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27. CUMULATIVE IMPACTS

27.1. Introduction

This chapter addresses Section 7 of the ToR and provides clear and concise information on the overall impacts of the Project, and discusses the interrelationship of these impacts in collective terms. Within the Environmental Impact Statement (EIS), Sections 3 to 26 have described the existing environment within and surrounding the Project using information from historical and EIS specific studies/surveys, literature and database searches and information collected through the consultation phases of the Project. These Sections also assessed potential impacts, both positive and negative, individual and cumulative, associated with the Project during construction and operation and have further recommended practical and effective mitigation measures.

The aim of this Section is to:

- identify and describe cause-effect relationships (direct and indirect impacts/effects) using network analysis methods;
- identify valued attributes within the Dawson River Catchment that may be effected by the Project; and
- assess potential cumulative effects of the Project as a whole.

Requirements of relevant State Planning Policies, Environmental Protection Policies (EPPs), National Environmental Protection Measures and the Fitzroy Basin WRP and their application to the Project have been evaluated and discussed at length within the main text of the EIS and are again considered within Chapter.

27.1.1. Cumulative effects of development

Cumulative Impact Assessment (CIA) has been defined, and is applied in this Section, as the analysis of all the effects on an area from one or more activities as they accumulate over time and space (IPENZ, 2000).

Cumulative effects can be different in nature (e.g. additive, synergistic or interactive), larger in magnitude, greater in significance, more long-lasting, and/or greater in spatial extent than is the case with individual effects (IPENZ, 2000). Additionally, the individual impacts from a single development may not be singularly significant on their own, but when combined with other impacts, those effects could become significant (Cooper, 2004).

Additive, synergistic or interactive processes, often termed impact pathways, include:

- incremental effects; where impacts are repeated additions of similar nature (a + a + a + a….); and
- interactive or synergistic effects occur when the resulting impact is different in nature to the individual ones (a + b + c… + n).

Thresholds exist where additional disturbance can result in significant deterioration of resources or ecosystems. Cumulative effects become apparent when such thresholds are breached (Cooper, 2004). The effects may become significant when these impacts:

- occur so frequently in time or so densely in space that they cannot be assimilated (overcome); or
- combine with effects of other activities in a synergistic manner.

Further cumulative effects may occur when there is:

- spatial crowding or temporal overlap between existing development and operations, proposed development and actions;
- repeated removal or addition of resources due to existing and proposed development and operations; and
- repeated alteration of the landscape in the development area (Cooper, 2004).

27.1.2. Cumulative impact assessment in Australia and overseas

Australian law has the ability to regulate cumulative impacts. Prior to the release of the *Cumulative Impacts: A Good Practice Guide for the Australian Coal Mining Industry* (2010), no defined process for CIA existed within Australia. The methodology for this assessment has been based on international best practice guidelines and recent applications of these in Australia and the Good Practice Guide for the Coal Mining Industry.

A review of assessment guidelines from Australia, Canada, USA, Europe and the UK found that there were similar trends in approach from most countries to CIA. The most influential and applicable assessment processes were determined to be the USA and UK systems.

In 1997 the American Council on Environmental Quality (CEQ) produced a handbook titled *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ 1997). At this time CIA was still evolving and in 2002 Senner *et al.* produced a paper which looked at developing a systematic way of applying the CEQ's (1997) CIA process. This approach involved five parts, in the following sequence:

1) Scoping: Identify issues, resource components, and boundaries;
2) Organizing: Describe the affected environment, predicted direct and indirect effects, and external influences;
3) Screening: Identify potential cumulative effects;
4) Evaluating: Determine significance and whether beneficial or adverse; and
5) Mitigating: Monitoring and adaptive management.

In the UK, methodologies for integrating cumulative impact assessments into Environmental Impact Assessments (EIAs) are available from the Environment Agency UK with Cooper (2004) being one of the most recently prepared guidelines. The CIA process at a strategic level as outlined by Cooper (2004) involved five parts, in the following sequence:

1) Scoping;
2) Establish baseline conditions;
3) Identify and assess potential cumulative effects;
4) Mitigation measures; and
5) Monitoring.

In the Australian context, the Coal Mining Industry guide (2010) outlines a three phased process including:

1) Scoping – identifying alternatives, establishing spatial and temporal boundaries, considering adaptive capacity, forecasting planning and future developments;
2) Profiling – including baseline studies pre impact, reflection on historical trends, identification of existing cumulative impacts; and
3) Predicative Assessment – identifying and predicting cumulative impacts, evaluating the scale and significance of impacts, considering these potential impacts in the context of both the present and future environment.

27.2. CIA methodology

The CIA methodology adopted herein is a combination of approaches used in the USA, UK and Australia and involves the following stages:

1) *Scoping:* Identify issues, define assessment boundaries and valued attributes;
2) *Establish Baseline Conditions:* Describe the environmental characteristics of the areas likely to be significantly affected;
3) *Screening*: Identify potential cumulative effects on valued attributes. This task involved:
4) review of potential future projects within the Project area;
5) understanding of potential cumulative impact pathways; and
6) *Evaluation and Mitigation*: Determine Significance and Whether Beneficial or Adverse, Determine appropriate mitigation measures if and where required.

Each of these tasks is discussed in detail below.

27.2.1. Scoping

27.2.1.1. Identification of issues

The first step in the scoping phase involves identifying potential issues or impacts, positive and negative, direct and indirect. This has been undertaken through the risk assessment and management framework process, developed for the Project, described in Section 1.9.3. This framework enabled the technical authors of each Section (Chapters 3 to 26) to identify, prioritise, manage and compare the environmental, social and economic risks (as relevant), associated with each aspect of the Project. It is based on criteria developed in accordance with Australia/New Zealand ISO/AS/NZS 31000:2009 Risk Management: Principles and guidelines and HB436:2004 Risk Management Guidelines. The risk analysis criteria developed specifically for the EIS provides a semi-quantitative analysis. These specific assessments and results are presented in each relevant section of the EIS.

27.2.1.2. Establishment of boundaries

An assessment of potential cumulative risks and opportunities has been undertaken by focusing on activities occurring within three spatial areas associated with the Project:

1) Dawson catchment;
2) dam construction footprint; water storage area and associated infrastructure; and
3) water distribution pipeline.

The two temporal timeframes assessed as part of this CIA are defined as follows:

- short term: impacts occurring only within the Project construction timeframe; and
- long term: impacts occurring/continuing post construction of the Project.

In investigating potential impacts associated with the Project, several different 'study areas' have been defined to reflect the area of influence, i.e. the study area for visual amenity has been defined as the Dawson Valley while the study area for contaminated land has been defined as FSL plus buffer. It is important when evaluating the potential risks and opportunities, discussed later in this chapter, that readers consider these values in the context of these definitions. It should also be noted that this matrix should not be assessed in isolation from the main EIS. This is because these values have been assigned in the context of the detailed information presented within each of the relevant EIS chapters. This matrix provides an overview only and has been used here as a tool to clearly and concisely show potential impacts associated with the Project.

As mentioned earlier, potential risks and opportunities have been assessed at both a local and regional scale. As with the term 'study area', these definitions also vary somewhat to best reflect the potential extent of impact. These definitions are described in Table 27-1 below.

Table 27-1 Local and Regional Scale Definition

Attribute	Local Scale	Regional Scale
Air	The area approximately 5 km from the activity	The broader Fitzroy and Condamine Basins up to approximately 50 km from the activity
Noise and Vibration	The immediate vicinity of the activity and the dam	The Central Queensland Region
Transport and Access	The local road network	District and regional road network including highways
Land Contamination	The Project area as well as up to 5 km downstream of the proposed dam wall	The Dawson River catchment both upstream, downstream and within adjacent tributaries
Terrestrial Flora and Fauna	The water storage area	Local government areas and the Brigalow Belt (North and South) and Nandewar bioregions.
Aquatic Flora and Fauna	Site-specific or reach scale	Catchment wide
Soils and Geology, Groundwater	The Project area as well as up to 5km downstream of the proposed dam wall	The Dawson River catchment both upstream, downstream and within adjacent tributaries
Geomorphology	Site-specific or reach scale	Catchment wide
Landscape Character and Visual Amenity	Areas within the immediate vicinity of the activity and of the dam	The Dawson River catchment area

Attribute	Local Scale	Regional Scale
Water Quality	Site-specific or reach scale	Catchment wide
Hydrology	Dam construction footprint Flood Operations: Upstream of Dam wall to Taroom Flow Releases: Immediately downstream of the dam wall	Flood Operations: downstream of the dam wall. Flow Releases: beyond Theodore Weir
Social and Economics	The area surrounding and within the water storage area forms the primary study area for social impact assessment. The primary study area population includes: ■ The communities of Taroom, Cracow and Theodore	The LGAs and towns of Banana Shire Council and Western Downs Regional Council area of Central Queensland have been considered as part of the potential 'catchment' for social impacts and benefits, with broad detail for relevant characteristics provided. .

27.2.1.3. Defining valued attributes

Identification of valued attributes within the Fitzroy / Dawson River Catchment was achieved through the review and consideration of current local and regional strategic plans, in conjunction with available information collected as part of this EIS.

Specifically, the desired environmental outcomes, principles and or objectives for the Project area outlined within the:

- Central Queensland Regional Growth Management Framework;
- local government Planning Schemes; and
- Natural Resource Management (NRM) Regional Plans;

have been used to develop a framework on which to base this assessment.

The objectives outlined within these documents have been discussed at length within the main text of the EIS.

The current Dawson Valley Water Supply Scheme has also been recognised as a valued attribute extending 338 km along the Dawson River from the upstream limit of Glebe Weir to the downstream limit of the Boolburra waterhole, approximately 18 km upstream of the Fitzroy River junction (DNRW, 2009).

Mappable valued attributes have been presented in a series of three figures (Figure 27-1 to Figure 27-3) with the first figure highlighting attributes at a catchment scale and the latter two highlighting attributes at a Project scale.

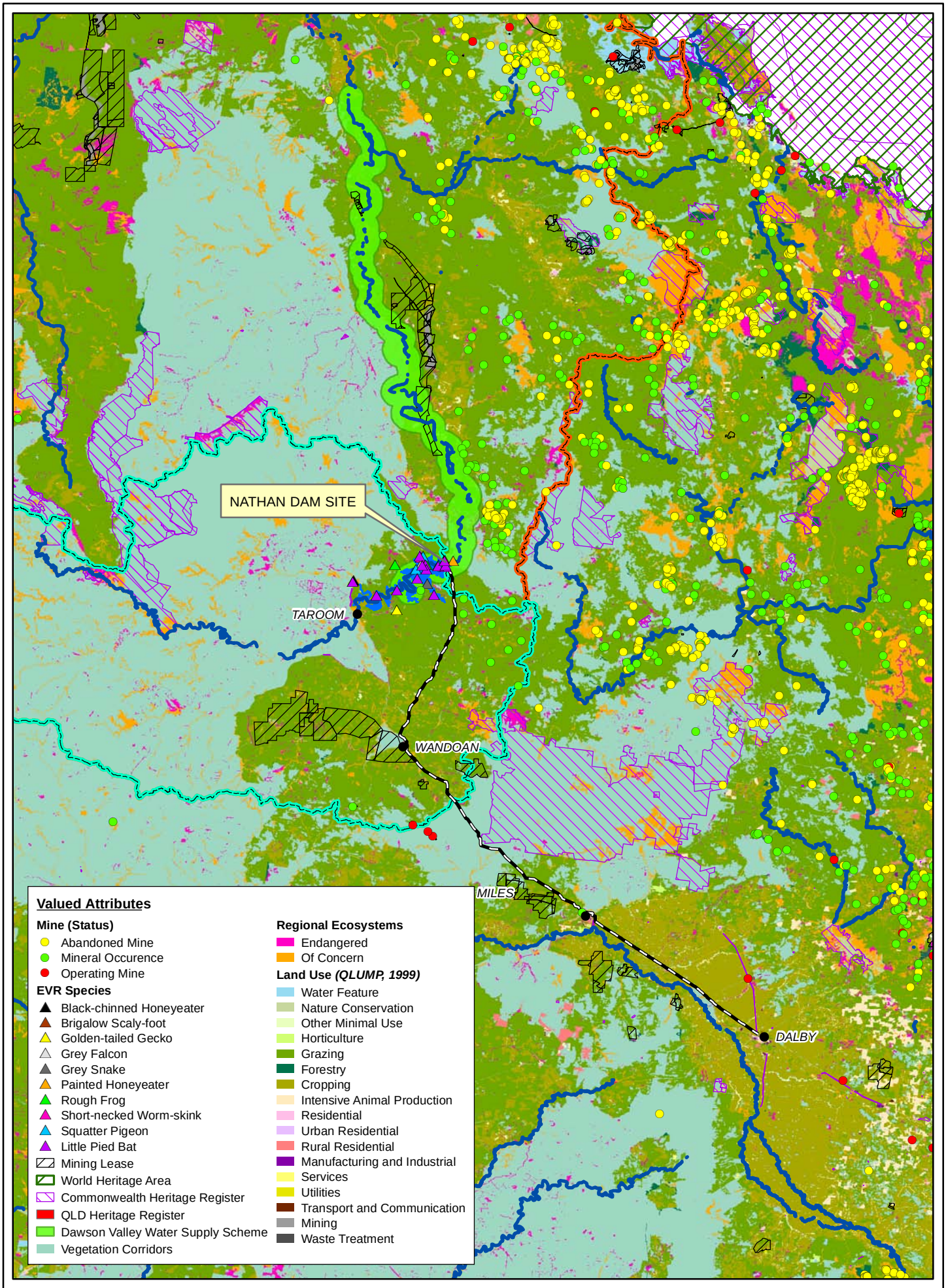
Valued environmental attributes mapped include:

- national and State parks/forests;
- Great Barrier Reef World Heritage Area;
- Shoalwater and Corio Bays Ramsar Wetland (located 60 km north of Fitzroy river mouth);
- dugong protected area;

- fish habitat areas
- EVR species records;
- regional ecological corridors; and
- regional ecosystems.

At the Project scale the following valued attributes have also been mapped:

- Valued resources attributes:
  - mining activities;
  - GQAL; and
  - land use type.
- Valued cultural attributes:
  - local Indigenous heritage (not provided on mapping); and
  - local non-indigenous heritage (Glebe Homestead).



LEGEND

- Town
- Proposed Pipeline
- Major River
- Full Supply Level (183.5m AHD)
- Nathan Catchment
- Fitzroy Catchment

Projection: GDA94 Zone 56

Figure 27-1

0 10 20 40
Kilometres

N

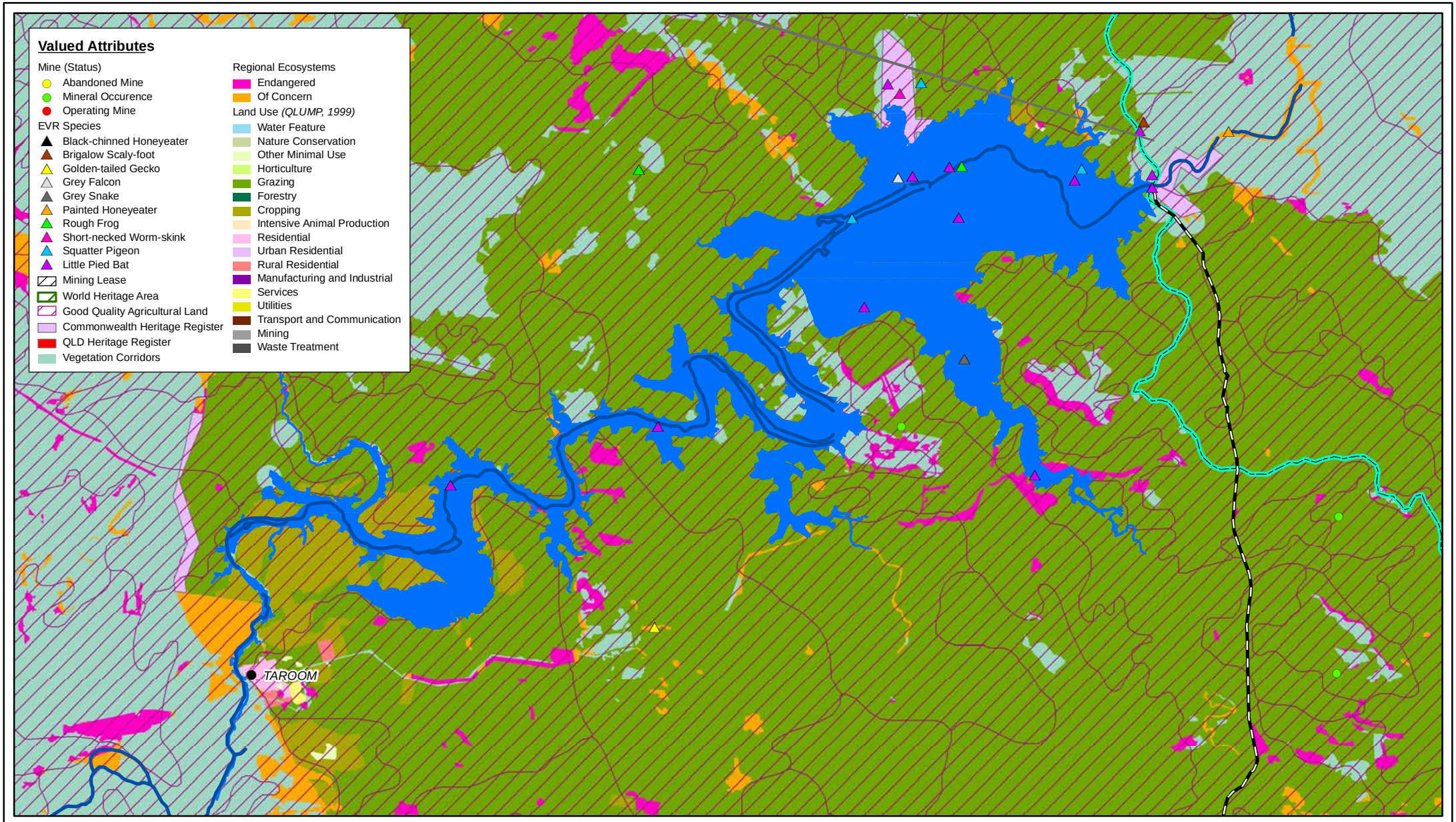
Scale 1:2,000,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Valued attributes within the catchment

I:\QENV2\Projects\QE40192\400 - Nathan - Spatial\ArcMXD\Figures\270_CumulativeImpacts\Figure27-1_ValuedAttributes_Catchment_v2.mxd Produced: 29/06/2011



LEGEND

- Town
- Proposed Pipeline
- Major River
- Full Supply Level (183.5m AHD)
- Nathan Catchment
- Fitzroy Catchment

Projection: GDA94 Zone 56

Figure 27-2

0 1.5 3 6
Kilometres

N

Scale 1:200,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Valued attributes within the dam and surrounds

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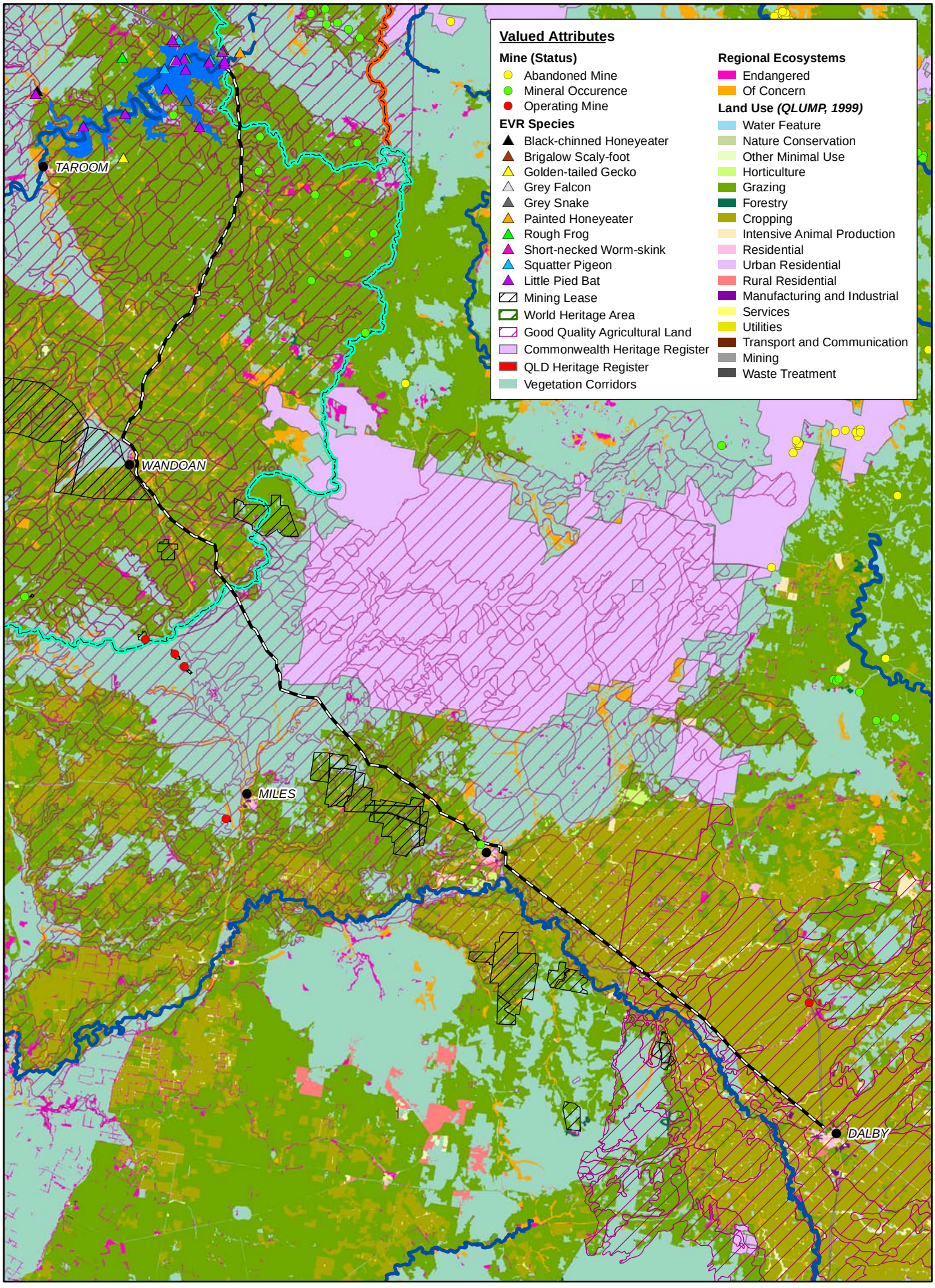


LEGEND

- Town
- Proposed Pipeline
- Major River
- Full Supply Level (183.5m AHD)
- Nathan Catchment
- Fitzroy Catchment

Projection: GDA94 Zone 56

Figure 27-3

0 5 10 20
Kilometres

N

Scale 1:900,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Valued attributes within the water distribution pipeline easement

I:\QENV2\Projects\QE40192\400 - Nathan - Spatial\ArcMXD\Figures\270_CumulativeImpacts\Figure27-3_Valued_Attributes_Pipeline_v2.mxd Produced: 29/06/2011

27.2.2. Establish baseline conditions

It is important when assessing potential cumulative impacts of a project to consider the existing or baseline condition in which the impacts will occur. Chapters 3 through 26 describe the existing environment within and surrounding the Project utilising information from historical and EIS-specific studies/surveys, literature and database searches. Below is a summary of current baseline conditions across each of the three spatial areas being assessed.

27.2.2.1. Catchment

The Dawson River is located in the southern corner of the Fitzroy Basin, which has a total catchment area of approximately 142,600 km^2. The Nathan Dam catchment has a total area of approximately 23,185 km^2, comprising approximately 16% of the total Fitzroy Basin.

The Dawson River, downstream of Glebe Weir, is a highly regulated river, as demonstrated by the flow duration curves in Chapter 14. The regulated reach covers a total length of 338.1 km with the total impounded extent from existing storages is 138.5 km, or approximately 41% of the regulated reach.

The study area is situated within a highly fragmented landscape that has been subject to historical clearing practices for improved pasture and livestock grazing and more recently for the clearing of regrowth vegetation. These land uses and land management practices have resulted in a matrix of remnant and non-remnant vegetation patches within an agricultural landscape.

Vegetation communities found within the dam and pipeline study areas and listed as threatened under the EPBC Act include:

- Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin;
- Brigalow;
- the community of native species dependent on natural discharge of groundwater from the Great Artesian basin; and
- semi-evergreen vine thickets of the Brigalow Belt and Nandewar Bioregions.

While existing water use in the Dawson River catchment is dominated by agriculture, there is also demand to meet urban town water supply, power generation, large scale industrial and mining requirements.

Chapter 9 provides a detailed summary of the environmental values within the study area.

27.2.2.2. Dam construction footprint, water storage area, flood margin and associated infrastructure

The dam construction footprint is characterised by a number of low ridges, hills and floodplains adjacent to the Dawson River. Land use within the dam and surrounds is predominantly beef cattle grazing, although land adjacent to the dam wall on the northern bank of the Dawson River has not been cleared or developed and comprises sparse native pastures. A reserve for recreation and camping activities is located adjacent to Glebe Weir on the northern bank of the Dawson River.

At Full Storage Level (FSL) the water storage area will have a direct impact on approximately 74 land parcels, ranging from small holdings on the outskirts of Taroom to pastoral leasehold and freehold lots. The minimum area of land to be acquired (by purchase or flood easement) for the water storage area is approximately 24,644 ha, comprising 13,824 ha within the FSL, 10,603 ha of flood margin and 217 ha of construction area and buffer.

Some new infrastructure will be required in order to construct and operate the Project. Some elements of the local road, power and telecommunications networks will require relocation, while others will require upgrading or new construction to accommodate a higher water level.

27.2.2.3. Pipeline

Land use adjacent to the pipeline route from the dam to Chinchilla is predominantly grazing, including both breeding and fattening enterprises. Land to the north of Miles, however, is well vegetated and the topography is characterised mostly of rolling hillsides and escarpments, limiting the extent of potential grazing. The most prevalent land use from Chinchilla to Dalby is dryland agriculture (cropping and plantations) with some areas of irrigated land. The topography of the land surrounding this segment of the pipeline route is extremely flat. In the eastern outskirts of Wandoan, rural residential land uses are located in close proximity to the pipeline route, while in the town of Chinchilla the pipeline route traverses land used for rural residential purposes and grazing uses. At the end of the pipeline in Dalby, residential land uses and industrial land uses are located in proximity to the proposed route.

The pipeline will mainly be buried and follow existing easements for approximately 82% of the 260 km route from Nathan Dam to Dalby, although just under half of the pipeline easement width will be located within these easements.

27.2.3. Screening

27.2.3.1. Review of potential future projects within the Study area

As suggested by Cooper (2004) this CIA has taken into consideration other relevant plans or projects which may affect the same valued attributes as outlined above. These include major infrastructure projects as described below.

Major Infrastructure Projects:

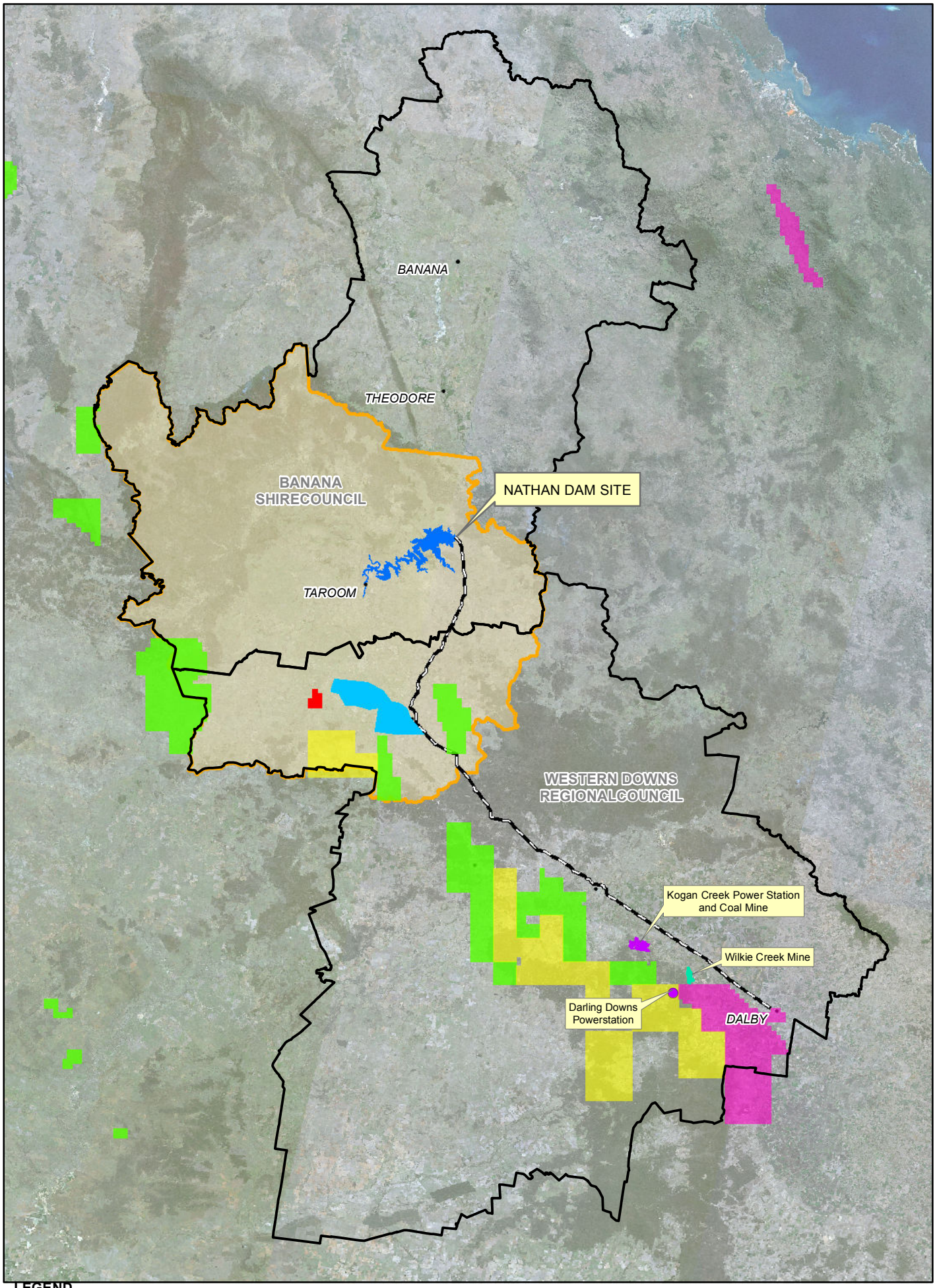
Two additional water infrastructure projects are currently proposed within the Fitzroy River Basin (Figure 27-4). These are:

- Connors River Dam and Pipelines; and
- Lower Fitzroy Weirs Project including construction of Rookwood Weir and raising Eden Bann Weir.

Several other major projects are currently operating or planned for future development in the study area. The majority of these are in proximity to towns along the pipeline (Table 27-2 and Table 27-3). These projects have been considered as part of the cumulative impact assessment.

Table 27-2 Existing projects, 2010

Wilkie Creek Mine	
Company	Peabody Energy
Description	2.35 Mta thermal coal mine, 45 km north-west of Dalby. 250 km rail line to the Port of Brisbane
Workforce	No data
Darling Downs Power Station Project	
Company	Origin Energy
Description	630 MW gas fired power station located at Braemer, 40 km west of Dalby
Workforce	300
Kogan Creek Power Station	
Company	CS Energy Ltd
Description	750 megawatt coal fired power station approximately 35 km from Chinchilla Linked to the Kogan Creek Mine, supplying 2.8 Mta of coal
Workforce	Mine – 60 people Power station - 70 people



LEGEND

- Town
- Proposed Pipeline
- Full Supply Level (183.5m AHD)
- Taroom Statistical Local Area
- Regional Council Boundaries
- Wilkie Creek Mine
- Other Projects
- Elimatta Project
- Wandoan Coal Mine
- QGC Petroleum Lease/Application
- Arrow Petroleum Lease/Application
- Origin Petroleum Lease/Application

Projection: GDA94 Zone 56

Figure 27-4

0 10 20 40
Kilometres

N

Scale 1:2,000,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Existing and proposed major infrastructure projects

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Table 27-3 Planned projects, 2010

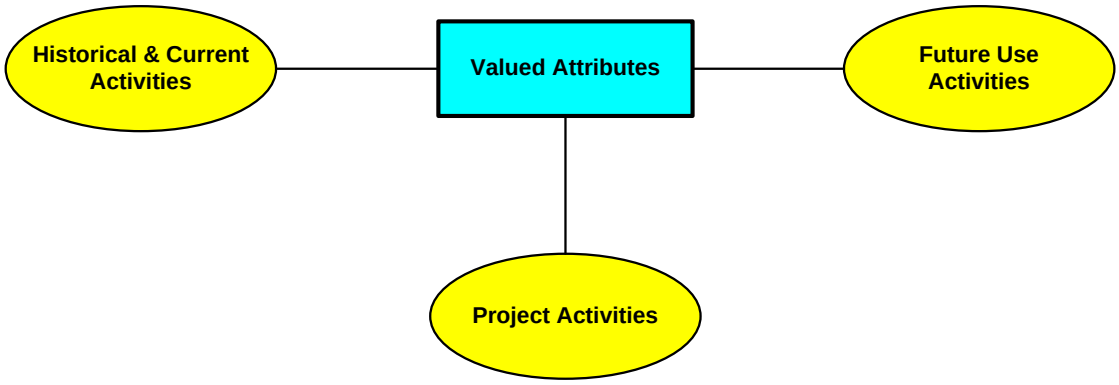
Australian Pacific LNG Project	
Company	Australia Pacific LNG
Description	Further development of Australia Pacific LNG's existing coal seam gas fields in the Surat and Bowen basins. Construction of a gas transmission pipeline approximately 450 km long from the coal seam gas fields to an LNG plant at Gladstone. Development of the LNG plant which will have a processing capacity of up to 18 million Mtpa
Workforce	Construction – up to 5,000 direct jobs Operation – up to 1,000 direct jobs
Accommodation	Temporary accommodation villages near project infrastructure areas
Construction date	2011
Surat Basin Railway – Southern Missing Link	
Company	Surat Basin Rail Joint Venture (Australian and Energy Corridor Pty Ltd (ATEC), Xstrata Coal and Queensland Rail)
Description	210 km railway joining the Surat Basin (at Wandoan) to the Moura Railway system near the township of Banana, facilitating the export of coal to the Port of Gladstone
Workforce	Construction - 1,000
Accommodation	Up to three temporary workers accommodation villages, located in proximity to major work fronts
Construction date	2012
Wandoan Coal Project	
Company	Xstrata Coal Queensland Pty Ltd
Description	Open cut coal mine producing 20 Mta, located directly west of the Wandoan township
Workforce	Construction - 1,375
Accommodation	Accommodation camp in or adjacent to the mining lease area. Construction of some houses in Wandoan
Construction date	2010 Early Works 2011-2013 Construction
Queensland Curtis LNG Project	
Company	Queensland Gas Company
Description	Integrated LNG project comprising expansion of Coal Seam Gas (CSG) operations in WDRC (primarily west of Chinchilla), and the development of a 380 km gas pipeline to Gladstone, transecting through Taroom SLA and BSC
Workforce	Construction - 1,000 people (CSG operations) 400 people (export pipeline)
Accommodation	Temporary construction camp adjacent to CSG operations and pipeline.
Construction date	2011-2012

Gladstone LNG Project	
Company	Santos
Description	Integrated LNG project comprising expansion of CSG operations near the townships of Roma and Injune, and the development of a 435 km transmission pipeline to an LNG Facility in Gladstone, passing through the BSC area
Workforce	Construction - 2,000 people (CSG operations) 1,000 people (export pipeline)
Accommodation	Temporary construction camp adjacent to CSG operations and pipeline
Construction date	2011-2012
Surat Gas Project	
Company	Arrow Energy Ltd
Description	The Project proposes to develop a major coal seam gas exploration, development and production project near the townships of Chinchilla, Dalby and Wandoan and the development of a 467 km transmission pipeline to Arrow Energy Ltd Curtis Island Project, starting in WDRC and traversing through BSC
Workforce	No Data
Accommodation	No Data
Construction date	2011-2012

With respect to mining, as particular coal mining projects proceed, each project will assess potential sources of water supply. The Nathan Dam and Pipelines Project has been identified in the Central Queensland Regional Water Supply Strategy (CQRWSS) as the preferred option to meet water supply shortfalls, but this does not make any particular mining activity reliant on the Project.

27.2.3.2. Understanding of potential cumulative impact pathways

Cumulative effects can occur on a range of spatial scales and affect an array of environments and environmental attributes. It is therefore important to understand the focus or purpose of any particular CIA. In this assessment, potential cumulative effects on recognised local and catchment attributes, valued by community and regulatory authorities (valued attributes), have been the focus. Utilising simple cause and effect network diagrams developed for existing, Project and future activities, multiple network (impact) pathways have been identified that link activities within the catchment to impacts/effects on valued attributes.



These network diagrams allow for the identification of direct and indirect impacts. Direct impacts are those which, as a result of the activity occurring, lead to an immediate impact while indirect impacts are ones which occur as a result of another (usually a direct impact). For example, the clearing of vegetation will have a direct impact on flora, however it is likely to have an indirect impact on the fauna which utilise this vegetation as habitat and may also impact on the erodibility of soils. Similarly, construction of the dam will have a direct positive impact on employment and an indirect impact on local expenditure within the community.

Three cause and effect network diagrams have been prepared to understand the linkages between potential impacts/effects associated with:

- existing (historical and current activities);
- Project specific activities;
- future activities; and
- and the environment.

27.2.3.3. Determine cumulative impact potential at a location (Spatial Analysis)

With an understanding of the linkages between potential impacts/effects and various activities, an assessment of the spatial extent of potential cumulative impacts was assessed. This process involved the development of an assessment matrix for both the dam and surrounds and the pipeline which considers both construction and operational phases of the Project. Where potential impacts associated with Project shared the same spatial extent, as defined in Section 27.2.1.2, with an existing and / or proposed projects a tick was added.

In addition to the assessment matrix, where known, potential impact footprints, i.e. noise contours, dust deposition footprints, vegetation clearing areas, were overlaid. Where two or more potential impacts occurred at the same location, this has been mapped as a location in which cumulative impacts are likely.

27.2.4. Evaluating and mitigation

Evaluation of potential risk and opportunities (Risk and Opportunities Table)

The network diagram and spatial analysis, however, do not assess or quantify potential impacts. This is undertaken through compilation of the risk and opportunities tables developed for this Project. Having identified potential impacts within the network diagram, the risk and opportunities table (Table 27-4) is a consolidation of the residual risk tables completed within each of the relevant EIS Sections whereby a cumulative impact has been defined within the spatial analysis. This consolidated table allows impacts associated with the Project to be assessed at both a local and catchment scale, determine their potential effects over the short and long-term and determine the potential for these impacts to act in a cumulative manner.

Table 27-4 Example cumulative impacts - risks and opportunities table

Potential Impacts	Existing Impact (Y/N)	Future Impact (Y/N)	Short-term or Long-term Impact?	Catchment or Local Scale Impact?	Mitigation or Enhancement Measures	Significant Cumulative (Y/N/ Potentially)
Spread of weeds	Y	Y	Long-term	Local	Soil disturbance within retained vegetation must be kept to a minimum to avoid weed recruitment. Areas to be regenerated (weed control) or revegetated completed under strict supervision to avoid unnecessary soil disturbance. Prepare and implement a weed management plan (Chapter 29) including construction vehicle washdown procedures.	Y

- Identification of Cumulative Effects on Valued Attributes

Before the risk and opportunities table can be completed each of the potential cumulative impacts needs to be viewed against the defined valued attributes. In this instance, valued attributes have been defined as those attributes recognised within current local and regional strategic planning instruments as attributes that should be protected, maintained or enhanced (Section 27.2.1.3). This has been achieved by mapping the potential cumulative impacts identified under (Section 27.2.3.2) and overlaying them against the defined valued attributes.

27.3. CIA results

27.3.1. Cause and effect analysis (network diagrams)

In scoping the cumulative effects and the environmental resources affected, three network diagrams were developed to illustrate the cause-effect relationship (effect pathways) between existing and Project specific and future activities and their potential impacts on the environment. The network diagram for existing activities (Figure 27-5) highlighting that current and historical activities such as agriculture, grazing, and mining have and continue to place a range of pressures on the local environment.

The network diagrams prepared for the dam and surrounds and the pipeline (Figure 27-6 and Figure 27-7), investigate potential impacts and their interrelationships. These network diagrams highlight the range of activities associated with the Project and the complex interactions between these and potential impacts.

What these diagrams do not show, is that many of the Project's impacts are temporary in nature as identified in the risks and opportunities table discussed in Section 27.3.3.

Existing – Project Area

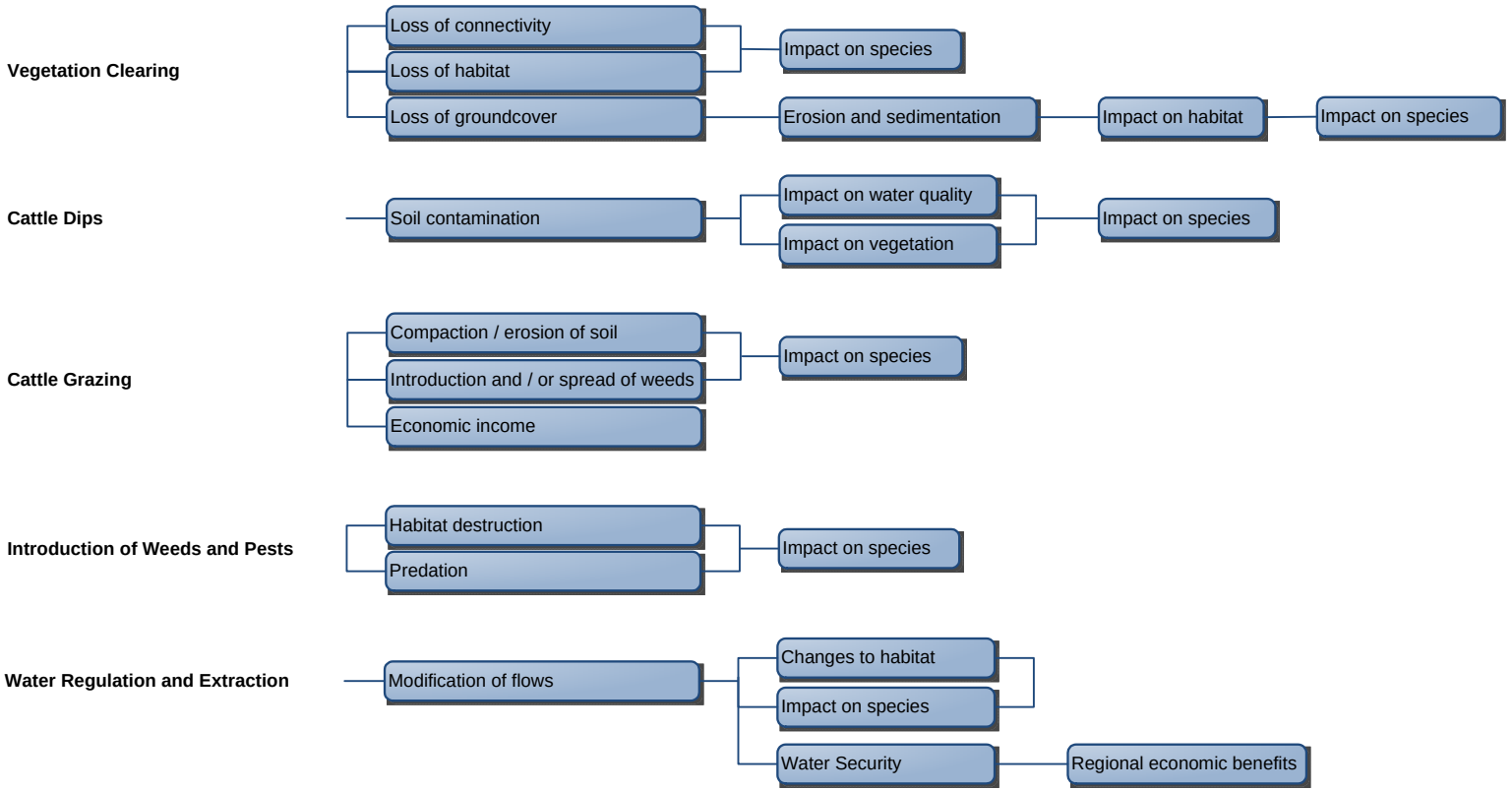


Figure 27-5 Cause and effect relationships associated with existing activities within the dam and surrounds

Dam Construction Footprint, Water Storage Area, Associated Infrastructure

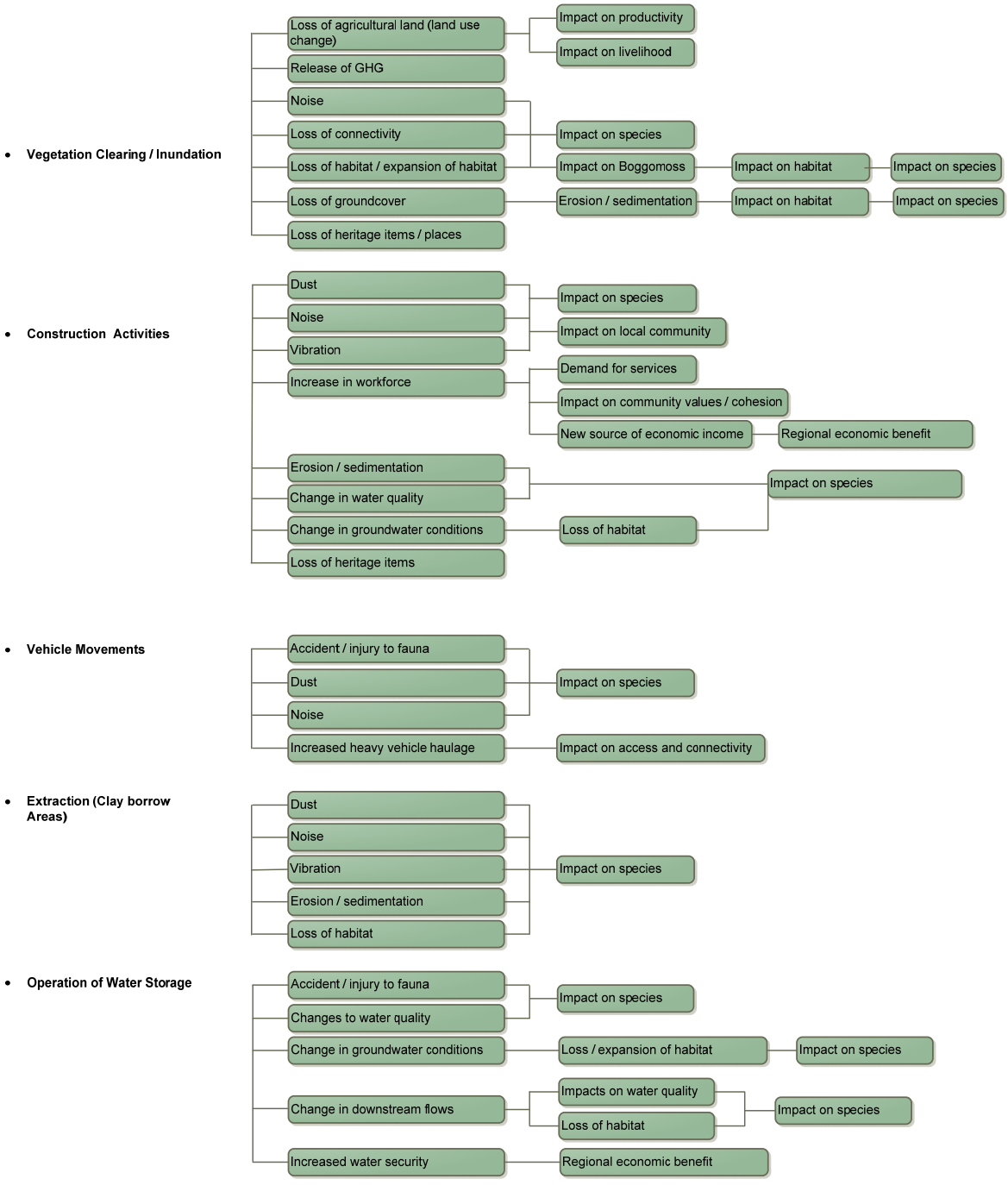


Figure 27-6 Cause and effect relationships - dam construction footprint, water storage area and associated infrastructure

Construction Pipeline

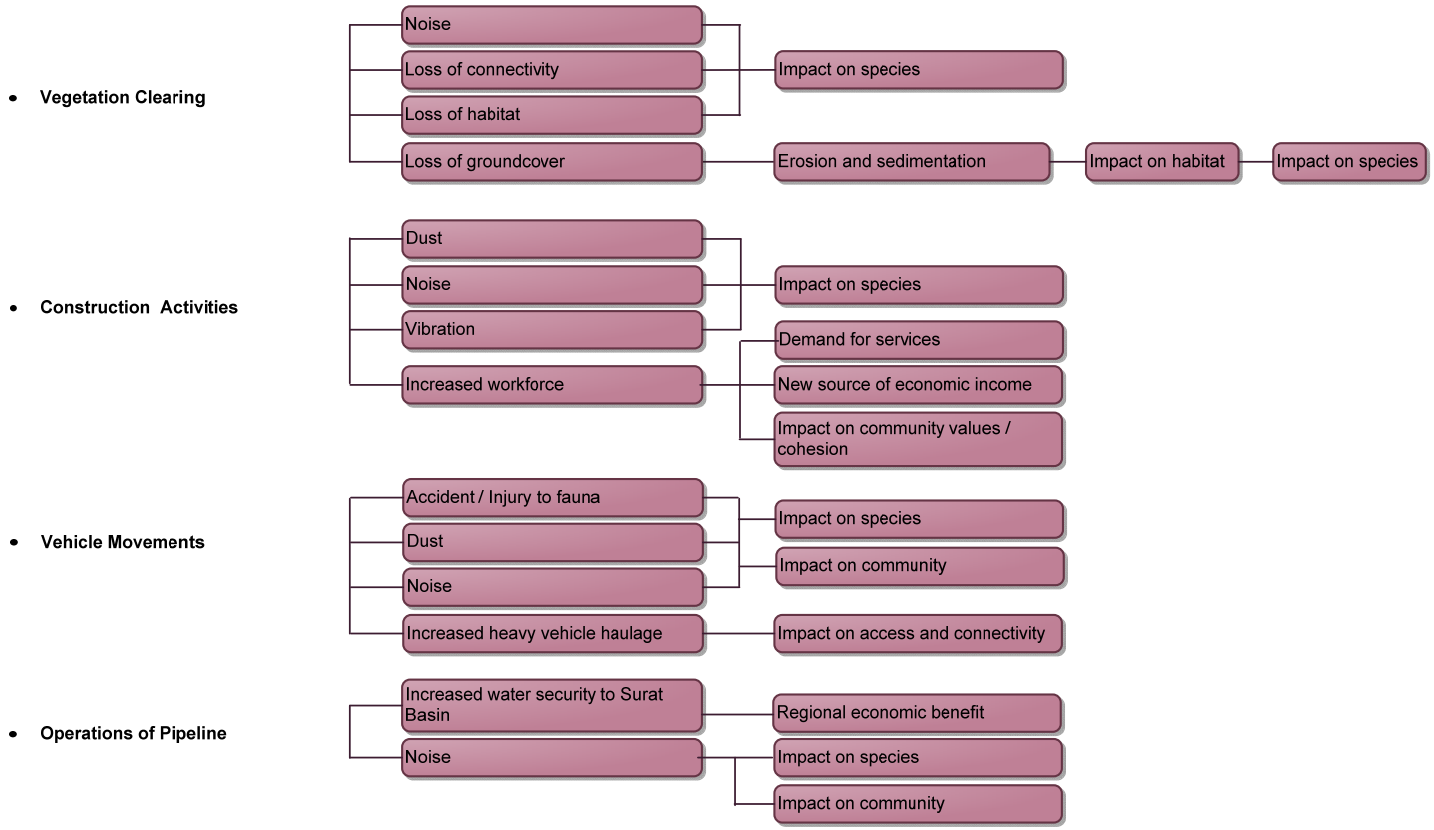


Figure 27-7 Cause and effect relationships associated with the pipeline

27.3.2. Potential cumulative impacts (matrix and spatial analysis)

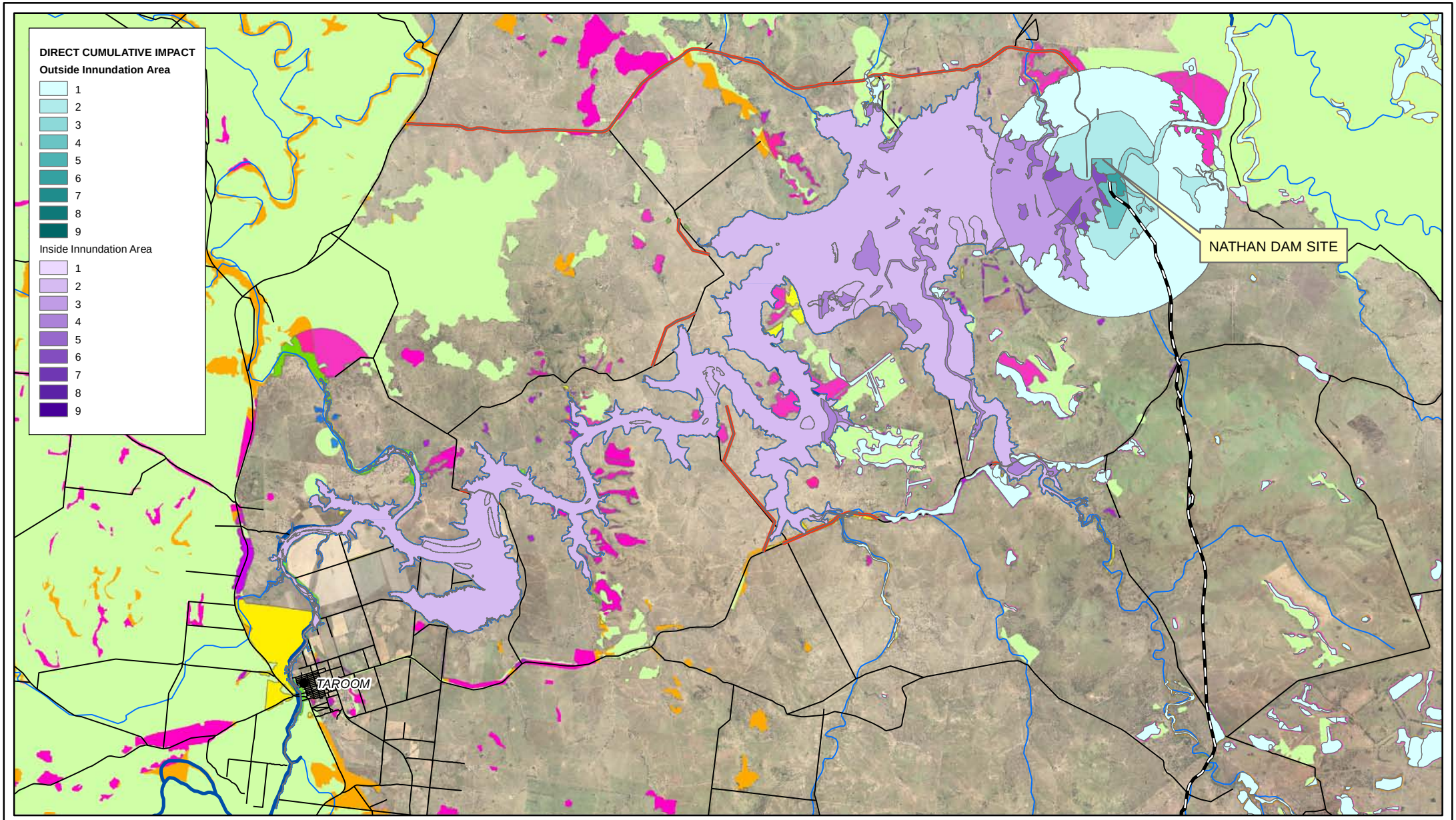
Cumulative impacts are possible where project footprints overlap or intersect. Table 27-5 and Table 27-6 have been completed to demonstrate where these overlaps / intersections occur by placing a tick against projects with shared footprints. As an example, Peabody Energy in not located within the same visual landscape as Nathan Dam therefore there is no potential for cumulative impacts. As such no tick has been assigned to this impact.

The assessment matrix for the dam and surround indicates (through the absence of ticks) that there are few projects within the vicinity of the dam, with the majority of potential cumulative impacts are associated with other water infrastructure projects within the Basin and operational impacts. With the presence of several other projects within proximity of the pipeline, potential cumulative impacts associated with its construction raise the risk of more short-term (construction phase) impacts (Table 27-6).

To assist in identifying potential cumulative impacts the relevant aspects of Project specific activities have been graphically presented against mapped valued attributes, as defined in Section 27.2.1.3 (Figure 27-8 and Figure 27-9).

Table 27-5 Potential cumulative impacts: dam

		Topo/Geomorph	Landscape and visual	Geol / Soils	Land Use		Contaminated Land	Terrestrial ecology			Aquatic ecology			Water resources	Groundwater			Water Quality	Air quality	Greenhouse gas emissions	Noise and vibration	Waste	Traffic and transport	Heritage	Social		Economic	
		Operation of the water storage	Inundation	Construction activities / extraction (clay borrow areas)	Inundation	Inundation	Construction activities	Vegetation clearing		Construction activities	Construction activities (Dam Wall)	Construction activities	Inundation	Operation of the water storage	Construction activities	Inundation	Construction activities	Inundation	Construction activities	Construction activities/ operation	Construction activities	Construction activities	Increased vehicle movements	Inundation	Construction activities		Construction activities	
Project		Changes to downstream channel morphology	Modifcation to Landscape Character	Soil Erosion and Sedimentation	Land Use Change	Loss of productive GQAL	Accidental spillage event during construction of the Project.	Loss of habitat	Loss of connectivity	Potential spread of weeds	instream barrier to movement	Localised effects on water quality and habitat through instream construction	Increased growth of aquatic plants and algae.	Changes to Flow Regime	Shortterm potential for reduced groundwater discharge to Boggomoss	Long term, potential increase of groundwater discharge to Boggomoss recharge springs	Potential for decreased taxa diversity in stygofauna communities	Increased growth of aquatic plants and algae.	Dust	Release of GHG	Noise and Vibration	Short term increase in construction waste materials	Impacts on road safety and delays and disruptions for road users, including emergency services.	Loss of heritage items/places	Increased Demand for skilled workers	Changes to community cohesion and values, community stress	Increased employment opportunities	Increased opportunities for local suppliers of materials and a range of construction services
SunWater - Nathan Dam and Pipeline	Construction			✓	✓		✓	✓	✓	✓	✓	✓			✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Operations	✓	✓			✓							✓	✓		✓		✓		✓				✓				
SunWater - Connors Dam and Pipeline	Construction							✓	✓											✓					✓			
	Operations	✓			✓	✓					✓		✓	✓				✓		✓								
Lower Fiztroy	Construction							✓	✓											✓					✓		✓	✓
	Operations	✓									✓		✓	✓						✓								
Peabody Energy	Construction																											
	Operations																			✓			✓					
Origin Energy	Construction																											
	Operations																			✓			✓					
CS Energy Ltd	Construction																											
	Operations																			✓			✓					
Surat Basin Rail JV	Construction																			✓		✓	✓		✓	✓	✓	✓
	Operations																			✓								
Xstrata Coal	Construction																			✓		✓	✓		✓	✓	✓	✓
	Operations																			✓								
QGC	Construction																			✓		✓	✓		✓	✓	✓	✓
	Operations																			✓								
Santos	Construction																			✓		✓	✓		✓	✓	✓	✓
	Operations																			✓								
Arrow Energy Ltd	Construction																			✓		✓	✓		✓	✓	✓	✓
	Operations																			✓								



LEGEND

- Town
- Proposed Pipeline
- Major River
- Road Upgrade/Construction
- Local Roads
- Full Supply Level (183.5m AHD)
- Clay Borrow Pits
- Vegetation Corridors
- Dam Construction Footprint

Habitat Type

- Brigalow/Belah Open Forests
- Cypress Pine/Ironbark Woodlands
- Eucalypt Alluvial Woodlands
- Non-Alluvial Woodlands
- Riparian Woodlands
- Wetlands/GAB Springs

Regional Ecosystems

- Endangered
- Of Concern

Projection: GDA94 Zone 56

Figure 27-8

0 1.5 3 6
Kilometres

N

Scale 1:200,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Cumulative Project impacts - dam construction footprint, water storage area and associated infrastructure

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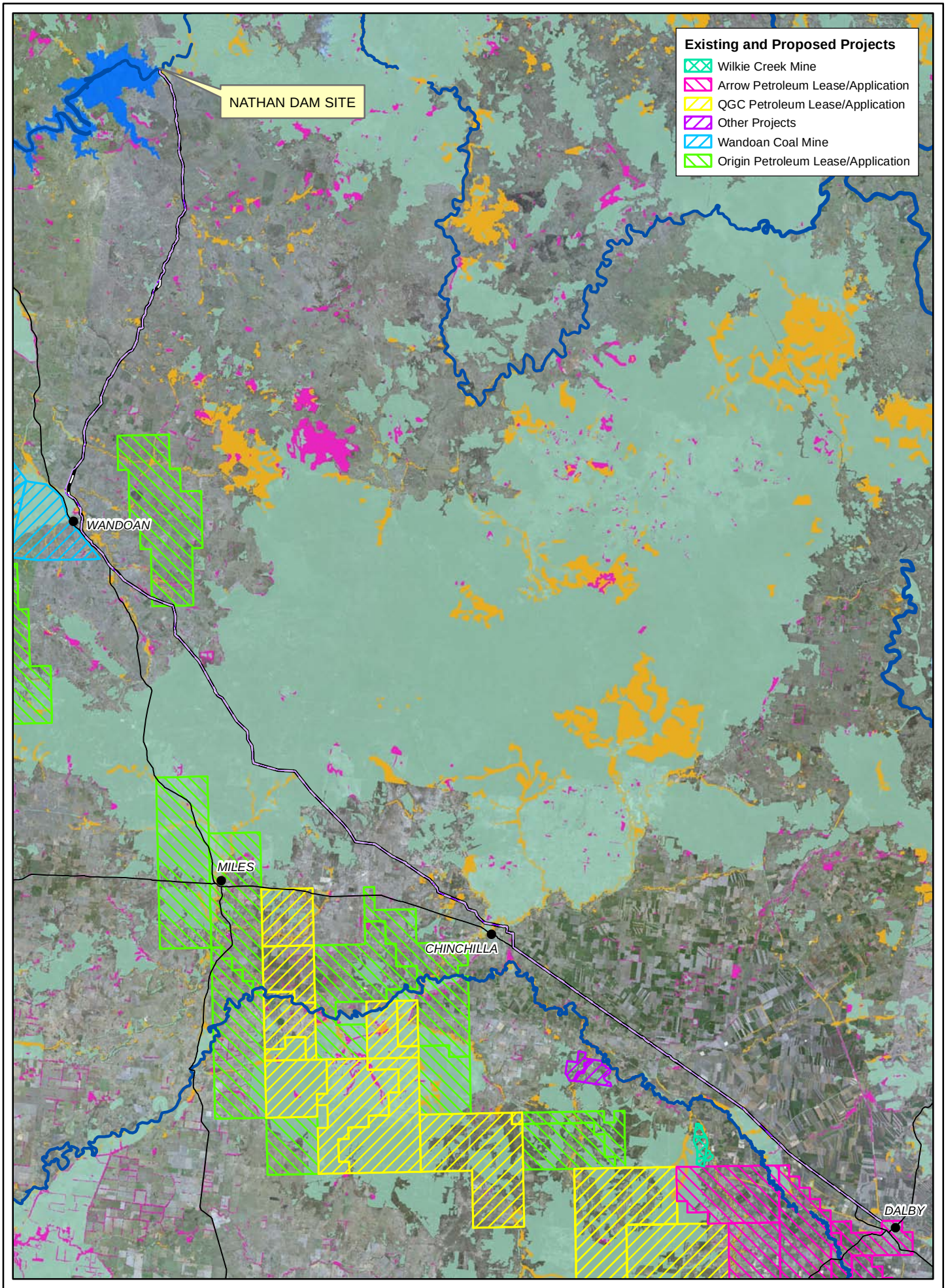
Table 27-6 Potential cumulative impacts: pipeline

	Project		Topo/Geomorph	Landscape and visual	Geol / Soils	Land Use		Contaminated Land	Terrestrial ecology			Aquatic ecology			Water resources	Groundwater			Water Quality	Air quality	Greenhouse gas emiss	Noise and vibration	Waste	Traffic and transport	Heritage	Social		Economic	
			Operation of the water storage	Inundation	Construction activities / extraction (clay borrow areas)	Inundation	Inundation	Construction activities	Vegetation clearing		Construction activities	Construction activities (Dam Wall)	Construction activities	Inundation	Operation of the water storage	Construction activities	Inundation	Construction activities	Inundation	Construction activities	Construction activities/ operation	Construction activities	Construction activities	Increased vehicle movements	Inundation	Construction activities		Construction activities	
			Changes to downstream channel morphology	Modifcation to Landscape Character	Soil Erosion and Sedimentation	Land Use Change	Loss of productive GQAL	Accidental spillage event during construction of the Project.	Loss of habitat	Loss of connectivity	Potential spread of weeds	Instream barrier to movement	Localised effects on water quality and habitat through instream construction activities.	Increased growth of aquatic plants and algae.	Changes to Flow Regime	Shortterm potential for reduced groundwater discharge to Boggomoss	Long term, potential increase of groundwater discharge to Boggomoss	Potential for decreased taxa diversity in stygofauna communities	Increased growth of aquatic plants and algae.	Dust	Release of GHG	Noise and Vibration	Short term increase in construction waste materials	Impacts on road safety and delays and disruptions for road users, including emergency services.	Loss of heritage items/places	Increased Demand for skilled workers	Changes to community cohesion and values, community stress	Increased employment opportunities	Increased opportunities for local suppliers of materials and a range of construction services
Proposed Water Infrastructure	SunWater - Nathan Dam and Pipeline	Construction			✓			✓	✓	✓	✓									✓	✓	✓	✓	✓	✓	✓	✓	✓
		Operations		✓																	✓				✓				
	SunWater - Connors Dam and Pipeline	Construction							✓	✓											✓								
		Operations																			✓								
	Lower Fiztroy	Construction							✓	✓											✓					✓	✓	✓	✓
		Operations																			✓								
Existing Projects	Peabody Energy	Construction																											
		Operations																			✓			✓					
	Origin Energy	Construction																											
		Operations																			✓			✓					
	CS Energy Ltd	Construction																											
		Operations																			✓			✓					
Proposed development	Surat Basin Rail JV	Construction		✓				✓	✓	✓	✓										✓		✓	✓		✓	✓	✓	✓
		Operations																			✓								
	Xstrata Coal	Construction																			✓		✓	✓		✓	✓	✓	✓
		Operations																			✓								
	QGC	Construction		✓				✓	✓	✓	✓										✓		✓	✓		✓	✓	✓	✓
		Operations																			✓								
	Santos	Construction		✓				✓	✓	✓	✓										✓		✓	✓		✓	✓	✓	✓
		Operations																			✓								
	Arrow Energy Ltd	Construction		✓				✓	✓	✓	✓										✓		✓	✓		✓	✓	✓	✓
		Operations																			✓								



LEGEND

- Town
- Proposed Pipeline
- Local Roads
- Major River
- Full Supply Level (183.5m AHD)
- Vegetation Corridors

Regional Ecosystems

- Endangered
- Of Concern

Cumulative Impact along Pipeline

- 2
- 3

Projection: GDA94 Zone 56

Figure 27-9

0 5 10 20
Kilometres

N

Scale 1:800,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Cumulative Project impacts associated with the pipeline

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27.3.3. Evaluation of potential risk and opportunities (risk and opportunities tables)

Having established the cause-effect relationship (impact pathways) for existing, Project specific and future activities (Table 27-5 and Table 27-6) a risks and opportunities table has been developed to quantify potential impacts. The table assesses impacts associated with the Project at a local and regional scale, and determines their potential effects over the short and long-term.

Project activities were assessed in the following spatial areas:

1) dam construction footprint, water storage area and associated infrastructure; and
2) pipeline.

Using the activities identified within the network diagrams, the following activities were assessed:

- vegetation clearing;
- inundation;
- construction activities;
- extraction (clay borrow areas);
- vehicle movements; and
- operation of the water storage.

From these 6 broad activities, 19 direct impacts (positive and negative) associated with these activities were assessed:

- release of GHG;
- loss of connectivity;
- loss of habitat;
- accident / injury to fauna;
- spread of weeds;
- erosion/sedimentation;
- change to geomorphology;
- changes to water quality;
- loss of heritage items/places;
- change in land use;
- dust;
- noise;
- vibration;
- increase in workforce;

- changes to community cohesion and values, community stress;
- increased Heavy Vehicle haulage, particularly related to the pipeline;
- change in groundwater conditions;
- changes to downstream flows; and
- regional economic benefits.

The results from the risks and opportunities assessment are summarised below in Table 27-7.

Table 27-7 Cumulative impacts - risks and opportunities

Project Impacts	Existing Impact (Y/N)	Future Impact (Y/N)	Short-term or Long-term Impact?	Catchment or Local Scale Impact	Mitigation or Enhancement Measures	Significant Cumulative (Y/N/ Potentially)
Release of GHG	Y	Y	Long-term	Catchment	Management measures proposed to minimise greenhouse gas emissions from construction of the Project are outlined in Section 29.9.14. The continued implementation of SunWater's Energy Management Standard will minimise greenhouse gas emissions from the operation of the Project by: ■ identifying opportunities to improve energy efficiency and to reduce greenhouse gas emissions; and ■ providing education and training to increase energy management competencies of SunWater staff.	**N**
Vegetation Clearing/Inundation: Loss of connectivity	Y	Y	Long-term	Local	**Dam and Surrounds** Minimise impacts of fragmentation along the Dawson River by not clearing riparian vegetation within 1.5 m vertical below FSL. Offsets package to provide compensation for fragmentation impacts. Aim to re-establish the riparian corridor by rehabilitation and management of non-remnant habitat on land parcels surrounding the water storage. Aid natural regeneration (i.e. Filling gaps). Improve habitat quality through weed, feral animal and fire management. **Pipeline** Refine alignment to avoid habitat. Minimise construction easement width in sensitive environmental areas.	**Y**
Vegetation Clearing / Inundation: Loss of habitat	Y	Y	Long-term	Local	**Dam and Surrounds** Timber suited to use as aquatic or terrestrial fauna habitat will be salvaged and placed in strategic locations possibly in riparian habitat offset areas. Rehabilitation of temporary infrastructure sites.	**Y**

Project Impacts	Existing Impact (Y/N)	Future Impact (Y/N)	Short-term or Long-term Impact?	Catchment or Local Scale Impact	Mitigation or Enhancement Measures	Significant Cumulative (Y/N/ Potentially)
					Vegetation offsets in compliance with the VM Act, and which meet the relevant performance requirements under the Regional Vegetation Management Code (RVMC) for the Brigalow Belt Bioregion. The Project will provide vegetation offsets to mitigate the loss of Endangered, Of Concern and riparian REs. Habitat offsets which directly relate to impacts on rare and threatened species, and least concern species will be be provided should mitigation strategies be deemed inadequate. Habitat offsets will only be provided if they are not completely covered in the vegetation offsets. Additional offsets may be required to satisfy the Australian Government offset policy. Revegetation of GAB springs in poor condition. Improved conservation and management of existing GAB springs in good condition. Continual monitoring of the relationship between increased groundwater flows and terrestrial biota through long term monitoring and research. **Pipeline** Refine alignment to avoid habitat. Minimise construction easement width in sensitive environmental areas. Use felled vegetation as habitat. Rehabilitate construction easement. Establish and maintain offsets Implement weed management plan from outset of construction	

Project Impacts	Existing Impact (Y/N)	Future Impact (Y/N)	Short-term or Long-term Impact?	Catchment or Local Scale Impact	Mitigation or Enhancement Measures	Significant Cumulative (Y/N/ Potentially)
Accident / injury to fauna	Y	Y	Short-term	Local	Habitat within the water storage area will only be cleared shortly before the dam becomes operational, though millable timber will be removed prior to this. Habitat will be cleared progressively to ensure that fauna move of their own volition away from impact areas and into habitats within the upper reaches of impacted waterways. Engagement of a spotter-catcher during construction to minimise impacts to fauna. Use of alternative clearing measures such as pushing of significant trees rather than cutting and felling vegetation to ensure hollows are left intact and can be replaced as fauna habitat features in the neighbouring habitat. Stockpiling of felled vegetation to provide compensatory shelter sites for terrestrial fauna. Fitting of physical barriers with fishways to allow effective and safe movement and migration of species. Design and implementation of effective turtle bypass to facilitate safe movement of turtles past the dam wall.	**N**
Spread of weeds	Y	Y	Long-term	Local	Soil disturbance within retained vegetation must be kept to a minimum to avoid weed recruitment. Areas to be regenerated (weed control) or revegetated completed under strict supervision to avoid unnecessary soil disturbance. Prepare and implement a weed management plan (**Chapter 29**) including construction vehicle washdown procedures.	**Y**
Erosion / Sedimentation	Y	Y	Short -term and Long-term	Local	Utilisation of erosion and sedimentation control techniques in accordance with guidelines such as IECA Australasia 2008. Rehabilitate disturbed areas as soon as practicable after completion of works by backfilling, covering with topsoil and revegetating, hydroseeding or hydromulching. Rehabilitation work should use appropriate native or sterile species. Construction activity scheduled so that work in sensitive areas can be completed and rehabilitated as quickly as feasible.	**N**

Project Impacts	Existing Impact (Y/N)	Future Impact (Y/N)	Short-term or Long-term Impact?	Catchment or Local Scale Impact	Mitigation or Enhancement Measures	Significant Cumulative (Y/N/ Potentially)
Change in water quality	Y	Y	Short-term and Long-term	Local	As for erosion/sediment control. Implement bunding / spills procedures for potential contaminants during construction. Manage downstream water quality by use of multi-level offtake to select best quality water for releases.	**N**
Loss of heritage items/places	Y	Y	Long-term	Local	Follow agreed management procedures contained within Cultural Heritage Management plans for indigenous cultural heritage (Chapter 21). Follow management procedures for non-indigenous cultural heritage items and places including possible relocation of Glebe Homestead, as outlined in **Chapter 22**.	**N**
Change in land use	Y	Y	Long-term	Local	No mitigation proposed as the proportion of agricultural land affected by the Project is not considered significant. Whilst recognised there is a cumulative impact, the loss of GQAL from the Project is offset by increased regional water security and economic benefits stemming from the Project	**N**
Dust Generation	N	N	Short-term	Local	Dust control measures will be implemented during construction as part of the EMP.	**N**
Noise	N	N	Short-term and Long-term	Local	Implementation of standard industry practice for environmental management on construction sites.	**N**
Vibration	N	N	Short-term	Local	Blasting will be designed and managed by a blasting contractor, who would control blast overpressure and vibration in accordance with the Project limits, through a detailed management plan. The plan must address AS 2187 (2006) 'Explosives-Storage and Use Part 2: Use of explosives'.	**N**
Increase in workforce	N	Y	Short-term	Local	Use of local labour to the extent possible, involving local service providers Implementation of employment and training programs in partnership with education and training organisations (i.e. TAFE). Compliance with Building and Construction Contracts Structure	**Potentially**

Project Impacts	Existing Impact (Y/N)	Future Impact (Y/N)	Short-term or Long-term Impact?	Catchment or Local Scale Impact	Mitigation or Enhancement Measures	Significant Cumulative (Y/N/ Potentially)
					Training Policy (10% Training Policy). Identification of Indigenous employment and training opportunities in consultation with local Aboriginal and Torres Strait Islander agencies.	
Increased Heavy Vehicle haulage, particularly related to the pipeline.	Y	Y	Short-term	Local	Traffic impacts will be managed through a Road Use Management Plan (RUMP) and associated Traffic Management Plans (TMPs). These are to be developed in consultation with Queensland Department of Transport and Main Roads, local Police, local councils and proponents of other projects which may contribute to cumulative road impacts during the timeframe of this project. The RUMPs and TMPs will be developed during detailed Project design.	**Potentially**
Changes to community cohesion and values, community stress	Y	Y	Short-term	Local	Development and implementation of protocols around worker behaviour within the camp and in local communities. Encourage integration in local community and participation in local events. Consult with directly affected landholders in an early and ongoing manner.	**Potentially**
Change in groundwater conditions	Y	Y	Short-term and Long-term	Local	Reduce dewatering rate to slowest practical to minimise groundwater drawdown during construction. Monitor boggomoss springs during dewatering and irrigate if necessary. Monitor boggomoss springs and areas of potential new discharge during operation. Review land use practices in new discharge zones. Assess, rehabilitate or replace (prior to dam operation) bores identified as high risk of collapse from increased aquifer pressures.	**N**

Project Impacts	Existing Impact (Y/N)	Future Impact (Y/N)	Short-term or Long-term Impact?	Catchment or Local Scale Impact	Mitigation or Enhancement Measures	Significant Cumulative (Y/N/ Potentially)
Changes to downstream flows	Y	Y	Long-term	Local	Nathan Dam water releases will be managed and scheduled to: - Optimise the distribution of water from Nathan Dam - Conform to flow requirements of the Water Resource Plan (WRP) - Comply with the Resource Operations Plan (ROP) Compensation will be negotiated with impacted water harvesters downstream of the dam.	**Potentially**
Regional economic benefits	N	Y	Short-term and Long-term	Local and Catchment	In the short-term, benefits include increased expenditure in the region that could support regional contractors, create jobs and support other businesses. SunWater has a preference to source construction materials locally, providing potential local economic benefit. In the longer term the Project will support regional economic activities through the more secure provision of water and additional water for mining and urban centres.	**Y**

27.3.3.1. Cumulative effects of the Project

The majority of impacts associated with the Project occur at a local scale and are relatively temporary in nature. Table 27-7 also highlights that regionally the Project has relatively few impacts that are likely to have a significant level of impact on the environment.

Three primary activities were identified as having the potential for long term cumulative impact, namely:

- vegetation clearing and inundation;
- operation of the storage; and
- potential spread of weeds.

These were identified as leading to potential long-term cumulative impacts of:

- loss of habitat and connectivity;
- changes to downstream flows; and
- regional economic benefits.

Three potential short-term cumulative impacts were identified as increased heavy vehicle haulage, increase in workforce and changes to community cohesion and values, particularly related to the potential for impacts from multiple projects along the pipeline route.

These are discussed in more detail below.

- Loss of habitat and connectivity

The Project will result in the loss of approximately 3655 ha of remnant vegetation (assuming islands lost as a result of fragmentation) and 342 ha of non-remnant vegetation. Of the remnant total area, 128.2 ha is classed as Endangered REs, 1777.9 ha Of Concern REs and 1727.7 ha Least Concern REs under the VM Act. With the retention of remnant vegetation on islands created by inundation, the total area of remnant vegetation impacted will decrease to 3582 ha. The Brigalow (*Acacia harpophylla* dominant and co-dominant) listed threatened ecological community was also impacted.

Field surveys identified three threatened ecological communities as occurring within the dam and pipeline study areas. These include:

1) Brigalow (*Acacia harpophylla* dominant and co-dominant);
2) natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin; and
3) semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions.

The cumulative impact of this clearing or inundation is on species and communities of flora and fauna. Mitigation strategies described in the respective chapters and summarised above aim to minimise the direct impact. Measures that address the cumulative impact relate to the rehabilitation and offset strategies. These aim to provide and protect appropriate areas of vegetation over the long term such that habitat is available for the impacted flora and fauna. Both state and federal policies require a larger area of vegetation to be included within the offset than is actually impacted by the Project. This multiplier ensures that the offset is adequate to address the impact. With mitigation and offsets, the

development of these projects is not expected to have a cumulative impact upon the terrestrial flora or fauna of the Dawson Valley (in relation to the dam) or the Condamine (in relation to the pipeline).

Changes to downstream flows

As discussed in detail in Chapter 14, a Cumulative Impacts scenario was modelled in order to represent the infrastructure currently proposed for the basin: Connors River Dam, Nathan Dam and Lower Fitzroy Weirs. Existing dams and weirs in the system were also included within the model.

The performance of the Cumulative Impacts scenarios was assessed against the WRP 1999 environmental flow objectives: seasonal baseflow, first post winter flow and medium to high flows, including mandatory and non-mandatory objectives. This is discussed in detail in Section 14.2.4. The revised WRP was approved on 8 December 2011. The modelling undertaken for the EIS will be revised using the model developed for the new WRP and compliance with the *Water Resource Plan (Fitzroy Basin) Plan 2011* (WRP) will be assessed prior to project approval.

The model results show that WRP environmental flow objectives are met under the Cumulative Impacts scenario in most cases. Where they are not met initially, operational strategies will be revised to ensure that they are met (at least in the case of mandatory flow objectives).

Chapter 28 provides a detailed assessment of potential cumulative flow impacts on matters of national environmental significance including the GBRWHA.

Based on this modelling and other data, impacts to water quality in the Fitzroy River and Estuary are not expected (Chapter 16). Therefore no significant impacts on estuarine and marine flora, including in the GBRWHA and the Shoalwater and Corio Bays Area Ramsar site, are expected. Nor are any significant impacts to estuarine or marine fauna predicted, and no major disruption of cues or impacts to estuarine and coastal fisheries productivity are expected due to the cumulative impacts of proposed water infrastructure.

Construction of all the proposed water infrastructure will result in a greater proportion of lacustrine (pool) habitat in the Fitzroy Basin, at the expense of habitat such as runs, glides, riffles and backwater. This is likely to result in a reduction in biodiversity and a shift in community composition in the affected reaches, perhaps significantly reducing the extent of available habitat for habitat-specialist species. However, the cumulative impacts of these developments are not expected to result in an overall reduction in aquatic fauna diversity in the Fitzroy Basin.

Construction of the proposed water infrastructure will also result in a greater number of physical barriers to aquatic fauna movement and migration in the Fitzroy Basin. In each case, fauna passages will be developed to facilitate movement past the dam or weir.

Potential spread of weeds

To minimise the potential for the spread and introduction of weeds from the outset of construction of the dam and pipeline, a weed management plan will be developed for construction and operation of the Project. This will include use of wash-down facilities for construction vehicles and equipment, weed inspection and control and monitoring.

- Regional economic benefits

The Project will provide an overall positive economic impact in terms of providing additional water security to support the development of the coal mining industry and to ensure water supplies for regional urban development. However, because the regional economy is already relatively buoyant due mainly to the mining activity, the Project impacts are likely to be dispersed more widely across the State than a similar project undertaken in a region with a less buoyant economy and more under-utilised resources.

- Heavy vehicle haulage

While the impacts of the Project do not adversely affect the Level of Service of the key haul route of the Leichardt Highway and Warrego Highway during the construction period, the effect of other major projects in the region would be cumulative in terms of impact

Road traffic demands associated with the existing Wilkie Creek Mine, Darling Downs Power Station and Kogan Creek Power Station are included in the AADT data provided in Chapter 21. Cumulative impacts of these projects have therefore been effectively taken into consideration in the road link assessment in Chapter 21.

Of the planned projects, the Wandoan Coal Project and the Surat Basin Railway Project, are identified as the two projects with the highest potential for cumulative traffic impacts. Should both these projects commence construction concurrent to the Project's construction phase, the surrounding state and local roads would experience a considerable increase in additional traffic demand.

Traffic impacts will be managed through a Road Use Management Plan (RUMP) and associated Traffic Management Plans (TMPs). These are to be developed in consultation with Queensland Department of Transport and Main Roads, local Police and councils. SunWater will also liaise with other parties currently or planning to add significant volumes of traffic onto the surrounding road network. The Project RUMP and TMPs will consider cumulative traffic movements, in particular to/from the Wandoan Coal and Surat Basin Rail projects. The RUMPs and TMPs will be developed during detailed design of the Nathan Dam Project.

- Workforce and community cohesion and values

While no other projects are located in close proximity to the dam area, a range of CSG, resource and infrastructure development projects are currently planned for the wider region and along the pipeline. As noted in Chapter 24, the workforce requirements of many of these projects are substantial, with up to approximately 10,000 new workers required for the construction of projects between 2010 and 2012. If realised, this would have a direct impact on the resident and non-resident populations of townships such as Wandoan, Chinchilla and Dalby in the study area.

The OESR has produced projected workforce and population statistics for the WDRC area based on planned gas, rail, power, and major infrastructure Chapter 24 projects (including road and water).

Figure 27-10 shows that the non-resident workforce numbers in the Western Downs Region are expected to increase significantly towards the end of 2011 and through most of 2012, peaking at almost 7,000 non-resident workers in the Region. As the Projects move into their operational phase, workforce requirements will decline, and the proportion of non-resident workers will decrease accordingly.

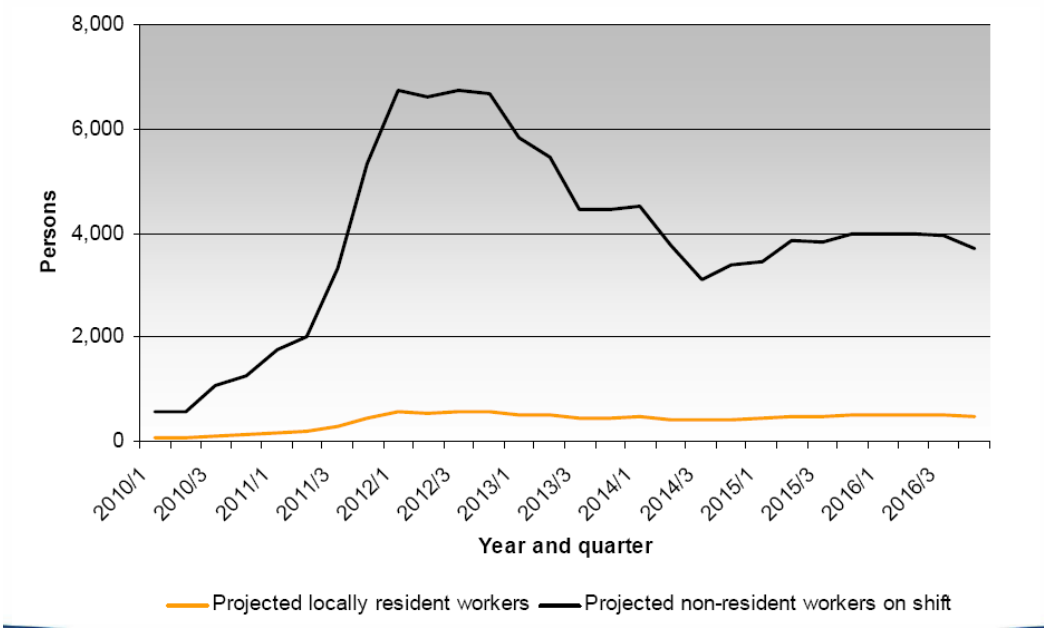

Figure 27-10 Projected workforce for the Western Downs Region

Source: OESR, 2010.
Note: projections are based on the assumption that 5% of construction workers will be local, 10% of operations workers will be local, and the construction of all projects will delayed by 6 months.

In addition to these workforce-related population increases, there will be further growth associated with the partners and families of some workers choosing to move to local communities as well as indirect population increases associated with the growth of businesses, infrastructure and services in response to increased demand from development in the region.

Figure 27-11 outlines projected resident population increases between 2008 and 2016, and shows that while the non-resident population of the area will increase significantly, there are only moderate increases expected in the resident population. These projections, however, acknowledge that the timing of projects creates difficulties in predicting population changes, as projects are often delayed or timeframes are changed.

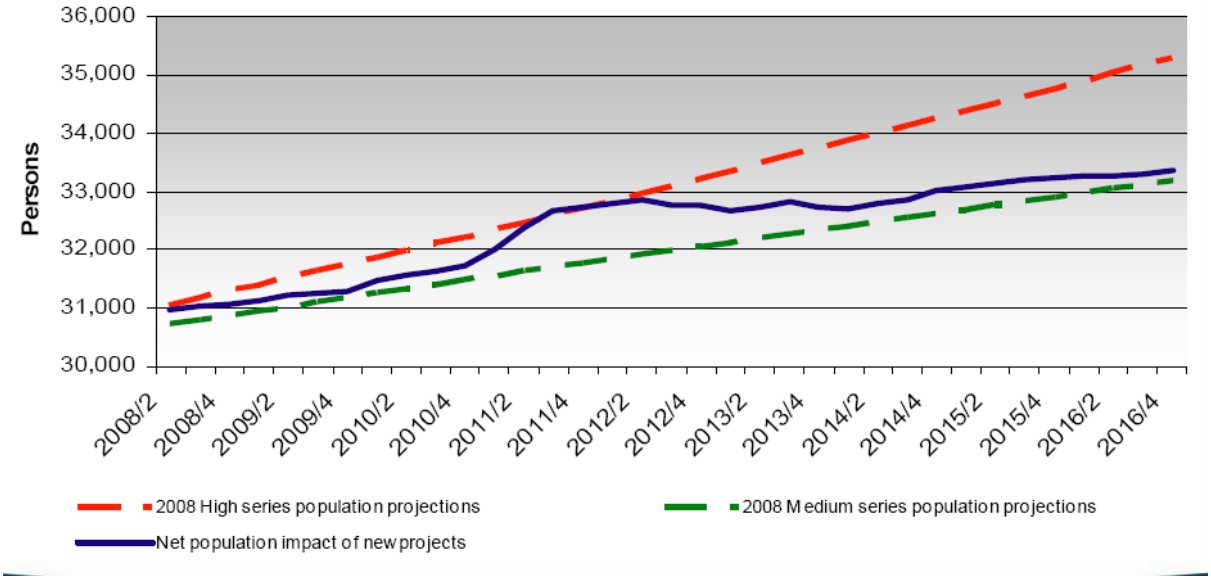

Figure 27-11 Projected resident population impact for the Western Downs

Source: OESR, 2010.
Note: projections are based on the assumption that 5% of construction workers will be local, 10% of operations workers will be local, and the construction of all projects will occur in the planned timeframes.

Increases in resident and non-resident populations in the pipeline area and Western Downs Region may result in some social impacts described in this section being experienced at a greater magnitude and scale. In particular, these may include:

- impacts on community values associated with the loss of rural land and agricultural lifestyles;
- impacts on employment and skills availability, due to competition for labour and scarce local skills;
- impacts on local access and connectivity including road safety and disruptions;
- impacts associated with increased demand for social services, especially health and police services;
- environmental effects such as dust and noise generation; and
- visual impacts of surface infrastructure and construction equipment and machinery.

An increase in the population due to cumulative construction workforce requirements, particularly an influx of young, male-dominated workers may also have an impact on community concerns regarding safety and health.

Existing initiatives and potential alignment

Mitigation measures identified in this section would assist in reducing the social impacts of the Project on local communities. In particular, the establishment of construction camps to accommodate workers and the provision of buses to transport workers between regional centres would help to reduce impacts on health service provision, accommodation and road safety and access, which are key concerns for local communities. In addition, the majority of cumulative impacts would be experienced during the construction phase of the Project, as there are very few operational workers that would be required over the longer term.

However, the mitigation and management of cumulative impacts across Queensland and the Surat Basin is an issue that requires detailed consideration by all project proponents in the area. Therefore wherever possible, SunWater will align with and contribute to existing government and industry initiatives that are being implemented to deal more holistically with cumulative impacts. A summary of potential initiatives is presented in Table 27-8.

Alignment and integration with these initiatives would facilitate a regional approach to dealing with cumulative issues, and would assist in assigning joint responsibilities involving government, industry and community stakeholders.

Table 27-8 Potential alignment with existing cumulate impact initiatives

Existing Initiative	Description	Potential SunWater Actions
Sustainable Resource Communities Policy	Policy designed to provide guidance on the identification and mitigation of social impacts associated with rapid growth of the resource industry. Suggests a number of mechanisms to facilitate assessment of cumulative impacts, including the preparation of SIMPs. Under this policy, a number of groups and committees have been formed to deal with specific issues.	▪ Ongoing liaison with Surat Basin Local Leadership Group ▪ Ongoing liaison with SRC Policy Partnership Group ▪ Preparation of a stand-alone Social Impact Management Plan for the Nathan Dam and Pipelines Project
Surat Basin Cumulative Impacts Working Group	Established under the *Blueprint for Queensland's LNG Industry.* Aims to explore how Queensland Government can further work with industry and local communities to progress the LNG industry in a mutually beneficial way.	▪ Regular liaison with members of the Working Group to ensure that identified issues and strategies are considered in the SIMP for the Nathan Dam and Pipelines Project
Surat Basin Future Directions Statement	High level document to bring key stakeholders together to develop a coordinated region-wide approach to managing cumulative impacts. Commits Queensland Government to work with local government, industry and the community. Proposes a regional economic strategy, workforce development planning, preferred settlement planning, and regional transport investigation and planning.	▪ Regular liaison with Steering Committee to identify and address cumulative impacts ▪ Participation in relevant working groups and task forces ▪ Work through DEEDI's designated Community Liaison Officer with regard to land access to minimise disruption for landholders. This officer is also responsible for coordinating key messages and information distribution to avoid fatigue for landholders affected by multiple projects
Cumulative Growth Management Framework	Product of the Surat Basin Future Directions Statement. Will focus on processes to assess cumulative impacts and mechanisms to implement the outcomes of the EIS process. Will also consider the issue of industry contributions to cumulative impacts of growth, and negotiations with relevant stakeholders will be undertaken in this	▪ Ongoing liaison with Future Directions Steering Committee to review draft framework and contribute to its finalisation

Existing Initiative	Description	Potential SunWater Actions
	regard.	
OESR Cumulative Population Projections	Regular population projection updates, which account for the development of projects across the study area.	▪ Regularly update the SIMP to reflect changes in population projections across the study area

In addition to the above, ongoing consultation and communication with the BSC and WDRC, as well as relevant Queensland Government agencies (e.g. DoC, Queensland Police, Queensland Health, Department of Transport and Main Roads, DEEDI and DET) and other project proponents in the study area will also help to ensure the early identification of potential issues relating to the construction and operation of the Project.

27.4. Conclusion

This section has presented an overview of the impacts of the Project and the potential for cumulative impacts arising from the Project construction and operation. Three Project activities (vegetation clearing/inundation, operation of the storage and potential spread of weeds) were identified as having the potential to cause long term cumulative impact, whilst three short-term cumulative impacts associated with multiple projects within the vicinity of the pipeline route (increased heavy vehicle haulage, increase in workforce and changes to community values and cohesion) were addressed.

With respect to vegetation clearing/inundation, a Vegetation Clearance Management Plan will be developed for the Project to manage clearing and minimise the impacts on vegetation. There will however be an unavoidable loss of remnant vegetation and as such an offsets strategy will be developed to comply with the legislative requirements.

To determine potential cumulative impacts associated with changes to downstream flows, a cumulative impacts scenario was modelled in order to represent the infrastructure currently proposed for the basin. Overall, the impacts of the Cumulative Impacts scenario are moderate and able to be managed through a combination of environmental flow releases and management rules. These will need to be developed as the proposed infrastructure is approved and finalised.

To minimise the potential for the spread and introduction of weeds from the outset of construction of the dam and pipeline, a weed management plan will be developed for construction and operation of the Project. This will include use of wash-down facilities for construction vehicles and equipment, weed inspection and control and monitoring.

Should a number of projects currently undergoing environmental approvals commence construction concurrent to the Project's construction phase, the surrounding state and local roads would experience a considerable increase in additional traffic demand. These additional demands will be managed through a Road Use Management Plan (RUMP) and associated Traffic Management Plans (TMPs) developed in consultation with Queensland Department of Transport and Main Roads, local Police and councils. SunWater will also liaise with other parties currently or planning to add significant volumes of traffic onto the surrounding road network.

To minimise cumulative social impacts on local communities during pipeline construction, ongoing consultation and communication with the Banana Shire Council, Western Downs Regional Council, relevant Queensland Government

agencies (e.g. DoC, Queensland Police, Queensland Health, Department of Transport and Main Roads, DEEDI and DET) and other project proponents in the study area, will be undertaken.

The Project will provide an overall positive economic impact in terms of providing additional water security to support the development of the coal mining industry and to ensure water supplies for regional urban development.