will be captured in an Environmental Line List. This list is sorted by chainage (KPs) and includes the location, issue and management practices (e.g. protocols to be implemented) required for site specific environmental issues. Results of the specialist surveys and consultation are captured here. All crews will be issued with the Environmental Line Lists.

Land Management Strategy

A Stage 5 Expansion Land Management Strategy will be developed that will outline land management processes, such as the notification of landowners and facilitation of land owner agreements, and land management activities, such as determining construction access to the pipeline corridor and rehabilitation requirements. A Stage 5 Land Management Team will be responsible for communicating with landowners along the pipeline route advising them of all aspects of the construction activities that are likely to affect them. The aim is to deliver the project with minimum disruption to the landowners affected by both pre-construction and construction activities.

Operational Environmental Management Plan (OEMP)

Under the *Petroleum Pipeline Act 1969*, the proponent is also required to submit to DoIR for approval an Operational Environmental Management Plan (OEMP) prior to commissioning of the pipeline.

1.3 STAGE 5 EXPANSION ENVIRONMENTAL OBJECTIVES AND PERFORMANCE CRITERIA

The proponent has developed a number of environmental objectives for the Stage 5 Expansion (Table 5.1). These objectives have been developed to provide guidance for the management of environmental issues during the construction of the pipeline and will be incorporated into the CEMP (Chapter 5, Section 1.2).

Table 5.1 Stage 5 Expansion environmental objectives and performance criteria

Issue	Objective	Performance Indicator
INCIDENT RESPONSE		
Environmental impact	To minimise and limit environmental impacts to the extent of the environmental approval.	Breaches of Ministerial Conditions.
Complaint	Investigate complaint and implement action to minimise future complaints.	Investigation completed. Remediation action undertaken. Complainant advised of outcomes.
Protocol	Protocols implemented to manage potential environmental impacts.	Protocol updated to minimise potential for future complaints.
CONSERVATION AREAS		
Disturbance to areas of conservation value	Minimise and manage disturbance to areas of conservation value.	No vegetation outside approved areas in areas of conservation value is cleared or destroyed. No vehicle or machinery movement outside of approved areas. Weeds and diseases managed consistent with the *Weed and Dieback Management Protocol*.
VEGETATION		
Weeds and diseases	Prevent the introduction and dispersal of weeds and pathogens and pest species.	The presence of weeds, pathogens and pest species on the construction corridor is consistent with or better than adjacent land.
Disturbance to vegetation	Minimise and manage disturbance to remnant vegetation Declared Rare Flora and Priority Flora populations.	All construction activities undertaken within the construction corridor. All areas of remnant vegetation (habitat) avoided outside the construction corridor, the width of the construction corridor reduced to prevent or minimise disturbance to the populations.

Issue	Objective	Performance Indicator
WEED AND DIEBACK		
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.	No new species of weeds or pests recorded in the pipeline corridor within one year of completion of construction activities.
Threat of spreading weeds, pests and diseases	To minimise the risk of spreading existing weeds, pests and dieback along the corridor and to adjacent areas.	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.
THREATENED FLORA		
Disturbance to Threatened Flora	To minimise the disturbance or clearing of Threatened Flora including Declared Rare Flora and Priority Flora species listed under the Wildlife Act.	No disturbance or clearing to Threatened Flora species other than that approved under license to take.
WETLANDS		
Disturbance to wetlands	To minimise and manage disturbance to wetlands and wetland buffer areas from construction activities.	No wetland dependent vegetation outside approved areas is cleared or destroyed.
Wetland water quality and water regimes	To prevent adverse changes to wetland water quality or hydrological regimes resulting from construction activities.	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.
DEWATERING AND WATER DISPOSAL		
Water Quantity	To ensure that dewatering activities do not extract excessive amounts of water that may be detrimental to the water resource.	No drawdown of the aquifer beyond the immediate proximity of the construction works from dewatering activities.
Water Quality	To ensure that dewatering activities do not degrade the beneficial use of the aquifer or compromise the ecological value of nearby surface receptors.	No long-term detrimental impact to the aquifer compared to pre-construction background water quality from dewatering activities. Groundwater returned to the aquifer will meet or exceed pre-construction groundwater quality components. No greater than a 10% variation of water quality in nearby ecological receptors from dewatering activities.
ACID SULPHATE SOIL		
Acidification and release of metals	To ensure that the are no adverse impacts to sensitive receptors as a result of the excavation and stockpiling of acid sulphate soils.	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.
FAUNA INTERACTION		
Fauna habitat	To minimise the temporary and permanent reduction or fragmentation of existing 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	To minimise the direct impacts on fauna through impacts with vehicles, entrapment in construction works, or extraordinary exposure to predators.	Vehicle speeds limited on unformed access tracks and construction worksite. Achievement of fauna inspection and clearing requirements. Adherence to injured animal protocol.

Issue	Objective	Performance Indicator
WATERCOURSE CROSSING		
Disturbance to watercourses	Minimise and manage disturbance of 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 construction corridor.
Contamination of watercourses	Prevent contamination of watercourses from construction activities.	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.
FIRE		
Prevent fires	To prevent fires occurring as a result of construction activities.	No pipeline construction related fires.
DUST		
Landholders	To minimise the temporary impact of dust emissions from construction activities, machinery and vehicles.	Few reasonable substantiated complaints. Accordance with relevant policies. Acceptable ambient dust levels down-wind of the construction site.
Vegetation	To minimise the impact of dust on surrounding vegetation so long-term existence is ensured.	Health of vegetation adjacent to the construction corridor remains the same post-construction as it was pre-construction.
NOISE		
Public/residents	To minimise the impact of noise and vibration emissions from construction activities, machinery and vehicles.	No reasonable landholder complaints. Compliance with Noise Regulations.
FUEL AND CHEMICAL STORAGE, SPILL AND EMERGENCY RESPONSE		
Contamination	Prevent contamination of groundwater, surface water and soil.	Chemicals and fuels stored and handled within designated areas. No significant spills or leaks of hydrocarbons (in excess of 80 litres near wetlands and rivers) during construction and rehabilitation operations outside of areas designated for maintenance, refuelling or storage. No significant spills or leaks of hydrocarbons (in excess of 500 litres) during construction and rehabilitation operations outside of areas designated for maintenance, refuelling or storage. No spills or measurable leaks of hydrocarbons within any Water Reserve.

Issue	Objective	Performance Indicator
WASTE		
Waste management	Minimise generation of waste during construction.	Minimise waste generation.
	Minimise pollution or environmental harm due to inappropriate disposal of waste.	No uncontained waste, rubbish or litter is found within construction corridor or at facilities during construction. No waste found within construction corridor or at facilities immediately following construction. A waste register is maintained during construction indicating waste categories, approximate volumes of waste, and location of disposal. Waste material is contained and disposed of in accordance with EP Act.
SOIL		
Topsoil	Minimise change to soil profile from excavation activities.	No evidence of subsoil on surface (as detected by colour and texture) within construction corridor following backfill. No visual evidence of soil compaction following backfill and rehabilitation (e.g. hard soil, local water pooling).
Erosion	Prevent occurrence of soil erosion during and following construction.	The extent of soil erosion within the construction corridor during and within two years following construction is consistent with surrounding land. No visible soil erosion from construction corridor during or within three years following construction.
ABORIGINAL SITES		
Known (recorded) Aboriginal heritage sites	To avoid disturbance to Aboriginal heritage sites identified for protection near the pipeline corridor.	No disturbance to Aboriginal heritage sites identified for protection.
New (unrecorded) Aboriginal heritage sites	To manage new Aboriginal heritage sites/artefacts uncovered or identified during construction in accordance with the requirements of the Aboriginal Heritage Act 1972.	All new Aboriginal heritage sites managed in accordance with the *Aboriginal Heritage Act 1972*.
REHABILITATION		
Vegetation	To re-establish vegetation and associated habitat areas to the condition that it was in prior to disturbance or better.	Achievement of the completion criteria set out in the *Rehabilitation Protocol.*
Soil	To control sediment and erosion.	Achievement of the completion criteria set out in the *Rehabilitation Protocol.*

2 SITE/ISSUE SPECIFIC MITIGATION MEASURES

2.1 AREAS OF CONSERVATION VALUE

A *Conservation Area Management Protocol* will be developed within the CEMP to describe the measures that will be implemented during construction of the pipeline within areas of conservation value (including Bush Forever sites, nature and conservation reserves, TECs, areas supporting DRF and Priority Flora, ESAs, conservation category and resource enhancement wetlands and places listed on the Australian Heritage database).

Most loops traverse through or adjacent to areas of conservation value. The location of areas of conservation value are indicated on the Environmental Line List, being developed for the CEMP.

The *Conservation Area Management Protocol* will include the following key measures:

- minimising the working area required to be cleared within areas of conservation value affected by the pipeline corridor to 20 m or less
- avoiding disturbance of regionally significant vegetation in Bush Forever Sites outside the pipeline corridor by locating any required turnabouts, turkey nests and/or equipment required to be stored in areas already cleared within Bush Forever Sites or outside any Bush Forever Sites
- avoiding clearing of habitat trees in areas of conservation value where possible by trimming and pruning subject trees
- rehabilitating disturbed areas with minimal delay and including weed control for a period of two years after construction is finished
- implementing hygiene measures for vehicles and machinery to prevent the introduction and spread of weeds and diseases (e.g. dieback)
- liaising with officers from DEC regarding the nature of the construction activities and likely fire dangers within conservation areas.

The measures described in the protocol will be in addition to those that will be implemented as part of other relevant protocols (e.g. *Weed and Dieback Management Protocol, Threatened Flora Protocol*) and those that are described for the general management of project activities for construction activities in the CEMP.

2.2 THREATENED FLORA

A *Threatened Flora Protocol* will be developed to address the management of conservation significant flora (e.g. DRF and Priority Flora) that may be present along the pipeline corridor. Priority Flora species were recorded in most looping sections. The location of DRF and Priority Flora will be indicated on the Environmental Line List being developed for the CEMP.

The *Threatened Flora Protocol* will include the following key measures:

- requirement for flora surveys to identify DRF and Priority Flora prior to construction commencing
- requirements for permits to be obtained where disturbance of DRF is unavoidable (e.g. DEC permit to 'take flora')
- flagging and/or fencing of Threatened Flora so as to avoid disturbance to flora

- translocation of Threatened Flora to adjacent vegetation should it need to be cleared.

2.3 WEEDS AND DIEBACK

A *Weed and Dieback Management Protocol* will be developed to contain and minimise the spread of weeds and *Phytophthora cinnamomi* (dieback) along the pipeline corridor during the construction period. Dieback will only be of concern for Loops 8 to 10 as all other loops are in areas where there is not sufficient rainfall for the dieback fungus to survive. Weeds are of concern in all loops. The hygiene boundaries will be indicated on the Environmental Line List being developed for the CEMP.

The *Weed and Dieback Management Protocol* will include the following key measures:

- requirement for a dieback survey to be undertaken along Loops 8 to 10 to map dieback infected/free areas, prior to construction commencing in these loops
- movement of machinery from disturbed/cleared areas into undisturbed areas, and from offsite into the pipeline corridor (and vice versa), and machinery cleaning requirements
- movement of machinery across dieback hygiene boundaries and machinery cleaning requirements
- cleaning requirements for footwear and hand tools
- handling and stockpiling of topsoil
- flagging hygiene boundaries.

2.4 FAUNA

A *Fauna Interaction Protocol* will be developed to provide for the management of interactions between people/machinery and fauna so that the effects on fauna are minimised. The protocol has been developed to minimise the risk of stress, injury or death of fauna, as discussed in Chapter 2 Section 2.4 (Injury or death of fauna).

The *Fauna Interaction Protocol* will include the following key measures:

- requirement for pre-construction fauna surveys
- minimising vehicle speeds within the construction area
- minimising loss of habitat through pruning rather than clearing large habitat trees
- recovery of fauna trapped in pipeline and trenches
- minimising the spread of weeds
- reducing the potential for the introduction of feral fauna
- requirements for trench clearing during adverse weather conditions
- fauna record keeping.

2.5 REHABILITATION OF CORRIDOR

A *Rehabilitation Management Protocol* will be developed to guide the re-establishment of native vegetation over the pipeline corridor following installation of the pipe. All areas of disturbance along all loops will be rehabilitated to re-establish native vegetation or land use cover (e.g. agricultural land).

The *Rehabilitation Management Protocol* describes:

- rehabilitation methods (e.g. replacement of topsoil, seeding)
- management of DRF and priority flora, including translocation
- resource management (e.g. management of topsoil and cleared vegetative matter for subsequent use in rehabilitation)
- soil profile and landform management to establish pre-construction soil profiles and landforms
- rehabilitation completion criteria.

2.6 RIVER AND STREAM CROSSINGS

A *Watercourse Crossing Management Protocol* will be developed to provide for the management of the river and stream crossings along the pipeline corridor. Most loops cross rivers and/or streams and will require the implementation of the measures described in this protocol. Two different methods will be used to construct the major river crossings; open-cut and HDD.

The Swan, Canning and Murray Rivers are perennial, and construction by HDD is planned to be used under the riverbed to minimise disturbance. HDD may also be used for other watercourse crossings where geotechnical conditions are conducive. Open-cut construction will be used as an alternative in those situations where HDD is not considered feasible. The decision on the specific methodology for crossing each individual watercourse will be determined by the Construction Contractor based on geotechnical survey information to be obtained prior to commencement of construction. This assessment considers both methods and is intended to provide for the choice of method to be made, subsequent to obtaining environmental approval.

Permits will be obtained from the Department of Water where crossings involve any interference to bed or banks.

The location of all river and stream crossings will be indicated on the Environmental Line List being developed for the CEMP.

The *Watercourse Crossing Management Protocol* will include the following key measures:

- minimising bank and bed disturbance
- minimising riparian vegetation disturbance (e.g. pruning riparian trees in preference to removing)
- dewatering requirements and disposal of dewater product.

2.7 WETLAND AREAS

A *Wetland Management Protocol* will be developed to provide for the management of pipeline construction activities within wetland areas. The loops on the Swan Coastal Plain (Loops 9 and 10) traverse numerous wetland areas. There are also some ephemeral wetlands (claypans that fill after rainfall events) in the northern loops, associated primarily with the floodplains of major rivers. Within the Perth Metropolitan Area, the corridor traverses several conservation category wetlands and passes within 200 m of Forrestdale Lake and 10 km of the Peel-Harvey Estuary system, both of which are part of Ramsar wetlands[29]. The location of all wetlands requiring the implementation of the *Wetland Management Protocol* will be indicated on the Environmental Line List.

The *Wetland Management Protocol* will include the following key measures:

- reducing construction widths in wetland areas (similar to areas of conservation value)
- limiting trench lengths to minimise changes to hydrology regimes
- dewatering requirements and disposal of dewater product
- sourcing and disposal of hydrotest water.

2.8 DEWATERING

A *Dewatering and Water Disposal Management Protocol* will be developed, which will describe management measures to be implemented in areas where dewatering may be required.

The following activities may require dewatering to facilitate construction works if shallow groundwater/surface water is encountered:

- trenching
- bell holes[30]
- watercourse crossings.

A desktop assessment was undertaken to identify the potential areas where groundwater and surface water would be likely to be encountered during construction activities. The results of the assessment are presented in Table 5.2.

Table 5.2 Locations of shallow groundwater

Loop	Rivers, Streams and Water Bodies	Locations of Shallow Groundwater (<5 mBGL)
0	Maitland River, Yanyare River, Fortescue River and 4 unnamed rivers	KP22 – KP36, KP53 – KP60
1	Robe River, Cane River	None
2	Yannarie River, Lyndon River	None identified based on sparse information. Available information suggests shallow groundwater is unlikely.

[29] Forrestdale Lake is part of the 'Forrestdale and Thomsons Lakes' Ramsar listed wetland system and the Peel Inlet and Harvey Estuary are both part of the Peel-Yalgorup System Ramsar listed wetland system.

[30] Bell holes are constructed where pipe strings are joined, at mainline valves, at major bends, at facilities crossings, and where loop ends are tied into the existing pipeline or compressor station. Bell holes are usually benched and have ramped access points that enable personnel to enter the trench but also provide points for entrapped wildlife to leave the trench.

Loop	Rivers, Streams and Water Bodies	Locations of Shallow Groundwater (<5 mBGL)
3	Minilya River, Newman Creek, Lyons River	None identified based on sparse information. Available information suggests shallow groundwater is unlikely.
4	Jacobs Gully, Wooramel River, unnamed lake	None identified based on sparse information. Available information suggests shallow groundwater is unlikely.
5	2 unnamed lakes	None identified based on sparse information. Available information suggests shallow groundwater is unlikely.
6	Murchison River, Greenough River	None identified based on sparse information. Available information suggests shallow groundwater is unlikely.
7	Irwin River, unnamed lake	None
8	Moore River	None
9	Gingin Brook, Swan River, Helena River, Canning River, Wright Lake Melaleuca Park Wetland, Armadale Sumpland, Mandogalup Swamp North, Spectacles Wetlands	Most areas between KP1281 and KP1395 excluding a few isolated 1-5 km areas where pipeline crosses topographical highs.
10	North Dandalup River, South Dandalup River, Murray River, Harvey River	Most areas on the Swan Coastal Plain excluding a few isolated 1-5 km areas where pipeline crosses topographical highs.

The purpose of the protocol is to provide for:

1. The management of dewatering and the preservation of environmental water quality during excavation and dewatering to achieve the environmental objectives for the water management factor.

2. The management of abstraction and disposal of groundwater associated with post-construction hydro-testing of the pipeline.

2.9 ACID SULPHATE SOILS

An *Acid Sulphate Soils Management Protocol* will be developed, which will describe management measures to be implemented in areas of potential acid generating soils. There were only small areas of potential acid sulphate soils in the northern loops with relatively large areas of potential acid sulphate soils in the southern loops. Soils along the pipeline corridor were classified as low, medium to low, medium and high acid generating risk based on a desktop assessment. Field investigations of the identified risk areas will be undertaken to validate the occurrence of potential acid sulphate soils and provide the basis for specific management in accordance with the *Acid Sulphate Soils Management Protocol*. The location of sites along the corridor that will require implementation of the protocol will be indicated on the Environmental Line List.

The *Acid Sulphate Soils Management Protocol* will include the following key measures:

- requirement for pre-construction soil surveys in areas classified as high or medium risk soils
- in-field testing at time of excavation of soils classified medium to low risk
- minimising trench open times in areas of high, medium and medium to low risk to reduce oxidation potential
- treatment of susceptible soils
- management of dewatering and disposal of dewater product.

2.10 HERITAGE

An *Aboriginal Heritage Management Protocol* will be developed as part of the CEMP and will provide for the management and protection of known (e.g. recorded) Aboriginal heritage sites identified for protection and any new sites/artefacts uncovered or identified during construction. Numerous archaeological sites have been recorded along and adjacent to the corridor. The location of sites along the corridor requiring the implementation of the protocol will be indicated on the Environmental Line List.

The *Aboriginal Heritage Management Protocol* will include the following key measures:

- requirements for heritage site monitors and archaeologists to be onsite in certain areas during ground disturbance activities
- sites identified for protection to be flagged and/or fenced
- contingencies for the uncovering of potential heritage material.

2.11 NOISE

A *Noise Management Protocol* will be developed as part of the CEMP, to provide for the management of construction noise emissions. The majority of the pipeline traverses low-medium density living areas, however Loop 9 intersects the Perth Metropolitan region which contains high density areas and thus stricter noise mitigation measures will be implemented. The *Noise Management Protocol* will include the following key measures:

- scheduling construction in accordance with the EPA Noise Regulations
- locating semi-fixed equipment (e.g. generators) as far as practicable from residences
- enforcing vehicle speed restrictions
- all equipment and plant shall conform to appropriate noise control standards
- all equipment used shall be the quietest practicably available.

2.12 DUST

A *Dust Management Protocol* will be developed as part of the CEMP, to provide for the management of construction dust emissions. The majority of the pipeline traverses low-medium density living areas, however Loop 9 intersects the Perth Metropolitan region which contains high density areas and thus stricter dust mitigation measures will be implemented. The *Dust Management Protocol* will include the following key measures:

- minimising the extent and period of exposed soil surfaces
- minimising the height of stockpiles
- using water trucks and sprayers to dampen down the soil during construction, where practicable
- rehabilitating exposed surfaces as rapidly as practicable
- vehicles adhering to appropriate speed limits within the pipeline corridor and on access tracks.

2.13 WASTE

A *Waste Management Protocol* will be developed as part of the CEMP, to provide for the management of generation and disposal of waste materials within the DBNGP corridor and associated construction areas. Waste disposal must also be undertaken to ensure compliance with relevant environmental legislation, including the Environmental Protection (Controlled Waste) Regulations 2004 and the EP Act. The *Waste Management Protocol* will include the following key measures:

- collection and disposal of all waste at licensed waste disposal facilities
- provision and emptying of waste collection bins
- oils, solvents and chemicals will be collected in appropriate containers and will be collected by licensed carriers for off-site disposal
- bunded areas will be used for storage of oil, solvent and chemical wastes.

2.14 FUEL AND CHEMICALS

A *Fuel and Chemical Storage, Spill and Emergency Response Management Protocol* will be developed as part of the CEMP, to provide for the management of fuel and chemicals required on-site during construction of the pipeline. The protocol will include the following key measures:

- majoring servicing of plant and machinery will occur off-site
- fuels and chemicals will be stored on leak proof trays and/or bunded areas
- spill containment and recovery equipment will be kept on-site
- Material Safety Data Sheets will be kept on-site for all hazardous materials stored on-site
- no fuel or chemicals will be stored within areas of conservation value
- no refuelling will be undertaken in areas of conservation value.

2.15 FIRE

A *Fire Management Protocol* will be developed as part of the CEMP. There are a number of activities that, if not managed appropriately, may result in an increased fire risk during construction. Fire can have a detrimental effect on the conservation values of natural areas, result in damage to property and cause injury and loss of life. The protocol will include the following key measures:

- no open fires, such as barbecues, campfires or burning of rubbish, will be allowed
- a water cart will be available at all times during welding activities
- fire response equipment will be kept in good working order on-site.

2.16 ACCESS AND SAFETY

Access management is primarily managed under the DBNGP Stage 5 Expansion Land Management Strategy. An *Access and Safety Management Protocol* will be developed as part of the CEMP, to ensure public amenity is not significantly affected by temporary or permanent change in access and land use due to the project. The protocol will include the following key measures:

- consulting with affected landowners pre-construction
- ensuring minimal delay between construction and restoration works.

2.17 INCIDENTS

An *Incident Response Protocol* will be developed to provide for the management of environmental incidents and concerns raised by residents and members of the public, including consultation and advice on proposed management. The protocol will include requirements for:

- recording public complaints and environmental incidents
- investigating causes of complaints or incidents
- undertaking mitigative work, should it be required.

Chapter 6 Stakeholder consultation

1 DESCRIPTION

The proponent has undertaken a program to identify and consult stakeholders, including local residents and all landholders whose properties will be affected by the project, to inform them of the Stage 5 Expansion, the proposed schedule of construction works and the actions that will be undertaken to minimise potential impacts.

The proponent and its contractors will continue this consultation program to ensure stakeholders are kept informed on the project and to minimise disruption to the landowners affected by both pre-construction and construction activities. Many of the management actions, particularly those with the potential to affect neighbouring residences including measures relating to dust, noise and rehabilitation, require continued ongoing consultation with landowners.

As part of this consultation program, the proponent has also consulted and will continue to consult with a number of regulatory authorities, including:

- Department of Environment and Heritage (proposal has been formally referred as a "controlled action" under the *Environment Protection and Biodiversity Conservation Act 1999*)
- Department of Water (permits and licences required for river crossings and water supplies respectively under the *Rights in Water and Irrigation Act 1914*)
- Department of Environment and Conservation (development of protocols for activities regulated under the *Conservation and Land Management Act 1984* and the *Wildlife Conservation Act 1950)*
- Environmental Protection Authority Service Unit (proposal has been formally referred under the *Environment Protection Act 1986*)
- Department of Industry and Resources (approval of the Stage 5 Expansion CEMP under the pipeline licence issued under the *Petroleum Pipelines Act 1969*)
- Department of Planning and Infrastructure (land access)
- Department of Indigenous Affairs (*Aboriginal Heritage Act 1972*).

Chapter 7 Commitments

Table 7.1 presents the environmental management commitments for the proposed Stage 5 Expansion of the DBNGP.

Table 7.1 Proponent environmental management commitments

No	Factors	Objective	Action	Timing	Advice From
1	All factors	To minimise environmental impacts and public risk during construction of the DBNGP Stage 5 Expansion.	Prepare a Construction Environmental Management Plan (CEMP) for the construction of the DBNGP Stage 5 Expansion that addresses the environmental management of the following issues: u) access and safety v) incident response w) conservation areas x) vegetation y) weed and dieback z) threatened flora aa) wetlands bb) dewatering and disposal of water cc) acid sulphate soils dd) fauna interactions ee) watercourse crossings ff) dune crossings gg) fire hh) dust ii) noise jj) fuel and chemical storage, spill and emergency response kk) waste ll) soil mm) aboriginal heritage sites nn) rehabilitation	Prior to ground disturbance	DoIR, DEC, DIA
2	All factors	To minimise environmental impacts and public risk during construction of the DBNGP Stage 5 Expansion.	Implement the CEMP prepared under Commitment 1.	During construction	DoIR, DEC, DIA
3	Acid sulphate soil	To ensure that there are no adverse impacts to sensitive receptors as a result of the excavation and stockpiling of acid sulphate soils	Undertake an acid sulphate soil field investigation to validate results from the acid sulphate soil and hydrogeological desktop study undertaken in June 2006. Manage acid sulphate soils in accordance with the CEMP.	Prior to ground disturbance within risk areas identified in the desktop study	DEC

No	Factors	Objective	Action	Timing	Advice From
4	Dieback	To minimise the introduction and/or spread of dieback along the corridor or to adjacent areas.	Undertake a dieback field survey of Loops 8 to 10 of the DBNGP Stage 5 Expansion, to identify and map low, medium and high dieback risk areas. Manage dieback areas in accordance with the CEMP.	Prior to ground disturbance in Loops 8 to 10	DEC
5	Threatened Flora	To minimise the disturbance or clearing of DRF and Priority Flora species listed under the *Wildlife Conservation Act 1950*.	Undertake a spring flora field survey of Loops 8 to 10 of the DBNGP Stage 5 Expansion, to identify and map the occurrence of DRF and Priority Flora. Manage DRF and Priority Flora in accordance with the CEMP.	Prior to ground disturbance in Loops 8 to 10	DEC
6	Aboriginal heritage	To comply with the *Aboriginal Heritage Act 1972*.	Undertake further research of Aboriginal heritage sites of the DBNGP Stage 5 Expansion that were identified in preliminary investigations in June 2006 as not being covered by existing *Aboriginal Heritage Act 1972* Section 18 consents. Based on research findings, develop and implement appropriate heritage management measures for these sites.	Prior to ground disturbance in each Loop	DIA

Chapter 8 References, abbreviations and maps

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2 ABBREVIATIONS AND ACRONYMS

Table 8.1 sets out the abbreviations and acronyms used in this report.

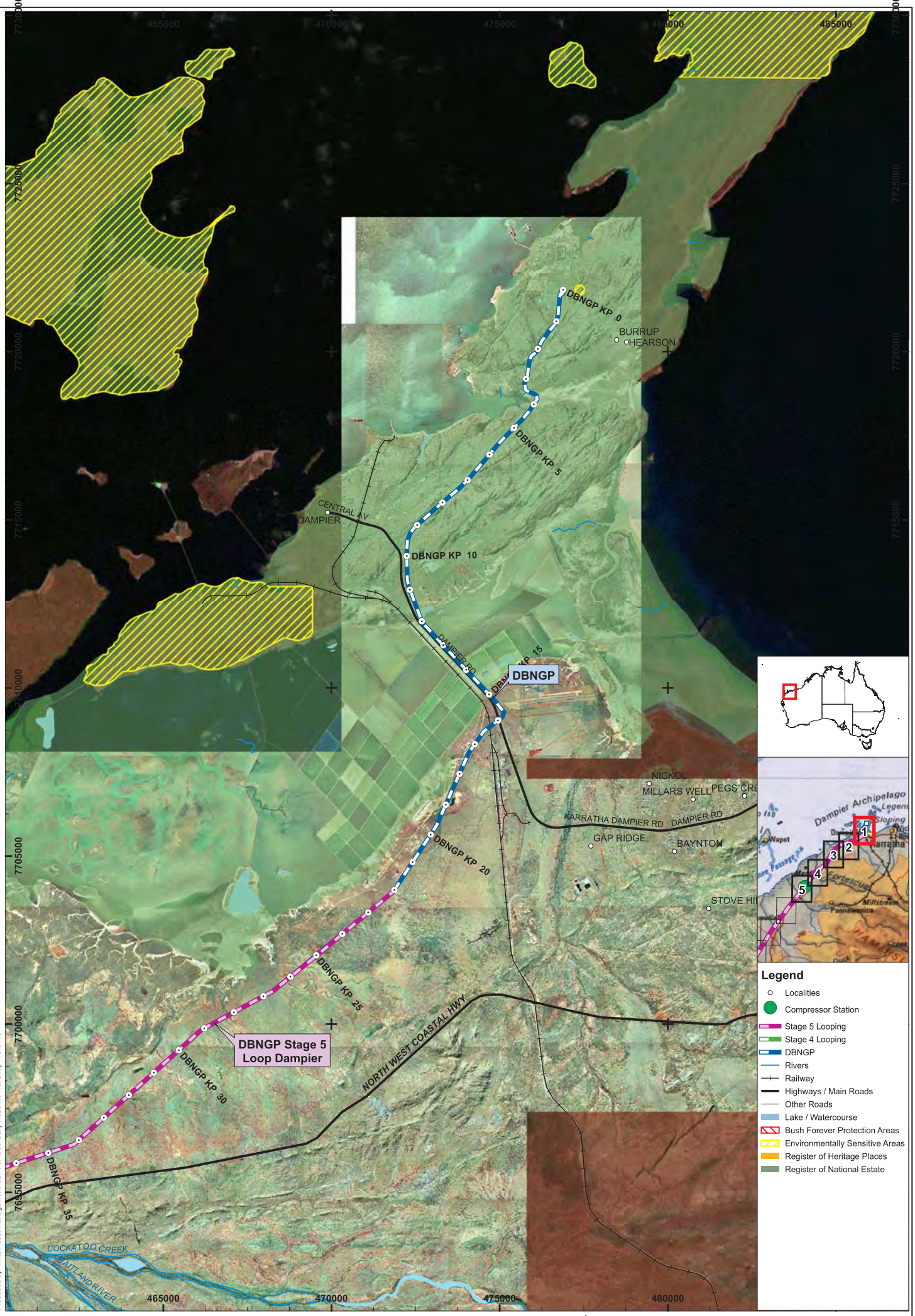
Table 8.1 Abbreviations and acronyms

Abbreviation/ acronym	Full Title
AIC	Australian Interaction Consultants
ANS	Alinta Network Services (the Proponent)
ANZECC	Australian and New Zealand Environment Conservation Council
APIA	Australian Pipeline Industry Association Inc
ARMCANZ	Agricultural and Resource Management Council of Australia and New Zealand
CAMBA	China-Australia Migratory Bird Agreement
CCW	Conservation category wetland
CEMP	Construction Environmental Management Plan
CITES	Convention on International Trade in Endangered Species
Cwlth	Commonwealth
d	day
dB	Decibel
DBNGP	Dampier to Bunbury Natural Gas Pipeline
DBP	Dampier Bunbury Pipeline (the trading name of the DBNGP group of companies)
DEC	Department of Environment and Conservation (WA)
DEH	Department of Environment and Heritage (Cwlth)
DIA	Department of Indigenous Affairs (WA)
DoIR	Department of Industry and Resources (WA)
DoW	Department of Water (WA)
DRF	Declared Rare Flora
DUET	Diversified Utilities and Energy Trust
DWECP	Department of Water, Environment and Protection (former)
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMS	Environmental Management System
EP Act	*Environmental Protection Act 1986* (WA)
EPA	Environmental Protection Authority (WA)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)
EPP	Environmental Protection Policy
ESA	Environmentally Sensitive Area
ha	Hectare
HDD	Horizontal directional drilling
Heritage Act	*Heritage of Western Australia Act 1990* (WA)
IBRA	Interim Biogeographic Regionalisation for Australia
IUCN	International Union for the Conservation of Nature
JAMBA	Japan-Australia Migratory Bird Agreement
km	Kilometre
KP	Kilometre point

Abbreviation/ acronym	Full Title
kW	Kilowatt
m	Metre
mAHD	metres above Australian Height Datum
mbgl	Metres below ground level
ML	Megalitres
mm	Millimetre
NEPC	National Environment Protection Council
NEPM	National Environmental Protection Measure
OEMP	Operational Environmental Management Plan
RWI Act	*Rights in Water and Irrigation Act 1914* (WA)
SWALSC	South West Aboriginal Land and Sea Council
TEC	Threatened ecological community
TJ	Tetra-joules
WA	Western Australia
WAPC	Western Australian Planning Commission
Wildlife Act	*Wildlife Conservation Act 1950* (WA)
WRC	Water and Rivers Commission (now DoW and DEC)
YMBBMAC	Yamatji Marlpa Barna Baba Maaja Aboriginal Corporation

3 CONSTRUCTION CORRIDOR MAPS

Map index



Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

Metres

Map 1. DBNGP Expansion Start to CS 1
SHEET 1 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 1
Map Revision: 0
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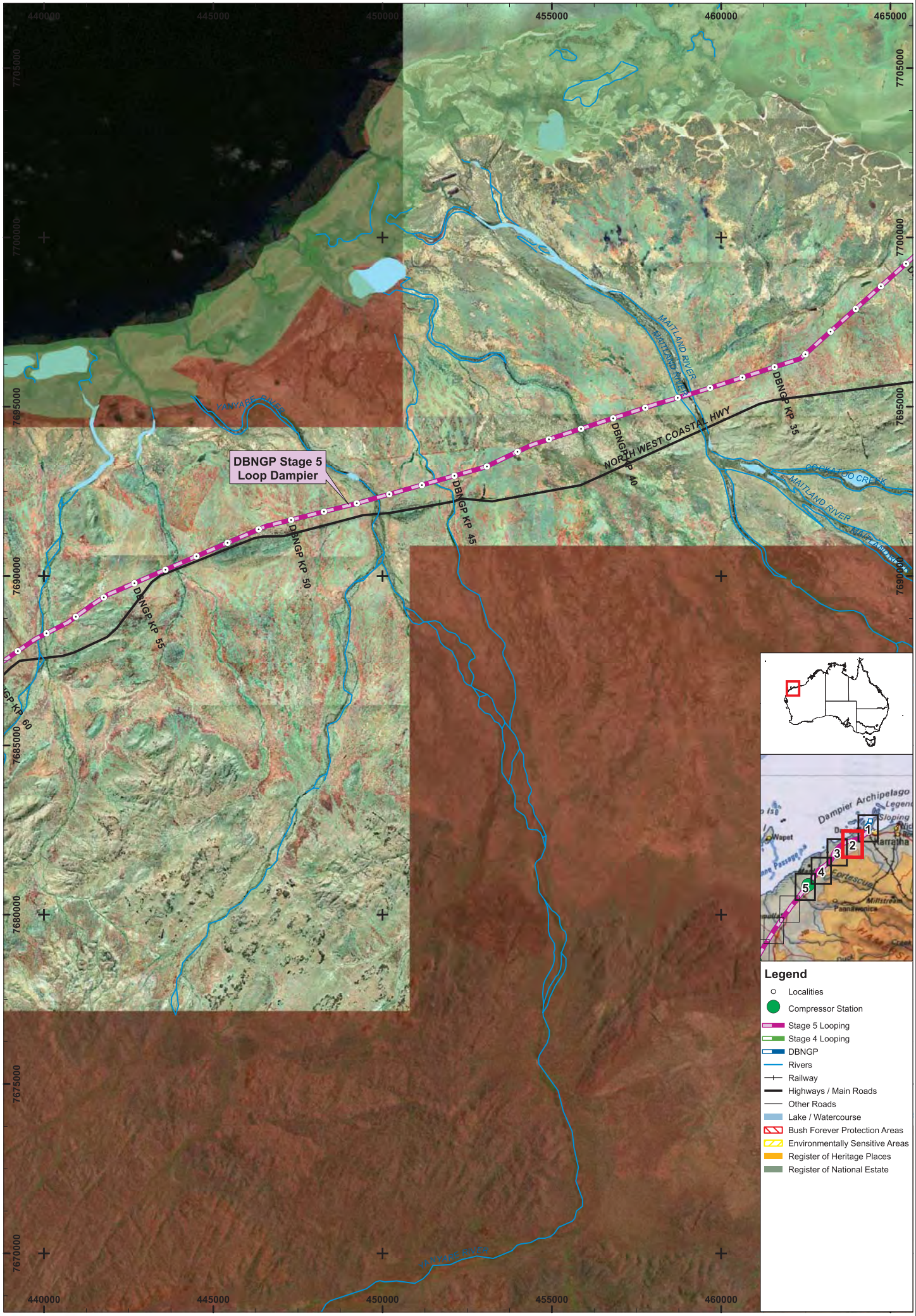
Sheet: 1 of 5
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Legend

- Localities
- Compressor Station
- Stage 5 Looping
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Scale 1: 100 000 (A3)
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Metres

Map 2. DBNGP Expansion Start to CS 1
SHEET 2 of 5

Coordinate System
MGA Zone 50 (GDA94)

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Map Revision: 0
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Sheet: 2 of 5
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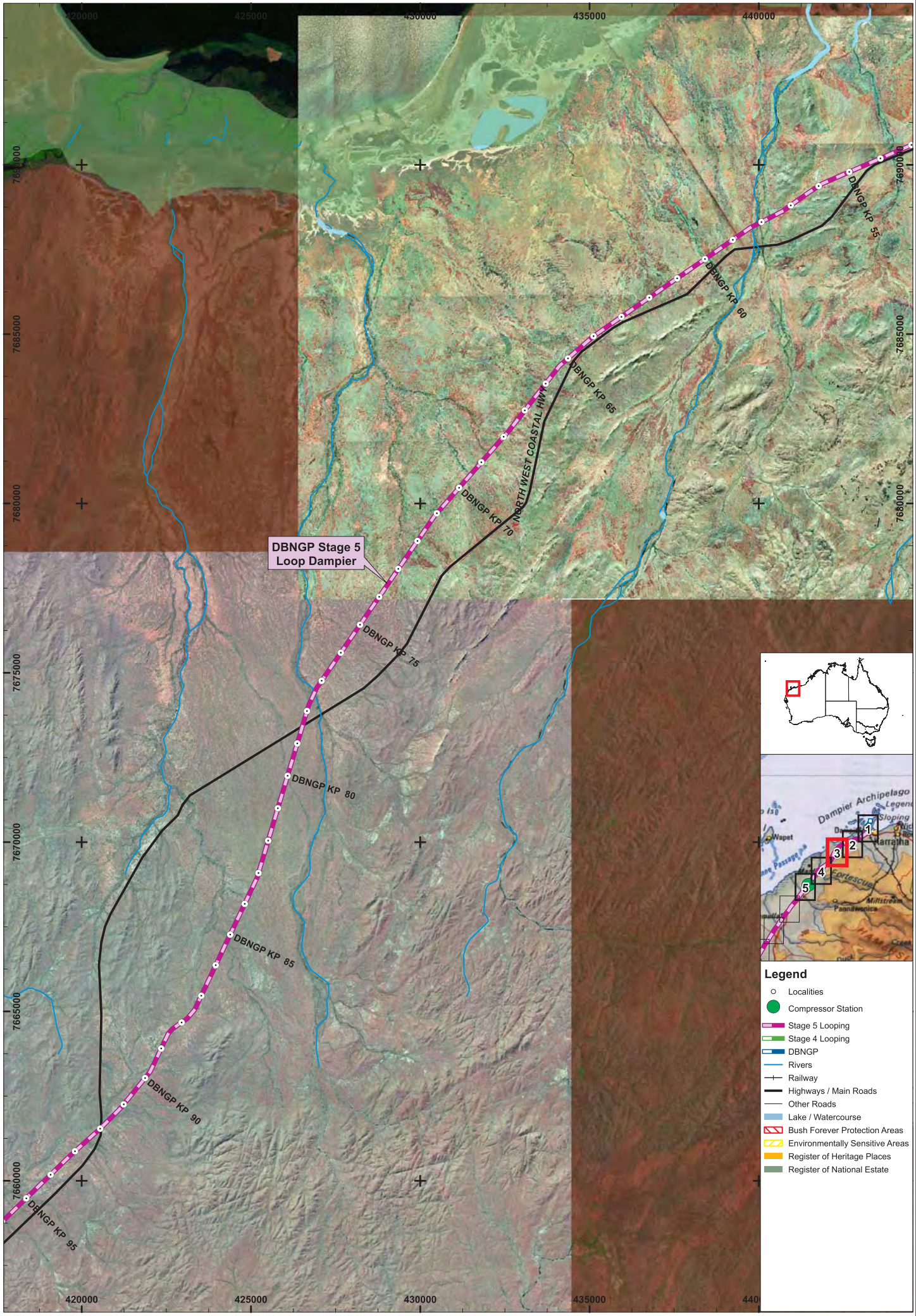

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

Metres

Map 3. DBNGP Expansion Start to CS 1
SHEET 3 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 3
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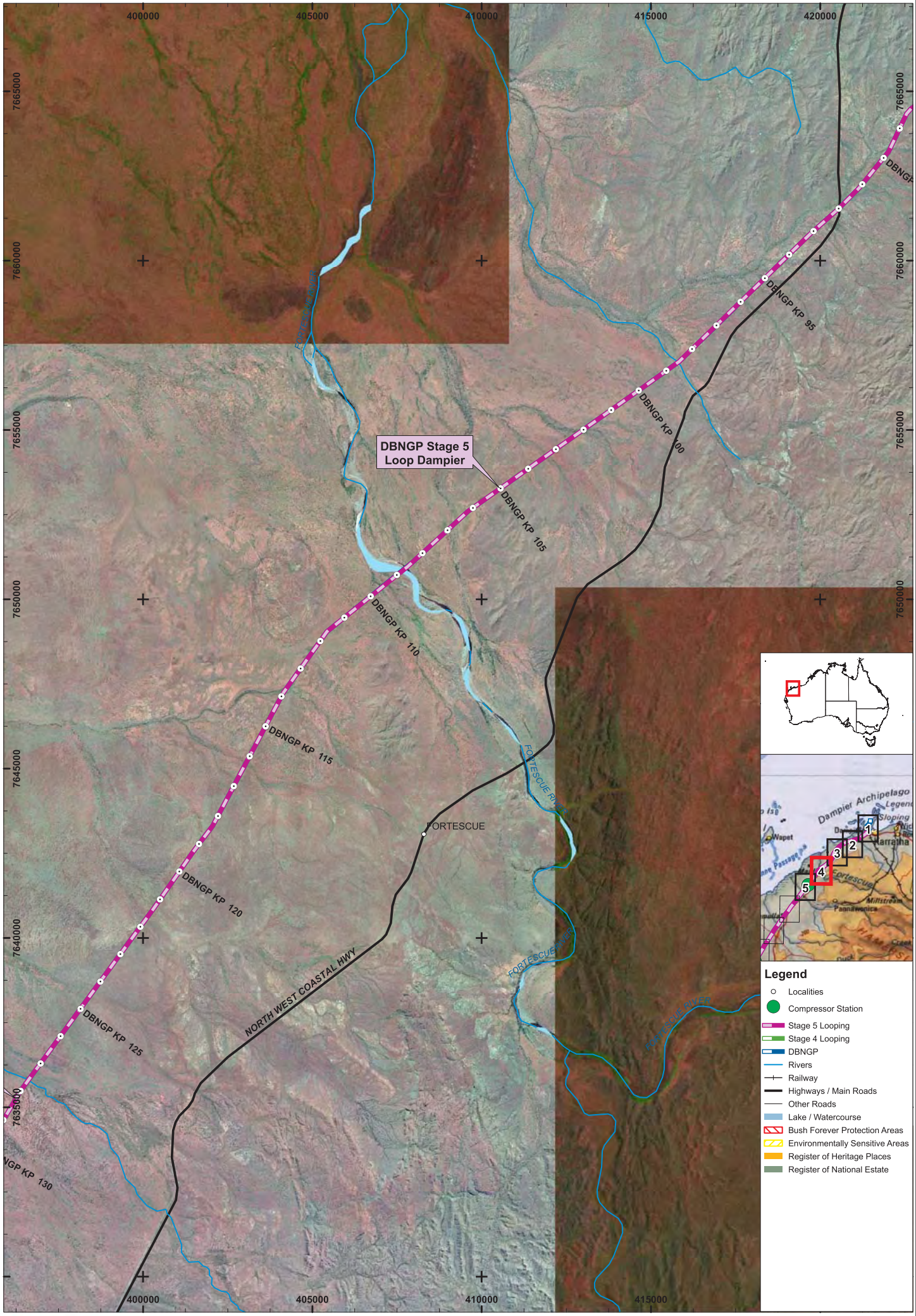
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006

GDA



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

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Alinta

Scale 1: 100 000 (A3)

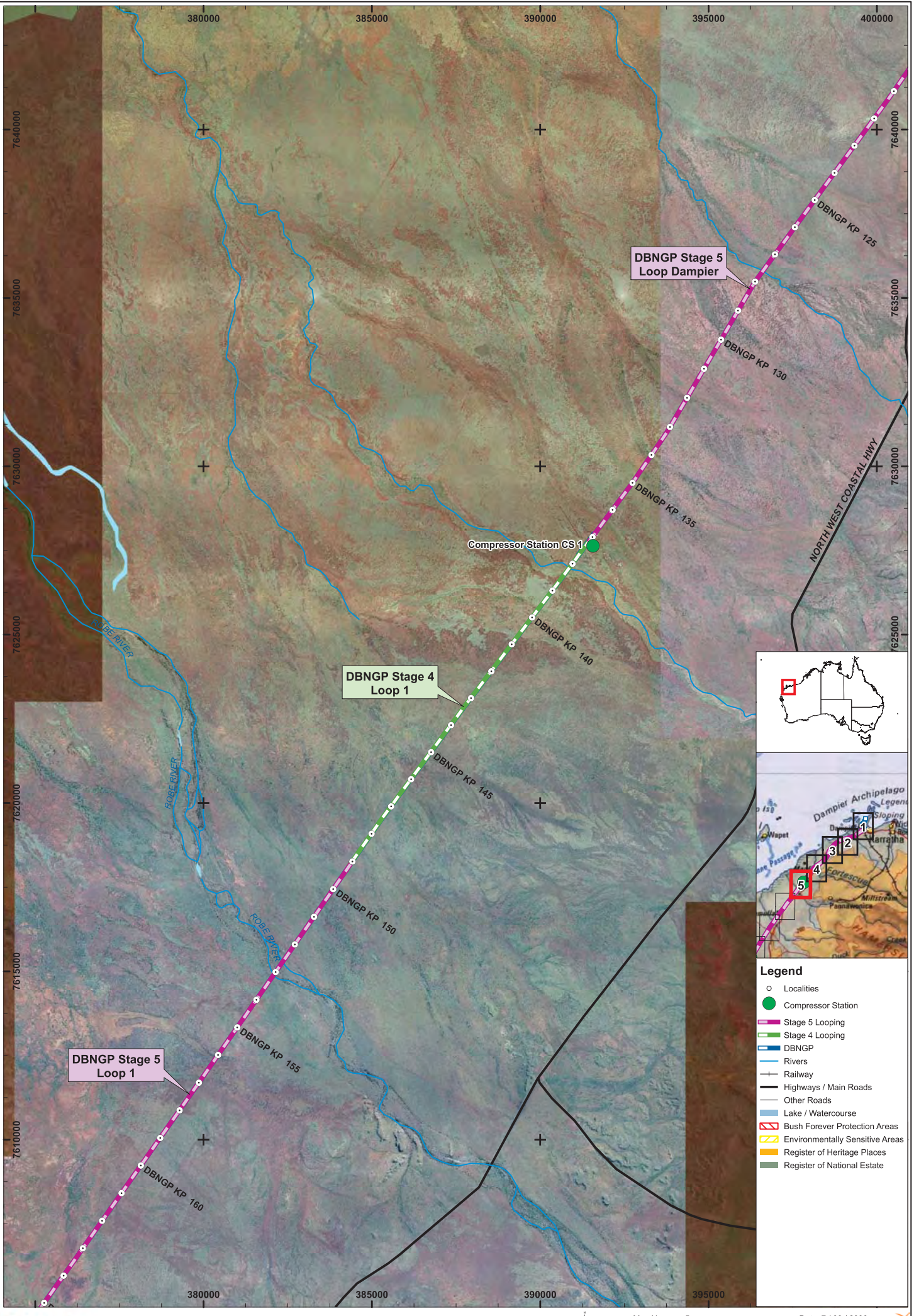
0 500 1,000 2,000 3,000 4,000

Metres

Map 4. DBNGP Expansion Start to CS 1
SHEET 4 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 4
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 4 of 5
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

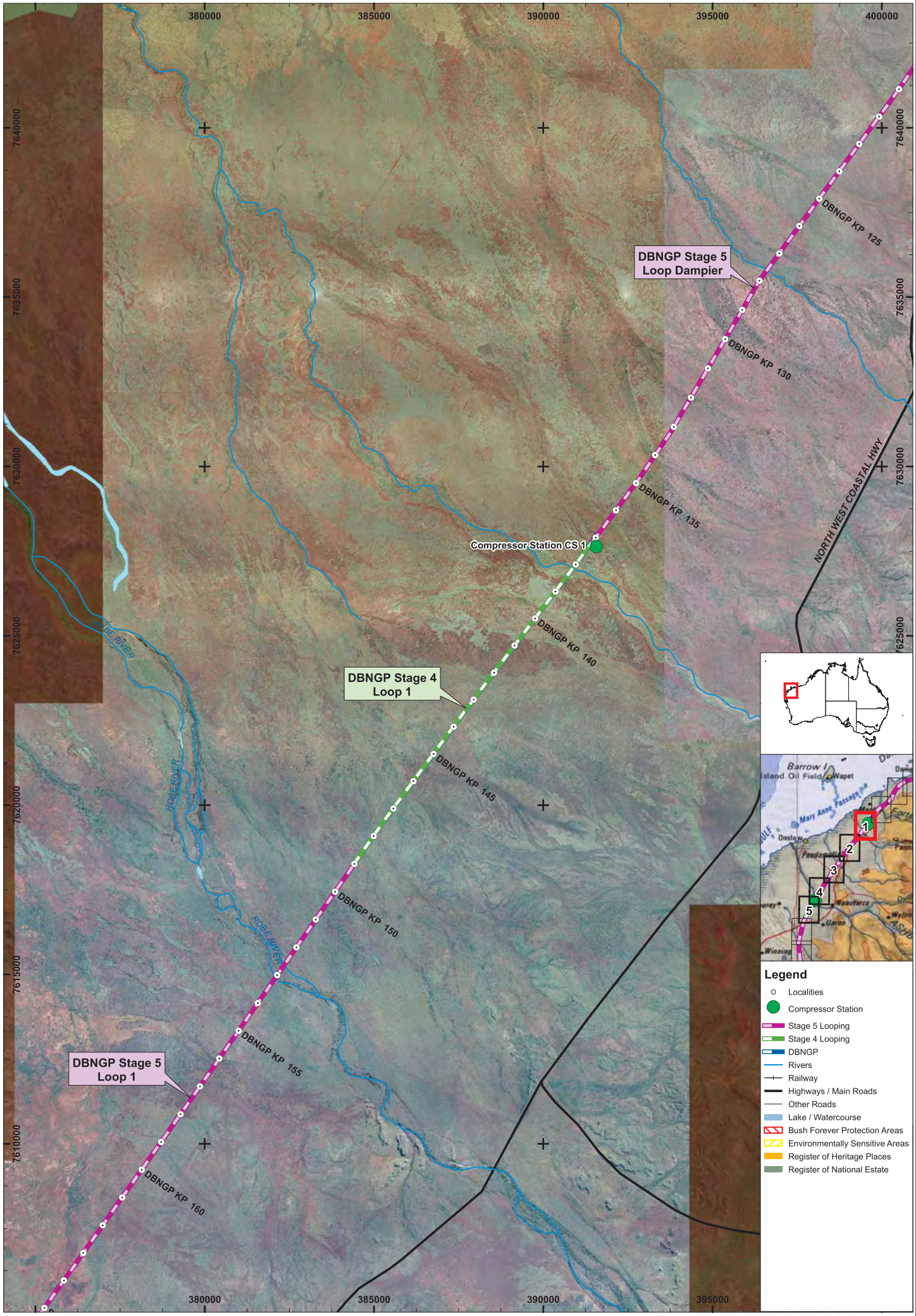
Metres

Map 5. DBNGP Expansion Start to CS 1
SHEET 5 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 5
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 5 of 5
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

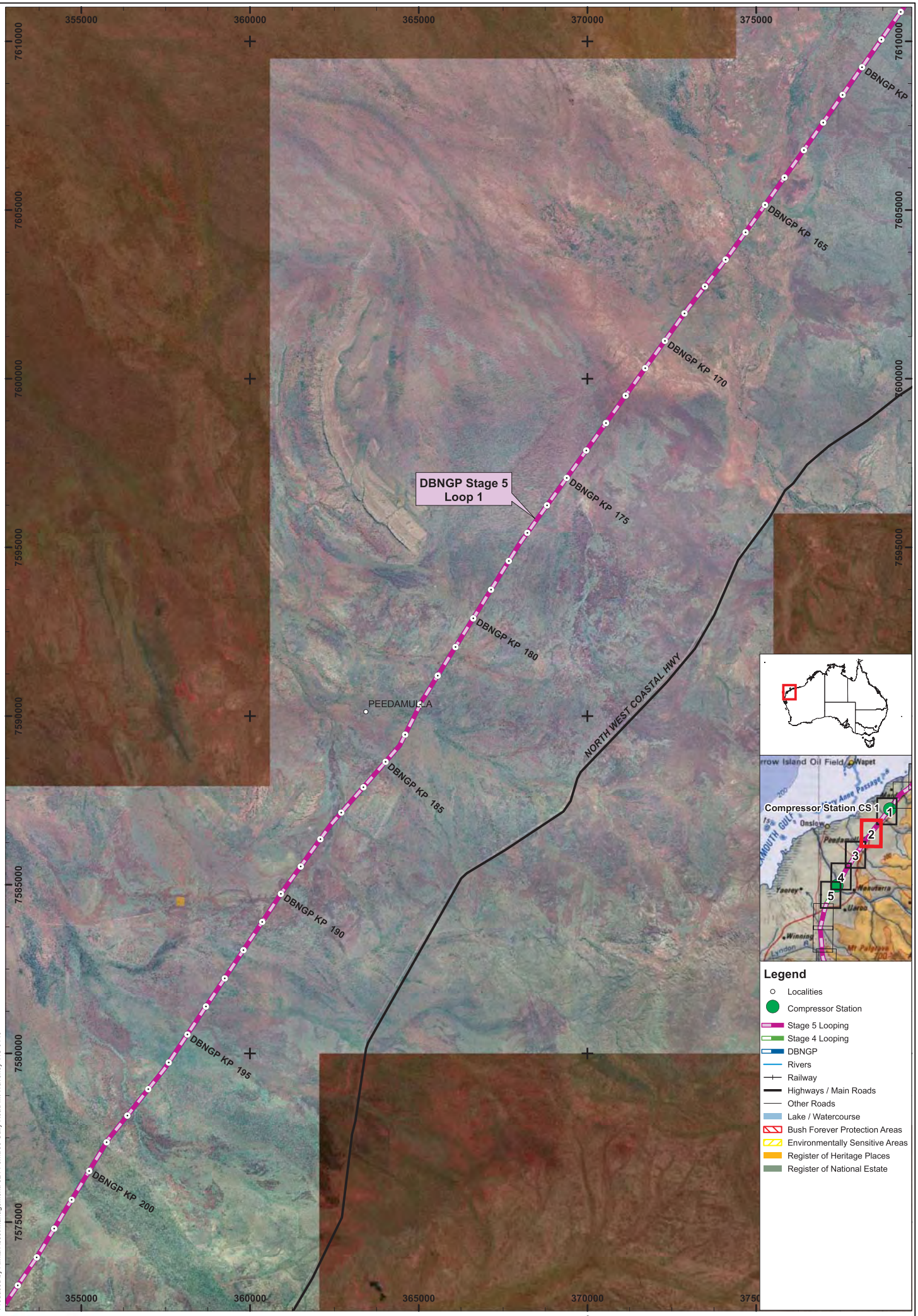
Metres

Map 6. DBNGP Expansion CS 1 to CS 2
SHEET 1 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 6
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 1 of 5
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006

GDA



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

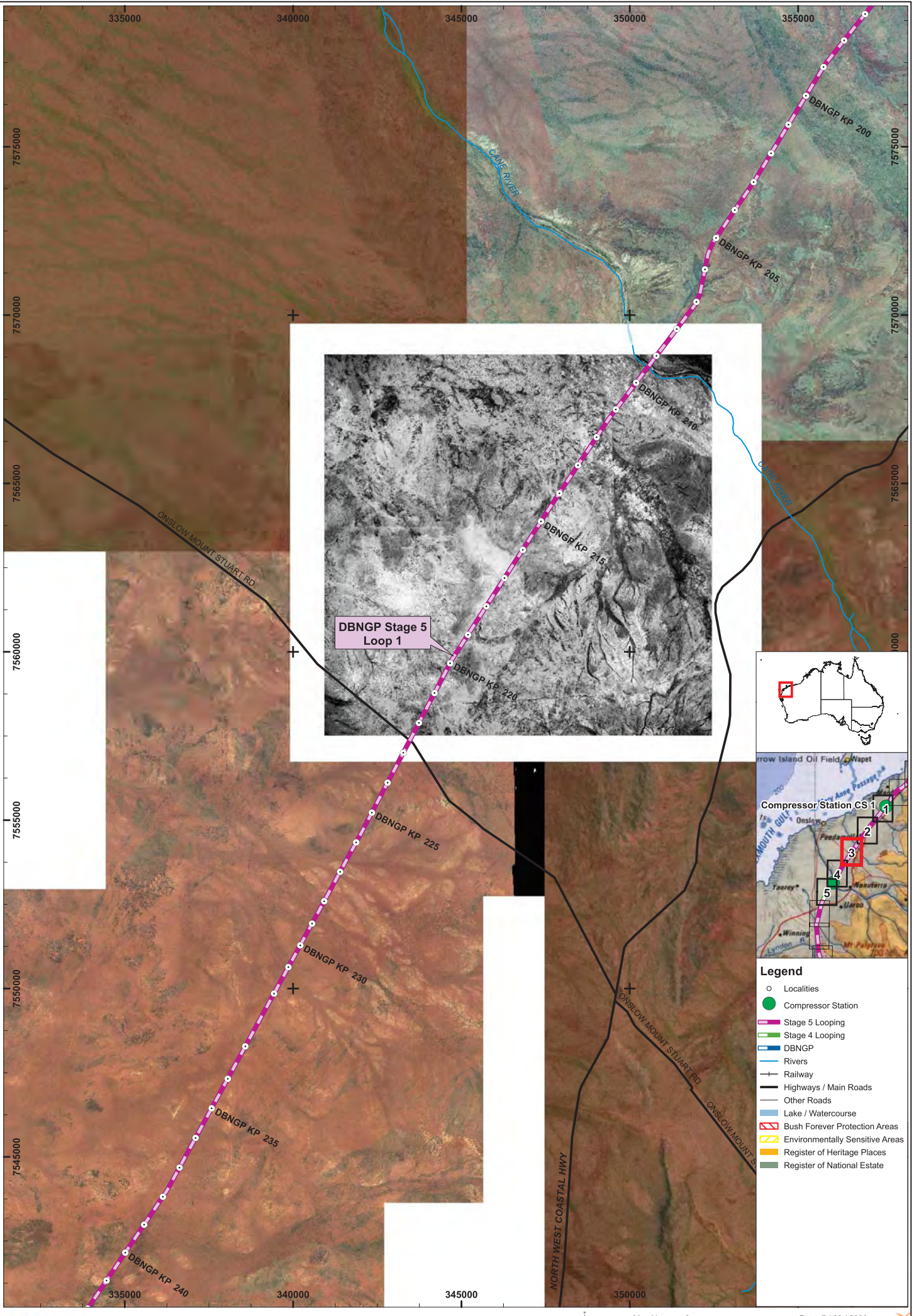
Metres

Map 7. DBNGP Expansion CS 1 to CS 2
SHEET 2 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 7
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 2 of 5
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

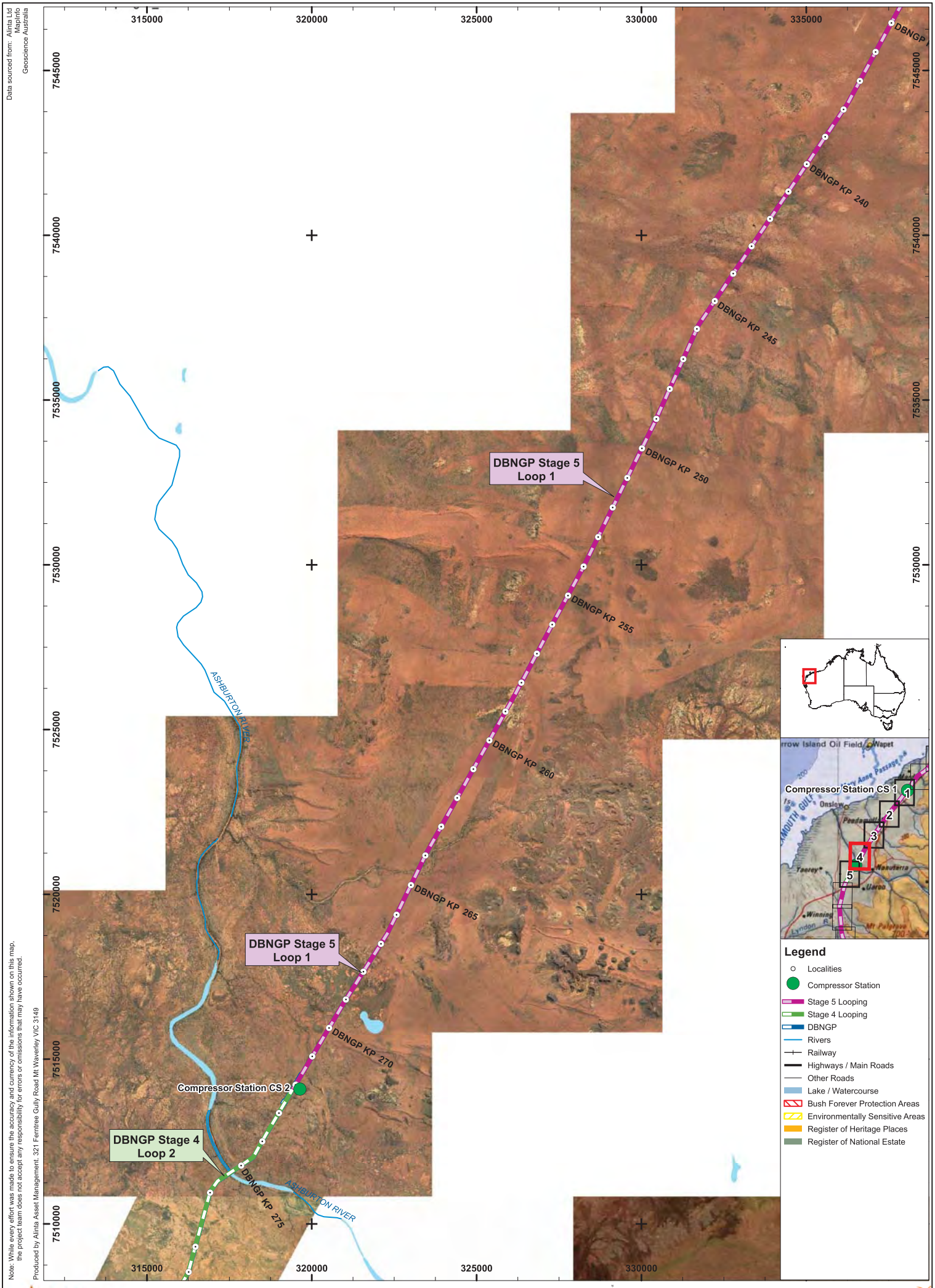
0 500 1,000 2,000 3,000 4,000

Metres

Map 8. DBNGP Expansion CS 1 to CS 2
SHEET 3 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 8
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 3 of 5
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

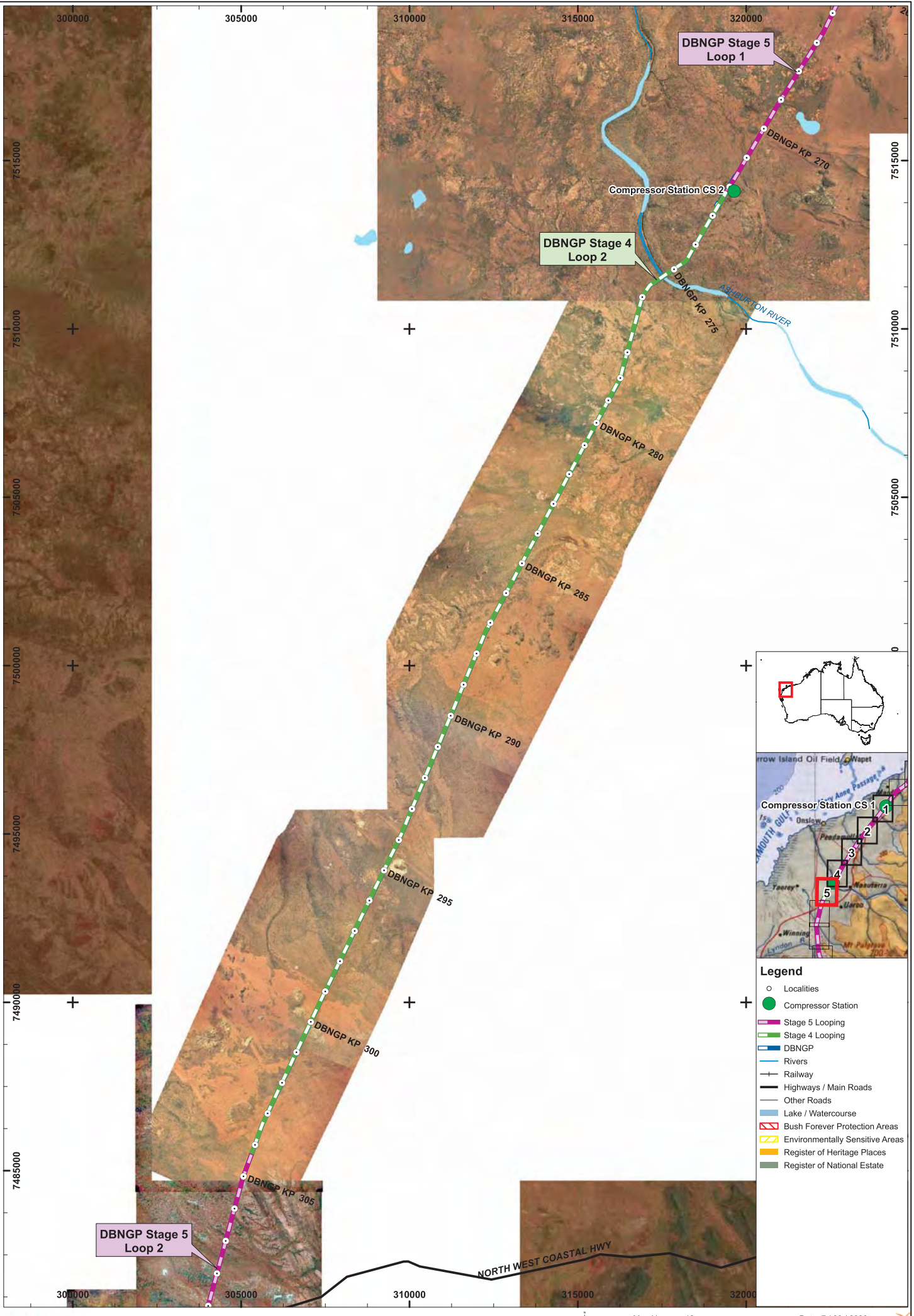
Metres

Map 9. DBNGP Expansion CS 1 to CS 2
SHEET 4 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 9
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 4 of 5
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

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Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

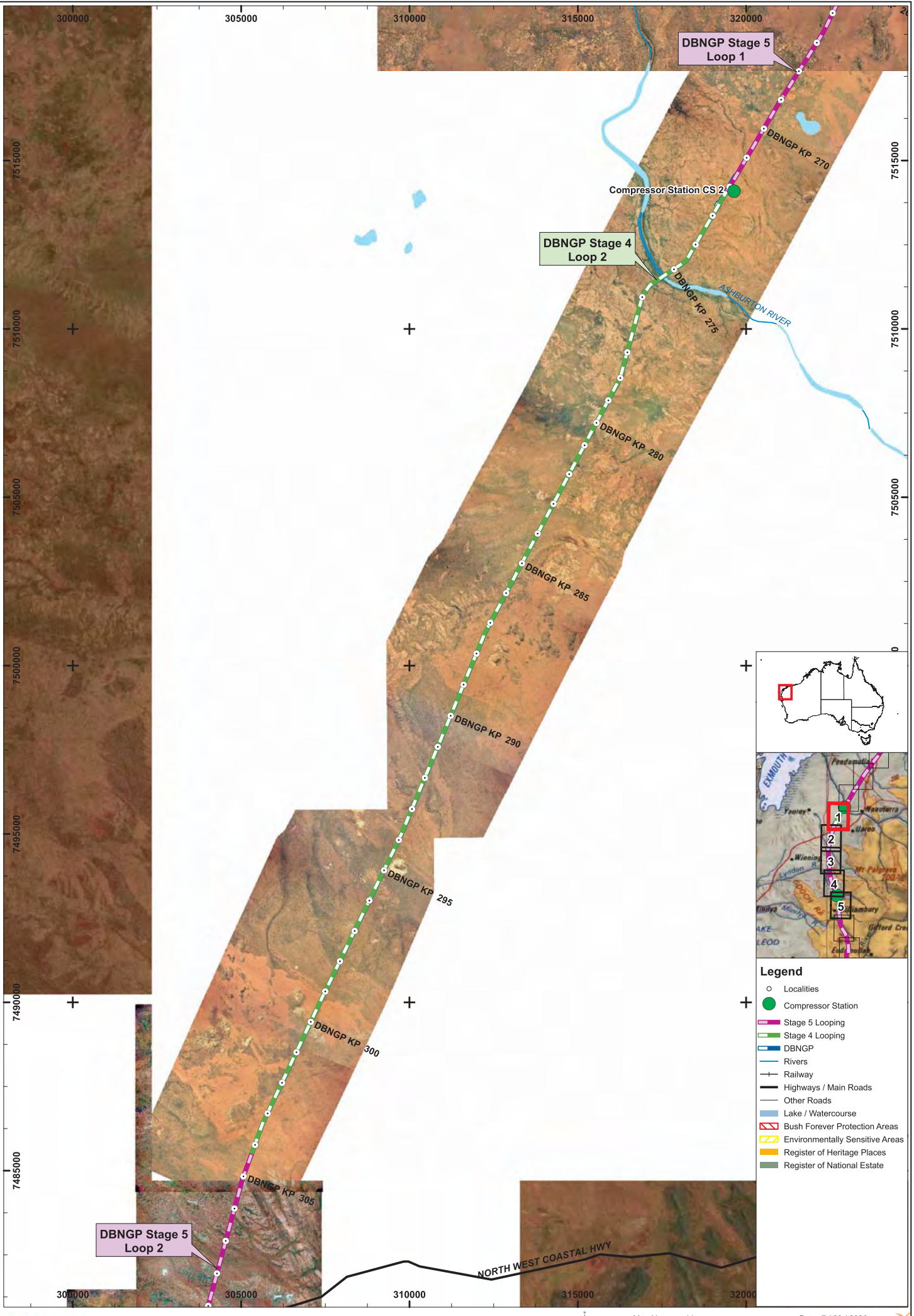
Metres

Map 10. DBNGP Expansion CS 1 to CS 2
SHEET 5 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 10
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 5 of 5
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

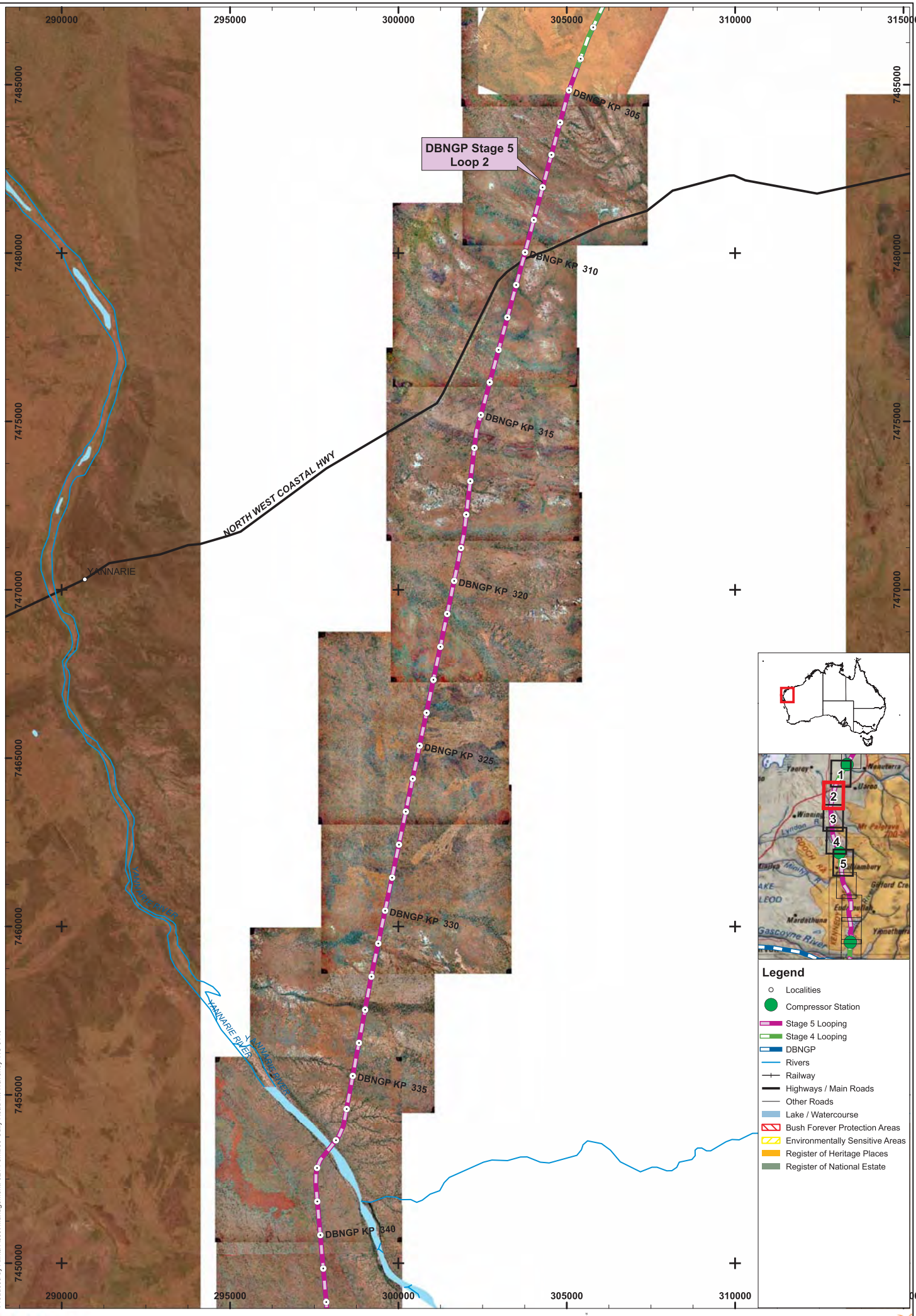
Metres

Map 11. DBNGP Expansion CS 2 to CS 3
SHEET 1 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 11
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 1 of 5
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

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Alinta

Scale 1: 100 000 (A3)

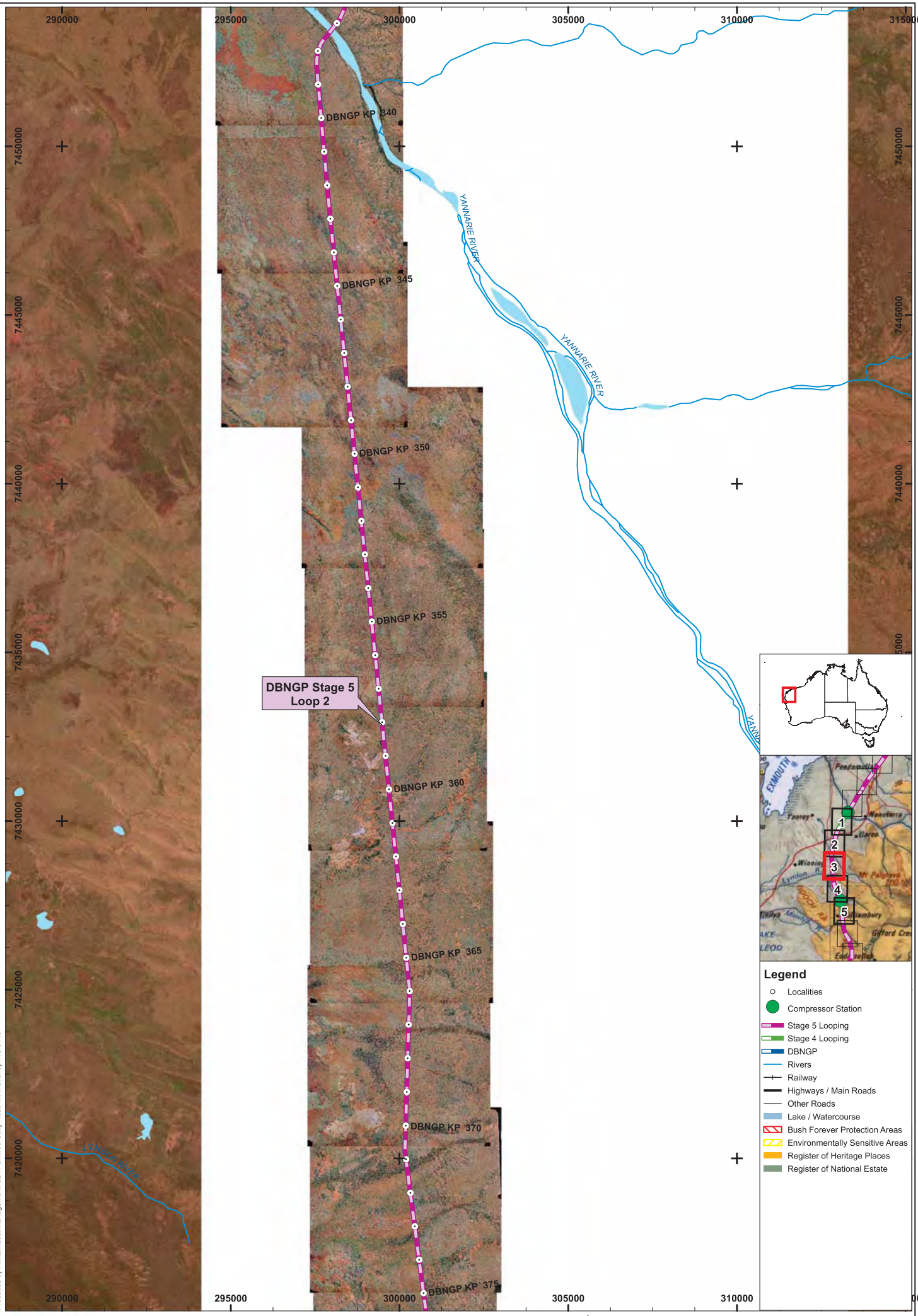
0 500 1,000 2,000 3,000 4,000

Metres

Map 12. DBNGP Expansion CS 2 to CS 3
SHEET 2 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 12
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 2 of 5
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

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Alinta

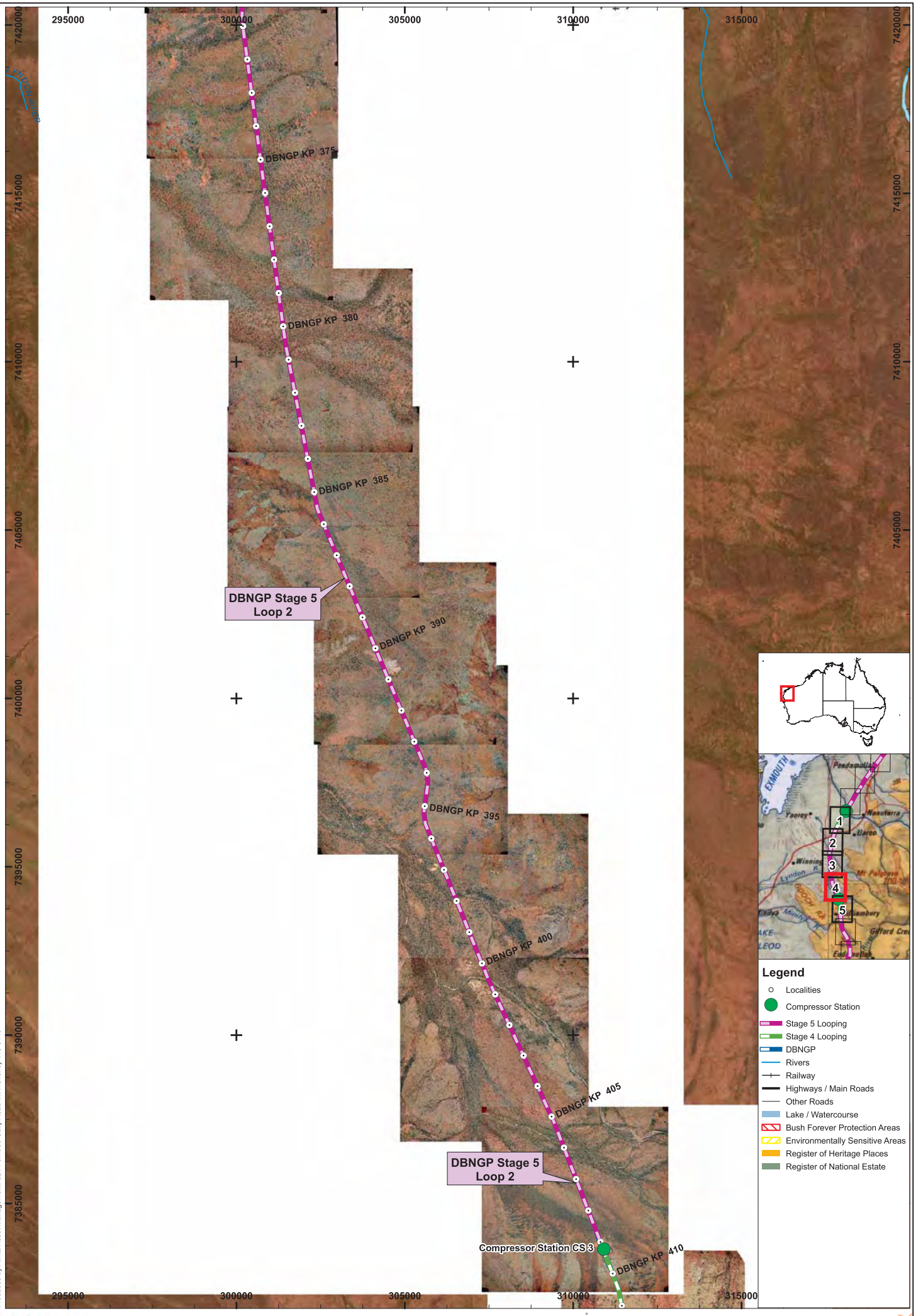
Scale 1: 100 000 (A3)
0 500 1,000 2,000 3,000 4,000
Metres

Map 13. DBNGP Expansion CS 2 to CS 3
SHEET 3 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 13
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 3 of 5
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006

GDA



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

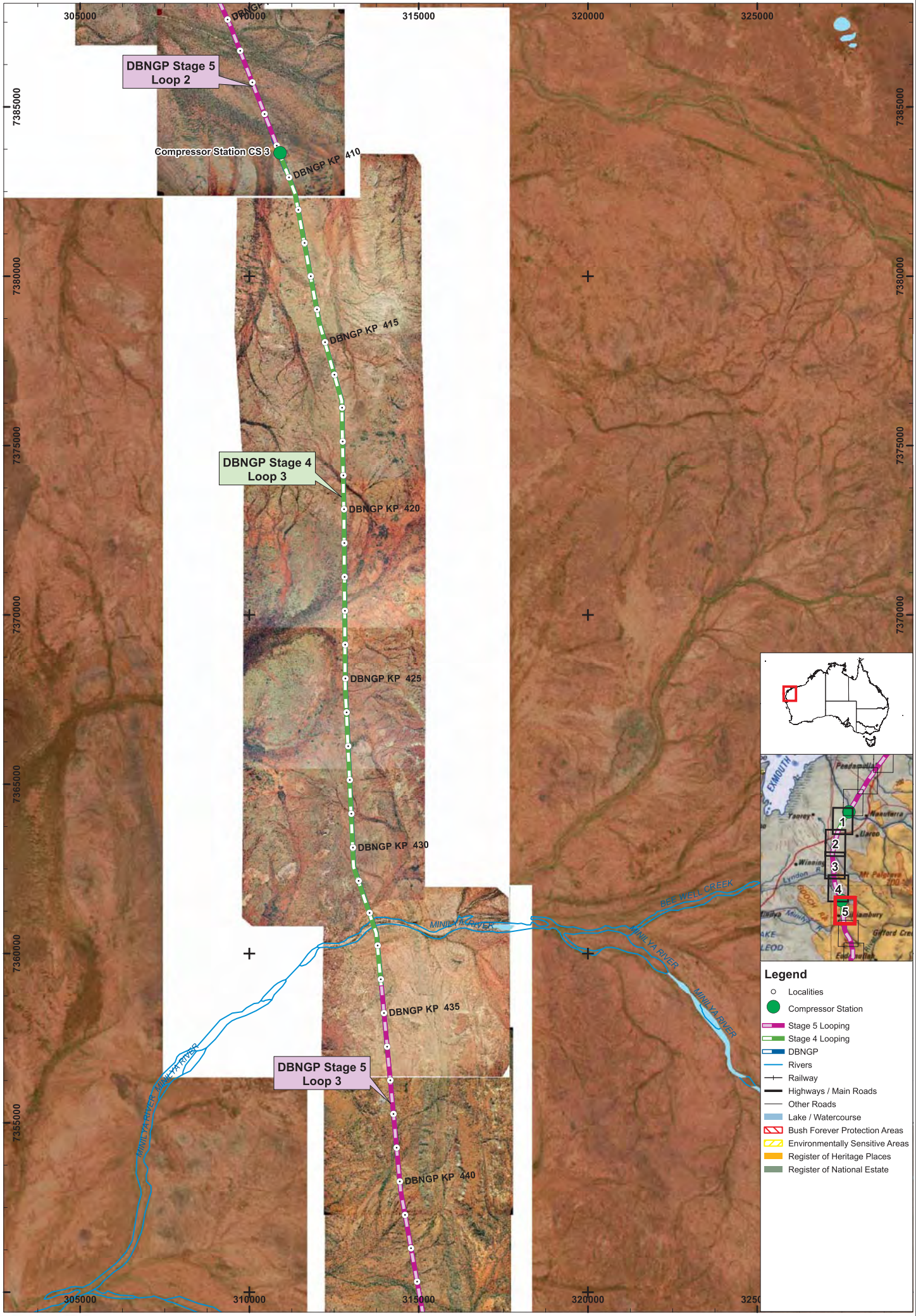
0 500 1,000 2,000 3,000 4,000

Metres

Map 14. DBNGP Expansion CS 2 to CS 3
SHEET 4 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 14
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 4 of 5
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

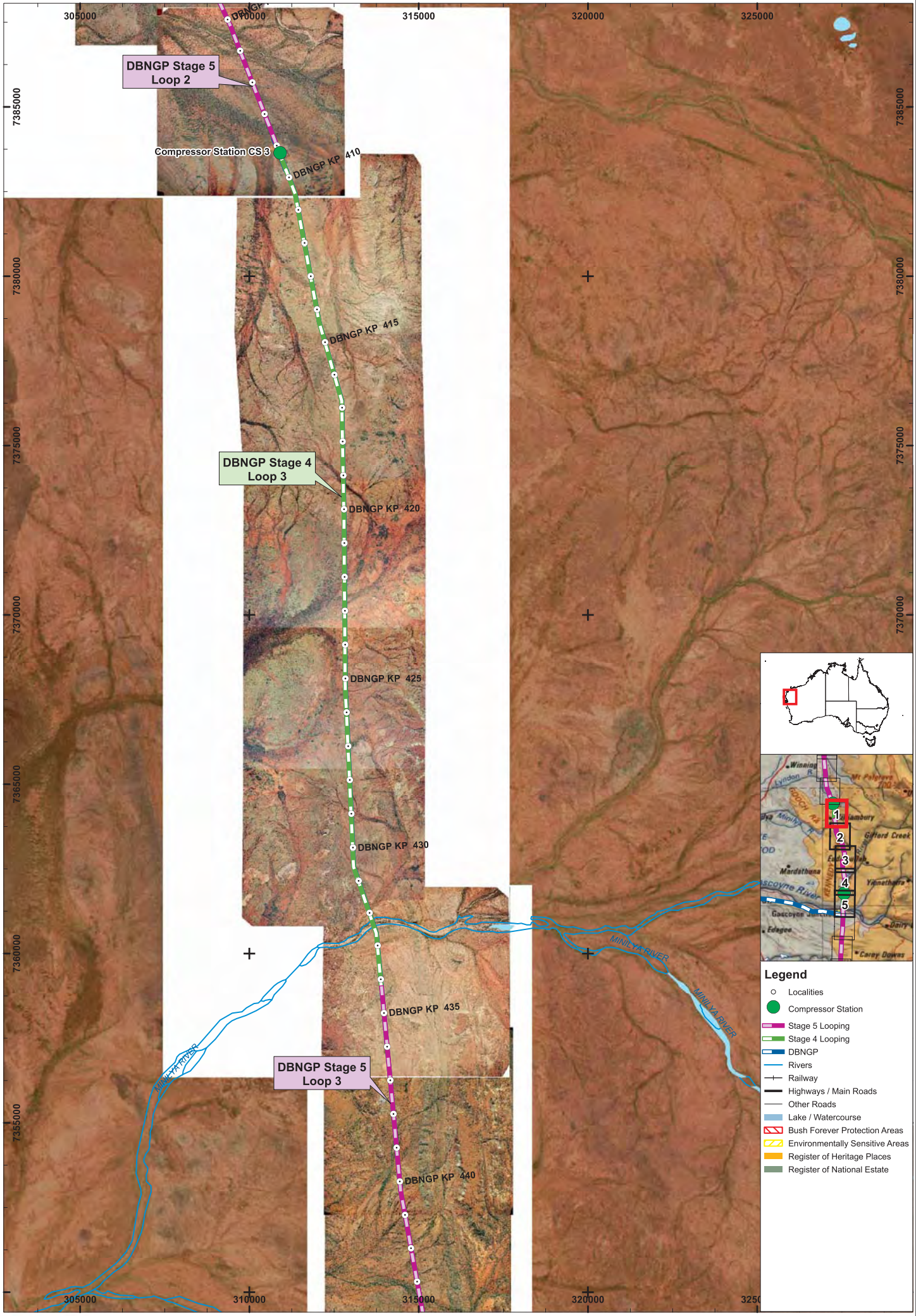
Metres

Map 15. DBNGP Expansion CS 2 to CS 3
SHEET 5 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 15
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 5 of 5
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

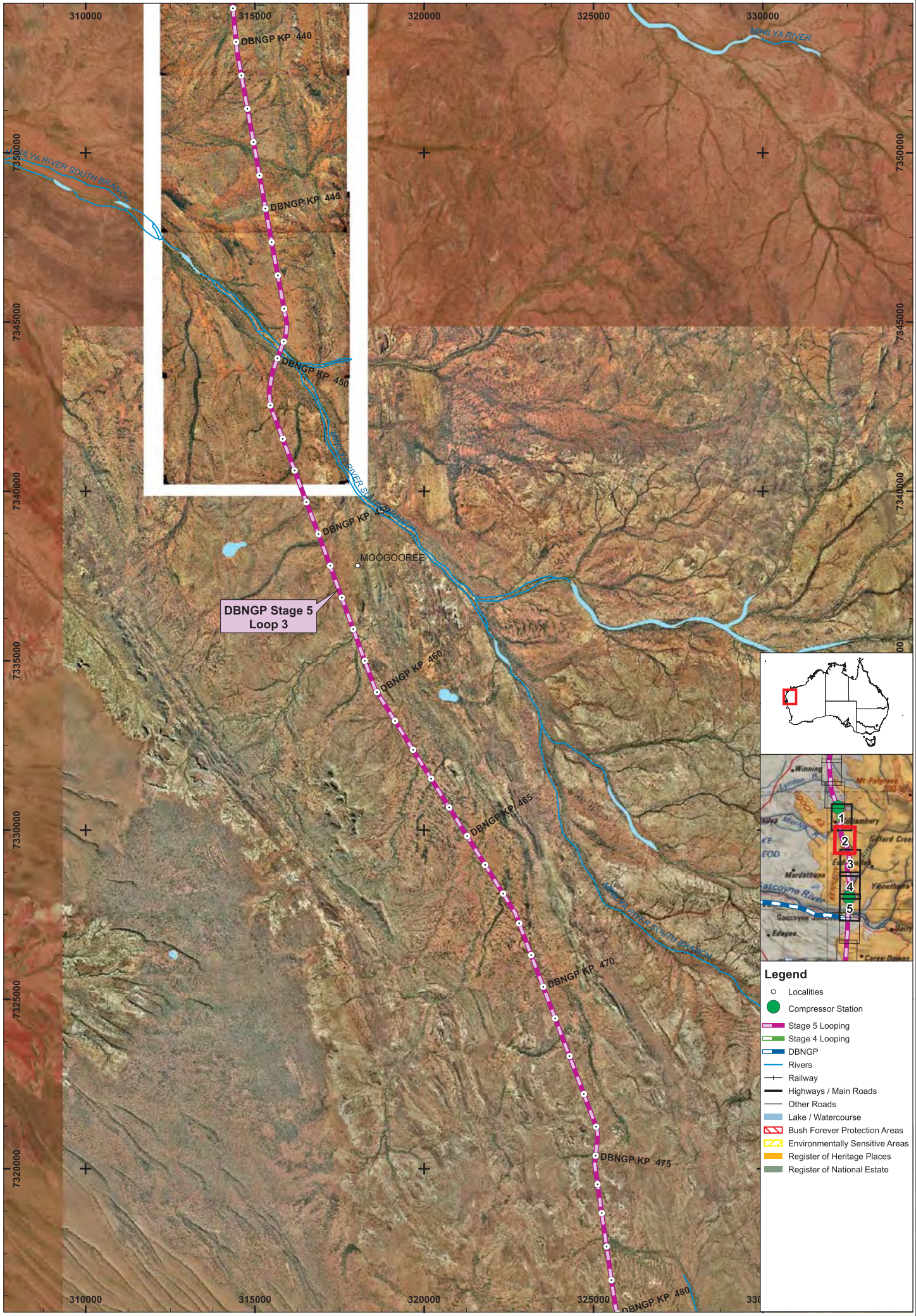
0 500 1,000 2,000 3,000 4,000

Metres

Map 16. DBNGP Expansion CS 3 to CS 4
SHEET 1 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 16
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 1 of 5
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

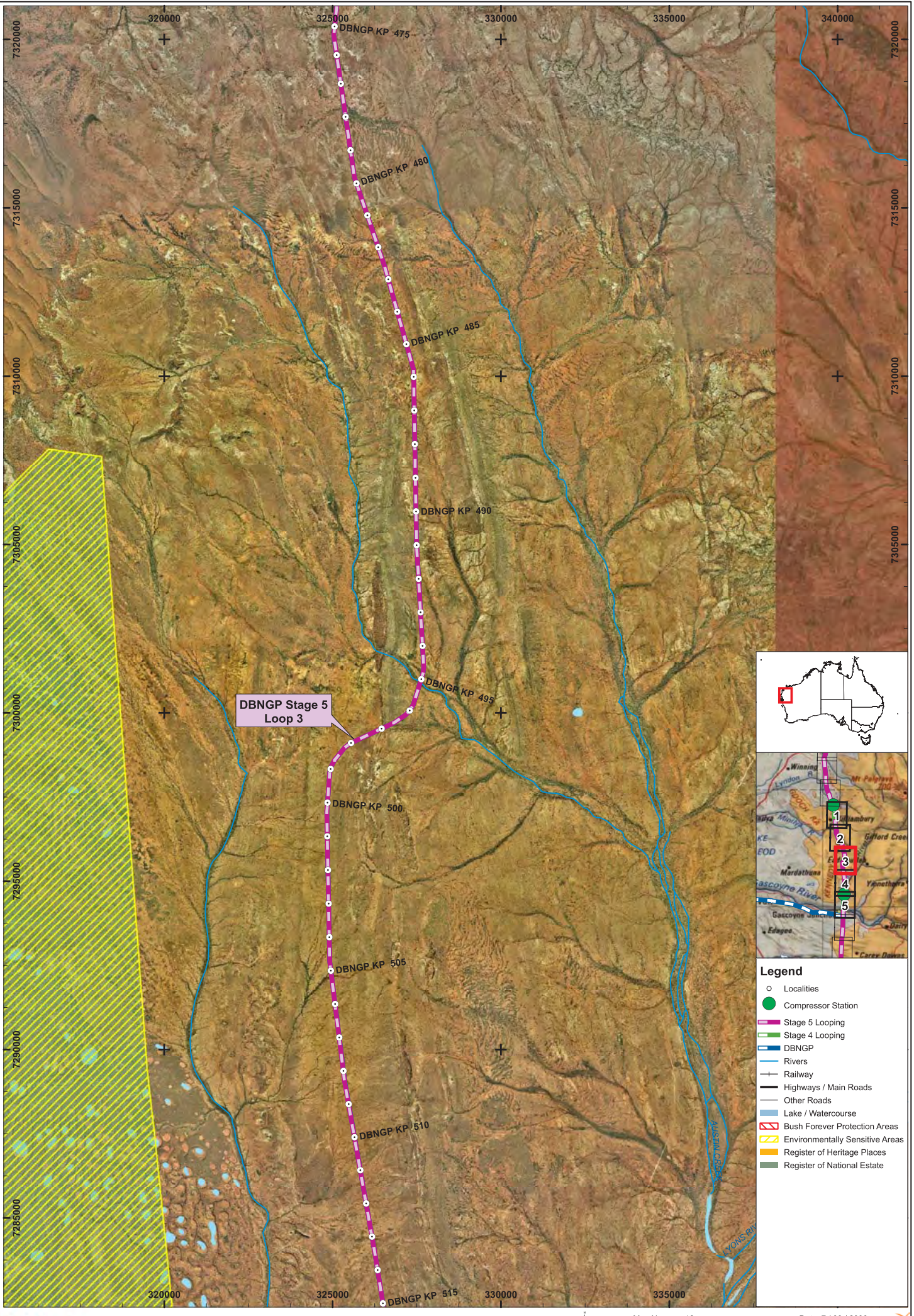
Metres

Map 17. DBNGP Expansion CS 3 to CS 4
SHEET 2 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 17
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 2 of 5
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006

GDA



Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

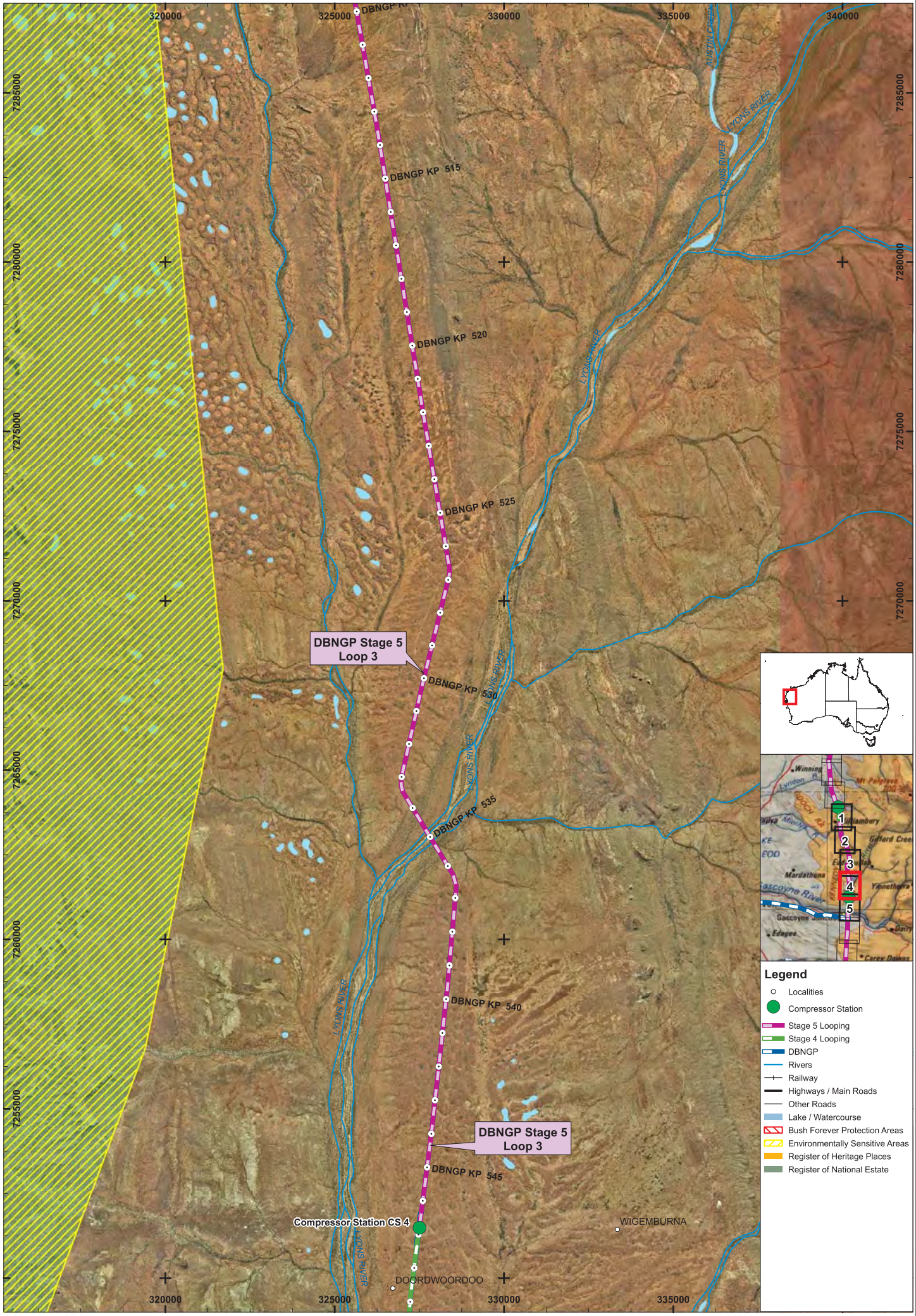
Metres

Map 18. DBNGP Expansion CS 3 to CS 4
SHEET 3 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 18
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 3 of 5
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

Metres

Map 19. DBNGP Expansion CS 3 to CS 4
SHEET 4 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 19

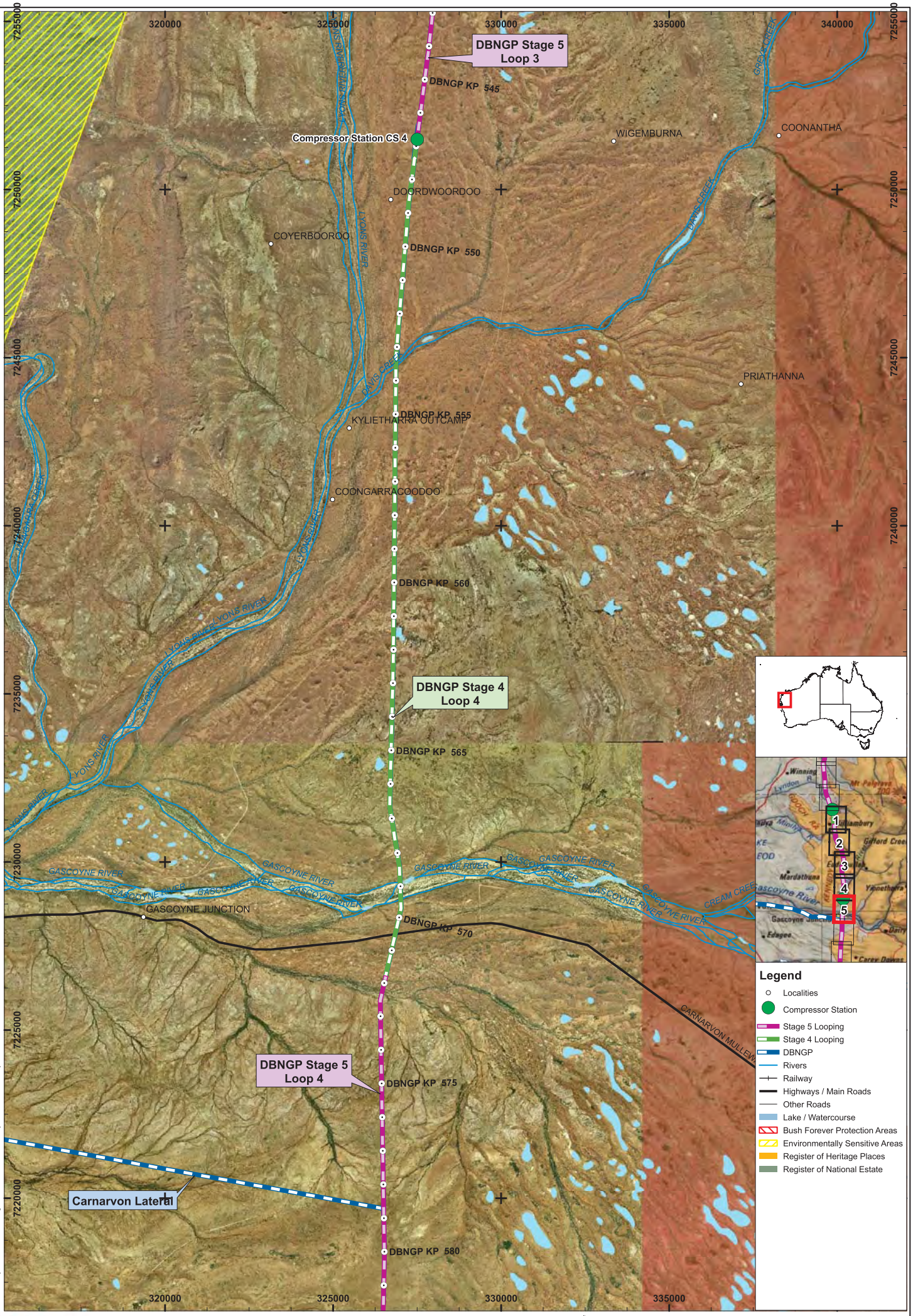
Map Revision: 0

Date: 7 / 09 / 2006

Sheet: 4 of 5

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd

Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

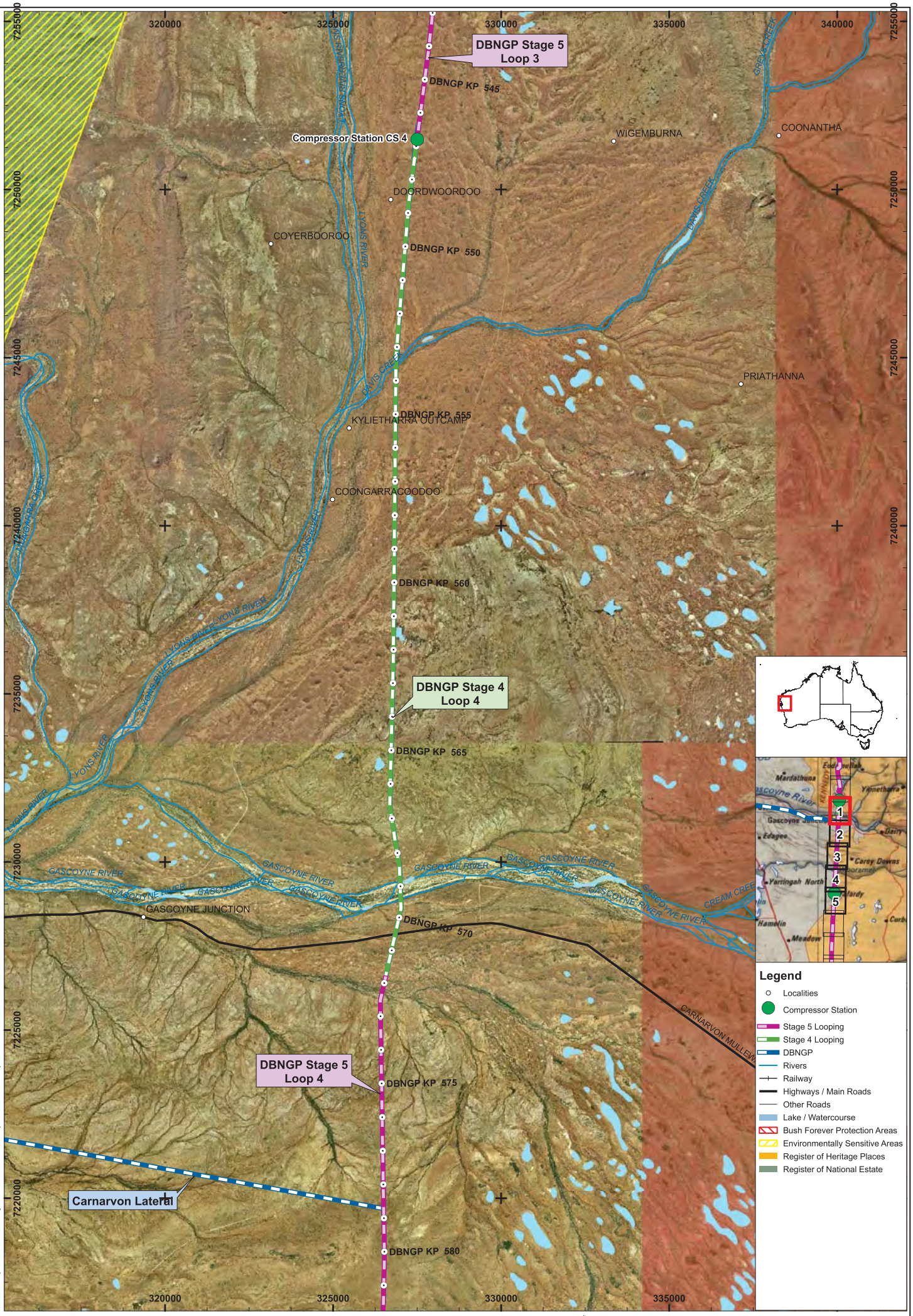
Metres

Map 20. DBNGP Expansion CS 3 to CS 4
SHEET 5 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 20
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 5 of 5
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

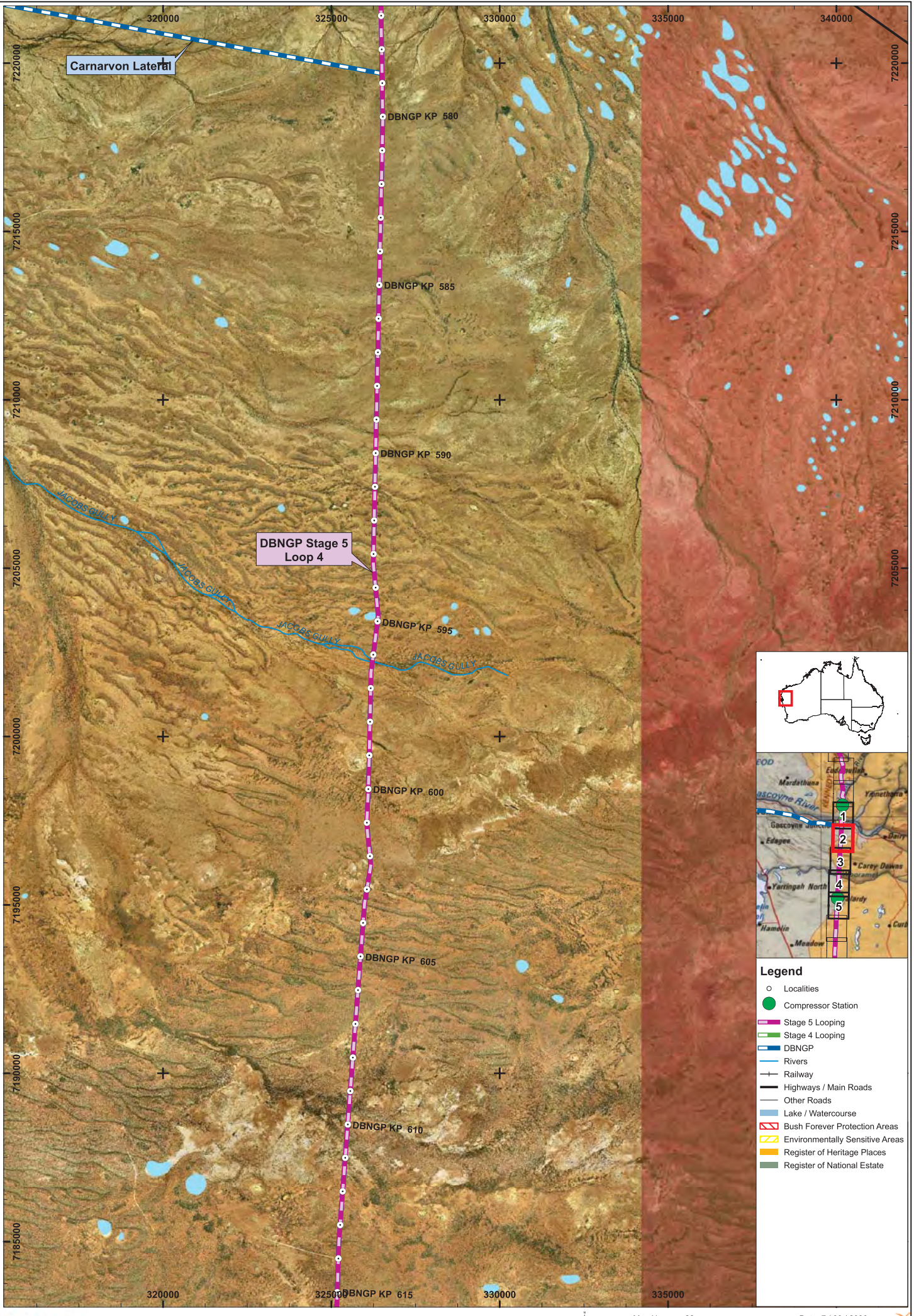
0 500 1,000 2,000 3,000 4,000

Metres

Map 21. DBNGP Expansion CS 4 to CS 5
SHEET 1 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 21
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 1 of 5
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

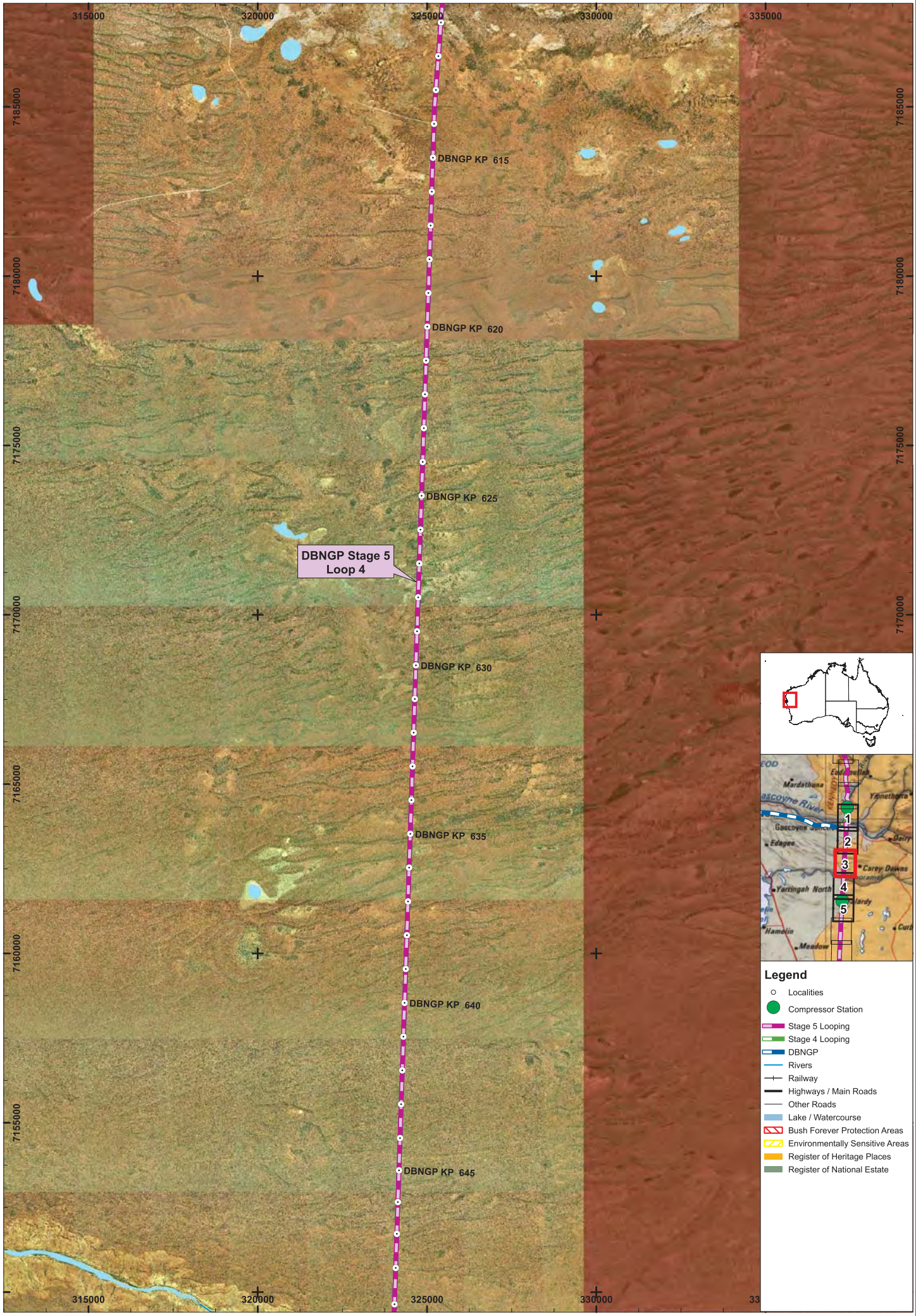
0 500 1,000 2,000 3,000 4,000

Metres

Map 22. DBNGP Expansion CS 4 to CS 5
SHEET 2 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 22
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 2 of 5
GDA
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

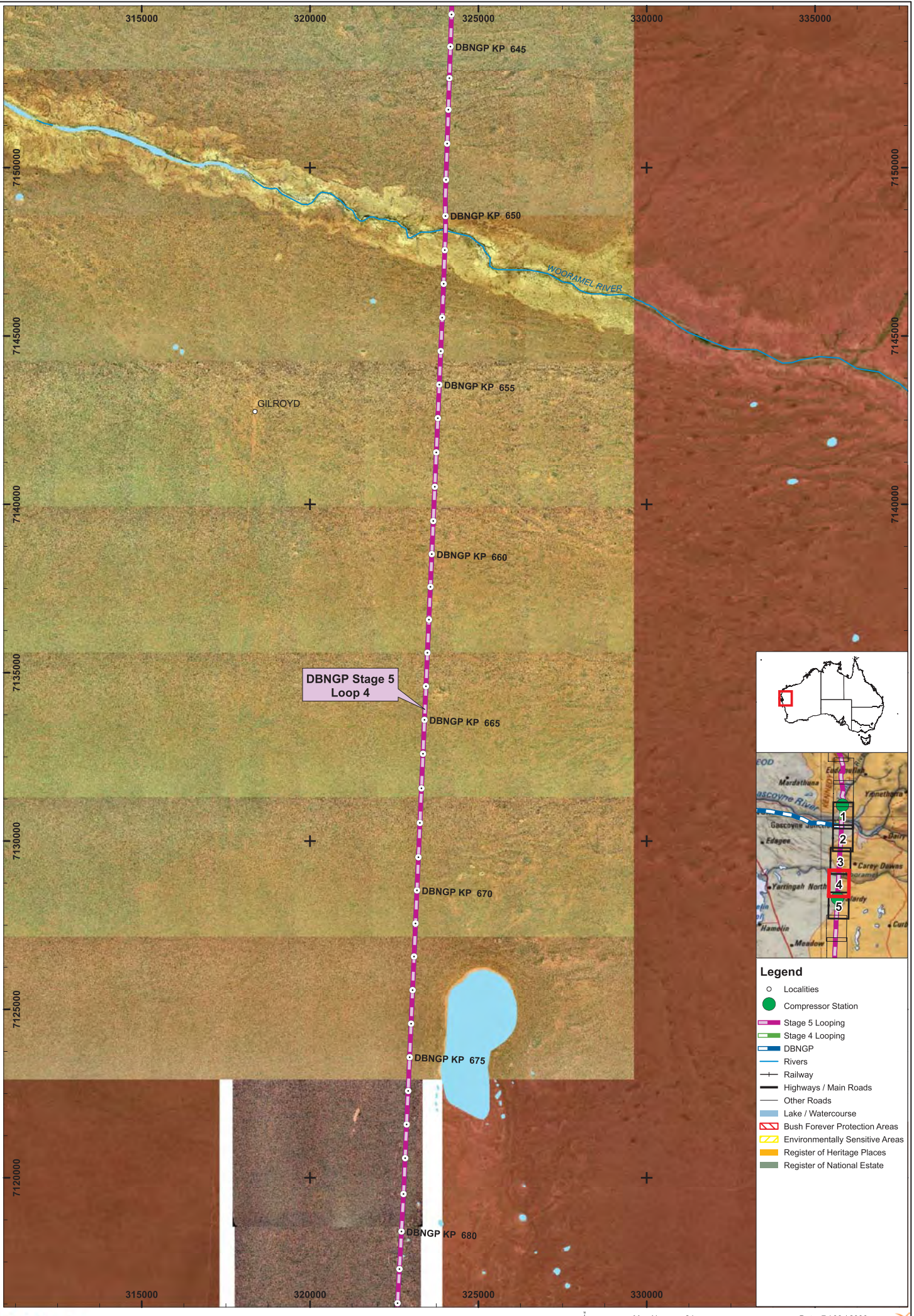
Metres

Map 23. DBNGP Expansion CS 4 to CS 5
SHEET 3 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 23
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 3 of 5
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

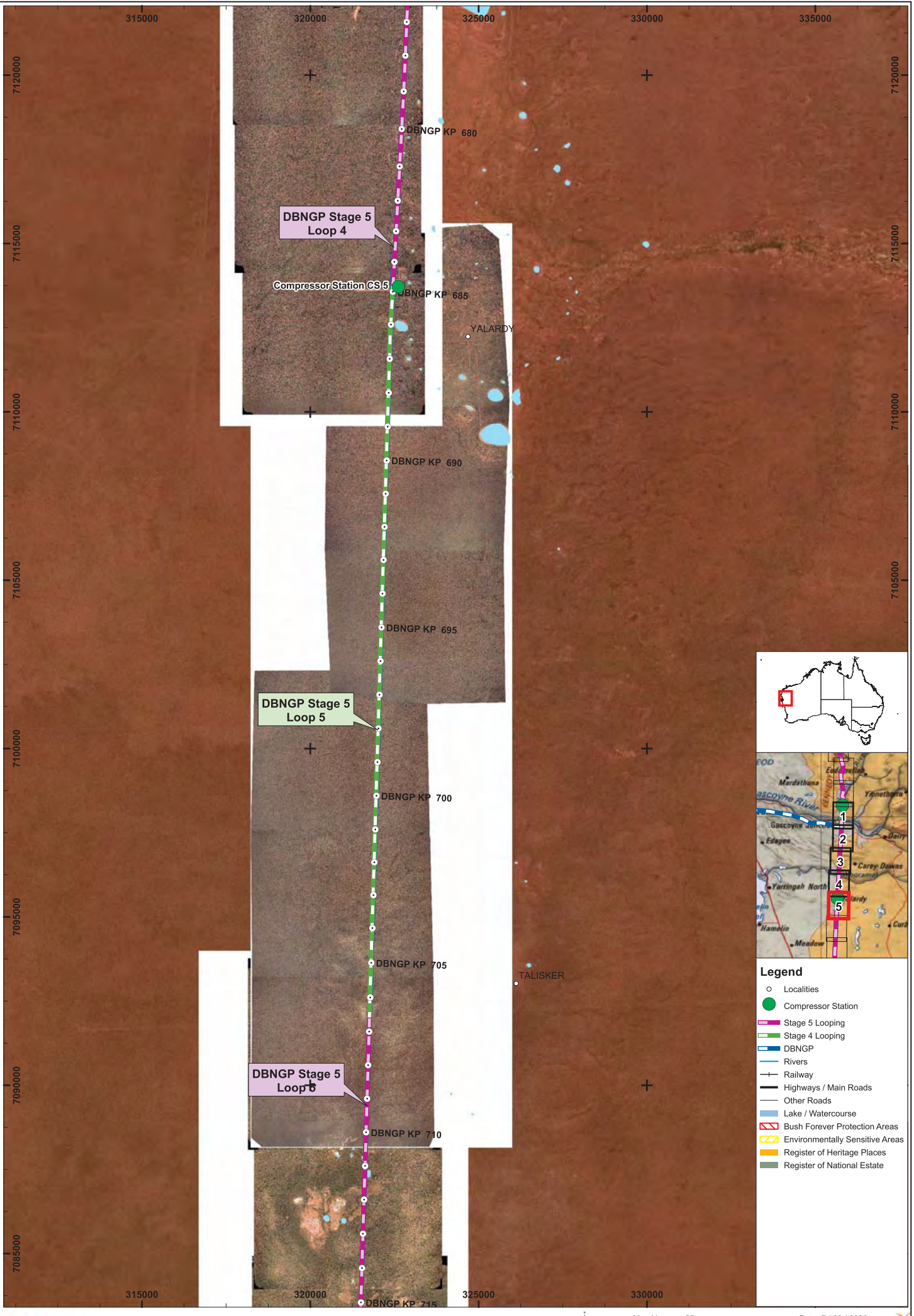
Metres

Map 24. DBNGP Expansion CS 4 to CS 5
SHEET 4 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 24
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 4 of 5
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

Produced by Alinta Asset Management. 321 Ferntree Gully Road Mt Waverley VIC 3149

Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

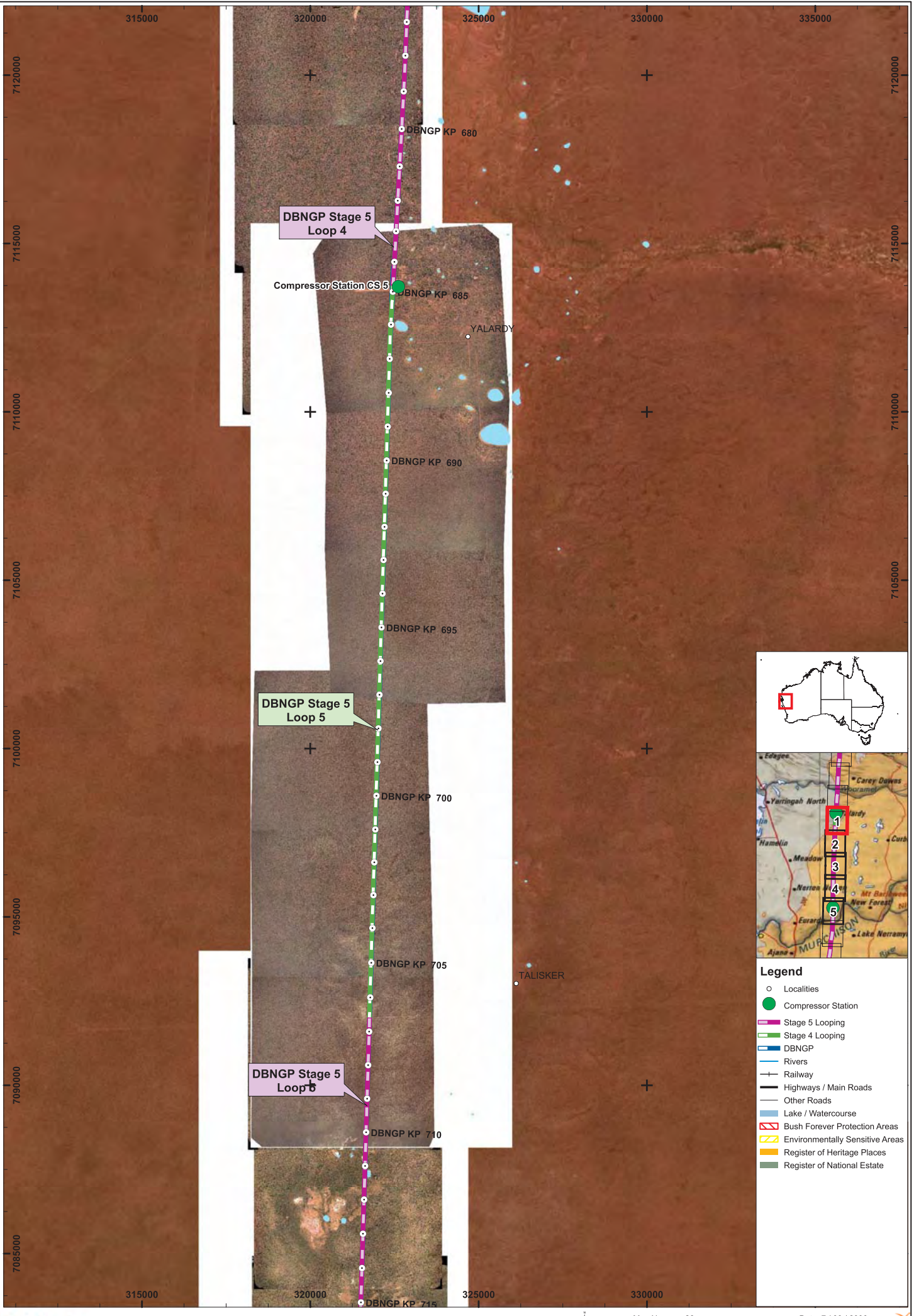
Metres

Map 25. DBNGP Expansion CS 4 to CS 5
SHEET 5 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 25
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 5 of 5
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

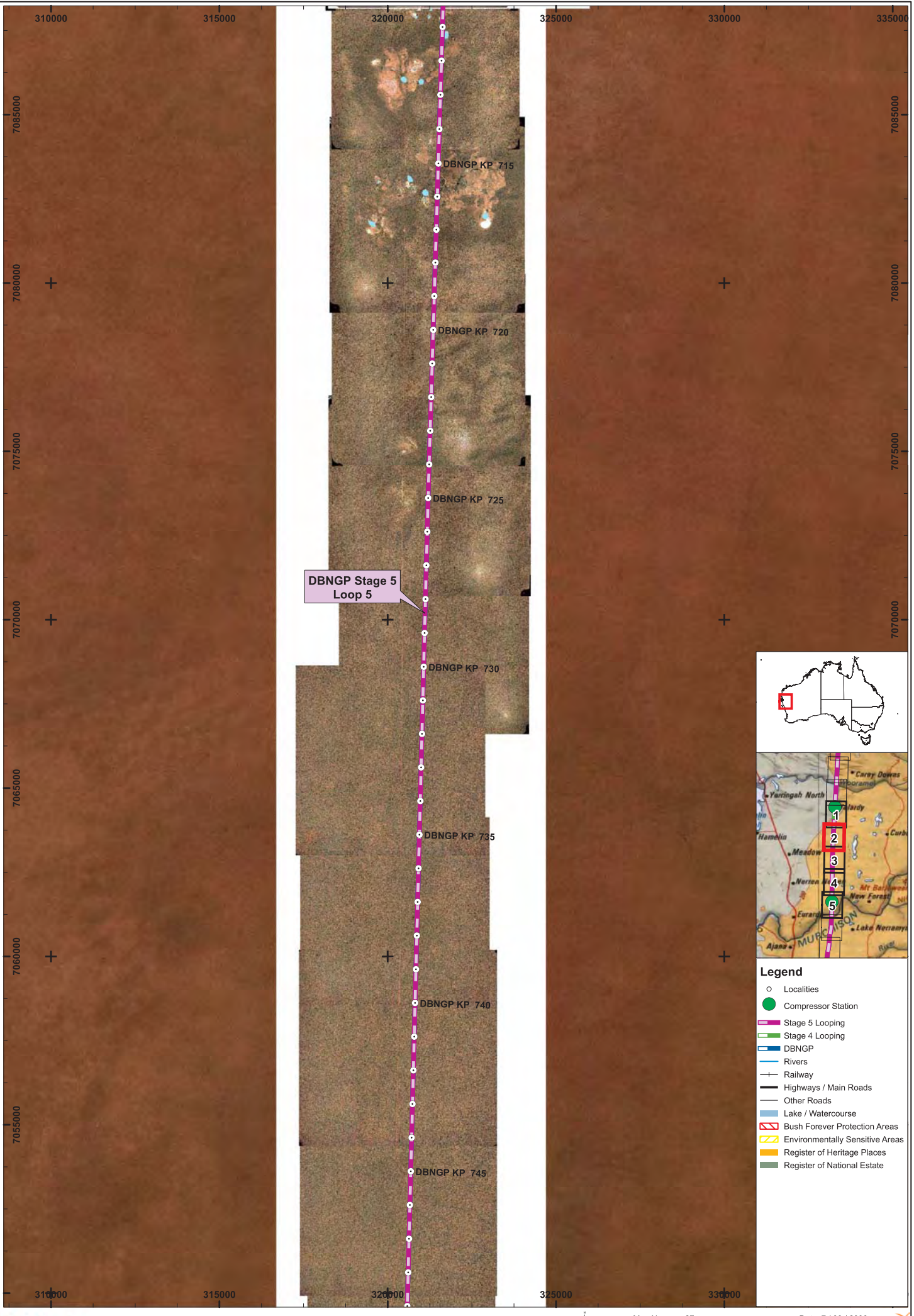
Metres

Map 26. DBNGP Expansion CS 5 to CS 6
SHEET 1 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 26
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 1 of 5
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

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Alinta

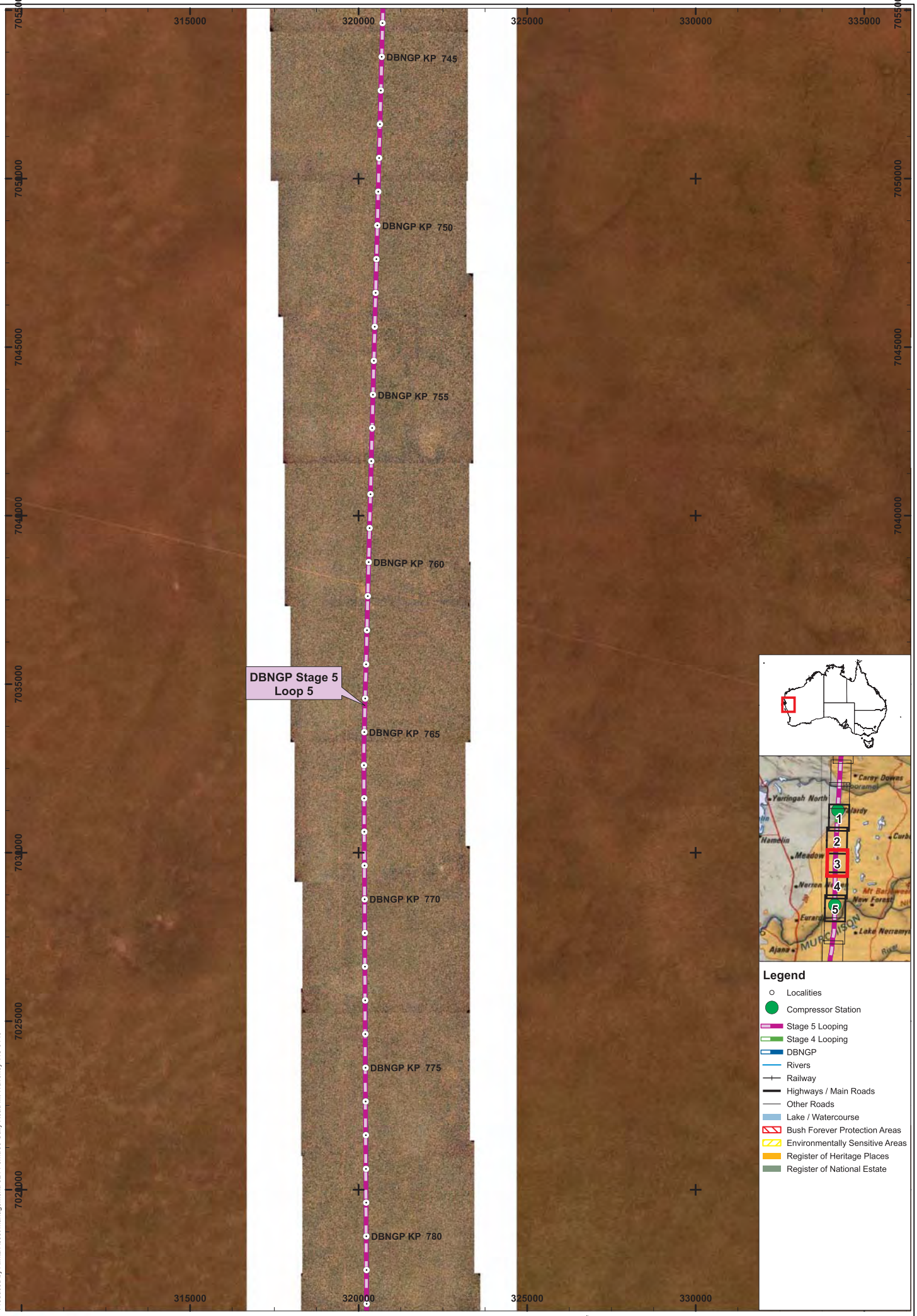
Scale 1: 100 000 (A3)
0 500 1,000 2,000 3,000 4,000
Metres

Map 27. DBNGP Expansion CS 5 to CS 6
SHEET 2 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 27
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 2 of 5
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006

GDA



Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

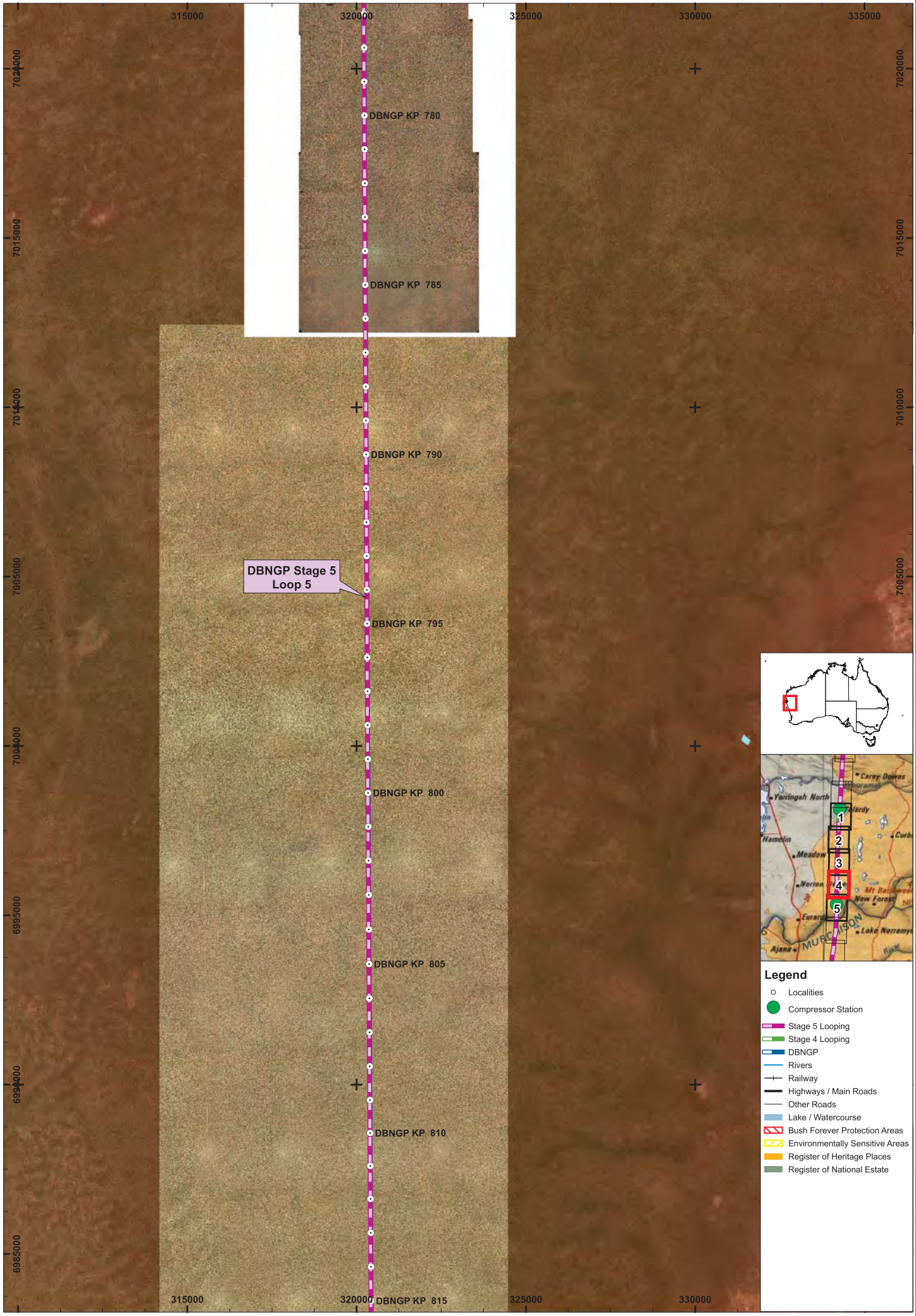
Metres

Map 28. DBNGP Expansion CS 5 to CS 6
SHEET 3 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 28
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 3 of 5
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

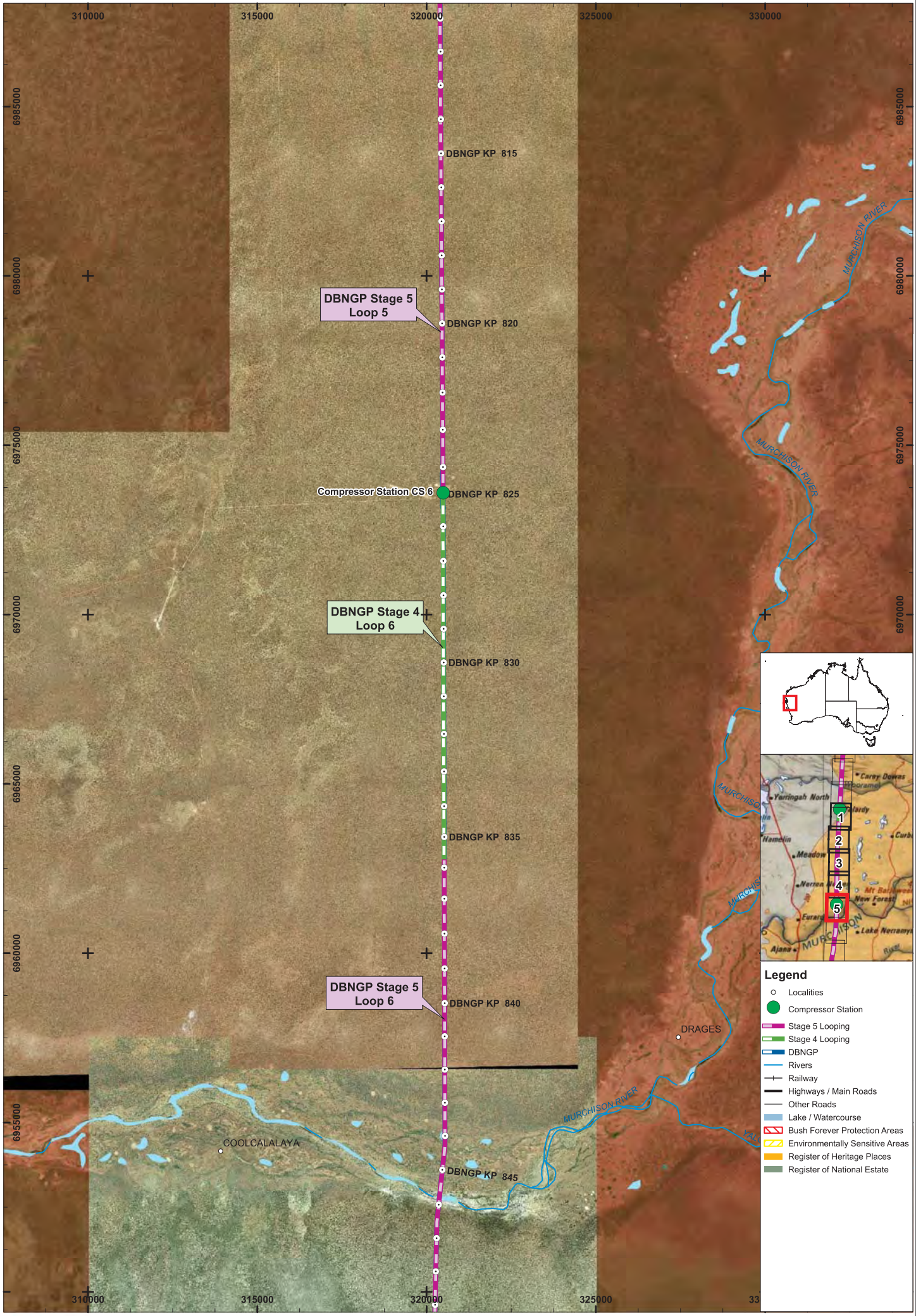
Metres

Map 29. DBNGP Expansion CS 5 to CS 6
SHEET 4 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 29
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 4 of 5
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

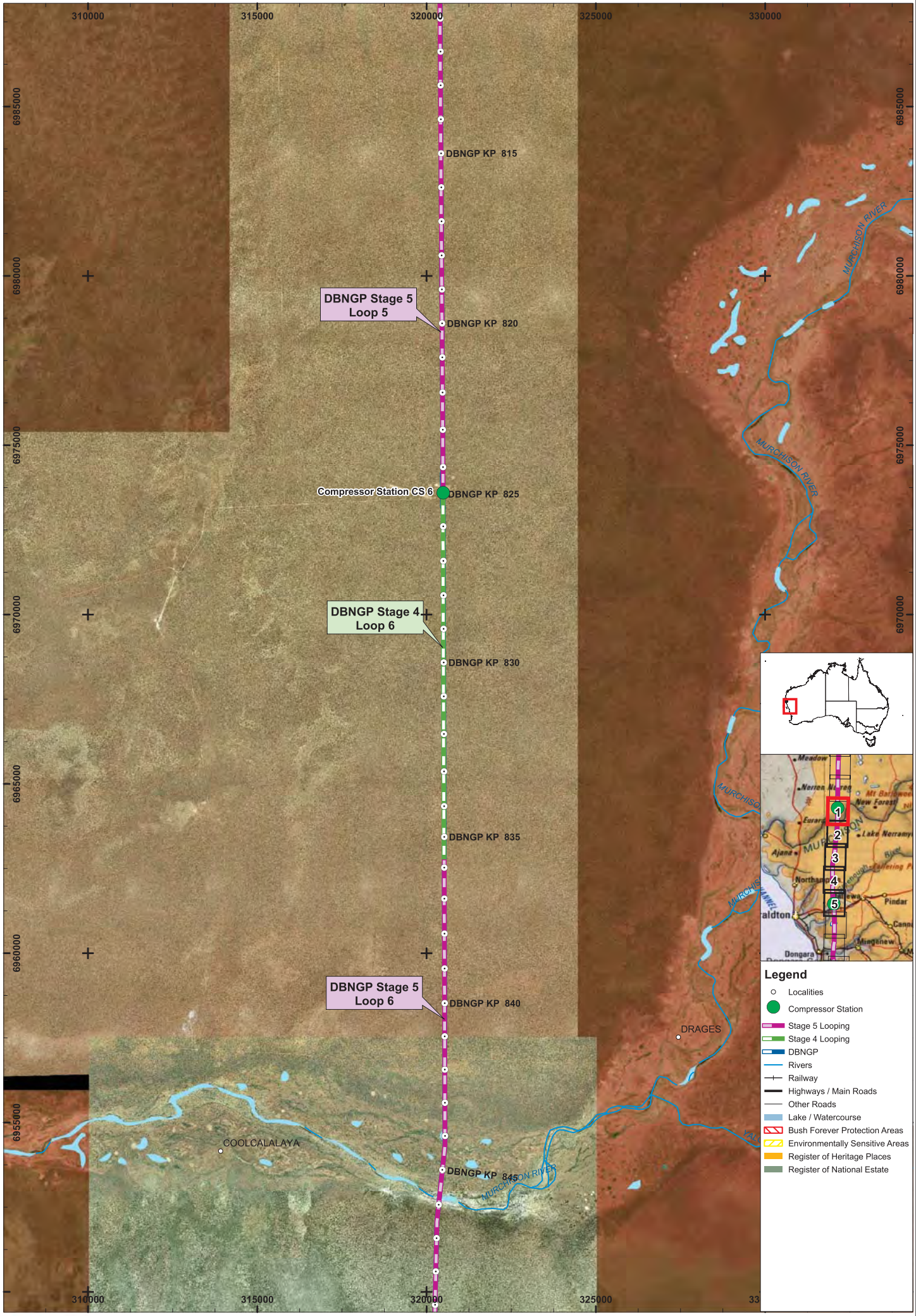
0 500 1,000 2,000 3,000 4,000

Metres

Map 30. DBNGP Expansion CS 5 to CS 6
SHEET 5 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 30
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 5 of 5
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

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Alinta

Scale 1: 100 000 (A3)

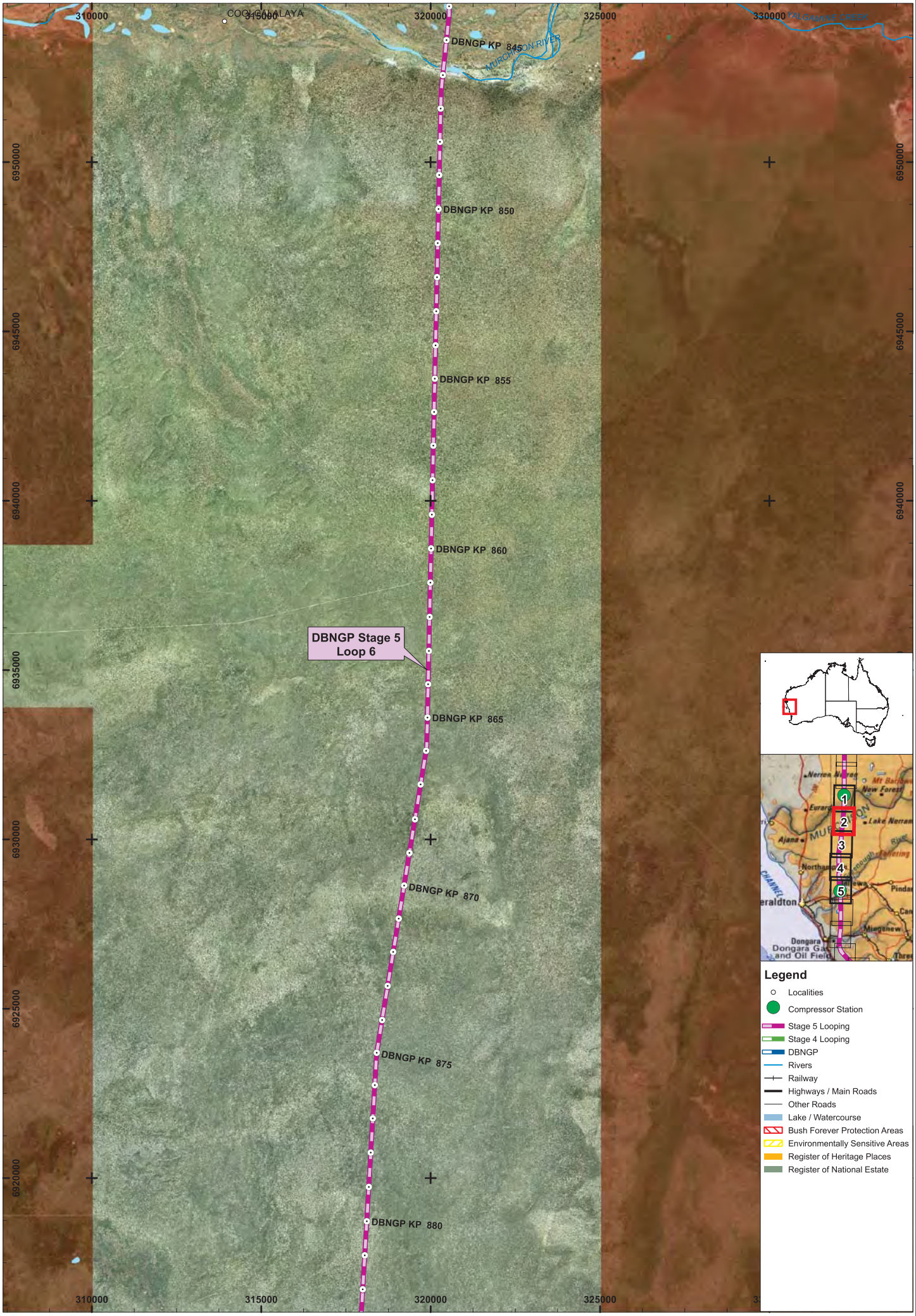
0 500 1,000 2,000 3,000 4,000

Metres

Map 31. DBNGP Expansion CS 6 to CS 7
SHEET 1 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 31
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 1 of 5
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

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Alinta

Scale 1: 100 000 (A3)

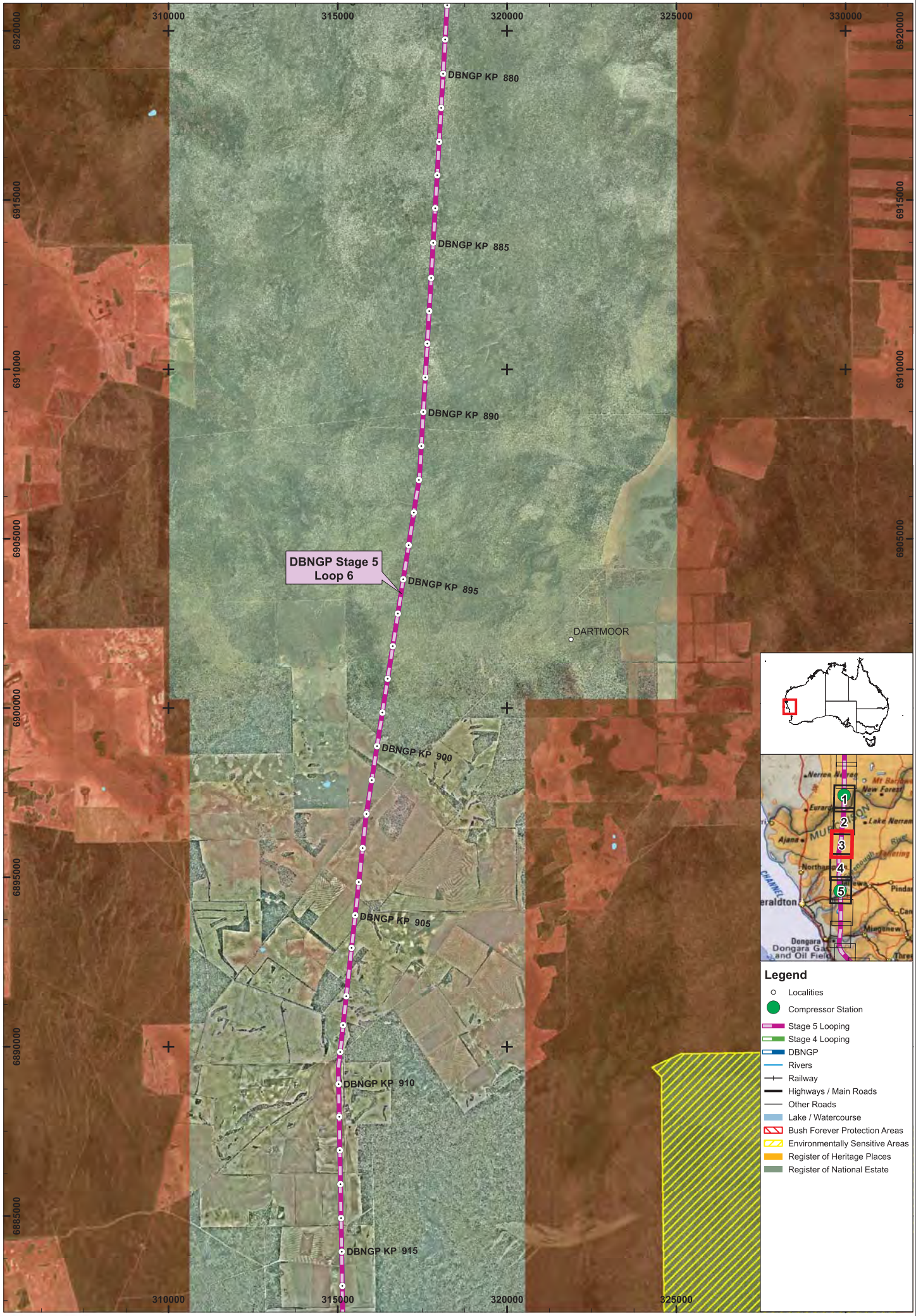
0 500 1,000 2,000 3,000 4,000

Metres

Map 32. DBNGP Expansion CS 6 to CS 7
SHEET 2 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 32
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 2 of 5
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

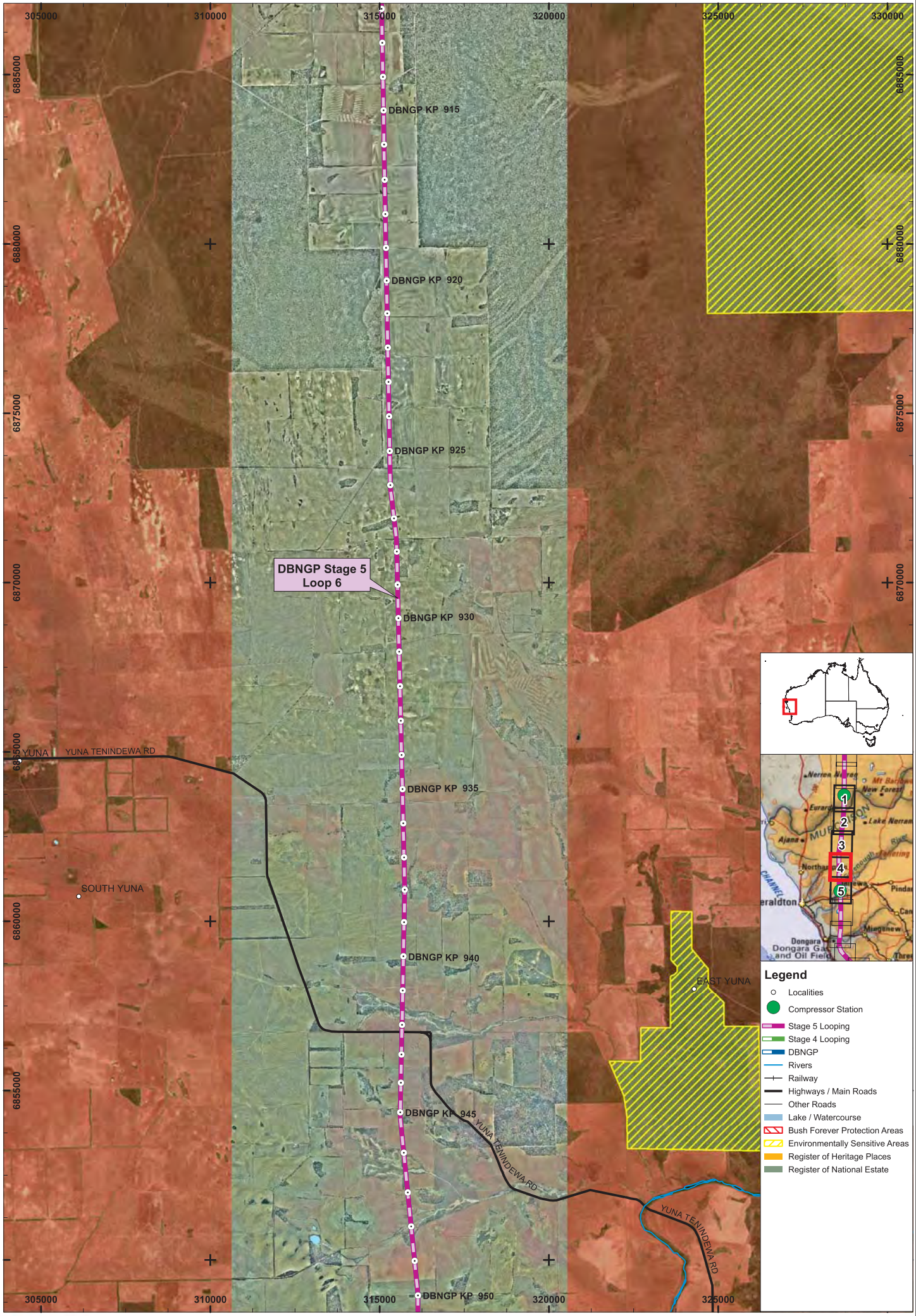
Metres

Map 33. DBNGP Expansion CS 6 to CS 7
SHEET 3 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 33
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 3 of 5
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

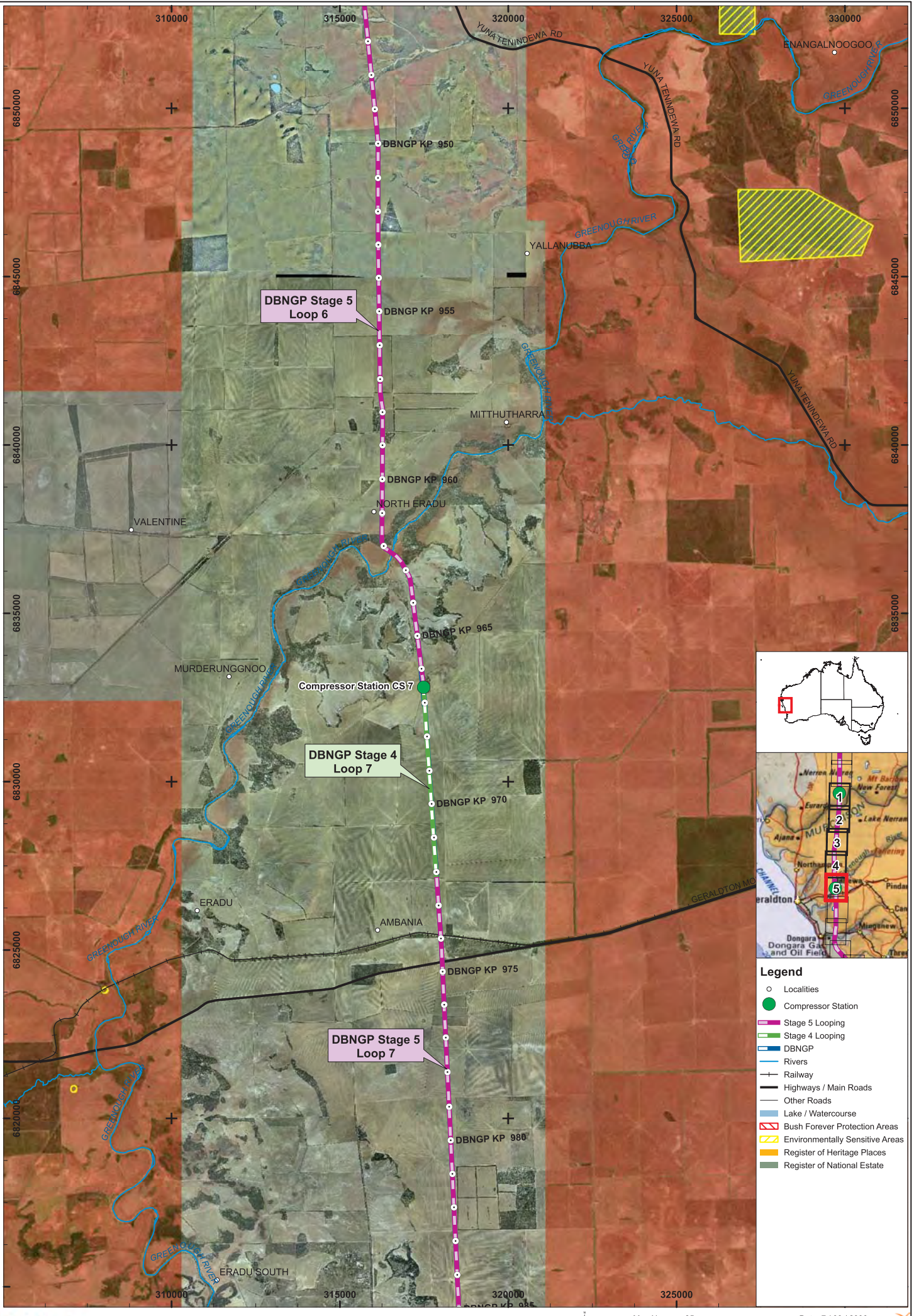
Metres

Map 34. DBNGP Expansion CS 6 to CS 7
SHEET 4 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 34
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 4 of 5
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

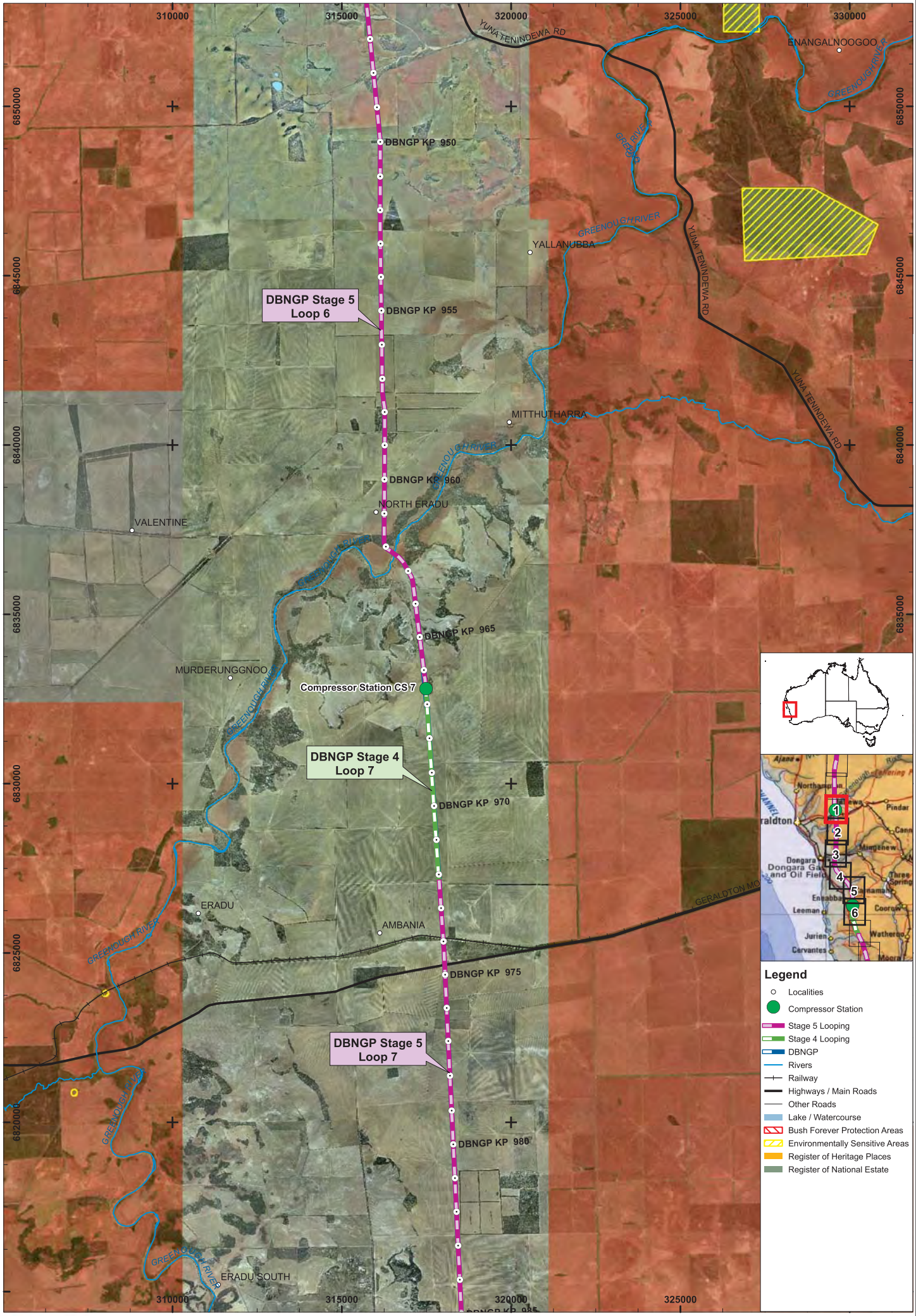
Metres

Map 35. DBNGP Expansion CS 6 to CS 7
SHEET 5 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 35
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 5 of 5
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

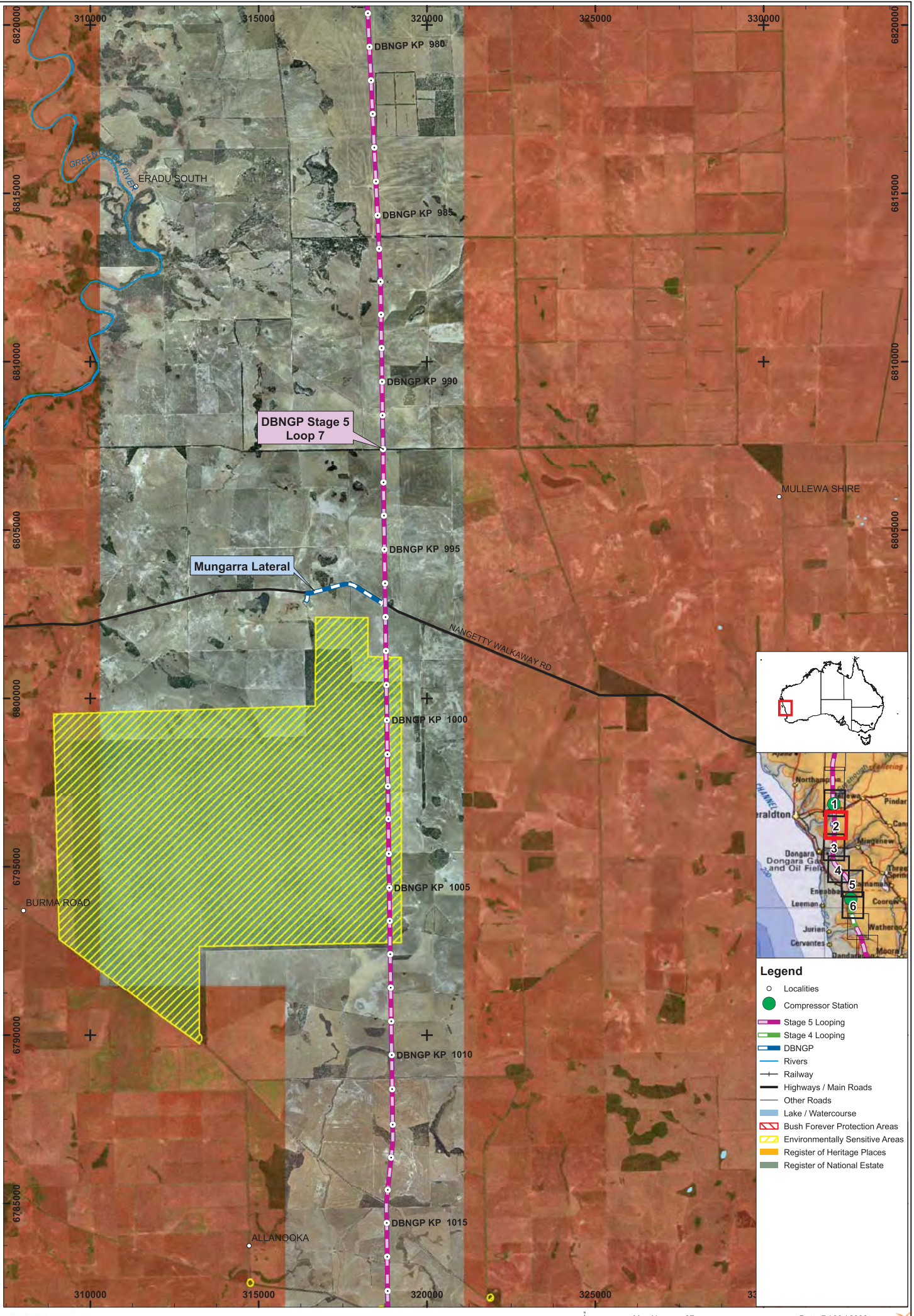
0 500 1,000 2,000 3,000 4,000

Metres

Map 36. DBNGP Expansion CS 7 to CS 8
SHEET 1 of 6

Coordinate System
MGA Zone 50 (GDA94)

Map No: 36
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 1 of 6
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

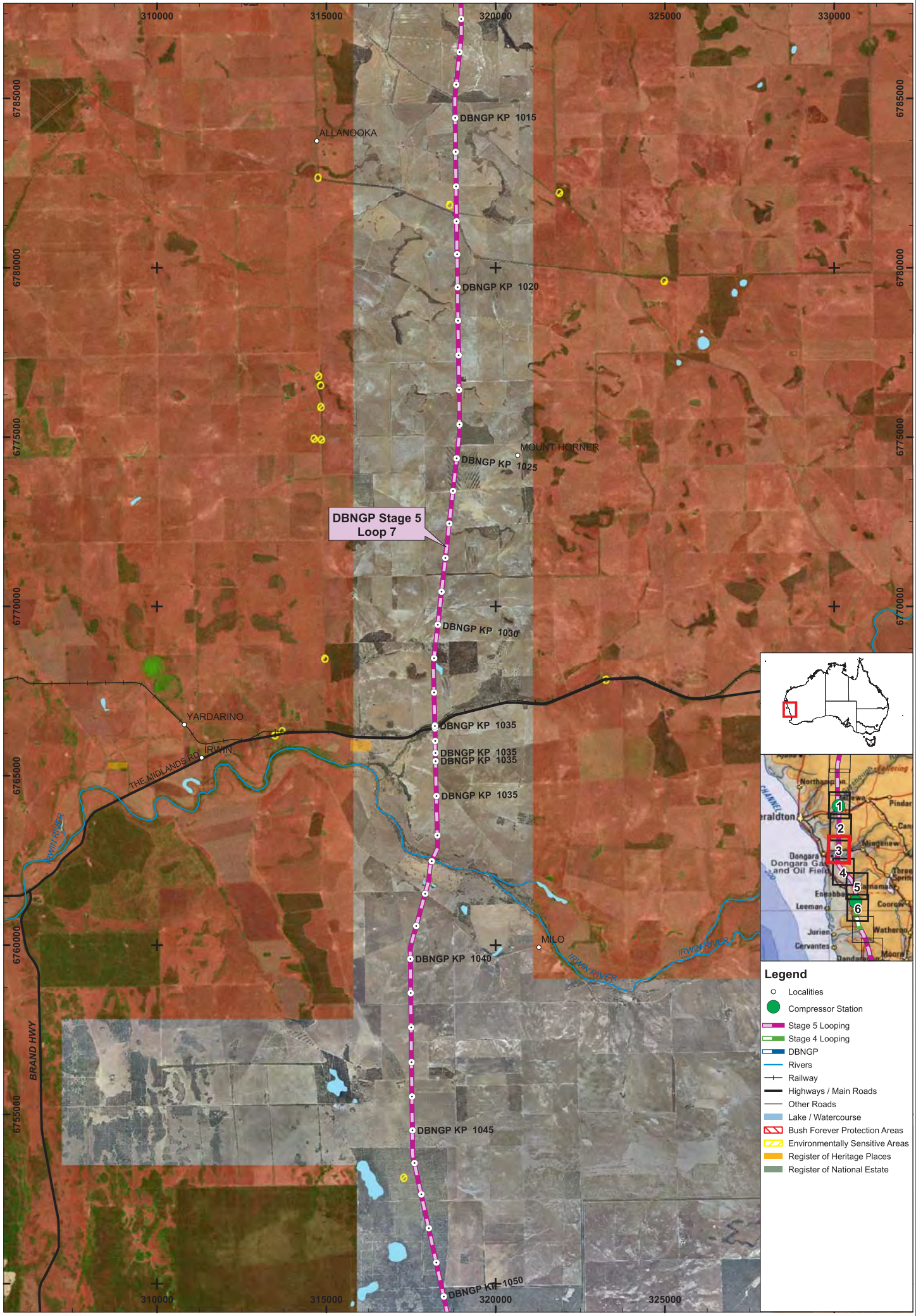
0 500 1,000 2,000 3,000 4,000

Metres

Map 37. DBNGP Expansion CS 7 to CS 8
SHEET 2 of 6

Coordinate System
MGA Zone 50 (GDA94)

Map No: 37
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 2 of 6
GDA
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

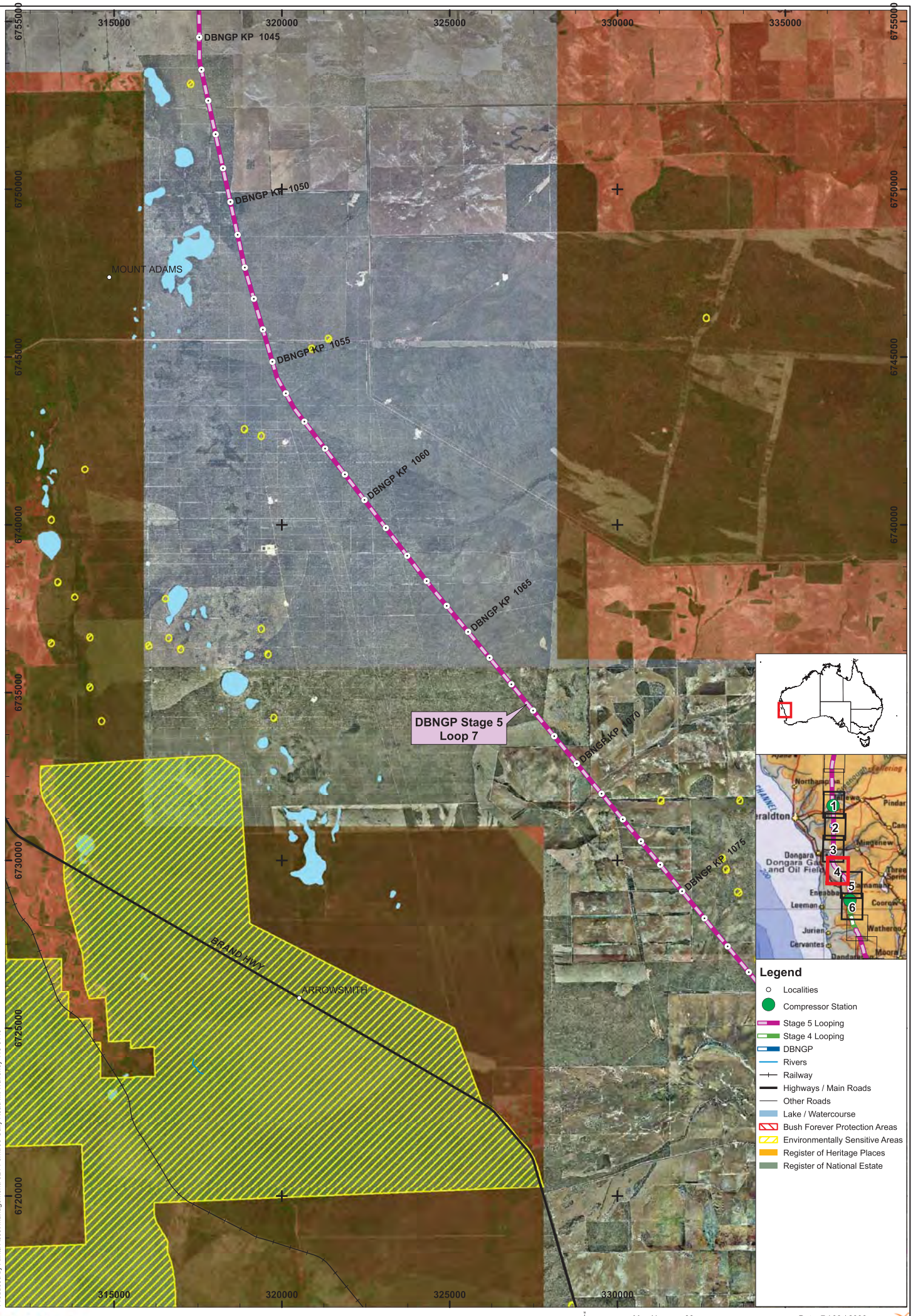
0 500 1,000 2,000 3,000 4,000

Metres

Map 38. DBNGP Expansion CS 7 to CS 8
SHEET 3 of 6

Coordinate System
MGA Zone 50 (GDA94)

Map No: 38
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 3 of 6
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

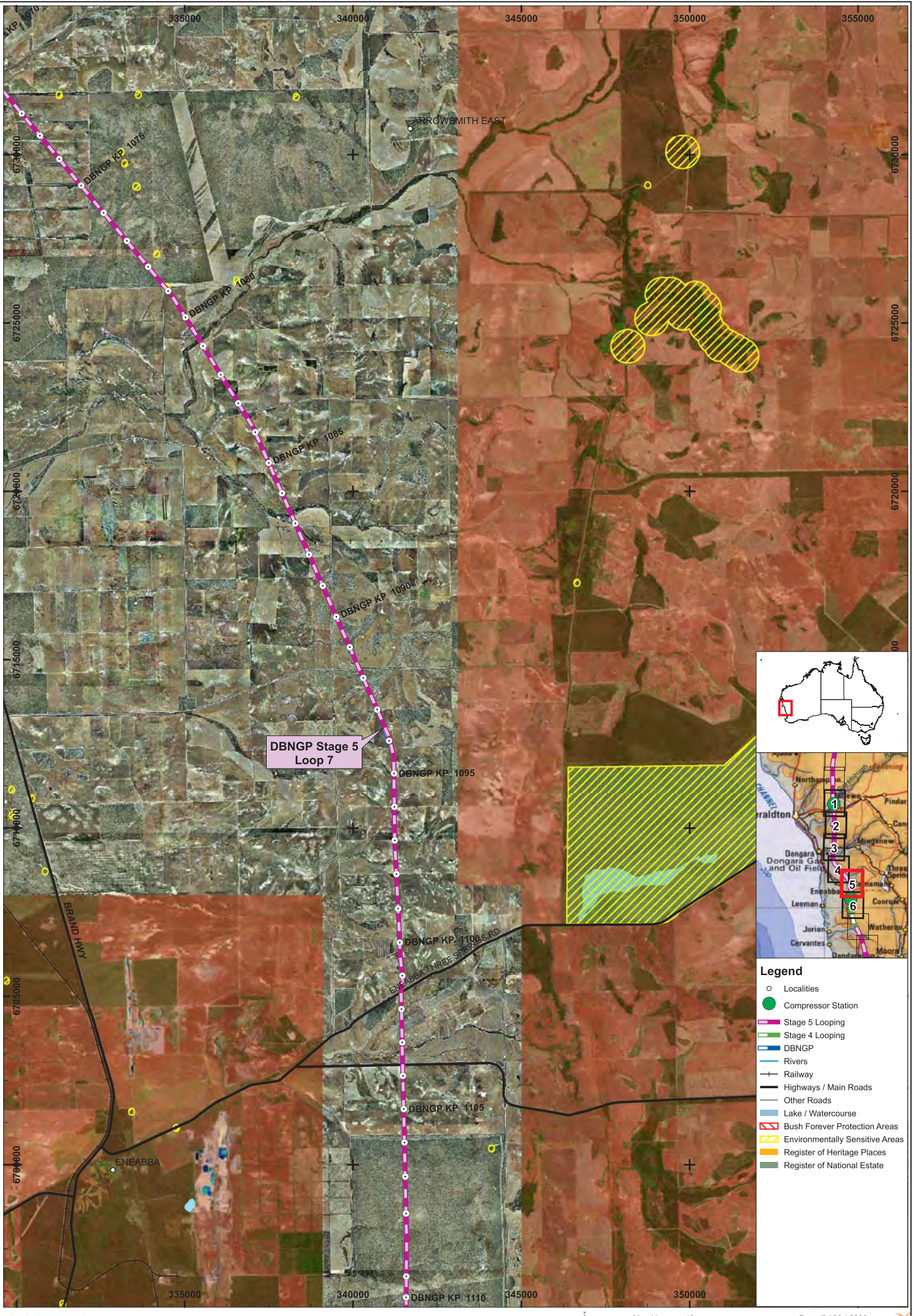
0 500 1,000 2,000 3,000 4,000

Metres

Map 39. DBNGP Expansion CS 7 to CS 8
SHEET 4 of 6

Coordinate System
MGA Zone 50 (GDA94)

Map No: 39
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 4 of 6
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

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Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Alinta

Scale 1: 100 000 (A3)

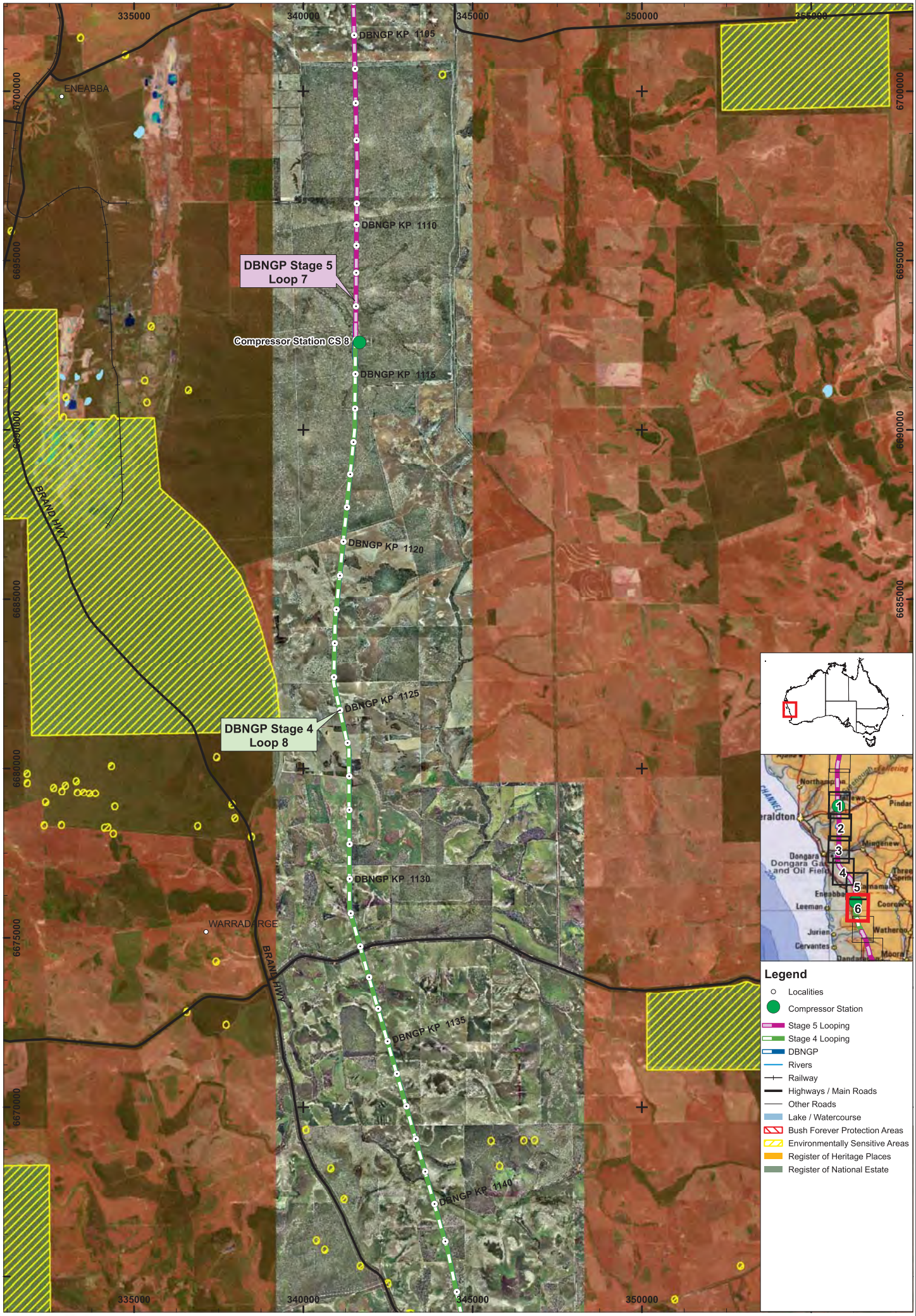
0 500 1,000 2,000 3,000 4,000

Metres

Map 40. DBNGP Expansion CS 7 to CS 8
SHEET 5 of 6

Coordinate System
MGA Zone 50 (GDA94)

Map No: 40
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 5 of 6
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

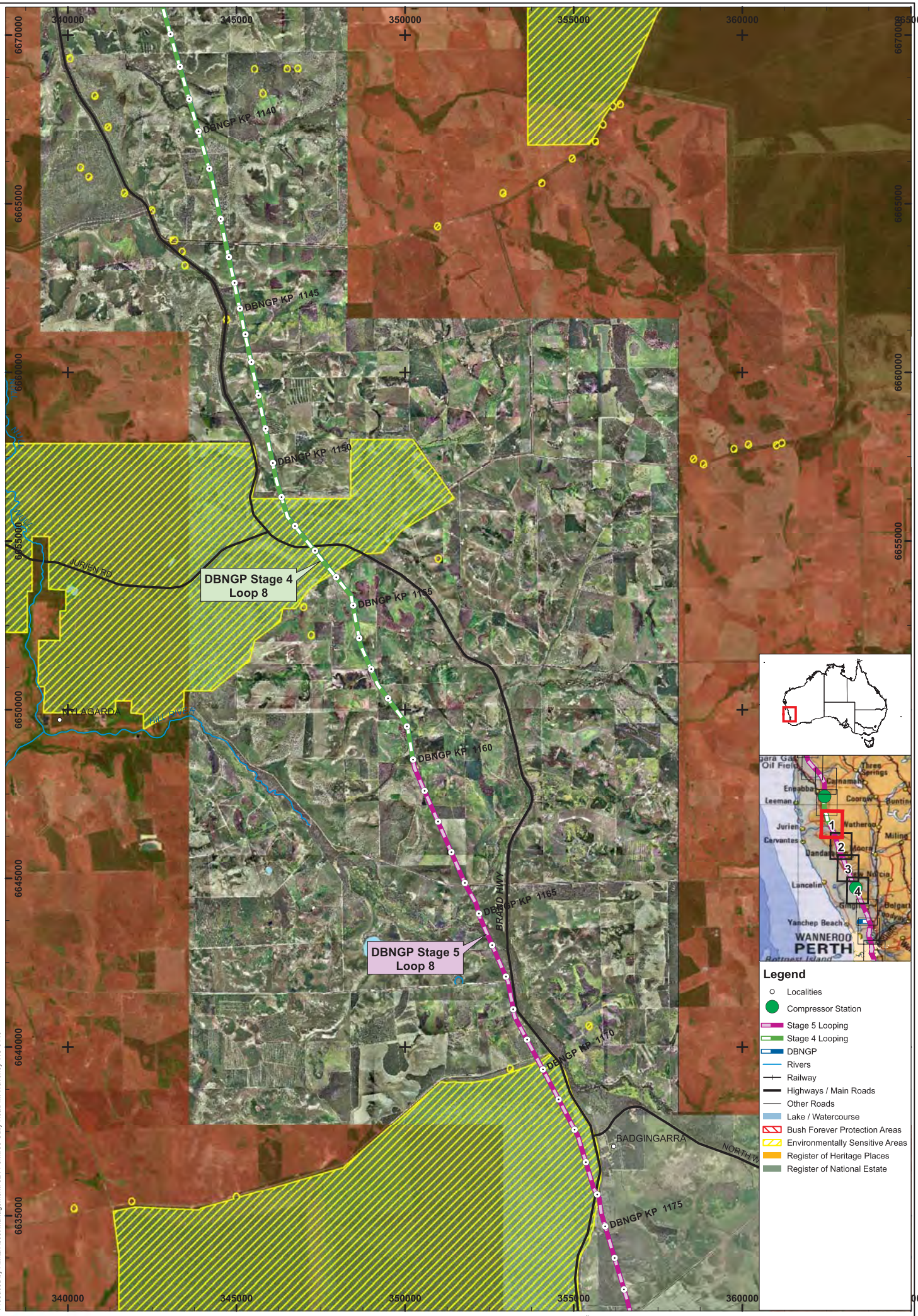
Metres

Map 41. DBNGP Expansion CS 7 to CS 8
SHEET 6 of 6

Coordinate System
MGA Zone 50 (GDA94)

Map No: 41
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 6 of 6
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

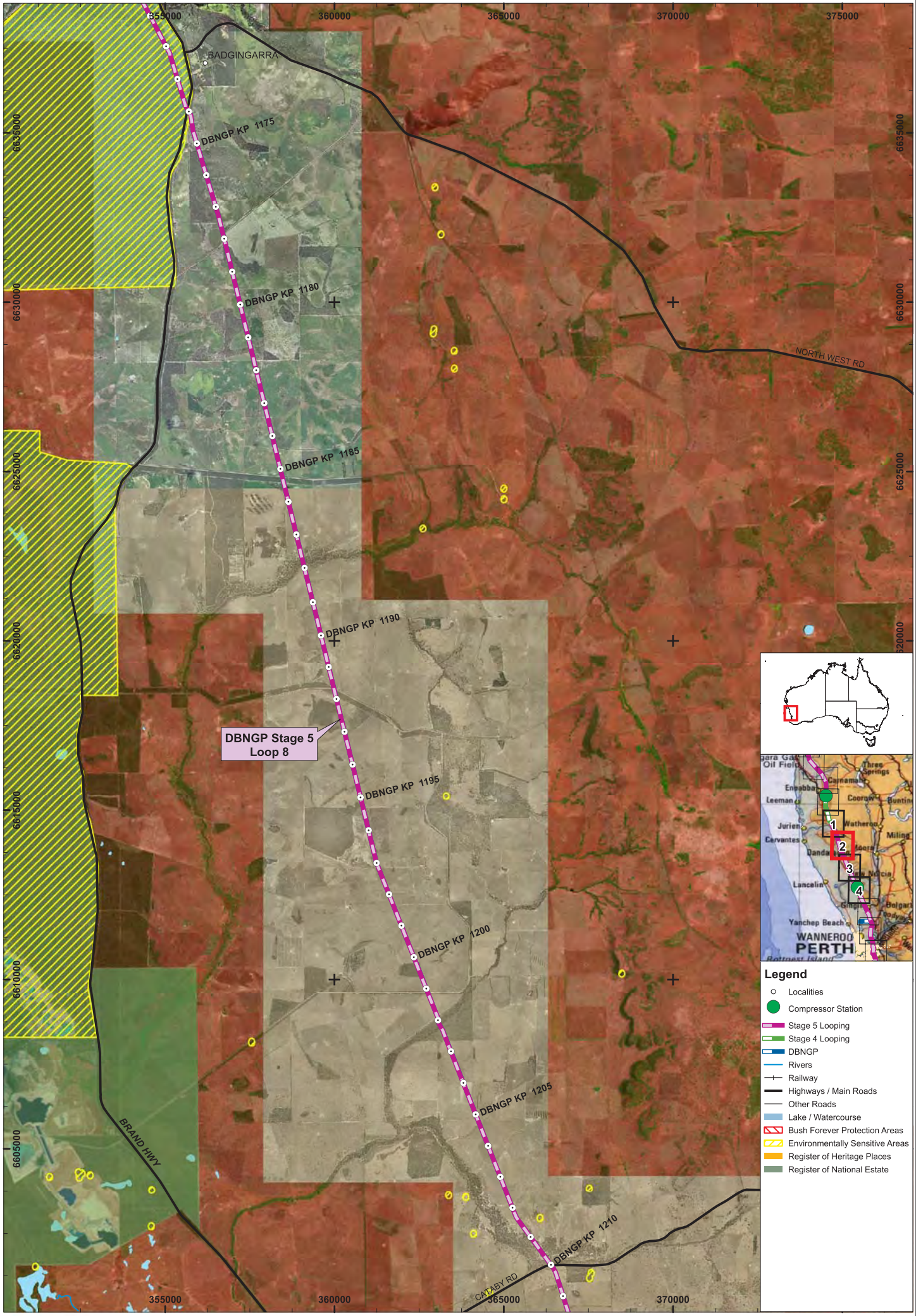
Metres

Map 42. DBNGP Expansion CS 8 to CS 9
SHEET 1 of 4

Coordinate System
MGA Zone 50 (GDA94)

Map No: 42
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 1 of 4
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

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Alinta

Scale 1: 100 000 (A3)

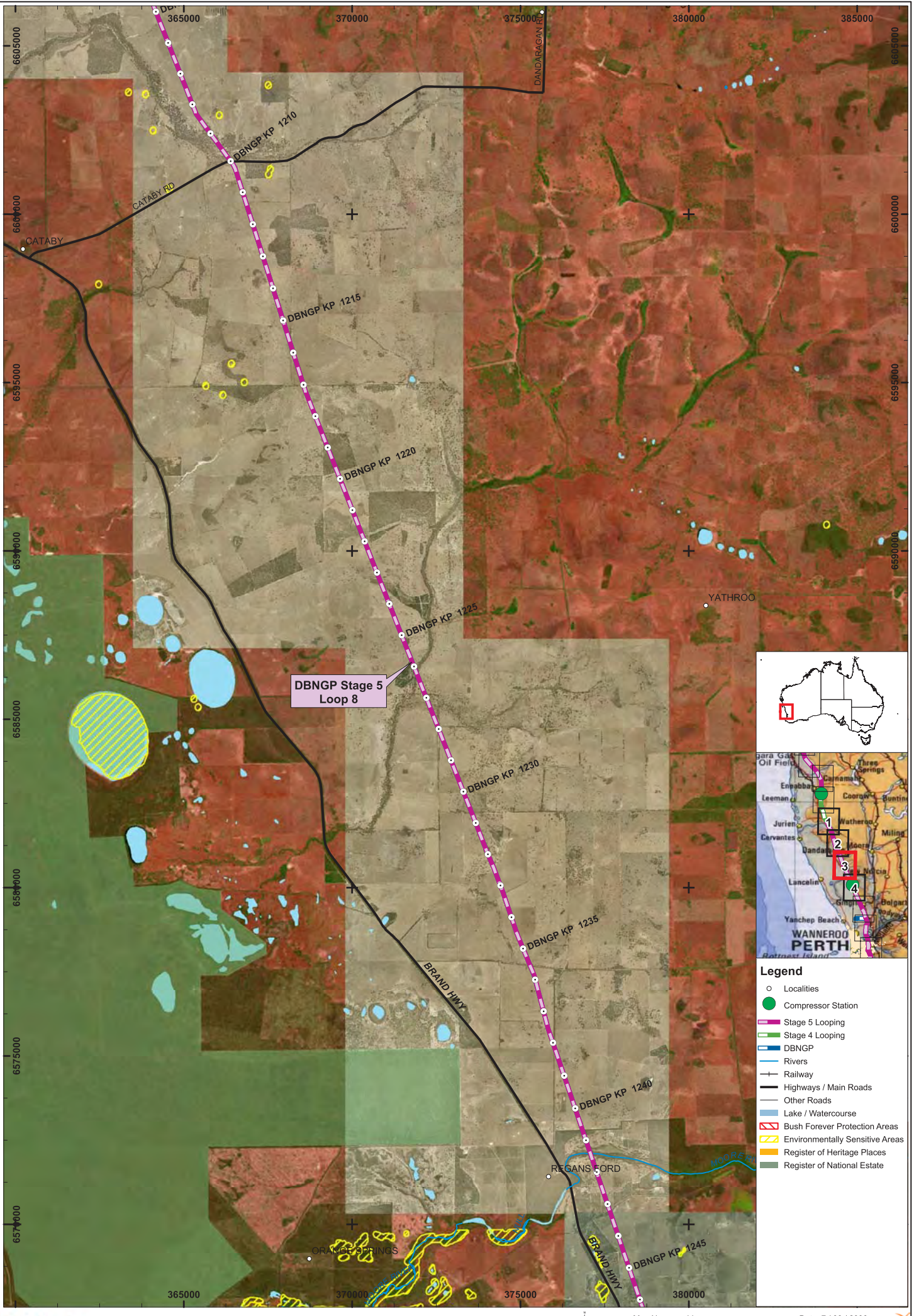
0 500 1,000 2,000 3,000 4,000

Metres

Map 43. DBNGP Expansion CS 8 to CS 9
SHEET 2 of 4

Coordinate System
MGA Zone 50 (GDA94)

Map No: 43
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 2 of 4
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Legend

- Localities
- Compressor Station
- Stage 5 Looping
- Stage 4 Looping
- DBNGP
- Rivers
- Railway
- Highways / Main Roads
- Other Roads
- Lake / Watercourse
- Bush Forever Protection Areas
- Environmentally Sensitive Areas
- Register of Heritage Places
- Register of National Estate

Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

Produced by Alinta Asset Management. 321 Ferntree Gully Road Mt Waverley VIC 3149

Alinta

Scale 1: 100 000 (A3)

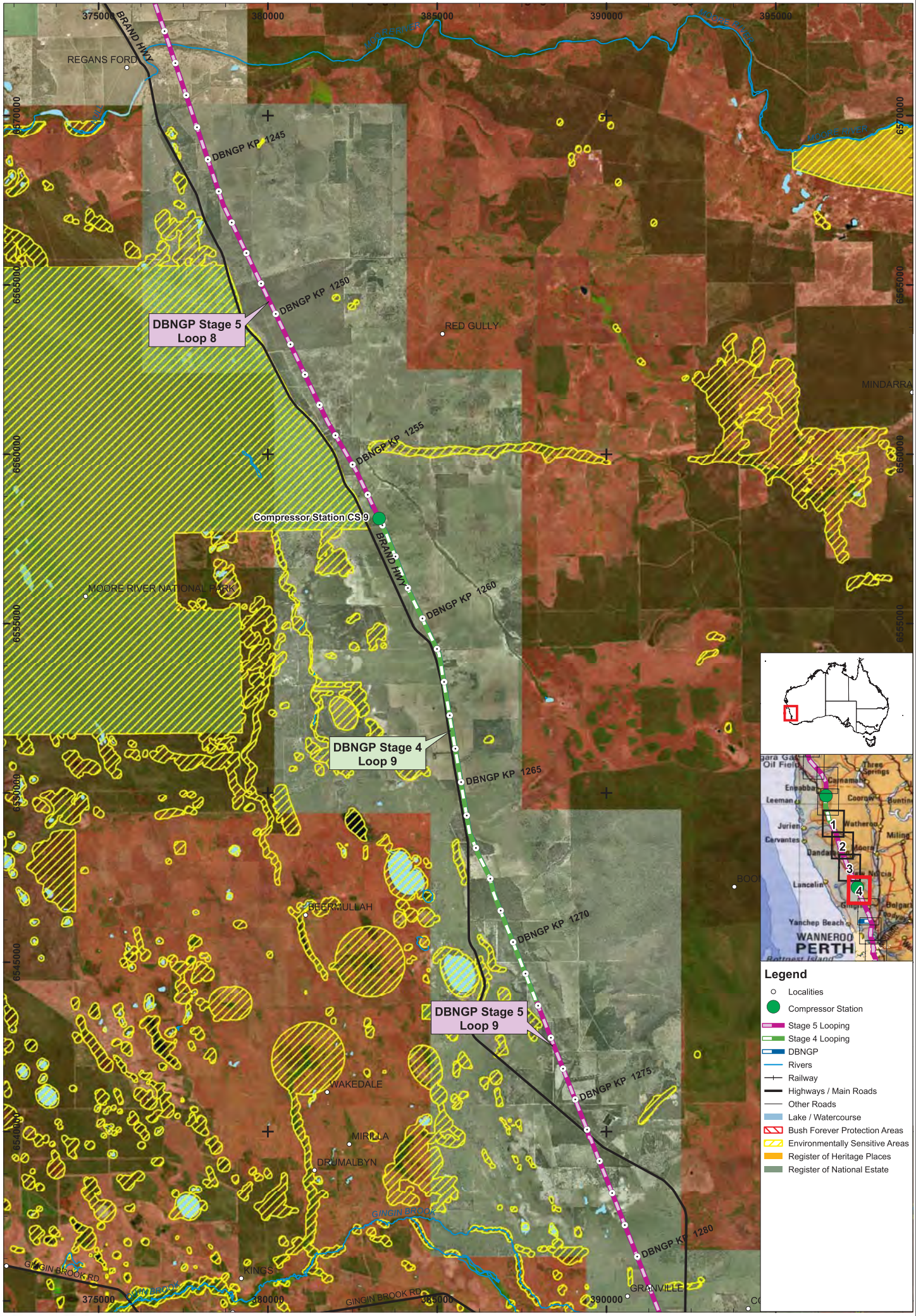
0 500 1,000 2,000 3,000 4,000

Metres

Map 44. DBNGP Expansion CS 8 to CS 9
SHEET 3 of 4

Coordinate System
MGA Zone 50 (GDA94)

Map No: 44
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 3 of 4
GDA
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

Produced by Alinta Asset Management. 321 Ferntree Gully Road Mt Waverley VIC 3149

Alinta

Scale 1: 100 000 (A3)

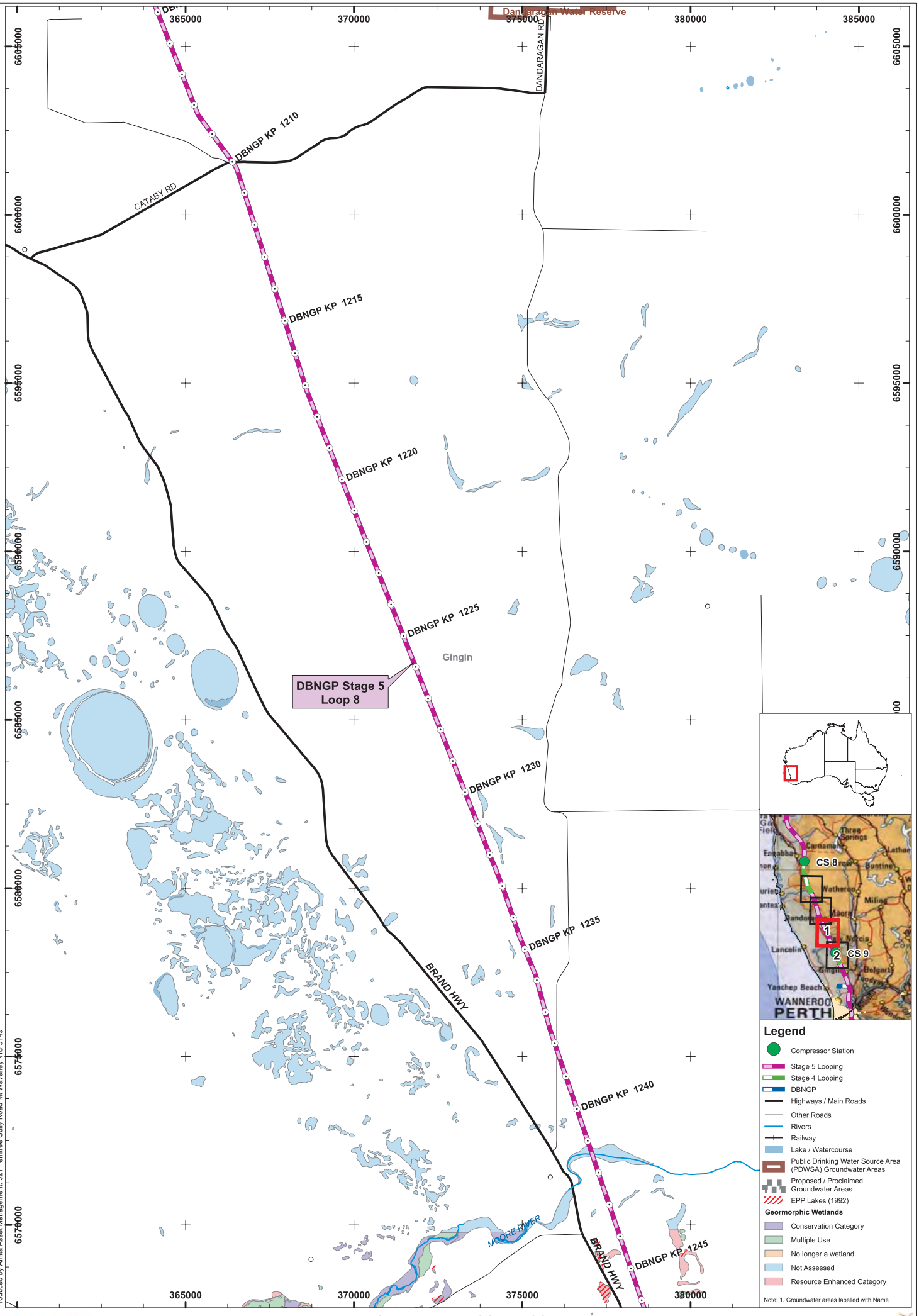
0 500 1,000 2,000 3,000 4,000

Metres

Map 45. DBNGP Expansion CS 8 to CS 9
SHEET 4 of 4

Coordinate System
MGA Zone 50 (GDA94)

Map No: 45
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 4 of 4
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

Produced by Alinta Asset Management. 321 Ferntree Gully Road Mt Waverley VIC 3149

Alinta

Scale 1: 100 000 (A3)

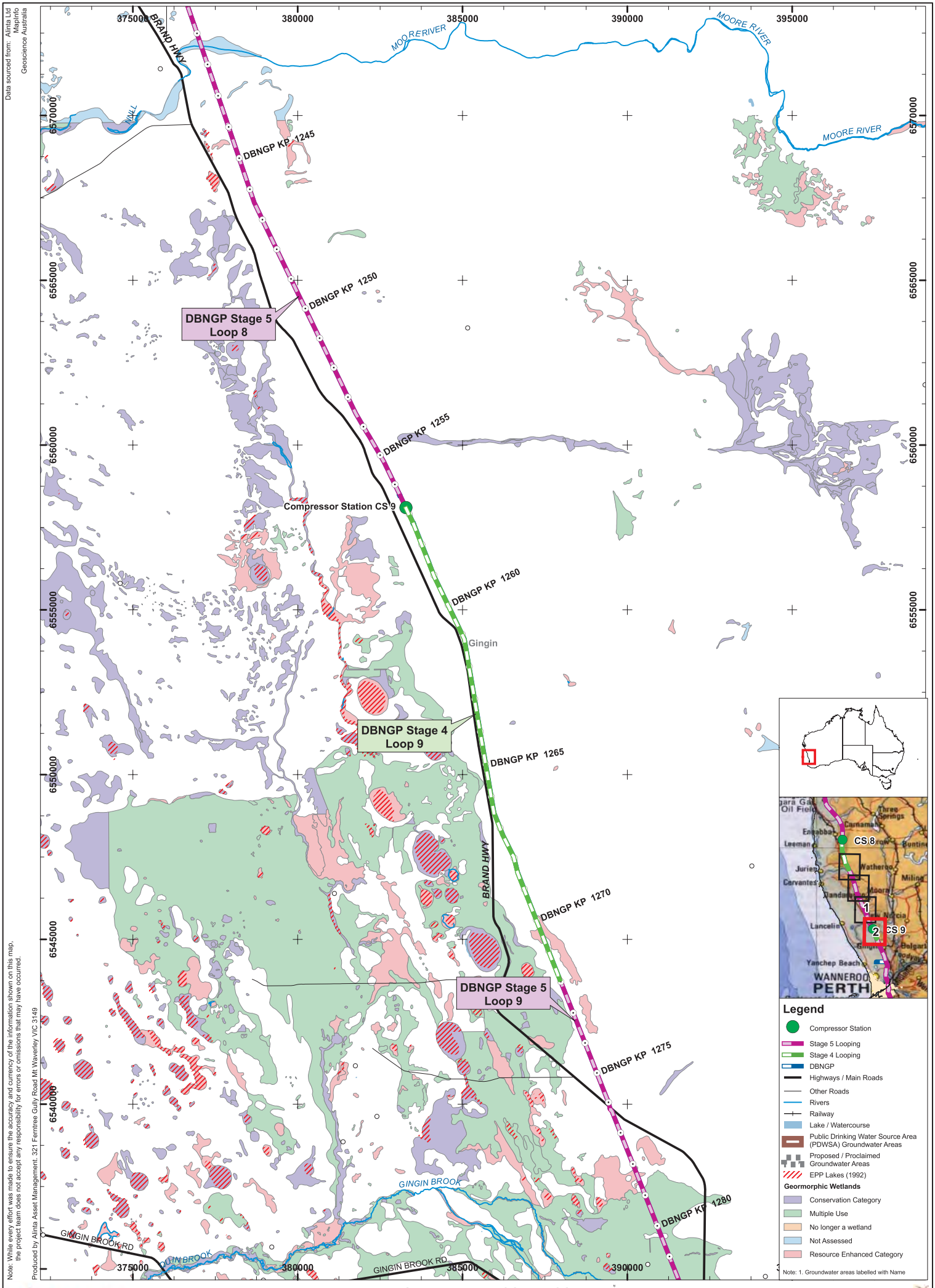
0 500 1,000 2,000 3,000 4,000

Metres

Map 46. DBNGP Expansion CS 8 to CS 9 Groundwater and Wetlands 1 of 2

Coordinate System
MGA Zone 50 (GDA94)

Map No: 46
Map Revision: 0
Date: 06 / 09 / 2006
Sheet: 1 of 2
Project File: DBNGP Expansion - Groundwater and Wetlands.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

Produced by Alinta Asset Management. 321 Ferntree Gully Road Mt Waverley VIC 3149

Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

Metres

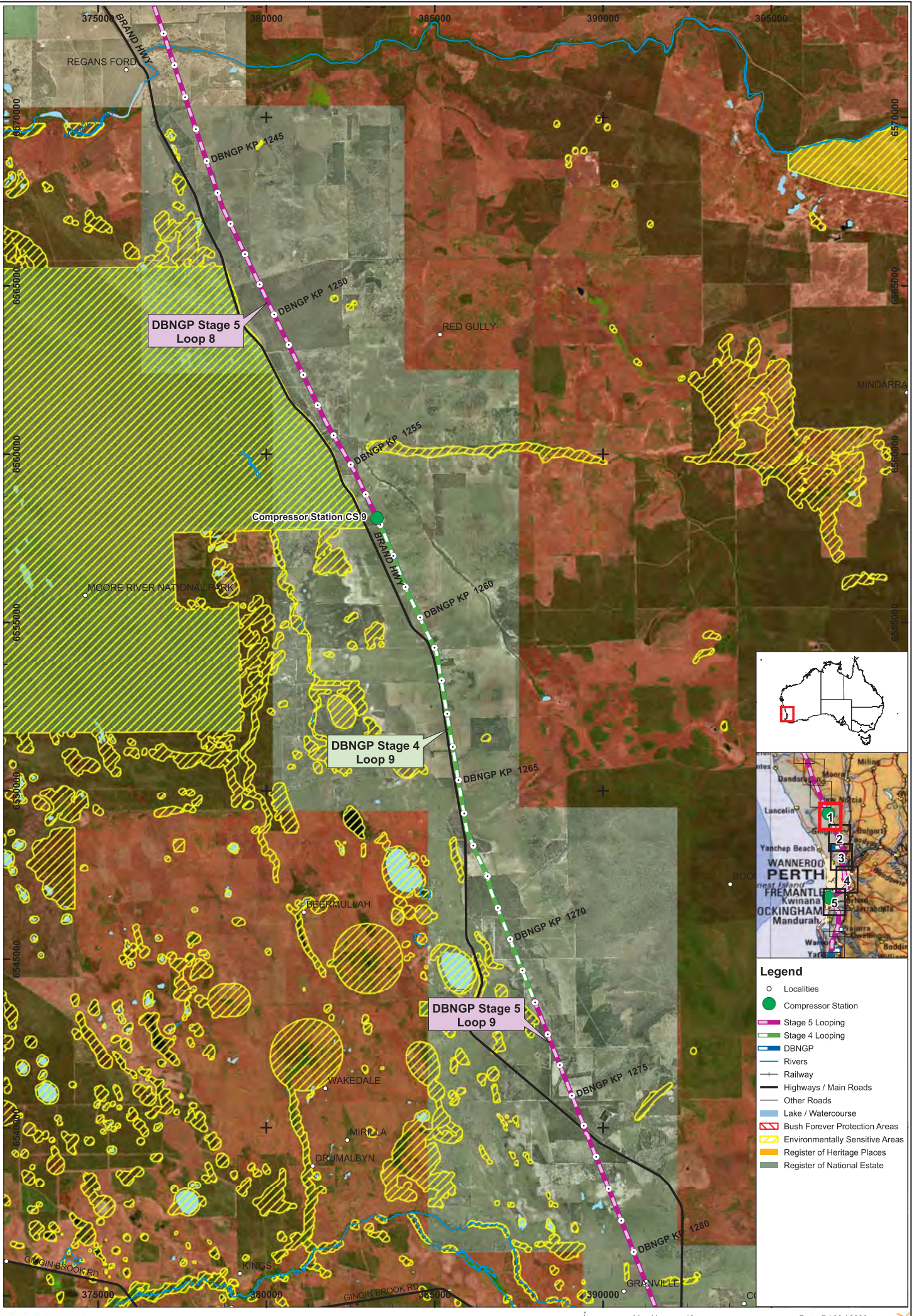
Map 47. DBNGP Expansion CS 8 to CS 9 Groundwater and Wetlands 2 of 2

Coordinate System
MGA Zone 50 (GDA94)

Map No: 47
Map Revision: 0
Date: 06 / 09 / 2006
Sheet: 2 of 2
GDA

Project File: DBNGP Expansion - Groundwater and Wetlands.mxd

Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

Produced by Alinta Asset Management. 321 Ferntree Gully Road Mt Waverley VIC 3149

Alinta

Scale 1: 100 000 (A3)

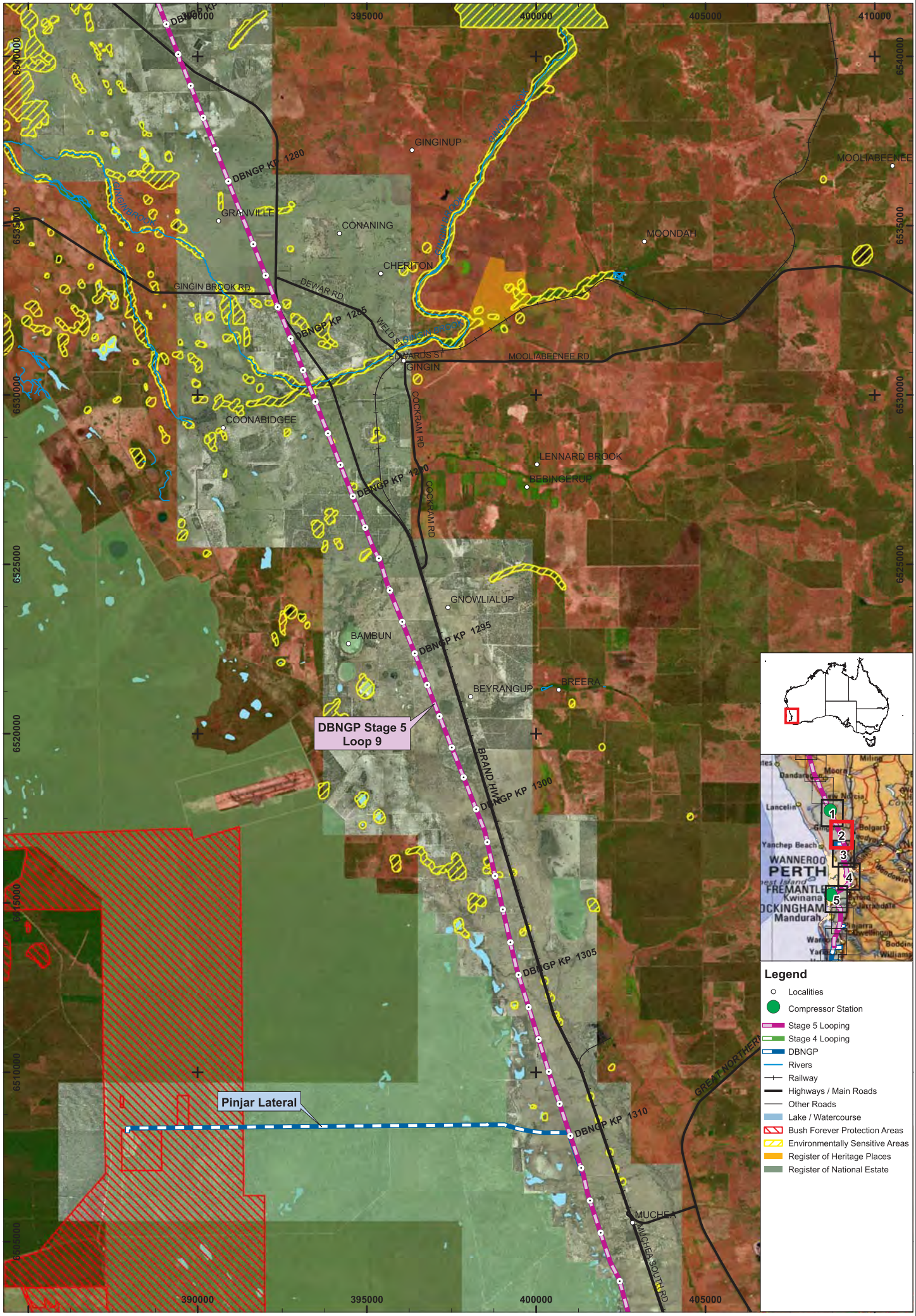
0 500 1,000 2,000 3,000 4,000

Metres

Map 48. DBNGP Expansion CS 9 to CS 10
SHEET 1 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 48
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 1 of 5
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

Produced by Alinta Asset Management. 321 Ferntree Gully Road Mt Waverley VIC 3149

Alinta

Scale 1: 100 000 (A3)

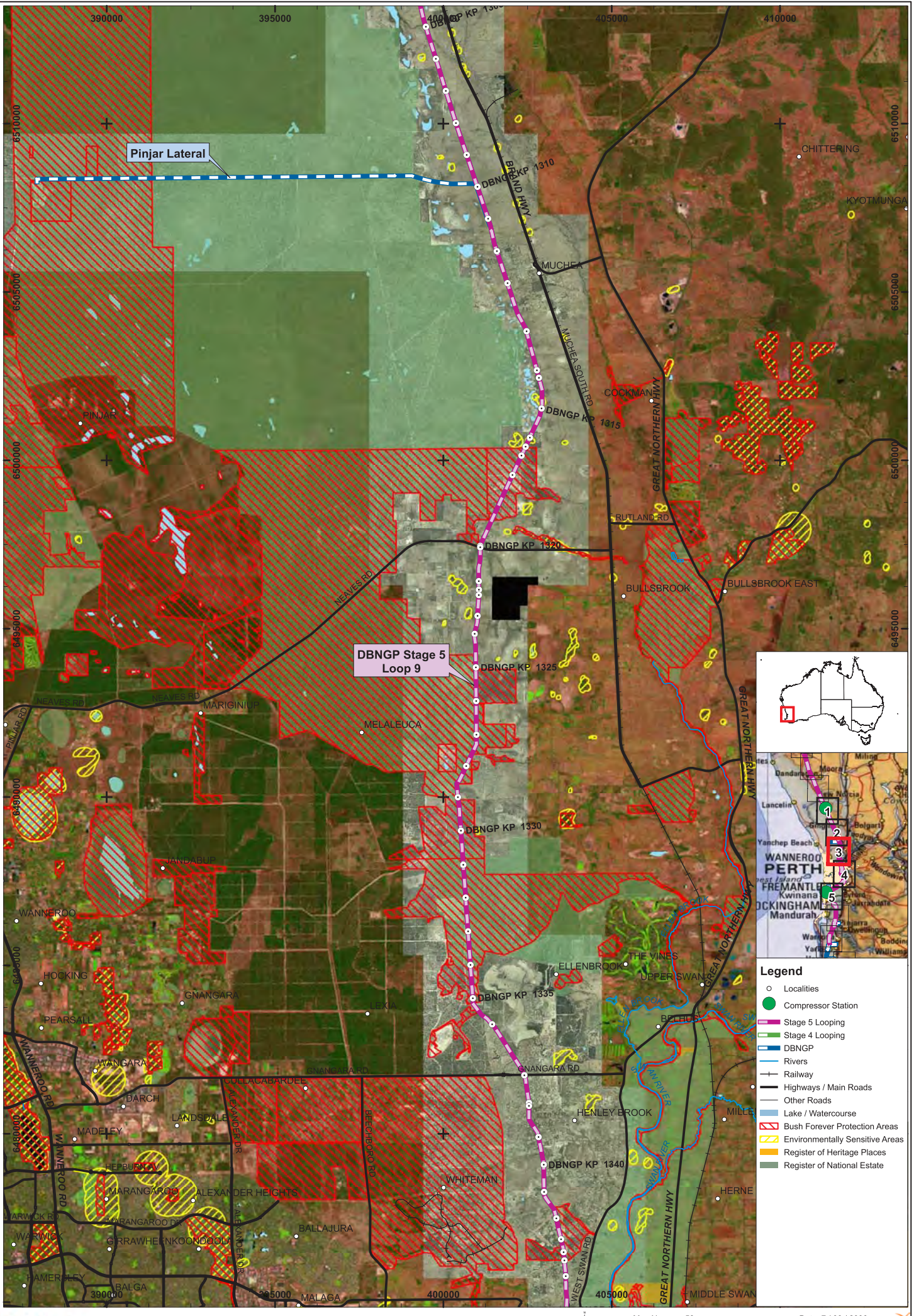
0 500 1,000 2,000 3,000 4,000

Metres

Map 49. DBNGP Expansion CS 9 to CS 10
SHEET 2 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 49
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 2 of 5
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

Produced by Alinta Asset Management. 321 Ferntree Gully Road Mt Waverley VIC 3149

Alinta

Scale 1: 100 000 (A3)

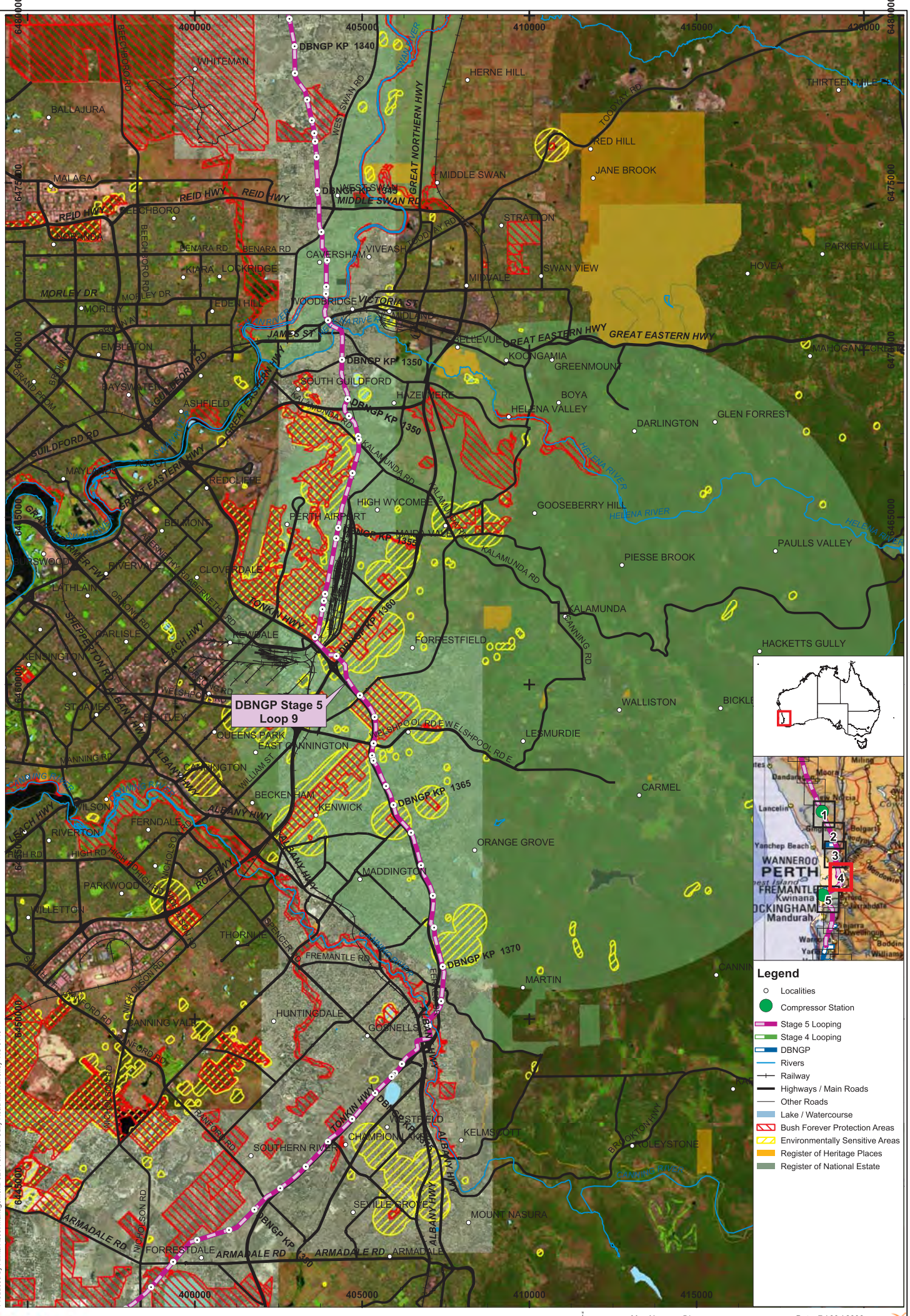
0 500 1,000 2,000 3,000 4,000

Metres

Map 50. DBNGP Expansion CS 9 to CS 10
SHEET 3 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 50
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 3 of 5
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

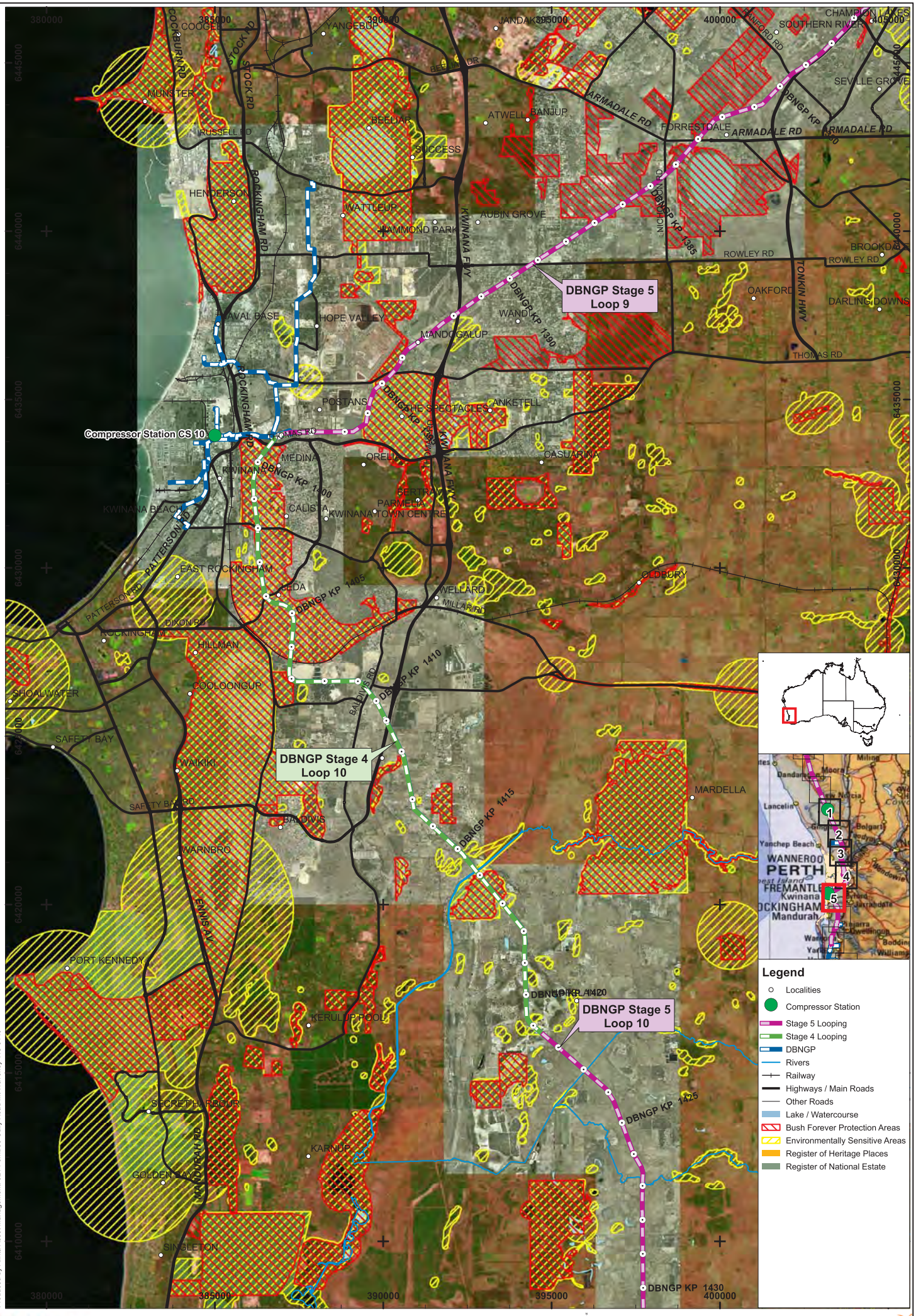
Metres

Map 51. DBNGP Expansion CS 9 to CS 10
SHEET 4 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 51
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 4 of 5
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

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Alinta

Scale 1: 100 000 (A3)

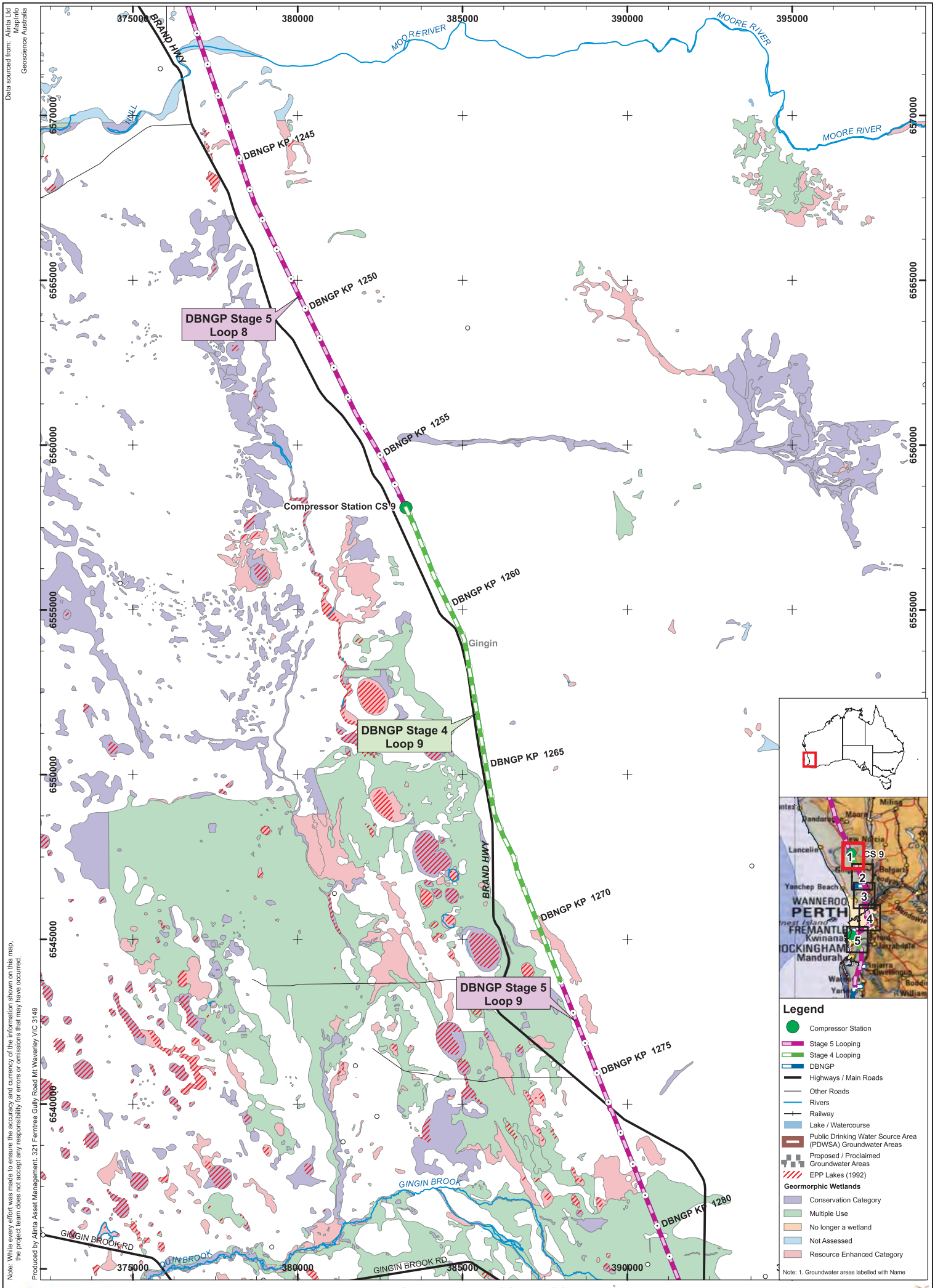
0 500 1,000 2,000 3,000 4,000

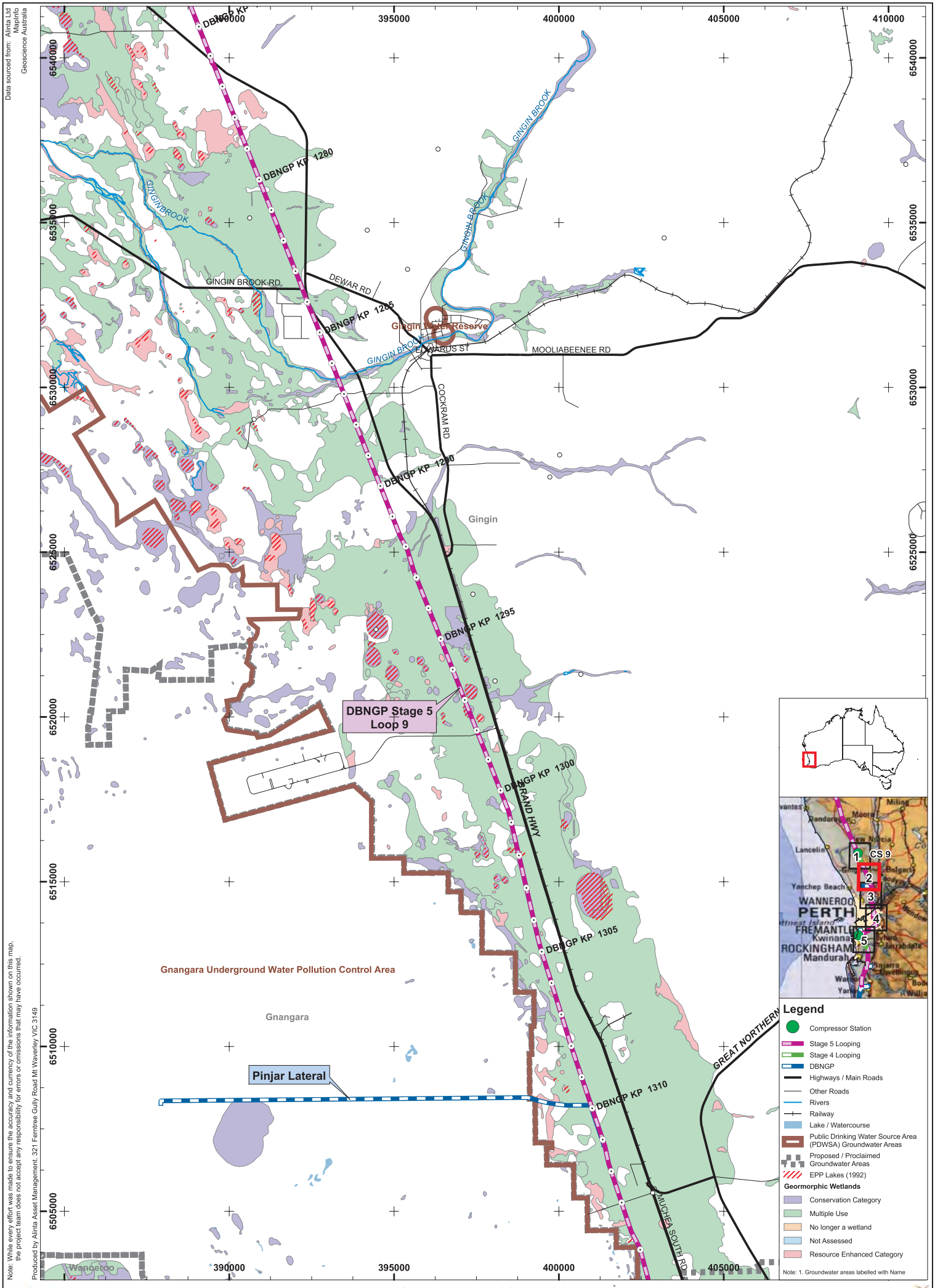
Metres

Map 52. DBNGP Expansion CS 9 to CS 10
SHEET 5 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 52
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 5 of 5
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006


Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia
375000
380000
385000
390000
395000
6570000
6565000
6560000
6555000
6550000
6545000
6540000
BRAND HWY
MOORE RIVER
NWL
DBNGP KP 1245
DBNGP KP 1250
DBNGP KP 1255
DBNGP KP 1260
DBNGP KP 1265
DBNGP KP 1270
DBNGP KP 1275
DBNGP KP 1280
DBNGP Stage 5 Loop 8
Compressor Station CS 9
Gingin
DBNGP Stage 4 Loop 9
DBNGP Stage 5 Loop 9
GINGIN BROOK
GINGIN BROOK RD
Legend
Compressor Station
Stage 5 Looping
Stage 4 Looping
DBNGP
Highways / Main Roads
Other Roads
Rivers
Railway
Lake / Watercourse
Public Drinking Water Source Area (PDWSA) Groundwater Areas
Proposed / Proclaimed Groundwater Areas
EPP Lakes (1992)
Geormorphic Wetlands
Conservation Category
Multiple Use
No longer a wetland
Not Assessed
Resource Enhanced Category
Note: 1. Groundwater areas labelled with Name
Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.
Produced by Alinta Asset Management. 321 Ferntree Gully Road Mt Waverley VIC 3149
Scale 1: 100 000 (A3)
0 500 1,000 2,000 3,000 4,000
Metres
Coordinate System
MGA Zone 50 (GDA94)
Map 53. DBNGP Expansion CS 9 to CS 10
Groundwater and Wetlands
Sheet 1 of 5
Map No: 53
Map Revision: 0
Date: 06 / 09 / 2006
Sheet: 1 of 5
Project File: DBNGP Expansion - Groundwater and Wetlands.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006
GDA



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

Produced by Alinta Asset Management. 321 Ferntree Gully Road Mt Waverley VIC 3149

Alinta

Scale 1: 100 000 (A3)

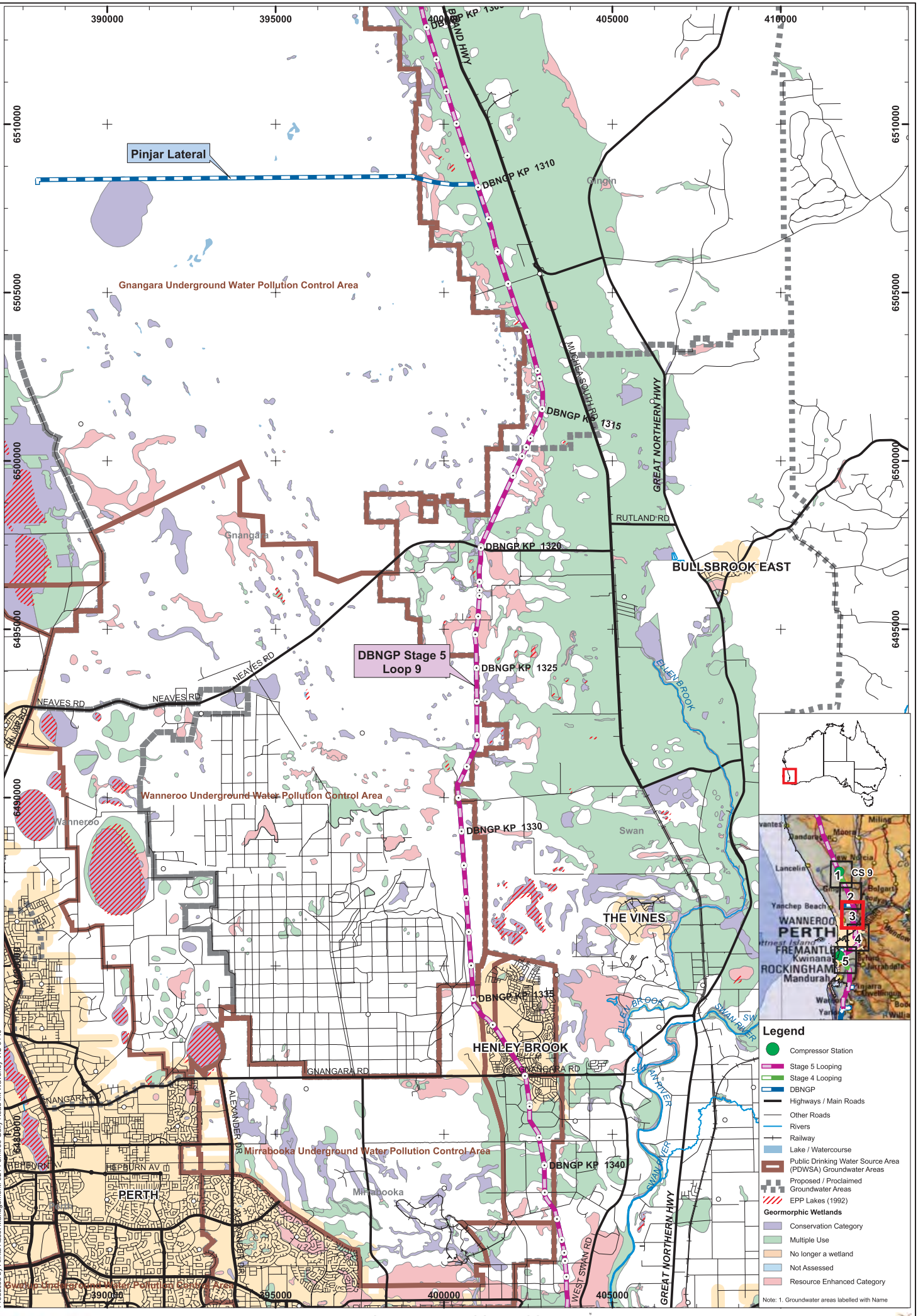
0 500 1,000 2,000 3,000 4,000

Metres

Map 54. DBNGP Expansion CS 9 to CS 10 Groundwater and Wetlands 2 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 54
Map Revision: 0
Date: 06 / 09 / 2006
Sheet: 2 of 5
Project File: DBNGP Expansion - Groundwater and Wetlands.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

Produced by Alinta Asset Management. 321 Ferntree Gully Road Mt Waverley VIC 3149

Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

Metres

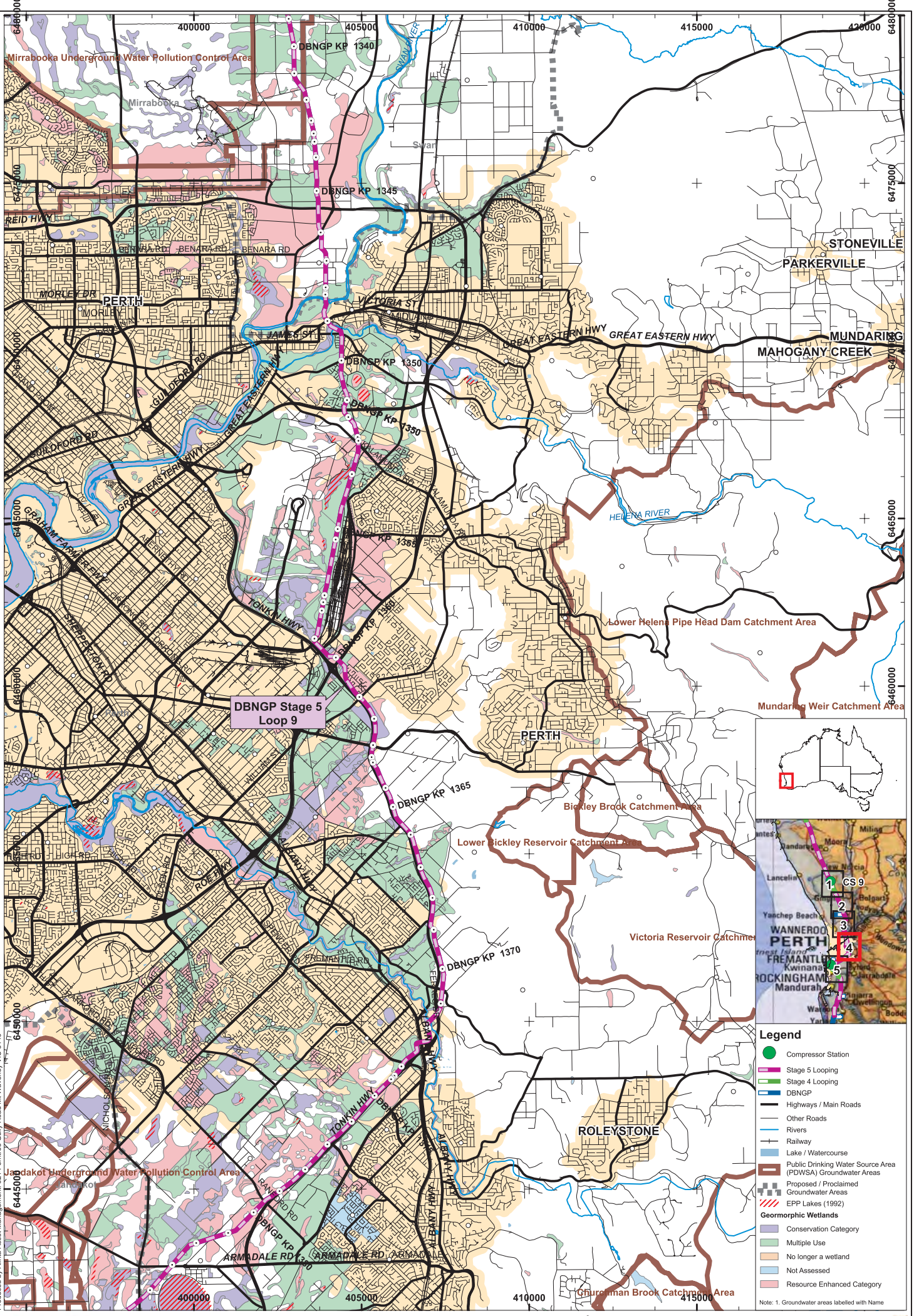
Map 55. DBNGP Expansion CS 9 to CS 10 Groundwater and Wetlands 3 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 55
Map Revision: 0
Date: 06 / 09 / 2006
Sheet: 3 of 5
GDA

Project File: DBNGP Expansion - Groundwater and Wetlands.mxd

Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

Produced by Alinta Asset Management. 321 Ferntree Gully Road Mt Waverley VIC 3149

Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

Metres

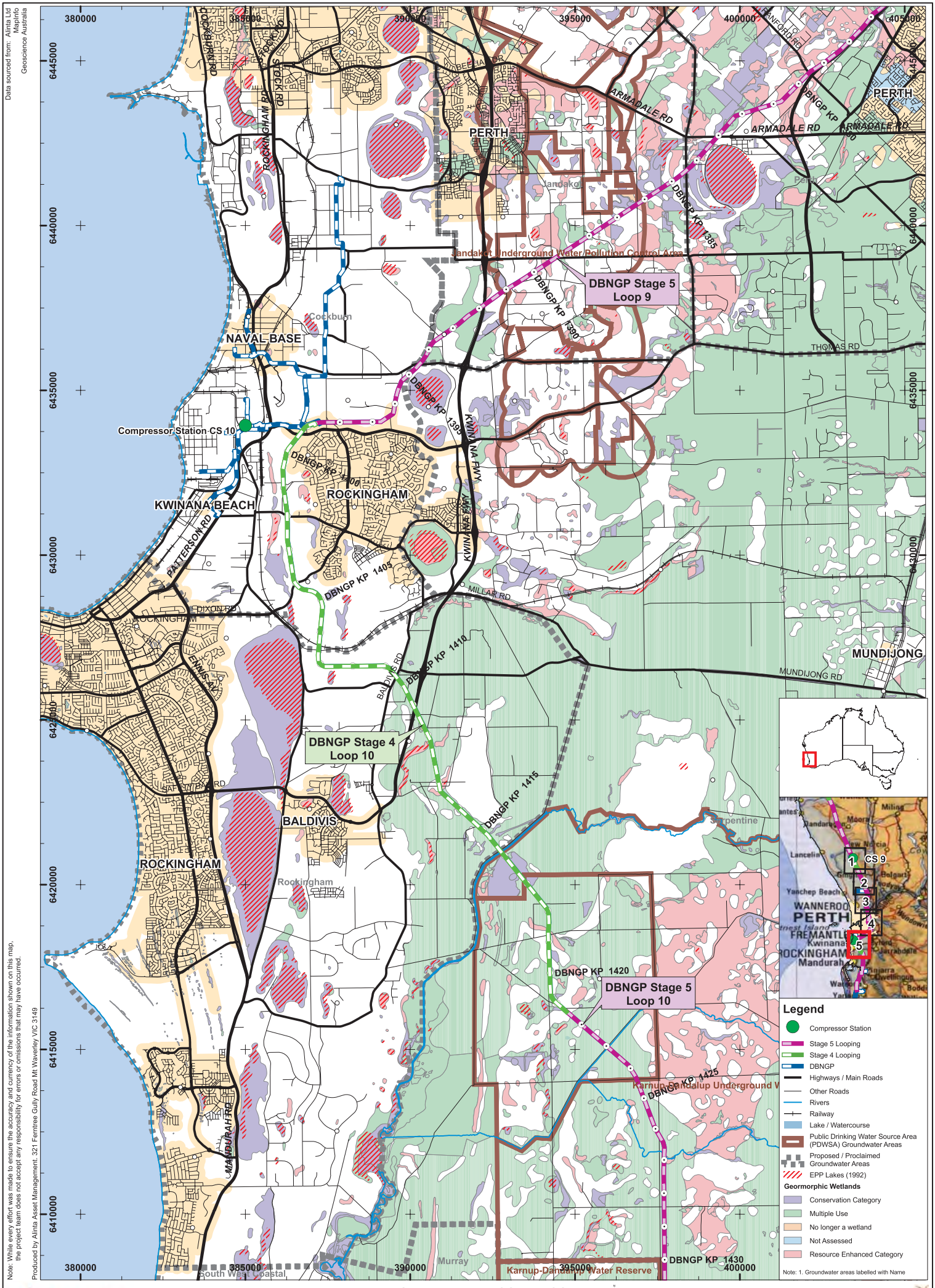
Map 56. DBNGP Expansion CS 9 to CS 10 Groundwater and Wetlands Sheet 4 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 56
Map Revision: 0
Date: 06 / 09 / 2006
Sheet: 4 of 5
GDA

Project File: DBNGP Expansion - Groundwater and Wetlands.mxd

Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

Produced by Alinta Asset Management. 321 Ferntree Gully Road Mt Waverley VIC 3149

Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

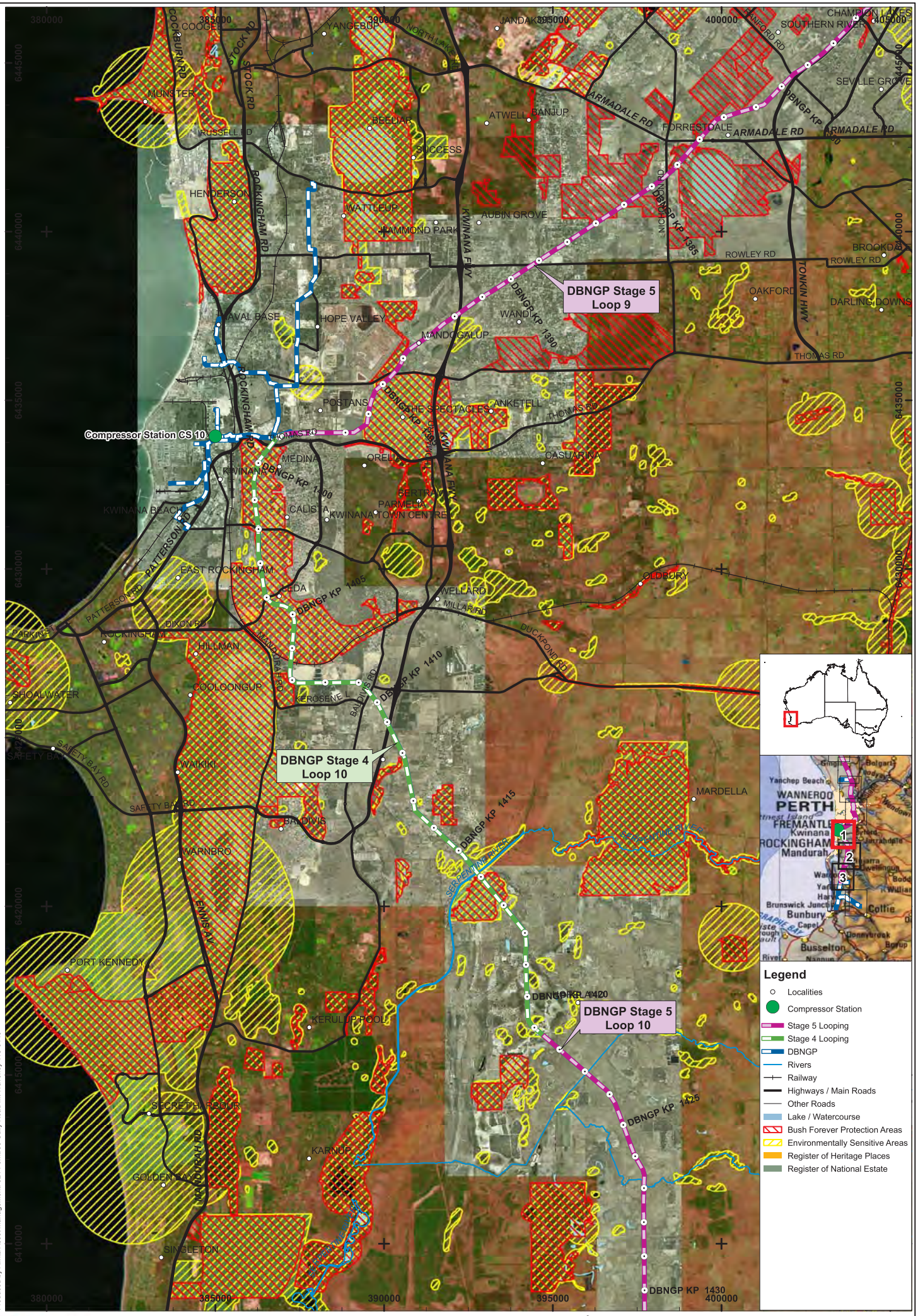
Metres

Map 57. DBNGP Expansion CS 9 to CS 10 Groundwater and Wetlands Sheet 5 of 5

Coordinate System
MGA Zone 50 (GDA94)

Map No: 57
Map Revision: 0
Date: 06 / 09 / 2006
Sheet: 5 of 5
Project File: DBNGP Expansion - Groundwater and Wetlands.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006

GDA



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

Produced by Alinta Asset Management. 321 Ferntree Gully Road Mt Waverley VIC 3149

Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

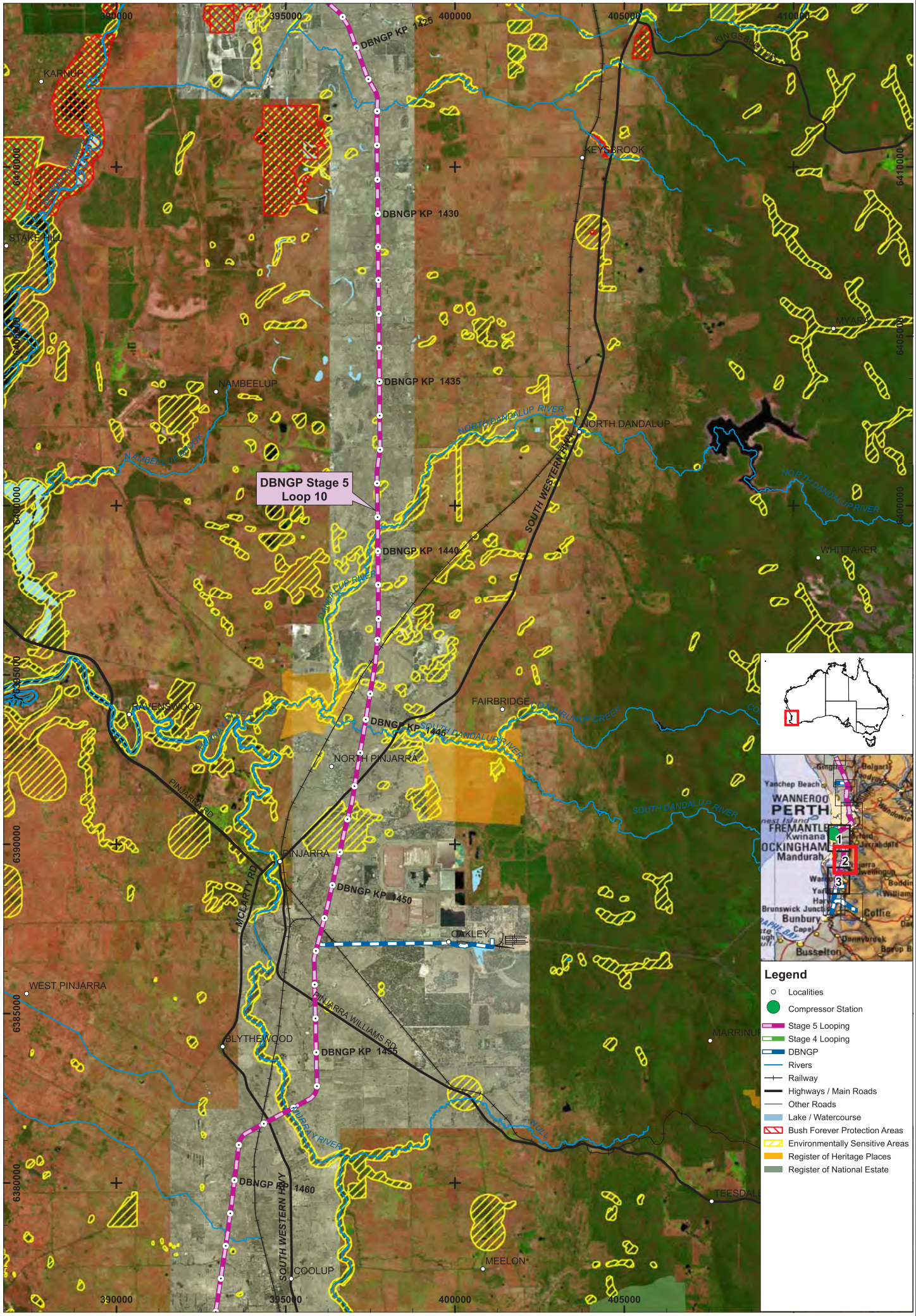
Metres

Map 58. DBNGP Expansion CS 10 to End
SHEET 1 of 3

Coordinate System
MGA Zone 50 (GDA94)

Map No: 58
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 1 of 3
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

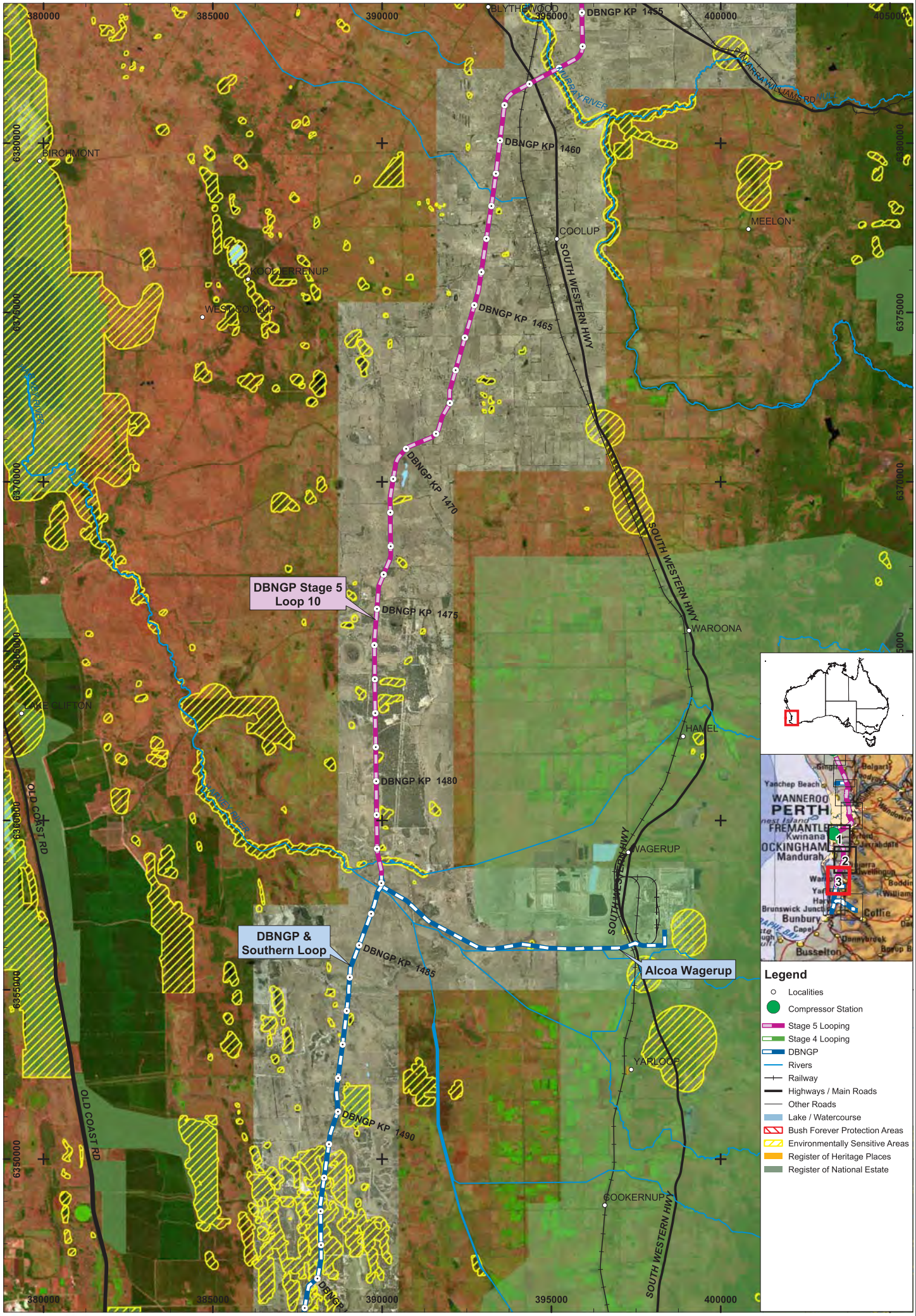
Metres

Map 59. DBNGP Expansion CS 10 to End
SHEET 2 of 3

Coordinate System
MGA Zone 50 (GDA94)

Map No: 59
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 2 of 3
Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006

GDA



Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

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Alinta

Scale 1: 100 000 (A3)

0 500 1,000 2,000 3,000 4,000

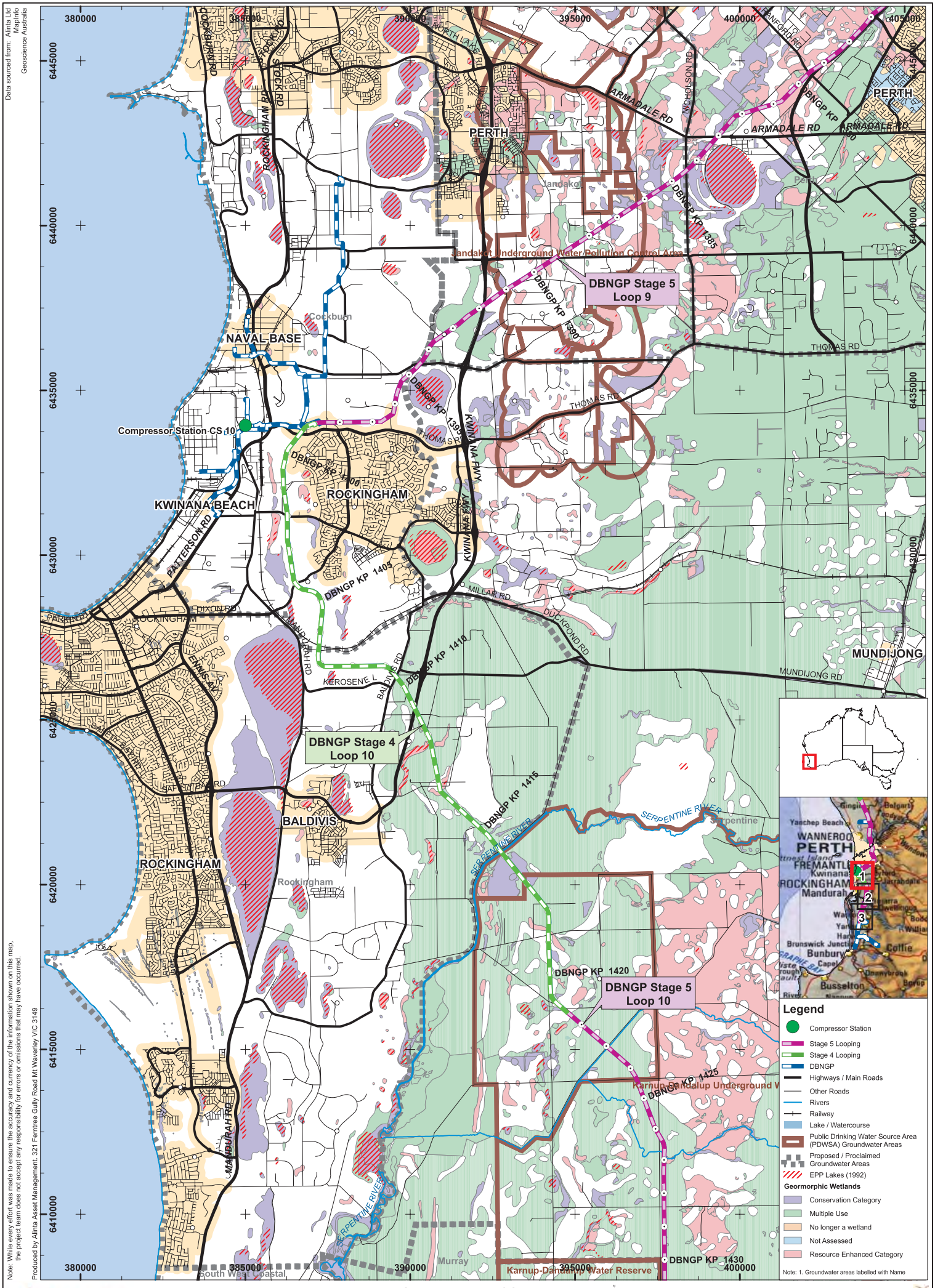
Metres

Map 60. DBNGP Expansion CS 10 to End
SHEET 3 of 3

Coordinate System
MGA Zone 50 (GDA94)

Map No: 60
Map Revision: 0
Date: 7 / 09 / 2006
Sheet: 3 of 3
GDA

Project File: DBNGP Expansion ARI Site Plan - Existing Environment.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

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Alinta

Scale 1: 100 000 (A3)

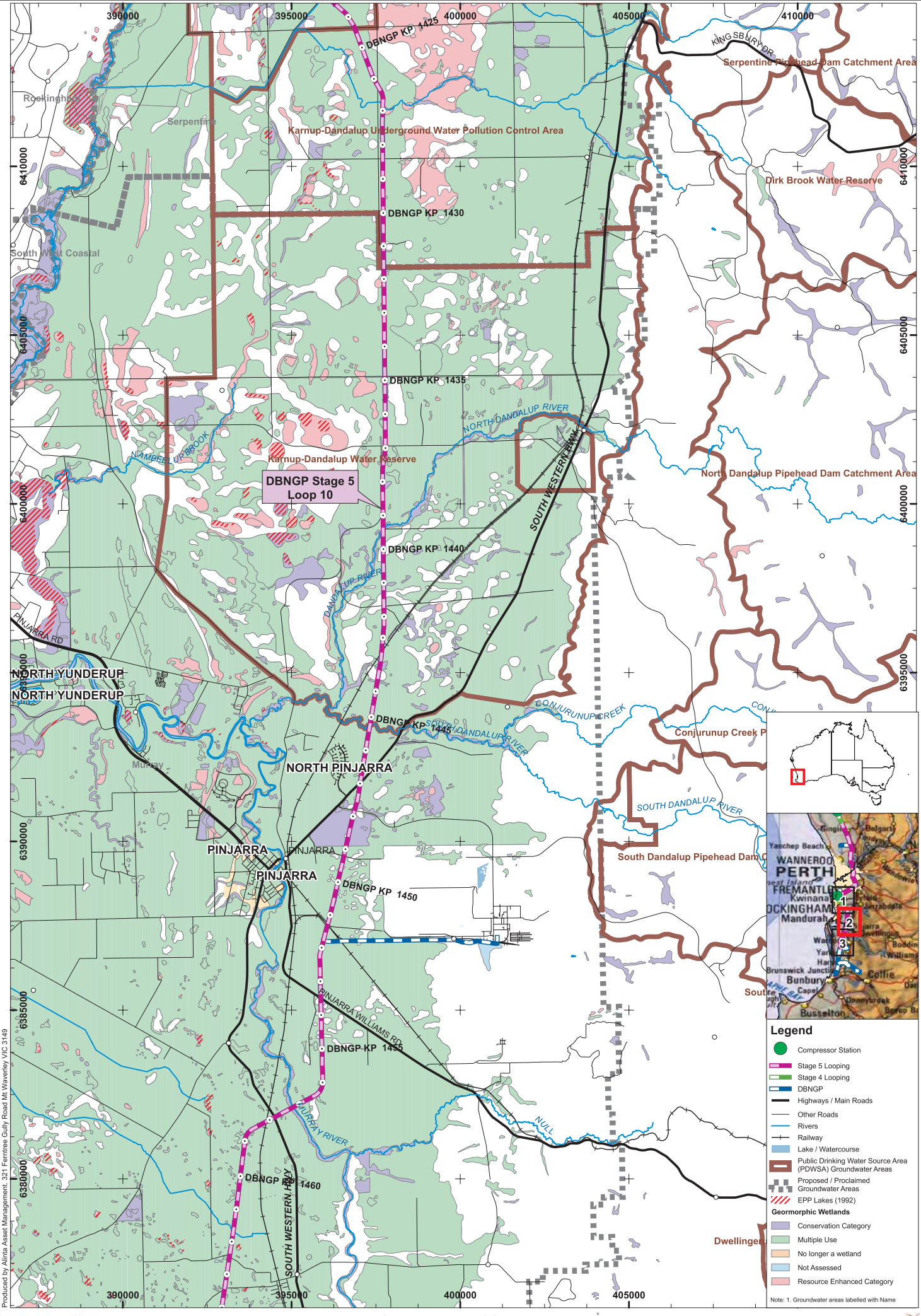
0 500 1,000 2,000 3,000 4,000

Metres

Map 61. DBNGP Expansion CS 10 to End Groundwater and Wetlands Sheet 1 of 3

Coordinate System
MGA Zone 50 (GDA94)

Map No: 61
Map Revision: 0
Date: 06 / 09 / 2006
Sheet: 1 of 3
Project File: DBNGP Expansion - Groundwater and Wetlands.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006



Data sourced from: Alinta Ltd, MapInfo, Geoscience Australia

Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.

Produced by Alinta Asset Management. 321 Ferntree Gully Road Mt Waverley VIC 3149

Alinta

Scale 1: 100 000 (A3)

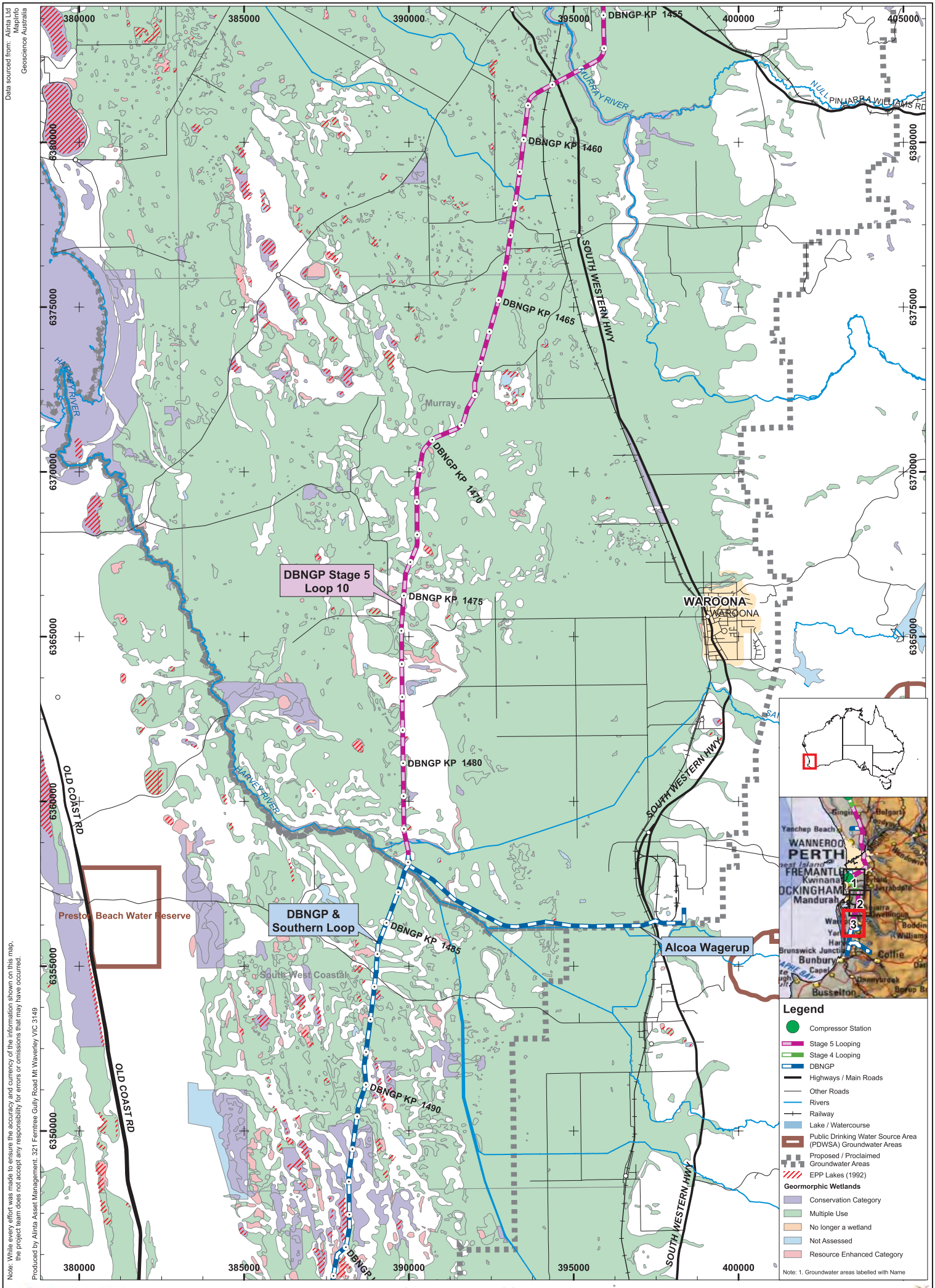
0 500 1,000 2,000 3,000 4,000

Metres

Map 62. DBNGP Expansion CS 10 to End Groundwater and Wetlands Sheet 2 of 3

Coordinate System
MGA Zone 50 (GDA94)

Map No: 62
Map Revision: 0
Date: 06 / 09 / 2006
Sheet: 2 of 3
Project File: DBNGP Expansion - Groundwater and Wetlands.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006


Data sourced from: Alinta Ltd
MapInfo
Geoscience Australia
380000
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6380000
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6360000
6355000
6350000
DBNGP KP 1455
DBNGP KP 1460
DBNGP KP 1465
DBNGP KP 1470
DBNGP KP 1475
DBNGP KP 1480
DBNGP KP 1485
DBNGP KP 1490
DBNGP KP 1495
MURRAY RIVER
NULL
PINJARRA WILLIAMS RD
SOUTH WESTERN HWY
HARVEY RIVER
Murray
DBNGP Stage 5
Loop 10
WAROONA
OLD COAST RD
Preston Beach Water Reserve
DBNGP &
Southern Loop
South West Coastal
Alcoa Wagerup
Legend
Compressor Station
Stage 5 Looping
Stage 4 Looping
DBNGP
Highways / Main Roads
Other Roads
Rivers
Railway
Lake / Watercourse
Public Drinking Water Source Area (PDWSA) Groundwater Areas
Proposed / Proclaimed Groundwater Areas
EPP Lakes (1992)
Geormorphic Wetlands
Conservation Category
Multiple Use
No longer a wetland
Not Assessed
Resource Enhanced Category
Note: 1. Groundwater areas labelled with Name
Note: While every effort was made to ensure the accuracy and currency of the information shown on this map, the project team does not accept any responsibility for errors or omissions that may have occurred.
Produced by Alinta Asset Management. 321 Ferntree Gully Road Mt Waverley VIC 3149
Alinta
Scale 1: 100 000 (A3)
0 500 1,000 2,000 3,000 4,000
Metres
Map 63. DBNGP Expansion CS 10 to End
Groundwater and Wetlands
Sheet 3 of 3
Coordinate System
MGA Zone 50 (GDA94)
Map No: 63
Map Revision: 0
Date: 06 / 09 / 2006
Sheet: 3 of 3
GDA
Project File: DBNGP Expansion - Groundwater and Wetlands.mxd
Stage 4 Route Rev A 10/06/2005, Stage 5 Route Rev B 19/04/2006