CHAPTER 4

Hazard and Risk

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4 Hazard and Risk

This chapter describes the potential risks to people and property that may be associated with the Six Mile Creek Dam Safety Upgrade Project, which are in addition to the existing hazard and risk environment. The risks to existing environmental values are addressed throughout this IAR. This section details the specific risks that have potential to affect people and property, including the Project workforce.

In accordance with ISO 31000:2018 Risk management, a preliminary risk assessment has been provided for the Project. This chapter:

- Describes the risks that could potentially affect the community and environment (i.e. people and property)
- Outlines mitigation strategies for identified risks
- Identifies any significant residual risks after mitigation
- Assesses the overall acceptability of the impacts of the Project considering the residual risk and risk profile
- Outlines the proposed emergency management planning procedures for situations identified in the preliminary risk assessment.

The chapter broadly covers the following key aspects:

- Project construction risks, such as accidents and chemical storage
- Natural events
- Dam safety and emergency actions.

4.1 Background

Six Mile Creek Dam is a referable dam in Queensland that also meets the definition for a large dam under the Australian National Committee on Large Dams (ANCOLD) Glossary of Definitions, Terms and Abbreviations. A dam is considered referable if a Failure Impact Assessment (FIA) completed in accordance with the Guidelines for Failure Impact Assessment of Water Dams (DEWS 2012) demonstrates that there would be people at risk if the dam were to fail. A referable dam is when FIA states the dam has, or the proposed dam after its construction will have, a category 1 or category 2 failure impact rating.

- Category 1— between two to 100 people at risk by the dam failing
- Category 2—more than 100 people at risk by the dam failing.

A FIA for the current dam was carried out by Worley Parsons for Sunshine Coast Council in July 2008. The report found that under the provisions of the *Water Act 2000*, the dam is referable and is classified with a Category 2 failure impact rating.

4.1.1 People and Property

Six Mile Creek Dam, which forms Lake Macdonald, is approximately 6 km from the town of Cooroy. There are 240 private properties adjoining the lake and over 2,000 people live in the immediate vicinity around the lake. Lake Macdonald is a focal point for the surrounding community, providing a range of recreational and leisure opportunities for both residents and visitors. Consequently, there are a number of existing community values, including in relation to health and safety, that may be affected by the Project.

It is important that the potential risks that the Project poses to the people and property of the surrounding community are managed and minimised. Key health and safety issues identified through community consultation were centred around traffic movement, noise and dust. The sensitive receptors for the Project are shown in Chapter 10 – Air Quality and Chapter 11 – Noise and Vibration, and further information regarding community values and concerns is provided in Chapter 12. The area is semi-rural and the potentially affected places are primarily residential properties. Discussion of the potential impacts is provided below and in the relevant chapters (as referenced).

In addition to people in the surrounding community, the health and safety of employees during Project construction and operation also need to be considered.

4.2 Areas of Risk

Background and general information on the broad areas of risk for the Project, in relation to people and property, are provided in the following sections. Relevant aspects of these risks are carried through to the hazard and risk assessment in section 4.3.

4.2.1 During Construction Stages

Hazardous Substances

The Project will involve storage and use of hazardous substances, particularly demolition and construction. Nevertheless, the Project will not require the use of many hazardous substances which are regulated by the Australian Dangerous Goods Code.

Note that the operational phase of the Project will not require any significant storage or use of hazardous substances, and will not be in addition to the existing hazard and risk environment for dam operation. Similarly, this assessment does not incorporate the Noosa Water Treatment Plant (WTP), as outside the scope of the IAR and not changing compared to the existing hazard and risk environment.

The principal dangerous goods likely to be used in construction are listed in Table 4-1 by name, classification, raw and storage concentration, UN number, and packaging group.

Table 4-1: Physical properties of Dangerous Goods and Hazardous Substances

SUBSTANCE	DG CLASS	RAW CONC (WT%)	STORAGE CONC (WT%)	UN NUMBER	PACKAGING GROUP	PURPOSE/USE
Diesel fuel oil	3 (Class C1*)	N/A	N/A	1202	III	Fuel for mobile plant
Unleaded petrol	3	N/A	N/A	1203	II	Fuel for mobile plant
Lubrication oils (hydraulic oil)	3 (Class C2**)	N/A	N/A	N/A	N/A	Lubricate plant and equipment and replenish hydraulic systems.
Solvents (e.g. acetone)	3	99.5%	99.5%	1090	II	Plant maintenance
Paints	3	N/A	N/A	1263	III	Paint - small amounts

* Class C1 a combustible liquid that has a flashpoint of 150°C or less
**Class C2 a combustible liquid that has a flashpoint exceeding 150°C

An indicative list of the relevant rate of use and maximum amount of the substance stored at the site during demolition and construction is provided in Table 4-2. These amounts are indicative only, as specific details will only become available through construction contractor planning.

Table 4-2: Indicative List of Dangerous Goods and Hazardous Substances – Demolition and Construction

SUBSTANCE / SHIPPING NAME	RATE OF USE	INDICATIVE MAXIMUM INVENTORY
Diesel fuel oil	2,500 L/day	5,000 L Plant to be filled using daily mobile site delivery
Unleaded petrol	100 L/day	500 L
Lubrication oils	200 L/day	1,000 L
Solvents	As required	<200 L
Paints	As required	<200 L

It is also anticipated that other substances will be used for specific construction purposes, which are not known at the current stage of Project design. Nevertheless, appropriate storage and use of other minor volume chemicals will be accommodated through standard work health and safety protocols, such as information and instructions in relevant Safety Data Sheets (SDS).

The storage, handling and use of hazardous substances will be in accordance with current Australian Standards, industry codes of practice and best environmental management practices. Given the implementation of appropriate controls for these materials there is negligible risk to employees, adjacent land users, general public and the environment.

Construction Schedule

There are several aspects of the Project construction schedule that may impact on risks to people and property. Namely, a delayed construction schedule may exacerbate other risks, such as the length of time Lake Macdonald is lowered, or sensitive receptors subject to potential dust and noise impacts. One of the key unknowns for the Project construction schedule is wet weather.

Wet weather

Weather conditions will present potential risks to the construction schedule as the works will necessarily occur within the Six Mile Creek waterway. The frequency of rain events and loss of work days is a standard construction consideration and will not be discussed in this chapter. There are two aspects of wet weather or catchment flows that are of particular interest for their risk of impact on the construction schedule.

The lake lowering period is scheduled to occur over a period of around three months to facilitate aquatic fauna salvage and relocation. Nevertheless, these activities are likely to be affected by rainfall and inflows so adaptive management will be required. For the purposes of starting dam demolition (discussed below), the ability to rapidly lower lake level will be necessary to ensure demolition can commence as scheduled, to minimise construction risk. To achieve these requirements, a dewatering system will be installed with the ability to lower the lake in around two weeks to the required level. The overall scheduling will be for lowering to occur over a three-month period, and with the ability to lower the lake from full supply level to the construction start level within two weeks.

Following lake lowering, decommissioning of the existing dam, and commencement of spillway construction, all catchment rain events will lead to spilling flows or floods being diverted through the construction site. The working platform for spillway foundations will be located across the Six Mile Creek waterway, per the existing dam location. Remaining impounded water within Lake Macdonald will be managed via the temporary sheet pile coffer dam (low flow crest) and channel through the spillway working platform. It is expected that, without alternative diversion measures (e.g. pumping, diversion pipeline), flows will be managed by the contractor through the low flow channel (construction site) for long periods of time. Allowing long-term low flows over the coffer dam crest and through the spillway construction area is not ideal from the perspective of construction efficiency and potential for adverse impacts on water quality. To mitigate this, the construction contractor will have the ability to use pumping, or other release infrastructure, to manage lake water level and bypass low flows around the spillway construction site. Constraints will be placed on the minimum lake water level resulting from bypass releases.

Demolition of spillway

In addition to delays in the construction schedule, there is also a key safety risk in the timing of breaching the spillway of the existing dam. Once the lake is lowered to the required level, the existing spillway will be breached and demolished to form the construction working platform, which is at a level that the mass concrete foundations will be installed from and will form the foundation level for construction of the new spillway reinforced concrete walls. The process of breaching the existing dam spillway is estimated to take around one week, with a further two weeks to establish the working platform and cap any exposed earthen surfaces to protect against erosion. This breaching process presents a risk that if a rainfall event produces spilling flows, it is possible that the remaining parts of the dam and foundation could erode to some extent.

Commencement of the dam breach will be a key part of construction planning. The construction schedule will be developed in consultation with the construction contractor. To mitigate the risk present for the dam breach, it may (although will not necessarily) be that the works are undertaken in the seasonal dry period and planned such that they are completed in as short a period as practical. These aspects will be considered as the construction proceeds. Extended working hours will be proposed during this period.

Environmental Hazards

The construction phase of the Project will present a number of environmental hazards that also have potential to impact on people and property. Examples of these are noise and air quality (dust).

The relevant environmental hazards are discussed in the relevant IAR chapters and summarised in the hazard and risk assessment presented in Section 4.3.

Public Access

Public access to the Project area during construction will be restricted as the area will not be safe without appropriate training and inductions.

Public access to Lake Macdonald and the shoreline will also be restricted during construction as the lake will be lowered for construction and safe access cannot be assured given the conditions of soft sediment and shallow waters.

Additional fencing and signage will be placed at all existing boat ramps and public access points for the lake to inform of the access closure and to warn the public of the safety hazards of entering the lake inundation area during the dewatering and construction period.

In addition to general public access, landholders adjoining Seqwater land (as part of the lake inundation area) may have direct access to the lake, with some properties not currently having fencing in place on the lake-side boundary. During the dewatering and construction phase, access to the lowered lake area may not be safe for people or livestock.

Seqwater will assist landowners whose property boundaries are directly adjacent to the existing lake to assess options for fencing of stock and personnel access to the lake during the lake lowering, decommissioning and construction period.

Following completion of the construction and lake refilling, public access will not change from the current arrangements, being that it's freely available for recreational use and angling for non-petrol-powered craft. A public access exclusion zone is in place around the current dam wall and water treatment plant intake tower as an operational area that is not safe for public access. These exclusion zones will remain in place post-construction when access to the lake is reopened.

4.2.2 Natural Events

Flooding

Flooding within the Six Mile Creek catchment may result in properties within the floodplain being inundated, generally in line with the existing situation. The probability of this happening is not significantly changed by the new dam. However, the consequence slightly changes due to the altered rating curve of the new spillway, which is different from the existing spillway type due to the need to pass more extreme floods, which the existing dam cannot.

The new dam has been designed to match the existing dam's outflows in a 1 in 100 Annual Exceedance Probability (AEP) event. This means that a 1 in 100 AEP flood event would be unchanged from the existing situation, both upstream and downstream of the dam. The 1 in 100 AEP (Noosa Council Q100) benchmark was used as it is a typical town planning provision. As the new spillway is of a different type than the existing dam, the outflows under other flood events differ slightly. The outcome of these changes is assessed in detail in Chapter 6 of this IAR.

During construction, when a flood event occurs, it will have different characteristics due to the altered functionality of the dam. The system would behave more like a natural waterway because dams naturally attenuate outflows, even when not specifically designed for flood mitigation, which is the case for Lake Macdonald. These changes are detailed in Chapter 6 of this IAR.

Water flows through the construction site, including during flooding, are described in Section 4.2.1 as part of the wet weather discussion for construction schedule impacts.

Drought

Drought during the Project (construction and future operation) will not significantly change the risks from the existing hazard and risk environment. This is largely due to water supply from alternative sources during construction, such that drought impacts on the lowered lake would not be of consequence to people and property. Operation of the proposed new dam would restore the existing lake level, with the same extraction rules for water treatment, and so the risk of drought on water supply will be unchanged.

Bushfire

Bushfire is not expected to be a significant risk for the construction phase of the Project, but the bushland of Tewantin National Park does border the Project area to the north. Contingency planning will be required for the occurrence of bushfire. The construction Project is unlikely to pose significant risk of initiating fires, but hot works activities (e.g. welding) will require standard measures as part of safe work method statements or similar.

Bushfire risk during operation of the proposed new dam will remain unchanged compared to the existing situation.

Climate Change

The Project is not anticipated to contribute to climate change in any significant way, though specific assessments have not been made due to the Project being a required safety upgrade, which is not optional.

Climate change may have implications for future operation of the proposed new dam in the sense that rainfall patterns are anticipated to change in climate change scenarios. The Project design is based on 2016 Australian Rainfall and Runoff Guidelines for estimations of design flood hydrology to derive dam inflows for the purpose of sizing the proposed spillway to pass the Probable Maximum Flood. The design flood hydrology was based on standard and accepted methods, but is always subject to changes in methodology and new information, regardless of potential climate change implications. The approach of Project design to incorporate design measures to safely passing the predicted Probable Maximum Flood is the best practice approach and any future changes in flood hydrology will be addressed on a risk basis within relevant guidelines from the Queensland Dam Safety Regulator and ANCOLD.

4.2.3 Dam Safety

Background

Seqwater is responsible for dam safety and must have an effective dam safety management program. Risk assessment forms part of the tool box available to maintain an effective dam safety management program.

The risks associated with the dam failure typically have a low probability of occurrence but incur extreme consequences. To ensure a consistent approach to these low probability / extreme consequence risks across the dam industry in Australia, ANCOLD has developed the Guidelines on Risk Assessment (2003), which are referred to by the Queensland dam safety regulator. The existing Six Mile Creek Dam was assessed in accordance with the ANCOLD Guidelines and the requirements of the Queensland Guidelines on Acceptable Flood Capacity (DEWS 2013), as part of a wider review of all of Seqwater's portfolio of dams.

The outcome of the risk assessment for the existing dam was that the overall risk was just above the ANCOLD limit of tolerability. Based on the definitions provided by ANCOLD, this risk is considered unacceptable and action should be taken to reduce the risk. This has resulted in the proposed Project.

In determining the resultant risk levels for the new dam, mitigation and control measures will be taken into account where these will be applied at the time of design, construction or operation.

The ANCOLD approach will be taken in relation to acceptability of risks, as follows:

- HIGH: This level of risk is not tolerable. Additional or alternative mitigation strategies to be implemented to reduce risk to lower level
- MEDIUM: This level of risk is acceptable provided all possible efforts have been made to reduce risk where those efforts have a positive cost benefit ratio (apply the principles of ALARP – As Low as Reasonably Practical), and
- LOW: This level of risk acceptable with normal management procedures.

Dam Design and Safety

The dam is being designed by experienced dam engineers, AECOM, to meet both the Queensland Dam Safety Management guidelines and ANCOLD guidelines, as appropriate. The dam design and construction will be subject to independent peer review to ensure that these guidelines and objectives are met. This peer review process will continue throughout the life of the Project.

The proposed new dam will be subject to risk assessment in accordance with ANCOLD guidelines, as described in the previous section. The risk assessment will involve an expert engineering panel to identify potential failure modes and assess the annual probability of failure for key failure modes. A detailed assessment of potential consequences associated with each failure mode will also be completed.

A robust and specific risk assessment process is in place for dam safety for Six Mile Creek Dam. The hazard and risk assessment as part of this IAR is not suitable to represent dam safety risk assessment, and so will not be duplicated for this IAR. Rather, a quantitative risk assessment will be carried out as part of dam design out according to ANCOLD 2000 (b), as referred to by the Queensland dam safety regulator.

Emergency Action Plan

As previously outlined, Six Mile Creek Dam is classified as a referable dam in Queensland. All referable dams must have an approved Emergency Action Plan (EAP) in place, as required by the *Water Supply (Safety and Reliability) Act 2008*. The EAP outlines provisions for:

- Identification, detection and management of dam hazards, as well as dam hazard and emergency events
- How effective warnings and notifications are communicated to those potentially impacted.

EAPs are not a complete emergency response package, and are intended to complement the plans of State and Local Disaster Management Groups (SDCC and LDMG), who have primary response roles in most disaster situations.

The existing EAP is in place for the current dam, which is publicly available ("Lake Macdonald Dam Emergency Action Plan"). This EAP will remain in place throughout Project construction, though it is noted that some aspects of the EAP will not be relevant at that time, such as dam failure, because the construction scenario largely removes the dam structure.

A dam safety management plan will be developed for the Project construction phase, to operate in tandem with the existing EAP and address relevant changes to dam operation. The dam safety management plan will outline the responsibilities of Seqwater and the construction contractor, triggers for actions per the EAP and consultation with the Noosa LDMG. This approach has been used and found to be effective in Seqwater's recent dam improvement projects.

EAPs are reviewed annually and so any necessary changes as a result of the new dam will be incorporated into the relevant annual EAP review. No significant changes are anticipated.

Noosa LDMG

As discussed above, the EAP for Six Mile Creek Dam feeds into planning for the LDMG. The proposed Project will have an impact on downstream releases in the construction and future operation phases, and so those changes are of interest to the LDMG both in terms of routine road closure as well as disaster management. In 2017, Seqwater representatives attended a LDMG meeting and gave a presentation on the proposed upgrade.

Seqwater is also in regular contact LDMG representatives to provide updates and input as required. This relationship will continue throughout the life of the Project.

4.3 Hazard and Risk Assessment

4.3.1 IAR Risk Assessment for Project

Note that this assessment deals with occupational health and safety hazards and those that affect the public and the workforce. Occupational hazards at the proposed Project site are similar to those of any construction or workplace site and would be identified and managed through sound workplace health and safety procedures.

A preliminary hazard analysis was undertaken for the IAR and is presented in this section. It should be noted that a number of technical aspects, such as dam safety, identified in this IAR chapter have been discussed for the purposes of informing regulatory stakeholders and the community through the IAR process. Many of the Project's technical aspects address hazard and risk through specific processes that are outside the scope of the IAR. As such, some aspects are incorporated in a broad sense for this IAR risk assessment, but will be assessed in a much more detailed manner through the relevant technical assessments.

The preliminary hazard and risk assessment involved:

- Intended operations and the proposed design of the facilities (described in Chapter 2 of the IAR);
- Identification of hazards and potential operational challenges for the construction process was undertaken using a qualitative risk assessment study referred to as a preliminary hazard analysis (PHA)
- Risk scenarios in the form of hazard review tables
- Possible causes and consequences from the hazards and their detection and protection mechanisms
- Preliminary qualitative assessment of the risk level associated with each hazardous scenario

- Preliminary qualitative assessment of the major risks from natural hazards and external risks to the public and major infrastructure
- Recommendations for the most appropriate environmental and quality management systems needed, in regard to key scenarios and potential impacts
- Key input for development of an emergency response plan.

The preliminary hazard analysis identified the key events that may have an impact on people and property from the associated lake lowering, demolition, construction, operation and transport.

Risk Assessment Methodology

The risk assessment has been undertaken in accordance with ISO 31000 Risk Management. The assessment outlines the implications for the Project and the impact on the public and workforce.

The risk assessment process includes a preliminary hazard analysis which considers:

- Relevant hazards (minor and major)
- Frequency of the potential hazards, accidents, spillages and abnormal events occurring
- Cumulative risk levels to the surrounding community
- Duration of any identified hazards
- Effects and rate of usage of the hazardous substances to be used, stored, processed or produced

Potential incident scenarios for the Project were identified through consideration of:

- The range of activities carried out and facilities present during the construction and operation phase. These included construction activities, energy supply, excavation and materials handling
- The range of potentially hazardous incidents that might be associated with each of the activities/facilities identified at the Project.

The identification of hazards is aided through the application of a prompt list. The list is based upon the possibility of damaging energy occurring as a result of a loss of control of that energy. Not all energies are relevant to this project as can be seen from the identified potential hazards.

- Animal
- Biological
- Chemical
- Electrical
- Falling objects
- Falls, slips and trips
- Fire & explosion
- Kinetic
- Manual handling
- Mechanical
- Noise
- Proximity
- Pressure
- Radiation
- Temperature
- Vibration
- UV
- Interface
- Sharp
- Vacuum
- Dust, fume, vapour
- Stressors
- Confined spaces

Having identified the range of hazards likely to occur at the site during the construction and operation phases, the following matters were considered for each hazard:

- Possible causes of hazards and the probability of these causes occurring and leading to the hazardous incident(s) identified. The probability of each hazardous incident occurring takes into consideration the proposed control measures
- The consequences of each of the hazardous incidents if they were to occur. Consequences might include direct impacts and the potential for their occurrence and secondary incidents. Assessment of the severity of consequences, considering the proposed mitigation measures
- Appropriate controls and mitigation measures proposed for the management of each hazard. These may include prevention and response measures
- This information was then tabled to prioritise the risks and evaluate these risk levels against acceptable risk criteria
- Where an extreme or high risk was identified, additional controls and mitigation measures were identified to further reduce the risk and/or if this were not possible, provide monitoring to identify changes and take mitigation measures.

These potential incident scenarios, including potential consequences and prevention, protection or mitigation measures were then examined.

Risk Analysis Criteria

The risk analysis matrix, which is shown in Table 4-5, is a tabular portrayal of risk as a combination of the probability of occurrence and level of severity.

Potentially hazardous incidents are identified for the facility or system with each potential incident having identifiable causes and consequences.

The consequence and probability are plotted on the risk assessment matrix in order to determine the risk level.

High risk incidents have priority for consideration of additional risk reduction and mitigation options whilst low risk incidents are subject to normal operational controls and ongoing improvement processes.

A likelihood/probability of occurrence was assigned to each identified hazardous incident based on definitions shown in Table 4-3. The contribution of the preventative and protective features was taken into account when assessing the likelihood of occurrence and potential consequence from each hazardous incident.

The consequence and likelihood of occurrence also assumes that any mitigation measures and other recommendations are implemented. The risk levels presented denote the residual risk for the most likely scenarios.

The consequences assessed are based on definitions shown in Table 4-4. Where a hazardous incident may have several outcomes or consequence each potential outcome was assessed in turn.

The risk scales and risk matrix for consequence and likelihood are based on Seqwater's Environmental Management System (Ref: J008238 and MAN-00326).

Table 4-3: Likelihood of Occurrence for Hazardous Incidents

DESCRIPTOR	DESCRITION
Rare	The event could only occur in exceptional circumstances <2%
Unlikely	The event could occur at some time, but only in unusual circumstances >2-10%
Possible	The event might occur, but not expected to occur under normal circumstances >10-50%
Likely	The event will probably occur in most circumstances >50-90%
Almost Certain	The event is expected to occur in most circumstances >90%

Table 4-4: Consequence Classes for Health and Safety and Environmental Losses

DESCRIPTOR	DESCRIPTION		
	ENVIRONMENT	HEALTH AND SAFETY (PEOPLE)	FINANCIAL (PROPERTY)
Insignificant	Localised, on site, actual or potential nuisance Routine short term remediation.	Minor injury requiring no treatment or first aid treatment only.	Property damage ≤$1m
Minor	Localised off-site, actual or potential nuisance, Routine short term remediation.	Minor temporary injury requiring medical treatment.	Property damage >$1m - $5m
Moderate	Localised on/off site actual or potential minor environmental harm/impact not material or serious to the ecosystem, flora, fauna (excluding declared and rare threatened and vulnerable species) that is not material or serious. Requiring limited resources to mitigate.	Moderate injury or temporary impairment requiring medical treatment.	Property damage >$5m - $10m
Major	Localised on/off site actual or potential material environmental harm/impacts to the ecosystem, flora, fauna (isolated/partial impact to declared and listed rare threatened and vulnerable species) that is not trivial or negligible in nature, extent or context. Requiring substantial resources to mitigate.	Permanent injury or impairment.	Property damage >$10m - $30m
Catastrophic	Actual or potential Serious widespread environmental harm/impacts to the ecosystem, flora, fauna including declared and listed rare threatened and vulnerable species) that is not trivial or negligible in nature, extent or context. Requiring extensive and complex resources to mitigate.	One or more fatalities.	Property damage >$30m

Table 4-5: Risk Assessment Matrix

CONSEQUENCE	LIKELIHOOD				
	Rare	***Unlikely***	***Possible***	***Likely***	***Almost certain***
Catastrophic	Medium (6)	High (10)	High (15)	Extreme (20)	Extreme (25)
Major	Medium (5)	Medium (8)	High (12)	High (16)	Extreme (20)
Moderate	Low (3)	Medium (6)	Medium (9)	High (12)	High (15)
Minor	Low (2)	Low (4)	Medium (6)	Medium (8)	High (10)
Insignificant	Low (1)	Low (2)	Low (3)	Medium (5)	Medium (6)

The shading and numerical coding in the risk matrix in Table 4-5 refers to the qualitative bands of risk level. Under Seqwater's corporate risk, a score of above Medium (6) is regarded as environmentally significant and will be treated as per Table 4-6.

Table 4-6: Improvement Treatments

DESCRIPTOR	IMPROVEMENT
Extreme	Improvement to be assigned.
High	Improvement to be assigned.
Medium (>6)	Improvement to be assigned.
Medium (≤6)	Monitor for improvement opportunity.
Low	Manage by routine procedures, unlikely to need additional specific application of resources

4.3.2 Construction Hazard Identification

Construction hazards identified in Section 4.2 have been incorporated into the risk assessment, in addition to general hazards that are common to construction projects.

4.3.3 Construction Phase Risks

The hazard and risk assessment for the construction phase, showing the risk levels, is shown in Table 4-7. The assessment takes into account the various aspects of the Project, such as demolition of the existing spillway, excavation and construction of the new dam, clay borrow pit, saddle dam construction, and ancillary infrastructure construction. The assessment also takes into account the occurrence of risks likelihoods and consequences both individually and collectively.

4.3.4 Operation Phase Risks

The hazards and risks due to operating the dam are similar to those that currently exist, as the new structure is not likely to alter these risks. An assessment of the main hazardous elements during operations (regarding people and property) is provided in Table 4-8. Due to the limited number of activities occurring during operations, the number of hazards is significantly less when compared to the construction phase.

Table 4-7: Risk Assessment Table – Construction Phase

HAZARD	CONSEQUENCE	RAW RISK			PROPOSED CONTROLS	RESIDUAL RISK		
		L*	C*	R*		L	C	R
1. Dust from road and earthworks	Impacts on sensitive receptors and adjacent vegetation	Likely	Minor	Medium (8)	1. Dust monitoring program and reporting. 2. Erosion and 3. Use of water trucks when required. 4. Speed limits within construction area.	Possible	Minor	Medium (6)
2. Excessive noise	Impacts on sensitive receptors (residents)	Likely	Moderate	High (12)	1. Design and operate all equipment to comply with the *Environmental Protection (Noise) Policy 1997*. 2. Stakeholder communication protocols for noisy activities or extended hours 3. Engagement with close residents to identify suitable tailored mitigation measures, such as temporary relocation or double glazing.	Possible	Moderate	Medium (9)
3. Traffic accidents remote from site	Injury or death of people Hazardous substance spills	Possible	Catastrophic	High (15)	1. Selection of transport contractor with appropriate plans for accident/emergency response, fatigue management, driver training 2. Relevant vehicles carry Hazchem Identification and responses for use by emergency personnel attending accident. 3. Local roadways to the construction site will be adequate for bulk transport vehicles.	Rare	Catastrophic	Medium (6)
4. Unauthorised impacts on surrounding property	Damage to roads or other infrastructure Clearing of vegetation past boundary	Possible	Moderate	Medium (9)	1. Experienced construction supervisors. 2. Boundaries are to be clearly surveyed and marked. 3. Seqwater supervision of construction contractor.	Rare	Moderate	Low (3)

HAZARD	CONSEQUENCE	RAW RISK			PROPOSED CONTROLS	RESIDUAL RISK		
		L*	C*	R*		L	C	R
5. Release of hazardous substances from site (spill, leak, natural event)	Polluting waterways Contamination of land	Possible	Major	High (12)	1. Refuelling in designated areas fitted with spill containment. 2. Storage and handling hazardous substances in accordance with AS1940. 3. Hazardous substances will be stored and used in an appropriate fashion to ensure containment. 4. Designated hazardous substance storage areas to be located out of stormwater/flood flow paths, or readily relocatable	Rare	Major	Medium (5)
6. Weeds brought to site by earthmoving equipment Weeds	Introduction/spread of weeds in surrounding environment	Possible	Minor	Medium (6)	1. All heavy vehicles must be washed down and inspected prior to commencement of arrival and work on site.	Unlikely	Minor	Low (4)
7. Known weeds distributed from Project site (i.e. Cabomba)	Distribution of noxious weed to new areas	Likely	Moderate	High (12)	1. Document and implement weed controls relevant to known weeds in Project area (Construction Environmental Management Plan)	Unlikely	Moderate	Medium (6)
8. Bushfire	Property damage, loss of vegetation, fauna injury/mortality	Possible	Catastrophic	High (15)	1. Facilities and equipment will be inspected and tested for fire safety on a regular basis. 2. Emergency planning and training for response to fire.	Rare	Catastrophic	Medium (6)
9. Working near water body.	Drowning of site personnel.	Possible	Catastrophic	High (15)	1. Fall protection equipment used when working near the water body. 2. Water rescue equipment available. 3. Personnel trained in water rescue.	Rare	Catastrophic	Medium (6)

HAZARD	CONSEQUENCE	RAW RISK			PROPOSED CONTROLS	RESIDUAL RISK		
		L*	C*	R*		L	C	R
10. Wet weather/flows through spillway site impacting construction schedule	Exacerbates exposure timeframe for other potential hazards (e.g. dust, noise)	Likely	Moderate	High (12)	1. Install pumping capacity for initial lake lowering to cater for rapid drawdown if required due to inflows 2. Install temporary sheet pile coffer dam with low flow channel to manage flows 3. Install ongoing bypass release infrastructure to mitigate manage low or trickle flows through the construction site	Possible	Moderate	Medium (9)
11. Demolition of spillway and concurrent spilling flows/flood	Partial dam failure due to erosion of partially demolished spillway	Possible	Catastrophic	High (15)	1. Design and construction planning on sequencing and criteria for commencing demolition 2. Extended working hours for spillway demolition	Rare	Catastrophic	Medium (6)
12. Public access to lake during construction (lowered lake)	Injury of public Injury of livestock	Likely	Major	High (16)	1. Restricted access to lake during construction (fencing and signage) 2. Engagement and land management/fencing of adjacent landholder properties with livestock	Rare	Major	Medium (5)
13. Changes to flood characteristics during construction	Property damage	Possible	Moderate	Medium (9)	1. Assess flood impacts for representative events to understand level of change 2. Incorporate changes into flood notifications	Possible	Moderate	Medium (9)

*C = Consequence, L = Likelihood, R = Risk.

Table 4-8: Risk Assessment Table - Operation Phase

HAZARD	CONSEQUENCE	RAW RISK			PROPOSED CONTROLS	RESIDUAL RISK		
		L*	C*	R*		L	C	R
1. Release of hazardous substances from site (spill, leak, natural event)	Polluting waterways Contamination of land	Unlikely	Major	Medium (8)	1. Minimise on-site refuelling to portable equipment only 2. Refuelling in designated areas fitted with spill containment. 3. Storage and handling hazardous substances in accordance with AS1940. 4. Designated hazardous substance storage areas to be located out of stormwater/flood flow paths, or readily relocatable	Rare	Major	Medium (5)
2. Bushfire	Loss of vegetation, fauna injury/mortality	Possible	Catastrophic	High (15)	1. Facilities and equipment will be inspected and tested for fire safety on a regular basis. 2. Relevant site staff will complete fire safety training during induction.	Unlikely	Moderate	Medium (6)
3. Changes to flood characteristics with new spillway	Property damage	Possible	Moderate	Medium (9)	1. Assess flood impacts for representative events to understand level of change 2. Incorporate changes into flood notifications 3. Design new spillway to match outflows of existing spillway at Q100	Rare	Moderate	Low (3)

*C = Consequence, L = Likelihood, R = Risk.

4.3.5 Risk Assessment - Conclusion

The information contained in Table 4-7 and Table 4-8 shows that the risk profile for the proposed facility is generally Low to Medium.

There are no identified extreme or high risks to people or property as a result of the Project.

4.4 Emergency Planning and Response

Emergency planning represents the outer layers of the "defence in depth" approach to community safeguards. Any emergency planning must be based on the following components:

- Analysis of the emergency incidents likely to take place for each operational area
- Assessment of the degree of impact likely to occur
- Assessment of what constitutes an "emergency" for the particular operation
- On-site plan to handle incidents
- Off-site plan with reference to emergency services needed
- Communication, emergency responsibilities, control centre establishment
- Post emergency procedures, including recovery, debriefing and review of plan
- Test the plan under emergency-like conditions.

Plans will assess the access for emergency services. The inundation area may change the travel routes for response and response times. Discussions will be held with emergency services to identify route access issues and emergency response procedures prior to the commencement of construction activities.

The final detailed plans would be developed by the constructor as the detailed engineering design takes shape. This would involve local emergency services such as police, fire brigade and State Emergency Services personnel as well as the local emergency response groups.

4.5 Community Safeguards

It is vitally important that the impacts of the Project have minimal impact on the local community of Lake Macdonald and Cooroy. The community safeguards will be implemented through a 'safety in depth' or 'defence in depth' approach where there exists a multi-layered approach to public and environmental impacts.

These safeguard layers come in two principal forms:

- Design of processes to 'good engineering practice' standard
- Implementation of safety management systems and emergency planning appropriate for the hazards involved in the Project.

Using the "defence in depth" approach, the 'inner layer' deals with the actual engineering designs and these are usually dictated by Australian Standards and industry codes of practice as specified by ANCOLD.

The outer layers of the approach can include:

- Continuous regulation and control
- Alarm systems
- Fire detection and suppression systems
- Local and site emergency procedures
- Off-site emergency procedures.

All of these items need to be in place where the hazards dictate.

4.6 Health and Safety Management System

The safety management system adopts an integrated approach to risk management of the dam construction and operations, recognising the hazards at all points in the operations and how these are controlled. Australian Standard's 4801 and 4804 should be complied with in developing and operating the safety management system.

The safety management system will comprise many of the "defence in depth" layers but should also include the following:

- Strict review of modification and design procedures
- Policies for managing change (new technology and new procedures)
- Assessment of human factors in the design and operation
- Training programs for operators
- Internal standards and codes of practice
- Process and equipment integrity including preventative maintenance and procedures
- Documentation and propagation of process knowledge to operators and engineers
- Incident investigation procedures
- Enhancement of safety knowledge and its dissemination to staff
- Risk and compliance auditing
- Statements of risk management objectives and goals.

These systems and practices are currently in place for the existing dam, but will be revised and updated by Seqwater as the Project progresses and will have the revised systems in place prior to commissioning.

4.7 Decommissioning Phase

A decommissioning date for the Project has not been determined at this stage. The dam will continue to be an integral part of the Seqwater water supply network and as such will be maintained to meet dam safety requirements. A possible decommissioning date is likely to be too far in the future to allow effective planning for decommissioning to occur at this point in time.

When this does occur, consideration to matters such as potential impacts on terrestrial and aquatic ecology and surrounding land use, and the resultant changed hydrology will need to occur. It is not practical to identify the hazards and risks that could be relevant at the decommissioning phase because the decommissioning process and timing has not been determined.

4.8 Public Liability of Infrastructure

For the construction phase, public liability and protection of infrastructure will be managed by Seqwater and constructor with closure of the area to the public, to prevent public access to the construction site and the Lake Macdonald area whilst in a lowered state.

Protection of infrastructure will be maintained by ensuring the constructor has identified all assets and undertakes construction in a way that does not damage this infrastructure or cause a reduction in service provided by the dam and associated infrastructure.

A safety risk assessment will be undertaken for the Project to identify areas of high risk to public safety. Exclusion zones will be developed to prevent public access to high risk areas, particularly for existing boat ramps and public access points, with fences and signs erected to delineate such areas. For land that surrounds the inundation area, public liability for access onto that land will be with the landholder.

Seqwater will continue to hold adequate public liability insurances.

4.9 Update of Dam Safety Documentation and Systems

The Project will result in changes for dam safety with respect to Six Mile Creek Dam (Lake Macdonald). Seqwater will undertake the following updates with respect to the new dam structure:

- Undertake a failure impact assessment study according to relevant guidelines
- Undertake dam safety risk assessment according to relevant guidelines
- Safety management systems for all of the operations are to be reviewed and updated for the new dam and in line with current guidelines as directed by the Queensland dam safety regulator
- Emergency Action Plan (Reference ERP-00034) updated as required in annual review process, including consultation with Noosa LDMG prior to dam commissioning.