CONTENTS

TABLES

FIGURES

4. TOPOGRAPHY AND GEOMORPHOLOGY

This Chapter addresses Section 3.2.1 of the ToR.

4.1. Methodology

Topography and geomorphology have been described for the Project. Descriptions are based on topographic mapping, interpretation of aerial photography, review of published information, and field observation.

Potential impacts have been assessed from likely levels of disturbance to natural features and, where appropriate, mitigation strategies have been developed based on the levels of disturbance and recognised mitigation techniques. The potential impacts of the dam on the fluvial geomorphology are assessed in Chapter 14.

4.2. Description of environmental values

4.2.1. Dam and surrounds

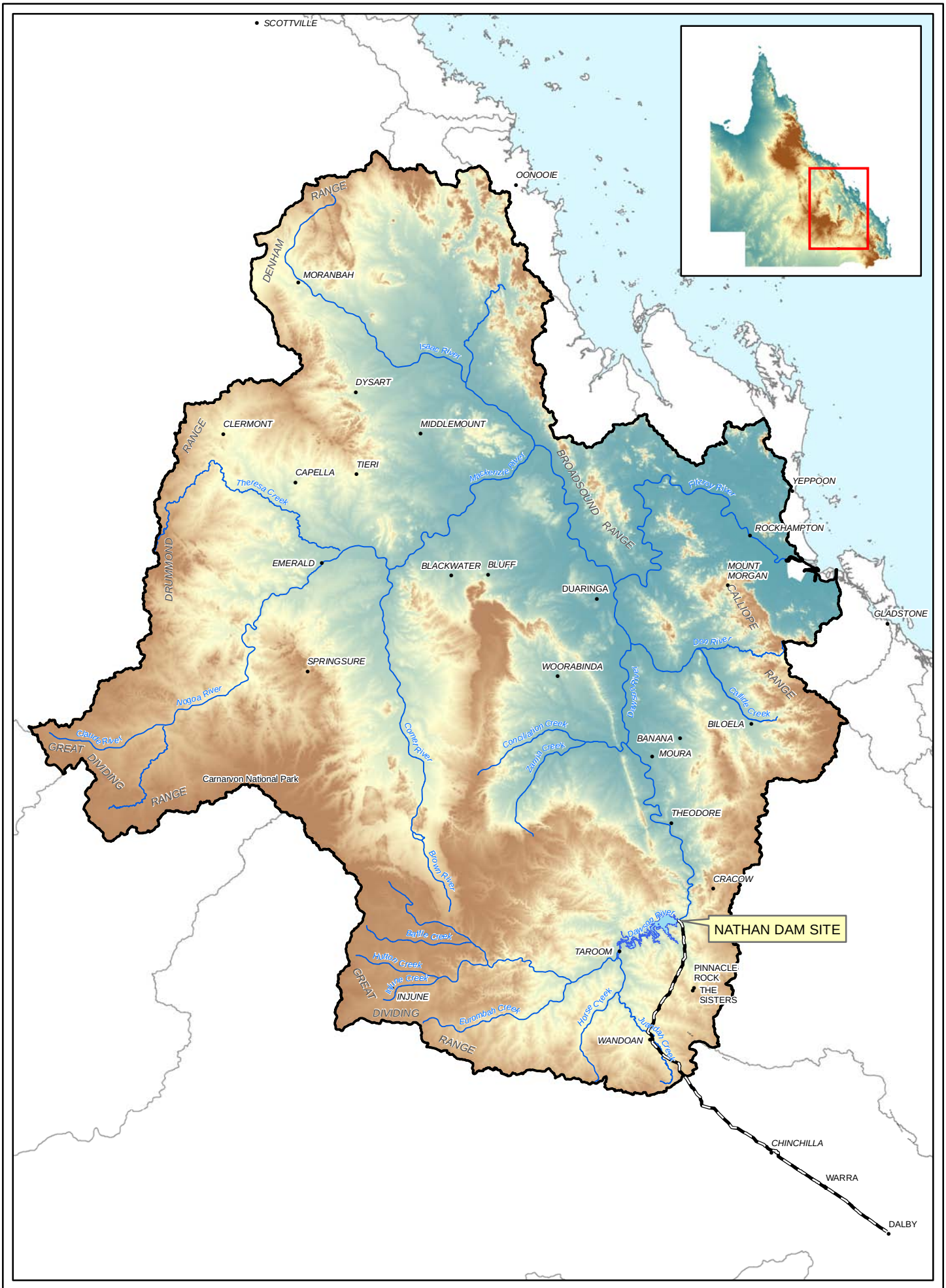
The Dawson River rises in the south-east part of Carnarvon National Park , approximately 336 km upstream of the proposed dam (Figure 4-1). It flows south-east for approximately 225 km then bends to the north-east past Taroom and Glebe Weir (Figure 4-2). Approximately 6 km downstream of the dam site, the Dawson River bends to the north in Nathan Gorge and generally continues in this direction until it joins the Mackenzie River to become the eastward-flowing Fitzroy River north-east of Duaringa.

The catchment area of the Dawson River upstream of the dam site is approximately 23,185 km^2 or 46% of the total catchment area of the Dawson River. This upstream catchment is bounded by the:

- Carnarvon, Expedition and Bigge Ranges to the north;
- Great Dividing Range to the west and south; and
- Auburn Range to the east.

Significant topographic features around the water storage area include:

- Glebe Mountain – maximum elevation approximately 330 m AHD;
- Mount Kinnoul – maximum elevation approximately 380 m AHD;
- The Peak – maximum elevation approximately 350 m AHD;
- the eastern end of the Lynd Range separating Kinnoul Creek, a minor tributary of the Dawson River, from Robinson Creek, a tributary of Palm Tree Creek;
- the eastern end of Murphy Range separating Robinson Creek from Palm Tree Creek;
- Mount Moss – peak elevation approximately 450 m AHD; and
- Nathan Gorge downstream of the dam site.



LEGEND

- Towns
- Proposed Pipeline
- Major Watercourses
- Full Supply Level (185.3 m AHD)
- Fitzroy River Catchment

Elevation

High : 1247 m

Low : 0 m

Projection: GDA94

Figure 4-1

0 20 40 80

Kilometres

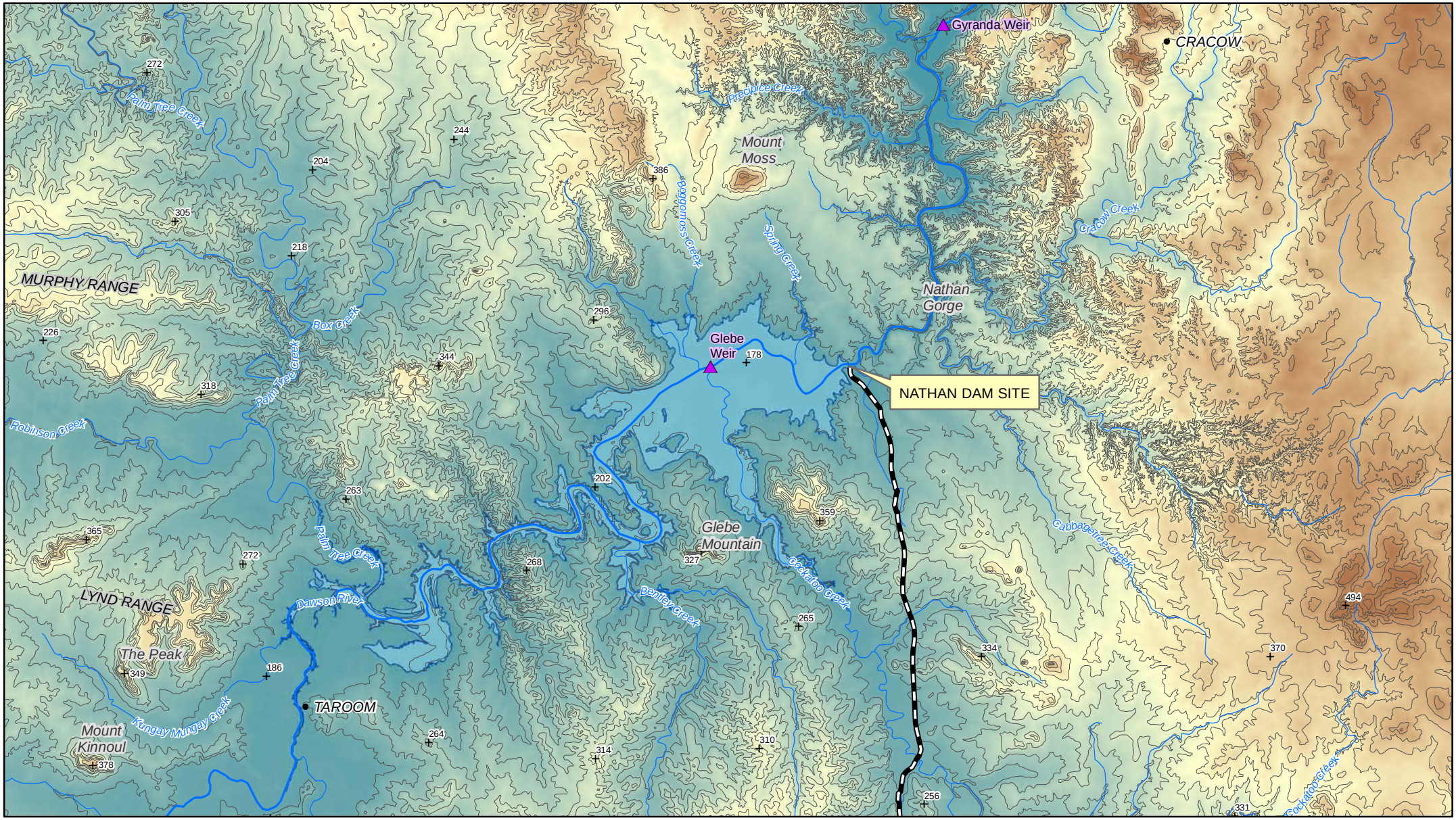
N

Scale 1:3,000,000 (at A4)

NATHAN DAM AND PIPELINES EIS

Fitzroy Basin showing major streams and topographic features

I:\QENV2\Projects\QE40192\400 - Nathan - Spatial\ArcMXD\Figures\040_Topography_Geomorphology\Figure_4-1_FitzroyBasin_TopoFeaturesV2.mxd Produced: 14/06/2011



LEGEND

- Spot Elevation
- Towns
- Weir
- Watercourse
- Dawson River
- Proposed Pipeline
- Contours (20m Interval)
- Full Supply Level (183.5m AHD)

Elevation (m)

High : 1146

Low : 88

Projection: GDA94 Zone 56

Figure 4-2

0 1 2 4 6
Kilometres

N

Scale 1:300,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Topography and significant landscape features in the vicinity of dam

I:\QENV2\Projects\QE40192\400 - Nathan - Spatial\ArcMXD\Figures\040_Topography_Geomorphology\Figure_4-2_Topography_and_LandscapeFeatures_NathanDam_v2.mxd Produced: 9/6/2011

In and surrounding the water storage area, landforms range from level plains to rolling low hills, some of which have plateaus on their crests (McDonald *et al*., 1990). Landforms around the dam site are classed as steep low hills. The steep rock walls on both sides of the broad river channel that characterise Nathan Gorge commence immediately downstream of the Price Creek junction approximately 0.3 km downstream of the dam site and depth of incision increases with distance downstream.

4.2.2. Pipeline

The route of the pipeline from Nathan Dam to Dalby is shown in Figure 4-3 and Figure 4-4.

Significant topographic features in the vicinity of the pipeline include:

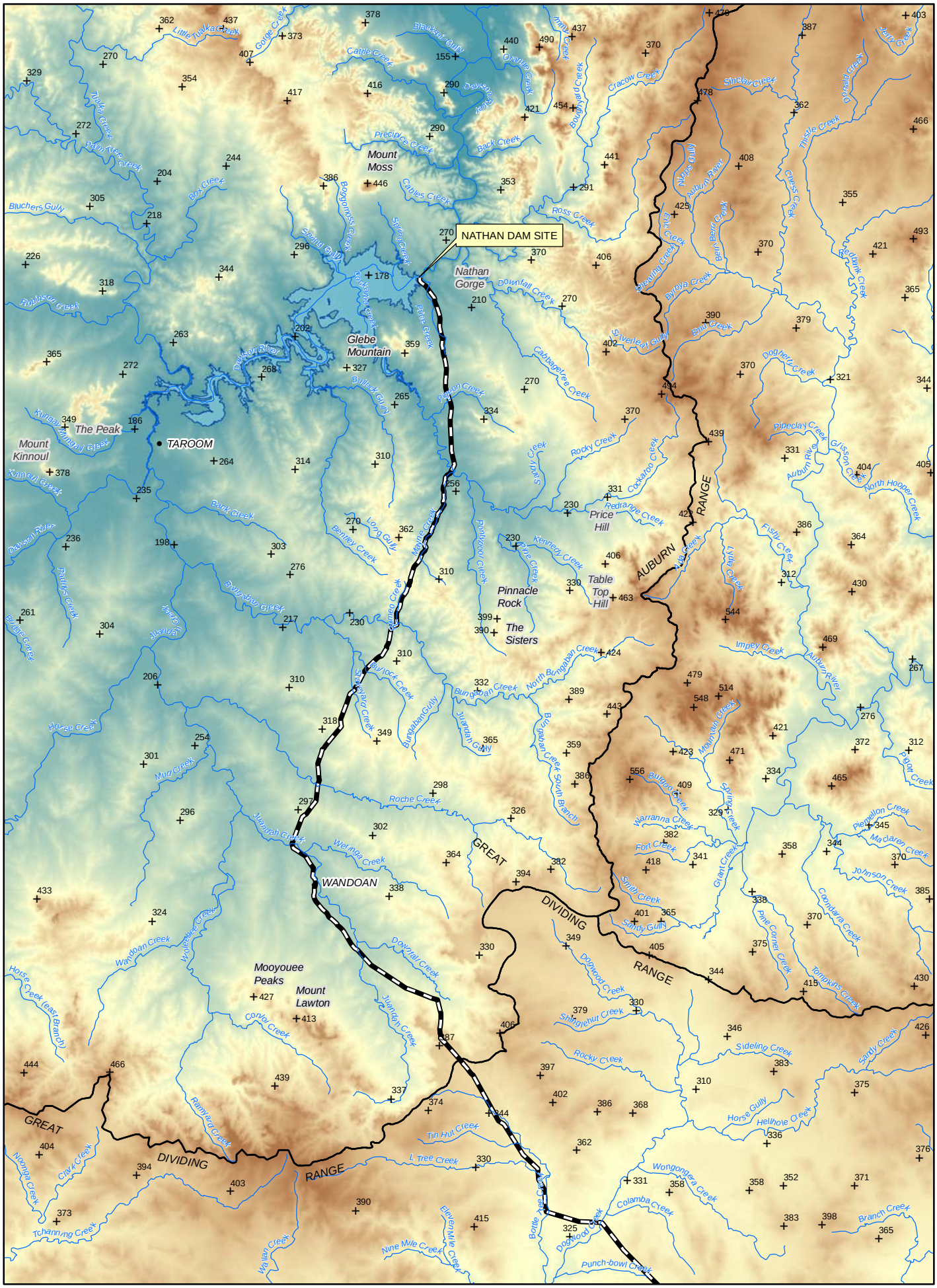
- Glebe Mountain;
- Mount Pinnacle Rock;
- The Sisters;
- Mooyouee Peaks;
- Mount Lawton;
- the Great Dividing Range; and
- Miles Hill.

The pipeline from Nathan Dam to the crossing of the Great Dividing Range lies within the Nathan Dam catchment and the geomorphology of the Nathan Dam catchment has been considered (Section 4.2.1).

The landscapes of the Condamine River catchment have undergone similar cycles of erosion as the Dawson River Catchment and there are similarities in the sedimentary rocks that dominate the underlying geology along the pipeline. Between Nathan Dam and Warra, the pipeline traverses relict alluvial plains and clay plains. In addition, there are also floodplains forming along some of the larger drainage lines. Relict alluvial plains and floodplains also dominate the landscape between Warra and Dalby.

4.2.3. Associated infrastructure

The associated infrastructure is located within the area of the dam and surrounds and the pipeline. As such, the topography and geomorphology relevant to associated infrastructure is as described in Section 4.2.1.



LEGEND

- Spot Elevations
- Proposed Pipeline
- Watercourse
- Drainage Basin
- Full Supply Level (183.5m AHD)

Elevation (m, AHD)

High : 1146

Low : 88

Projection: GDA94 Zone 56

Figure 4-3

0 2.5 5 10
Kilometres

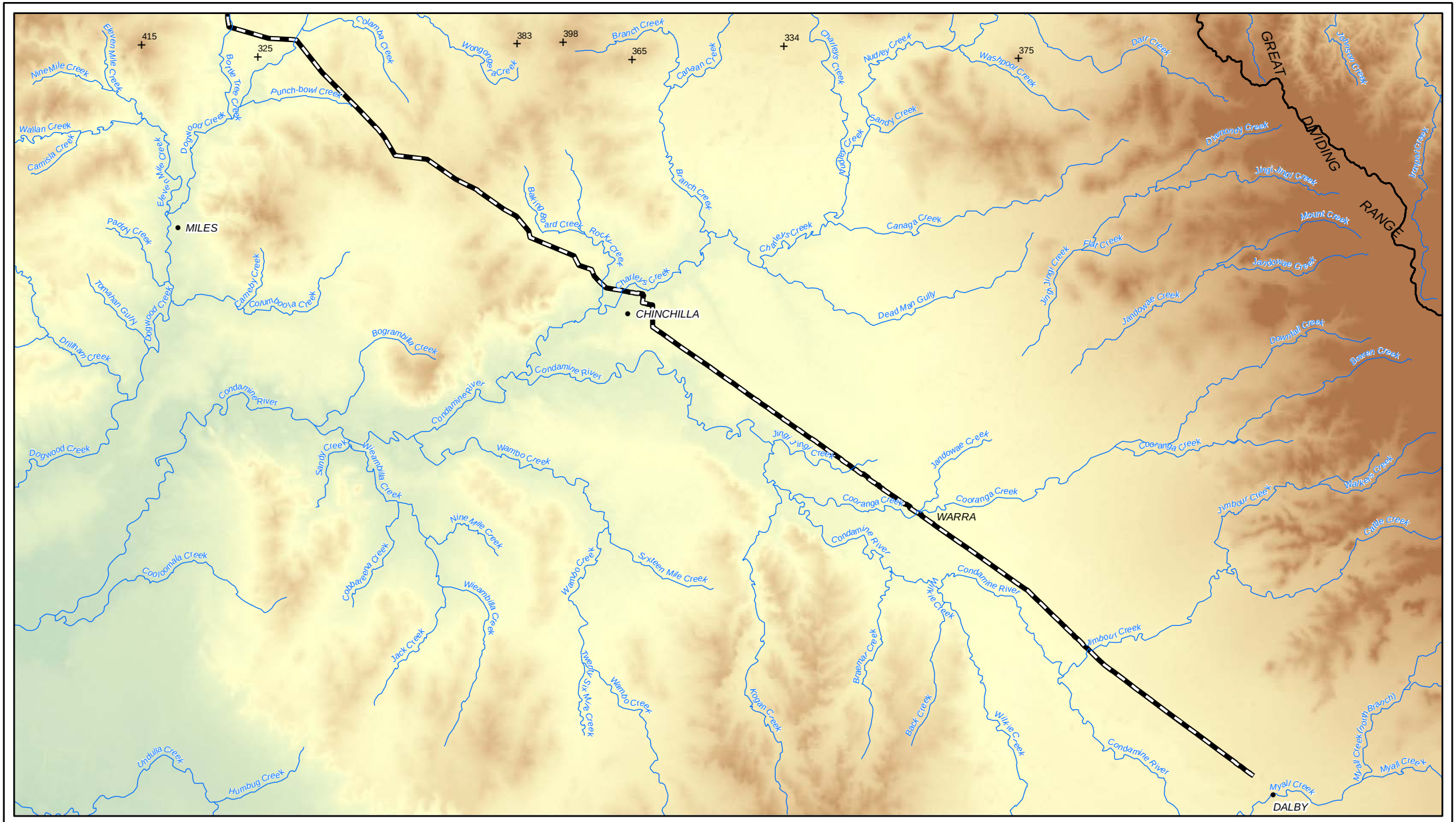
N

Scale 1:600,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Topography and significant landscape features in the vicinity of pipeline between Nathan Dam and Miles



LEGEND

- Towns
- Spot Elevations
- Proposed Pipeline
- Watercourse
- Drainage Basin

Elevation (m, AHD)

High : 1146

Low : 88

Projection: GDA94 Zone 56

Figure 4-4

0 2.5 5 10
Kilometres

N

Scale 1:500,000 (at A4)

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Topography and significant landscape features in the vicinity of pipeline between Miles and Dalby

I:\QENV2\Projects\QE40192\400 - Nathan - Spatial\ArcMXD\Figures\040_topography_Geomorphology\Figure_4-4_Topography_and_LandscapeFeatures_Pipeline2_v2.mxd Produced: 9/06/2011

4.3. Potential impacts and mitigation measures

4.3.1. Dam and surrounds

The dam will have the effect of inundating areas that lie below the FSL of 183.5 m AHD. The dam site is just upstream of Nathan Gorge, the bed of which is already partly inundated by the tailwater of Gyranda Weir. The duration and frequency of flooding of the channel bed and adjacent floodplain areas will, however, change. Other topographic features in close proximity to the storage area are Glebe Mountain and ridges north-east of Cockatoo Creek and south-west of Spring Gully. Steeper slopes associated with these three features all commence above 200 m AHD so the storage will not encroach on them, nor will it isolate them or restrict access to them. None of the other significant features mentioned in Section 4.2.1 will be impacted by the Project.

The storage formed by the dam will create a number of islands when it is at FSL. Most of these will be in areas of alluvial material upstream of approximately 366 km AMTD. At FSL, only shallow water will separate the islands from the storage margin. Due to the expected low gradients at margins of islands, and given areas within 1.5 m (vertical) of FSL or where significant vegetation is near FSL will not be cleared, no strategies are proposed to manage the consequences of islands.

Geomorphic effects of the water storage resulting from changes to the Dawson River and creek-related fluvial processes such as sediment transport and deposition are considered in Chapter 14. This section discusses possible geomorphic issues associated with the construction site.

Dam construction works will temporarily disrupt the landscape and natural flow paths in work areas and the dam wall, and associated infrastructure such as permanent access roads around the site will cause permanent disruption. Landscape disturbance and changes to flow paths have the potential to cause landscape instability, particularly accelerated erosion. Erosion and sedimentation management measures will be developed to minimise erosion during construction and ensure appropriate rehabilitation of the site, which have been detailed in Section 6.2. Additional impact mitigation strategies that could be considered to specifically manage potential landscape changes during construction include:

- planning site access tracks and similar infrastructure to provide the minimum network for safe work practices and traffic management; and
- construct terraces to graduate steep slopes such as cut and fill areas and clay borrow areas (both above and below FSL).

Objectives for rehabilitation of areas disturbed by dam construction to ensure landscape stability include:

- shaping the land surface so that slopes are at or below those of the natural landscape in the area and are appropriate to the soil materials involved and surface protection measures proposed;
- using exposed rock, which is currently a feature of the natural landscape on both banks of the Dawson River at the dam site but is particularly prominent on steep slopes on the left bank, to provide surface protection on steeper slopes or where terracing may be appropriate;

- using local endemic plant species that are adapted to the area and the soil materials involved for revegetation of disturbed areas;
- fencing to permanently exclude introduced livestock from areas where trees and shrubs and their leaf fall will provide long-term surface protection, and to control grazing where grasses will provide surface protection; and
- monitoring vegetation establishment and persistence and replacing trees and shrubs that fail to establish and persist, possibly with hardier species.

4.3.2. Pipeline

The buried pipeline from Nathan Dam to Dalby crosses landforms ranging from level plains to rolling to steep low hills and crosses the Great Dividing Range. Construction and operation of the pipeline will have no appreciable impacts on topographic features along the route. The largest item of above ground infrastructure is the 600 ML balancing storage which equates to similar turkeys nest on-farm storages in the catchment so will not be out of place. It will be in a relatively isolated location.

A large volume of spoil will be generated because of the size of the pipe to be buried and the volume of bedding material that will be placed around it. This spoil has the potential to affect landscape stability if it is not disposed of appropriately.

Options for the disposal of spoil which are noted in the Project Description include:

- using the spoil to fill and reclaim existing gully erosion – with adequate shaping, soil cover, and probably flow diversion;
- creating a shallow broad mound over the pipeline covering it with topsoil and revegetating with grasses – this option must be used with care to avoid diverting overland flows and will not be appropriate on level plains subject to flood flows such as those between Warra and Dalby;
- identifying areas on the affected property where spoil can be utilised; and
- trucking excess spoil to Dalby for placement at Western Downs Regional Council's licensed waste disposal facilities where there is an ongoing demand for waste cover material.

Additional options for spoil disposal could include:

- using the spoil as additional fill for railway embankments along the Surat Basin Railway which will be near to the pipeline for part of the route adjacent to Nathan Road; and
- placement as fill in coal mine voids such as those at Kogan and Wilkie Creek and the recently approved Wandoan Coal mine.

Options that result in productive use are preferred.

Pipeline construction works will be undertaken in general accordance with the Australian Pipeline Association Guidelines Code of Environmental Practice for Onshore Pipelines (APIA, 2009).

4.3.3. Associated infrastructure

The proposed access road to the dam site avoids significant topographic features and will not have any appreciable impact on topography. Also, the upgrades or other changes to existing roads that are proposed around the storage require only minor changes so will not impact on the topography.

Road construction works will be undertaken according to the appropriate Banana Shire and/or Main Roads guidelines (QDMR, 2004). These should ensure the long-term stability of the resultant works and any adjacent disturbed landscapes. Generally, the strategies to be applied to ensure landscape stability and the objectives for rehabilitation of disturbed areas during dam construction works should be applied.

Clay borrow areas and areas with steep slopes, though below FSL, will require re-contouring.

4.3.4. Impact assessment and residual risks

The methodology used for risk assessment and management is discussed in Section 1.8.

This section assesses the risks relevant to topography and geomorphology and summarises the mitigation measures proposed to minimise those risks.

Unmitigated and mitigated consequence and likelihood ratings for the identified hazards are shown with explanatory notes in Table 4-1. The risk assessment is of the Project as described in Chapter 2, in which SunWater has already incorporated a range of risk reduction and mitigation measures.

Based on this assessment, the following conclusions can be made:

- inundation of areas that lie below FSL of 183.5 m is inevitable;
- changes to landscape character resulting from the construction of the dam and other infrastructure (such as roads) are inevitable; and
- rehabilitation and landscaping will soften edges and shield some of the infrastructure items.

Overall the risks to topography and geomorphology are low to medium. Based on this risk assessment, the risks relevant to topography and geomorphology can be effectively managed and the residual risks are acceptable.

Table 4-1 Risk assessment results

Hazards	Factors	Impacts	Project Description Controls and Standard Industry Practice	Risk with Controls			Additional Mitigation Measures	Mitigation Effectiveness	Residual Risk		
				C	L	Current Risk			C	L	Mitigated Risk
Change in landforms and landscape character.	There is no long term impact on the pipeline, only within the water storage area	Inundation of areas that lie below FSL of 183.5 m AHD inevitable. Creation of a lake.	Sediment and Erosion Control Plan. Landscape Management Plan	Minor	Absolute	Medium			Minor	Absolute	Medium
	Creation and construction the dam and other infrastructure (such as clay borrow areas)	Landform will change with the construction of the dam and water storage area.	While the presence of these landform features is unavoidable, the creation of a water body not usually associated with the area will benefit the area.								
		Dam is a large single structure in a natural surrounding as is the balancing storage.	Rehabilitation and landscaping to soften edges and shield some of the infrastructure items								

4.4. Summary

This section has assessed the potential impact of the Project on topography and geomorphology in the Project area. The Project will have a significant and permanent impact on topography and geomorphology as a result of the creation of the water storage area. This impact is acceptable because the changes produce significant direct benefits (a lake and associated recreation opportunities). Other components of the Project have minor impacts. The residual risks relevant to topography and geomorphology are acceptable and can be effectively managed. Erosion issues related specifically to soil and fluvial geomorphology are addressed in Chapter 6 and Chapter 14 respectively.