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FIGURES

2. DESCRIPTION OF PROJECT

2.1. Project overview

The Project is the construction and operation of Nathan Dam on the Dawson River in Central Queensland and associated water distribution infrastructure (Figure 2-1).

Water from the dam will be distributed via a trunk pipeline to primarily service coal mines and power stations (and associated urban communities) in the Surat Basin, extending to Dalby (Figure 2-3). Water will also be released downstream to towns along the Dawson River, to new mining customers in the Southern Bowen Basin, and to existing irrigation customers in the Dawson Valley Water Supply Scheme. Water may also be reserved within the storage as required to meet critical urban supply needs in the lower Fitzroy and other parts of Queensland in line with the government's objective to establish a state water grid.

The dam wall will consist of an Earth and Rockfill (E&R) embankment spanning 1240 m. The main spillway is situated on the right abutment. The capacity of the dam will be 888,312 Megalitres (ML) at a Full Supply Level (FSL) of 183.5 m Australian Height Datum (AHD) and it will inundate an area of approximately 13,508 ha (with an additional 316 ha of islands created) from a catchment of 23,185 km^2 (Figure 2-1 and Figure 2-2). The dam FSL will inundate 75.2 km of the Dawson River from Adopted Middle Thread Distance (AMTD) 315.3 km to 390.5 km, although 30.3 km of this length is already occupied by the existing Glebe Weir which extends from AMTD 326.2 km to 356.5 km.

The pipeline will be buried along most of the route and largely follow existing easements south then southeast over a distance of approximately 260 km from Nathan to Dalby. It will be capable of delivering 136 ML/day, with the design discharge reducing down the system. The delivery system will include four pump stations and three balancing storages, as well as air valves, scour points, surge tanks and standpipes. Potential future lateral delivery pipelines are not included in this Project (Section 1.4).

The Project also includes the following components:

- establishing clay borrow areas (all other materials such as sand and rock will be sourced from commercial suppliers);
- constructing a dam site access road;
- relocating, raising or otherwise upgrading sections of local government roads and state controlled roads;
- providing new property access where required;
- relocating local power and telecommunications infrastructure and providing new infrastructure;
- removing or treating redundant infrastructure (such as Glebe Weir);
- relocating private infrastructure required to support continued use of land not affected by the Project;
- constructing various related facilities such as offtake and outlet works, fish and aquatic fauna transfer device, protective works and recreational facilities;
- establishment of temporary material lay-down areas;

- installing new gauging stations at the headwater and tailwater of the dam and at major tributaries upstream of the dam (including rainfall gauges strategically located throughout the catchment area); and
- providing access tracks to the pipeline.

LEGEND

- Major Roads
- Major Rivers
- Major Creeks
- Full Supply Level 183.5 AHD
- Catchment Boundaries
- Nathan Dam Catchment

Projection: GDA94 Zone 56

Figure 2-1

0 6.25 12.5 25 37.5

Kilometres

Scale 1:1,250,000 (at A4)

SW 233056A

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Catchment area

Operation of the water storage involves management of the infrastructure (including a small buffer area to the infrastructure), and the land inundated by the water at FSL. This definition represents the minimum land purchase area for the water storage area.

SunWater will also obtain an easement over land above the FSL based on the peak surface water level reached during a 1 in 100 AEP (Annual Exceedance Probability) flood. The ownership and management of this land will remain the responsibility of the respective land owners.

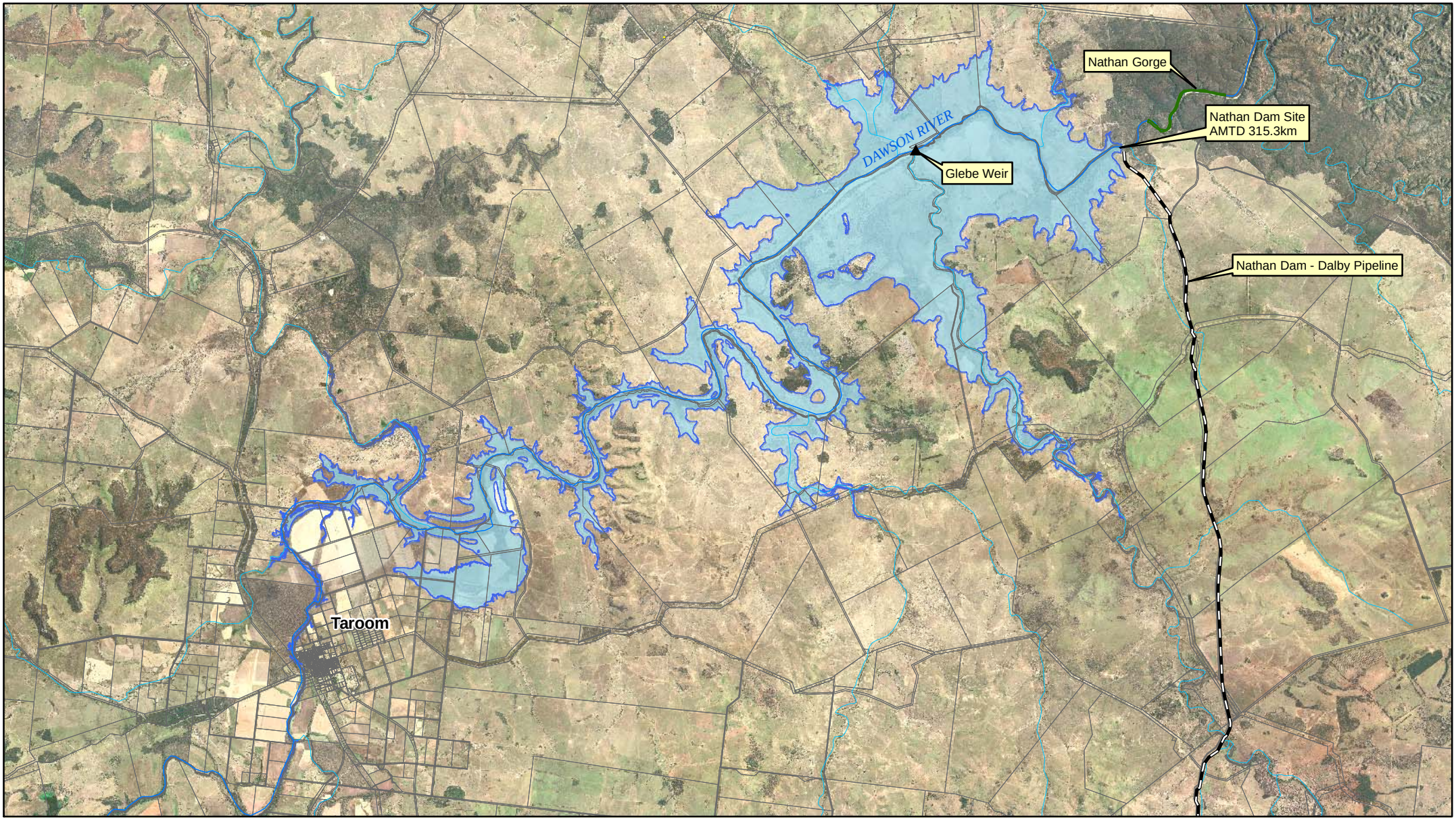
Operation of the pipeline involves maintenance of the pipes, valves, surge tanks, standpipes, scour points, access tracks and other structural components primarily with a permanent easement of 15 m width. An easement of 30 m width will be required for construction. It also includes balance tanks and pump stations for which land will be acquired. In some cases land may also be acquired for surge tanks.

All of the above components represent the proposed Project Designation Area referred to in the EIS text as the Project Area.

The Project has been divided into seven primary sections for the purpose of the Environmental Assessment. These comprise the:

- dam and surrounds – includes the dam construction footprint and water storage area
- dam construction footprint – the dam wall footprint, embankments, spillway, site offices, associated facilities and immediate downstream works area (Figure 2-25);
- water storage area – the area inundated at FSL plus the flood margin (Figure 2-2);
- pipeline – including pipeline, pipeline infrastructure such as valves, surge tanks, standpipes, scour points and easements / access agreements covering construction and operational requirements (Figure 2-5);
- associated infrastructure footprint – the location of clay borrow areas, road works, construction camps and realignment of any associated infrastructure;
- downstream – the Dawson River and Fitzroy River downstream of the Project ending at the Great Barrier Reef World Heritage Area (Figure 2-3);
- potential benefited areas, being areas that receive water from the Project;
  - downstream areas (Dawson Valley Water Supply Scheme, Bowen Basin mining and industrial areas, Lower Fitzroy Water Supply Scheme, State Water Grid (Figure 2-3); and
  - potential pipeline lateral access areas (Surat Basin mines, urban areas, power stations, other industry).

The capital cost of the Project is $1400 million (at preliminary design accuracy). The aim is to commission the Project in June 2016. Pending approvals, the construction period is programmed for between July 2013 and June 2016. This will include a six month early works program in the latter half of 2013 where the required road upgrades are performed and site facilities are established prior to the commencement of dam and pipeline construction activities in January 2014.



LEGEND

Full Supply Level 183.5 AHD

Projection: GDA94 Zone 56

Figure 2-2

0 1.5 3 6

Kilometres

Scale 1:200,000 (at A4)

N

SW 233205B

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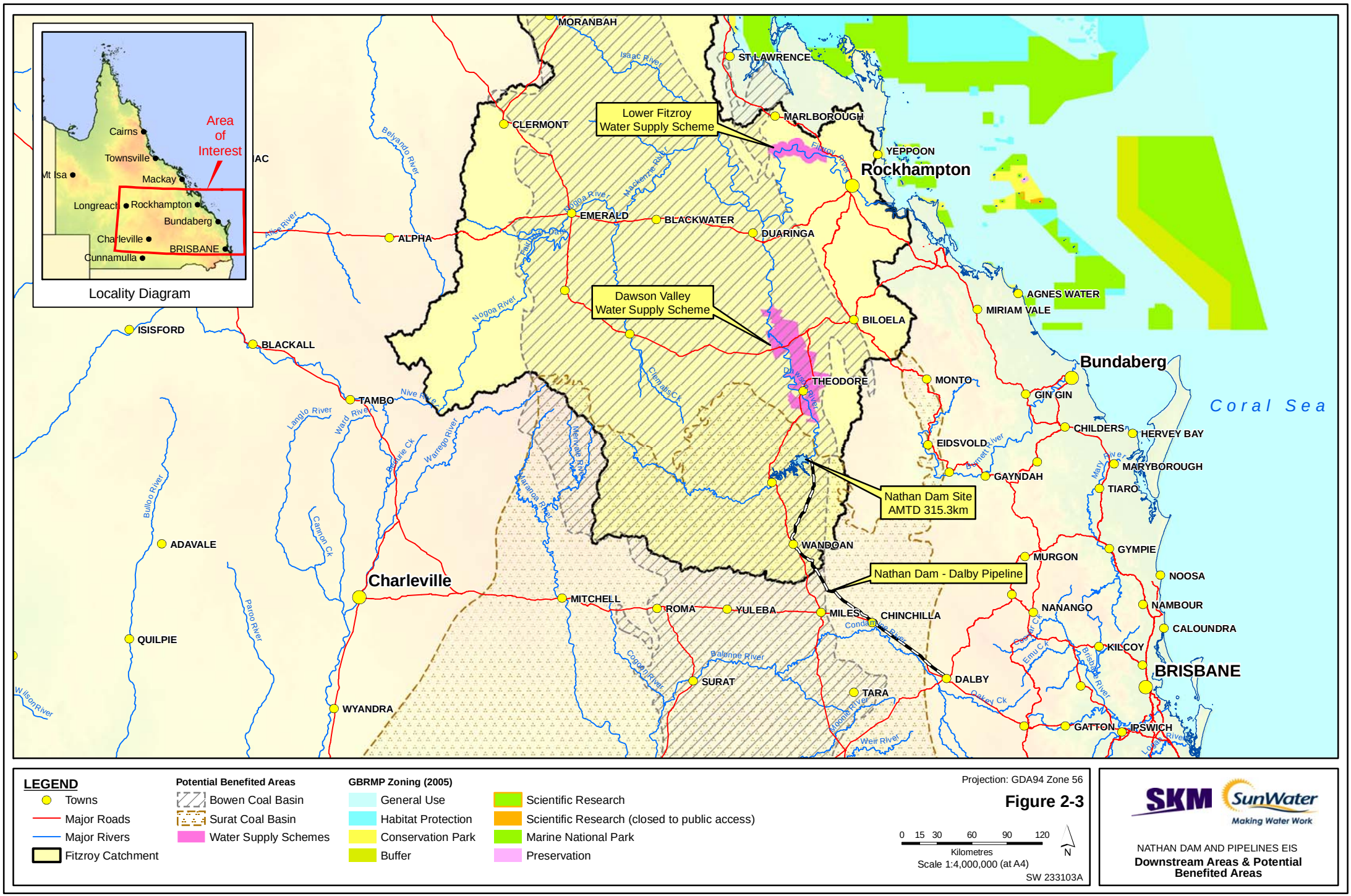
NATHAN DAM AND PIPELINES EIS

Water storage area


Locality Diagram
Area of Interest
Cairns
Townsville
Mackay
Rockhampton
Longreach
Bundaberg
Charleville
BRISBANE
Cunnamulla
Mt Isa
Lower Fitzroy Water Supply Scheme
Dawson Valley Water Supply Scheme
Nathan Dam Site AMTD 315.3km
Nathan Dam - Dalby Pipeline
MORANBAH
ST LAWRENCE
CLERMONT
MARLBOROUGH
YEPPOON
Rockhampton
EMEROLD
BLACKWATER
DUARINGA
ALPHA
AGNES WATER
MIRIAM VALE
BILOELA
ISISFORD
BLACKALL
THEODORE
MONTO
Bundaberg
GIN GIN
TAMBO
CHILDERS
HERVEY BAY
EIDSVOLD
MARYBOROUGH
GAYNDAH
TIARO
Coral Sea
WANDOAN
GYMPIE
MURGON
NOOSA
ADAVALE
Charleville
MITCHELL
ROMA
YULEBA
MILES
CHINCHILLA
NANANGO
NAMBOUR
CALOUNDRA
QUILPIE
KILCOY
BRISBANE
SURAT
DALBY
TARA
WYANDRA
GATTON
IPSWICH
Isaac River
Belyando River
Fitzroy River
Mackenzie River
Nogoa River
Alice River
Nogoa River
Dawson River
Nive River
Langlo River
Ward River
Warrego River
Bullloo River
Cannon Ck
Paroo River
Wilson River
Merivale River
Maranoa River
Condamine River
Balonne River
Cogoon River
Moonie River
Weir River
Logan River
Brisbane River
Emu Ck
Oakey Ck
Coomera River
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Towns
Major Roads
Major Rivers
Fitzroy Catchment
Potential Benefited Areas
Bowen Coal Basin
Surat Coal Basin
Water Supply Schemes
GBRMP Zoning (2005)
General Use
Habitat Protection
Conservation Park
Buffer
Scientific Research
Scientific Research (closed to public access)
Marine National Park
Preservation
Projection: GDA94 Zone 56
Figure 2-3
0 15 30 60 90 120
Kilometres
Scale 1:4,000,000 (at A4)
N
SW 233103A
SKM
SunWater
Making Water Work
NATHAN DAM AND PIPELINES EIS
Downstream Areas & Potential Benefited Areas

The dam and water storage area incorporates the following environmental and social design features:

- multi-level offtake to enable the best quality water to be extracted;
- outlet mechanisms that provide flexible options for environmental flow releases;
- outlet mechanisms that provide for re-aeration of the water released downstream;
- aquatic fauna transfer devices;
- design consideration and protective mechanisms to avoid or mitigate injury to fauna during operations;
- provision of structural habitat for fish and other fauna;
- lease conditions that provide for management of the edges of the storage and riparian zone;
- recreational facilities; and
- operation phase monitoring that addresses water quality, ecology and human use.

The Project also includes an Environmental Management Plan (EMP) that incorporates the impact mitigation measures identified in this assessment. Vegetation and biodiversity impacts which cannot be entirely mitigated will be offset through a package of measures including vegetation and habitat protection and rehabilitation.

2.2. Location

2.2.1. Water storage area

The dam is located on the Dawson River at AMTD 315.3 km, approximately 75 km downstream of Taroom along the river, some 11 km downstream of Glebe Weir and 8 km upstream of Nathan Gorge (Figure 2-2). Gyranda Weir is below Nathan Gorge and some 30.8 km downstream from the dam site. The total river distance from the dam site to the Fitzroy River mouth is approximately 620 km (Figure 2-3). This site was selected through a process described in Section 1.6.

The major land uses in the immediate area are grazing with some irrigation, primarily of fodder, near the Dawson River.

Taroom is the closest town upstream of the dam and has a population of 607 (ABS 2006 census). Theodore is the closest town downstream (85 km) and has a population of 430. The latitudes and longitudes of the dam (including the water storage) are summarised in Table 2-1 with the Nathan Dam wall being sited as follows:

- Latitude 25:27:51S
- Longitude 150:06:52E

Table 2-1 Bounding location points delineate the dam wall and water storage area

Location Point	Latitude			Longitude		
	degrees	minutes	seconds	degrees	minutes	seconds
North West	25	25	35	149	46	46
North East	25	25	35	150	06	57
South East	25	41	02	150	06	57
South West	25	41	02	149	46	46

The precise location of the dam wall (Figure 2-15) and that of the associated works may be subject to minor changes when further detailed site and geological investigations have been carried out. This fine tuning will not materially affect the information provided in this EIS, or the conclusions from the impact assessment.

The water storage area is entirely within Banana Shire whilst the pipeline commences in Banana Shire and extends into Western Downs Regional Council (WDRC) area. The downstream distribution area constitutes the Dawson Valley Water Supply Scheme and the Dawson and Fitzroy rivers as included within the Fitzroy Basin Water Resource Plan .

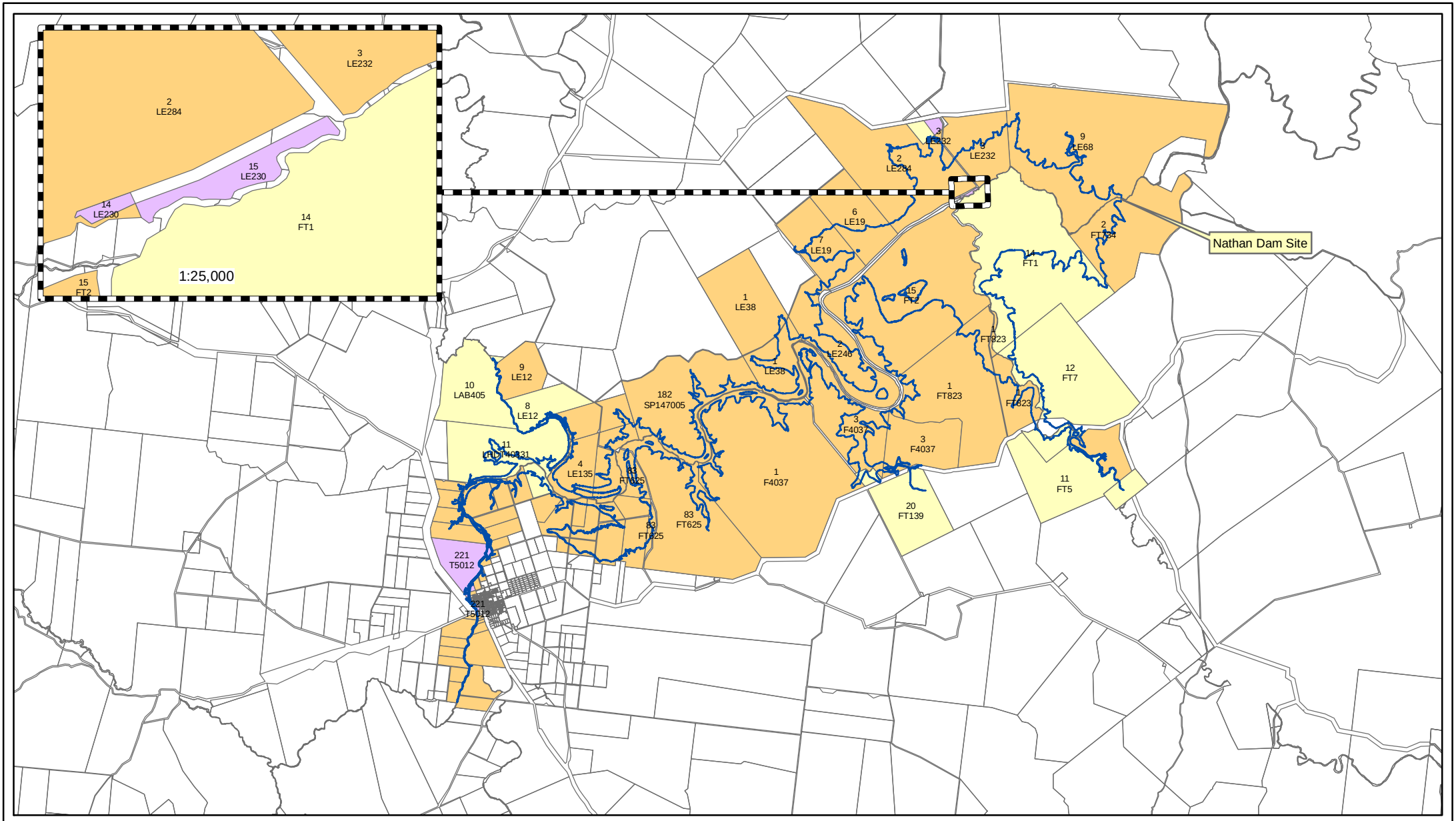
The dam construction footprint includes the dam wall, embankments, spillway, dam access road, associated infrastructure and facilities and a buffer for this area, as well as the water storage and flood margin areas. It also includes an area immediately downstream of the wall that may be physically impacted by released water. This entire area has been included in the impact assessment process.

The water storage at FSL will potentially have direct impact on approximately 74 land parcels (Table 2-2). These range from small holdings on the outskirts of Taroom to large pastoral leasehold and freehold lots (Figure 2-4).

Table 2-2 Summary of tenure of land within water storage area at FSL

Tenure	Area (ha)	Percentage (%)
Freehold	10 016.0	74.2
Leasehold	2600	19.3
Reserve	22.8	0.2
State Land - roads	244.5	1.8
State Land - watercourse	625.5	4.6

The minimum area of land to be acquired (by purchase or flood easement) for the water storage area is approximately 24,644 ha. This comprises 13,824 ha of area within the FSL, 10,603 ha of flood margin and 217 ha of construction area and buffer. The area of the watercourse within the Project Area is included in these figures. More details on land tenure are provided in Chapter 7 and a list of Real Property descriptions within (partially or wholly) the water storage area is provided in Appendix 2A.



LEGEND

Full Supply Level 183.5 AHD

TENURE

- Freehold
- Leasehold
- Reserve

Projection: GDA94 Zone 56

Figure 2-4a

0 1.25 2.5 5 7.5

Kilometres

Scale 1:250,000 (at A4)

N

SW 233209A

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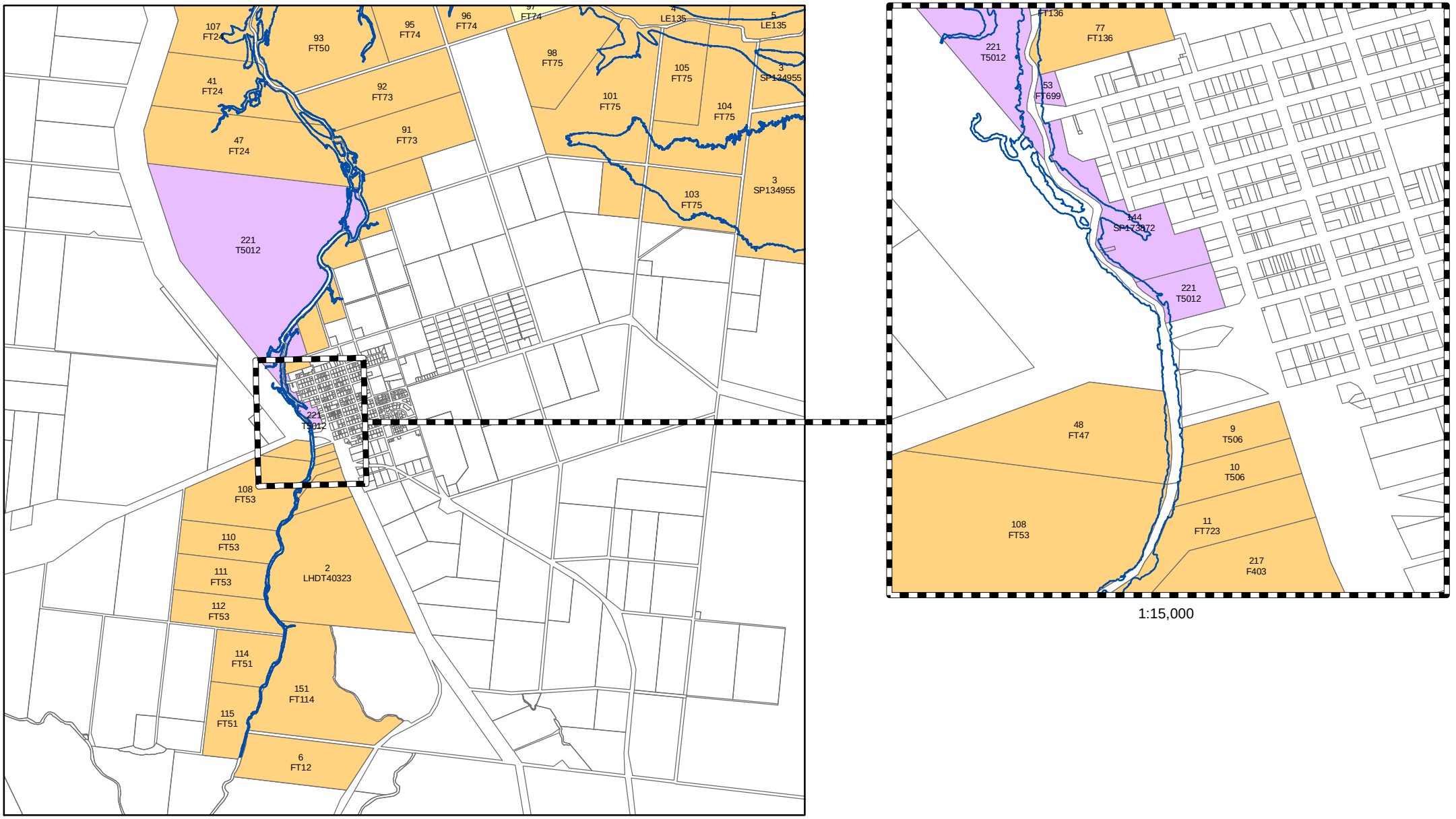
NATHAN DAM AND PIPELINES EIS

Affected Properties (Project Area)



1:15,000

LEGEND

Full Supply Level 183.5 AHD

TENURE

- Freehold
- Leasehold
- Reserve

Projection: GDA94 Zone 56

Figure 2-4b

0 0.25 0.5 1 1.5 2

Kilometres

Scale 1:70,000 (at A4)

N

SW 233210A

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NATHAN DAM AND PIPELINES EIS

Affected Properties (Taroom Area)

The Queensland Government stood in the market for properties related to the Project Area from 1996 to 2009 and currently owns approximately 50% of the required land. In most cases the land is being leased back to the previous landholders. Should the Project be approved to proceed, the Government will continue to seek to voluntarily purchase only that part of a property that is required for the Project. Some landowners may elect to sell their entire properties rather than part, in which case the Government may agree to purchase the whole of their property.

Should the Project be approved, where relevant land cannot be purchased voluntarily, SunWater will seek to have the land or easement compulsorily acquired.

It should be noted that SunWater is not seeking approval for the construction camps as part of the EIS. The exact location of the site offices and construction camp area will be determined during detailed design and in conjunction with the construction Contractor. However, at this stage it is anticipated that they will be sited as follows:

- site office and compound on both banks at the dam site (Figure 2-25); and
- construction camp located in Taroom.

Site access for emergency purposes is addressed in detail in Chapter 20 and Chapter 25.

2.2.2. Pipeline

The pipeline will mainly be buried and follow existing easements (notably road reserves) for approximately 82% of the 260 km route from Nathan Dam to Dalby. SunWater will attempt to locate the pipeline and its associated construction footprint within these existing easements, however in many cases where existing easements do not provide the necessary capacity a new construction or operational easement will be required in adjoining properties.

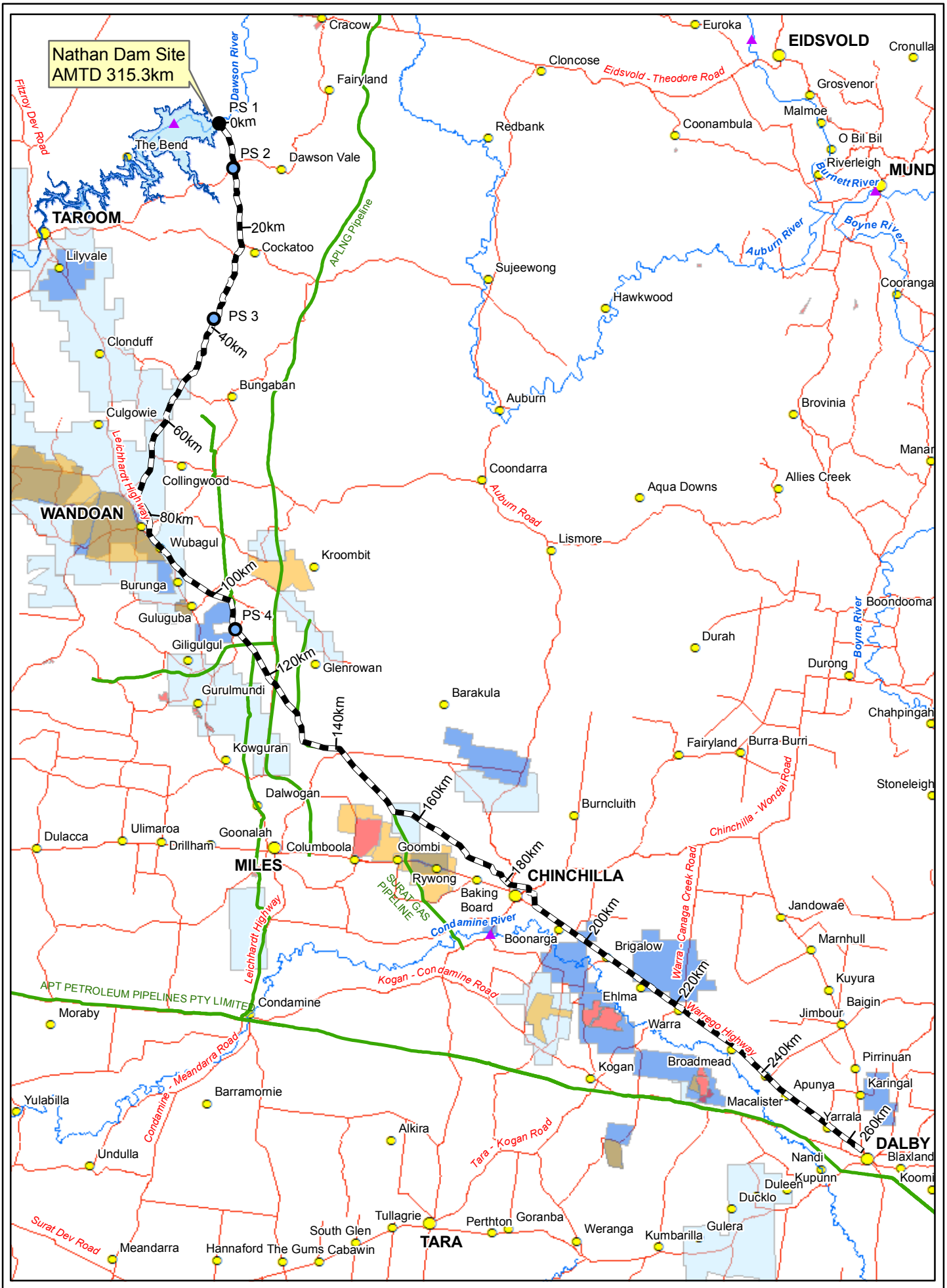
In addition to the pumps at the dam site, three pump stations and associated balancing storages will be required along the route. Air release valves will be required at high points and scour valves at low points. A number of surge tanks and standpipes will also be required to control transient pressure surges due to waterhammer. The smaller items of above ground infrastructure will all be contained within the easement. SunWater intends to acquire ownership of land needed for the larger above ground infrastructure, such as the pump stations and balancing storages. Short access tracks from the nearby road network to the pipeline easement or pump stations will require easements.

End users will access the water from the pipeline via metered offtake points provided as required.

The pipeline extends from the dam to Nathan Road, along Nathan Road to Wandoan, southeast from Wandoan across private property to Chinchilla, then follows the Warrego Highway to Dalby (Figure 2-5). The pipeline has been divided into three areas for planning purposes.

Area 1 is approximately 80 km long and commences at the dam site and ends near Wandoan. It generally follows Nathan Road in private property, but departs Nathan Road to the north of Wandoan and diverts to the east around Wandoan. The area includes a low-lift pump station (Pump station 1) at the dam site adjacent to the outlet works.

A balancing storage and relift pump station (Pump station 2) is required at approximately the 9 km point (Latitude 25:30:24S Longitude 150:08:16E), with an elevation of approximately 205 m AHD. It consists of an open air ring tank and the tank and pump station has an estimated footprint area of 7,500 m^2.



LEGEND

- Pump Station
- Pump Station & Balancing Storage
- Nathan Dam - Dalby Pipeline
- Gas Pipeline

Mining Leases
- Application
- Granted

Mineral Development Licences
- Application
- Granted

Projection: GDA94 Zone 56

Figure 2-5

0 5 10 20
Kilometres
Scale 1:900,000 (at A4)
N

SW 237633B

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Nathan Dam to Dalby Pipeline

Pump station 3 and associated balancing storage will be located approximately 38 km from the dam (Latitude 25:47:08S Longitude 150:05:58E), with an elevation of approximately 327 m AHD. It will be of similar design and footprint to the second pump station.

Area 2 is approximately 100 km long and commences near Wandoan and ends near Chinchilla. This section runs parallel to the Leichhardt Highway south for approximately 20 km before diverting east for another 6 km then approximately southeast through to Chinchilla. After departing the highway, the alignment traverses private property for some 80 km, again running parallel to existing roads and property boundaries where practical and finishing to the north of Chinchilla township.

A third balancing storage will be required at the major high point along the pipeline at approximately 110 km (Latitude 26:16:45S Longitude 150:06:04E), roughly 25 km south east of Wandoan with an elevation of approximately 389 m AHD. Pump station 4 is required at this location to meet the design flow requirements, although a bypass line will be incorporated to meet low demands downstream without pumping. The balancing storage is proposed as a 600 ML earth tank with a footprint of approximately 30 ha.

Area 3 is approximately 80 km long, beginning near Chinchilla and terminating just to the west of Dalby, with the intention that the Western Downs Regional Council will connect to the termination point with their own lateral pipeline for transportation to their water treatment facility. This section is located parallel to the Warrego Highway, predominantly within a former highway reserve on the northern side of the Western Queensland railway line. The reserve is no longer continuous as a number of sections have been extinguished and are under cultivation.

During the selection of the pipeline route SunWater focused on minimising the impacts of the planned infrastructure on property owners. SunWater has contacted all of the property owners impacted by the pipeline, and in the vast majority of cases entered into direct dialogue over the placement of the pipeline on landholder's properties and the associated constraints. SunWater is very cognisant of the fact that the Surat Basin is currently the subject of a large amount of mining and coal seam gas development, and through the consultation process with landholders has become aware that many of the property owners impacted by the pipeline are also impacted by other developments. The primary opportunity for avoiding impacts to landholders is through the placement of the pipeline in road reserves, and by co-locating the pipeline with other infrastructure (notably other pipelines) or along property boundaries to avoid infrastructure being spread across properties. Examples of this route selection process include:

- Area 1, chainage 9 km to 73 km – Nathan Road. SunWater is currently developing the Glebe Weir pipeline for Xstrata's Wandoan Coal Project. Depending on the approval timeframes for both projects there may be an opportunity to construct a single pipeline rather than two pipelines as currently proposed. Should this be the case SunWater will utilise the Glebe route as a preference, which is substantially in the road reserve for its entire length. Should two pipelines be required (which could result if the Nathan approval is delayed and Xstrata need to proceed) then the Nathan pipeline would be constructed as close to the Glebe pipeline as possible;
- Area 2, chainage 130 km to 150 km – Surat Gas Pipeline (SGP). SunWater has altered its original route to the north of Miles to collocate with the SGP alignment, thereby restricting construction and operational disturbance for the two projects in this area. SGP have been consulted regarding this process and are in agreement that this offers the best outcome for landholders, and have provided their horizontal alignment and other data to SunWater to enable this process to occur; and

- Area 3, chainage 180 km to 260 km – Council road reserves. Between Chinchilla and Dalby sections of Council road exist to the north of the Warrego Highway where opportunity exists to place the pipeline. At present Optus is planning to construct an optic fibre cable in this road reserve which will occur prior to the construction of the pipeline which may limit SunWater's ability to utilise this road reserve. At this stage it has been necessary for SunWater to plan on placing the pipeline along the inside of property boundaries to the north of this reserve. SunWater will liaise with Optus to encourage placement of the cable to the southern extremity of the reserve in order to maximise the chances of moving the final pipeline alignment into the road reserve.

Workers accommodation camps will be located at Wandoan and Chinchilla. The precise location of the camps will be determined in consultation with the relevant local councils and agencies. It should be noted that SunWater is not seeking approval for the construction camps as part of the EIS.

It is envisaged that in the order of 9 materials lay-down areas will be required during the construction phase. These will be placed at strategic points approximately every 30 km. The areas are likely to vary in size from about 4 to 9 ha. The lay-down areas cannot be accommodated within the existing reserves or proposed construction easements, so locations on adjacent private property will need to be negotiated with individual landholders. Any landholder agreements will include suitable site management and rehabilitation components. Cleared pasture land is anticipated to be used for the sites with little or no requirement for clearing of vegetation.

Material laydown areas along the route will be required for pipe, bedding sand, equipment and machinery. The exact location of these will be determined when the detailed construction plan is developed however they would generally be no more than 30 km apart. The larger of these sites may require areas of up to 120 m x 200 m (2.4 ha). As all material laydown sites will be temporary, there is some scope for SunWater to negotiate with landowners, or authorities to use or share pre-existing material laydown sites (such as for road works).

A permanent 15 m wide pipeline easement through private property is proposed, with an additional 15 m wide temporary construction width. Other than at material laydown sites, the total maximum construction width is therefore expected to be 30 m. This has been assumed for all area calculations, although it may be possible to reduce the width if the pipeline can be partially or wholly contained with another easement. The permanent pipeline easement includes allowance for a vehicle access track of approximately 3 m width adjacent to the pipeline to enable inspections and maintenance to be undertaken.

The 30 m wide construction corridor width is comparable to similar water and gas pipelines either constructed or proposed to be constructed throughout the state including:

- Northern Pipeline Interconnector Stage 1 (30 m);
- North Queensland Gas Pipeline (20 m to 30 m);
- Southern Regional Water Pipeline (30 m); and
- Central Queensland Gas Pipeline (30 m).

The pipeline corridor and balancing storages will potentially impact on approximately 238 land parcels on 127 properties. The land tenure associated with the pipeline is summarised in Table 2-3. More details on land tenure are provided in Chapter 7 and a list of Real Property descriptions affected by the pipeline is provided in Appendix 2B.

The locations of items of infrastructure that are not within the pipeline easement (access tracks between existing roads and the pipeline easement, lay down areas, etc.) will be finalised during detailed design and will include liaison with landholders and relevant agencies as appropriate (for example Main Roads and Emergency Services). Existing access tracks or previously cleared areas will be utilised as a preference.

Table 2-3 Tenure of land within pipeline (permanent) easement

Tenure	Area (ha)	Percentage
Freehold	352	81.4%
Leasehold	54.9	12.7%
Reserve	8.5	2%
Easement	0.6	0.1%
Covenant	2.9	0.7%
State land - road	12.5	2.9%
State land - watercourse	0.7	0.2%

2.2.3. Associated infrastructure

Some new infrastructure will be required in order to construct and operate the Project. Following the filling of the water storage, a number of roads, power and telecommunications infrastructure will be inundated or rendered redundant by isolation from other aspects of the relevant infrastructure network (Figure 2-6). Some elements of these networks may require relocation, while others may require upgrading to accommodate a higher water level.

More details on land tenure are provided in Chapter 7 and a list of Real Property descriptions affected by the associated infrastructure is provided in Appendix 2C.

2.2.3.1. Roads

New roads or existing roads which will be upgraded or closed for the water storage are shown in Figure 2-7.

In summary the changes to the local road network are:

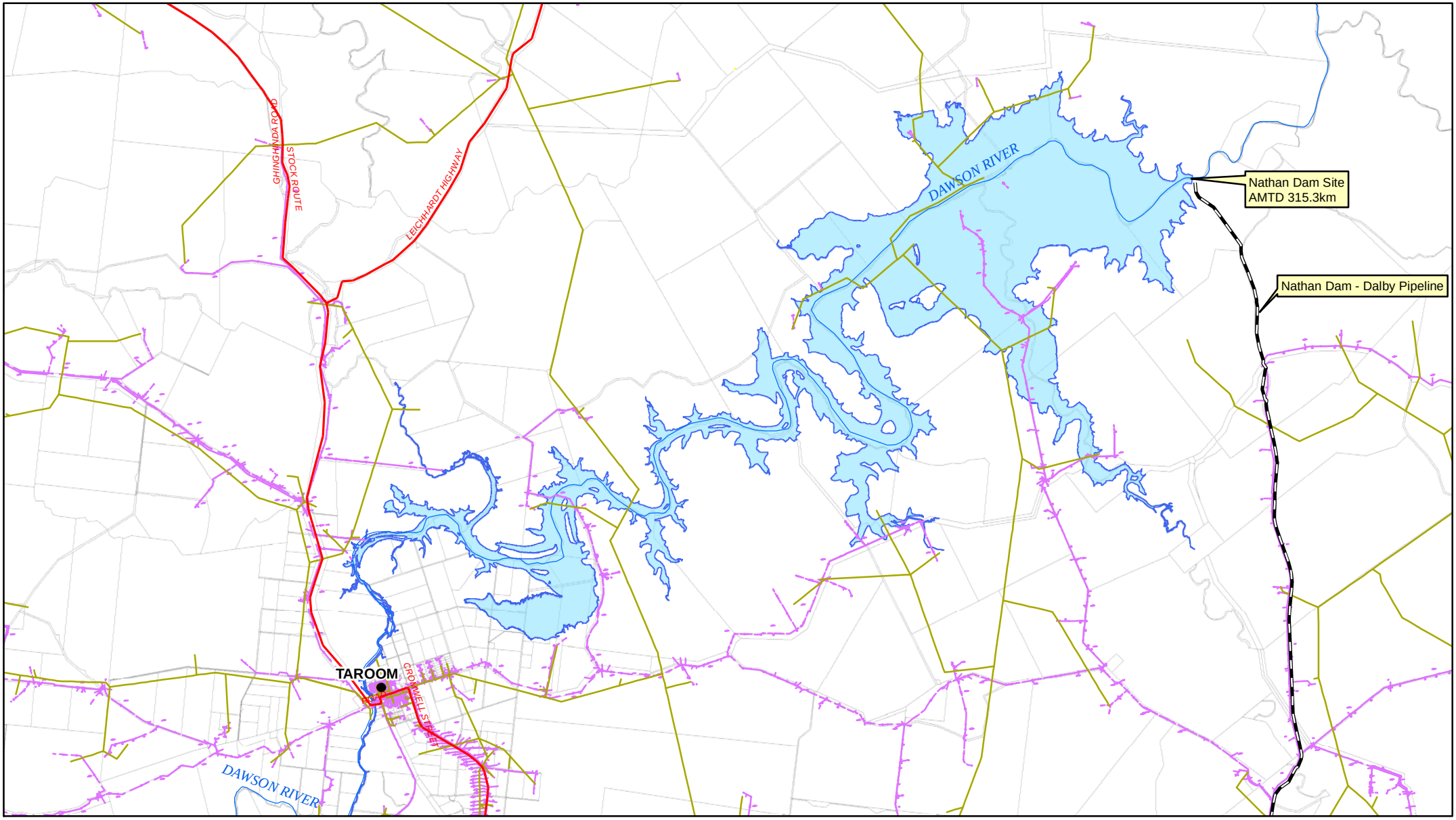
- upgrade Glebe Weir Road to the Spring Creek junction (approximately 25 km) and upgrade of the intersection with the Leichhardt Highway;
- 6.5 km of new 2-lane sealed dam access road from the north, being an extension of the existing Glebe Weir Road;
- close portion of Glebe Weir Road near Glebe Weir;
- a 2-lane rural road bridge on Cracow Road at Cockatoo Ck (approximately 200 m long with raised approaches over approximately 1.5 km);
- a 2-lane rural road causeway with culverts on Cracow Road at Bentley Ck with minor raising at low points;
- close the Bundulla Road crossing of the Dawson River and construct turning circles at the terminus on each side of the river;
- realignment of The Bend Road where the storage cuts across the existing road; and

- realignment of Brodies Road where the storage cuts across the existing road.

Operational access to the dam wall will be from the left (northern) bank of the Dawson River via Glebe Weir Road.

The FSL will cut existing vehicle access to a number of houses located on properties bordering the storage. SunWater will reinstate vehicle access for these properties.

The road upgrades are discussed in further detail in Section 2.3.3.1. The majority of road works would be within existing easements. Land requirements are listed in Appendix 2C. There will be a number of sections of road which will be located on private property and will need to be acquired by SunWater and transferred to Council.



LEGEND

- Ergon Energy Network
- Telstra Network
- Major Roads
- Full Supply Level 183.5 AHD

Projection: GDA94 Zone 56

Figure 2-6

0 1.5 3 6
Kilometres
Scale 1:200,000 (at A4)

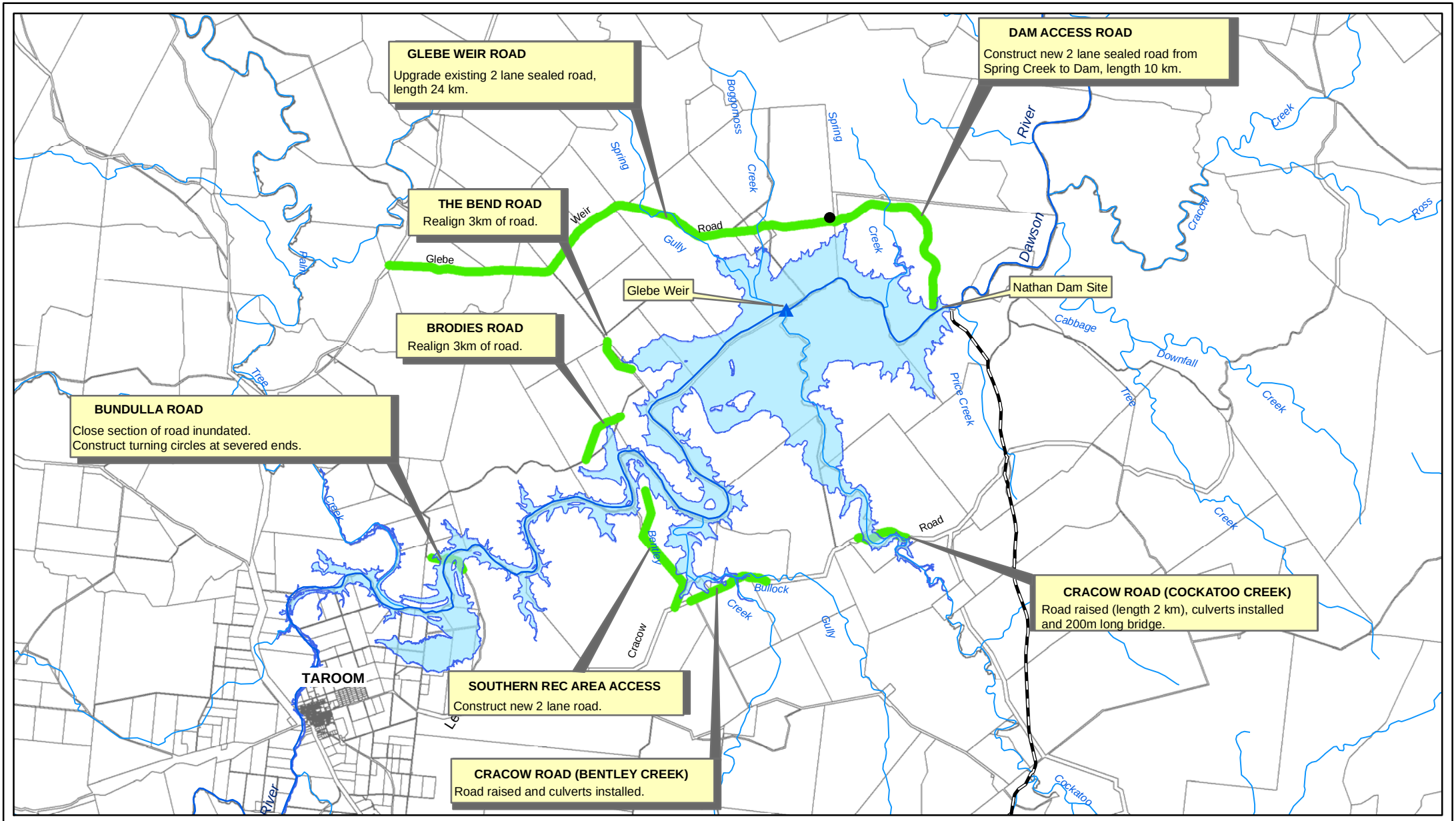
N

SW 233206A

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Infrastructure Plan



LEGEND

- Full Supply Level 183.5 AHD
- Road Upgrade / Construction for Permanent Access
- Nathan Dam - Dalby Pipeline

Projection: GDA94 Zone 56

Figure 2-7

0 1.5 3 6
Kilometres
Scale 1:250,000 (at A4)

N

SW 233207A

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

External Roadworks

These sections of road include:

- an extension of the Glebe Weir Road through to the dam site;
- a section of the southern recreation area access road;
- a section of Brodies Road; and
- a section of the Bend Road.

Depending on the final location of construction camps, there may also be a need for short sections of 2-lane sealed access road from the existing road network.

Roads which link the pipeline to the existing road network may also require minor upgrades to improve safety of intersections or lines of sight along the route. The location of these routes however will be confirmed in conjunction with the Project Contractor and will be discussed with Main Roads and / or Council during detailed design.

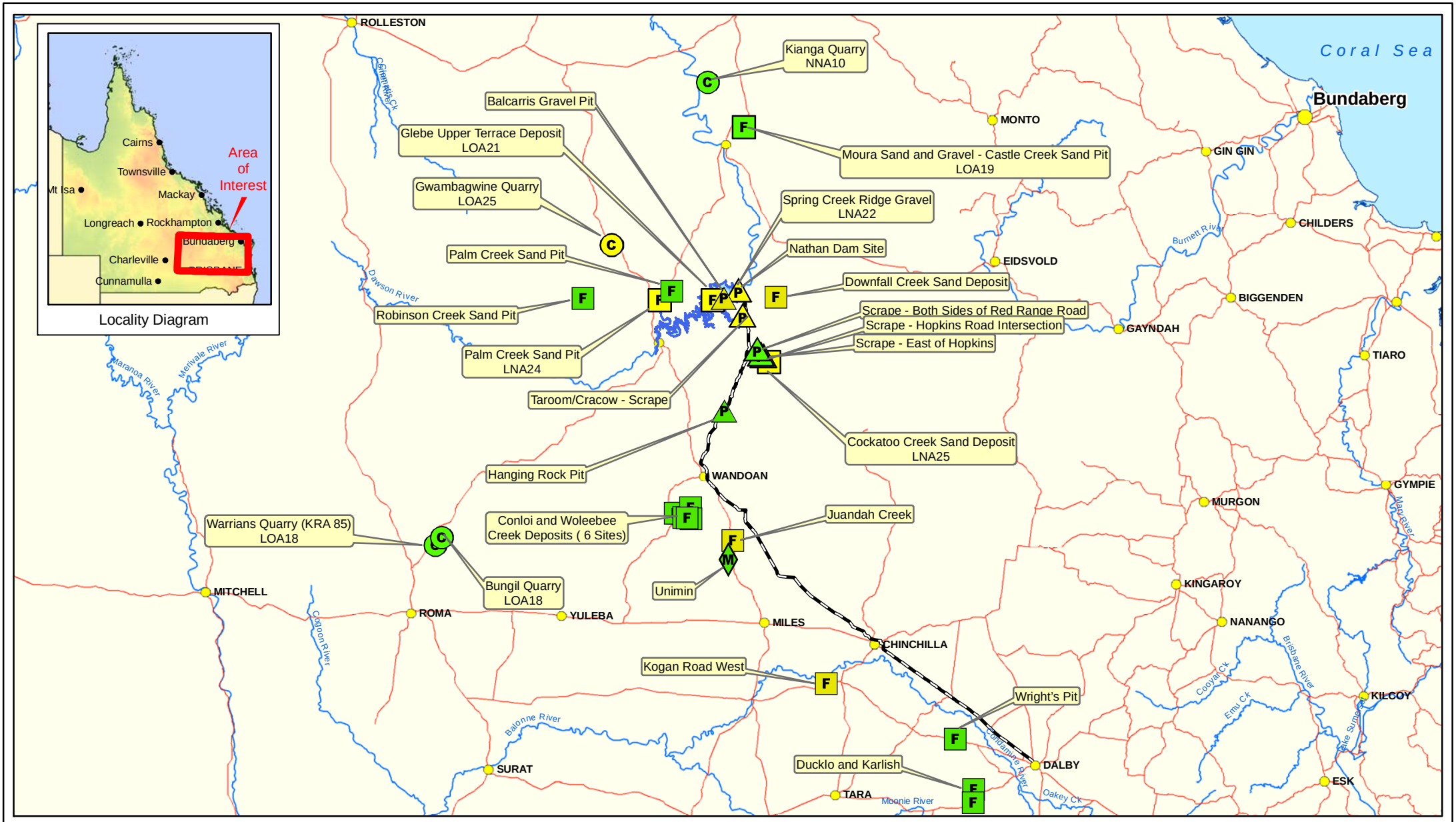
The pipeline will be accessed via local roads that intersect with the Leichhardt and Warrego Highways. These intersections may require upgrades such as turning lanes to enable safe access. The locations of these local roads and associated intersections are outlined in Chapter 21.

2.2.3.2. Resource extraction areas

Construction materials will be required for the E&R dam embankment, conventional and roller compacted concrete, access and haul roads, pipeline bedding sand, erosion protection, landscape rehabilitation and other similar applications. The majority of quarry resources in the region, including sand but not clay, have been allocated and SunWater anticipates purchasing materials from the allocation holder. In some circumstances the allocated resource has not yet been developed but this will be the responsibility of the allocation holder. The locations identified here are primarily to assist with assessment of transport related impacts. The majority of the areas have been identified during regional reconnaissance of the Nathan to Dalby area (PB, 2009). Most of the sites have, at some stage in the past, operated as borrow pits or quarries, whether licensed or unlicensed, by commercial operators, local councils or landholders, with only a small number currently permitted to extract resources. Unless otherwise noted below, the facility is not currently licensed. Where possible the preference will always be to use the existing source of supply which is closest to the point of use, assuming suitability of the material. For pipeline bedding sand that near the dam is likely to be Palm Creek Sand Pit, then Conloi and Woleebee Creek sites for the section near Wandoan; and Wright's Pit, Ducklo and Karlish towards Chinchilla and Dalby.

SunWater anticipates that the dam construction contractor will operate the clay extraction areas because they are located within the proposed water storage area and for the nearby pavement material (road base).

The precise details of the sources of materials to be used for construction will be determined and optimised during the detailed design phase of the Project and in conjunction with the allocation holders. The resource areas that will be considered for use on the Project are shown on Figure 2-8.



LEGEND

MATERIAL SOURCES

- Existing, coarse aggregate
- Existing, fine aggregate
- Existing, pavement
- Potential, coarse aggregate
- Potential, fine aggregate
- Potential, pavement
- Undefined , pavement
- Existing clay
- Nathan Dam - Dalby Pipeline
- Full Supply Level 183.5 AHD

Projection: GDA94 Zone 56

Figure 2-8a

0 12.5 25 50

Kilometres

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

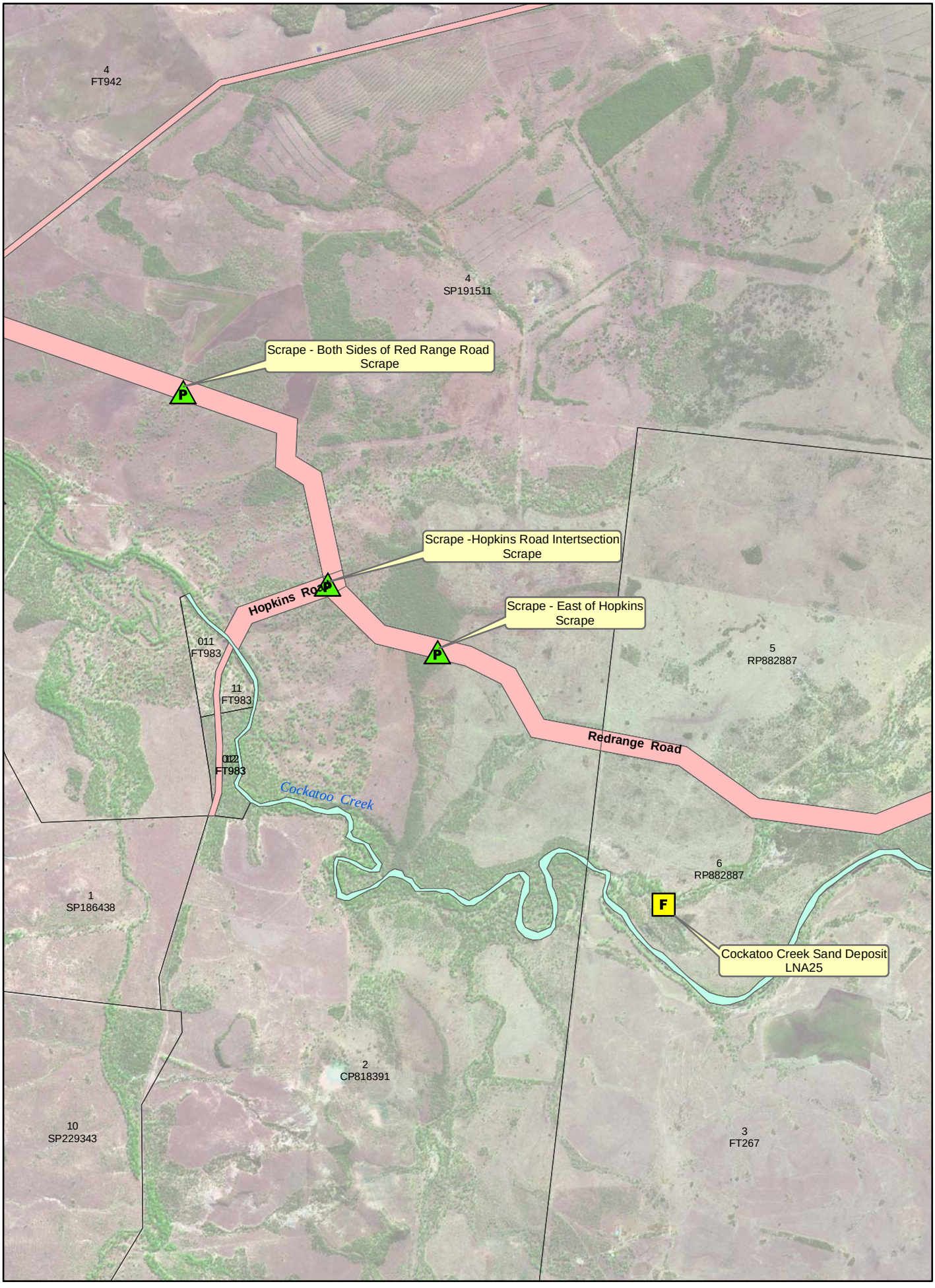
N

SW 233211A

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Potential Resource Extraction Areas



LEGEND

- C — Existing, coarse aggregate
- C — Potential, coarse aggregate
- P — Undefined , pavement
- F — Existing, fine aggregate
- F — Potential, fine aggregate
- P — Existing, pavement
- P — Potential, pavement

Projection: GDA94 Zone 56

Figure 2-8b

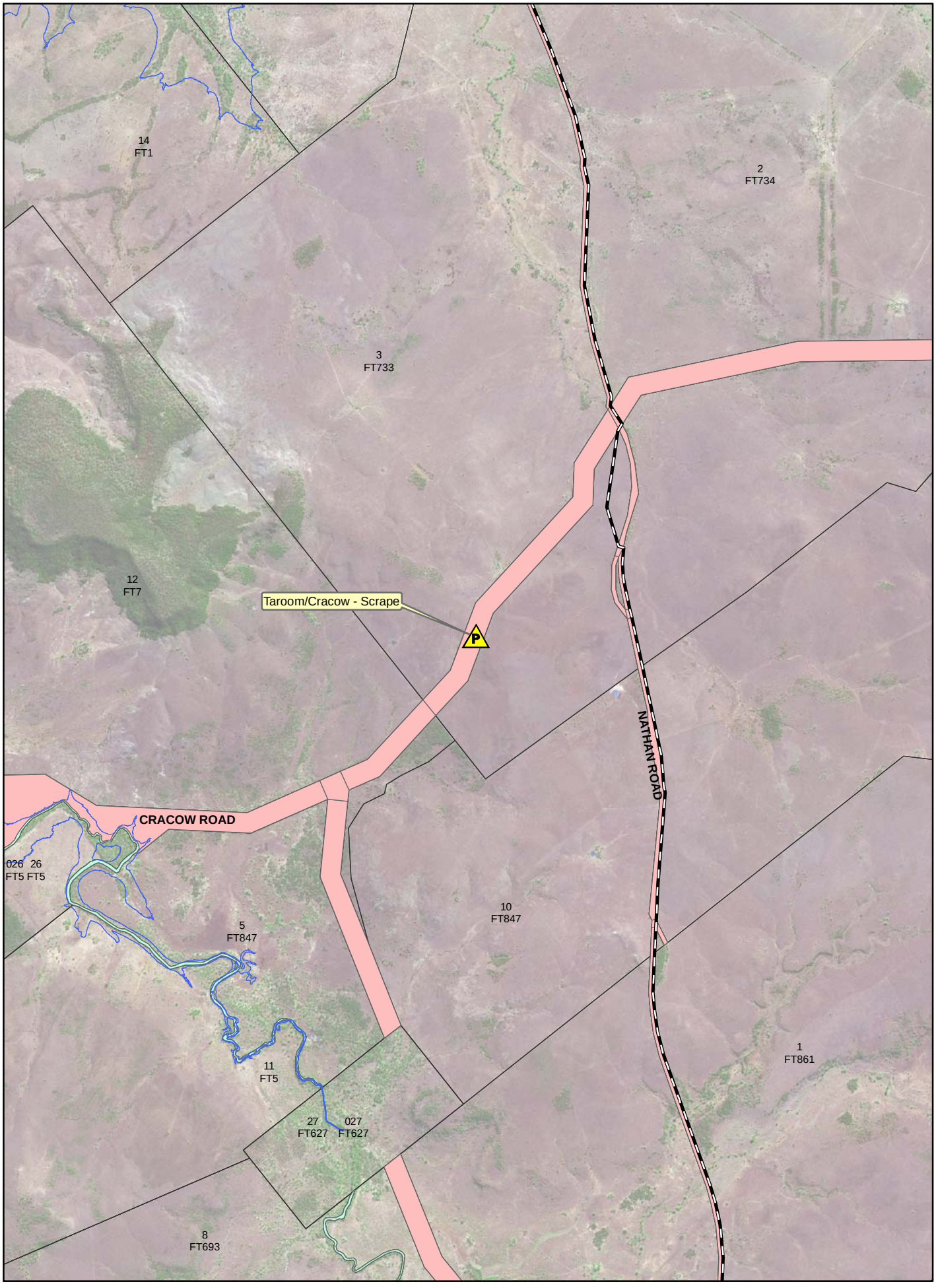
0 0.25 0.5 1
Kilometres
Scale 1:50,000 (at A4)
SW 233213A

N

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Potential Resource Extraction Areas
Cockatoo Creek Sand Deposit LNA25
Scrapes 1, 2 & 3



Legend

- C — Existing, coarse aggregate
- C — Potential, coarse aggregate
- P — Undefined , pavement
- Nathan Dam - Dalby Pipeline
- Full Supply Level 183.5 AHD
- F — Existing, fine aggregate
- F — Potential, fine aggregate
- P — Existing, pavement
- P — Potential, pavement

Projection: GDA94 Zone 56

Figure 2-8c

0 0.25 0.5 1
Kilometres
Scale 1:50,000 (at A4)

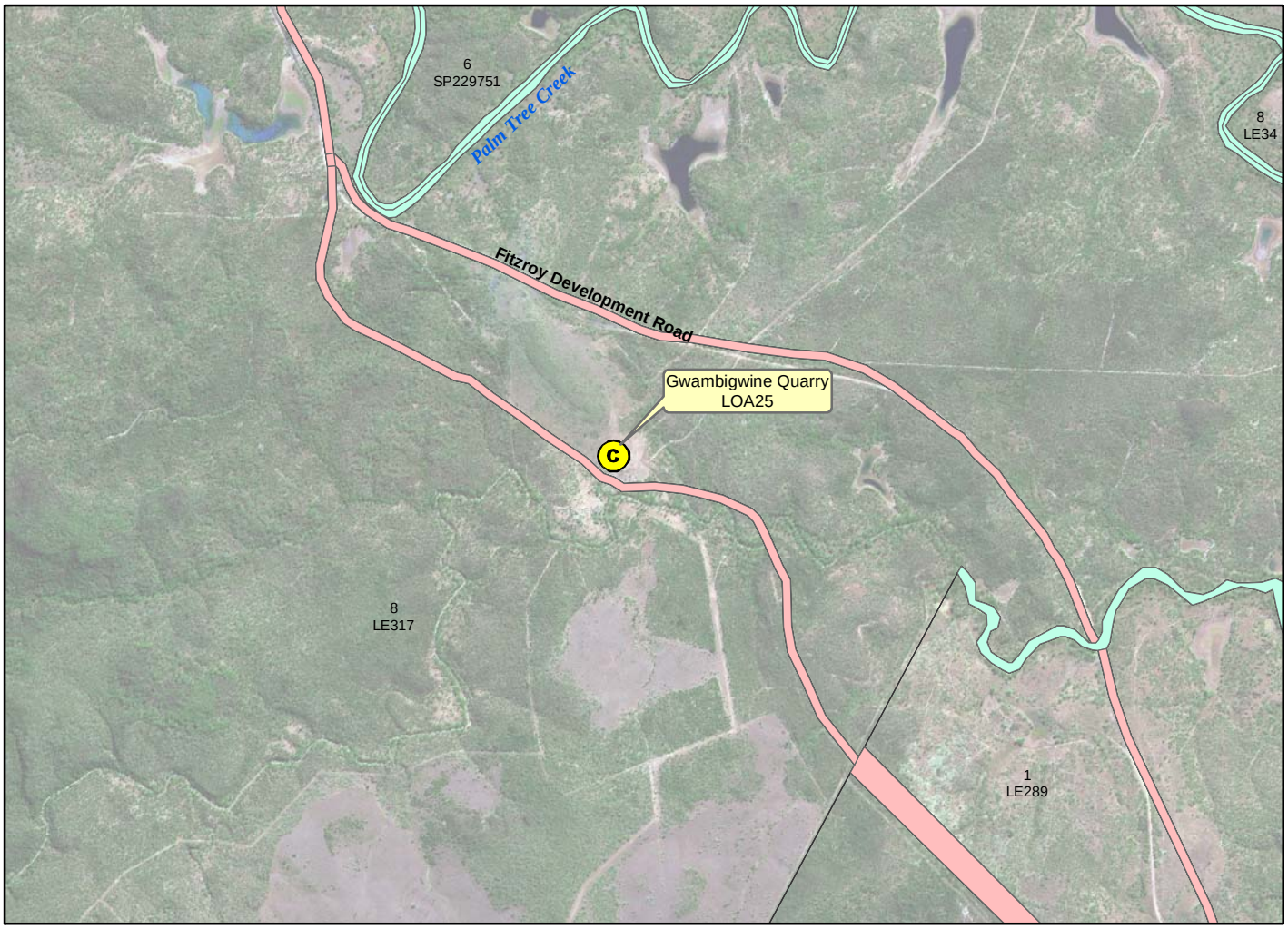
N

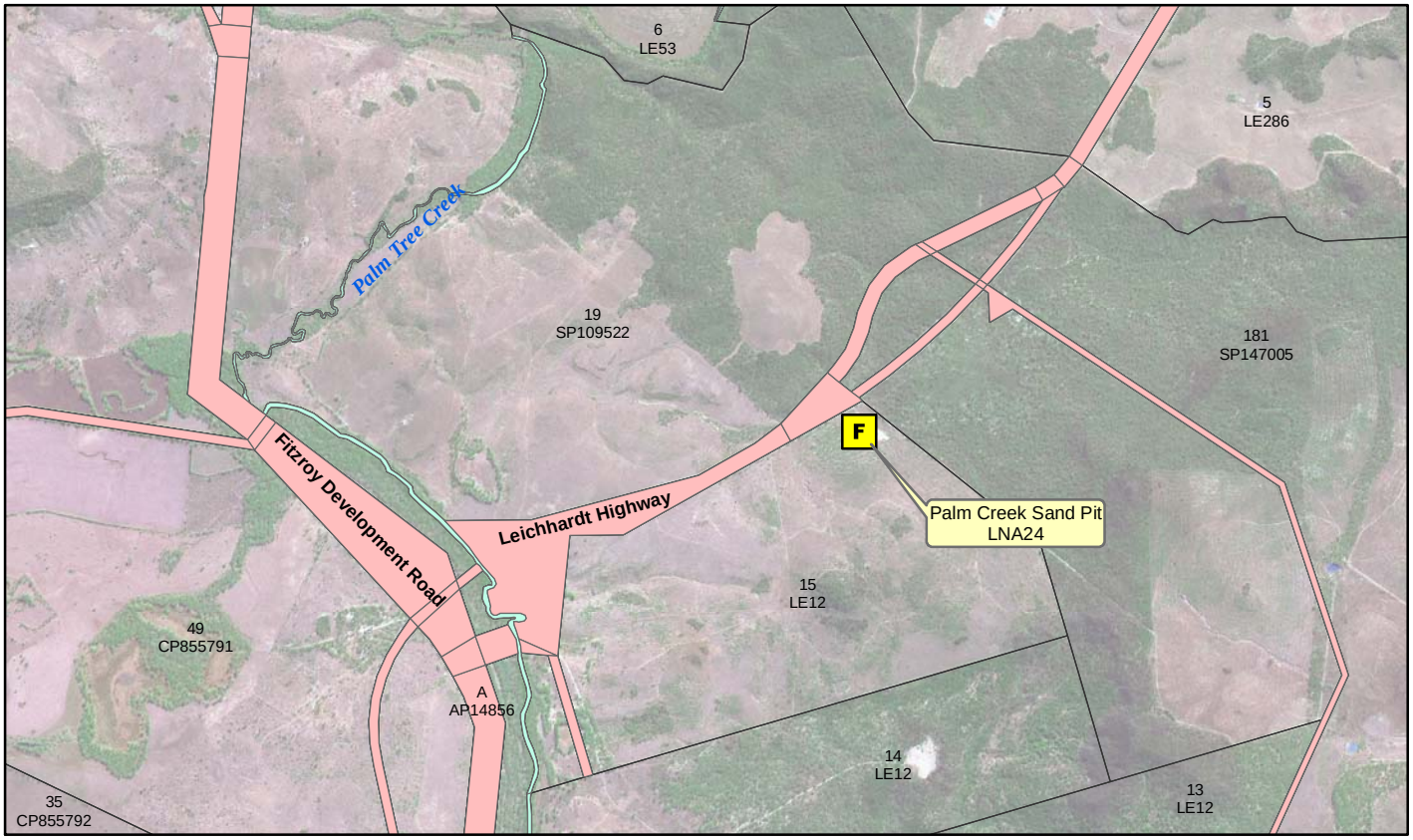
SW 233214A

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Potential Resource Extraction Areas
Taroom/Cracow Scrape





LEGEND

- C Existing, coarse aggregate
- C Potential, coarse aggregate
- P Undefined , pavement
- F Existing, fine aggregate
- F Potential, fine aggregate
- P Existing, pavement
- P Potential, pavement

Projection: GDA94 Zone 56

Figure 2-8d

0 0.25 0.5 1
Kilometres
Scale 1:50,000 (at A4)

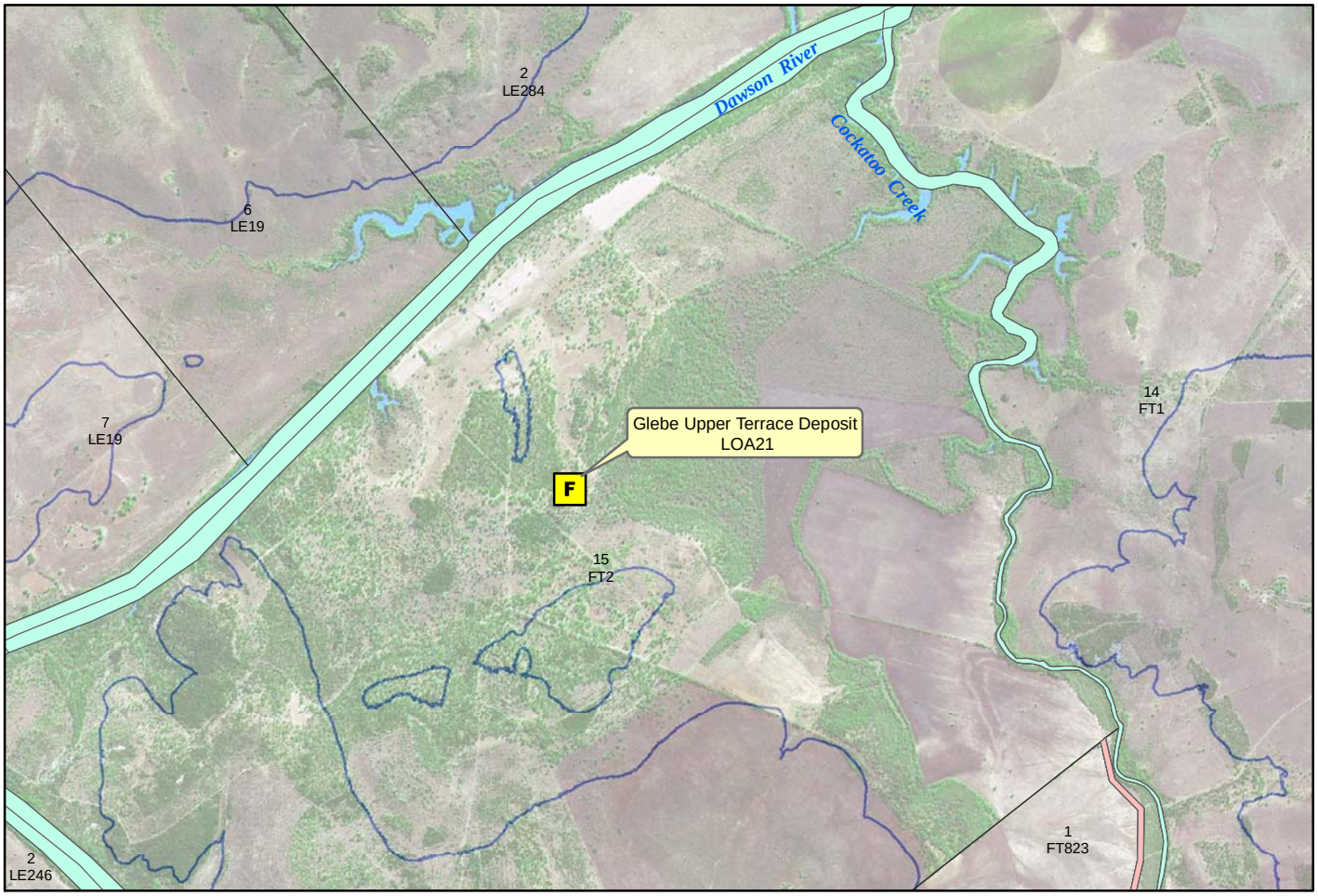
N

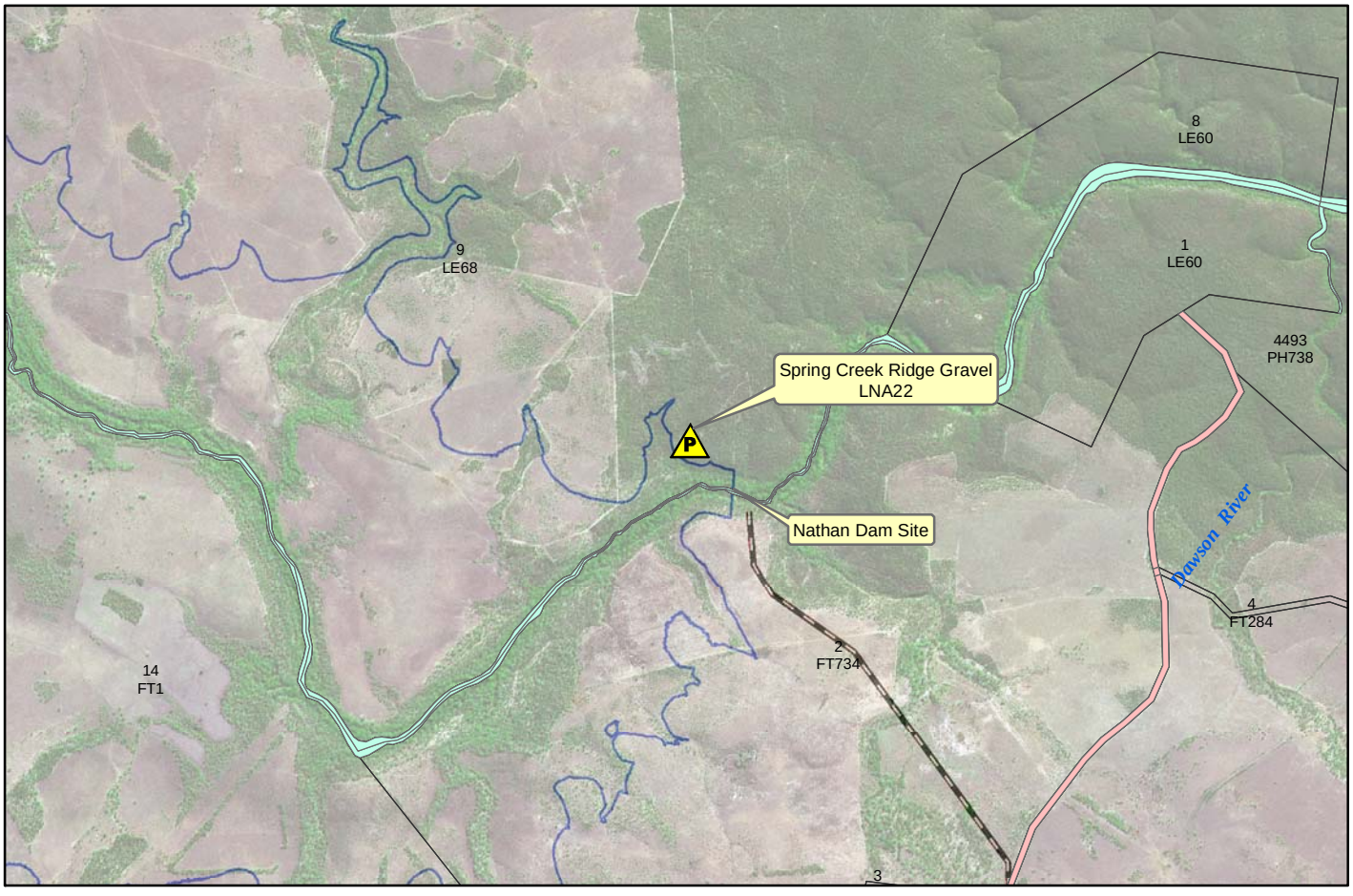
SW 233215A

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Potential Resource Extraction Areas
Gwambagwine Quarry LOA25
Palm Creek Sand Pit LNA24





LEGEND

- C — Existing, coarse aggregate
- C — Potential, coarse aggregate
- P — Undefined , pavement
- Nathan Dam - Dalby Pipeline
- Full Supply Level 183.5 AHD
- F — Existing, fine aggregate
- F — Potential, fine aggregate
- P — Existing, pavement
- P — Potential, pavement

Projection: GDA94 Zone 56

Figure 2-8e

0 0.25 0.5 1
Kilometres
Scale 1:50,000 (at A4)
N

SW 233216A

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NATHAN DAM AND PIPELINES EIS

Potential Resource Extraction Areas
Glebe Upper Terrace LOA21
Spring Creek Ridge Gravel LNA22

It is anticipated that no one resource/source will be able to supply whole-of-Project requirements for any one material, with the possible exception of the hard-rock quarries. It is most likely a combination of several suppliers or sources will be required to satisfy the demand. Up to two of the rock quarries and three of the earth and sand borrow areas are expected to be operated at the same time.

Coarse aggregate (for Conventional Concrete and Roller Compacted Concrete)

Gwambagwine Quarry

Gwambagwine Quarry is a disused basalt quarry located about 76 km from the Nathan Dam site on the Fitzroy Developmental Road and is located on Lot 8 LE317.

Warrians and Bungil Quarry

The Warrians and Bungil Quarries are located on the Roma to Taroom Road approximately 10 km and 15 km respectively north-east of Roma, about 196 km from the Nathan Dam site. The Bungil Quarry is operated by Bungil Shire and Warrians Quarry by Boral Construction Materials and is licensed.

Kianga Quarry

Kianga Quarry is located south of New Gibihi Road on the Theodore to Banana Road, about 131 km from the Nathan Dam site via the Leichhardt Highway and Taroom to Cracow Road. The quarry currently extracts olivine basalt and is licensed.

Moura Sand and Gravel (Castle Creek Quarry)

Moura Sands and Gravel operates a quarry about 15 km north of Theodore and about 114 km from the Nathan Dam site. The quarry currently extracts olivine basalt and is licensed.

Hanging Rock Pit

Hanging Rock Pit is located approximately 51 km south of the Nathan Dam site and comprises a large multi-bench pit. The pit is dominated by sedimentary rocks of the Injune Creek Group and is considered to be suitable for use as bulk fill or sub-base for sealed roads.

Balcarris Gravel Pit

The Balcarris Gravel Pit is located approximately 2 km from the proposed pumping station at Cockatoo Creek. The site has produced material suitable for use as road base, comprised of a clayey medium to coarse grained gravel.

Cracow Road Scrapes

A series of small scrapes occur along the Cracow Road, producing weathered siltstone and mudstone. These scrapes are thought to be council borrow pits to provide for local road repairs.

Sand

Cockatoo and Sandy Creek Sand

The sand deposit is at, and upstream of, the confluence of Sandy and Cockatoo Creeks 34 km from the Nathan Dam site located on Lot 6 RP 882887.

Palm Creek Sand Pit

The sand deposit is located off the Leichhardt Highway about 41 km from the Nathan Dam site on property 181 SP147005. The sand pit is located to the eastern side of the highway.

Glebe Upper Terrace Deposit

The sand deposit is located on Lot 15 FT2 on the right bank of the Glebe Weir about 31 km from the Nathan Dam site. A resource of silty and clayey sand occurs in this area and is estimated to be of the order of 30,000 m^3.

Downfall Creek Sand Deposit (aka Cracow Road Sand Deposits)

The Downfall Creek Sand Deposit is located approximately 20 km east of Nathan Dam site. This grouping of three deposits has an expected total quantity of approximately 60,000 m^3.

Juandah Creek Sand

Juandah Creek is located adjacent to the Leichhardt Highway, south of Wandoan, approximately 112 km from the Nathan Dam site. This deposit is undeveloped and is currently being investigated by Boodle Sand and Gravel. It is estimated that the resource is of the order of 50,000 m^3. The majority of the sand is contained within the bed of the creek, although sand has been won from the floodplain in the past for use in concrete.

Conloi and Woleebee Creeks Sand Deposits

Six sand deposits occur in the Conloi and Woleebee Creek area, some of which have been worked in the past, with others potentially available as new resource areas. This area lies approximately 22 km south west of Wandoan along the Jackson-Wandoan Road, approximately 120 km from Nathan Dam site. These deposits are relatively extensive, occurring within the creek beds, achieving widths in excess of 100 m, and thickness of between 3 – 4 m.

Robinson Creek Sand

This deposit occurs on private land, approximately 70 km to the west of the proposed Nathan Dam site.

Ducklo

The Ducklo pits are located on Ducklo School Road approximately 27 km from Dalby and 300 km from the Nathan Dam site.

Karlish

The Karlish Pit currently supplies the Dalby Regional Council bedding sand, dominated by fine to medium grained silty sand (PB, 2009). The pit is located approximately 303 km from the proposed Nathan Dam site and approximately 31 km from Dalby. The available resources are reported as 'large', and the quarry is licensed.

Wright's Pit

Wright's Pit is a commercial pit located approximately 35 km from Dalby and 261 km from the Nathan Dam site. The sand produced from the operation is reported to be suitable for use as bedding and concrete sand and the operation is licensed.

Kogan Road West

The Kogan Road West sand pit is located approximate 28 km southwest of Chinchilla and approximately 222 km from the Nathan Dam site. A resource of approximately 35,000 m^3 may occur in this area.

Pavement (for roads and hardstand)

Taroom-Cracow Road Scrape

The deposit is crushed ferruginised sandstone suitable as pavement material. It is an existing scrape on the southern side of the Taroom-Cracow Road within the road reserve and on Lot 3 FT733 a few kilometres from the Glebe turnoff and about 11 km from the Nathan Dam site. Banana Shire Council currently uses this source for local unsealed roads.

Cracow Road Scrape

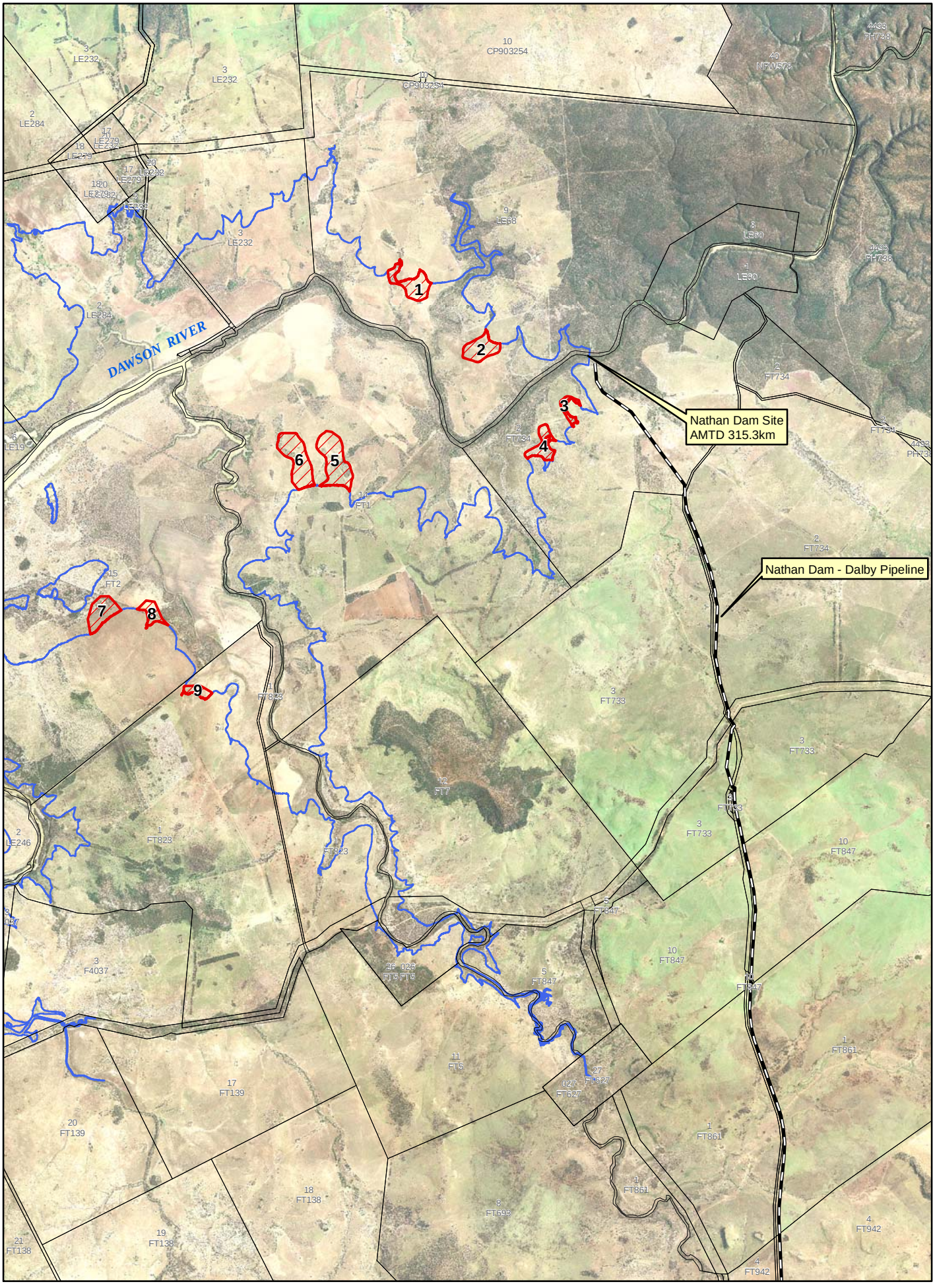
Three scrapes exist within the road reserve along the Red range road situated 27 km, 30 km, and 31 km from the Nathan Dam site.

Spring Creek Ridge Gravels

The potential resource is expected to be of small to medium volume distributed over a relatively large area on the left bank of the Dawson River adjacent to the dam site on Lot 9 LE68.

Clay (damsite)

There are nine potential clay borrow areas (Figure 2-9). These areas have been targeted using radiometric data (DEEDI), in addition to soil mapping completed by the Bureau of Rural Sciences in the 1960's.



LEGEND

- Potential Clay Borrow Area
- Nathan Dam - Dalby Pipeline
- Full Supply Level 183.5 AHD

Projection: GDA94 Zone 56

Figure 2-9

0 0.75 1.5 3
Kilometres
Scale 1:100,000 (at A4)

N

SW 236499

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NATHAN DAM AND PIPELINES EIS

Potential Clay Borrow Areas

All nine potential clay borrow areas occur within the water storage area. Table 2-4 lists the lot and plan numbers of each clay area as well as the calculated area for each. The deposits are expected to be small to medium volume with the upper zone of each deposit containing organic detritus which will need to be removed prior to use. The areas would not be excavated any further than 5 m.

Table 2-4 Lot and plan number and calculated area (ha) for clay area's 1-9

Clay Area	Lot & Plan Number	Area (ha)
1	Lot 9 on LE68	27.9
2	Lot 9 on LE68	26.0
3	Lot 2 on FT734	7.4
4	Lot 2 on FT734	19.0
5	Lot 14 on FT1	49.3
6	Lot 14 on FT1	45.9
7	Lot 15 on FT2	27.2
8	Lot 1 on FT823	12.8
9	Lot 1 on FT823	9.0

Each of the possible clay borrow areas is undeveloped and will require appropriate investigation and permitting prior to use.

It is anticipated that Clay Area Number 4 within Lot 2 FT734 would be the most likely source (Figure 2-9).

Clay (for lining of balancing storage)

Unimin

Unimin operates a small bentonite quarry about 500 m south of Gurulmundi, approximately 2 km west of the Leichhardt Highway and approximately 118 km from the Nathan Dam site. The quarry is existing, has a large annual production capacity and is licensed.

2.2.3.3. Power and telecommunications

Energex and Telstra have recoverable assets within the Project area consisting of existing 11 kV and 33 kV overhead power lines and associated infrastructure and telecommunications cables (Figure 2-6). It is anticipated that these assets will be relocated outside of the water storage area by the asset owner. Powerlink has no assets impacted in the Project area.

Infrastructure to service the dam site during construction and operation will be installed adjacent to the dam access road as far as is practical.

The pipeline will 'cross' power and telecommunication, however the infrastructure will remain intact and services maintained. New power supply to the pump stations will likely be sourced from the proposed Powerlink substation located south-west of Wandoan and the existing Ergon Energy infrastructure within the area. The possibility of sharing part of the pipeline easement is available. It is currently anticipated that the design and construction of these

infrastructure components will be the responsibility of the service provider with approvals sought by their respective standard processes.

2.2.3.4. Water and sewerage

No water or sewerage network was identified within the water storage area. The pipeline will traverse water and sewerage networks near towns; however the construction methods will be such that services will not be disrupted. The infrastructure will remain intact and the pipeline will either pass above or below the existing infrastructure. Exact locations will be confirmed prior to construction.

Septic tanks will be constructed for the permanent dam site office which will be located within the dam construction area (though it will not be permanently occupied). Dry composting toilets will be constructed at new recreation facilities. Water supply will be either from rainwater or pumped from the dam.

2.2.3.5. Recreation facilities

Two recreation areas and a viewing platform are planned to be established at the new water storage and are shown on Figure 2-10. One of the recreation areas will be located on the southern side of the "Bend". The other recreation area will be on the northern side at the termination of Glebe Weir Road at Boggomoss Creek. A viewing platform will be provided at the dam wall (Figure 2-10). Other than the boat ramp, these facilities will be located above the 1:100 flood line and will be situated in previously disturbed areas.

2.3. Design

2.3.1. Water storage

SunWater has progressed the dam design to a preliminary level. The work completed includes:

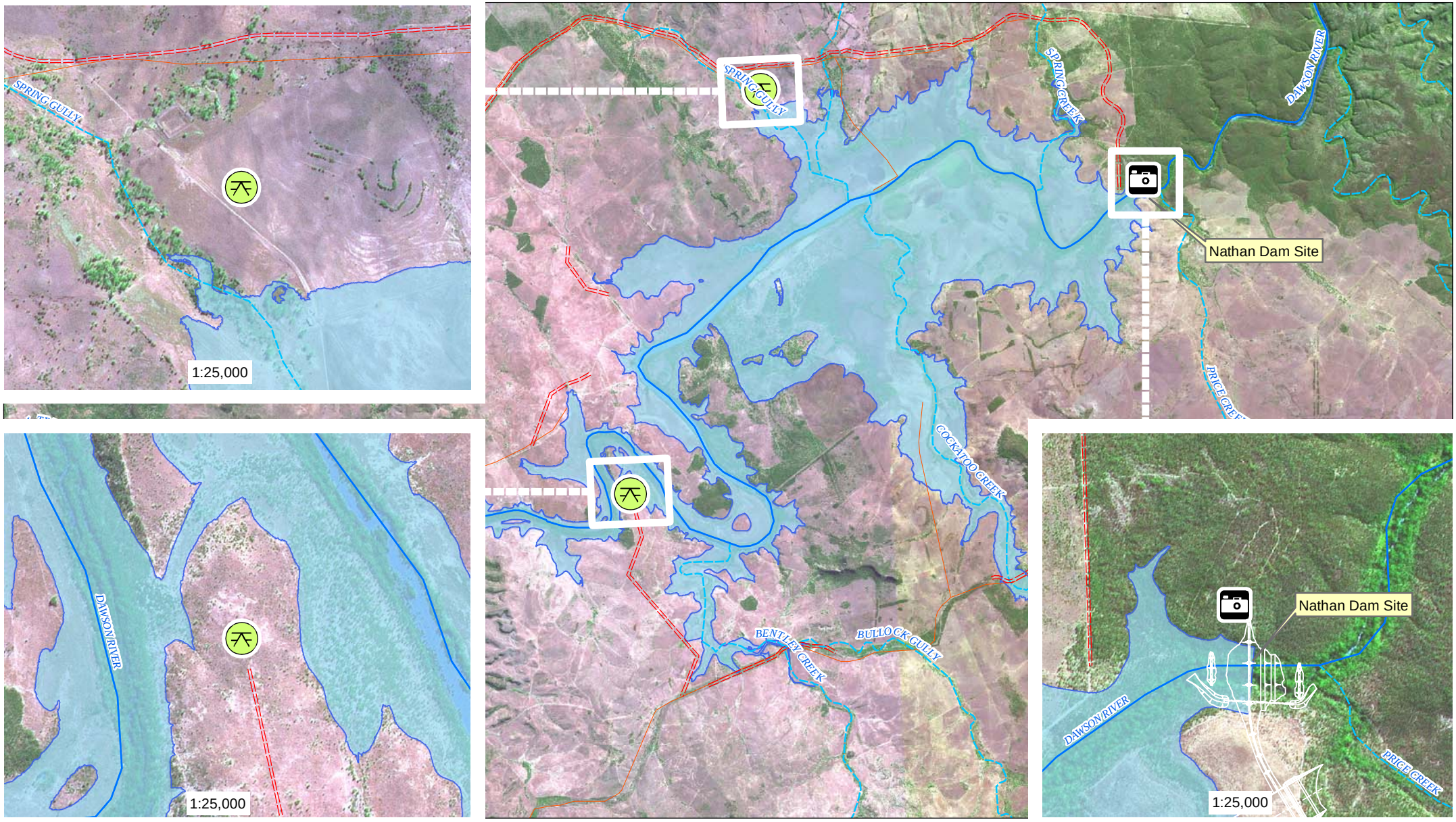
- flood modelling; and
- preliminary engineering design.

The following investigations are in progress:

- geotechnical investigations; and
- materials investigations.

A technical review panel was formed to review the development of the preliminary design. The panel members were internationally recognised dam experts, Emeritus Professor Robin Fell of the University of New South Wales and Mr Graeme Bell, formerly of the Snowy Mountains Engineering Corporation. The panel met on a regular basis with the design team, representatives from SunWater and the Director of Dam Safety from DERM during the ongoing geotechnical investigations and the development of the preliminary design.

The main approval for construction of the dam will be a development permit (operational works for constructing a referable dam) under the *Sustainable Planning Act 2009*. Approval conditions are likely to reference relevant sections of the Queensland Dam Safety Management Guidelines (which represent current best practice in dam safety) and which are generally consistent with the Australian National Committee on Large Dams (ANCOLD) Guidelines.



LEGEND

Recreation Area

Lookout

Upgraded Roads

Full Supply Level 183.5 AHD

Projection: GDA94 Zone 56

Figure 2-10

0 1 2 4

Kilometres

Scale 1:150,000 (at A4)

N

SW 233223A

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NATHAN DAM AND PIPELINES EIS

Recreational Areas

For the purpose of preliminary design, it has been assumed that the dam will be assessed as an Extreme Hazard category dam. Accordingly the preliminary design allows sufficient flood discharge to safely pass the Probable Maximum Flood (PMF).

The PMF is defined as "the limiting value of the flood that can reasonably be expected to occur". Modelling of the design flows for the PMF indicates that the PMF event would result in a peak surface water level of 200.1 m AHD within the water storage. The dam is designed to have sufficient discharge to safely pass the PMF so that if such an event occurs, the downstream community will not be subject to additional risk due to it being in place.

2.3.1.1. Flood studies

Hydrologic and hydraulic modelling of the Dawson River catchment above the water storage with and without the dam has been undertaken (Department of Natural Resources 1997, SunWater, 2008). A range of design floods with AEPs ranging from 1 in 5 up to the PMF have been derived. The estimated maximum inflows and outflows for a selection of these flood events are shown in Table 2-5.

Flood routing using the proposed spillway configuration and gate operating rules was carried out to determine the storage levels for a range of flood events. The spillway rating curve took account of factors such as depth of approach, downstream apron interference and degree of submergence. Detailed topographic assessment was used to determine the storage capacity and surface area relationships with reservoir level.

Table 2-5 Estimated flood routing results for a range of AEPs

AEP	Peak Inflow (m^3)	Peak Outflow (m^3/sec)
1 in 5	1,697	980
1 in 50	3,328	2,430
1 in 100	4,032	3,040
1 in 1,000	5,935	4,380
PMF	25,280	18,965

The relationship between headwater and tailwater is shown in Figure 2-11. The total storage curve is shown in Figure 2-12.

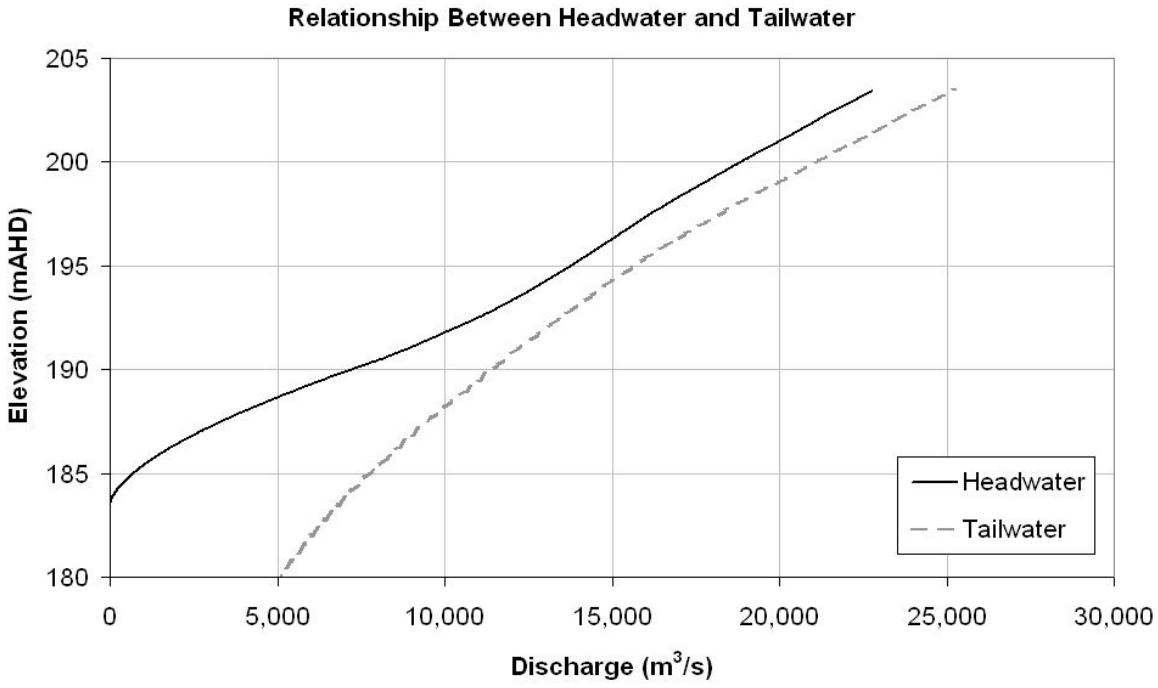


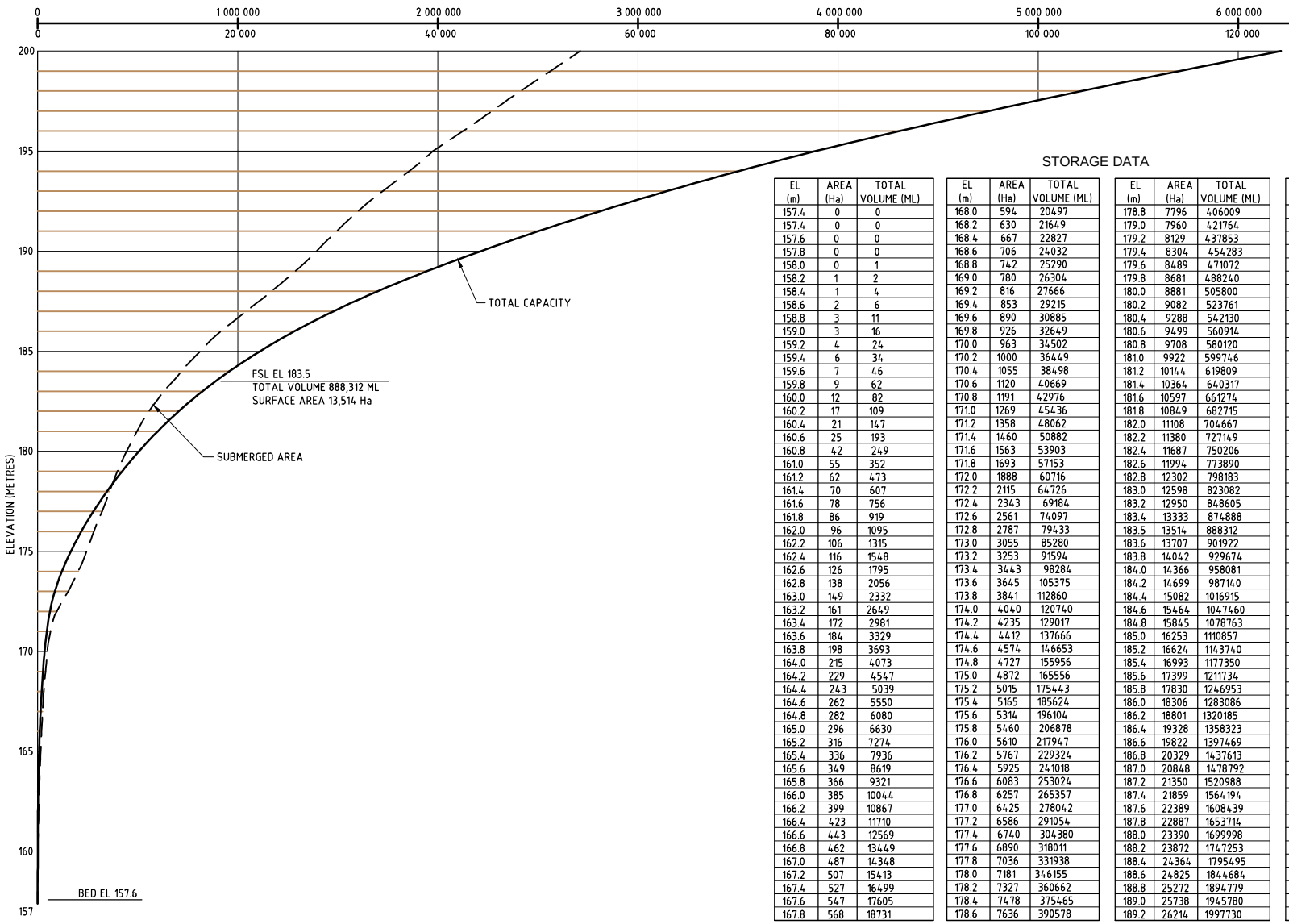
Figure 2-11 Relationship between headwater and tailwater

The results of the flood routing were used in conjunction with the storage characteristics to determine the reservoir storage capacity and surface area for the peak surface water level reached during the floods as shown in Table 2-6.

Table 2-6 Reservoir area and storage capacity for Nathan Dam under a range of flood conditions

Tenure	Peak Reservoir Level (m AHD)	Reservoir Storage Capacity (ML)	Reservoir Area (ha)
No Flood and Reservoir at FSL	183.5	888,312	13,824
1 in 100 AEP (post dam)	187.4	1,564,194	24,427

A water storage map showing the extent of the reservoir at FSL and the 1 in 100 AEP flood level (pre and post dam) is presented in Figure 2-13. Figure 2-14 presents the depth of the water storage at FSL.



STORAGE DATA

EL (m)	AREA (Ha)	TOTAL VOLUME (ML)
157.4	0	0
157.4	0	0
157.6	0	0
157.8	0	0
158.0	0	1
158.2	1	2
158.4	1	4
158.6	2	6
158.8	3	11
159.0	3	16
159.2	4	24
159.4	6	34
159.6	7	46
159.8	9	62
160.0	12	82
160.2	17	109
160.4	21	147
160.6	25	193
160.8	42	249
161.0	55	352
161.2	62	473
161.4	70	607
161.6	78	756
161.8	86	919
162.0	96	1095
162.2	106	1315
162.4	116	1548
162.6	126	1795
162.8	138	2056
163.0	149	2332
163.2	161	2649
163.4	172	2981
163.6	184	3329
163.8	198	3693
164.0	215	4073
164.2	229	4547
164.4	243	5039
164.6	262	5550
164.8	282	6080
165.0	296	6630
165.2	316	7274
165.4	336	7936
165.6	349	8619
165.8	366	9321
166.0	385	10044
166.2	399	10867
166.4	423	11710
166.6	443	12569
166.8	462	13449
167.0	487	14348
167.2	507	15413
167.4	527	16499
167.6	547	17605
167.8	568	18731

EL (m)	AREA (Ha)	TOTAL VOLUME (ML)
168.0	594	20497
168.2	630	21649
168.4	667	22827
168.6	706	24032
168.8	742	25290
169.0	780	26304
169.2	816	27666
169.4	853	29215
169.6	890	30885
169.8	926	32649
170.0	963	34502
170.2	1000	36449
170.4	1055	38498
170.6	1120	40669
170.8	1191	42976
171.0	1269	45436
171.2	1358	48062
171.4	1460	50882
171.6	1563	53903
171.8	1693	57153
172.0	1888	60716
172.2	2115	64726
172.4	2343	69184
172.6	2561	74097
172.8	2787	79433
173.0	3055	85280
173.2	3253	91594
173.4	3443	98284
173.6	3645	105375
173.8	3841	112860
174.0	4040	120740
174.2	4235	129017
174.4	4412	137666
174.6	4574	146653
174.8	4727	155956
175.0	4872	165556
175.2	5015	175443
175.4	5165	185624
175.6	5314	196104
175.8	5460	206878
176.0	5610	217947
176.2	5767	229324
176.4	5925	241018
176.6	6083	253024
176.8	6257	265357
177.0	6425	278042
177.2	6586	291054
177.4	6740	304380
177.6	6890	318011
177.8	7036	331938
178.0	7181	346155
178.2	7327	360662
178.4	7478	375465
178.6	7636	390578

EL (m)	AREA (Ha)	TOTAL VOLUME (ML)
178.8	7796	406009
179.0	7960	421764
179.2	8129	437853
179.4	8304	454283
179.6	8489	471072
179.8	8681	488240
180.0	8881	505800
180.2	9082	523761
180.4	9288	542130
180.6	9499	560914
180.8	9708	580120
181.0	9922	599746
181.2	10144	619809
181.4	10364	640317
181.6	10597	661274
181.8	10849	682715
182.0	11108	704667
182.2	11380	727149
182.4	11687	750206
182.6	11994	773890
182.8	12302	798183
183.0	12598	823082
183.2	12950	848605
183.4	13333	874888
183.5	13514	888312
183.6	13707	901922
183.8	14042	929674
184.0	14366	958081
184.2	14699	987140
184.4	15082	1016915
184.6	15464	1047460
184.8	15845	1078763
185.0	16253	1110857
185.2	16624	1143740
185.4	16993	1177350
185.6	17399	1211734
185.8	17830	1246953
186.0	18306	1283086
186.2	18801	1320185
186.4	19328	1358323
186.6	19822	1397469
186.8	20329	1437613
187.0	20848	1478792
187.2	21350	1520988
187.4	21859	1564194
187.6	22389	1608439
187.8	22887	1653714
188.0	23390	1699998
188.2	23872	1747253
188.4	24364	1795495
188.6	24825	1844684
188.8	25272	1894779
189.0	25738	1945780
189.2	26214	1997730

EL (m)	AREA (Ha)	TOTAL VOLUME (ML)
189.4	26662	2050613
189.6	27073	2104351
189.8	27464	2158887
190.0	27853	2214204
190.2	28246	2270299
190.4	28643	2327187
190.6	29048	2384872
190.8	29468	2443388
191.0	29882	2502739
191.2	30301	2562922
191.4	30715	2623934
191.6	31137	2685786
191.8	31568	2748484
192.0	32030	2812081
192.2	32487	2876604
192.4	32911	2942002
192.6	33433	3008282
192.8	33975	3075717
193.0	34497	3144188
193.2	35015	3213703
193.4	35539	3284252
193.6	36080	3355872
193.8	36614	3428569
194.0	37135	3502321
194.2	37653	3577116
194.4	38145	3652919
194.6	38612	3729681
194.8	39062	3807358
195.0	39502	3885926
195.2	40094	3968477
195.4	40694	4051927
195.6	41296	4136290
195.8	41899	4221565
196.0	42511	4307762
196.2	43112	4394883
196.4	43701	4482903
196.6	44272	4571789
196.8	44837	4661518
197.0	45415	4752091
197.2	45981	4843523
197.4	46533	4935779
197.6	47090	5028853
197.8	47681	5122762
198.0	48244	5217556
198.2	48853	5313676
198.4	49458	5410606
198.6	50059	5508329
198.8	50657	5606843
199.0	51247	5706133
199.2	51842	5806191
199.4	52437	5907026
199.6	53037	6008642
199.8	53630	6111037
200.0	54222	6214204

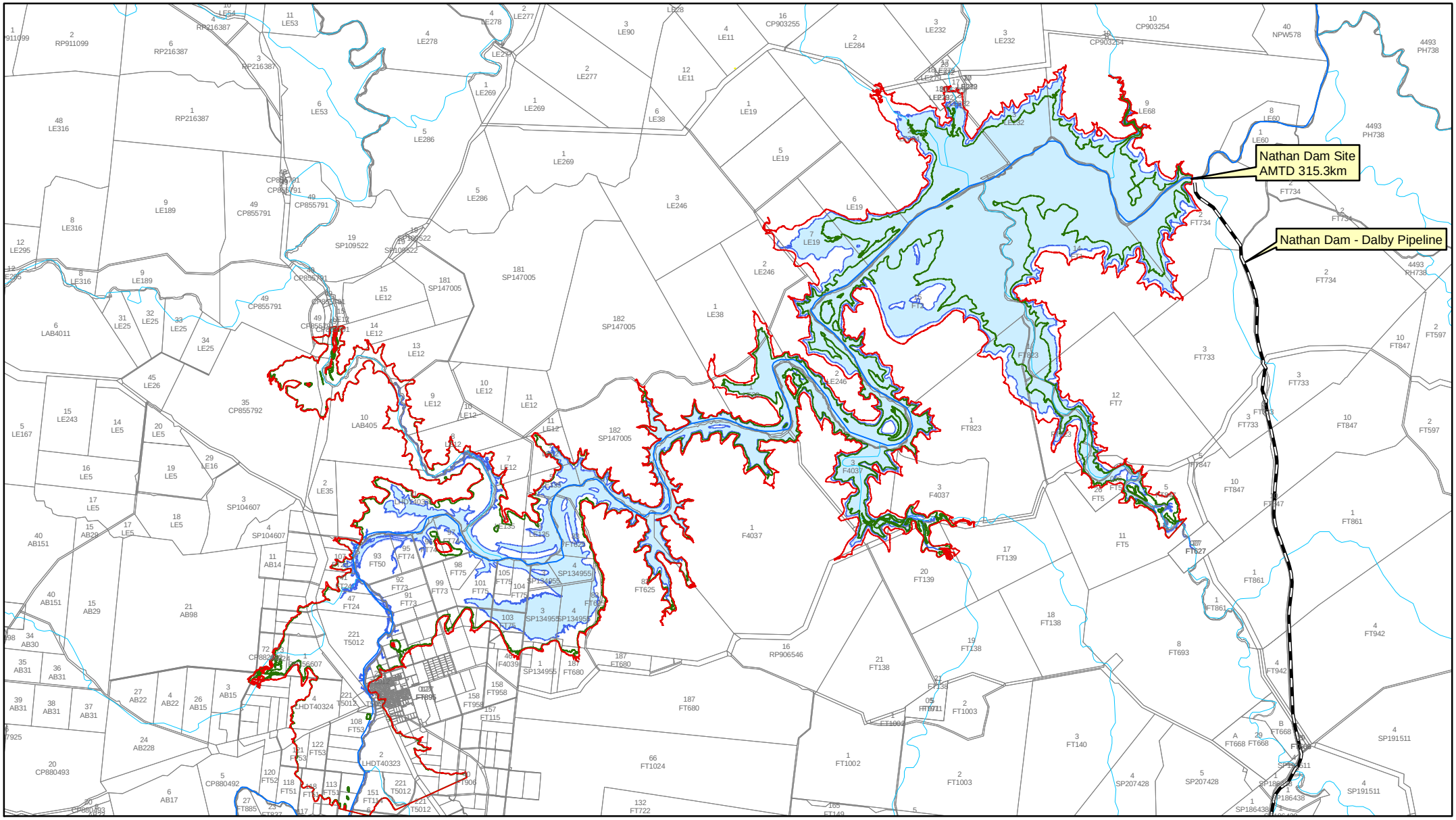
Figure 2-12

SW 233217A

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Storage Curve



LEGEND

- Q100 with dam
- Q100 no dam
- Nathan Dam - Dalby Pipeline
- Full Supply Level 183.5 AHD

Projection: GDA94 Zone 56

Figure 2-13

0 1.5 3 6
Kilometres
Scale 1:200,000 (at A4)

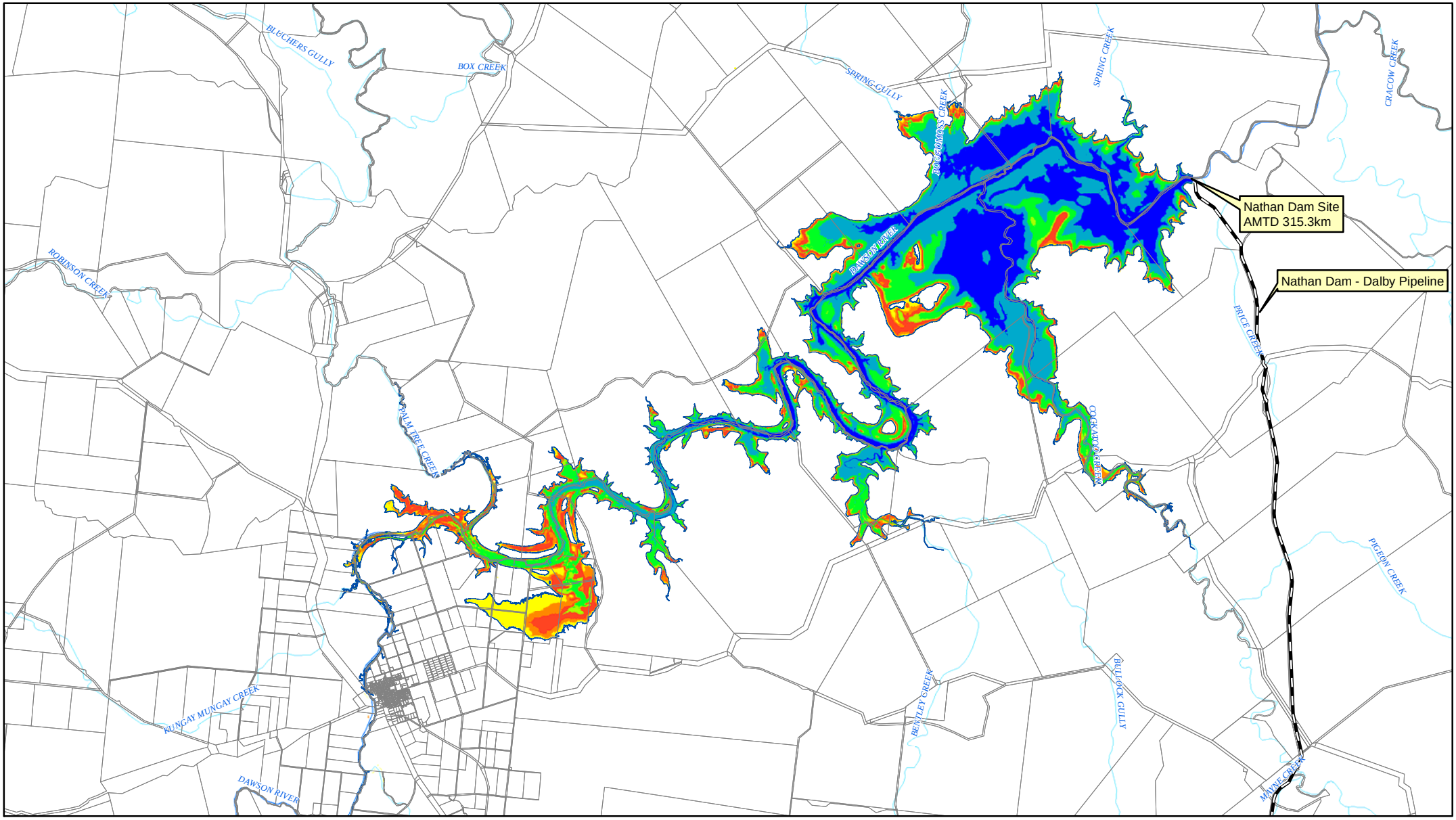
N

SW 233218A

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

1 in 100 AEP Flood Level



LEGEND

- Major Streams
- Nathan Dam - Dalby Pipeline
- Full Supply Level 183.5 AHD

Depth of Inundation

> 10	2.0 - 2.5	0 - 0.5
5.0 - 10.0	1.0 - 2.0	
2.5 - 5.0	0.5 - 1.0	

Projection: GDA94 Zone 56

Figure 2-14

0 1.5 3 6
Kilometres
Scale 1:200,000 (at A4)

N

SW 233224A

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Depth of the Water Storage at Full Supply Level

In accordance with the results presented in Section 1.6, the E&R option has been adopted for the purpose of design.

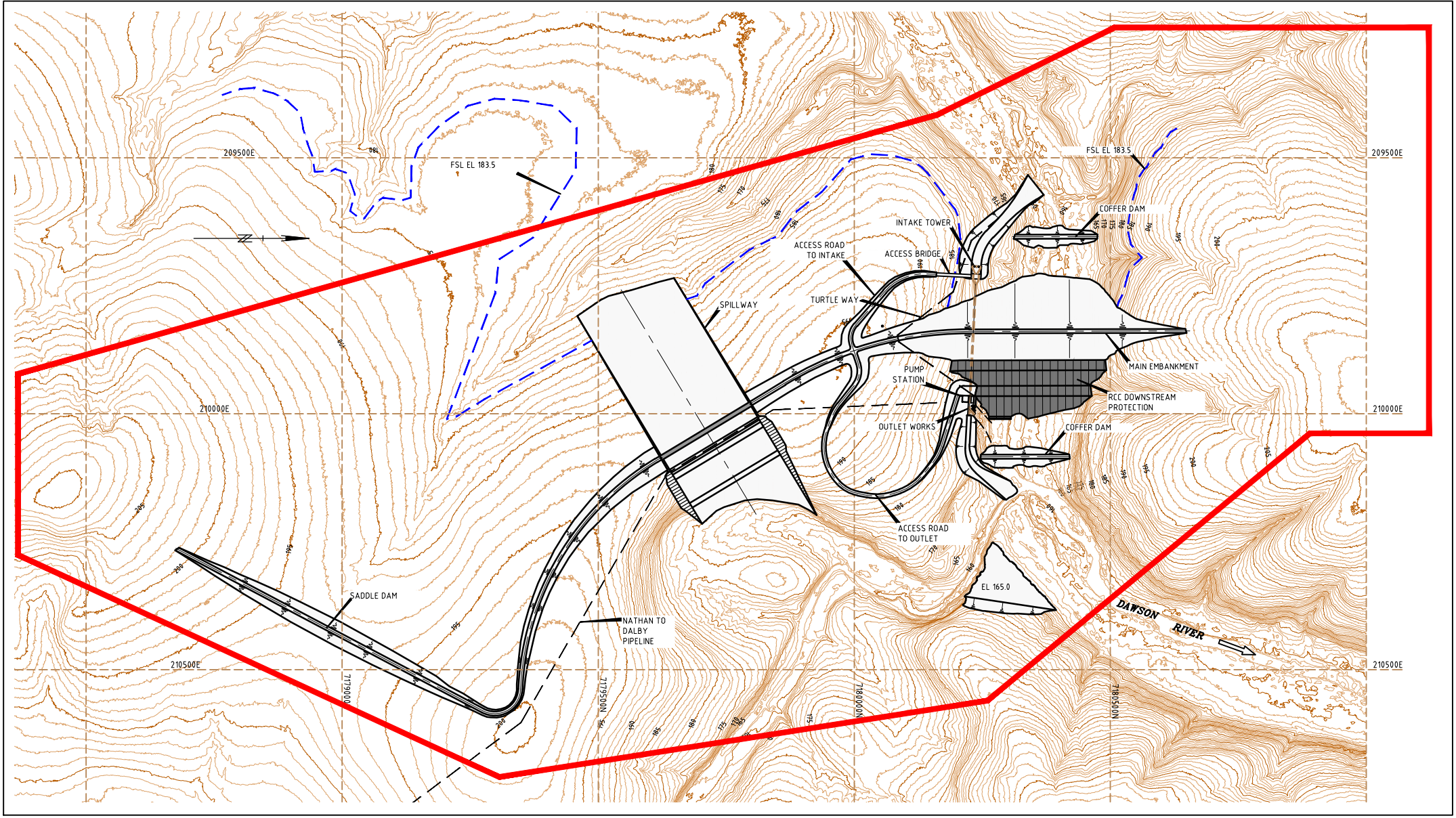
The upstream limit of storage at FSL will be at approximately 390.5 km AMTD which is downstream of Taroom.

Key aspects of the water storage are presented in Table 2-7.

Table 2-7 Key parameters of the water storage

Parameter	Description
Full Supply Level	183.5 m AHD
Total width, spillway and embankments	1240 m
Area inundated at FSL	13,508 ha (excl. islands)
Storage capacity at FSL	888,312 ML
Dead storage	34,500 ML
Yield	66,011 ML/a (high priority equivalent)
Maximum depth at FSL	23 m
Average depth at FSL	7.4 m
Spillway crest height above stream bed	23.5 m
Maximum structure height above stream bed	Approximately 38 m
Saddle dam length and max height	730 m long and up to 8 m high
Length of Dawson River inundated at FSL	75.2 km
Length of major streams inundated at FSL:	
Spring Ck	7.0 km
Cockatoo Ck	27.5 km
Boggomoss Ck / Spring Gully	10.9 km (combined)
Binghi Ck	9.3 km
Bentley Ck	10.3 km
Double Stable Yard Ck	4.5 km
Blackboy Ck	4.7 km
Scotchy Ck	4.6 km
Palm Tree Ck	12.0 km

The preliminary design consists of an E&R dam with a spillway on the right abutment and a saddle dam located south east of the spillway (Figure 2-15).



LEGEND:

Dam Operations Area

Projection GDA 1994 - Zone 56

Figure 2-15

0 100 200 300

Metres

Scale 1:10,000 (at A4)

SW 233208A

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Dam Operations Area

2.3.1.2. Spillway

The spillway comprises an entry channel with invert level at 180.0 m AHD and a 3.5 m high, mass concrete ogee (a shape consisting of a concave arc flowing into a convex arc), un-gated control crest. The spillway is flanked by concrete facings anchored to exposed rock in the sides of the spillway channel.

The ogee crest profile has been designed for a 4.7 m head – approximately 75% of the maximum head on the crest when the tailwater level is equal to the spillway crest level. The apron level at the downstream toe of the ogee crest falls uniformly to a shallow flip bucket. The lip directs high flows to an excavated plunge pool 200 m wide with a base at 160 m AHD. This will dissipate flow energy in such a way that minimises stress to fish passing over the spillway whilst achieving minimal erosion downstream of the dam wall.

On the downstream side of the dam wall the stream meanders, so the plunge pool has been designed to discharge into an excavated channel with a bed at 160 m AHD, and discharge into the Dawson River downstream of the dam embankment.

The steep face below the flip bucket lip will be concrete-faced to protect the rock from weathering and erosion.

The spillway width is still to be optimised and may vary between 200 m and 300 m. The narrow 200 m width has been used for flood studies and it will safely discharge the PMF peak inflow of 25,280 m^3/sec.

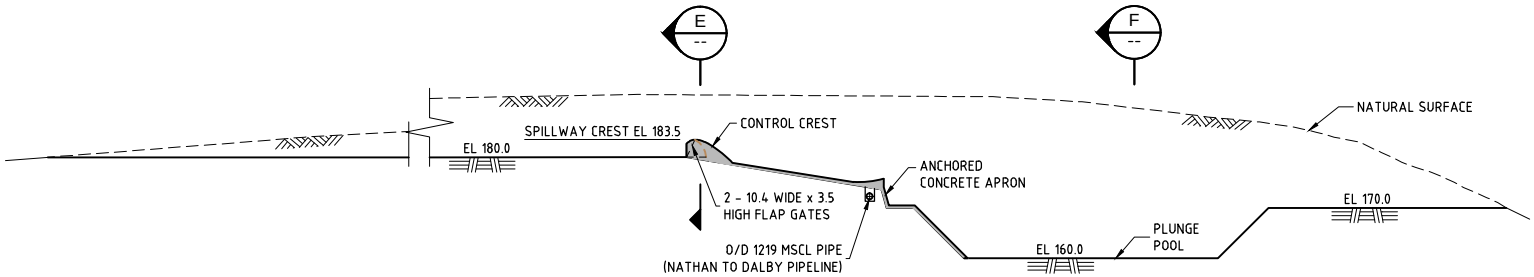
The 200 m wide spillway will pass the 1 in 100 AEP flood with a peak water surface elevation of 187.3 m AHD, approximately 3.8 m above the spillway crest.

An engineering summary of the principal features of the Spillway is shown in Table 2-8. Also a typical cross section of the Spillway is shown in Figure 2-16.

The precise details of the spillway profile and energy dissipation arrangements will have to be determined and optimised by physical hydraulic modelling. Accordingly some changes in the dissipator arrangements may be anticipated during the detailed design phase. Notwithstanding, the general appearance, layout and footprint of the spillway will not change significantly.

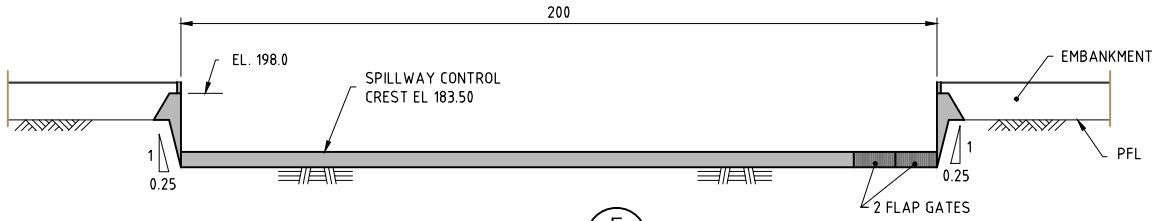
Table 2-8 Summary of engineering details of the conceptual design for main spillway

Parameter	Description
Spillway Type	Ogee and flip bucket
Spillway Crest Elevation	EL 183.5 m AHD
Crest Design Head	4.7 m
Total Main Spillway Width	200 m
Energy Dissipation Method	Plunge Pool (to be confirmed by physical hydraulic model)



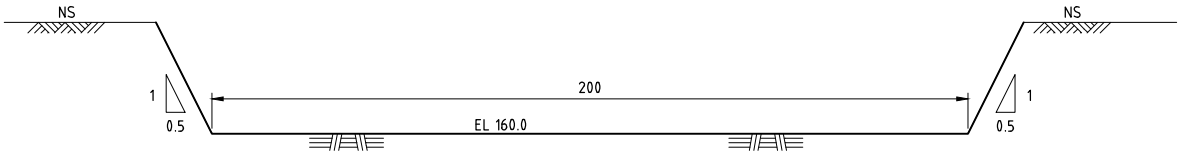
SECTION D 2-14

SCALE A



SECTION E --

SCALE B



SECTION F --

SCALE B

Figure 2-16

A 0 25 50 Scale 1:1,500 (at A4)

B 0 50 Scale 1:2000 (at A4)

Metres

SW 236409

NATHAN DAM AND PIPELINES EIS

Typical Spillway Sections

A small portion (approximately 11 m wide) of the spillway will have flap gates. These gates will enable a discharge of 230 m^3/s to enable the first post winter flow objectives of the Water Resource Plan to be met.

The stream bed upstream and downstream of the dam wall location has been mapped and is presented in Chapter 14. In general the area consists of a long pool with a substrate primarily of silt with fine to coarse sand and occasional gravel bars. The more upstream section grades to a shallow pool with a similar substrate.

2.3.1.3. Dam wall

The preliminary design for an E&R dam is shown in Figure 2-17. The design involves an earth (clay, sand) and rockfill embankment with maximum base thickness approximately 280 m tapering upwards to a crest 8 m wide with a roadway to the spillway. Slopes on both faces of the embankment are set at 2.5 horizontal to 1 vertical and contains a weighting zone to increase stability.

Rock excavated during spillway construction will be used as rockfill in the dam structures. The diversion conduit and outlet works would be located on the right abutment to allow simple access to the intake tower and as it is closer to the river channel it will assist in fish attraction to the fishway.

Weathering resistant stone (rip rap) imported to the site will provide wave protection on the upstream face of the embankment and coarse, reinforced sandstone rockfill will provide weather protection on the downstream face and erosion protection in the event of overtopping during construction. The embankment is designed not to overtop on completion.

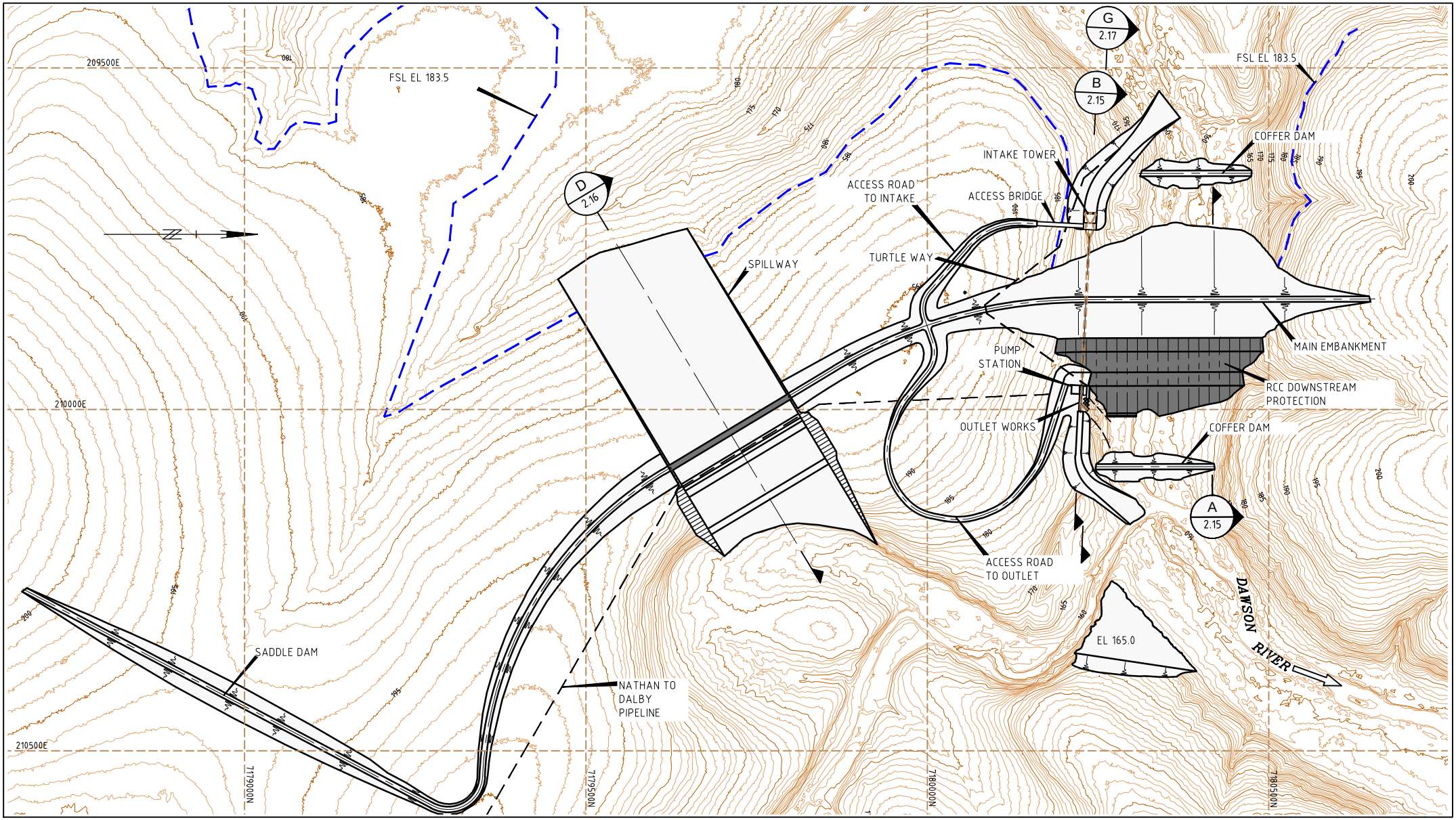
An engineering summary of the principal features of the E&R dam is shown in Table 2-9. A typical cross section of the E&R dam is shown in Figure 2-18.

Table 2-9 Engineering summary E&R dam

Parameter	Description
Location	Dawson River AMTD 315.3 km
Crest Elevation	EL 201 m AHD
Crest Width	8 m
Embankment Length	Approx 1240 m
Embankment Base Width	Maximum 280 m

2.3.1.4. Saddle dam

The saddle dam will be of similar cross section and detail to the E&R dam. An engineering summary of the principal features of the saddle dam is shown in Table 2-10.



Projection GDA 1994 - Zone 56

Figure 2-17

0 100 200

Metres

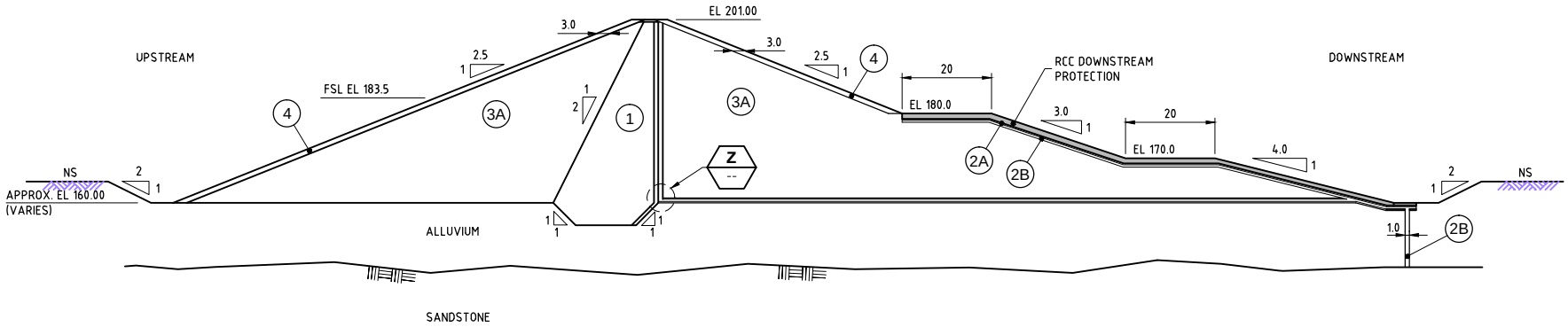
Scale 1:7,500 (at A4)

SW 233219A

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

General Arrangement

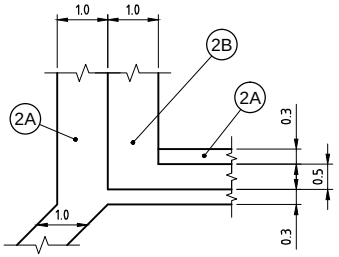


SECTION A 2.14

SCALE A

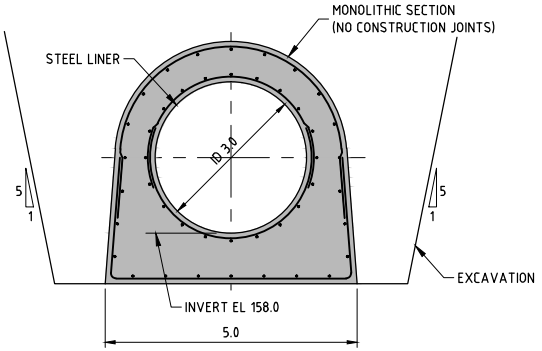
LEGEND:

1	CORE
2A	FINE FILTER
2B	COARSE FILTER
3A	EARTH FILL
3B	REINFORCED EARTHFILL
4	RIP-RAP



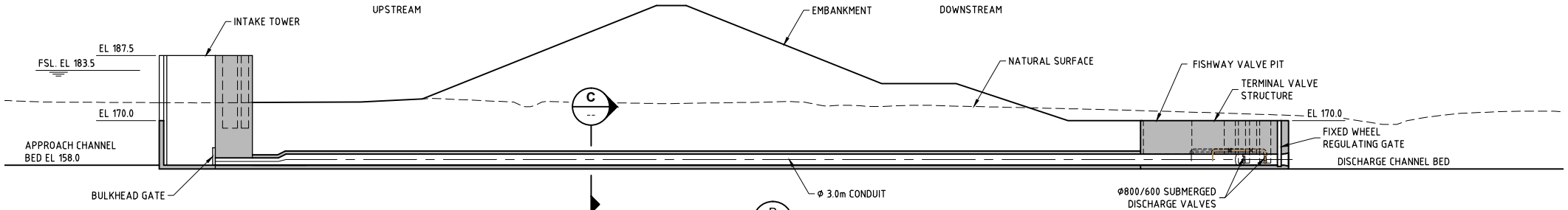
DETAIL Z --

SCALE B



SECTION C --

SCALE B



SECTION B 2.14

SCALE A

Figure 2-18

A 0 25 50 Scale 1:1,500 (at A4)

B 0 2.5 5 Scale 1:150 (at A4)

Metres

SW 233220A

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Typical Dam Sections

Table 2-10 Engineering summary of saddle dam

Parameter	Description
Location	Approximately 1150 m south east of the dam wall.
Description	E&R
Crest Elevation	201 m AHD
Crest Width	8 m
Embankment Length	730 m

2.3.1.5. Intake structure

The selective withdrawal system (multi-level offtake) providing for both downstream and pipeline release consists of a series of closed baulks and open trashrack panels that can be located in any order down the baulk and trashrack slot. The draw-off level is selected by positioning the trashrack panels at the level of the best quality water available from the storage and opening the downstream valves. The trashrack panels protect the outlet facilities from floating debris of a size that may damage outlet works components or jam valves. In addition to the trashrack panels a large area fine screen is provided to prevent fauna being drawn through the outlet works or being forced onto the screens themselves. The fine screens are oriented so as to direct fish toward the entrance chamber of the fishway. These elements have been discussed with agencies and relevant fauna experts and these discussions will continue during detailed design.

2.3.1.6. Outlet works

The basic elements of the downstream outlet works (Table 2-11) comprise the intake structure described in the preceding section and a number of outlet conduits with facilities to regulate and control flow through each. In addition, the water supply for the fishway and turtleway and for the Nathan to Dalby pipeline is also drawn from the conduit. The principal features of these outlet components are summarised in Table 2-11.

The primary river outlet facilities are a reinforced concrete steel lined conduit within the right abutment of the dam. Discharge will be controlled by a wheeled gate at the downstream end. A bulkhead gate will serve as a guard gate whilst the downstream gate acts as the regulating gate. A secondary river outlet facility is provided by way of a regulating valve fitted to the tunnel. This valve is intended to meet the environmental flow objectives of the Water Resource Plan. This secondary outlet is also suited to use at times when small releases are required.

The water supply for the fishway and turtleway is also drawn from the conduit that supplies the secondary outlet valve. The other circular steel conduit supplies the pipeline water supply low head pumps and the local domestic water supply for the dam and its associated facilities.

The precise arrangement for these facilities will be optimised during final design and hence the layout and size may change marginally. Notwithstanding the required outlet capacity will be maintained.

Table 2-11 Description of outlet elements

Parameter	Description
Primary River Outlet	3000 mm outlet controlled by a gate located at downstream end of conduit
Outlet Works Capacity:	45 m^3/sec (3888 ML/day)

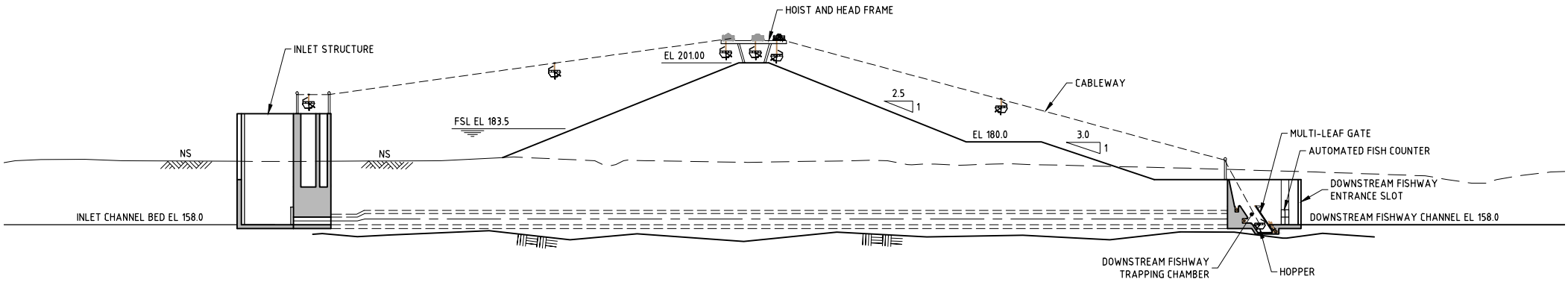
2.3.1.7. Fishway

A fishway has been included in the preliminary design to accommodate both upstream and downstream fish movement. Initial discussions have been held with Fisheries Queensland (DEEDI) and DERM staff and the design presented here is conceptual having regard to those discussions (Figure 2-19). The design of the facility will be finalised during detailed design following further consultation with relevant agencies and experts and in general accordance with the process provided by Queensland Fisheries. The concept is based on experience gained during several recent high-dam fishway design processes in Australia and on monitoring of various existing fishways. Experience from these processes has led to a number of potential design modifications being suggested by operators and agencies, to both enhance the targeted positive outcomes of the device and also to minimise accidental damage to fauna, particularly turtles.

With the relatively high lift height required for fish passage (up to 38 m), the most effective facility is likely to be a lift arrangement. The fish lift is provided for upstream and downstream transport. A conceptual arrangement for the proposed fishway is shown in Figure 2-19.

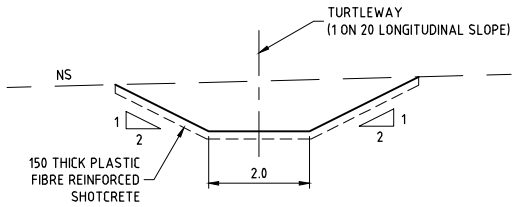
2.3.1.8. Turtleway

A turtleway has been included in the preliminary design to accommodate both upstream and downstream turtle movement. Initial discussions have been held with DERM and the design presented here is conceptual having regard to those discussions. The design of the facility will be finalised during detailed design following further consultation with relevant agencies and experts.



SECTION G 2-14

SCALE A



TURTLEWAY SECTION

SCALE B

NOTE:
PUMP TO BE PROVIDED AT TOP OF
TURTLEWAY FLOW IN BOTH DIRECTIONS

Figure 2-19

A 0 25 50 Scale 1:1,500 (at A4)

B 0 2.5 5 Scale 1:150 (at A4)

Metres

SW 233221A

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Fishway Concept

2.3.2. Pipeline

2.3.2.1. Trunk Pipeline Design parameters

The design flow rate for the trunk pipeline, based on an operation period of 20 hours/day and 350 days/year is 1865 L/s, for an annual capacity of 47,700 ML. The proposed pipe has a nominal diameter of 1200 mm, although the diameter is likely to be reduced as demands tail off towards the Dalby end of the pipeline.

The pipeline will be constructed from mild steel cement lined (MSCL) pipe, with a minimum earth cover of 900 mm, possibly increasing up to about 2500 mm over short lengths. The pipeline will be bedded in sand or similar inert material throughout its length. Surrounding the pipes with sand provides a stable environment and appropriate structural support.

It is SunWater's preference to bury the pipeline, and this will be the case for the majority of its length. However there is a section of the route between chainage 105 km and 150 km that is dominated by shallow stoney topsoils and underlain by low to medium strength rock from about 1 m in depth, and at this stage it is unknown whether or not this material can be successfully excavated. Subsequently there is a possibility that certain lengths of the pipeline through this region will need to be placed above the ground, although the pipeline will be buried in any sections of the area that will allow trenching to the required depth.

The design life of the pipeline is 80 years.

2.3.2.2. Pump stations and balancing storages

A low head pump station will be constructed at the dam. The preliminary design provides for these pumps to be located in a well adjacent to the outlet works valve chamber. The pump station will house up to four pumps (two duty and two standby), with associated pipework and valving. At full capacity the pump station will be capable of delivering a flow rate of 136 ML/day.

The pump station layout will include a concrete pit/well housing the four submersible pumps, a loading bay and a small building raised above the 1 in 100 AEP flood level to house the control and switch room.

The second and third pump stations will be of similar design. Each will contain conventional high lift centrifugal pumps which will draw water from a 5 ML concrete balance tank at the site (Figure 2-20). The balance tank upstream of the second station will be filled by the low lift pumps at the water storage.

The balance tank at the third pump station will be filled by the pumps at the second pump station. The pumps at the third pump station will supply a 600 ML balancing storage located just before the half way point in the delivery system. This storage will be at the high point in the system and will be able to make limited downstream releases under gravity alone. However, under normal supply conditions a fourth pump station will be draw from the 600 ML storage to meet downstream requirements. It will consist of a booster arrangement that will supply additional pressure to booster discharges when the gravity supply rate is too low. Although the discharge requirements will be lower, an arrangement similar to that proposed for the second and third pump stations is likely to be adopted. This may be scaled down marginally, where possible, to reflect smaller equipment requirements.

The second, third and fourth pump station layouts will include a concrete pit, building to protect mechanical and electrical equipment from the weather, loading bay and control room raised above the 1 in 100 AEP flood level. A crane will be incorporated into the design of the overhead structure to allow for pumping equipment to be lifted for maintenance or replacement. The pump station building will typically be an open structure to allow for adequate ventilation, however, noise generated by the pumping equipment may need to be restricted and will require the structure to be enclosed. The 5 ML balancing storages at stations two and three will be circular reinforced concrete tanks with dimensions of approximately 35 m in diameter and 5.2 m in height.

The dimensions of the 600 ML earthen balance storage will be dependent upon the topography of the proposed location, however, initial investigations have identified a required area of approximately 30 ha. The tank walls will be constructed from an earth fill derived from site with a fall of 1:3 and a 5 m wall height. A low grade access path will be provided at the apex of each wall. Ten metres of impervious fill topped with geotextile and rock material will line the inner walls. The use of clay or synthetic liner may alter depending on clay availability. Inlet and outlet pipe work with associated pits and valves will feed under the storage walls. The maximum storage of 600 ML is described in this document, however, it is likely that this balancing storage would initially be constructed of a smaller capacity and staged to maximum capacity in line with the water demand profile over time.

Power infrastructure will be designed and constructed by the service provider.

The pipeline will be remotely operated via an automated control system. The control systems will be connected via a fibre optic cable that will be laid within the pipeline trench.

The pipeline will terminate on the outskirts of Dalby. It will be the responsibility of Western Downs Regional Council to connect a lateral pipeline to the termination point in order to transport water to their water treatment facility.

2.3.2.3. Other above ground infrastructure

The following infrastructure will be required along the pipeline:

- control and reflux valves located on the pump station branch lines (~16 of each) to facilitate pump starting and stopping, to prevent back-flow and minimise loss of water from the pipe in the event of an unplanned shutdown (Figure 2-21);
- surge tanks (~5) and air cushion standpipes (~40) to assist in the control of waterhammer pressure surges (Figure 2-22);
- scour outlets (~260) to dewater the pipeline for maintenance purposes (Figure 2-23);
- air valves (~650) to release air from the pipeline during normal operation and filling, and admit air into the pipeline during emptying;
- swab insertion and removal stations (~11) for internal pipe cleaning purposes;
- isolation valves and pits (~26) for isolating sections of the pipeline;
- cathodic protection systems; and
- thrust blocks (~700) to prevent pipe movement under internal pressure.

Pipeline markers will be placed approximately every 500 m along the route. While the pipeline easement will not be fenced, some items of above ground infrastructure will be, in order to protect them from damage by stock or vehicles.

(Note the accompanying plates are from the recently completed Eungella pipeline southern extension project and are presented by way of example only).

Figure 2-20 Balancing Storage and Pump Station

Figure 2-21 Control valve

Figure 2-22 Surge tank

Figure 2-23 Scour outlet

Figure 2-24 Typical swab insertion and removal station

Access roads will be required for construction and maintenance of all sections of the pipeline that cannot be accessed from existing roads. These are likely to be a minimum of 3 m wide and surfaced with gravel.

Temporary material laydowns along the route will be required for pipes, bedding sand, pre-fabricated infrastructure, tools and machinery. As the precise location does not need to be fixed, it will be decided based on the area of least impact which is approximately in the area needed, as such, cleared flat areas will be chosen.

2.3.2.4. Lateral connections

Lateral pipelines are likely to be required from both the river downstream of the dam and from the trunk pipeline to deliver water to individual demand nodes, be that node a mine, power station, town or landholder. The DVWSS already has a distribution system and depending on the location of new demands, that system may be used. Alternatively the new demand node may require a dedicated lateral pipeline from the river.

Each connection to the trunk pipeline will consist of a smaller diameter pipe which connects to the trunk pipeline underground, before diverting above ground for a short section where appropriate isolation valving and metering devices are installed before again diverting below ground. The above ground section of pipe will generally be approximately 1m above ground and up to 10m in length.

Lateral pipelines constructed to extract water from the Nathan trunk main will be the responsibility of the water user, and will be assessed as part of their development. No lateral pipelines are included in this Project and all future such pipelines will require their own approvals. Similarly, if users require water of a particular standard, it will be their responsibility to undertake that treatment and obtain appropriate approvals for same.

2.3.3. Associated infrastructure

The relevant Queensland Government departments, local councils and the infrastructure owners have been consulted to determine changes necessary to:

- maintain the connectivity and functionality of road networks;
- construct any new roads to current design and safety standards for roads of that category;
- maintain utility infrastructure and services for landowners;

- co-locate, within any new road corridors, any other infrastructure where practicable;
- maintain safe and convenient access for landowners to their property;
- develop clay extraction areas;
- minimise environmental impacts; and
- comply with the Cultural Heritage duty of care.

2.3.3.1. Roads and property access

All roadworks will be to the standard applicable to the designation, that is, local government or Main Roads. The more significant road works are discussed below. Pavement condition surveys will be undertaken prior to construction commencing and restoration works will be included as appropriate at conclusion of works.

Glebe Weir Road

The majority of this road will become part of the northern access to the dam wall and spillway from the Leichhardt Highway. The intersection with the Leichhardt Highway will require upgrade to accommodate construction traffic. Approximately 25 km of the public Glebe Weir Road from its junction with the Leichhardt Highway and 6 km of the branch to Spring Creek property will require upgrading to a two lane rural road standard and provided with a sealed road pavement. On Spring Creek property approximately 6.5 km of new access road will be constructed to the same standard, terminating at the upper left abutment of the dam. The alignment has been selected to minimise road length, cut and fill. A culvert and floodway will be constructed over Spring Creek.

As Glebe Weir will be inundated by the water storage, Banana Shire Council will be requested to rename Glebe Weir Road. Infrastructure needs for the dam operation, such as power and telecommunications, would be aligned along this road.

Approximately 1.5 km of the access road to Glebe Weir will be subject to inundation by the new water storage. It is proposed to abandon this section of road. The remaining portion of the access road is about 1.5 km in length and will be retained to provide public access to the proposed recreation area. Notwithstanding it is proposed that the retention and future use of this road would be determined in consultation with the local Council. Council will continue to be consulted about the proposed arrangements throughout the detailed design phase.

Cracow Road

Cracow Road is currently a 2 lane unsealed road. At Cockatoo Ck the road will be raised onto an embankment over a distance of 1.5 km and adequate drainage will be provided via culverts in the embankment. A bridge of approximately 200 m in length will be required to cross the creek and water storage area. Flood immunity at least equal to the present will be provided.

The main channel of Bentley Creek and two small tributary gullies will be affected by water storage area. In the case of the two small gullies it is proposed to raise the road and improve the cross drainage structures so the current flood immunity is retained or slightly improved. At Bentley Creek the road will be raised and a large culvert and flood causeway constructed.

Bundulla Road

Bundulla Road crosses the Dawson River about 20 km by river downstream of Taroom and would be severed by the reservoir. As this road will remain accessible from either end it is proposed to abandon the inundated section of road and to construct turning circles at each end where it abuts the reservoir. The impact of severing this through road is assessed in Chapter 21.

Pipeline access track

There are four types of tracks associated with the pipeline:

- maintenance track that runs along the length of the pipeline within the permanent easement. The design standards is graded but unsealed. Road base or gravel will be used where the native material is not adequate, such as in low lying or wet areas;
- access tracks from the road network to the pipeline easement. The design standard will be as per the maintenance track;
- access tracks to pump stations and balancing storages. The design standard is unsealed gravel roads; and
- temporary access tracks will be constructed through creek crossings during pipeline construction. These will typically consist of a compacted fill and gravel or roadbase overlying parallel pipes. The pipes will be sized to allow base flow to pass, with any higher intensity flooding passing over the top and will be removed upon completion of construction.

Property access

A number of private property accesses will require realignment as a result of the dam, specifically Balcarris, Glebe, Mt Rose, and Bently.

2.3.3.2. Resource Extraction Areas

The establishment period will include the development of new clay extraction sites within the water storage area. Site establishment works for clay quarry operations will include:

- internal haul roads to the extraction sites;
- clearing of vegetation;
- stock fencing including gates;
- clearing and removal of topsoil and overburden;
- provision of appropriate sediment and erosion control;
- provision of a crib room and toilet facility;
- delivery of the raw products to material laydown areas at dam site; and
- final demobilisation and restoration.

Clay will be extracted directly into trucks for delivery to the dam construction area and will not be stockpiled.

The other construction material to be sourced locally is the sandstone that will be utilised in the protection of the downstream face of the dam wall. This material will be sourced from the spillway cutting on the right bank, with material progressively relocated from the spillway spoil pile to the dam wall as required.

All other materials required for construction will be sourced from commercial suppliers.

2.3.3.3. Power and telecommunications

All above-ground infrastructure will be removed prior to commissioning of the dam.

The infrastructure owners (Ergon and Telstra) will undertake removal, recovery and replacement and will do so in accordance with the applicable legislation. Work will involve:

- removing redundant infrastructure; and
- installing new power and communications infrastructure.

There should be no discernible communication disruption to any customer as cable cut-over should be transparent. Community or individual customer dislocation will be minimised.

Whilst temporary power and telecommunication facilities may be provided during the early phases of construction, extension of services will be carried out soon after access to the site has been completed. The following service extensions are proposed:

- approximately 12 km of 11 kV powerline from the existing power transmission line servicing Glebe Weir; and
- telephone and data services from the nearest existing facilities with adequate capacity. This will be confirmed during final design.

For the pipeline, portable diesel generators will be used for power generation during construction but permanent mains power will be required at each pump station. 66 kv capacity is required at pump station no. 1 and 33 kv at each other pump station.

2.3.3.4. Water and wastewater

Once operational, the water storage will include a manager's residence (not permanently occupied) and recreation areas. Water supply to the residence and recreation areas will be from rainwater tanks. Direct extraction from the water storage will provide water for non-potable uses. No water treatment facilities are proposed in association with the distribution of water from the storage by either pipe or downstream release.

Domestic wastewater from the residence and recreation areas will be disposed via a septic trench or envirocycle style system designed to accord with local government standards.

2.3.3.5. Recreation facilities

The design of each recreation areas will be negotiated with the Council, Sport and Recreation (Nth Qld), Department of Transport (re access roads, the boat ramps and parking), Queensland Fisheries and recreation groups. As a minimum the areas will include a picnic ground, boat ramp, toilet facilities with solar power, and non-potable water supply.

Camping facilities may also be provided at the recreation area off Glebe Weir Road should the Council wish to maintain such a facility. Early discussions with the Council have been undertaken regarding the provision of recreation facilities, but further discussions are planned regarding facility design and compliance with other local government requirements. The design will cater for disability access.

The dam will be subject to SunWater's blue-green algae monitoring program, and signage will be provided at each recreational facility indicating the current hazard level associated with monitoring results. SunWater will liaise with Queensland Transport regarding the provision of appropriate boating safety signage, and with DEEDI regarding the provision of weed and pest transfer signage at the boat ramps.

It is intended that responsibility for the operation and maintenance of the recreational facilities will rest with Banana Shire Council, as is the case presently with the camping area beside Glebe Weir. SunWater will confirm or secure tenure of the land as necessary and construct the facilities in consultation with Council.

2.3.3.6. Decommissioning of Glebe Weir

Glebe Weir and its associated infrastructure will be inundated by the Nathan Dam storage. Upgrade of Glebe Weir has been approved as part of the Wandoan Coal Project. The following assumes that the upgrade occurs. The infrastructure affected includes:

- the weir structure of concrete, sheet piling and a fabridam or steel shutters (not yet confirmed);
- a control building housing air compressors;
- an intake and pump station on the right bank;
- a water supply pipeline from the pump station to Nathan Road (thence to Wandoan Joint Venture coal mine);
- a camping and recreation area including toilets and showers (septic trench disposal), tables and shade buildings, waste bins, a boat ramp and various signage;
- power supply infrastructure (11 kV lines and timber poles);
- Glebe Weir Road; and
- river gauging stations.

Glebe Weir will continue to serve its role in the Dawson Valley Water Supply Scheme until Nathan Dam commences to store water and can take over that role.

When decommissioning, owners must prepare a decommissioning plan. Current practices for decommissioning are established by ANCOLD for referable dams. Although Glebe Weir is not a referable dam it is likely practices similar to those adopted by ANCOLD will be used by SunWater as a responsible dam owner. ANCOLD (2003) identify two principal alternatives when decommissioning. Both alternatives involve completely abandoning the storage, such that the structure no longer retains water. While this is best achieved by complete removal of the wall and reinstatement of the bed and banks, in some situations it may be appropriate to only partially remove the structure. This is the case with respect to Glebe Weir because the weir is approximately 11 km upstream of the dam, will be 12 m underwater at FSL and will be inundated for most of the time.

The decommissioning plan for Glebe Weir will be prepared should the Project be approved. Principle features of the plan will include:

- all removable or light weight infrastructure will be removed and re-used where possible. This includes the fabridam (or steel shutters), pumps, compressors, signage, shade buildings, waste bins, etc;
- all horizontal hard surfaces will be left in place (Glebe Weir Road, boat ramp, building pads);
- all standing buildings will be demolished and the heavy waste (bricks, concrete) pushed into the weir pool; and
- the storage will be drawn down through releases through the outlet works and a portion of the weir wall demolished to allow flows directly through the breach.

2.4. Construction

2.4.1. Pre-construction activities

Pre-construction activities include:

- acquiring the necessary land or access to land;
- obtaining all necessary permits and approvals (addressed in Section 1.10);
- clearing vegetation;
- site decontamination;
- upgrading and constructing access roads and implementation of a traffic management plan;
- extending power and communications facilities to the water storage construction site;
- establishing site office facilities and secure compounds;
- establishing workforce accommodation;
- establishing resource extraction sites; and
- transporting construction materials to material laydown areas.

It also includes continuation of the various technical investigation programs necessary to finalise design and the detailed construction program.

2.4.1.1. Land acquisition and establishment of easements

Land acquisition is the responsibility of the Department of Environment and Resource Management (DERM) and not SunWater. For land affected by the dam, DERM Property Services are the agency acquiring land, with acquisition advice being provided by SunWater. Title will be transferred to SunWater prior to the commencement of construction. DERM is committed to treating all landholders affected by the Project fairly and with respect. DERM's preferred approach to acquiring the land, or an interest in, or access to the land required for the Project is to negotiate with landholders and their representatives.

DERM will require title to:

- land to be inundated at FSL;
- land occupied by the water storage construction footprint; and
- land occupied by significant above-ground infrastructure along the pipeline route such as balancing storages, pump stations and possibly surge tanks.

Prior to construction, interest in or access to land will be required by way of:

- negotiating with the current leaseholders of DERM owned properties to release a portion of their leases for the area of land impacted by FSL and the required buffer, and negotiating a new lease for these areas from DERM;
- leases from DERM where land has been acquired by the State of Queensland and leases to existing occupants provide for the Project;
- obtaining necessary resource entitlements from the State for any necessary development permits on land over a State resource;
- purchase through negotiation with private landholders affected by the water storage FSL and construction footprint, the balancing storage and pump station sites or, failing this, compulsory acquisition; and
- negotiation of easements to accommodate:
  - the flood buffer above FSL;
  - associated infrastructure including roads;
  - the trunk pipeline;
  - minor above-ground infrastructure associated with the pipeline; and
  - access roads and tracks;
  - obtaining permits to occupy over road reserves where necessary; and
  - interests in land may be required for temporary access tracks and material laydown areas.

SunWater and DERM are aware of the disruption that uncertainties over land requirement and processes for acquisition of land for projects such as the Nathan Dam and Pipeline Project can cause to landholders and will endeavour to minimise these.

Key elements of the DERM's policy regarding acquiring the land required for the Project include:

- engaging in open and meaningful dialogue and negotiations with landholders (including the Councils) concerning requirements for the Project, and the requirements and preferences of landholders;
- ensuring that landholders are paid fair market value for land acquired;
- ensuring that landholders are paid fair value for interests in or access to land based on permanent or temporary loss of productivity and disruption to on-going farm operations;
- meeting costs of surveys necessary to delineate the areas required for purchase or areas where interest or access is required;

- meeting costs of independent valuations of the land or interest in or access to land required;
- meeting reasonable costs, including legal costs, stamp duty, disturbance costs, general expenses incurred by landholders in arranging sale of land or interests in or rights of access to land, reasonable personal relocation expenses if required, expenses related to relocation of houses or infrastructure if this is the chosen option and relocation of services and access roads to any such new house location;
- finalising land acquisitions as expeditiously as possible to give landholders certainty of their position; and
- ensuring security and preventing public access to land which the landholder retains, or retains an interest in.

SunWater has contacted all impacted landholders and is in ongoing discussions. If the Project is approved, should DERM or SunWater be unable to acquire the land or interest in or access to land required through negotiation with landholders, it will be necessary to request the Coordinator General of Queensland to initiate proceedings for the compulsory acquisition of the land required under the provisions of the SDPWO Act.

SunWater or DERM will negotiate easements for the 1 in 100 AEP flood buffer around the storage area. SunWater will attempt to develop easement conditions that place minimum (if any) restrictions on current land use to ensure minimal impact to landholder activities. The exact location of land included in the flood buffer will have regard to specific on-site characteristics such as slope, vegetation, location of improvements and infrastructure and will be finalised in consultation with individual landholders.

Irrigation pumps owned by allocation holders will be allowed to be placed within this buffer but at the owner's risk. SunWater will negotiate modified fencing arrangements for the FSL and buffer with impacted landowners as part of the tenure negotiation process. Alternative water supplies to paddocks that have to date relied on access to the river for stock water would be provided if this access is impacted by the Project.

There are instances along the pipeline route where the pipeline preferred route is within Council road reserves, and in this instance SunWater will seek a permit to occupy from the relevant Council. Discussions have been undertaken with both Banana Shire and Western Downs Regional Councils regarding the placement of the pipeline with their road reserves to identify their requirements such as minimum separation distances from the road, potential future road realignments, management of above ground infrastructure such as air valves and stand pipes, and traffic control during construction. Both Councils are willing to provide access for the pipeline in the required locations.

More details on land tenure are provided in Section 2.2, Appendix 2A, 2B and 2C and in Chapter 7.

2.4.1.2. Site establishment - dam

Following the staged completion of the construction access roads (Sections 2.3.3.1 and 2.4.4.1) the dam construction site proper can be established on both abutments. The final selected arrangement depends on the Contractor's method of operations, choice of sand and aggregate sources and construction camp location. The following describes a likely general layout of facilities. The entire construction area will be fenced to exclude stock and larger fauna.

The main site office will be located on the left bank in an area prepared and covered with hardstand material suitable for offices, amenities, concrete testing facilities, power generation equipment, fuel and potable water bunkering and car park

facilities. The proposed area would be of the order of 14,000 m² of road base with security fencing. The office will support the site security required for the control of delivery vehicles and visitors to and from the site.

The main compound area for the location of the Conventional Concrete (CC) and Roller Compacted Concrete (RCC) plants, stockpiles of raw materials, cement and fly ash silos and water storage tanks would be located nearer the dam than the offices. On the right bank a satellite office and compound is to be established for the operations of the RCC and CC plant. An area of hardstand will be prepared for the location of the offices, amenities, workshops and for the concrete batch plant, water storage, fuel bunkering etc plus sand and aggregates stockpiles.

It is proposed to use river water for concrete batching. The procurement and installation of water pipes and pumps from the river to the batch plant and holding tanks is part of the establishment period. Commissioning of the batch plants includes trials for the various mix designs. The RCC material produced in these trials will be used in the formation of the all weather access roads to the dam site. Approximately 3,000 m³ could be required. RCC covered roads are to be used to reduce dust and any contamination of the RCC from transport vehicles where direct tipping is to be used in dam wall construction.

Construction of internal haul roads between the batch plants, material laydown sites, clay extraction areas, the construction site and offices will also occur within this establishment period. Pavement material for the hauls roads and hardstands would be sourced from scrapes along the Taroom-Cracow Road and the ridge gravels on the left bank.

Workshops are to be established on the right abutment for the purpose of maintaining the construction plant and to allow scheduled maintenance programmes to be continued throughout the construction phase. The workshops are required to be covered and have a concrete floor to allow for the collection and clean up of any spillages. All weather protection is required to allow activities to be continued during the colder months.

The large roof areas are to be connected to a rain harvesting network to allow captured water recycling for use in ablutions areas, to batch concrete, condition earthfill, dust control on haul roads and material laydown areas. The workshops could be located within walking distance to the main office compound but isolated enough to not interfere with the day to day operations of the administration. Insulation may be required to control the noise levels from within the workshops.

The storage of Hazardous and Non-hazardous materials must comply with the legislation and best practice guidelines which include the use of steel containers that may require purpose built ventilation. The collection and removal of waste products must comply with current best practice techniques regarding waste minimisation, separation and maximisation of re-use or recycling potential.

Three major storage areas for diesel fuel are envisaged:

- up to 8,000 litre capacity on the left bank for power generation for the office complex and workshops;
- 60,000 litres of storage is required for general machinery support on the left bank. This would mainly be distributed by service vehicles on site; and
- 20,000 litre capacity on the right bank to support the concrete batch plants self contained power generation; and satellite office.

Storage, including bunding, will be in accordance with regulations.

The storage of petrol in large quantities would not be required except for passenger vehicles. The option would be to source petrol from Taroom and not store on site.

Workshop oxy and acetylene will be contained separately in steel containers.

Explosives will be stored in bunkers or purpose built containment devices compliant with the regulations.

The control and distribution of all of these materials will be managed by an experienced yard manager.

As a means of reducing surface runoff in the event of heavy rain, areas of disturbance will be isolated with silt fencing that is supported by a defined maintenance system throughout the duration of the Project. A large sediment pond is anticipated on the left bank upstream of the dam wall as indicated on Figure 2-25. A detailed sediment erosion and control plan will be established by the construction Contractor in accordance with the EMP outlined in Chapter 29. Captured stormwater will be re-used on site in dust suppression or watering of rehabilitation areas. All material laydown areas will be similarly protected and areas of disturbance stabilised by grassing where appropriate.

2.4.1.3. Site establishment - pipeline

Project offices will be established in Wandoan and Chinchilla, likely from the existing rental market or via provision of demountable buildings in a Council approved location. Power and services will be accessed directly from the local networks.

Laydown areas will take delivery and store most of the construction consumables, including fuel and hazardous materials. All materials will be stored at the laydowns in accordance with the relevant regulations.

A substantial proportion of the pipe and bedding material will be delivered to the lay down areas prior to the construction teams coming on site. This will reduce potential conflicts between delivery and construction vehicles and spread the impact of delivery on the transport network.

2.4.1.4. Workforce accommodation

Section 2.4.6.3 describes the workforce accommodation camps. They will be established in the pre-construction phase and will be available to drivers of vehicles transporting materials to material laydown sites as well as to all other workers involved in pre-construction activities.

2.4.1.5. Establishment of resource extraction areas

The establishment period will include the development of new quarry and sand extraction sites by the current allocation holders (Section 2.2.3.2 and 2.3.3.2). All permits and approvals will be acquired by the allocation holder before SunWater will purchase any material from the sites. Clay extraction areas will be developed and managed by the dam construction Contractor and the likely design of such areas is addressed in Section 2.3.3.2.

2.4.1.6. Vegetation clearing and fauna relocation

Vegetation clearing and fauna relocation will be undertaken at all work sites, including the water storage area, pipeline, as necessary for road works and at resource extraction sites. The process described below is generally applicable to all sites.

As the vast majority of the water storage area is agricultural pasture, this will be left undisturbed; only trees and shrubs will be removed. Tree and shrub vegetation will be mechanically cleared to FSL within the storage area, except in the riparian zone of tributaries and the main channel which will be cleared to within 1.5 m (vertical) of FSL or where significant vegetation is near FSL. In this case it will be left in place as it may survive, depending on inundation frequency and duration. Millable timber, or timber suited to artisans will be sold (via DERM Forest Products) and as much of the remaining suitable material as practicable will be mulched for use in construction site rehabilitation, landscaping of recreational facilities or made available for potential use in regional rehabilitation schemes.

Appropriate material will be salvaged for use as 'large woody debris' aquatic fauna habitat, or terrestrial habitat above frequent flood inundation levels. Remaining material, of which little is expected, will be burnt on site under permit from the local fire warden.

Vegetation clearing will be staged, commencing with the area required for dam construction works. The remainder will be cleared progressively until the water storage is ready to fill.

Approval for clearing is required under the VM Act, NC Act and possibly the EPBC Act (Section 1.10). Appropriate measures to be incorporated into a clearing plan include:

- the presence of fauna spotter/catcher(s) accredited by Queensland Parks and Wildlife Service (QPWS) during vegetation clearing for safe handling and possible relocation of animals unable to safely move away from the disturbance;
- management procedures for the treatment of any injured animals; and
- clearing of vegetation to be undertaken so that any more mobile, non-volant (cannot fly) fauna is able to move to other areas of suitable habitat, i.e., patches of habitat should not be disconnected in a haphazard fashion that limits movement.

The fauna spotter/catcher is responsible for:

- actively searching all habitat within areas to be cleared and identifying wildlife species present; and
- facilitation of clearing activities, ensuring methods used are appropriate with minimal risk of injury or death to resident wildlife in accordance with the EMP and the instructions of the construction site manager.

The fauna spotter/catcher will work ahead of proposed clearing activities and check vegetation and fauna habitats for the presence of native species. The most desirable approach is to allow wildlife to move out of the disturbance area of their own volition.

2.4.1.7. Relocation of private infrastructure

The following Sections 2.4.1.7 to 2.4.1.10 are not expected to apply to the pipeline as the route can generally be adjusted slightly to avoid such interference.

Re-usable infrastructure on land that will be inundated or is within a construction area will be relocated to a suitable location above the flood buffer conforming to local and state planning requirements and following discussion with the landholders. This may include sheds, yards, pumps, water tanks and machinery. One house (Glebe Homestead) exists within the water storage area and it will be relocated if possible. Minor items such as fencing will be at the discretion of the landowner, but if not removed, will be treated as redundant. All relocation will be completed prior to commencement of operation of the storage.

2.4.1.8. Redundant infrastructure

Infrastructure which is not suitable for relocation will be regarded as redundant and will either be left in place if it is inert and not a potential safety hazard, or will be removed and disposed of in accordance with relevant legislation. Fencing in other than the deepest areas of the dam would be regarded as a safety hazard.

- Sewerage Infrastructure

The water storage area is not sewered. The septic disposal trench at the Glebe Weir camping reserve will remain operational during construction and will be treated in accordance with the decontamination processes developed prior to completion of the construction process.

- Local Government Infrastructure

The recreation facilities adjacent to Glebe Weir will be removed where viable and reused. Local Government road infrastructure is discussed in Section 2.3.3.1.

- Gauging Stations

The following gauging stations will be inundated by the water storage and become redundant:

  - Glebe Weir Headwater: Station No. 130338a
  - Glebe Weir Tailwater: Station No. 130345a

New gauging stations will be established at the headwater and tailwater of the new dam and at major tributaries upstream of the dam. Rainfall gauges will be strategically located throughout the catchment area.

2.4.1.9. Site decontamination

Decontamination of sites in all construction areas and within the water storage area and buffer will be completed prior to dam closure. Potential sources of contamination include cattle dips, septic tanks and agricultural chemicals. This is further detailed in Chapter 8.

2.4.1.10. Resource salvage

Valuable soils, sand and gravel resources within the water storage area which will not be used in construction, site rehabilitation, landscaping or other identified needs, will be made available to the commercial market for extraction. DERM Forest Products is the agency responsible for administering the sale of forest and quarry material from crown lands and will be consulted regarding the appropriate processes. Extraction will only occur in a short timeframe prior to dam closure and strict controls will be in place to minimise potential impacts to riverine fauna and downstream water quality. SunWater will permit, subject to the extraction contractor obtaining necessary approvals, such resources to be stockpiled within suitable parts of the Land Purchase Area but free of flood risk. Such stockpiles must be grassed and protected from erosion and runoff until they are used.

Chemical and hazardous goods to be utilised during the life of the Project are outlined in Chapter 26, Table 26-9 and Table 26-10.

2.4.2. Water storage

2.4.2.1. Extent of dam construction work

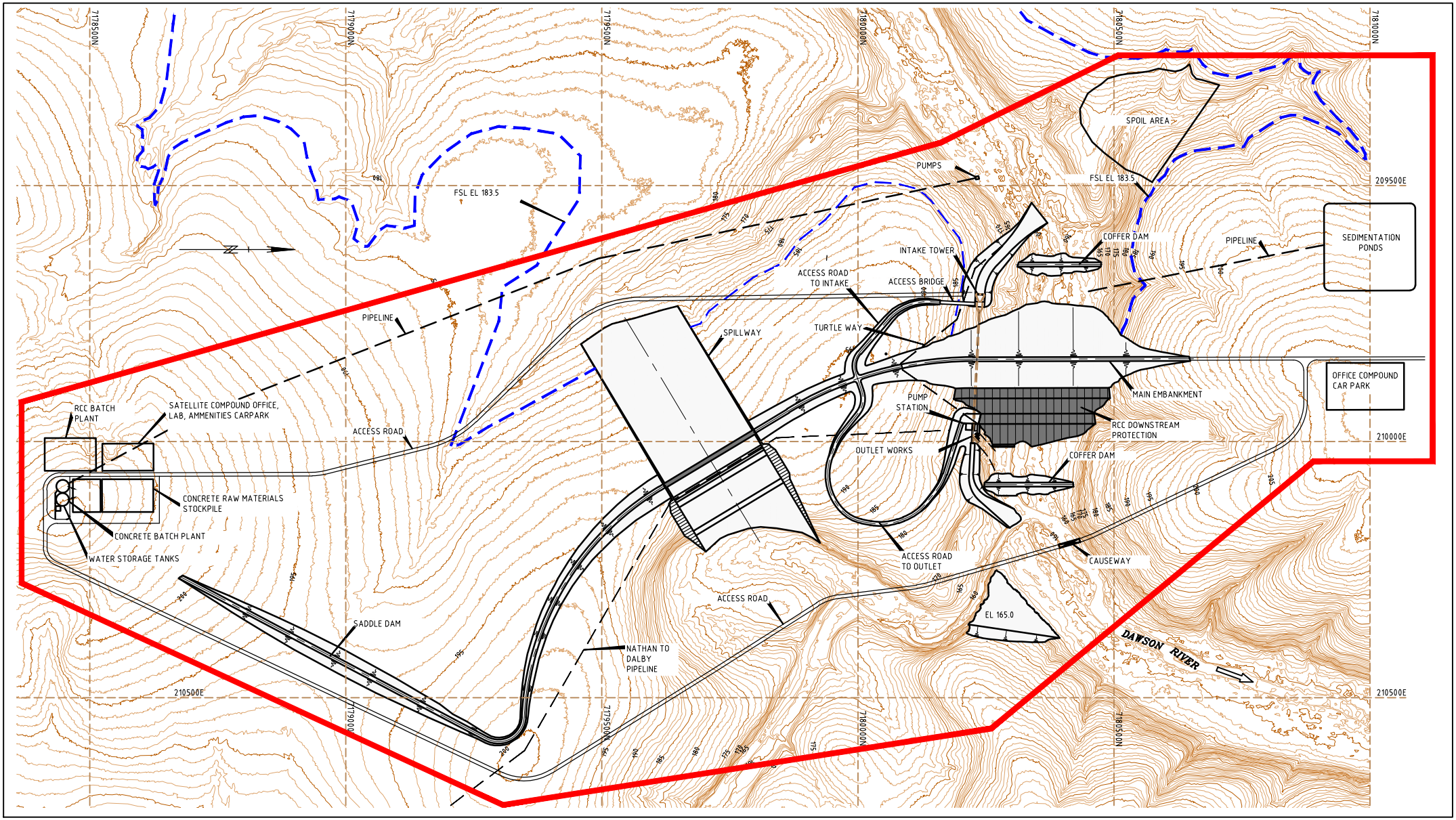
Nathan Dam consists of three individually positioned structures: an E&R embankment, spillway and saddle dam.

The proposed dam construction works are all located in the same general area as shown in Figure 2-25.

2.4.2.2. Diversion channel and coffer dams

Having regard to the flood hydrology, topography, dam layout and geotechnical conditions at the site, a river diversion channel around the works is considered to be appropriate. It has a base at elevation 158 m AHD and is excavated into solid sandstone. Should the diversion channel be incapable of passing river flows during any particular rainfall event the dam wall will overtop. The risk of erosion to the downstream face of the dam during such an occurrence will be mitigated by the ongoing and progressive placement of roller compacted concrete over the downstream wall as it is constructed. The excavation of the channel is the start of the bulk earthworks. The excavated material can be used directly in the construction of the coffer dams or be hauled to stockpile for later re-use.

When the diversion channel passes the dam axis, the dam wall foundation preparations can commence (Section 2.4.2.4).



LEGEND:

Dam Construction Footprint

Projection GDA 1994 - Zone 56

Figure 2-25

0 100 200 300

Metres

Scale 1:10,000 (at A4)

SW 233204A

SKM SunWater Making Water Work

NATHAN DAM AND PIPELINES EIS

Dam Construction Footprint

2.4.2.3. Dewatering

Before installing the chimney filter (a sand filled drain which extends through the foundation of the dam to prevent the risk of erosion beneath the embankment), a dewatering program may be undertaken to draw down the water table in the vicinity of the proposed dam foundation. It is anticipated that dewatering bores will be located around the excavation with some drilled to depths above the sandstone foundation and others below it. The bores will be pumped initially at a higher rate until dewatering has been achieved, reducing to a maintenance rate to keep the excavation dry. Dewatering is expected to occur over a period of approximately 50 days.

The bore drilling, construction and development methods will be in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (Land and Water Committee, 2003). The final bore construction details will be designed by a supervising hydrogeologist as each borehole is drilled, to ensure target yields are obtained for the localised ground conditions encountered.

Any bore which will be drilled below a depth of six metres will require the use of a licensed groundwater driller and will need to be registered under the *Water Act 2000*. The dewatering bores will be decommissioned in accordance with the minimum construction requirements for water bores in Australia (DNRME, 2003) after the dam wall foundations are in place.

The groundwater discharge from the bores will be pumped to a sedimentation pond on the left bank of the river as shown in Figure 2-25. The water retained in sedimentation ponds is to be re-used on the construction site where possible, for watering of any otherwise unimpacted natural springs that may show signs of drying because of the dewatering, or progressively released back into the river under a water quality management plan.

The impacts of dewatering on river flow, the local groundwater environment and water quality are assessed in Chapters 13, 14 and 15.

2.4.2.4. Dam foundation preparation

Excavation will remove any unsuitable material and is anticipated to range in depth from 1 m up to about 5 m. Following excavation to the foundation level, the exposed foundation will be compacted.

2.4.2.5. Dam wall construction

In general terms the placement method for the E&R dam involves spreading and compacting of the earthfill in layers along the axis of the dam. The dam will be protected from overtopping during construction by roller compacted concrete installed on the downstream face of the rockfill.

2.4.2.6. Dam construction sequence

The construction sequence for the E&R dam is primarily determined by the strategy adopted to manage river flow including floods during construction.

The proposed construction sequence is described below (not necessarily listed in the order in which they will be undertaken):

- excavating a channel within the right abutment to be used for flow diversion;
- constructing coffer dams, at either end of the flow diversion channel, to store water upstream and safely divert flows through the channel, to catch site runoff downstream for treatment or use and to prevent backflow of diverted water from downstream (note that the dimensions of the coffer dam may be varied to optimise the construction program);
- making provision for safety and site stability in the event the upstream coffer dam is over-topped and the site is flooded;
- establishing temporary surface drainage, erosion protection and ongoing water quality management across the site through measures such as:
  - design of work areas to minimise exposure of unprotected soil to rainfall and minimise slopes on drains;
  - temporary runoff barriers;
  - sedimentation ponds;
  - progressive rehabilitation as work stages are completed;
- excavating foundations until suitable foundation is encountered and stockpiling soil materials for use in rehabilitation;
- dewatering and cleaning foundations using air or water and collecting and recycling any water used;
- completing final design and producing 'for construction' drawings;
- constructing the intake tower;
- placing concrete foundation material with rock anchor bars where required;
- completing aquatic fauna transfer system works, and placing downstream aquatic fauna transfer pipe (if the final method selected);
- blasting and excavating the spillway and spillway exit channel and stockpiling soil materials for use in rehabilitation;
- constructing the spillway crest, plunge pool and outlet channel with anchor bars as required and concrete protection as necessary;
- excavating earth core materials, any sandy materials required and any additional rockfill not sourced from the spillway works;
- establishing the embankment drainage system;
- placing core, rockfill, filter and rip rap materials concurrently with compaction and reinforcement as required and reinforcement on the downstream face;
- completing the embankment crest to include road pavement along the full extent of the dam wall including the saddle dam, with the exception of the spillway;
- completing the inlet tower, bridge, valve system, valve house, dissipater system and the flume to existing stream channel;

- completing the embankment drainage system with leakage monitoring and outlets as required;
- converting the diversion conduit to function as the outlet conduit and decommissioning the coffer dams;
- providing erosion protection on the stream banks in the vicinity of the spillway outfall;
- constructing permanent access tracks for operations and maintenance with locked gates;
- constructing facilities required for public access including measures to restrict public access to hazardous areas and to ensure public safety generally;
- completing the permanent surface drainage system with appropriate erosion and outfall protection;
- decommissioning the site offices, storage and maintenance area with appropriate treatment or disposal of any contaminated soil or materials; and
- completing site rehabilitation works including re-shaping and re-vegetating areas where materials have been stockpiled or extracted and all other disturbed areas.

2.4.2.7. Quantities of raw materials required to construct the dam

Table 2-12 and Table 2-13 indicate the quantities of raw materials required to construct the dam and the likely sources.

Table 2-12 Indicative quantities of material required for dam construction

Material	Likely Source	Quantity
Cement	Imported to site from commercial source in Gladstone	2,300 tonne
Flyash	imported to site from source in Gladstone	600 tonne
Concrete aggregate nominal 40 mm	Imported to site from either Bungils, Warrian or Gwambagwine	10,000 m³
Concrete aggregate sand	Imported to site from either Wooloobe Creek, or Conloi Creek	5,000 m³
Rip rap	Imported to site from either Bungils or Warrian	90,000 m³
Coarse filter material	Imported to site from Malu Quarry or Cockatoo Creek	50,000 m³
Fine filter material	Imported to site from Wooloobe Creek, Conloi Creek Malu or Glebe Upper Terrace	25,000 m³
Rockfill	Excavated sandstone from spillway cutting	750,000 m³
Core material	Clay from borrow areas upstream of to the dam embankment	180,000 m³
Total imported		**2,900 tonnes and 180,000 m³** (or total approx. 380,000 tonnes at 2.1 tonnes/m³)
Total sourced on site		**930,000 m³**

Table 2-13 Indicative quantities of imported pavement material for roads and hardstands required for dam construction (including associated infrastructure).

Material Location	Likely source	Quantity
Pavement Type 2.4	Existing scrapes or Spring Creek gravels	70,000 tonne
Pavement Type 2.2	Existing scrapes or Spring Creek gravels	60,200 tonne
Concrete for culvert bases and causeways	Existing scrapes or Spring Creek gravels	1,200 m^3
Hardstands for material laydown areas and compounds	Existing scrapes or Spring Creek gravels	42,000 tonne

2.4.2.8. Plant and machinery requirements

A preliminary assessment of vehicles, machinery and equipment that may be required during the excavation and construction of the dam are shown in Table 2-14. As work items are often consecutive, the requirements from each phase are not additive.

Table 2-14 Anticipated potential plant requirements

Work Item	Anticipated Plant Requirement
Access road construction and upgrading.	2 x excavators 2 x backhoe 3 x water trucks 3 x 825 compactors 3 x graders 3 x tip trucks 1 x bitumen truck 1 x tractor broom 5 x twin cab 4x4
Clearing (sub-contract)	A variety of excavators with attachments including tree grabs, hooks, mulchers Horizontal tub grinders Broad acre mulchers Tippers and semi-tippers Transport vehicles
Diversion and care of the stream	2 x excavators 3 x 6x6 dump trucks 2 x rollers 1 x compactors 2 x dozers 2 x water carts 1 x 50 t crane 1 x concrete batch plant 1 x loader 2 x concrete trucks 1 x drill rig, explosives truck
Site establishment	4 x broad-acre mulchers 2 x excavators (tree pullers, mulchers, pincers) 2 x horizontal tub-grinders 7 x 6x6 dump trucks 1 x RCC batch plants

Work Item	Anticipated Plant Requirement
	1 x concrete batch plant 2 x dozers 2 x excavators 1 x grader 3 x scrapers 1 x compactors 2 x water carts
Dam construction	2 x drill rigs 2 x excavators 5 x large dump trucks 2 x water carts 3 x scrapers 2 x graders 2 x compressors 1 x de-sanding plant 3 x pumps 1 x recycle water plant 1 x concrete pumps 1 x batch plant and associated equipment 1 x crane 2 x 966 loaders
Restoration	Graders Water trucks 2 x dozers 2 x excavators 4 x 6x6 dump trucks Spray grass equipment

It is anticipated up to 15 light vehicles will be on site during the construction period.

2.4.2.9. Hours of operation

It is proposed that dam construction will be run on a day shift schedule. Typically this would be 12 hours per day. If a significant proportion of the workforce is fly in/fly out, which is likely, then a long roster such as 24 days on and 7 days off may be in place with the hours of operation being 12 hours per day, 7 days per week. Workers would most likely fly in to Roma or Chinchilla and a bus service would be provided from the airport to the accommodation camp.

To minimise the number of trips made in private vehicles, the majority of the Project workforce will be fly-in/fly-out, estimated as 70% of personnel as fly-in / fly-out evenly split between the air fields in the Wandoan Coal area, Roma and Chinchilla. Fly in-fly out and east coast personnel will travel to/from their respective construction camps to Dalby and Chinchilla by bus at the start and end of their roster. Assuming a single staggered basis for the design daily volume this is conservatively estimated at 10 buses per day.

2.4.2.10. Indicative construction timetable and potential weather effects

The indicative timetable for design and construction of the dam, assuming the Project is approved through the EIS process is shown in Section 1.2.

The actual dam construction period is estimated to extend for approximately three and a half years.

The critical period during which the dam construction is most susceptible to inclement weather will be in the wet season which is generally between November and March. It is anticipated that the construction of the dam will be carried out over two dry seasons with the placement of the E&R ceased over the actual wet season. The Contractor will be required to monitor weather conditions and cease work if the weather conditions are likely to impact on the effectiveness of mitigation and environmental management strategies of the works. In a drought or very dry scenario, works could potentially continue through the summer period.

2.4.2.11. Disruption to flows during construction and diversion works

The river diversion strategy and associated construction sequence proposed is described in detail in Section 2.4.2.2. The construction sequence is such that no interruption to natural flows in the river will occur prior to closure of the dam at the commencement of storage. After that time the outlet works will be operated according to the transitional operational strategy, which will define the dam operations in the period between starting to store water and reaching a nominal operating volume. The transitional operational strategy will maintain water access for downstream users and key environmental flows but will otherwise aim to fill the storage as quickly as possible. After reaching the nominal operating volume the outlet works will be operated according to the operational strategy described in Chapter 14.

During construction, all flood events will have to be either passed around the works or safely through the works. The E&R style of dam will allow for safe overtopping by major flood waters during construction when protected by concrete on the downstream face with minimal risk of damage to the construction works. Likewise the coffer dams, which will not be referable dams, will be protected on the downstream face with gabions.

2.4.2.12. Safety of the workforce and public

Emergency aid and medical facilities will be provided in accordance with the Work Place Health and Safety Guidelines and the selected Constructor's Site Safety Plan. Trained first aid staff will be present at the active construction site and accommodation camp. Daily inspections of temporary structures such as coffer dams will be undertaken to ensure their safety. Notwithstanding the above, a failure impact assessment has been undertaken which demonstrates there is no population at risk in the unlikely instance that a coffer dam fail. Access for emergency services (including a helipad) will be maintained at all times and will be discussed with the service providers during detailed design.

A security service will be required both at the camp site and on the construction site and this will include patrols of both sites for the duration of the contract.

All visitors will be directed to the site office on arrival for induction.

2.4.2.13. Water supply

The volume of water required for construction is outlined in Table 2-15.

Table 2-15 Indicative quantities of water required for dam construction (including associated infrastructure)

Activity	Quantity (ML)
Conditioning of earthfill for cofferdams and dust suppression	320
Plant washdown	6
Road construction	40
Construction Camp	14
Other miscellaneous	16
Total	**454**

Generally, construction water at the dam site is to be drawn from the Dawson River under permit or from sedimentation ponds. It is anticipated that this water would be of sufficient reliability and quality that it would be suitable without treatment.

For extraction from the Dawson River, floating booms may be required around the water supply inlet pipe to prevent aquatic fauna or flora from approaching the inlet.

The groundwater discharge retained in sedimentation ponds is to be re-used on the construction site where possible, used to water any mound springs that appear to be drying, or progressively released back into the river under a water quality management plan.

Potable water will be sourced from both rainwater tanks and from town to the site and delivered by tanker to holding tanks. Rainwater will be treated on site to potable standards. The construction camp will likely be able to access town water but will aim to recycle on site as much as possible as well as capture rainfall.

2.4.2.14. Containment / disposal of construction spoil

The proposed method of construction requires the excavation from the diversion channel during the early stages of the Project. This is to be stockpiled on the right bank for later use in the construction of upstream and downstream coffer dams requiring 85,000 m^3 of this fill with additional clay. The stockpiles will be managed in such a way that they cover the minimum area causing the least disturbance but offer easy access for rehandling. The will be placed above significant flood levels.

At the completion of the dam the coffer dams will be removed to spoil and in this instance require permanent disposal.

Permanent disposal can be in the form of shallow mounds that can be landscaped and stabilised complementing the existing country side, or backfilled within the diversion channel or excavation or within the water storage area.

Excavation material from the initial stripping may be used partially in the upstream and downstream coffer dams. That which cannot be used will be disposed of clear of the dam either in managed stockpiles having been stabilised and landscaped or within the water storage area.

Any material extracted that may be of further use to either this contract or to external entities will be identified and placed in stockpiles that are readily accessible and managed to form stable platforms and not causing ongoing environmental issues regarding runoff or dust.

Surplus rock spalls are to be disposed of within the water storage area potentially near tributary entry points or in locations that favour their use as habitat.

2.4.2.15. Erosion control and stormwater / water quality management

As a means of reducing surface runoff in the event of a rain event, areas of disturbance will be isolated with silt fencing that is supported by a defined maintenance system throughout the duration of the Project. A large sediment pond is anticipated on the left bank upstream of the dam wall as indicated on Figure 2-25. A detailed sediment erosion and control plan will be established by the construction Contractor in accordance with the EMP outlined in Chapter 29.

All stockpiles will be similarly protected and areas of disturbance stabilised by grassing where appropriate.

To prevent the loss of silts and clays to the river downstream a series of floating booms supporting silt curtains weighted to the river bed may be installed isolating the areas of activity.

These screens should be installed prior to any disturbances to the river banks and be maintained on a daily basis. They will need to be removed prior to any substantial flow event.

2.4.2.16. Waste management

The waste management strategy for the Project will consider waste management from the pre-preparation and planning stage through to design, construction and operation. By necessity, there is appropriate flexibility in the strategy for the management of all wastes (Chapter 20). Construction of the dam will generate waste material, particularly packaging, tyres and waste oils from machinery, and wastewater from the construction site facilities. It is likely that grey water will be pumped out and disposed of by a licenced Contractor. Similar previous projects have allowed for an accurate assessment of the types and volumes of wastes likely to be generated.

The Contractor for the works will be responsible for:

- minimising the amount of wastes generated, where possible;
- collection of wastes, other than natural earth, soil or rocks in suitable skips or bins;
- reusing or recycling waste on site or at an appropriate facility where feasible;
- disposal of inert construction waste by burial on site below FSL;
- disposal of remaining wastes at an appropriate licensed landfill; and
- arranging transport of wastes with a licensed carrier and in accordance with the EPA tracking system as defined in Environment Protection (Waste Management) Regulation 2000.

The estimated waste volumes are provided in Table 2-16.

Table 2-16 Waste volumes

Waste type	Estimated quantity
Excavated spoil	260,000 m³ (dam) 378,000 m³ (pipeline)
Cleared vegetation	4,737 ha
Concrete	~1% of 292,900 m³
Stormwater & construction wastewater	262 ML (dam) 203 ML (pipeline)
Grease trap wastes, oil water, oily rags, waste oil	500/month hydrocarbons 1 skip bin/ week solid waste
Sewage from construction site	6,000 L/day
Sewage from accommodation camp	14,000 L/day

Sewage from the construction site will be pumped out and disposed of at a licensed facility. Portable toilets will be used along the pipeline route, and collected or pumped out by a contractor for off-site disposal to a licensed facility. Sewage from the accommodation camp will directly connect to the town system if the final location is close enough to town services. Sewage from Project offices in towns will be discharged to the town sewer systems.

It is anticipated that following waste types will only be produced in minor amounts:

- steel and metal cut-offs;
- timber (pallets and off-cuts);
- general building materials;
- piping;
- general wastes including food and non-recyclable plastics and paper;
- recyclable paper and packaging;
- paints resins and solvents;
- tyres and batteries; and
- oil filters.

2.4.2.17. Licensing / permitting

All requirements for approvals related to construction are noted in Section 1.11.

2.4.3. Pipeline

2.4.3.1. Construction activities

It is envisaged that the pipeline will be laid simultaneously on four work fronts. There will also be dedicated teams undertaking:

- construction of each of the pump stations and balancing storages;
- vegetation clearing in advance of pipe laying;
- river/ creek crossings;
- general pipeline fittings; and
- electrical and mechanical fit-out.

Upon completion of construction the line will be tested by hydrostatic testing crews and finally commissioned by another crew.

2.4.3.2. Construction Methodology

Each work front would only open as much trench per day as could be laid in a day, with trench backfilling occurring simultaneously to ensure minimal trench remains open at any given time. Any open trench will be temporarily fenced at the end of each day.

Pipe laying will commence following site establishment, access track formation and easement clearing and includes:

- excavation of a benched trench. Spoil is placed in a pile to the side of the trench;
- 150 mm layer of bedding material placed on the base of the trench;
- pipe is laid and Cathodic Protection fitted (connected to lugs). Any additional welding or grouting is performed;
- bedding material is filled to 150 mm above pipe and compacted;
- conduit and /or fibre optic cable (FOC) is connected and laid just off pipe centreline;
- warning tape laid over FOC and pipeline;
- backfilling using excavated material which is then compacted;
- excess spoil is mounded or used in erosion rehabilitation; and
- any reinstatement or additional works are performed i.e. installation of communication pits, etc.

The typical pipeline trench will be approximately 2.7 m deep, 1.9 m wide at the base and about 3.6 m wide at the surface. It is estimated that for a 1200 ND pipe, up to 1 km could be laid in a day on each front, with up to approximately 500 m of trench open at each front at any given time, reducing to 50 m at the end of each day. Upon refilling the trench, waste spoil will be formed into a low mound over the trench and easement with appropriate gaps to allow for water movement. More detailed consideration of the landform above the pipeline will be undertaken in farming areas where laser levelling of paddocks has been undertaken.

Vegetation and fauna disturbance will be managed as noted in Section 2.4.1.6 including:

- the presence of fauna spotter catchers accredited by Queensland Parks and Wildlife Service when conducting activities that may harm or disturb fauna;
- management procedures for the treatment of any injured animals; and
- activities that may disturb fauna will be undertaken in such a manner that any mobile, non-volant (cannot fly) fauna is able move to other areas of suitable habitat, i.e. patches of habitat should not be disconnected in a haphazard fashion that limits movement.

Creek crossings

Watercourses along the route flow intermittently or are ephemeral and as works in these areas are programmed for the dry season it is expected that most will be dry when crossed. The preferred crossing method is by trench with the width of clearing of the riparian zone minimised as much as possible. The trench may need to be shored to ensure safe working conditions and temporary work platforms for machinery may be necessary. Depth of the trench will be such that the pipe will be below the level of flood scour.

For larger watercourses which contain permanent water that cannot be avoided the trench area will be isolated by coffer dams constructed from excavated material from either the pipeline trench or imported material. This will be stabilised by sandbags and/or geotextile fabric. Depending on the stability and porosity of material in the stream bed sheet piling may be used. Fauna enclosed by the coffer dams will be salvaged in accordance with DPI's Fish Salvage Guidelines (DPI&F 2004). It may be necessary to dewater the trench using pumps and discharge the water downstream. A secondary low level coffer dam may need to be constructed to act as a sediment basin depending on the environment downstream and the suspended sediment concentration of the discharge water.

In most stream beds the pipeline will be encased in concrete. It is not essential that the trench be fully dewatered in order to place the concrete, which can be achieved under water.

On completion of works the coffer dams will be removed slowly and the stream bed and banks reinstated to their original profile. Excavated trench material will be replaced in the vertical order in which it was removed if any stratification of material is evident.

Pump stations and balancing storage

Construction works for the pump stations will include:

- site preparation involving any vegetation clearing required and excavation of earth to create a level working area;
- placement of concrete and sheet pile foundations;
- construction of pump housing structure;
- installation of the pumps and pipe work;
- connection to the upgraded electric power supply;
- fitting and testing the control system; and
- removal of temporary facilities and revegetation of disturbed areas.

These areas will be securely fenced.

Construction works for the concrete balancing storages and other above ground infrastructure are generally similar and include:

- vegetation clearing and excavation works to clear area for construction;
- concrete foundations and trenching for installation of inlet and outlet pipe works;
- formwork;
- reinforcing steel and concrete pouring and stressing;
- hauling and craning valves and fittings;
- installation of automated sensor equipment;
- hydrostatic testing of tank; and
- reinstatement and rehabilitation of disturbed areas.

Construction of the 600 ML earth tank will involve:

- vegetation clearing and site establishment;
- earthworks including excavation of natural ground and mounding of tank walls (overburden to provide material for storage walls);
- installation of pipe work, valves and pits for inlet and outlet piping;
- hauling materials and compaction along tank walls;
- geofabric or clay lining installation;
- installation of automated sensory equipment; and
- reinstatement works to disturbed areas including placement of topsoil and spraying of hydro-mulch.

Material requirements

The volumes of material needed for the pipeline construction are provided in the tables below.

Table 2-17 Indicative quantities of raw materials required to construct the pipeline

Material Location	Likely source	Quantity
Bedding Sand/gravel	Commercial sources - Wandoan, Miles, Dalby, Chinchilla	500,000m³
Gravel	Commercial sources - Wandoan, Miles, Dalby, Chinchilla	240,000 tonne
Rock Facing	Commercial sources - Wandoan, Miles, Dalby, Chinchilla	15,000 tonne
Road Base (CBR 2-1 & 2-4)	Commercial sources - Wandoan, Miles, Dalby, Chinchilla	14,000 tonne
Rock Fill	Commercial sources - Wandoan, Miles, Dalby, Chinchilla	20,000 tonne
Clay	Gurulmundi	175,000m³
Concrete	Commercial sources - Wandoan, Miles, Dalby, Chinchilla	30,000m³

The pre-fabricated structures will most likely be transported via road from existing suppliers with distribution depots located in Brisbane and/or Gladstone to laydown areas along the pipeline route. There is also some potential for the pipe and structures to be delivered by rail using the existing western railway system. This will be subject to negotiation with Queensland Rail. However, it is likely that the majority of the material will be delivered by road.

Table 2-18 Indicative quantities of imported pavement material for roads and hardstands required for pipeline construction

Activity	Quantity
Pavement	90,000 m^3
Hardstands for material laydown areas	10,000 m^3

Concrete used for the pipeline structures would be sourced from existing commercial local suppliers near Dalby, Chinchilla, Miles and Wandoan.

Section 2.3.2.2 indicated the number of items of above ground infrastructure that would need to be delivered to site. In addition, some 18750 lengths of pipe (13.37 m unit length x 1219 mm ND, 3200 fittings) would be required.

A substantial proportion of the pipe and bedding material will be delivered to the lay down areas prior to the construction team coming on site. This will reduce potential conflicts between delivery and construction vehicles and spread the impact of delivery on the transport network. Delivery of material may be impeded following rain as local unsealed roads and access tracks to work site may be inaccessible for varying periods. The construction timeline currently allows for substantial lost time as a result of wet weather.

Other material requirement include diesel fuel usage ranging from a low of about 5,000 L/day to a high of about 10,000 L/day during peak periods. It is anticipated that the fuel would be tankered to bulk storage tanks at the dam and the 600 ML balancing storage, before being distributed by mobile refuelling trucks to the on-site machinery. Local suppliers will be used where possible to avoid the need for bulk storage, particularly near Chinchilla and Dalby.

Preliminary assessment of vehicles, machinery and equipment that may be required across all work fronts during construction of the pipeline are described in Table 2-19 . Work items are largely consecutive so the machinery total is not additive.

Table 2-19 Anticipated potential pipeline plant requirements

Work Item	Anticipated Plant Requirement
Access road construction and upgrading.	2 x excavators 2 x backhoe 3 x water trucks 3 x 825 compactors 3 x graders 3 x tip trucks 5 x twin cab 4x4
Clearing (sub-contract)	A variety of excavators (3) with attachments including tree grabs, hooks, mulchers 3 x Horizontal tub grinders 3 x Broad acre mulchers

Work Item	Anticipated Plant Requirement
	4 x D8 Dozers 4 x Tippers and semi-tippers Transport vehicles
Preliminary earthworks	1 x D9 dozer 3 x 631 scrapers 2 x water trucks 1 x 825 compactors 1 x grader
Delivery of bedding material to site	8 x truck and dogs 1 x water truck
Site establishment	2 x dozers, 2 x excavators, 1 x grader 3 x scrapers, 1 x compactor, 2 x water carts
Pipeline Installation (assuming 4 work fronts)	12 x excavators 4 x Loaders 2 x welding equipment Graders 4 x water trucks 2 x dozers 4 x compactors
Concrete Works	3 x concrete delivery trucks 1 x concrete pump 2 x mobile cranes 1 x lighting tower
Restoration	2 x Graders 3 x Water trucks 2 x dozers 2 x excavators 4 x dump trucks Spray grass equipment

It is anticipated up to 20 light vehicles will be on site across all work fronts during the construction period.

The quantity of bedding sand and the volume of pipe in the trench will mean that the volume of soil and rock material excavated from the trench will be greater than that required for backfilling.

All surplus and unsuitable excavated material from the construction of the pipeline as a first priority will be used to reclaim existing gully erosion within or near the easement. Permanent provisions will be made for the drainage of all water passing through, around or discharging into and out of these disposal areas. The provisions will also include permanent works for the trapping of sediment in the discharge of water from disposal areas. These works will conform to the provisions of Soil Erosion and Sediment Control, Engineering Guidelines for Queensland Construction Sites" published by The Institute of Engineers, Australia, Queensland Division 2008, or other applicable guideline.

When the available gully erosion areas have been exhausted, spoil excluding boulders will be spread and compacted by earth moving machinery such that a gentle mound is formed over the easement. The stripped and stockpiled topsoil will then be spread over the completed mounds. There may be some exceptions to this process for cultivated areas,

particularly over the eastern extent of the pipeline route where spoil mounds may result in impacts to drainage and associated scouring and erosion. In these areas the preferred option will be to identify areas on the affected property where spoil can be utilised, but failing this areas on nearby properties will be sought or the last option will see the spoil trucked to Dalby for placement at the licensed waste disposal facilities. This possibility has been discussed with Council.

2.4.3.3. Indicative construction timetable and potential weather effects

The pipeline construction period will be similar to the dam, that is early works will commence mid 2013 with the pipeline construction commencing in early 2014. A two year construction program will result in commissioning of the pipeline in early 2016. Pipeline construction will be programmed around actual seasonal rainfall. Potential high risk areas such as the river pump station and major watercourse crossings will be targeted during dry season, i.e. normally April to November.

2.4.3.4. Hours of operation

It is likely that pipeline construction will be run on the same schedule as the dam though as it may be under a separate contract, this is not certain.

2.4.3.5. Safety of the workforce and public

The constructor will be required to prepare a Site Safety Plan for approval prior to the works commencing. Emergency first aid and facilities will be provided in accordance with the Work Place Health and Safety Act and Guidelines and the selected Constructor's Site Safety Plan. Persons trained in first aid will be present at each work site and construction camp. Daily inspections of the works will be undertaken to ensure their safety. All visitors will be directed to the site office on arrival for induction. Gates on property boundaries that allow access to the workfront will be locked at the end of each day. Open trench sections will be fenced with construction tape at the end of each day.

2.4.3.6. Water supply

Water for use in Project offices and accommodation camps will be drawn directly from the town water supply. This supply will also be the basis of trucking potable supplies to the work fronts. Access will be negotiated with Council. Generally, water for construction is to be drawn from the Dawson River and major tributaries and the Condamine River and tributaries under permit. It is likely that only small volumes will be available from tributaries given the nature of these systems and the need for the Project not to interfere with current users or to significantly lower the water level in any pools accessed. This will be discussed with DERM during detailed design and approval application processes. Table 2-20 provides indicative quantities of water required for construction.

Table 2-20 Indicative quantities of water required for pipeline construction

Activity	Quantity (ML)
Sand compaction	338
Dust suppression	43
Vehicle washdown	10
Pigging	1
Other miscellaneous (e.g. construction camps, testing and commissioning)	39
Total	**432**

2.4.3.7. Erosion control and stormwater / water quality management

Construction spoil stockpiles will be minimised during construction by backfilling and mounding of the pipeline trench as the work progresses. As discussed above, excess spoil will be mounded over the trench in a low mound with appropriate gaps to allow for water movement. Spoil stockpiles waiting backfill/mounding will be contained at the end of each day with the use of temporary sediment control devices (e.g. silt fences). Upon completion of topsoiling and profiling, areas disturbed by the works will be revegetated. The revegetated areas will be kept moist until germination has been obtained and thereafter as required to establish appropriate cover.

2.4.3.8. Waste management

Waste management for the pipeline contract will be undertaken as described for the dam contract under Section 2.4.2.16.

2.4.4. Associated infrastructure

2.4.4.1. Roads

The following typical construction stages could be expected for upgrade or construction of roads:

- initial survey including location of boundaries and set out of road corridors;
- set up environmental controls;
- clearing of vegetation along the proposed alignment (following the process outlined in Section 2.4.1.6);
- construction of new stock fencing (if required) including gates and demolition of existing;
- set out for road and drainage structures;
- installation of cattle grids and demolition of existing, as required;
- installation of drainage culverts and creek crossings including demolition and replacement of existing;
- construct causeway crossings or bridges as required;
- cut and fill operations;
- road base operations, and
- bitumen seal (if required by design).

Impacted property access within the water storage area will be replaced during the dam construction phase prior to commissioning.

Quantities of materials required to construct these roads are included in Table 2-13.

2.4.4.2. Recreation facilities

The recreation areas will be constructed late in the construction program. The facilities are relatively simple and will be completed within approximately 2 weeks.

2.4.4.3. Power and telecommunications

During the initial phases of dam construction power generators and fuel tanks will be used to supply power until such time that mains power can be established. Generators will be maintained at the campsite and worksite to provide backup power when required.

During construction the majority of power will be sourced from 66 kV powerlines.

2.4.4.4. Water and wastewater

Construction of these facilities at the dam will be done in conjunction with the construction of the recreation and operational facilities.

2.4.5. Demobilisation and rehabilitation

2.4.5.1. Water storage

As the various stages of construction are completed, surplus construction equipment will be washed down and removed from site. Construction material surplus to needs, and waste materials, will be removed from site. For some inert material it may be appropriate to bury it within the storage area rather than take up space in local landfills.

All underground cables and pipework will be neutralised. Water and wastewater pipework will be flushed to sediment basins or pump-out facilities to ensure no contaminant remains. Pipework will then be sealed to prevent habitation.

Demountable buildings will be removed from site and the foundations treated as waste.

The strategies and guidelines that will underpin rehabilitation at all construction sites including stabilisation of the landscape around the dam wall, all roads, resource extraction sites and the pipeline route are set out in Chapter 4 and Chapter 6. Every effort will be made to:

- minimise the areas disturbed during construction;
- provide temporary erosion control and water quality control wherever needed;
- progressively reshape and revegetate with native species as work phases are completed; and
- ensure that water leaving the sites is of similar or higher quality than the receiving waters.

During construction site stripping, any quality topsoil will be stockpiled for later use for site landscaping or other identified opportunities. Mulch produced from cleared timber at the site will be treated similarly. The area cleared for the dam will initially be limited to the required works area, the internal haul roads and the clay extraction areas.

Sedimentation ponds and similar structures in the immediate vicinity of the site will be pumped out regularly to minimise breeding habitat for biting insects. Water will be re-used on-site.

Areas requiring rehabilitation will generally include the construction area shown in Figure 2-25. Much of the dam construction site will be within the water storage area. These will be drained, reshaped to a smooth profile and revegetated with grasses pending filling of the dam. However, those areas located outside the water storage will be reshaped and revegetated with trees, shrubs and grasses as appropriate and in accordance with a detailed landscaping

plan to be developed during detailed design. Temporary erosion control measures will be installed as needed and dictated by the final EMP.

Sites within the construction footprint that may require specialised attention including decontamination, during rehabilitation include:

- concrete raw materials stockpiles;
- 1 x concrete batch plant;
- construction water storage tank facilities;
- water treatment plant;
- construction offices;
- workshops;
- ablutions facilities;
- storage areas;
- bulk fuel supply tanks; and
- refuelling areas.

These sites will be fully rehabilitated when the need for the facility ceases. This will include removal of any contaminated soil to a licensed facility, re-contouring, topsoiling, grassing and / or landscaping with native trees and shrubs, and mulching.

Rehabilitation of the disturbed areas downstream of the dam should be completed as the work in the surrounding areas has been completed and should include both the temporary and final scour and erosion control measures.

Erosion control measures will be required around the perimeter of all work areas listed above and will remain around areas restored following the completion of the dam and roads for an establishment and maintenance period.

The construction of the permanent dam access road would be completed early on in the construction program, but with the volume of traffic during the construction stage it is likely that restoration of the pavement and rehabilitation of the roadsides may be necessary.

Rehabilitated areas will be monitored to ensure that vegetation cover is maintained and that any minor erosion is repaired and the area re-stabilised.

2.4.5.2. Pipeline

All areas disturbed along the pipeline route will require rehabilitation. The approach will depend on current land use and situation and final proposed use of the area. Prior to commencing excavation work on site, the Contractor will prepare a plan for rehabilitation. The plan will detail proposed timings for grassing, weed control, planting, establishment and the temporary erosion and sediment controls to be put in place prior to grassing.

Temporary erosion and sediment control measures will be promptly put in place, as necessary as the work progresses on site, such that soil or sediment does not leave the area to be grassed and contaminated water does not flow into drainage lines or creeks. Upon completion of top soiling and profiling areas disturbed by the works will be grassed. The grassed areas will be kept moist until germination has been obtained and thereafter as required to establish appropriate cover.

Native or naturalised pastures may be established in cleared grazing lands while a mix of native trees, shrubs, and native grasses may be established in areas which abut such areas or where such vegetation existed prior to works and the operational requirements of the pipeline allow such rehabilitation. Trees or shrubs will not be established directly over the pipeline.

Particular attention will be paid to land shaping in areas where the pipeline and / or access track run down slope and are likely to concentrate or divert flows.

Areas cleared along watercourses to permit the construction of the works will be replanted with tree species to allow restoration of other than the minimum area required by the operation of the works.

2.4.6. Workforce and accommodation

SunWater is not seeking approval for the construction camps as part of the EIS. The final location and details will be determined as part of the Social Impact Management Plan and associated stakeholders consultation process.

2.4.6.1. Dam site and associated works facilities

A typical allowance for dam construction site personnel for a Project of this size would be of the order of 120 to 140 people during the peak construction period. An additional professional work force of 20 to 30 including senior and junior engineers, clerical staff, supervisors, foremen as well as soil technicians, environmental officer/s and their support staff would be required. A graph representing the anticipated construction workforce is shown in Figure 2-26 below.

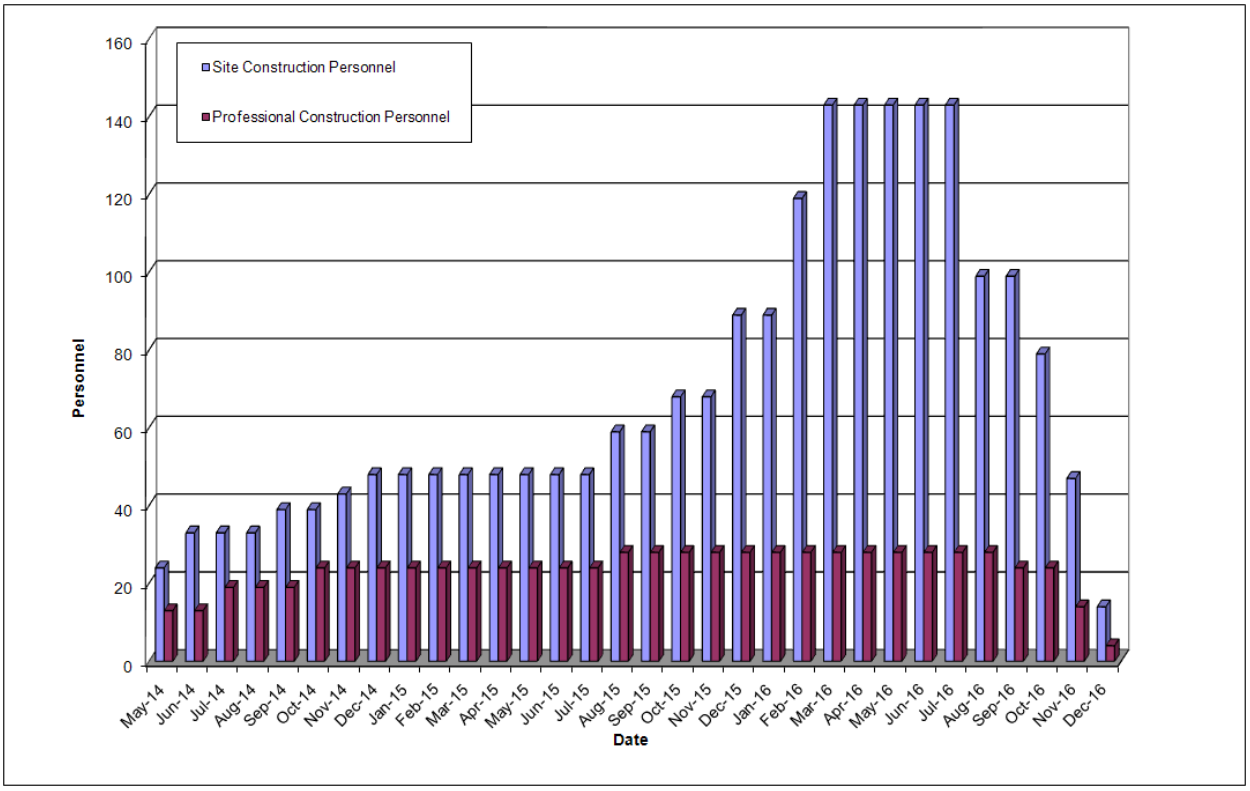


Figure 2-26 Anticipated dam construction workforce

The road construction workforce would likely comprise approximately 35 additional staff plus professionals.

Crib rooms will be provided at the dam site and toilet and shower facilities will be provided in demountable buildings. Grey water will be re-used where feasible and toilet waste will go to pump-out facilities. Cleaning and domestic staff will be employed to maintain these areas. Site offices would be air conditioned, meet all occupational health and safety requirements and be regularly audited for compliance, including with respect to disease vector and vermin control and fire safety. Waste management is discussed in Section 2.4.2.16.

Power supply from onsite generation and onsite fuel tanks will be necessary, in addition to mains supply. Large supply tanks will be located above the future inundation and flood buffer area.

Contracts will stipulate a requirement to show how energy use has been minimised during all stages of the works. Expected options would include using solar power at the site offices (at least), choice of high efficiency lighting and devices in all locations and ensuring all machinery using liquid fuel is in good working order. Energy conservation in relation to Government policies is discussed in Section 1.11.2.1 and Chapter 18. The Contractor will be required to purchase “green” power if it is available.

2.4.6.2. Pipeline work front facilities

Pipeline construction may involve up to 150 people at any one time with four pipe laying work fronts consisting typically of 15 to 20 people. Because of the nature of the task, these work fronts will use mobile facilities that will relocate as the laying of the pipe progresses.

Along the pipeline route transportable buildings will be used to provide basic facilities such as lunch rooms, refrigeration and minor office space. Relocatable toilet facilities (porta – loos) will be provided and serviced by a contractor. Power will be provided by a portable generator or solar panels. Potable water will drawn from local council treated water networks, either by direct temporary connection where feasible, or by water carrier delivery to an on site polyethylene water tank. Only small volumes are required to provide drinking water and to service an emergency shower. The sites will generate little waste but it will be stored in bins with lids and these will be removed to approved local waste facilities as needed.

Similar facilities will be provided at sites which will need a longer construction period, such as balance tanks / pump stations. The crews working at each site would be bussed or transported in light vehicles from the construction camp and central collection points for local workers. Only a small percentage of staff will use private vehicles.

Project offices will be established within the towns along the route (Wandoan and Chinchilla) to accommodate the administration staff and design office. Approximately 35 support staff will be based at each of these offices with staff moving between offices as required. The offices will therefore access town services with respect to supplies and waste disposal.

2.4.6.3. Off site accommodation

SunWater is not seeking approval for the construction camps as part of the EIS. Due to the distances to regional centres and the limited available accommodation in Taroom, it is expected a construction camp servicing the dam will be sited at Taroom. At present, Banana Shire Council has indicated an area zoned “industrial” or on Racecourse Road may be suitable as access to the town facilities is likely to be available. In Wandoan, Mac Group has lodged an application to develop a camp outside of town. This will be available to any contractors and will be used for additional staff if necessary. For the pipeline, camps are expected to be in Wandoan and Chinchilla and to each cater for 150 persons. Western Downs Regional Council has suggested it prefers camps to be close enough to town to access the town’s facilities. Both Councils foresee no fundamental problems related to camp establishment but ongoing consultation is required and will be undertaken. The exact location of the camps will be negotiated in consultation with the Contractor, council and the relevant agencies. The development timing of these camps will be determined in conjunction with the selected construction Contractor, but given multiple work fronts it is expected that the camps will be active concurrently. It is anticipated that the camps will be operational prior to commencement of construction and hence will be able to accommodate early works contractors (site establishment, access tracks, material deliveries, etc).

The camps would be operated by the Contractor and comprise demountable facilities including sleeping areas, showers and toilet, laundry, rest area and a kitchen. A limited bar would likely be provided in order to minimise the need for workers to drive from town after consuming alcohol. The facilities provided will meet, and be maintained to comply with, all occupational health and safety requirements including those related to food preparation and storage, ablutions, water

quality, vector and vermin control and safety and emergency services. Discussions with Council and service providers will result in detailed plans covering management of the camps, parking, security, access to town services and facilities and potential interactions with local residents, businesses and service providers (further developed in Chapters 24 and 25). The camps will have codes of conduct and all occupants will be inducted on first arrival with respect to this code, with respect to expected interactions with the local township and with respect to issues such as driver fatigue and site safety.

A limited number of staff are expected to relocate their families for the duration of the Project; in these instances rental accommodation or purchase of existing properties in Taroom and Chinchilla will be utilised.

Camp site selection will be finalised following Project approval and appointment of a contractor. The criteria upon which final site selection will be based include:

- Isolation from the works areas such that the workforce can relax;
- minimisation of travel distances to and from work areas;
- minimisation of interaction with public and private transport networks;
- minimisation of site impacts, e.g. little clearing required, simple site drainage management, lighting will not impact on residents or travellers on nearby roads etc; and
- suitable agreement can be reached with the landholder.

2.4.6.4. Workforce skills

The Project will require a labour force with skills in a number of areas including:

- plant, machinery, and crane operation;
- truck driving;
- form work construction and reinforcement setting;
- concrete pouring and finishing;
- general labouring;
- welding, electrical, plumbing, dogmen, riggers, drillers;
- trenching, pipe laying, and joining;
- explosives;
- surveying;
- clerical and record keeping;
- construction engineering supervision (range of skills, including foremen);
- environmental supervision;
- laboratory technicians; and
- vegetation clearing and re-establishment.

Opportunities for training through longer formal schemes such as apprenticeships will be the responsibility of the contractors as many of the team members move from project to project to fulfil the requirements of their training. The Project will provide scope for considerable on-the-job training and skills development.

The proportion of the workforce that may be drawn from the local area and the training to be provided to workers is addressed in Chapters 24 and 25. Only a small proportion of the workforce is expected to be from local sources as employment is very high in this region and the size of the local workforce is small. However, expressions of interest will be called for supply of skills and services to the Project. A number of planning forums have been established by Government in the Surat Basin to oversight the large number of projects planned for the region. SunWater undertakes to be an active participant in the relevant forums and to act on the outcomes of such processes as they apply to its project.

2.4.7. Commissioning

2.4.7.1. Dam

The commissioning process of the dam will consider the proper and effective operation of the:

- intake structure;
- outlet works;
- fishway; and
- all other mechanical and electrical components that are associated with the structure.

Commissioning of the inlet and outlet works will include a testing program to ensure proper operation for the range of the design limits. All tests must comply with the requirements of the Dam Safety Regulator and will be in accordance with the manufacturers' specification with respect to such items as gates, valves and pumps. All documentation required by the regulator will be prepared and submitted for approval. Such documentation includes:

- standing operating procedures; and
- operations and maintenance manuals.

The commissioning of the fishway facilities will include the involvement of Queensland Fisheries and DERM and will likely extend beyond the construction timeframe to ensure that it is achieving its desired purposes.

2.4.7.2. Pipeline

The water distribution infrastructure and control systems will be thoroughly tested on completion. Pipeline commissioning will involve hydrostatic testing and flushing of the pipeline. Testing is undertaken progressively as construction within a section ceases. Test sections will be approximately 10 km long and tests last approximately 9 days in each section. Generally water used to commission a section of pipeline will be re-used for the following section. In some cases the water may be required to be ejected in to bunded areas approximately 20 m x 10 m. This will occur at or near swabbing stations within the construction easement and will be isolated and controlled to reduce the impact on any surrounding areas. Bunded areas will be removed when the water is retrieved or the basin has dried.

First filling of the pipeline and balancing storage will be closely monitored to ensure that valves and controls all operate in the correct sequence. Pumping will be stopped and started until operators are confident that all control systems and valves are operating and that the system will function correctly under unintended stoppages such as those resulting from power failures. All components will be regularly inspected for leaks during initial operations. The water used in these stages will be sourced from the Dawson River.

2.4.8. Environmentally Relevant Activities

Environmentally Relevant Activities (ERAs) are those activities which have been identified by the Environmental Protection Act as likely to have significant environmental impacts and are defined in Schedule 1 of the Environment Protection Regulation 2008 (EP Reg).

A development approval under IDAS for a material change of use for an ERA is likely to apply to various activities undertaken during the construction phase of the Project. Relevant ERAs include the following:

- ERA 8 Chemical Storage;
- ERA 16 Extractive and screening activities;
- ERA 14 Electricity Generation (if generating electricity by using fuel at a rated capacity of 10MW electrical or more);
- ERA 15 Fuel Burning (if using fuel burning equipment capable of burning at least 500 kg of fuel in a hour);
- ERA 33 Crushing, milling, grinding or screening (if crushing, milling, grinding or screening more than 5000 t in a year);
- ERA 43 Concrete Batching (consists of producing 200t or more of concrete or concrete products in a year by mixing cement with sand, rock, aggregate or other similar materials);
- ERA 56 Regulated Waste Storage (operating a facility for receiving and storing regulated waste for more than 24 hours);
- ERA 61 Waste Incineration or Thermal treatment (including incinerating waste vegetation, clean paper or cardboard); and
- ERA 63 Sewage Treatment (operating 1 or more sewage treatment works at a site that have a total daily peak design capacity of at least 21 EP; or operating a sewage pumping station with a total design capacity of more than 40 kL in an hour).

2.5. Operation

2.5.1. Water storage infrastructure

The objectives for the operation of the water storage are to:

- be able to divert 66,011 ML/a of high priority or equivalent water (including medium priority users in the Dawson Valley Water Supply Scheme) via a pipeline and downstream distribution to existing and new users;
- minimise upstream impacts of floods;
- safely pass flood flows such that the integrity of the dam is not compromised;

- meet the requirements specified in the Water Resource (Fitzroy Basin) Plan (WRP) and ROP including environmental flow requirements;
- provide for effective movement of aquatic fauna past the dam;
- minimise environmental degradation in and around the storage and downstream; and
- minimise community impacts in the areas around the storage and downstream.

It should be noted that the Fitzroy WRP was under review at the time of drafting the EIS and therefore *Water Resource Plan (Fitzroy Basin) Plan 1999* (WRP) has been used in the assessment of potential impacts and associated compliance. 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 water storage will be available for recreational use and such facilities as discussed in Section 2.3.3.5 will be provided.

Operational costs of the dam are addressed in Section 1.6.2.

2.5.1.1. Operating staff

The dam and pipeline will be operated and maintained from SunWater's current facilities in Theodore and Pittsworth. At least two duty dam and pipeline operators will be available at any one time, with standby operators also available. The Theodore office will undertake reporting and inspections on the dam in accordance with the Standard Operating Procedures and Resource Operating Licence.

The outlet works and fishway facilities will be capable of remote operation and monitoring. This would be the normal means of operation, but these facilities will be capable of local operation and manual opening and closing in an emergency. This includes multiple back-up power supply sources.

The water storage area will require routine inspection to identify and manage issues that may arise which might affect water quality or the stability of the shoreline, for example. This includes assessment of macrophyte growth, noxious species, wave erosion or slumping. In addition, rehabilitation work will require monitoring for a number of years to ensure permanent establishment of vegetation and landscape stability and areas used for recreation will require monitoring to maintain public safety.

2.5.1.2. Management of extractions and releases

At the catchment level, the WRP provides a framework for water sustainability into the future for both human and environmental needs. This plan is subordinate legislation to the Water Act 2000. The Fitzroy Basin Resource Operation Plan (ROP) was issued to implement the WRP including a framework to allow delivery of environmental flow objectives (EFOs) and water allocation security objectives (WASOs).

Under the ROP, the owner of infrastructure would be issued with a Resource Operations Licence (ROL). Conditions attaching to this licence will specify how the infrastructure is to be operated to ensure that WASO, monitoring and EFO rules for the relevant parts of the plan are met.

The operator will be responsible for achieving compliance with matters such as:

- water quantities in storage, released or delivered;
- stream flows;
- water levels;
- water quality including temperature and biological and physical parameters; and
- operation of dam and weir outlet works.

In June 2008, the minister for Natural Resources and Water announced his intention to prepare a Draft Water Resource (Fitzroy Basin) Plan to replace the Water Resource (Fitzroy Basin) Plan 1999. Water resource plans being subordinate legislation are required to be reviewed and have replacement plans prior to the end of a plan's 10 year life. 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 WRP 2011 will be assessed prior to project approval.

The release of water downstream for users (via the fishway, multi-level offtake and outlet facilities), the environment and during floods is described above. The ability to select the depth from which extractions are drawn through the intake tower will be used to ensure that water of the most appropriate quality is withdrawn. Factors considered in selecting the depth will include water temperature and oxygen content.

High priority users downstream access their water in a consistent and regular manner. This is currently achieved for a number of towns and mines through operation of the Dawson Valley Water Supply Scheme. Nathan Dam will take the place of Glebe Weir in this scheme and will be the uppermost storage in the scheme. Medium priority supply is generally based on orders when the irrigators need water. Traditionally this has seen water released from Glebe in spring and summer though there have also commonly been releases in May/June.

As discussed above, water will also be extracted and pumped via a new trunk pipeline. The justification for the Project relies upon these users primarily being mines, power stations, and urban communities, all of which require a high priority supply. These supplies are provided regularly and consistently such that withdrawal from the dam is almost constant. The balancing storages provide a small supply which allows shut down of part of the system for maintenance.

It is proposed that SunWater will be the owner of the water storage and distribution infrastructure however this will be determined by government.. The ownership of any infrastructure required to access released water from either the river or the trunk pipeline will vest with the organisation seeking access to the water. If urban areas seek increased supply then responsibility for the suitability of existing infrastructure to accept that supply rests with the relevant local government body. SunWater does not envisage the need to upgrade any of its existing infrastructure (such as the irrigation channels attached to weirs in the DVWSS) as a result of the Project.

2.5.1.3. Flood monitoring

The Bureau of Meteorology operates a flood monitoring system in the Dawson River. The flood monitoring system consists of a network of radio and telephone telemetry gauges owned and operated by local councils, DERM, SunWater and Bureau of Meteorology. Data from these stations are linked in real time to the same model used in the design hydrology study. The model has been successfully used for forecasting flood levels in the Dawson and Fitzroy Rivers for many years.

2.5.1.4. Dam safety management

For the purpose of preliminary design, it has been assumed that the Project will be assessed as an Extreme Hazard category dam in accordance with Queensland Dam Safety Management Guidelines and the definitions given by the Australian National Committee on Large Dams (ANCOLD). As an Extreme Hazard category dam, a comprehensive dam safety program will be required to be instituted under the current Queensland legislation regarding dam safety. Such a program will be expected to adequately conform to the recommendations set out by ANCOLD under their current Guidelines on Dam Safety Management. Whilst remote monitoring of the dam and its instrumentation may be possible, the dam safety program will require, among other surveillance activities, daily visual inspection. SunWater has a Dam Safety program that includes Standard Operating Procedures (SOPs) and an Emergency Action Plan (EAP) and regular inspection programs for each dam it operates.

A maintenance program will be required. Some grassed areas may require slashing for aesthetic reasons and / or to assist with fire control. As well, the results of routine visual inspection by operations staff will provide a key input to the development of the annual maintenance program and hence appropriate management of the asset.

It is anticipated that regular maintenance work will be required for tasks such as:

- patch painting of metalwork such as baulks and exterior pipework;
- lubrication of moving parts in hoists, cranes and fishway and replacing parts as necessary; and
- replacing when necessary baulks and trashracks and fine screens in the outlet tower.

Vehicles and equipment likely to be used during normal operations are:

- utilities and four-wheel-drive vehicles;
- small outboard-powered boats; and
- tractors and slashers.

2.5.1.5. Waste generation

Waste generated in the operations phase will include household wastes and those associated with the maintenance tasks described above. Volumes will be minimal and all wastes will be disposed of at licensed facilities. Waste generated by contractors undertaking significant maintenance tasks will be the responsibility of the Contractor. Waste generated at recreational facilities will be the responsibility of the operator.

2.5.1.6. Traffic

Traffic related to operations will be minimal but public visitation to the dam and recreational areas is likely to be significant during holiday periods. While the storage will provide a significant attraction, it is still in an isolated location with low local populations. Other than weekend and holiday periods, a regular low level of visitation is expected from tourists, particularly the "grey nomad" travellers.

2.5.1.7. Access

Access to the dam wall will be via Glebe Road and the new extension of Spring Creek Rd. Access from the southern side will be via the access track established for pipeline maintenance and this is not a public access.

The recreation area near the flooded Glebe Weir will be accessed via Glebe Road. The second recreation area near The Bend will be accessed by a new access road from the existing Cracow Road (Figure 2-7).

The public will be excluded from some parts of the dam and associated infrastructure for safety reasons and excluded from any nature reserves established in relation to the Project or vegetation rehabilitation areas for environmental reasons.

2.5.1.8. Land use on the storage margins

DERM has purchased 7 of the 35 properties required for the dam. Note that some properties contain multiple land parcels. SunWater will obtain ownership of the full supply level (FSL), with easements to be taken over the flood margin. It is intended that the current land use activities being undertaken within the flood margin (predominantly grazing and cropping) will continue, with easement conditions generally not impinging on these activities. Grazing above the FSL would be permitted under grazing lease arrangements.

2.5.1.9. Power and Telecommunication

Energy and telecommunications requirements will be supplied via permanent mains, SunWater has discussed these requirements with the relevant service providers who will build, own and provide these services to the project.

2.5.2. Water distribution

2.5.2.1. Downstream distribution

The means of extracting water from the dam for downstream release (intake and outlet works) is discussed in Section 2.3.1. The dam will essentially be taking the place of Glebe Weir in the Dawson Valley Water Supply Scheme hence will need to release water to satisfy the Water Allocation Security Objectives and Environmental Flow Objectives that relate to that scheme and the downstream Fitzroy River. SunWater does not plan to construct any new infrastructure for the purpose of extraction from the downstream river in association with the development of Nathan Dam. Means to extract water from the river or SunWater's existing reticulation network in irrigation areas, will be the responsibility of the future client and approvals will be sought at the time.

The locations and volumes of additional water that will be extracted from the scheme as a consequence of the dam have been modelled on the basis of the demand surveys that SunWater has conducted.

These volumes have all been modelled at 100% reliability because they will be either industrial or urban customers and include:

- 47,700 ML/a supplied direct from Nathan Dam via the pipeline;750 ML/a supplied from Gyranda Weir;
- 400 ML/a supplied from Theodore Weir;
- 7,092 ML/a supplied from Moura Weir;
- 2,269 ML/a supplied from Neville Hewitt Weir, and
- 7,800 ML/a extracted at Duaringa (from the Boolburra Waterhole) and supplied from Neville Hewitt Weir.

2.5.2.2. Pipeline

The pipeline will generally operate automatically. Water level sensors in each balancing storage detect a drop in water level therein and call the previous pump station to start automatically. This automation ensures that the pumps start and stop in the correct start-up sequence to prevent excessively high or low hydraulic pressures within the system. In the event of a system or pump station failure an alarm is sent to the operator who will respond accordingly.

Regular monitoring of the pipeline will be required to ensure:

- the detection of minor leaks;
- the effectiveness of landscape shaping, revegetation and weed control;
- that valves and sensors are functioning;
- that above ground infrastructure is maintained in a safe and secure condition; and
- the efficiency of water flow.

Leaks are generally detected by manual inspection and operator experience. If significant, they may also be inferred by the control system by a gross water balance, e.g. by detecting that the pumps are operating but, when accounting for the outflows, the storage levels are not changing at the expected rate. The location and severity of any detected leak influences how it is treated. A major break spilling a large quantity of water with a high potential for damage would require rapid shutdown. The emergency shutdown sequences will be described in the system manual produced for handover at commissioning. Typically lines are not completely drained for repairing leaks. If the leak is high up in the profile, lower sections of the pipeline will remain full of water during the repair process.

Regular maintenance will be required to lubricate pumps and associated infrastructure and to slash grass in areas at risk of damage from fire.

If monitoring of pipeline performance indicates a decline in pipeline flow efficiency, sections of the pipeline may require cleaning. This can take the form of scouring to remove sediment accumulations by releasing water from dedicated “scour valves” located at low points along the pipeline or “pigging” of the pipeline to remove pipe wall slimes, encrustations or similar accumulations.

A number of different types of pigs (also known as “swabs”) are typically used including foam pigs with or without scour pads attached to the outer surface of the pig, rigid pigs consisting of central spindle with a number of circular urethane disks. Depending on the size of the pig, the cleaning action will either use the hydraulic scouring action of the water forcing past the outside edge of the pig on the pipe wall, or the mechanical action of the pig against the pipe wall. Pigs can also be designed incorporating wire or bristle brushes and spiral vanes which impart a rotating action to the pig as it travels along the pipeline, thus adding mechanical scrubbing of the pipe wall, although these are not used in SunWater at this time.

To allow for pig insertion into and removal from the pipeline, swab insertion / retrieval points are designed at regular intervals along the pipeline, typically every 20 km. These can be located above or below ground (i.e. in a pit) and consist of a short section of pipeline which can be removed from the line. Once the section removed, the pig is inserted before that short section replaced into the pipeline. The pipeline is then brought back into service and the pressure of water behind the pig pushes it along the pipeline to the next insertion / removal point.

As the pig travels along the pipeline a zone of dirty water is created around the pig. The traverse of the pig along the pipeline is tracked by operators by opening the scour valves along the pipeline to release a small amount of water and observe the release of dirty water as the pig passes each scour valve point. Once the pig has passed the last scour valve prior to the retrieval point, the retrieval point is opened allowing the dirty water to be released at that point and the pig to be retrieved. The volume of water released at this point is relatively small as it is only the volume from the last scour valve to the release point. Depending on environmental considerations the water released at scour points and the retrieval point can be either released onto the ground or caught in a small holding pit (e.g. Figure 2-23). This process is repeated for each section of the pipeline to be pigged.

Typically, major pipelines are pigged once a year, however, pigging can occur more frequently if conditions dictate.

Pipeline operators will typically inspect the pipeline once a month. This will involve driving along the length of the pipeline and inspecting all above and below ground structures. Access to the pipeline will be along existing roads where the pipeline runs parallel. Where no existing roads are available access tracks maintained by the pipeline operators will be used. Some inspection by foot may be required in hard to access areas.

2.5.3. Associated infrastructure

All roads and services which are affected by the Project will remain in the control and operational responsibility of the respective local government or service provider. Operational responsibility for the recreation areas will be vested in Banana Shire Council via a lease or other arrangement.

2.6. Decommissioning

2.6.1. Water storage

The nominal engineering design life of the Project is expected to be 100 years, although it is likely to be maintained after that period provided that it continues to meet dam safety requirements and remains an integral part of the regional water supply strategy.

While unlikely, the Project may be decommissioned during or after initial engineering design life if:

- it suffers significant damage that cannot be remedied to meet safety standards; or
- it is no longer needed to provide water.

Current practices for dam decommissioning are established by ANCOLD. ANCOLD (1994a) identifies two principal alternatives when decommissioning a dam. Both comprise completely abandoning the dam, with its removal to the extent that it no longer retains water. While this is best achieved by complete removal of the dam wall and reinstatement of the bed and banks, in some situations it may be appropriate to only partially remove the structure.

Environmental issues associated with dam decommissioning must also be addressed. These include:

- treatment and / or removal of silt sediments that may be anoxic or otherwise pose a threat to water quality and ecosystem health at the site and downstream of the site;
- treatment of stratified water layers that may be low in oxygen and have other chemical characteristics that may be harmful to downstream ecosystems;
- stabilisation and reinstatement of the river bed and banks at the dam site; and
- stabilisation and reinstatement of lands formerly inundated by the Water Storage.

When decommissioning a dam, the dam owners at the time should prepare a decommissioning plan. The decommissioning plan should:

- include a time sequence of studies and works associated with the decommissioning; and
- address all issues associated with the decommissioning including:
  - impacts of sudden loss of remaining embankments or other dam sections for a range of flood events in compliance with the Guidelines for Failure Impact Assessments of Water Dams;
  - provision of safe release of stored water;
  - assessment of altered hydraulic character of spillways and streams;
  - provision to minimise impact on the downstream residents; and
  - provision for consultation with downstream residents and landholders.

A decommissioning date for the Project has not been determined at this stage and the likely date is too far in the future to allow effective planning for decommissioning to occur at present.

2.6.2. Water distribution pipeline

The life span of the pipe is anticipated to be in the order of 80 years. Pumps, valves and motors would have a design lives ranging from 20 to 40 years. Decommissioning is not in the foreseeable future but if it was to occur it would involve the following procedures:

- leaving the buried pipeline in place and marked;
- all entry and exit points would be sealed after the removal of all valves;

- above ground structures would be demolished or dismantled and removed for reuse, burial in an excavated pit on or near the site, or disposal off site; and
- consideration may be given at the time to filling the line with some relatively inert material such as a cement slurry, because over time, probably over one hundred years hence, it is possible that an empty pipe will lose its wall strength and fail, causing some local subsidence.