CHAPTER 2

Project Description

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2 Project Description

2.1 Project Overview

2.1.1 Summary

The Project comprises removing and replacing Six Mile Creek Dam (also known as Lake Macdonald) with a new structure to improve the safety and performance of the dam to meet current Queensland dam safety regulations.

The existing dam is an ungated zoned earth and rock fill dam. The spillway consists of anchored concreted slabs on compacted earth fill, with an uncontrolled ogee crest. The capacity of the dam is 8,018 megalitres (ML) at a full supply level (FSL) of 95.32 m Australian Height Datum (AHD), creating an impoundment area of approximately 260 hectares (ha) at FSL.

The Project will incorporate the demolition of the existing spillway and embankments and the construction of a new spillway and embankments. The new spillway will be an uncontrolled dual height labyrinth weir, with the capacity, FSL and inundation area remaining the same following the completion of the Project. The current Project area shown in Figure 1-1 is indicative of the proposed construction and ancillary works area necessary to safely undertake the demolition and construction of the dam and embankments. The majority of Project activities are expected to be undertaken in the areas adjacent to Lake Macdonald Drive and around the existing spillway.

The capital cost estimate is in the order of $100 million.

The construction period is currently programmed for between August 2020 and December 2022 subject to obtaining approvals and inclement weather through the construction period. Based on the program, drawdown of Lake Macdonald will begin in May 2020.

Lake Macdonald is connected to the South East Queensland (SEQ) Water Grid – a network of dams, water treatment plants, reservoirs and pipelines supplying drinking water to residents. The works will not affect the adjacent Noosa WTP's ability to draw water from the existing lake intake structure. Nevertheless, Lake Macdonald will not be used as a water source during construction due to lower water levels and the associated reduction in reliability of water quality and yield during this period. During construction, the Noosa water supply zone will be serviced from alternative supplies and existing services to residents and business will not change as a result of the Project.

After Project completion, the operation of water supply from Lake Macdonald will be unchanged from the existing situation. Water will continue to be sourced from Lake Macdonald via the existing infrastructure for treatment at the Noosa WTP and supplied to the SEQ Water Grid.

2.1.2 Project Rationale

In Queensland, dam owners like Seqwater are responsible for the safety of dams in accordance with the *Water Supply (Safety and Reliability) Act 2008*. In 2012-13, Seqwater commissioned a Portfolio Risk Assessment, which found improvements were needed at many of its 26 regulated dams to meet Queensland's dam safety guidelines and bring them in line with the latest engineering standards. Dam upgrades have been prioritised in a staged program to give Seqwater time to thoroughly scope, design and plan each project, while maintaining public safety and continuing to deliver a safe and secure water supply to the region. Seqwater's Dam Improvement Program is about upgrading dams, so they continue to perform safely into the future.

Dams are large-scale public infrastructure and while the probability of failure is very low, it is a risk that dam owners like Seqwater must manage because of the potential for large consequences. To ensure a consistent approach to these types of risks across dams throughout Australia, the Australian National Committee on Large Dams (ANCOLD) developed the Guidelines on Risk Assessment (2003), which is referred to by the Queensland dam safety regulator. The Seqwater Portfolio Risk Assessment was undertaken in accordance with these guidelines.

The risk assessment was also undertaken with reference to the Queensland Guidelines on Acceptable Flood Capacity (DEWS 2013). This requires that "dam owners should ensure that their dam can safely pass floods up to the Acceptable Flood Capacity". The Acceptable Flood Capacity is the overall flood discharge capacity required of a dam determined in accordance with the guidelines including freeboard as relevant, which is required to pass the critical duration storm event without causing failure of the dam.

Adhering to these guidelines has been a significant driver for Seqwater's Dam Improvement Program due to the high standards and mandatory timeframes required. Seqwater's Portfolio Risk Assessment ensured:

- Each dam was reviewed by an expert panel to identify all viable failure scenarios
- The risk to life at each dam was assessed using a consistent methodology
- Dam safety issues were prioritised within the context of risk to life
- Opportunities to stage upgrades could be identified.

For Lake Macdonald, the identified key risks were failure by piping through the embankment during flood and the possible liquefaction of foundation materials under the spillway due to earthquake. Factors that contribute to the key risks of dam failure include:

- The original dam design and changes to design standards
- Deterioration of structural elements (based on condition assessment and subsequent repairs in 2014-15)
- Urban development downstream leading to greater population at risk
- Presence of alluvial sands in the dam foundations with potential for liquefaction during an earthquake.

The societal risk for Lake Macdonald is just above the ANCOLD defined 'limit of tolerability', which is based on the likelihood and consequences of a dam failure. Based on the definitions provided by ANCOLD, this risk is considered unacceptable and action should be undertaken. The risk assessment also found that Lake Macdonald does not satisfy the Queensland Guidelines on Acceptable Flood Capacity and an upgrade is needed to meet the requirements. The guideline stipulates that prioritisation of upgrades across a dam owner's portfolio should be based on risk, related to the 'limit of tolerability'. The dam upgrade at Lake Macdonald has been prioritised on this basis.

Around 100 options were assessed to ensure the dam could continue to perform safely in the future, including decommissioning the dam. The preferred option is to remove and replace the existing spillway and embankments with new structures that comply with design and safety guidelines and standards, while essentially occupying the current dam footprint.

2.1.3 Project Options

Dam Safety – Project Alternatives

In 2013, Seqwater commissioned URS to undertake an options study for improving safety at dam. The options study, along with investigations by Seqwater, identified a number of potential options to improve the safety of the dam. These were:

- Risk reduction strategies – this option would maintain the dam in its current condition, but limit the impact of dam failure by reducing the population at risk. This would be done primarily through the purchase of 'at risk' properties downstream of the dam, and would also include improvements to dam monitoring and early warning systems. This option would fail to satisfy legislative risk requirements, and was therefore ruled out.
- Partial dam upgrade – this option would involve elements such as installing filters on current embankments to mitigate risk of piping during flood. This option was eliminated because it didn't address the risks associated with alluvial materials in the dam foundation with potential for liquefaction during an earthquake.
- Reconstructing the embankment and relocating the spillway to the right of the dam – this option was subsequently eliminated due to poor foundation conditions and regulatory approval, land ownership and environmental impacts.
- Decommissioning the storage – this option was eliminated due to the potential impacts on Seqwater operations, and the cost of bringing forward a project to provide an alternate water source to meet future potable water demand in the Sunshine Coast and Noosa regions.
- Replacing the current dam with a 2,000 ML weir structure located immediately downstream of the existing dam – this option was eliminated due to the cost of bringing forward a project to provide an alternative water source to meet future potable water demand in the Sunshine Coast and Noosa regions.
- New dam options – a number of new dam types were considered in locations upstream and downstream, though generally in the vicinity of the existing dam location. New dam options were appealing in terms of constructability and dam safety, however, the costs were high compared with rebuilding the dam at the existing location, and therefore a new dam was ruled out.

Project Design

The final detailed design of the dam is currently being progressed and is not expected to differ significantly from that described in the Initial Advice Statement (2017). However, since the Initial Advice Statement was submitted to the Coordinator General for consideration in September 2017 some design aspects have evolved in response to

geotechnical investigations and further assessment of dam safety, constructability and water security considerations. In particular, there were notable changes to the left embankment and coffer dam, as outlined below

Left Embankment

The left embankment will now be completely replaced, instead of a partial upgrade, for ease of construction and a certainty of outcome. The replacement will involve demolishing the existing embankment to the natural foundation level, and reconstructing a simpler embankment section, with dual filter zones and rock fill shoulders to allow for a steeper embankment. This design will use the same footprint as the existing embankment.

Coffer Dam

The purpose of the coffer dam is to act as a temporary water retaining element (holding back water remaining in the lake), so that dam construction works can be completed. It is also designed to allow typical catchment low flows to pass through the construction site in a controlled manner.

Options for temporary lake water levels were considered on the basis of dam safety, environmental impact, cost and associated impacts. In general, maintaining the lake water level at the current Full Supply Level was not considered an option while the existing dam structure was rebuilt as part of the Project. If the existing dam's FSL was maintained during construction, Seqwater would need to effectively build two new dams to the same safety and engineering standards – a large temporary structure (coffer dam) to hold the water back during construction and the new permanent dam structure. Not only is this option not cost-effective, but it would result in additional impacts including dredging and more trucks on local roads to import materials. It would also mean a longer construction period.

The concept design provided in the Initial Advice Statement (2017) was based on a coffer dam crest level of RL 91.5 m AHD, with water level and low flow section crest at RL 90.5 m AHD (10.5% capacity). Following the concept design, a number of coffer dam design options and crest heights were evaluated. Coffer dam crest levels of RL 93.0 m AHD, 91.5 m AHD, and 90.0 m AHD were considered.

Coffer dam RL 93.0 m (earth fill)

A temporary coffer dam at RL 93.0 m, with a water level at RL 92.0 m (26.5% capacity), was considered in the evaluation because of the potential benefits in retaining a higher water level for water supply, though only in a reduced capacity. The water body would also maintain a larger water body for aquatic fauna. Further evaluation of water supply led Seqwater to determine that Lake Macdonald would be excluded as a water supply source until the Project was complete due to unreliable yield and likely variability of water quality. In addition, the larger coffer dam would need to incorporate similar safety and engineering standards of the new dam, due to the higher water level resulting in greater dam safety and construction risks for people working and living downstream.

Subsequently, the higher water level option for a temporary coffer dam (RL 93.0 m) was eliminated due to the high costs and life-safety risks associated with the temporary structure.

Coffer dam RL 91.5 m (earth fill)

The concept design for a temporary coffer dam at RL 91.5 m involved an earth fill structure installed immediately upstream of the existing dam with a single row of sheet piles in the centre of the fill embankment. The design includes a low-flow section at RL 90.5 m to maintain the temporary lake water level and direct catchment low-flows through a dedicated channel. On further assessment of constructability for this coffer dam option, several adverse impacts were identified:

- Dredging of low strength lake sediments would be necessary for the foundation of the earth fill coffer dam. This leads to the direct impact of dredging on water quality, as well as the need for on-site disposal of around 100,000 m^3 of dredge slurry.
- Transport of coffer dam fill material to the site, estimated at 34,000 m^3 of earth fill and 6,500 m^3 of rock fill.
- Lowering the lake level to RL 89.5 m (5.1% capacity), or 1 m below the proposed temporary lake level, to construct the coffer dam, which is estimated to take 3-4 months.

Coffer dam RL 90.0 m (sheet pile)

The alternative design for a temporary coffer dam at RL 90.0 m option involved a sheet pile structure installed on the upstream slope of the existing dam embankments. This configuration would be similar to the earth fill coffer dam described above, but it would make use of the existing dam fill and foundations to support sheet piles rather than importing materials to place within the lake for this purpose. The main drawback of this arrangement is that the maximum height of sheet piles is constrained by the working level for spillway construction. At the time of initial

evaluation, this was for a maximum sheet pile height at RL 90.0 m and lake level at RL 89.0 m. Comparison of the earth fill coffer dam (RL 91.5 m) and sheet pile coffer dam (RL 90.0 m) below was based on this arrangement. Subsequently, the height of the working level for spillway construction was raised by 1 m for design/constructability reasons, which results in a higher lake level as described under 'preferred coffer dam option' below.

The main advantages/disadvantages of the sheet pile coffer dam compared with the earth fill coffer dam approach are as follows:

- Reduced safety risk associated with the coffer dam – less exposure to failure risk with the sheet pile coffer dam due to greater certainty in foundation materials.
- Smaller construction footprint for the construction works – the sheet pile coffer dam design leads to a reduction of approximately 1.46 ha (27%) in the in-stream Project construction area by removing the earth fill coffer dam footprint.
- No requirement for dredging or dredge spoil disposal – the sheet pile coffer dam will be installed through the existing embankment, with no need to dredge an area of the lake bed for the coffer dam foundations.
- Reduced requirement to import granular material and rock – the sheet pile coffer dam will be installed through the existing embankment material and require only minimal import of rock for erosion protection.
- A shorter construction period – this would result in less disruption to local residents and local businesses.
- A lower water level in Lake Macdonald – the sheet pile coffer dam retains less water in the lake than the earth fill coffer dam, leading to reduced aquatic habitat retained during construction.

Using a sheet pile coffer dam results in a decrease in the potential impacts to some matters, in particular the surrounding community, as well as reducing safety risks; however, the potential impacts on aquatic habitat may increase. Nevertheless,

Under both the RL 90.0 m and RL 91.5 m coffer dam options, there is a period where the habitat available for aquatic species will be very limited. Consequently, an initial aquatic fauna salvage program is required for both options to relocate species of conservation significance before construction begins and populations of these species will be re-established in the lake after construction is complete. Fauna salvage would also involve relocating other native species caught during this process.

Preferred coffer dam option

Based on a comparison of the potential impacts and benefits, the option to build a sheet pile coffer dam (RL 90.0 m option) has been selected. This meant that a separate earth fill coffer dam, upstream of the existing dam, was not required.

Following the evaluation of temporary coffer dam concepts and selection of the sheet pile coffer dam concept, Project design updates have improved the environmental outcomes of this option. The height of the working level for spillway construction has been raised by 1 m for design/constructability reasons and this has led to an updated coffer dam crest at RL 90.0 m (around 7.5 % capacity at maximum level before spilling).

Further fine-tuning of design relating to the spillway and temporary coffer dam is expected through the detailed design and construction planning phases. These changes are not expected to differ significantly from that presented here. If any significant changes are proposed and lead to adverse impacts, further assessment and regulatory requirements will apply.

Further information on the proposed coffer dam is provided in Section 2.4.3.

2.2 Project Site

2.2.1 Location and Footprint

The Six Mile Creek Dam Safety Upgrade Project area covers the dam wall, embankments and the immediate surrounds as shown in Figure 2-1. Notwithstanding this, it is recognised that the Project will have direct and indirect impacts on the lake impoundment area and surrounding community. This Impact Assessment Report (IAR) outlines what the perceived and potential impacts are and the mitigation measures proposed to manage these impacts. As such, there may be references to a wider area outside the 'Project area' and where this occurs it will be defined in the relevant section.

Six Mile Creek Dam (Figure 2-1) is situated on Six Mile Creek (at AMTD 55 km, latitude 26°22'57" S and longitude 152°55'49" E) and forms Lake Macdonald in the headwaters of the Mary River Basin (DES 2018). The dam is

approximately 55 km upstream of the confluence between Six Mile Creek and the Mary River, and the total river distance from the dam to the Mary River estuary is approximately 95 km. The Lake Macdonald catchment is approximately 49 km^2 and generally consists of rolling hills, with a high proportion of rural residential land-use. The dominant land uses surrounding Lake Macdonald include rural land, low-density rural residential areas, and open space conservation including the Tewantin National Park on the adjoining northern border of the Project area (refer to Figure 2-1).

Lake Macdonald is approximately 4 km north-east of Cooroy, 8 km east of Pomona, and 15 km west of Noosa Heads, and is wholly within the Noosa Shire Council area. The dam wall is accessed directly via Lake Macdonald Drive, and indirectly via the Noosa Water Treatment Plant (WTP) and Collwood Road. Collwood Road ends at the Seqwater property boundary adjacent to Noosa WTP. The road reserve connecting Collwood Road and Lake Macdonald Drive, which runs along the northern Boundary of Seqwater property, is currently undeveloped. Collwood Road extends to Gumboil Road to the east. To the south Lake Macdonald is generally bounded by Cooroy-Noosa Road.

Cooroy, the closest town to the dam, has a population of 2,897 (ABS Census 2016). The next closest town, Pomona, has a population of 1,738 (ABS Census 2016), and Tewantin has a population of 10,920 (ABS Census 2016). The wider Noosa Shire has a population of 52,149 (ABS Census 2016).

Once the Project is complete, the dam will generally occupy the same footprint as the current structure (Figure 2-2Figure 2-2), and the inundation area will not change. The Project construction footprint is located within Lot 118 MCH814, Lot 1 RP800331, and the road reserves of Lake Macdonald Drive and Collwood Road (Figure 2-3).

FIGURE 2-1: EXISTING DAM INFRASTRUCTURE

Six Mile Creek Dam Safety Upgrade Project

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CREATED BY / DATE: BM14706, 30/11/2018

VERSION: DRAFT A

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WATER FOR LIFE

LEGEND

- Local Roads
- Six Mile Creek
- Existing Dam Layout
- Project Area

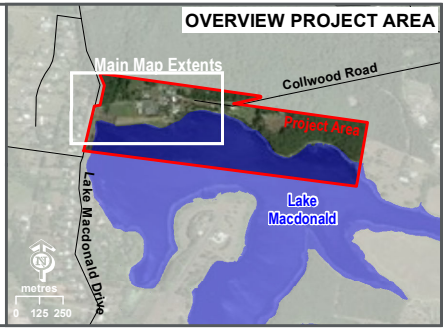

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FIGURE 2-2: UPGRADED DAM INFRASTRUCTURE AFTER CONSTRUCTION

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WATER FOR LIFE

LEGEND

- Local Roads
- Six Mile Creek
- Upgraded Dam Layout (after construction)
- 1 m Contour Interval Line
- 0.25 m Contour Interval Line
- Project Area

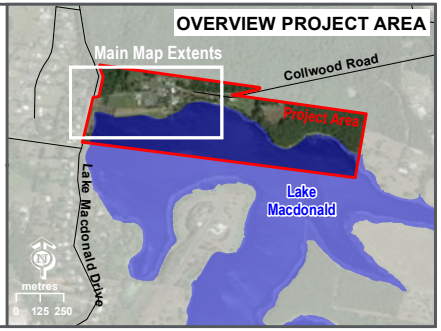

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FIGURE 2-3: DAM INFRASTRUCTURE DURING CONSTRUCTION

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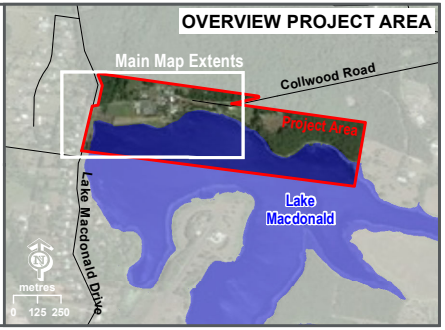
WATER FOR LIFE

LEGEND

- Local Roads
- Six Mile Creek
- 1 m Contour Interval Line
- 0.25 m Contour Interval Line
- Dam Layout during construction
- Project Area



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2.2.2 Land Tenure and Affected Properties

The Project is located within land owned by Seqwater, with the exception of works for the left embankment and the saddle dam as outlined in Figure 2-3. The tenure of Lot 118 MCH814 and Lot 1 RP800331, which incorporate the majority of the construction footprint, is freehold and owned by Seqwater. The construction footprint for the left embankment encroaches on the Lake Macdonald Road reserve, and the saddle dam will be constructed on, or adjacent to Collwood Road, noting that the majority of the saddle dam will be on a section of Collwood Road that is on Seqwater's freehold property and only a small section will be within the Collwood Road reserve. Lake Macdonald Drive and Collwood Road are road reserves controlled by Noosa Shire Council, as local roads.

The works are immediately adjacent to, but will not impact, an undeveloped local government road reserve (Collwood Road) on the northern boundary of the Noosa WTP, adjoining the Tewantin National Park.

The water storage area is located within freehold land owned by Seqwater, with the exception of road reserve for Gumboil Road, Cooroy Noosa Road and Hoy/Hayward Road, and reserves on Lot 143 MCH989 and Lot 212 MCH4148, and Lot 186 MCH4148.

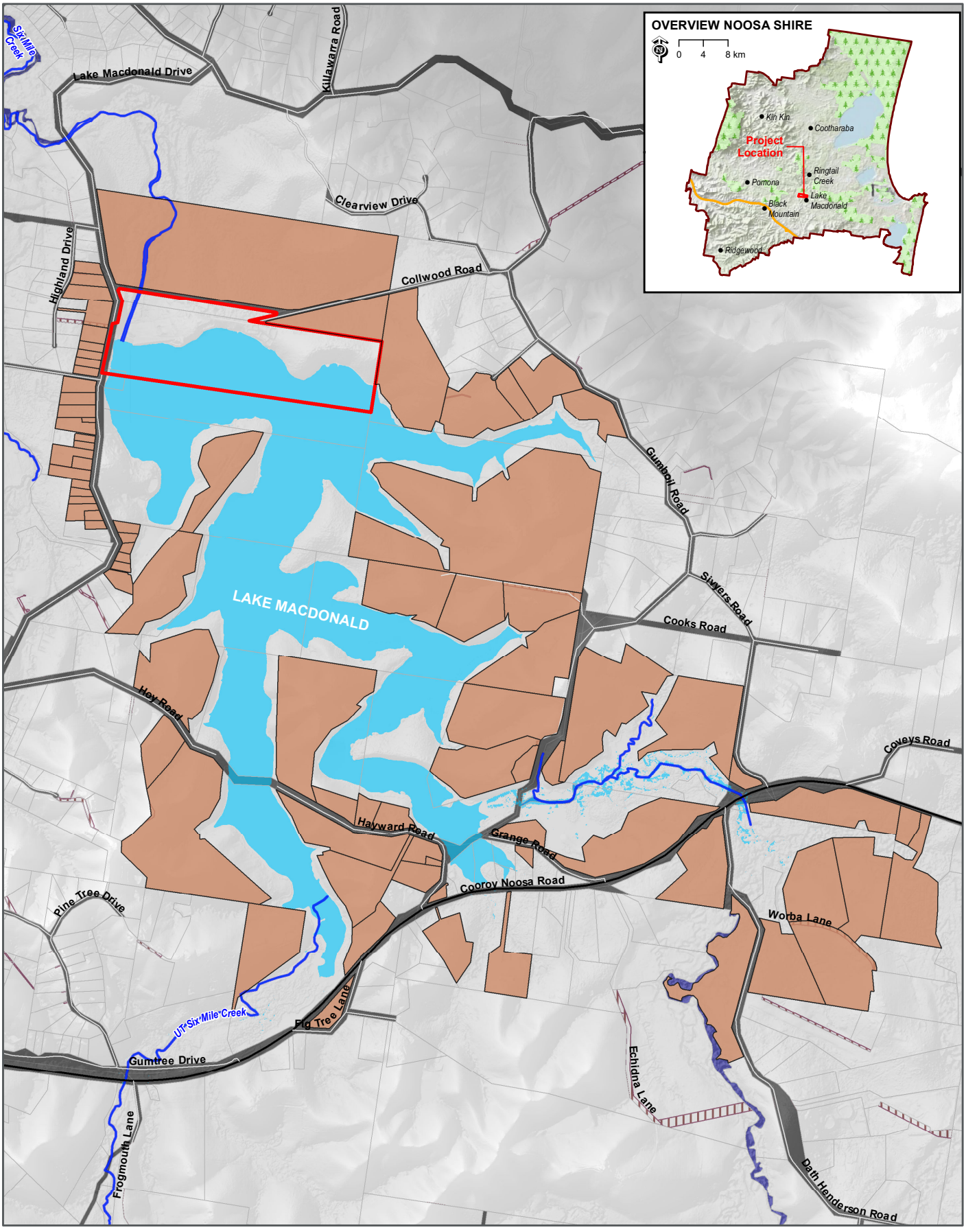
Within Lot 118 MCH814, Seqwater licences areas of land for the operation of the Gerry Cook Fish Hatchery, which is managed by the Mary River Catchment Coordinating Committee (MRCCC); Lake Macdonald Rowing Club; and Scouts Association of Australia (Camp Cooroora). These licences will end in 2019 to facilitate construction.

There are nine properties adjacent to the construction footprint on the corner of Lake Macdonald Drive and Collwood Road, and 68 properties around Lake Macdonald, adjoining Seqwater land. The tenure for these properties is privately owned freehold land as shown in Figure 2-4.

There is currently no registered Cultural Heritage Body for Lot 118 MCH814, on which the works will occur. However, the area is under a Registered Native Title Application (QC2013/003 – QUD280/2013) by the Kabi Kabi First Nation. At the time of writing, it is not known when a determination on this application is expected.

FIGURE 2-4: AFFECTED PROPERTIES

Six Mile Creek Dam Safety Upgrade Project



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LEGEND

- Bruce Highway
- Secondary Road
- Local Roads
- Watercourse
- Six Mile Creek and Upper Tributary
- Lake Macdonald
- Project Area
- Local Governmental Area
- Affected Properties

Cadastral Boundaries

- Lot Type Parcel
- Road Type Parcel
- Easement

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2.2.3 Existing Infrastructure

The Project area is typical of a semi-rural zoning in terms of existing infrastructure, and is supplemented by infrastructure requirements for small-lot rural residential properties along Lake Macdonald Drive as well as the existing Lake Macdonald and associated Noosa WTP. Existing infrastructure services are shown in Figure 2-5.

Power and Telecommunications

There is an existing permanent overhead power supply that supports the operation of the Noosa WTP and ancillary buildings.

Telecommunication lines run along Lake Macdonald Drive and Collwood Road through the Project area.

Water and Sewerage

Reticulated water is available to a proportion of residential dwellings surrounding Lake Macdonald, via the Unitywater distribution network, which Seqwater supplies. Connection to Unitywater's sewer network is limited within the Project area. There is a trunk sewer main present along the alignment of Lake Macdonald Drive in Cooroy, however most residents surrounding Lake Macdonald would use septic tanks or similar sewage systems.

Hard infrastructure for the management of stormwater in the Project area is limited. The majority of stormwater is captured and diverted through the use of open and unlined spoon and table drains along road alignments.

Existing Seqwater infrastructure near the dam is serviced by WTP service lines for potable water and various septic tank or holding tank systems for sewage.

Water Supply Infrastructure

The Noosa region water supply zone is currently supplied from two sources – the Noosa WTP and the Northern Pipeline Interconnector (NPI), which transports bulk treated water in either direction depending on needs, connecting Noosa to the SEQ Water Grid. In addition, the Noosa WTP receives raw water from two sources – Lake Macdonald and the Mary River.

During the Project, Lake Macdonald will not have a reliable yield as a raw water source. While Lake Macdonald's water level is temporarily lowered, the Noosa WTP will continue to operate using water from the Mary River. Supply will also be supplemented from other dams such as Baroon Pocket Dam on the Sunshine Coast or North Pine Dam in Brisbane via the NPI. All current treated water supply points will continue to be supplied by Seqwater, via the existing water reticulation network managed by Unitywater. This would include water truck standpipes that may be used to supply residents typically using rainwater tanks.

In relation to this change in water supply, Seqwater has undertaken water supply assessments to identify any water supply, water quality and water security risks associated with removing Lake Macdonald as a raw water source for the duration of the Project.

This process has provided a sound understanding of the risks and reliability compared with business as usual and has fed into the proposed supply options and any ancillary activities needed to maintain safe and reliable drinking water supplyreliability. This assessment has also incorporated the potential for emerging drought.

Seqwater will be monitoring the region's water storage levels before and during construction and will continue to assess various scenarios to determine the best way to supply water the Noosa zone. Seqwater plans for managing water supply during all weather conditions, including a detailed drought response plan.

No major works at the Noosa WTP are proposed as part of the Project. There will be associated infrastructure projects occurring to improve the safety and reliability of water supply to the Noosa region water supply zone.

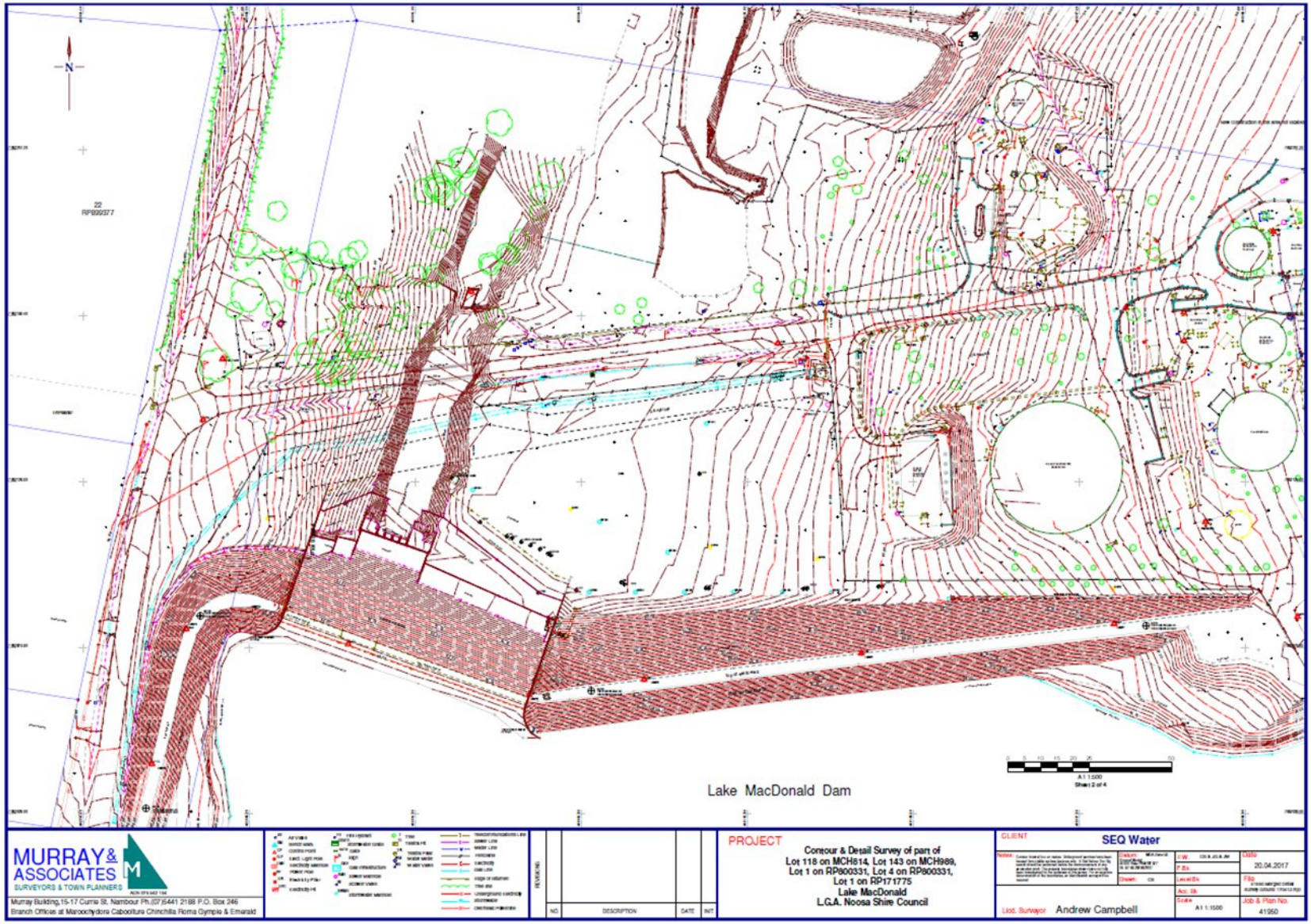


Figure 2-5: Existing infrastructure services

Roads

The Project area is serviced by a range of State controlled and council roads as shown in Figure 2-6 and described in more detail in Chapter 9 – Traffic and Transport.

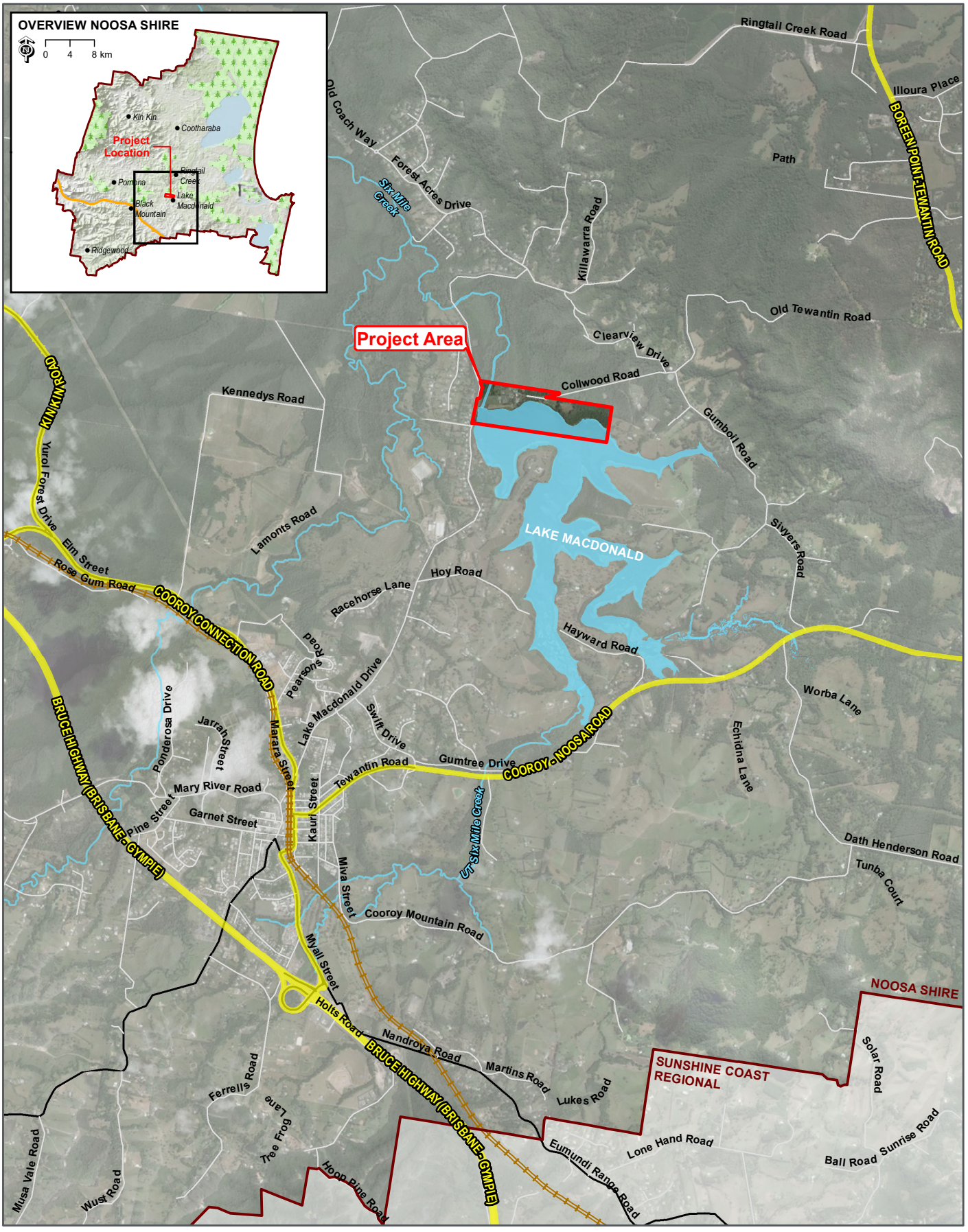
All heavy vehicles will access the Project one of two ways, as follows:

- Bruce Highway, Elm St and Lake Macdonald Drive, or
- Bruce Highway, Elm Street, Noosa-Cooroy Road, Sivyers Road, Gumboil Road and Collwood Road.

The construction work force is likely to be sourced from the surrounding district and commute to the Project site via light vehicles. Car parking for all light vehicles will be located within the Project area and Seqwater will specify that construction workforce will not use road verges for parking to minimise impact on local residents.

A detailed assessment of the existing road network and the possible impacts of the Project on the local road network is in section 10.

FIGURE 2-6: LOCAL AND STATE CONTROLLED ROADS



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LEGEND
- State Controlled Roads (surveyed centerline)
- Secondary Road
- Local Roads
- North Coast Railway Line
- Six Mile Creek and Upper Tributary
- Lake Macdonald
- Project Area
- Local Governmental Area

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2.2.4 Social Environment

The Project is located in a semi-rural area within the Noosa Shire local government area. The region surrounding the Project area supports small to medium sized country and coastal towns, and dispersed rural to semi-rural populations. The primary land uses include agriculture, forestry, rural residential, and a variety of uses such as conservation, tourism and recreational activities.

Seqwater provides a range of recreation facilities at Lake Macdonald including parklands, picnic facilities, and boat ramps as shown in Figure 2-7. Seqwater also allows unpowered boating (electric motors only), paddle craft and fishing on the lake, with a designated canoe trail. Seqwater owns and manages the following parks at Lake Macdonald:

- Jabiru Park (Fearnley Bird Hide)
- Mary River Cod Park.

Other recreation facilities near Lake Macdonald that are not managed by Seqwater are:

- Lake Macdonald Park
- Perch Park
- Noosa Botanic Gardens
- Kookaburra Park
- Tinbeerwah School Park
- Camp Cooroora (Seqwater land licensed to Scouts Association of Australia)
- Lake Macdonald Rowing Club (Seqwater land licensed to the club)
- Darter Park
- Worba Park

During construction, on-water access to Lake Macdonald will not be permitted for safety. Other temporary changes to recreation in and around Lake Macdonald include:

RECREATION FACILITY	IMPACT ON FACILITY
Kookaburra Park (adjacent to the Project area)	Park and public amenities will remain open, but may be restricted at times
Perch Park and Lake Macdonald Park	Facilities may be closed during construction
Mary River Cod Park and associated boat ramp	Facilities will be closed during construction
Camp Cooroora	The camp ground and facilities will be closed during construction
Noosa Botanic Gardens	Park and public amenities will remain open
Jabiru Park (Fearnley Bird Hide)	Park facilities will remain open
Tinbeerwah School Park	Park facilities will remain open
Lake Macdonald Rowing Club	Facilities will be closed during construction
Gerry Cook Fish Hatchery	Facilities will be closed during construction
Darter Park	Park and public amenities will remain open
Worba Park	Park and public amenities will remain open

Following the completion of construction, all impacted recreation facilities and areas will be reinstated.

The Gerry Cook Fish Hatchery is also within the Project construction footprint. The hatchery is managed and operated by the MRCCC who run a breeding and restocking program for Mary River cod. During construction, the hatchery operation will be relocated, but the facilities at Lake Macdonald will largely retained and likely used for construction related activities. The hatchery will be reinstated after the Project is completed.

2.3 Project Program

The indicative construction program, from the contract award to demobilisation, runs from August 2020 to December 2022. The high level Project sequencing is shown below.

This indicative program is subject to change based on procurement, design and approvals. The overall sequencing is expected to apply regardless of the Project commencement.

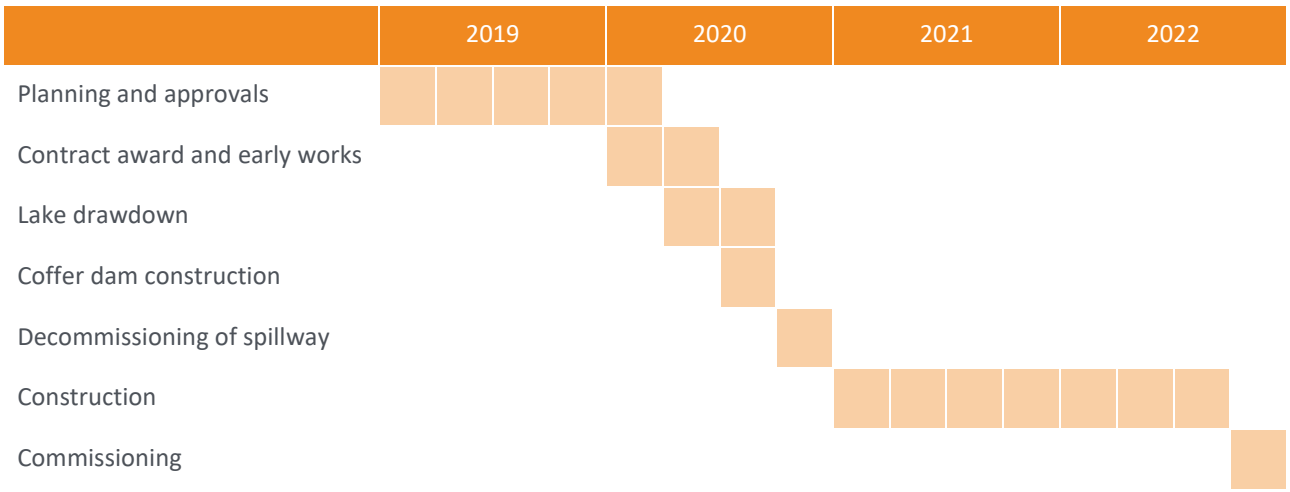
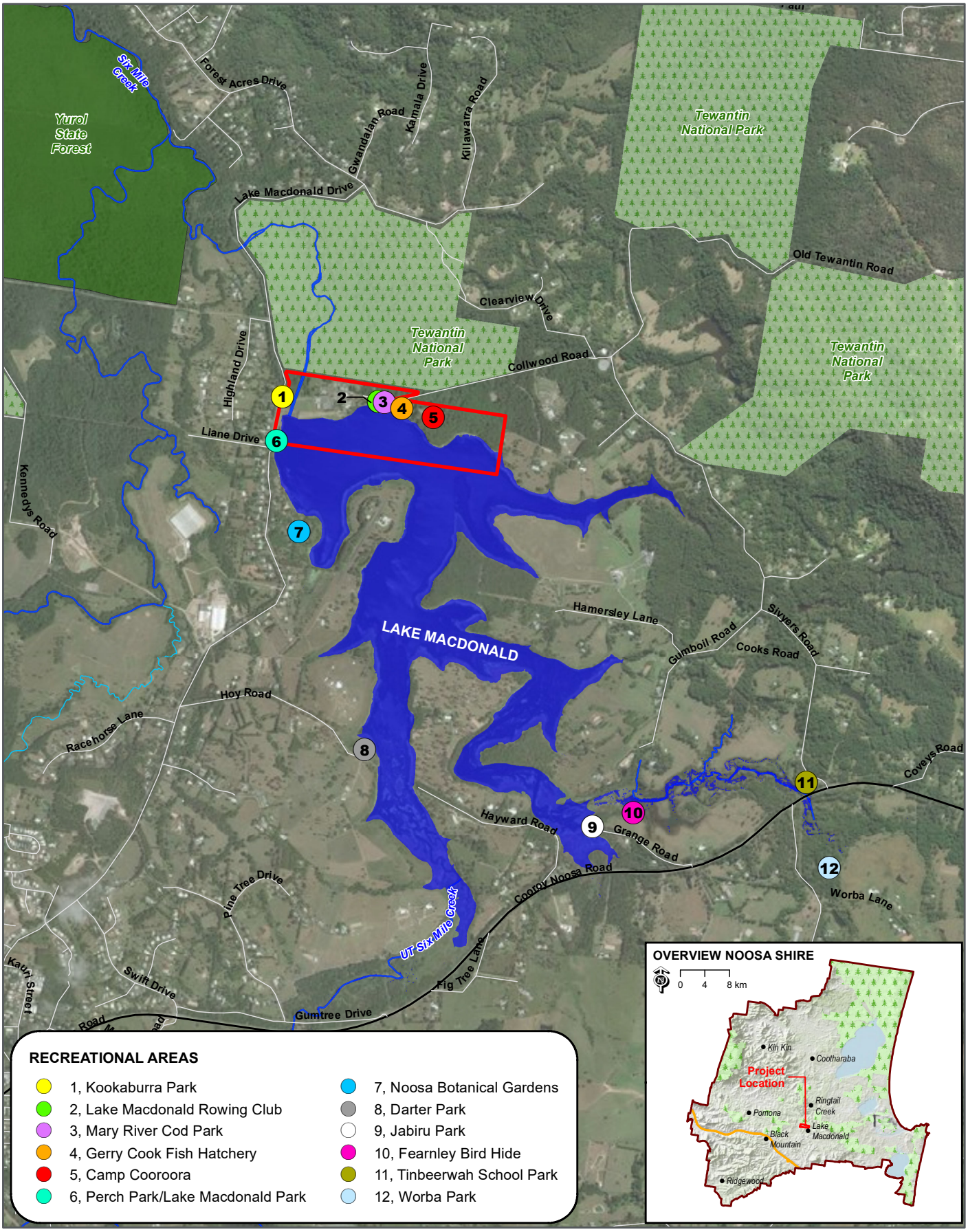


FIGURE 2-7: LAKE MACDONALD RECREATIONAL AREAS

Six Mile Creek Dam Safety Upgrade Project



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seqwater WATER FOR LIFE

LEGEND
Bruce Highway
Secondary Road
Local Roads
Watercourse
Six Mile Creek and Upper Tributary
Lake Macdonald
Study Area
Project Area
Local Governmental Area
Protected Areas
National Parks
State Forest

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2.4 Project Elements

2.4.1 Design

The first stage of damming Six Mile Creek was constructed between 1961 and 1965 and consisted of a homogenous low earth embankment with downstream drainage blanket. It was subsequently upgraded in 1979-1980, with the second stage adding a further 3.6 m of height to the dam and increasing its storage to the current capacity of 8,018 ML at full supply.

The Project will involve the removal of the existing dam structures and construction of a dual-height labyrinth weir, reconstructed left and right embankments, and a new saddle dam to the east of the dam wall and Noosa WTP along Collwood Road. The key parameters of the existing and upgraded dam structures are provided in Table 2-1 for comparison.

Table 2-1: Key parameters of the existing and upgraded dam

	EXISTING STRUCTURE	UPGRADED STRUCTURE
Spillway type	Uncontrolled fixed ogee crest	Uncontrolled dual height labyrinth
Spillway description	Concrete slab broad crest weir	Mass concrete dual height, multiple cycle labyrinth weir
Spillway crest elevation (low level)	Notch/initial: RL 95.32 m AHD Full width: RL 95.35 m AHD	Initial: RL 95.32 m AHD Full width: RL 95.40 m AHD
Spillway crest elevation (high level)	Not applicable	RL 97.1 m AHD
Stilling basin floor elevation	RL 83.5 m AHD	RL 84.0-86.0 m AHD
Energy dissipation method	Plunge pool/stilling basin	Plunge pool/stilling basin
Full supply level	8,018 ML	8,018 ML
Dead storage	RL 87.7 m AHD	RL 87.7 m AHD
Historical No Failure Yield	7,118 ML/y	7,118 ML/y
Maximum depth	10.5 m	10.5 m
Area inundated at FSL	260 ha	260 ha

Spillway

The labyrinth spillway structure will comprise new foundations of secant pile cells filled with mass concrete and socketed into bedrock. The spillway structure above ground will be a concrete crest control structure consisting of a dual height labyrinth weir as shown in Appendix D. The dual height layout of the spillway provides a lower level weir for flows up to 1:100 Annual Exceedance Probability (AEP) floods, which will closely mirror the way the current ogee weir passes these events. A wider upper level weir section will provide for larger flood flows. The spillway, in total, has been sized to pass a Probable Maximum Precipitation Flood (PMPF) event (100% Acceptable Flood Capacity).

This dual height arrangement channels the more frequent floods directly to Six Mile Creek, with the lower level labyrinth weir designed to address downstream erosion and allow the tailwater to build up before the upper weir begins to discharge. The lower spillway also considers downstream fish passage objectives, including:

- Provision for a plunge pool or pools on the spillway's downstream aprons to provide cushioning for any aquatic fauna transitioning from the lake level to Six Mile Creek. The likely options are either a single pool from the spillway crest to the creek level or two pools that step down sequentially and limit the vertical drop. The optimal arrangement from both an engineering and an environmental point of view will be determined though design and relevant assessments, including for safe fish passage.

- Passive drainage slots will be cut into the plunge pool walls to allow free drainage of pools after spillway flows cease. Plunge pool drainage design will consider floor grading and drainage slot width to provide volitional movement of aquatic fauna out of the spillway pools to avoid stranding. The drainage design will also consider filling time to ensure the pools fill quickly enough to provide for downstream fauna passage.

The upper level labyrinth weir spillway will have a tailwater depth of around 1 m before it commences spilling. The upper level labyrinth weir spillway will incorporate a concrete apron for erosion protection, but will not require a constructed plunge pool as the tailwater level will provide this function.

Stilling Basin Erosion Protection

The labyrinth weir performs as a straight drop spillway and the issuing flow plunges onto the downstream apron/plunge pool, with energy dissipation occurring in a similar way to that of a plunge basin. The spillway arrangement includes a base slab that extends 2 m and 3 m downstream of the lower level and upper level labyrinth cycles, respectively, providing space for the water flow (jet) to impinge upon the concrete slab for lower flows before the tailwater levels rise.

The base slab for the labyrinth is at an elevation of RL 89.5 m AHD with the downstream river channel bed at approximately RL 84 m AHD. An intermediate stilling basin was incorporated on the concrete spillway cell structure at base RL 86.0 m AHD to allow for the energy dissipation of low flows before being directed into Six Mile Creek.

Erosion protection works downstream of the spillway comprise large diameter rock armour and rip-rap type material, extending between the new dam and Six Mile Creek downstream of the current dam. The size of material required will be determined during the detailed design phase based on the outcomes of hydraulic modelling studies.

Right Embankment

The right embankment will be at a dam crest level of RL 99.5 m with embankment slopes of 2.5H:1V (Appendix D). This embankment will incorporate the follow key design parameters:

- A central earth fill core.
- An upstream earth fill shoulder with filter and protective rip rap surface at slope of 2.5H:1V.
- A filter blanket across the downstream foundation with an inclined chimney filter placed across the earth fill core, with an earth fill downstream shoulder at slope of 2.5H:1V.
- A downstream toe drain at the base of the filter blanket.
- Embankment shoulders comprising earth fill materials.
- A plastic concrete cut off wall under the core of the dam to manage seepage and piping risks through sand/gravel on the western portion of the right bank. The cut off wall will be founded 1 m into the underlying highly weathered rock, connected to the foundation cells at the right side of the spillway structure. A localised extension of the cut off wall is included to cut off a possible alluvial layer and to manage the risk of piping due to high seepage gradients.

Left Embankment (along Lake Macdonald Drive)

The left embankment will be at a dam crest level of RL 99.5 m with embankment slopes of 2H:1V and a crest width of 4 m (Figure 2-1). The design will incorporate the following:

- A central earth fill core.
- A 1 m wide filter trench in the foundation to a maximum depth of 4 m, as the risk of a continuous defect in the residual soil below this depth is very unlikely and it will be difficult to distinguish between the residual soils and completely weathered rock during construction.
- An upstream rock fill shoulder at a slope of 2H:1V with a filter upstream of the core.
- A two-stage filter blanket across the downstream foundation with an inclined two stage chimney filter placed across the earth fill core and rock fill downstream shoulder.

The filter trench will extend to completely weathered rock and provide filter protection for potential defects within the residual soil foundation.

Saddle Dam

A saddle dam may be constructed to the east of the existing dam along the alignment of Collwood Road, between the Noosa WTP and Camp Cooroora, to prevent flood water discharging from the lake at this location during an extreme flood event. The saddle dam will be built on an existing road alignment and so will be trafficable.

The saddle dam crest will be a maximum of RL 99.5 m AHD and will incorporate the following key design features:

- Base width of approximately 3 m at the residual soil or weathered rock foundation level.
- A 1 m wide filter trench through the centre of the earth fill core that extends approximately 2.5 m below the existing ground level.
- A downstream fine filter outlet.
- A downstream face with a 3H:1V slope that is covered by topsoil and grass for erosion protection.
- An upstream riprap face, with underlying filter, at slope of 1V:2.5H.

Intake Structure – Noosa Water Treatment Plant

The existing intake structure for the Noosa WTP, which is located east of the spillway along the right embankment, is not anticipated to change as a result of the Project. If it is identified during construction of the right embankment that there is a conflict with the pipework, there may be a need for a minor realignment of pipework. This will not have an impact on the construction of the dam or embankments.

During construction the intake structure will not be operational due to reduced water levels.

Outlet Works

The existing outlet works will be removed as part of the demolition of the existing spillway. The new outlet works system will comprise a multi-level intake on left side of spillway, leading to environmental and emergency/scour outlet. The environmental outlet will be a 300 mm diameter pipe, designed to fulfil the current environmental flow requirement of 0.3 m^3/s (at FSL). The emergency/scour outlet will be a 750 mm diameter pipe, designed to fulfil reservoir drawdown criteria (USBR, 1990).

The outlet works, at 90 m AHD, will allow the reservoir to be lowered for dam maintenance activities and will also provide some benefit in relation to:

- Controlled lowering of the reservoir in a dam safety emergency
- Lowering of the reservoir for dam maintenance activities
- Environmental flow releases.

Dam Safety

Lake Macdonald is classified as a 'High A' Consequence Category Dam, with an incremental population at risk (PAR) in the order of 140 (assessment undertaken by Worley Parsons in 2008, and confirmed in the PRA review). Seqwater is currently reassessing the hydrology for Lake Macdonald, as part of the Project. Following this, a consequence assessment will be undertaken and the Consequence Category of the Dam reassessed as part of the Detailed Design.

Flood Studies

The existing dam provides some flood routing benefits to downstream areas by attenuating the peak inflow within the lake. The upgraded dam will have a discharge capacity that matches the existing dam at the 1:100 AEP flow event, to maintain a similar standard of downstream flood risk. For outflows greater than the 1:100 AEP event, the peak spillway discharge would be greater than for the existing dam in order to meet Acceptable Flood Capacity requirements.

Hydrologic and hydraulic modelling of the catchment and floodplain with the existing and new dam have been undertaken. A range of design floods with AEPs ranging from 1:5 AEP up to the PMF have been derived. Further information on maximum inflows and outflows for these flood events is provided in section 6.

2.4.2 Site Layout

The proposed construction site layout, showing the proposed location of internal haul roads, raw material stockpiles, contractor site facilities, staging areas and the mass concrete batch plant, is shown in Figure 2-8.

Whilst the final configuration of the Project area will be decided by the contractor, the site works will be undertaken within Seqwater's property boundaries. There may be the need for encroachment onto Noosa Shire land/road reserve

during construction of the left embankment, however the extent of this is not known and will be discussed with Noosa Shire Council prior to any works being carried out.

The Noosa WTP will remain operational throughout the Project works. Although there is currently no thoroughfare for public traffic between Collwood Road and Lake Macdonald Drive, there will be a need for construction traffic to have temporary access. Internal roads around the treatment plant will be reconfigured to allow the safe passage of heavy vehicles while minimising the impact on the operations of the WTP.

2.4.3 Pre-construction Activities

The following pre-construction or enabling works are required before the Project starts:

- Acquire remaining licences, permits and approvals for the works to be carried out.
- Close recreational facilities (as outlined in section 2.2.4) and relocate the Gerry Cook Fish Hatchery
- Establish site works area on Seqwater land, including site office facilities, signage, secure compounds, and mass concrete batch plant.
- Prepare laydown, stockpile, and borrow areas.
- Establish safe site access for construction traffic via Lake Macdonald Drive, Collwood Road, and internal haul roads.
- Drawdown of lake to 89 m AHD, including aquatic fauna relocation.
- Install sheet pile coffer dam along the upstream slope of the existing embankments and spillway.
- Decommission and remove the existing spillway and embankments.
- Construct a working platform in preparation for the new spillway foundation works (secant pile cells).

Contractor Establishment

A Project contractor will be engaged via a tender process. Based on the indicative Project schedule, the contractor will be engaged in mid-2019.

Licences, Permits and Approvals

All licences, permits and approvals will be in place before the relevant works begin on site. Seqwater will hold relevant approvals, permits and licences, and condition the contractor to hold relevant permits and licences as part of the Project contract.

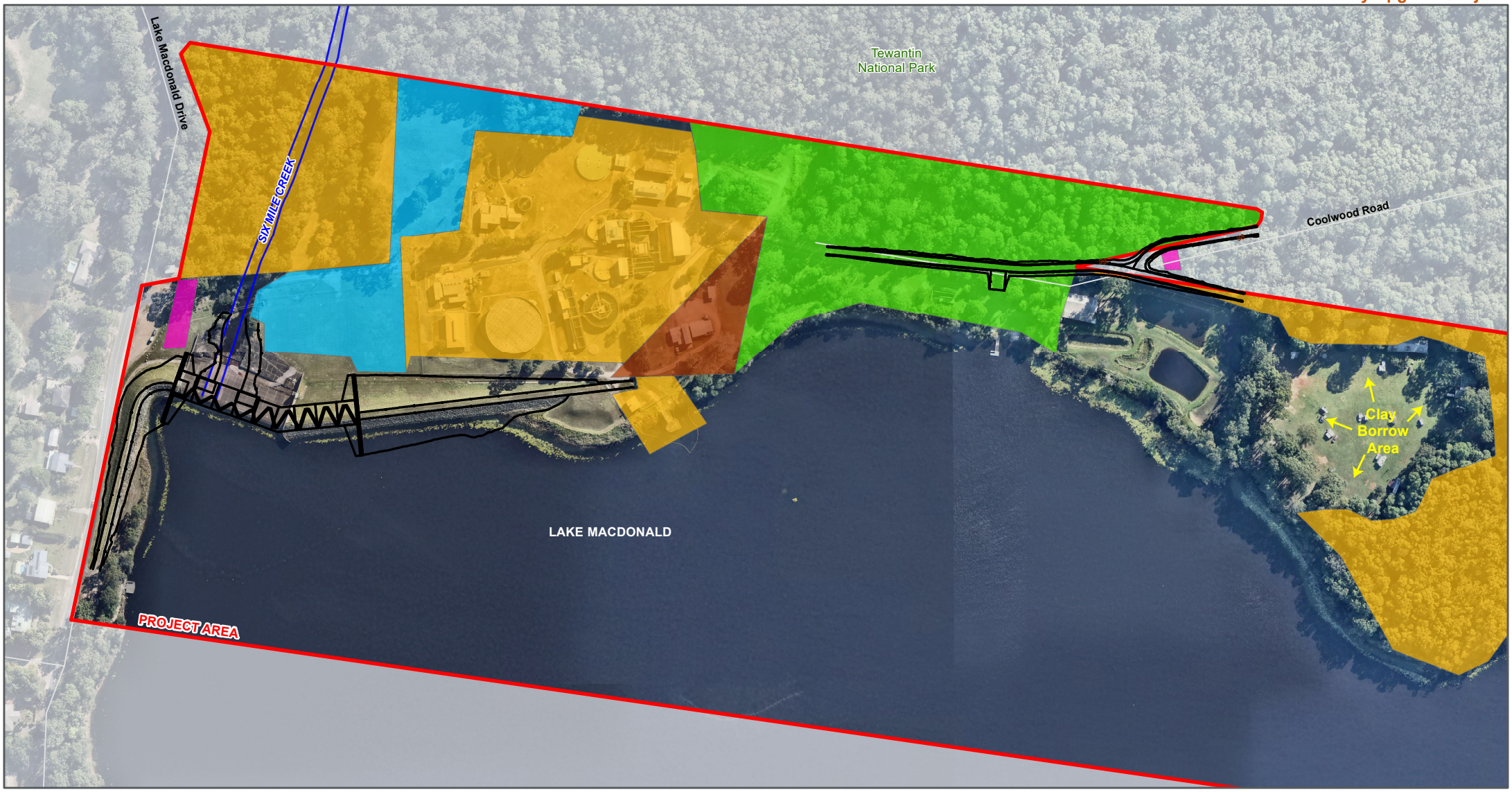
Close and Relocate Facilities

Licences for parts of Seqwater owned land (Lot 118 MCH814) will end in early 2020. The Gerry Cook Fish Hatchery, Lake Macdonald Rowing Club, and Camp Cooroora will be required to close during the Project. The operators of the hatchery will relocate brood stock from the licenced area to an alternative location not affected by the Project. Facilities to remain on site (i.e. hatchery ponds and buildings, camp ground buildings) will either be re-purposed for use or fenced to prevent access during the Project.

Perch Park and Mary River Cod Park will be closed to public access from mid-2020 to coincide with drawdown of the lake, based on the indicative Project schedule. Closure will be established through the erection of temporary fencing and signage to warn the public of the potential danger of entering the dewatered lake area during the construction period.

FIGURE 2-8: CONSTRUCTION SITE LAYOUT

Six Mile Creek Dam Safety Upgrade Project



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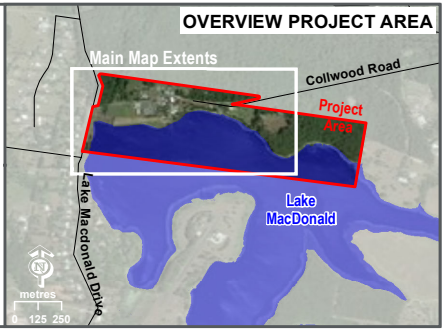
LEGEND

- Local Roads
- Six Mile Creek
- Upgraded Dam Layout (after construction)
- Project Area

Construction Site Layout

- Access Gate
- Area Not Available for Construction Activity
- Concrete Batching Plant
- Contractor Facilities and Parking
- Stockpile / Laydown Area

OVERVIEW PROJECT AREA



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Lake Drawdown

Before construction begins, Lake Macdonald will be lowered to a minimum of RL 89.0 m AHD for approximately two months to allow the installation of the sheet piles in preparation for the removal of the existing spillway and construction of the working platform. The maximum water level during construction will then be controlled by the temporary coffer dam crest level.

The lake would be drawn down by large scale bypass infrastructure, which is likely to be via siphons, pumping, or a combination of both. Siphons would be located on the existing spillway, and discharge water onto the spillway dissipator. Pumps could take a number of arrangements, from being located on the dam spillway to a pontoon based pump station located around the dam embankments in a sufficiently deep pool.

If a pumping option is used, pumps will be supported by a temporary power supply using diesel generators, potentially located near the left embankment or adjacent to the right embankment. It is possible that the existing mains power supply could power pumps, but requires further confirmation in detailed design.

Intakes for the drawdown bypass infrastructure will be arranged to ensure appropriate water quality of discharge. Intake screening will also be used to avoid entrainment of aquatic fauna. Discharge locations will be either onto the existing dam spillway or immediately downstream of the dam. Suitable erosion and sediment control and aeration for water quality will be put in place for discharge locations.

Coffer Dam

A temporary sheet pile coffer dam will be installed to maintain a static water level in Lake Macdonald and allow for controlled flow of water through the construction site. The coffer dam will comprise a single row of sheet piles driven into the upstream slope of the existing spillway embankment, with:

- A low flow crest, no lower than RL 89.5 m AHD, that will channel low flows through the construction site.
- An upper flow level, no lower than Rl 90.5 m AHD, that is designed to overtop during a flood event
- A no-overflow level, no lower than RL 92.0 m AHD, to protect embankment excavations.

The low flow notch may be moved during the construction phase, by cutting and repairing metal sheet piles, to allow low flows to be directed per site conditions. The coffer dam configuration is shown in Figure 2-9 and Figure 2-10.

The coffer dam will be installed using suitable excavators fitted with a vibrating head attachment. Sheet piles will be installed along the length of the existing spillway embankment and spillway to the underlying weathered bedrock and into the abutments to form a seepage barrier. The existing spillway, and a section of the right embankment will be demolished, levelled, and capped with reinforced concrete to form a working platform and protect against erosion during flood events. Rock fill will be placed against the downstream side of the sheet pile wall to protect the joint with the concrete capping and disperse overtopping flow. Mobile barriers will be used to direct low flows across the working platform.

A width of 30 m has been adopted for the low flow notch, but this width may be revised during design depending upon the construction staging of cells.

Under normal non-rainfall conditions during construction, water level within Lake Macdonald will be managed by the construction contractor using bypass infrastructure (likely pumping) to avoid water spilling into the low flow channel area, which will be the spillway construction site. This bypass may be required for various reasons, such as temporary coffer dam installation, anticipation of a storm event, or matching low level catchment inflows to avoid water spilling through the construction site over long periods of time. This arrangement will reduce the potential for water quality impacts with water flowing through the construction site.

In general, the construction contractor will not be permitted to draw down the lake level >0.5m below the coffer dam low flow crest level. Where the construction contractor is managing lake water level through bypass of catchment inflows, the lake water level is to be maintain within a lesser range. Note dry weather and natural processes may cause the lake water level to fall below managed levels.

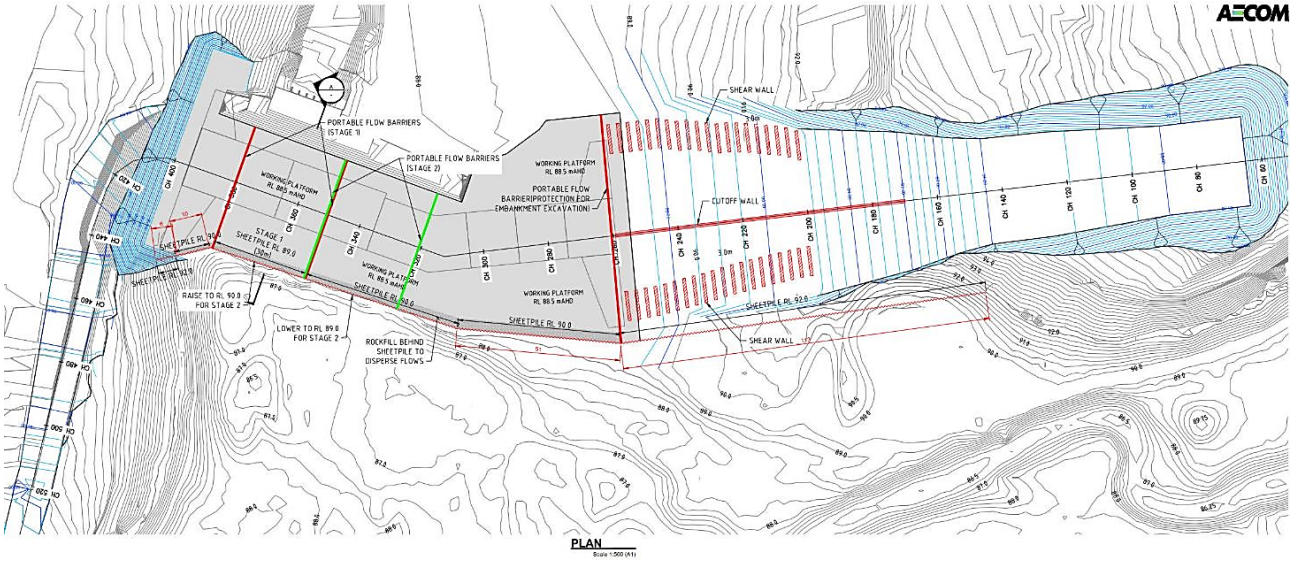

Figure 2-9: Coffer dam configuration

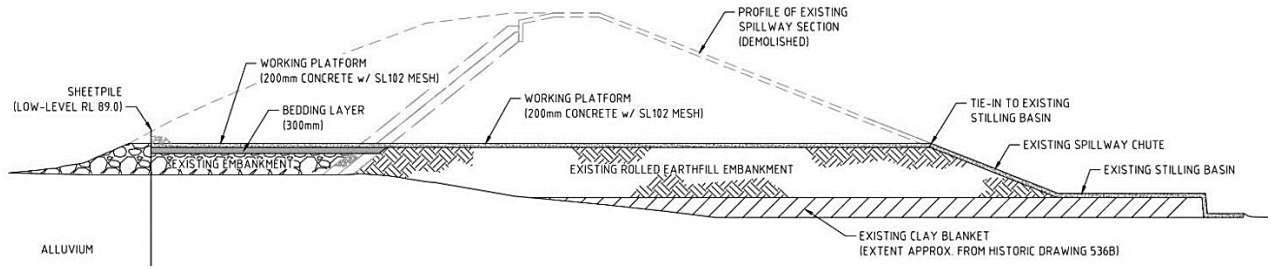

Figure 2-10: Coffer dam typical section

Establish Site Works Area

The site works area would be predominantly located on Seqwater land. There may be the need for encroachment on to road reserve during construction of the left embankment, however the extent of this is not known and will be discussed with Noosa Shire Council prior to any works being carried out.

Prior to construction, the works area will be established through the installation of fences and signage to limit access to authorised personnel only. The fencing and signage will delineate the construction zone and identify access limitations, at a minimum. Site facilities suitable for approximately 110 staff (at peak times) will be installed, including demountable site offices, lunch rooms, and toilet facilities.

A temporary mass concrete batch plant will be built in the works area (Figure 2-8) together with the associated facilities to support these works (i.e. stockpiles of raw material, such as aggregate and sand). The batch plant is described in section 2.4.8.

Wherever possible, facilities in the works area would be located in areas previously cleared of native vegetation. However, some vegetation clearing may be required within Seqwater owned land, and some existing Seqwater facilities and buildings, such as the dam operations office and sheds, are likely to be demolished to make way for construction infrastructure. The facilities and buildings will be reconstructed on completion of the Project.

Prepare Stockpile, Borrow and Laydown Areas

Preparation of stockpile, borrow, and laydown areas for construction materials and equipment will involve vegetation clearing and earthworks on Seqwater land in the Project area. Vegetation clearing will be completed only as required, in accordance with relevant permits and approvals.

It is proposed to use land at Camp Cooroora as a borrow pit for sourcing clay material that would be used in the construction of the embankments. There may be a need to condition this material prior to use in the construction of

the embankments and this would occur on site in a designated area. The camp buildings and other features will remain on-site and will not be significantly disturbed during construction.

A site specific stormwater management plan will be prepared prior to establishment and use of any stockpile, borrow and laydown areas to ensure that soil and sediment laden runoff is managed and does not enter Tewantin National Park, Lake Macdonald or Six Mile Creek.

2.4.4 Construction Activities

Once early works are complete, the next stage of the Project will involve the following:

- Construction of mass concrete secant pile cells that will form the base of the spillway
- Construction of the spillway wing walls
- Re-construction of the left and right embankments
- Construction of the outlet tower and labyrinth spillways
- Construction of the saddle dam along Collwood Road.

Spillway

Demolition of the existing spillway will be undertaken using rock breakers and excavators. Inert materials from the demolished spillway will be re-used where possible. For example, concrete material may be used to construct fish habitat structures within the dam inundation area.

Construction of the new spillway will involve:

- Drilling the primary piles of the secant pile wall through the alluvium to terminate in moderately weathered rock or better at the proposed founding level for the mass concrete structure. The secondary piles of the secant pile wall will be socketed nominally 5 m into the bedrock below the proposed foundation level of the mass concrete structure and will provide lateral restraint to the base of the excavation.
- Excavating the earth materials within the secant pile cells and dewatering as necessary.
- Backfilling each secant pile cell with mass concrete. The 135 m combined length of the spillway is subdivided into nine cells.
- Installing a single row grout curtain beneath the heel of the dam to reduce excessive seepage along potential foundation defects.
- Installing a vertical curtain drainage system and gallery immediately behind the grout curtain.

Left Embankment

The key construction components for the left embankment are:

- Demolition of the existing embankment to natural foundation level using excavators.
- Construction of the 1 m wide filter trench into the foundation downstream of the core. This filter trench will extend to completely weathered rock, and have a maximum depth of 4 m below the foundation level.
- Construction of a new embankment over stiff to very stiff residual soils. A new zoned earth fill embankment will be constructed across the left bank alignment. The embankment shoulders will comprise rock fill materials imported from local quarry/s (refer to section 2.4.6).

Right Embankment

The key construction components for the right embankment are:

- Demolition of the existing embankment to natural foundation level using excavators.
- Excavation of upper alluvial sand/low strength alluvium across the full extent of the right embankment footprint. The depth of excavation to remove the low strength alluvium will vary across the embankment, but will typically be in the order of 2 m to 3 m below the existing foundation level (once the existing embankment is removed).
- Construction of the new embankment over stiff to very stiff alluvium or residual soils, the foundation improvement works, and plastic concrete cut off wall.
- Construction of the cut off wall from the base of the foundation excavation in a series of panels using a clamshell grab. The excavations will be undertaken under bentonite slurry to maintain support of the excavation until placement of the plastic concrete.

- Construction of the shear walls under the upstream and downstream shoulders of the embankment using a series of plastic concrete 'panels' that will be constructed perpendicular to the dam alignment.

Earth fill materials for the right embankment would be sourced from select materials from the various embankment demolition works or from a local earth fill borrow area as described in section 2.4.6.

Saddle Dam

Construction of the saddle dam will involve:

- Excavation for the foundation, with temporary excavation slopes at 1.5H:1V.
- Back fill of the excavation with earth fill to form the core.
- Excavation of the 1 m wide filter trench through the centre of the earth fill core to approximately 2.5 m below existing ground level.
- Construction of a 3H:1V slope on the downstream side and a 1V:2.5H slope on the upstream side, including placement of topsoil and grass on the downstream face and riprap on the upstream face for erosion protection.

Management of Lake Flows during Construction

Expected inflows during construction may include:

- Base flows – small, consistent flows that spill over the coffer dam low flow crest or can be managed by bypass pumping. Temporary pumping around the work area may be used to manage base flows and keep the construction site dry. Should water enter the construction zone and be classified as 'construction contaminated water' alternative measures will be put in place to manage this water. Release criteria will be put in place to monitor this water and either hold it on site for treatment, or discharge this downstream under certain criteria so that it does not impact any environmental values downstream in Six Mile Creek.
- Minor flood flows – flows from small, frequent, sub-annual storm events. These flows would overtop the low flow crest and potentially the upper flow level of the sheet pile coffer dam. Pumping may be required after these flows to remove water from the construction site as required.
- Large flood flows – flows from less frequent storms that cannot be conveyed by the low-flow channel. These flows will overtop the coffer dam upper flow crest and flood the construction area. The working platform will have protection to prevent erosion during flooding, with a concrete cap and rock fill protecting the join between the coffer dam and the working platform. Pumping may be required after these flows to remove water from the construction site as required.

It is expected that the construction site will flood two to three times per season (or year). A detailed hydrologic assessment that considers peak storm flows (particularly sub annual flows) will be undertaken before construction commences to better estimate the frequency that construction activities may be impacted by flows within Six Mile Creek.

2.4.5 Plant and Equipment

Anticipated plant and equipment required for the Project are outlined in Table 2-2, but may be subject to change based on the detailed design and contractor.

Table 2-2: Anticipated Project plant and equipment by activity

ACTIVITY	VEHICLES AND PLANT
Mobilisation	1 x 50T Hydraulic Truck Crane
Clearing for stockpiles	1 x D6, 1 x CAT 140G, 1 x CAT 20T w/tree cutter
Supply of road base materials	1 x CAT 140G, Roller, 14,000L Water Cart, Delivery Truck & Dog, Traffic Management Crew
Coffer Dam platform and rock	2 x 30T Excavator, 1 x D6 Dozer, 1 x CAT 966 Front End Loader
Demolition and stockpile of spillway and training walls	1 x 30T Excavator, 1 x 40T Articulated Dump Truck,3 x 60T Excavator, 1 x CAT988 Front End Loader, 8 x Tipper

ACTIVITY	VEHICLES AND PLANT
Demolition of right embankment	2 x 55T Excavators, 6 x 40T Articulated Dump Trucks, 1 x Front End Loader CAT 988, 1 x 140G Grader, 1 x 14,000L Water Cart
Construction of right embankment and earth dam	1 x 45T Excavator, 3 x 40T Articulated Dump Trucks, 1 x D6 Dozer, 1 x 140M Grader, 2 x 14,000L Water Cart, 2 x Skid Steer, 1 x Cat 815, 2 x Sheep Foot Roller
Demolition of left embankment	2 x 55T Excavators, 6 x 40T Articulated Dump Trucks, 1 x Front End Loader, Cat 988, 1 x 140G Grader, 1 x 14,000L Water Cart
Construction of left embankment	1 x 45T Excavator, 3 x 40T Articulated Dump Truck, 1 x D6 Dozer, 1 x 140M Grader, 2 x 14,000L Water Cart, 2 x Skid steer, 1 x Cat 816, 2 x Sheep Foot Rollers
Mass concrete and associated batch plant establishment	2 x 40T Excavators w/vibrating needles, 2 x Snorkel Pumps
Demobilisation	1 x 50T Hydraulic Truck Crane

2.4.6 Materials

Earth and clay materials will be sourced from the demolition of the existing embankments and stockpiled and conditioned on-site for reuse. Clay and/or earth fill materials will also be won from an on-site borrow area, which is located on Seqwater land to the east of the dam (Camp Cooroora). The balance of any additional clay or earth fill materials will be sourced commercially.

Rock and aggregate materials will be required in embankment construction (filters, rock fill, erosion protection), concrete production and other temporary works such as rip rap or construction pads. Some rock will be sourced from the existing embankment materials and reused, but the bulk of rock material will be sourced commercially from local quarries and transported to the site.

Commercial materials will be sourced from existing quarries dependant on the final material specification. Quarries in the local area include:

- Boral, Moy Pocket, Kenilworth
- Holcim, Cooney Road, Nambour
- Sunshine Coast Council, Image Flat Quarry, Image Flat Road, Nambour
- Hanson, Mt Beerwah Road, Glasshouse Mountains
- Bracalba Quarry, D'Aguilar Highway, Wamuran.

2.4.7 Hours of Operation

Standard hours of operation during the Project will be 6:30 am to 6:30 pm Monday to Friday and 6 am to 4 pm on Saturdays, with no work scheduled for Sundays or public holidays.

There will be the need for extended work hours from time to time for critical construction activities, such as demolition of the spillway where failure to complete quickly could risk public safety. It is envisaged that prior to these activities outside of normal work hours, there would be an assessment of the works and mitigation measures proposed to minimise the impact on surrounding residents, particularly with regards to noise, vibration and light impacts.

In addition to the assessment, notification would be provided to the affected residents informing them of the upcoming works and expected impacts

2.4.8 Infrastructure Requirements

Power and Telecommunications

Mains power will be required during construction for site utilities and to support construction and associated activities. This will mainly be supplied via existing retail services. In addition to mains power, there is likely to be a need for standalone generators located on site to power various plant, such as the temporary concrete batching plant. In this case, generators will be silenced and located to avoid impact to neighbouring residents.

Until a contractor is engaged, the configuration of power supply for the operation of dewatering pumps is not known, however two options may be feasible. One being the installation of temporary power supply generator/s, the second being the installation of a temporary substation on the existing electricity network. Note that a network electrical supply study has not been carried out to date, but will be completed prior to construction.

To this end, the worst case scenario has been adopted for this IAR, which involves the installation of silenced diesel generators to operate a bank of electric water pumps needed to lower the lake level. The temporary pump station may have up to two power supplies, being two 800kVA generators providing power to eight 160kW pumps. The temporary power supply may be located on the left embankment, adjacent to Lake Macdonald Drive, however this configuration will be refined in consultation with the contractor.

Telecommunications will be via existing networks. The Project is not expected to impact on the telecommunications network.

Water and Sewerage

Access to potable water will be required during construction for site utilities and to support construction activities. These will be supplied by the existing reticulated water network.

During construction, waste water, including sewage will be generated. Temporary portable ablution blocks will be provided and sewage will be held in pumped holding tanks to be removed offsite by a licenced contractor. No on-site treatment of sewage will occur.

Non-potable water will be used to support construction activities (e.g. dust suppression) and sourced directly from Lake Macdonald or a suitable alternative. Seqwater is classified as a constructing authority for the purposes of the *Water Act 2000* and a general authority permits taking of water without a licence or allocation, subject to conditions which are outlined in the 'Exemption requirements for constructing authorities for the take of water without a water entitlement'.

Roads

Project site access is also described in Section 2.4.3 (Establish Site Access).

The Project site is accessible from two existing local roads, Collwood Road from the east and Lake Macdonald Drive from the west. No new access roads are required for the Project, however there may be the need to upgrade some existing intersections to allow for construction vehicle movements and/or to reinstate the condition of roads following the completion of the Project.

Lake Macdonald is most directly accessible via the State Route 6 Exit off the Bruce Highway through Cooroy and along Lake Macdonald Drive. However, this route poses a constraint at the right-hand turn from Myall Street onto Elm Street across a narrow rail overpass and would be unsuitable as a haulage route for Truck and Dogs throughout this Project. Therefore, it is likely that heavy vehicles will use the next exit north directly onto Elm Street into Cooroy and then turn either left on to Lake Macdonald Drive or Noosa-Cooroy Road as the most effective approach for deliveries coming from the north or south along the Bruce Highway.

Access to the eastern side of the site via Collwood Road has limitations due to the narrow sections along Gumboil and Sivyers roads. Additionally, these roads service the school buses with several drop off and pick up zones along this route. This area of road would only be suitable to one-way traffic. Therefore, it is suggested that the site operate as a one-way loop where heavy vehicles enter the site from one direction, i.e. Lake Macdonald Drive and exit via Collwood Road, or vice versa.

In addition, there would be the need for traffic control from time to time and this will be carried out under an approved traffic management plan approved by either Noosa Shire Council or Department of Transport and Main Roads, depending on the road ownership.

Temporary partial road closures may be required at times to facilitate access of plant and machinery to site.

Parking for staff vehicles will be on Seqwater land, within the Project area. No vehicle parking will be permitted within the road verges near the Project area.

A detailed road and traffic analysis for Project can be found in Chapter 9.

Concrete Batching Plant

The volume of mass concrete required in the construction of the spillway foundation, around 38,000 m^3, is significant enough to warrant the installation of a temporary concrete batch plant in the Project area. An on-site concrete batching plant provides flexibility in operation and control over concrete mixes and timing, which should lead to efficiencies in Project schedule and better quality control. The option of an on-site concrete batching plant should also result in fewer truck movements to the site, compared with trucking mixed concrete.

The volume of structural concrete required for the new spillway is much less than mass concrete, and no decision has been made whether to utilise structural concrete will be delivered to the site or batching on-site. This will depend on scheduling and logistics, to be progressed in later project planning.

The dimensions of the temporary concrete batch plant would be up to 100 m x 100 m, but these dimensions will likely be compressed to match on-site constraints. The footprint of hardstand and equipment is more likely to be up to 50 m x 50 m.

The temporary concrete batching plant will be located within Seqwater property, and is likely to be adjacent to the WTP as shown on Figure 2-8. The batch plant will have the capacity to store two weeks' worth of materials including:

- 3,500 m^3 of stone aggregate
- 2,500 m^3 of sand
- Cement powder in vertical silos or alternative.

Mobilisation of materials for the plant will take place at least two weeks prior to the initial concrete pour and run two weeks ahead of schedule continuously throughout its use. Bulk materials will likely be stored in three-sided bins and moved with a front end loader to trailer mounted batching equipment. Cooling of concrete in the batching process is likely to be required, and will be undertaken using either ice or liquid nitrogen. These details will be determined by the construction contractor.

Once established, the plant will have the capacity to produce up to 50 m^3 per hour.

The batch plant would operate using a 150 KVA silenced generator, or mains power supply if available. Operating hours will be in conjunction with construction activities requiring concrete, which is nominally from 6am to 6pm Monday to Friday and 6am to 4pm on Saturdays. There is likely to be the need for extended work hours from time to time for critical mass concrete pours. Refer to section 2.4.7 for further information. The concrete batching plant would only operate in conjunction with construction activities, which would be subject to notification and engagement with residents for extended work hours.

The temporary concrete batching plant will be de-commissioned and removed from site following completion of concrete works for the spillway.

2.4.9 Workforce

The maximum construction workforce would be 110 in total at any one time. There will be no camp style accommodation and it is envisaged that workers will stay in local accommodation and commute to the site daily. Depending on labour needs, the contractor may consider providing buses to transport people to and from the Project. The number of construction workers will vary over the course of the Project. Under the current proposed schedule, the workforce will peak during August, September and October 2021.

The social impact of the workforce on the community is assessed in Chapter 13.

2.4.10 Environmentally Relevant Activities

Environmentally Relevant Activities (ERAs) are those activities which have been identified by the *Environmental Protection Act 1994* as likely to have significant environmental impacts; they are defined in Schedule 2 of the *Environment Protection Regulation 2008.*

A borrow area will be established for the Project in the Camp Cooroora area, located within Seqwater owned land to the east of the WTP. Materials (primarily clay) will be extracted from this location for the construction of the

upgraded embankments. As such, the Project will require an Environmental Authority for an Environmental Relevant Activity (ERA) 16 2(a) – Extractive and screening activities under the *Environmental Protection Act 1994*.

Material will be sourced and conditioned on site prior to use as fill within the embankments. The location of these ERA activities within the Project area are shown in Figure 2-8.

2.4.11 Waste Management

The major construction wastes will comprise cleared vegetation, and waste soil, fines, rock and concrete, as well as wastewaters from plant and vehicle washing, and sewage. Opportunities for the beneficial reuse of materials from the existing dam structure and embankments will considered during the detailed design of the dam. The types of wastes generated by the Project may include regulated and unregulated waste, and may be managed by the following measures:

Solid Waste

- Vegetation clearing to be limited to the level necessary for construction purposes.
- Inert waste (concrete, rock and earthen material) from the demolition of the embankments and existing spillway will be stored and reused within the Project where possible. That material which cannot be used is likely to be recycled to backfill the borrow area or potentially placed within the inundation area and stabilised.
- Concrete waste can be reduced through appropriate planning of batches against placement requirements and efficient placement methods.
- Building material wastage can be reduced through efficient procurement and staging of supply of materials and (where possible) return arrangements with suppliers for unused materials.
- Packaging wastes can be reduced through specifying recyclable and low volume packaging (e.g. paper/cardboard filler or steel ties rather than foam or shrink wrap) from suppliers.

Liquid Wastes

Wastewater generation (e.g. sewage, vehicle wash water) relates to the quantity of input water and can be minimised through the water saving initiatives or cleaning off site.

Excess oils, fuels and chemicals will be minimised through efficient procurement practices (e.g. staged delivery), return arrangements with suppliers, and appropriate handling procedures to ensure that wastage is minimised.

Gaseous Wastes

Gaseous wastes primarily relate to emissions from fuel combustion, which will be minimised through initiatives to reduce fuel consumption.

All waste will be managed in accordance with relevant legislation and standards, including the *Waste Reduction and Recycling Act 2011, Environmental Protection Regulation 1998,* and *Local Government Act 2009*. Disposal of all trackable waste will be documented in accordance with legislative requirements.

2.4.12 Commissioning

Following the completion of construction, the site works area and recreational facilities will be reinstated.

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

- Outlet works
- 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 valves and pumps. All documentation required by the regulator (e.g. standing operating procedures and operations and maintenance manuals) will be prepared and submitted for approval.

The timeframe between Project completion and lake refilling is entirely subject to rainfall, however it is anticipated that Lake Macdonald will return to its normal full supply within the first year of Project completion.

2.4.13 Operation

After construction, the operation of the upgraded dam will not differ from the operation of the existing ungated dam. Following completion of construction, water will continue to be drawn from Lake Macdonald via the existing intake structure.

Operation will continue to comply with the Mary Basin Resource Operations Plan (September 2011).

2.4.14 Decommissioning

The nominal engineering design life of the Project is expected to be 150 years, although it is likely to be maintained after that period provided it continues to meet dam safety requirements and remains part of the regional water supply strategy. While unlikely, the Project may be decommissioned during or after initial engineering design life if It suffered significant damage that cannot be remedied to meet safety standards

If required, the dam would be decommissioned in accordance with the practices established by the Queensland dam safety regulator and relevant industry guidance, and the dam owners at the time should prepare a decommissioning plan. A decommissioning date for the Project has not been determined and the likely date is too far in the future to allow effective planning for decommissioning at this stage.