

Decommissioning dams

A guide for dam owners



OFFICIAL

Acknowledgment

We acknowledge and respect Victorian Traditional Owners as the original custodians of Victoria's land and waters, their unique ability to care for Country and deep spiritual connection to it. We honour Elders past and present whose knowledge and wisdom has ensured the continuation of culture and traditional practices.

We are committed to genuinely partner, and meaningfully engage, with Victoria's Traditional Owners and Aboriginal communities to support the protection of Country, the maintenance of spiritual and cultural practices and their broader aspirations in the 21st century and beyond.



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1.0	December 2016	DELWP	Original
2.0	June 2022	DELWP	Three additional case studies added: Nile Mile Dam – DELWP, Rethinking Reservoirs - South Gippsland Water and Beaconsfield Reservoir – Melbourne Water. Figures added to existing case studies (excluding Lake Mokoan as there is a photo of the dam on the cover). Additional information on the use of a dam for firefighting and it being something to consider if the water level is to be lowered. Additional information on hydraulic assessment and what to consider. Additional guidance on Traditional Owner engagement.

Cover Photo - Lake Mokoan embankment decommissioning, courtesy Goulburn-Murray Water

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The Department intends to review this document periodically. Please forward comments to Dam Safety and Regulation Team, Water and Catchments Group, Department of Environment, Land, Water and Planning, PO Box 500, East Melbourne VIC 3002 or email: dam.safety@delwp.vic.gov.au

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Introduction

There are thousands of dams in Victoria owned by private landholders, water authorities and government agencies. Dams are an important part of the landscape, serving a vital role by storing water to use at times when it is most needed. We rely on the water in these dams for a range of important uses including farming, water supply, hydro-power and recreation. Dams are built to last many decades but eventually dam owners may face a decision about whether to continue to maintain or decommission a dam. The case to decommission a dam will be informed by a number of considerations relating to public safety, functionality and economic viability, as well social and environmental impacts.

Decommissioning dams in Victoria

As part of their asset and risk management processes, dam owners need to continually assess the operation and use of their assets. In doing this, assets need to be rationalised to achieve the best balance for cost, quality and security of water supply.

Dams in Victoria are generally considered for decommissioning when alternative supply arrangements have been identified, when there are ongoing water quality issues or dam safety issues, when the costs of upgrading are disproportionate to the benefits of maintaining a dam or a combination of these reasons

As well as supplying water, dams also play an important social role, providing valued recreational spaces for surrounding areas. In some cases, dams may also play an incidental role in reducing flooding. For these reasons plus more, communities and stakeholders will have interests in the future of a dam.

About these guidelines

Every dam is different and the decision to decommission a dam will be based on a combination of factors. These guidelines have been prepared to support Victorian dam owners in considering decommissioning as a future management outcome for a dam.

The decision to decommission a dam would involve assessment of the following key aspects:

- **Functionality and safety** – assessing the dam’s current functionality and safety, future water supply needs, as well as obligations, such as dam safety improvements. It would also assess the dam’s current effectiveness to store water and other potential uses for the site.
- **Economic** – assessing the financial costs and benefits associated with maintaining and continuing to use the dam, including potential future upgrades, as well as options to decommission the dam.
- **Social** – considering the community’s relationship with the dam and the potential concerns decommissioning may bring. The views of stakeholders will be an important part of making a decision on the future of a dam.
- **Environmental and heritage** – looking at impacts of decommissioning on biodiversity, natural flow regimes and water quality, compared with the dam’s existing environmental issues. Other key aspects include potential effects on historical significance.
- **Traditional Owner cultural values** - partnering with Traditional Owners in the decision-making process when selecting a decommissioning option to understand the impacts.
- **Legal requirements and governance** – recognising any legal obligations of the existing dam and adhering to regulatory processes and approvals. Considerations include current and future land ownership, and arrangements to manage the site after decommissioning.
- **Technical feasibility** – considering the ease and efficiency of proposed decommissioning methods and related construction impacts.

These guidelines consider the key aspects above and provide a progressive approach for decision-making. Each step is designed to generate information and data that should be documented and retained as part of the management reporting process.

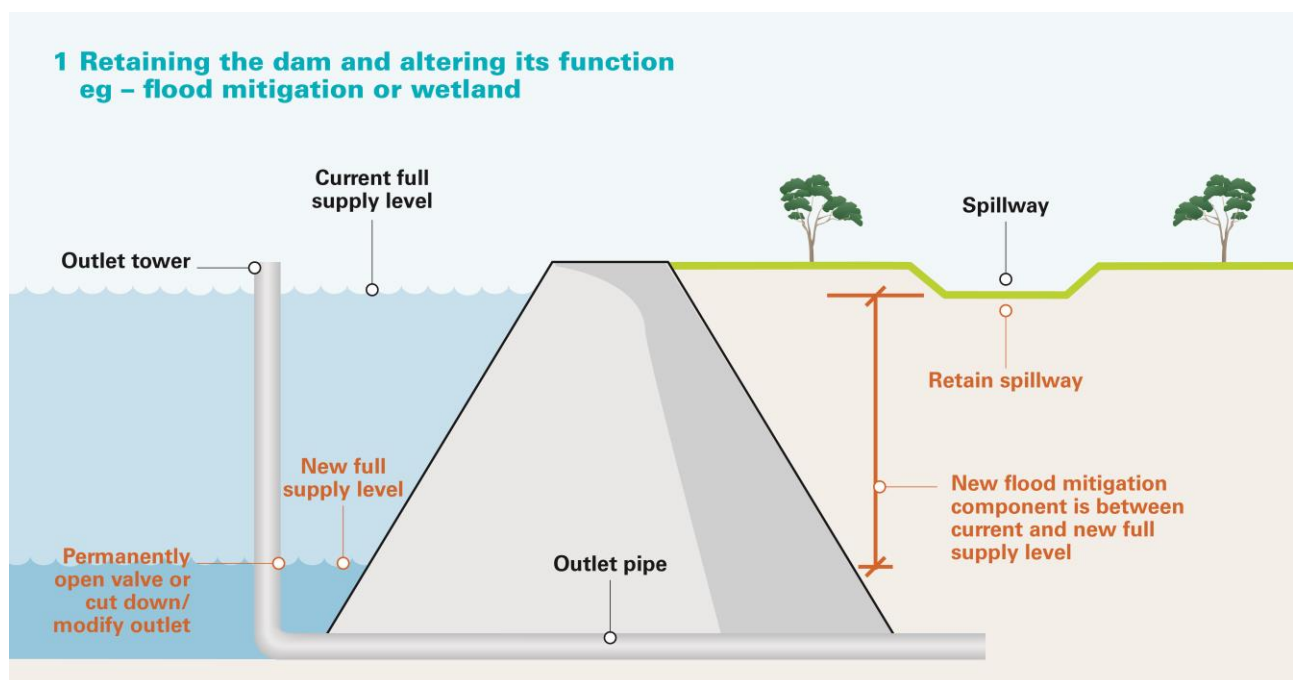
What is dam decommissioning?

Decommissioning can be defined in one of the following ways:

- Retaining the dam but using it for a different purpose with or without modification .
- Partially removing the dam structure.
- Fully removing the dam structure.

For the purposes of these guidelines, the term decommissioning in relation to dams refers to all three of the scenarios as illustrated in Figure 1.

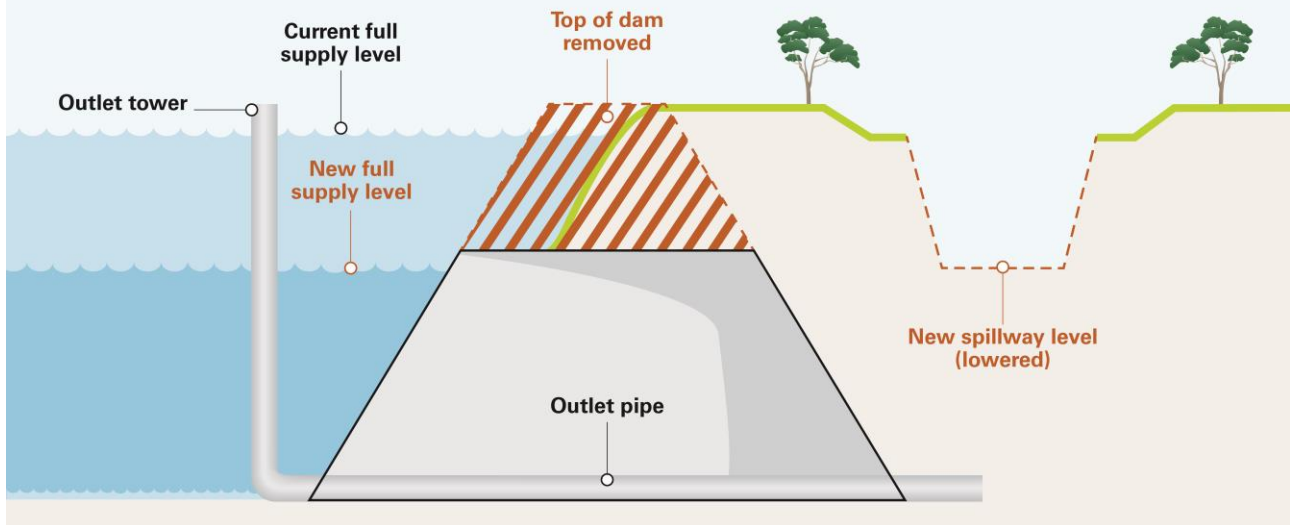
Figure 1: Overview of dam decommissioning methods



Decommissioning method 1: Retaining the dam and altering its function

This method involves retaining the dam, but the function of the dam will be changed. For example, a dam built for water supply may be altered so that its principal use is for community recreation. This method is likely to involve a number of structural changes, including safety improvements and additional features.

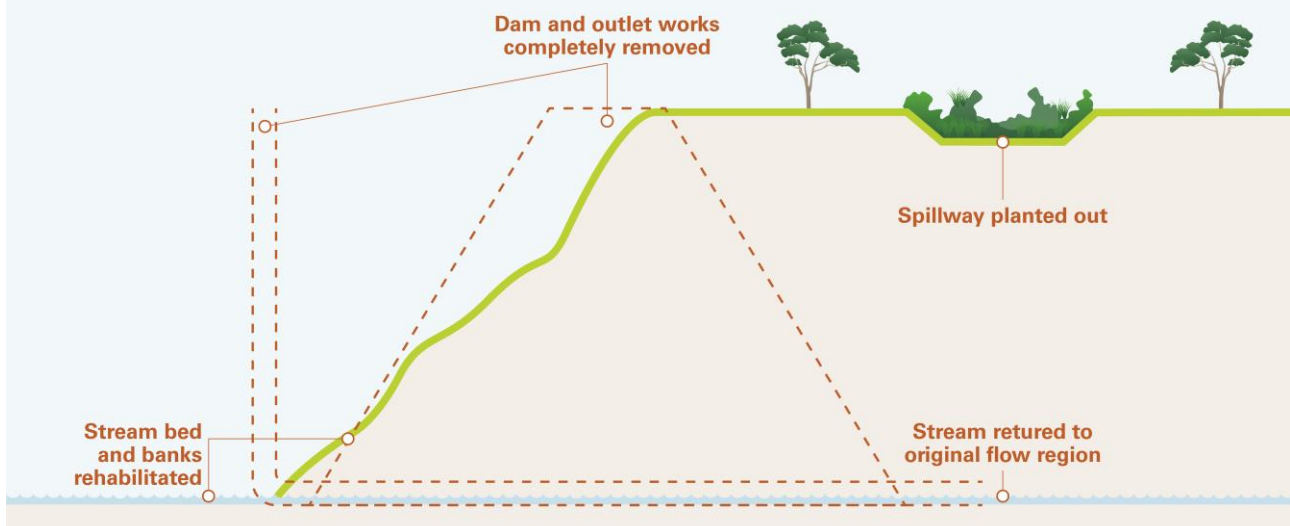
2 Partially removing the dam



Decommissioning method 2: Partially removing the dam

This method involves lowering the height of the dam, or the height of the spillway, to reduce storage capacity. A combination of lowering both the dam and the spillway may also be suitable. This would require excavation works with the desirable final height of the dam being influenced by factors such as future water demand, ecological impacts, community values and dam safety improvements. A range of structural changes and additional features would also be required.

3 Fully removing the dam



Decommissioning method 3: Fully removing the dam

This method involves removing the dam structure, and potentially the spillway, with the aim of restoring the site to conditions that existed before the dam's construction. In addition to major excavation works and a range of structural and additional features, this method would require a comprehensive sediment management strategy, as well as a site revegetation and reinstatement plan.

Page 20 provides further information on sedimentation.

Dam management guidance

Dam management in Victoria is guided by State legislation and policy regulated by the Department of Environment, Land Water and Planning (DELWP) and delegated licensing authorities. A suite of policy and guideline documents, both industry and regulatory, exist for dam owners to refer to.

In particular, the Australian National Committee on Large Dams (ANCOLD) prepares and issues guidelines which represent the best Australian and international engineering practice. ANCOLD's guidelines and other information provided by the Department and United States Society on Dams and The H. John Heinz Centre III (see *References*) would prove useful to refer to alongside this guideline.

Guiding steps

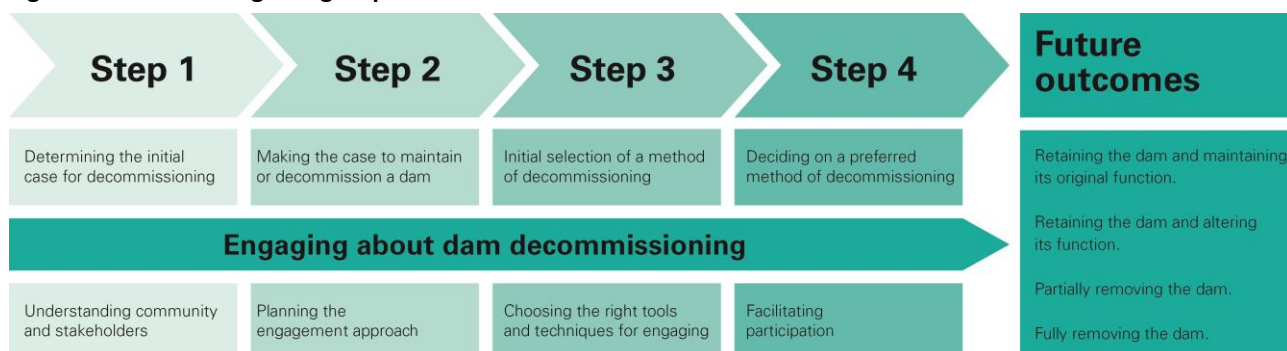
This guideline provides a set of guiding steps designed to help in making a decision about whether to decommission a dam and determine what method of decommissioning would be suitable.

Figure 2 summarises these steps and the possible outcomes that would result from following them. Each step comprises of a series of questions to compare the case for decommissioning or retaining the dam, with a focus on exploring what decommissioning would involve. Retaining the dam and maintaining its original function could be an outcome after any of the steps as explained below. The questions provided are not exhaustive and judgment will be required on additional matters that may be relevant or issues that are not applicable.

It is recommended to engage specialists in technical fields including engineering, environmental management, and stakeholder and community consultation to assist with gathering data and verifying inputs and assessments at certain stages in the process. Recording the process and outcomes of each step is an essential part of documenting issues, options, consultation and decisions as part of dam management and maintenance practices.

Stakeholder and community engagement will also be an essential consideration in any decision-making process. Dams are an important part of the landscape, providing precious recreation places and opportunities to appreciate nature. Owners are likely to find that comprehensive engagement will be required regardless of the size of a dam. Therefore, each step also presents strategies to engage with communities about dam decommissioning. Further guidance is provided in Appendix B.

Figure 2: Overview of guiding steps



Step 1 – Determining the initial case for decommissioning

As part of establishing an initial case for decommissioning, dam owners will need to assess the risks and challenges associated with continuing to maintain and operate their dams. By considering a few issues at a high level, a quick decision can be made about whether there is an initial case for decommissioning that requires further analysis.

An important part of Step 1 will be to set up a framework for gathering data. This way, there is a base of information that can be relied on and referred to in subsequent steps. An overview of the assessment criteria for decommissioning can be found in Appendix A.

The questions listed below can be used in the initial assessment and as a starting point for collecting data. These questions can be applied across a portfolio to screen out dams that require no further analysis and can be retained for their current function.

For further information, the Heinz Centre III for Science, Economics and Environment published *Dam Removal Science and Decision Making*. This book provides the first comprehensive treatment of dam removal and includes a range of indicators to be considered for dam removal decisions.

To carry out Step 1:

- Review the questions in Table 1 and refer to Appendix A for an overview of assessment criteria and to see if there are any other key indicators to be considered.
- Decide whether to answer ‘yes’ or ‘no’ to each question for each dam in the portfolio.
- Provide a succinct reason for each ‘yes’ or ‘no’ answer and record details for any other key indicators.

Outcome of Step 1:

- The reporting outcome for this step will either be that there is no current decommissioning potential (all answers ‘no’) or it will prompt further investigation and assessment.
 - If ‘yes’ is the answer to any of these questions for one or more dams, it is recommended to proceed to Step 2 for further consideration. The more questions answered with a ‘yes’ for any dam, the stronger the potential case for decommissioning. If an answer is uncertain, further analysis should be considered.
- Start to consider stakeholders’ views – see *Understanding community and stakeholders*.

Table 1: Step 1 initial screening questions

Questions	Y/N
1. Is the dam currently redundant or likely to become redundant due to alternative water supply options?	
2. Is the condition and safety status of the dam creating an unacceptable risk to public safety, property and/or the environment? <i>This may translate to what a dam owner considers is an ‘unacceptable liability’.</i>	
3. Is decommissioning the dam potentially more cost effective than maintaining and operating the dam? <i>Consider how effective the dam is in meeting its current function, the current costs associated with managing the dam, and the potential cost of decommissioning the dam.</i>	
4. Is there a reason to consider decommissioning as part of a wider objective? <i>Often the reason for answering ‘yes’ to this question is that there are broader government policy, community or environmental objectives decommissioning could contribute to. For example, if removing a dam could contribute to a wider scheme to restore aquatic habitats downstream or improve fish migration or water supply quality. Sometimes other opportunities arise prompting a ‘yes’ answer – for example, the dam might be better used for stormwater or recycled water storage or dedicated to recreation, as compared with its current use.</i>	
5. Does the dam have any detrimental environmental, cultural or community impacts?	

Traditional Owner cultural values

In 2015, the Victorian Government committed to Aboriginal self-determination as the central policy principle for guiding Aboriginal affairs (DPC, 2018). Aboriginal self-determination is about Aboriginal people being at the centre of decision-making around the issues that directly affect their lives. The decision to decommission a dam is likely to affect a waterway and require construction works on country meaning the project will affect aboriginal peoples lives and be a cultural matter. Key to successful partnership is to always engage early and incorporate timeframes compatible with the cultural protocols and decision-making processes of Traditional Owners and Aboriginal Communities. The sooner you engage, the sooner you will find out how (or whether) your project connects with Traditional Owner needs and aspirations. Incorporate what you learn into the options for the dam decommissioning project. Guiding steps for partnering with traditional owner are:

- Identify the Traditional Owners in your area – A map showing Victoria’s current registered Aboriginal Parties can be accessed here - <https://www.aboriginalheritagecouncil.vic.gov.au/victorias-current-registered-aboriginal-parties>
- Prepare for engagement – Think in terms of benefits to Traditional Owners; have you identified the Traditional Owner Group(s) affected by your project or matter? Do you understand the rights, interests or aspirations of the Traditional Owner Group you are partnering with? If your Traditional Owner Group(s) has a Country Plan, read about their aspirations for Country before you engage? Does your project, initiative or matter support Traditional Owners and/or Country?
- Traditional Owner engagement plan – Develop a plan which supports and enables meaningful engagement between the dam owner and Traditional Owners by creating the necessary mechanisms, opportunities and protocols for participation and collaboration.
- Project delivery – Engagement is a long-term relationship based on trust, respect and honesty. Having the right process is paramount to a successful relationship. Be transparent. Be open from the outset of your project so you can incorporate Traditional Owner and Aboriginal Community aspirations into your project at the planning and scoping stage. Respect Aboriginal Community decision-making processes. Good engagement takes time. Aboriginal community representatives can’t always make an on-the-spot decision. Often, they need to go back to a committee or their community. Often timeframes are too tight and unrealistic. You can’t build a partnership unless you respect Aboriginal decision-making processes. When and where possible, meet on Country.

If support is required, please direct enquires and requests to self.determination@delwp.vic.gov.au.

Understanding community and stakeholders

If further analysis were likely to be undertaken as part of Step 2, it would be useful to begin considering stakeholders and community groups who use, rely on, or live around the dam. While it is too early in the assessment process to begin discussing the future of the dam with these groups, it is worthwhile considering who might be interested in or impacted by a decision to decommission the dam, and the potential values the community might place on the dam.

Appendix B provides further guidance on understanding community and stakeholders.

Case study: Crusoe Reservoir

Crusoe Reservoir was built in 1873 and had a storage capacity of 1,500ML. The reservoir was owned and operated by Coliban Water as part of its provision of water to Bendigo. In 2002, Coliban Water built new water treatment works at another reservoir near Bendigo. This meant that Crusoe Reservoir was no longer required for water supply, and Coliban Water faced a decision on decommissioning.

The cheapest option for Coliban Water was to completely remove the dam and re-establish the surrounding forest. However, several other factors influenced the decision on the dam’s future:

- The City of Greater Bendigo expressed an interest in retaining Crusoe Reservoir as a recreational facility for swimming, fishing, boating and walking.
- Crusoe Reservoir is on the Heritage Register as a historically important engineering system. It was one of the earliest water supply systems in Victoria, and an important part of the development of a permanent water supply for Bendigo that allowed the local gold mining boom to occur.
- The reservoir is an important wildlife habitat, particularly for the Swift Parrot, an endangered species of high conservation significance.

Coliban Water ultimately decided the best option was to retain and upgrade the reservoir so it could be used as a recreational facility for the community. This option also meant the heritage assets could be retained, and the reservoir could continue to provide a habitat for birdlife.

The upgrade works that Coliban Water carried out were:

- Permanently reducing the full supply level by two metres as shown in Figure 3.
- Deepening and enlarging the spillway.
- Improving the embankment with a toe berm and drain.
- Upgrading a high-level outlet conduit and removing the original outlet.
- Partially filling historic settling ponds at the toe of the dam for safety and preservation reasons.

While carrying out the upgrade works Coliban Water ensured minimum disruption to habitat. Coliban Water funded the upgrade (at a cost of \$1.5 million above the cost of dam removal) as a contribution to the local community. But the option had a benefit to the water corporation in that they were able to relinquish responsibility for the site, handing it over to the City of Greater Bendigo and the Victorian Government. The reservoir and surrounding parkland is now a popular destination for outdoor recreation.

Lessons from the project

- The cheapest option is not necessarily the best option for the community or a dam owner's reputation.
- The value of consultation with a full range of stakeholders – not only as part of the decision-making process, but to ascertain early in the project what permits and approvals are required.
- The importance of planning for the future ownership and management of the site.
- The benefit to environment and heritage by being sensitive to these issues during construction.

Figure 3: Crusoe Reservoir dam wall viewed from left abutment post partial decommissioning and showing reduced water level (Goldfields Guide, 2021)



Step 2 – Making the case to maintain or decommission a dam

This step is designed to build on the initial assessment carried out in Step 1, which identified the possibility of decommissioning a dam. The guiding approach in this step is to define and evaluate the cases for and against maintaining or decommissioning a dam.

Step 2 is a qualitative assessment based on expert judgement. If the balance of the case against maintaining the dam outweighs the case for maintaining the dam, it indicates that there may be a strong case to decommission the dam. This means greater consideration would need to be given to one or more methods of decommissioning by moving on to Step 3.

The need to decommission may already be known because there is a clear rationale. For instance, the dam may be redundant, or there may be other economic or safety imperatives for removing it or changing its function. If this is the case it may still be useful to carry out Step 2, as it will yield results useful for further analysis in Steps 3 and 4.

To carry out Step 2:

- Document responses to each applicable item in Table 2.
- Use expert judgment to document and decide on the relativity between the cases for and against decommissioning and maintaining the dam. This will also involve documenting the outcome and reasoning.

Outcome of Step 2:

- If the balance of the case against decommissioning outweighs the case for decommissioning, there is little need to further consider decommissioning as it is likely the case to maintain the dam will be stronger.
- If the case for decommissioning is strong, explore methods of decommissioning in Step 3.
- If the outcome is unclear, it is still appropriate to move on to Step 3. This will enable all future dam management options to be properly considered.
- The reporting outcome of this step may confirm that there is no decommissioning potential (i.e. case against decommissioning outweighs the case for) or build the case for decommissioning (i.e. investigation continuing to Step 3, or a combination of Steps 3 and 4).
- If decommissioning is a likely option, start to plan a stakeholder and community engagement approach – see *Planning the engagement approach*.

Table 2: Arguments for and against decommissioning

Case for decommissioning	Case against decommissioning
<ul style="list-style-type: none"> • Risks to public safety/property/environment – To what extent does the dam not meet current safety guidelines or not comply with the requirements of the dam safety regulator and the guidelines of ANCOLD? • Recurrent costs – What is the annual cost of maintenance and operation? (To be compared with operating revenue and benchmarked against efficient dam operating costs) • Future costs – What are the likely capital and operating costs of any required future upgrades? • Water quality – To what extent does water quality not meet legal requirements and consumer expectations? • Traditional Owner cultural values – was the dam constructed on a culturally significant site? • Environmental impacts – How significant are any adverse environmental impacts? E.g. On flow/riverine regime. • Regulations – Are there, or are there likely to be, problems adhering to any other regulations, which apply to the current operation and ownership of the dam? 	<ul style="list-style-type: none"> • Purpose – What is the overall purpose of the dam and is the dam fulfilling this purpose well? • Revenue – What is the dam’s annual operating revenue? • Water supply – To what extent do users rely on the dam for water supply, and are there alternatives? • Flood mitigation – Does the dam play a role in reducing flood risk? • Recreation – How important is the site for recreational purposes such as fishing, boating and picnicking? • Community support & value – To what extent do local stakeholders value the dam including the effect on property and business? • Environmental benefits – Does the dam provide habitat for flora and fauna and to what extent? E.g. are there any protected species? • Heritage benefits – Does the dam and its immediate surrounds have heritage value? E.g. is it heritage listed?

Planning the engagement approach

There is no right way to engage on decommissioning a dam – every situation and circumstance is different and requires a tailored approach. Planning for engagement will involve developing an Engagement Plan. This plan will map out how to work with various stakeholders and community groups based on the size and complexity of the project.

Step 2 has important engagement potential for dams requiring further decommissioning consideration. This may involve mapping out ‘how’ and ‘when’ to seek input or information from stakeholders and specialists on the cases for and against decommissioning and maintaining the dam.

Appendix B provides further information about planning the engagement approach.

Case study: Honeysuckle Creek Reservoir

Honeysuckle Creek Reservoir was built in the early 1960s as a 120 ML water storage for Violet Town and was owned and operated by Goulburn Valley Water. After over 40 years of service, several problems with the reservoir became apparent:

- Algal blooms formed in warmer months, resulting in taste and odour complaints from customers.
- Dam levels were often low and water restrictions were imposed on Violet Town.
- The reservoir was constructed with no filters to alleviate pore water pressure within the embankment.

It was determined that due to the spillway's limited discharge capacity, flooding could cause a failure of the dam's embankments. This could lead to loss of life and the societal risk was deemed unacceptable.

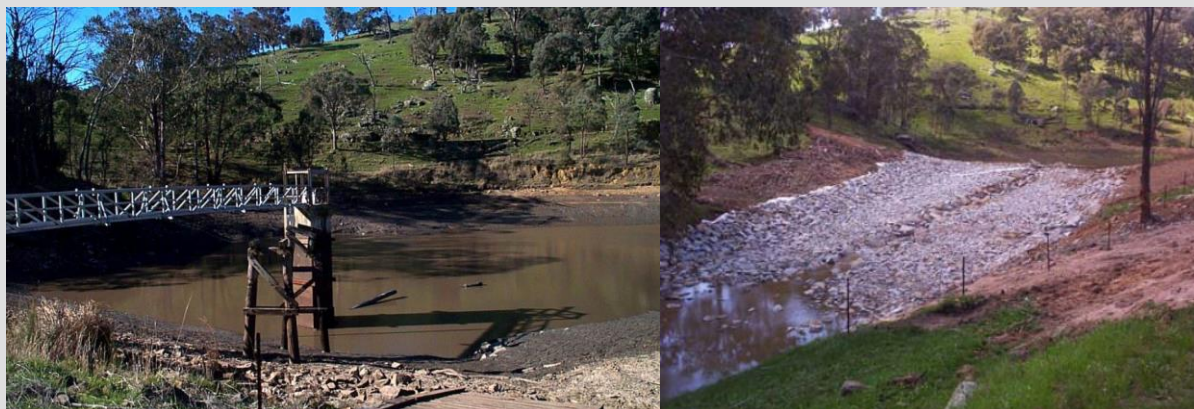
In 2002 the water quality and supply issues were resolved with a new pipeline from the Euroa Water Treatment Plant to supply Violet Town. The installation of this pipeline meant Honeysuckle Creek Reservoir was no longer required for water supply, and Goulburn Valley Water decided to decommission the dam.

The decision to decommission was strongly opposed by some of the community who saw the reservoir as a valuable amenity and recreational facility. The decision became the subject of legal and political conflict with significant media exposure. The case was referred to the Victorian Civil and Administrative Tribunal (VCAT). Figure 4 shows the reservoir before and after when eventually Goulburn Valley Water was able to decommission the dam but because of the legal issues the project took two years longer and cost more than initially estimated.

Lessons from the project

- Potential social and legal issues should be considered as early as possible, including their potential impacts on project timelines and budget. One way of doing this could be by considering the various scenarios.
- The reasons for a decommissioning project and the basis for objections should be fully supported by documented evidence.
- The importance of appointing an appropriate project manager.
- The need for effective community consultation, and the importance of ensuring that any information provided is clear and consistent.
- The support of the former Department of Sustainability and Environment, Goulburn Broken Catchment Management Authority and Goulburn-Murray Water was invaluable in achieving a successful VCAT decision.
- It is important to ascertain early on, what permits are required, possibly with the help of a planning expert. In this case Goulburn Valley Water initially assumed they would not need a planning permit.

Figure 4: Honey Suckle Creek Reservoir before (left) and after (right) removal of the embankment and outlet tower (Dwer, 2007)



Step 3 – Initial selection of a method of decommissioning

Step 3 begins to examine and compare different decommissioning strategies for a dam. This involves identifying one or more methods to decommission a dam as a potential future management outcome, and qualitative assessment of the benefits and costs of each proposed method. The method with the greatest benefit compared with its costs will emerge as the most favourable outcome.

As part of this step, retaining and maintaining the dam should continue to factor into the assessment as a management outcome. To be certain that the best option is selected – to decommission or maintain – the judgment should always include retaining the dam's status quo as a possibility (e.g. Do Nothing option). It is

best assessment practice, and required for business case submissions, to reflect on present circumstances in the analysis.

To carry out Step 3:

- Select one or more of the high-level methods to decommission a dam (see Figure 1). Also include the option of retaining it, including consideration of any likely future upgrades, as a potential outcome of the analysis.
- Eliminate any methods that are unviable. For example, a method may be an unviable option if it is:
 - Prohibitively expensive.
 - Technically unfeasible or impractical.
 - Unlikely to acquire the necessary approvals.
- Document responses to each relevant item in Table 3 for each decommissioning method under consideration. This should incorporate the analysis carried out in Step 2, reflecting on responses to the questions in Table 2. For example, assessing the costs of a decommissioning method should pay consideration to effects on the cases for and against. For example, the cost of a decision to fully remove a dam that is frequently used for boating could reduce the positive aspects of the case to decommission the dam due to its value as a place for recreation.
- Use expert judgment to evaluate and compare benefits and costs.
- Where required, engage the expertise of technical specialists to assist in evaluating the benefits and costs.

Outcome of Step 3:

- If costs outweigh the benefits for a method of decommissioning, it is a fair indication that this is not the preferred management outcome.
- If benefits are greater than costs for one or more methods of decommissioning, then proceed to Step 4.
- If one particular option has impressive benefits that clearly exceed its costs, it may be feasible to select this as the preferred future management outcome for the dam without carrying out Step 4.
- If the outcome is unclear, for example, all decommissioning methods have costs greater than benefits but equally costs are greater than benefits for maintaining the dam, then continue to Step 4.
- A number of decommissioning options can be taken through to Step 4.
- The reporting outcome for this step should show that there is:
 - No current decommissioning potential (i.e. costs are greater than benefits for all decommissioning methods and each decommissioning option has a greater cost to benefit outcome than maintaining the dam).
 - A preferred decommissioning option.
 - A requirement for further decommissioning investigation (i.e. undertake Step 4).
- Look at selecting tools and techniques for communicating and engagement with stakeholders – see *Choosing the right tools and techniques for engaging*.

Table 3: Costs and benefits of selected methods of decommissioning

Benefits of decommissioning	Costs of decommissioning
Alleviation of current negative aspects and new benefits	Removal of current positive aspects and new problems
<ul style="list-style-type: none"> • Does the option alleviate current negative aspects identified in Step 2? Describe these individually. • Will there be social benefits, such as new recreational opportunities? • Will there be environmental benefits? E.g. Restoration of river habitat by reinstating the natural flow regime. Will there be economic benefits, such as proceeds from the sale of land or new economic opportunities? • Will the option improve water quality from an environmental or human consumption standpoint? • Will decommissioning create an asset that is supported and valued by local stakeholders or the community? 	<ul style="list-style-type: none"> • Does the option reduce or remove current positive aspects identified in Step 2. Describe these individually. • What is the estimated cost of decommissioning and its relative cost to retaining & maintaining the dam (“status quo”)? • What are the legal risks or complications with land, water entitlements or regulations? (See <i>Legislative and regulatory obligations</i> on page 23) • Will social benefits, such as recreational amenity and tourism be affected? • Are there governance risks? Could a new owner be found? • Are there heritage risks? E.g. Adverse effects on assets with historical importance? • Are there environmental risks, such as removal of habitat or reduction in downstream water quality due to the release of sediment? (See <i>Managing sediment</i> on page 20)

Choosing the right tools and techniques for engaging

Dam management in Victoria occurs within a highly regulated system designed to protect our water supply and ensure assets are managed safely and responsibly. Although it can be hard to explain, finding ways to talk about the challenges of managing dams will be an essential starting point for conversations with stakeholders and the community. Communication materials and interactions should be clear about the assessment process and the negotiables and non-negotiables. Being transparent about the level of stakeholder and community involvement and how feedback will be used will help manage expectations around decision-making throughout the process for those involved.

Appendix B provides further information on engagement tools and techniques.

Case study: Lake Mokoan

Lake Mokoan was a major rural water supply storage operated by Goulburn-Murray Water. Constructed in the late 1960s and located in the Broken Valley in Northeast Victoria, the lake was an important source of water for local irrigation, domestic and stock customers.

The Victorian Government began plans to decommission Lake Mokoan in 2004, due to prevailing problems associated with the lake, including:

- Water loss from evaporation.
- Poor water quality.
- Costs of operating the lake as a water supply.
- Dam safety upgrade costs.

In the year leading up to the decision to decommission, and for the duration of the delivery of the project, Victoria experienced the worst period of drought and the lowest stream flows in the State's history. As Australia's largest dam decommissioning project, Lake Mokoan formed an important part of the government's long-term plan for water.

Three options were identified to mitigate the lake's ongoing issues, including:

- Reverting the lake back to natural wetlands.
- Reducing the size of the lake by constructing a partition and operating the lake under existing rules.
- Reducing the size of the lake and operating it as an annual water storage facility.

A study was initiated to determine the feasibility of each option, with the aim to provide government with sufficient information to make a decision about the future of the lake. Following this study, the decision was made to proceed with reverting the 7.3 m deep, 365,000ML capacity Lake Mokoan back to a natural wetland state.

This decision resulted in significant stakeholder interest and active local opposition. Concerns arose over the possible impacts on water supply reliability, loss of recreation and associated local development opportunities, flooding risk, and perceptions that the decision was not consistent with study findings.

Despite ongoing opposition, which lasted the length of the project delivery, Lake Mokoan was eventually decommissioned in 2011. The Victorian Government continues to work towards rehabilitating the site to a series of interlinked wetlands.

Lessons from the project

- While there were wider benefits to decommission the lake, the community perceived the associated local risks as outweighing these benefits, leading to low acceptance levels for the project.
- Limited resources will impact on a project's ability to engage with the community and key stakeholders effectively.
- It is important to be aware of how external changes, including changes in the natural environment and climate, which are outside of the project's control, can impact on project delivery.
- Ensuring that relevant project governance structure and procedures are implemented – this can significantly improve the quality of project coordination, delivery, and overall management.
- It is important to be realistic about project cost estimates throughout the life of the project.

Step 4 – Deciding on a preferred method of decommissioning

This step supports an in-depth analysis comparing two or more competing future management outcomes for a dam. It can be used if the previous steps have not led to a clear decision on whether to decommission the dam, or on which method of decommissioning to choose.

Building on previous analysis, this step involves a robust evaluation of the key aspects of dam decommissioning. Each of these aspects is represented by assessment criteria as discussed in more detail in Appendix A.

This step should be designed to identify a preferred future management outcome and provide extensive supporting information. The robust evaluation in this step may involve assessments adequate enough for direct input into a business case for the preferred future management outcome, or even satisfy some legislative or regulatory obligations.

This step utilises multi-criteria analysis (MCA) as a decision analysis tool. Although MCA could be introduced in previous steps, its use is particularly applicable to cases where a single-criterion approach (such as cost-benefit analysis) falls short. An advantage of MCA is that it enables a combination of measurable criteria (e.g. cost) with those that are hard to quantify (e.g. social benefit).

To carry out Step 4:

- Decide on a methodology for an in-depth comparison of the methods of decommissioning a dam. The use of MCA is recommended.
 - Even if a decision on whether to decommission the dam has been reached, retaining the dam and maintaining it should be included as a possible outcome to be certain the best option has been chosen. In addition, business case inputs require a comparison with the status quo.
- Identify relevant assessment criteria for a dam using Table 4 as a guide.
- Carry out a formal assessment of all criteria for each of the options, involving stakeholders and community, as required. Appendix C provides further guidance on the MCA assessment process.

Outcome of Step 4:

- Identify and report on the preferred future management outcome for the dam.
- Consider ways to facilitate participation from stakeholder and community – see *Facilitating participation*

Method of assessment

MCA provides a structured and easy-to-use framework for comparing options with varied criteria. Table 4 documents the issues to consider when deciding on a preferred method of decommissioning. Any of the criteria or sub-criteria could be an individual criterion in multi-criteria analysis.

Selecting criteria enables a formal assessment of each of them, documenting the results. One approach to this formal assessment is multi-criteria analysis (MCA), outlined in Appendix C. The approach relies heavily on preferences/weighting of criteria, but the preferences/weightings are made clear and transparent.

Table 4: Issues to consider

Criterion: Social, cultural and heritage aspects
Sub-criterion: Community values
<ul style="list-style-type: none"> • Community's attachment to the current dam and views on proposed alternative. • Effect on recreational activities associated with the reservoir. • Effect on a range of other possible values provided by the dam, such as fire fighting capability, flood mitigation and property values. • Effect on the aesthetics and cultural significance of the dam site and adjacent river reaches.
Sub-criterion: Cultural and heritage impacts
<ul style="list-style-type: none"> • Effect of modifying the dam and its surrounds on the heritage of the site, including heritage planning requirements. • Effect on any cultural activities associated with the site.
Sub-criterion: Traditional Owner cultural values
<ul style="list-style-type: none"> • Effect of modifying the dam and its surrounds on land of cultural significance. • Effect of releasing water downstream when lowering the water body in preparation for construction works.
Criterion: Protection and enhancement of the environment
Sub-criterion: Ecological health of waterway and wetlands
<ul style="list-style-type: none"> • Overall changes to aquatic ecosystems as a result of decommissioning, including groundwater. • Effect on movement patterns of fish and other aquatic species, including accessibility of upstream habitat and spawning areas for migratory fish. • Effect on migratory birds. • Effect on fauna inhabiting perimeter of reservoir. • Impact of invasive weeds once reservoir is removed.
Sub-criterion: Physical-chemical hydromorphological quality
<ul style="list-style-type: none"> • Changes to hydrological regimes and flood mitigation. • Effect on the waterway's natural flushing function. • Effect on water quality from any mobilisation of sediments. • Thermal impact downstream of the dam.

- Impact on groundwater levels and quality.

Criterion: Economic viability

Sub-criterion: Project costs

- Costs of impact assessments (e.g. ecological studies, hydrological assessments).
- Engineering design and construction cost estimates against potential future upgrade costs, including dam safety.
- Landscape design and revegetation costs.

Sub-criterion: Financial viability and longer term impacts

- Impacts on operation and maintenance costs.
- Effect on operational revenue.
- Available sources of funding and possibility of cost sharing.
- Effect on local or regional economy (e.g. farming activities, tourism, land development, etc).
- Benefit/cost assessments.

Criterion: Legal and governance

Sub-criterion: Legal requirements

- Level to which proposed solution reduces dam safety risk.
- Ability to meet requirements under the *Water Act 1989* (see *Legislative and regulatory obligations* on page 23).
- The need for a planning permit or a heritage permit.
- The need for a referral under the *Environment Protection and Biodiversity Conservation Act 1999*.
- Other legal implications for the owner associated with decommissioning and potential transfer of ownership including due diligence requirements.

Sub-criterion: Future governance arrangements

- Current and future land tenure.
- Parties interested in future management or ownership of the site and their requirements.
- Future operation and maintenance requirements and clarification of associated roles and responsibilities.
- Clarification of water rights and requirements for any associated approvals (see *Legislative and regulatory obligations* on page 23).

Criterion: Technical aspects

- Level of complexity of the proposed engineering design.
- Ability of the proposed engineering design to provide downstream erosion protection post decommissioning.
- Ease of constructability, including site access and availability of construction materials.
- Ability to develop and implement a sediment management plan.
- Requirements for interim measures such as operating restrictions, coffer dams or diversion of waterway.

Facilitating participation

Successful engagement with stakeholders and the community will be critical, not just because activities at the stakeholder and community level have a direct link to the dam, but because their involvement in the process can play major part in the successful delivery of the project. Effective engagement promotes sustainable decisions by recognising and communicating the needs and interests of all participants including decision makers. Although they may not be empowered to make the final decision, there are many ways to facilitate participation from stakeholders and the community in the decision-making process.

Appendix B provides further guidance on facilitating the participation of stakeholders.

Case study: Bakers Gully Dams

North East Water own and maintain two reservoirs in a cascade called Bakers Gully Dams. The dams are more than 100 years old and have not been in service for over 40 years. They do not meet modern safety standards and had an unacceptable risk profile according to ANCOLD guidelines.

As the dams were unsafe and were not required for water supply, North East Water decided to decommission them. The proposed method of decommissioning each dam was:

Upper dam, 21.5 ML capacity and 8.5 m high dam wall:

- Drain and dewater the dam.
- Prepare, condition and redistribute of sediment material in preparation of clay capping.

Lower dam, 18 ML capacity and 4.8 m high dam wall:

- Lower the water level.
- Shape wetland and open water bodies.
- Lower the embankment level.
- Lower the spillway level.

The community of Bright reacted strongly to these proposals, especially the lowering of the water level. The community saw the dams as a historical feature of their township, and placed a high value on the dams as wildlife habitat and a place to enjoy nature. North East Water responded to this negative reaction by formally initiating a community consultation process, and engaged an ecologist to discuss with the community how the decommissioning project would protect wildlife habitat, particularly for platypus.

As a result of community consultation, North East Water changed the concept design to retain water in both reservoirs by lowering the two embankments and lowering and widening the spillways. Figure 5 show the change in the spillway configuration by comparing the pre and post decommissioning condition. This design allowed sufficient water depth to maintain platypus habitat and aesthetic value. The dam owner also committed to avoid construction works during the platypus-breeding season.

The community's response to this revised concept design was far more positive, and this was reflected in local media articles. Although the community had some minor issues, they agreed that the dam owner should proceed and undertake the detailed design. In preparing this design the dam owner retained the involvement of a smaller group of representatives from the community. The outcome is a decommissioning project that satisfies the majority of stakeholders. This project has now been tendered for construction.

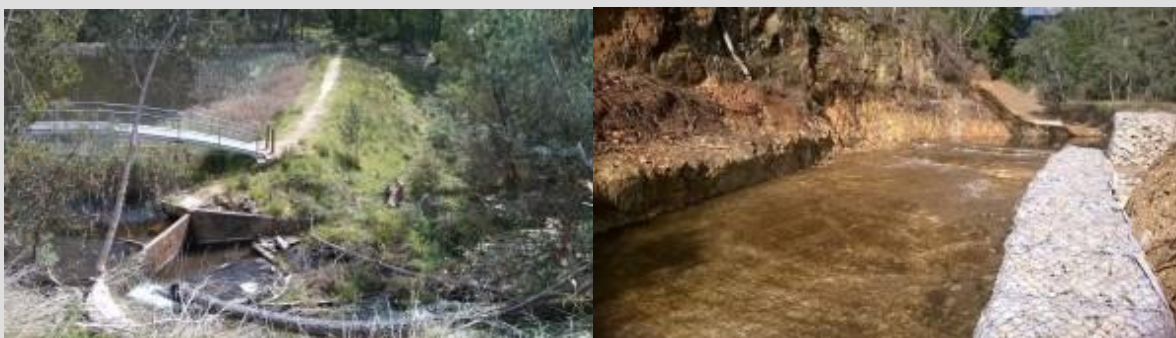
Lessons from the project

- The community should be engaged early in the project wherever possible. This can save time and resources by all stakeholders resolved.
- It is vital to understand how a community values a dam, and their different interests and usage of the site. The design should reflect these values where possible.

It is a good idea to divide the design plan into two parts:

- Non-negotiable – these relate to dam safety matters and cannot be changed.
- Negotiable – these are more flexible items in the design, in which the community can have impact.

Figure 5: Bakers Gully Lower Reservoir before (left) and after (right) decommissioning



Decommissioning project process

Once a preferred future management outcome has been determined, further approvals will be required. Actions may range from seeking endorsement to retain the dam and maintain its original function to preparing a more detailed submission explaining the method of decommissioning being proposed.

A detailed submission may require two stages, involving in-principle approval to undertake more detailed investigations followed by final approval to proceed. Once a decision has been made to decommission, the dam owner will need to manage a process to implement the chosen method of decommissioning.

Retain and maintain original function

If the decision is to retain the dam and maintain its original function, then the decommissioning process finishes at this point. Stakeholders and community who provided input into the process should be informed of the decision made.

It is also important that the owner continues to manage the dam and address identified dam safety deficiencies in accordance with the requirements of dam safety regulations and guidance provided by ANCOLD including, as appropriate, the engagement of stakeholders and the community.

Firefighting

Dams can be used as a water source during a fire emergency. In some cases, a storage will be published in a fire fighting handbook. This is not about an “approval to take water” as such, but to ensure that aircraft taking water do not cause damage to critical infrastructure such as valves, aerators, filters etc. DELWP and CFA can take water from anywhere in a fire emergency and there is no pre-approval necessary. Aircraft will generally take water from the nearest and most accessible source. Two key criteria in deciding if the waterbody can be safely accessed via aircraft and not become snagged on trees and debris are:

- Minimum 70 m horizontal clearance (diameter).
- Minimum 2 m deep water body.

This aspect should be considered as part of the MCA if a partial or full decommissioning option is being considered as the water level in the reservoir will change and stakeholders may prioritise firefighting depending on their experience.

Consultation with the right expertise (e.g. an environmental specialist) may be required in preparing a sediment management plan. Further information in the USSD Guidelines for Dam Commissioning Projects provides useful information on sediment management in Section 5.

Retain and alter

If the dam is to be retained but with a change of function, it is important to:

- Resolve any deficiencies with the dam safety in accordance with the requirements of dam safety regulations and guidance provided by ANCOLD.
- Plan ongoing management, compliance, monitoring and community engagement activities as required.
- Clearly document who would be responsible for the ongoing operation and maintenance of the dam, especially ownership or responsibility is being transferred, which will include any legislative and regulatory obligations (see *Legislative and regulatory obligations* on page 23).
- Manage any transfer of ownership or responsibility in consultation with future site owners and as appropriate, relevant government agencies.

The case study on Crusoe Reservoir (see page 8) describes an example of a reservoir being retained with a change of function and ownership.

Case Study – Nine Mile Dam

Nine Mile Road Dam is a 6 m high earthen embankment dam located approximately 600 m from the town centre of Rushworth, Victoria. It is approximately 130 m long, and has a crest width of 1-2 m. The dam is reportedly the original water supply for Rushworth constructed approximately 100 years ago. The Dam was owned by the Loddon Mallee District of the Department of Environment, Land, Water and Planning (DELWP). The reservoir had no formal use. It has been used as a backup water supply for firefighting purposes.

In 2017, GHD Engineering Consultants undertook a dam safety inspection. They assessed the dam to be in very poor condition and recommended immediate remediation or decommissioning.

Loddon Mallee District explored three options to remediate the dam which include:

- Removal of the dam and convert the waterbody to a wetland.
- Construct a new dam upstream of the existing structure.
- Remediate the existing structure.

Loddon Mallee District undertook a detailed options analysis followed by an economic evaluation of the three options. In terms of risk mitigation and financial viability decommission and removal option ranked better when compared to the other options.

Initial community engagement was through door knocking community members in the close vicinity of the dam. Followed by Loddon Mallee District organising a relatively large community meeting close to the dam. The community in principle agreed to the removal option. However, they proposed a section of the embankment be retained for heritage reason. Loddon Mallee District agreed to amend the decommissioning design to retain a section of the embankment.

Decommission design involved reducing the height of the dam to 1.5m, converting structure into a broad crest weir and cutting a v-notch in the middle. The Decommissioning process involved number of key aspects:

- Engineering design
- Native Vegetation/Flora & Fauna assessment study
- Heritage assessment
- Planning approval process
- Soil disposal options
- Community Consultation
- Contractor selection

The dam was decommissioned in June 2021. In the near future Loddon Mallee District are planning to install picnic tables in the vicinity of the newly constructed wetland for the benefit of the local community.

Lessons Leant

- Engage with the local community at the start of the project.
- Address their concerns and listen to their suggestions.

Figure 6. Nine Mile dam wall before (left) and during (right) decommissioning works



Partially or fully remove dam

Once a decision has been made to partially or fully remove a dam, the process becomes similar to a construction project. At this stage, there may still be a number of sub-sets of preferred design options to consider, and a number of iterations may be required between the preliminary and final design phase.

The project plan for the decommissioning project would include:

- Evaluation of options for final engineering and landscaping designs including need for significant temporary works, such as a cofferdam or stream diversion, and consultation with key stakeholders and future site owners.
- Further assessment of costs, financial viability, funding sources and any associated funding approvals required.
- Detailed impact analysis and studies. This may include ecological studies, heritage studies, sediment management and a possible referral for an Environment Effects Statement (EES). Generally, these assessments will expand on investigations undertaken to ascertain all potential issues and considerations needed to effectively evaluate decommissioning options. Step 4 may have already generated detailed assessments.
- Hydrological Assessments. While it is essential to assess the new dam break for a partially decommissioned dam, it is also important to assess how the waterway where the dam has partially or fully decommissioned will operate. This will include understanding the impact on downstream flooding and if any downstream properties will be affected. It will also be important to develop a drawdown plan so construction works can take place.
- Continuing the community engagement process, for example by inviting submissions from the public on the final proposal through local newspapers and gazetting.
- Developing a construction schedule and key relevant documents, which identify risks, technical specifications and environment management requirements, including a sediment management plan.
- Applying for approvals, licences and permits (see *Legislative and regulatory obligations* on page 20). As a minimum, preliminary investigations of these requirements and associated stakeholder engagement should have been undertaken as part of progressing through the four-step decision-making steps.
- Progress updates for all stakeholders, engaging the community on any ongoing concerns and resolution of any site-specific issues. For example, if water rights are involved additional legal arrangements may be required.
- Preparation of transfer of ownership documents and ongoing site management requirements in consultation with future site owners and relevant government agencies.

Managing sediment

All dams restrict the flow of sediment in a river. Some of this sediment becomes trapped and sinks to the bottom of the reservoir and builds up over time. Removing a dam is likely to lead to the movement of sediment, and possibly the restoration of a more natural river flow.

However, there are risks with releasing sediment. The quantity and quality of sediment released could have adverse consequences on water quality and biodiversity. Release of sediment could also lead to blockages or other problems downstream. Removal of permanent or semi-permanent exposed sediment during the decommissioning process may require permanent draining of the dam, which can create additional environmental impacts associated with odours and access. For these reasons, sediment issues may be one factor that helps determine the method of decommissioning and the decommissioning project is likely to require a sediment management plan.

A sediment management plan will need to be tailored to the project according to the volume of sediment and the presence of contamination. There are four broad approaches to managing sediment:

- No action – leaving the sediment in place.
- Sediment removal by natural river erosion processes.

- Mechanised removal.
- Stabilisation.

Consultation with the right expertise (e.g. an environmental specialist) may be required in preparing a sediment management plan. Further information in the USSD Guidelines for Dam Commissioning Projects provides useful information on sediment management in Section 5.

The case study on Honeysuckle Creek (see page 11) describes an example of the full removal of a dam.

Further useful information on aspects such as project design, lessons learnt from decommissioning and performance monitoring can be found in the United States Society on Dams (USSD) *Guidelines for Dam Commissioning Projects*.

Implementing decommissioning – structural changes and additional features

Decommissioning a dam may involve any or all of the following technical aspects. It is recommended that dam owners consider their individual situation to determine if alternative technical aspects should be investigated.

Typical structural changes:

- Modification or removal of parts or removal of the entire dam structure.
- Disconnection of outlet works such as intake towers and outlet pipes. Outlet pipes may be infilled with concrete.
- Disconnection of infrastructure connecting the dam to supply networks.
- Removal of part or all of instrumentation and monitoring equipment and any other mechanical and electrical equipment.
- Ensuring adequate flood mitigation post decommissioning by widening and/or deepening spillways.
- Improving erosion protection, for example by placing rock fill on the downstream face of the dam or spillway.
- Construction of cofferdams or temporary diversion of waterways.

Additional features may be required, including:

- Provision of fish passage facilities. Ecological studies may also reveal other aquatic species that require specific engineering design considerations.
- Landscaping. Typically, this would involve rehabilitating the land to echo the natural environment, for example by planting native vegetation.
- Provision for recreational facilities. This may include new footpaths, biking tracks or boating facilities. Depending on the layout of the site and the decommissioning design plan, provisions for public safety such as fencing may also be required.
- Construction of alternate water supply sources for any affected users, for example new offtakes to accommodate lower storage levels or for fire-fighting purposes.

Any method of decommissioning a dam is also likely to require consideration of sediment management (see page 18).

Monitoring the effectiveness of decommissioning

Once decommissioning is complete it is important to assess that the aims of the project have been achieved. It is also important to continue to monitor the site to ensure that the management and maintenance regime is followed, and objectives continue to be met. This may involve working with the new dam manager or owner where there has been a transfer of asset. Monitoring may highlight the need for additional work to address short-term or unforeseen effects of the decommissioning.

Monitoring of performance against objectives could involve asking some of the following questions:

- Is the dam being managed in accordance with any special conditions defined by the dam safety regulator or ANCOLD guidelines?
- Is the dam being managed in accordance with ongoing statutory requirements?
- Have the required licences been obtained as part of meeting regulatory requirements?
- Has the dam's change in use been successfully achieved?
- Has the full transfer of ownership been achieved, and is the new owner carrying out the required management and maintenance regime?
- Does the reaction from interested stakeholders and community to the dam's decommissioning require ongoing engagement?
- Has the environment management plan been implemented and is it effectively achieving its objectives?

- How has the river responded to the partial or full removal of the dam?
- How has the water quality downstream of the dam and water still stored in the dam changed?
- Is native vegetation in the inundation area re-establishing?
- What impact has the removal had on the flora and fauna in the area?
- Have there been changes in the aquatic populations in the river?
- Have there been detrimental impacts to the environment and if so, what is being done to manage them?

Case Study: Rethinking Reservoirs Project

In 2018 South Gippsland Water (SGW) completed a major project to connect four townships to the State Grid via the Lance Creek Water Supply System. The connection resulted in four reservoirs and two water treatment plants no longer required for their original purpose. The four dams did not meet current dam safety requirements and needed substantial investment to mitigate this risk.

The reservoirs are a range of sizes and attributes, three supplying Korumburra, one Poowong, Loch and Nyora:

- Bellview Creek Reservoir, 359 ML with a 16 m high dam wall, constructed in 1958.
- Coalition Creek Reservoir, 143ML with a 13 m high dam wall, constructed in 1895.
- Ness Gully Reservoir, 74 ML with a 11 m high dam wall, constructed in 1927.
- Little Bass Reservoir (Figure 7), 226 ML with a 12 m high dam wall, constructed in 1973.

A Steering group was formed, and sessions were held where the voice of community and stakeholders joined in assessing options and constraints. The sessions resulted in agreed statements for the long-term aspirations for the sites and shared understanding of the complexity of the task ahead.

- Coalition Creek: A level of water retained to be developed and used for golf club irrigation and a range of recreational purposes.
- Ness Gully: Lower the spillway to natural streamflow conditions.
- Little Bass: A level of water retained and eventually utilised as a recreational facility to benefit the local community.
- Bellview: Multi use site – industrial/commercial and recreational.

SGW's initial program plan was to finalise the direction including proposed budget of the long-term works. On completion of preliminary studies, structural works for the sites proved to be more expensive and more complex than initially envisioned. Allocation of significant capital funds for this program was not considered justifiable, given other SGW priorities. Regardless, the intent of the process continued and commitment to deliver on the long-term visions progressed.

Interim Progress

SGW are operating the reservoirs at lower levels to achieve the dam safety requirements. In parallel, a number of community partnerships completed to progress the Steering Committee aspirations.

Coalition Creek: Funding provided to install an irrigation system for the Korumburra Golf Club. In return the golf club is undertaking maintenance work at the site for a period of five years.

Ness Gully: The reservoir has been emptied. Land surrounding the reservoir is leased to a neighbouring property owner. The property owner is completing maintenance of the site as payment for the use of the land.

Little Bass: The reservoir is utilised by the Poowong Angling club. A partnership to install walking tracks, floating islands for birdlife, fish breeding habitat and revegetate the site is underway with Poowong Landcare.

Bellview Reservoir: The reservoir is utilised by the Korumburra Angling club.

Lessons from the project:

- The importance of completing the decision-making process with community and stakeholders resulting in a shared understanding and smooth transition from the localised water supply.
- The importance of understanding the process, complexity and requirements in recommissioning reservoir sites.
- The importance of being realistic about the process, budget and timing to reach a decommissioning long-term decision point. The process has taken much longer than initially envisaged.
- The importance of clear, open processes and communication.

Figure 7: Little Bass Reservoir



Legislative and regulatory obligations

This section describes some key legislative aspects that dam owners may need to consider during the decision-making process outlined in this document, as well as during a project to decommission a dam.

Dam safety regulatory framework

Major dam owners in Victoria are required to have regard to industry (ANCOLD) guidelines in developing and implementing dam safety management programs, and to give priority to reducing risks to life above other risks (DELWP, 2015a). This means that when a dam owner assesses a dam and finds that it poses a high risk to public safety, the owner should implement a range of risk reduction measures. These measures may include operating restrictions, structural upgrades, increased surveillance and monitoring and emergency management. In some cases, a dam owner may also consider decommissioning as a risk reduction measure. Generally, decommissioning as a risk reduction option is considered for smaller dams as those which are larger with higher consequence category tend to serve a more useful purpose (Walls, 2021)

Land ownership

In considering decommissioning, dam owners will need to be clear about who owns the site of a dam and its immediate surrounds. Land ownership will have implications for consent to modify the site as well as ongoing liability for the site. For example, if a dam is on crown land, and the dam owner would like to transfer ownership to a government agency after decommissioning, this agency would need to be a key stakeholder in developing decommissioning proposals.

Dam owners are advised to engage with existing landowners as early as possible if decommissioning is a likely future management outcome for a dam. Where transfers of ownership are being considered, dam owners are also advised to liaise early with DELWP to determine if section 74 of the *Water Act 1989* (the Water Act), which refers to transfer of licenses, applies to them.

Approval to decommission a dam

Section 139 of the Water Act requires public dam owners to seek Ministerial approval in order to decommission major works. For the purposes of this document, major works can be defined as dams or weirs that have significant economic, social, or environmental impacts.

Dam owners are advised to review section 139 of the Water Act and incorporate its requirements into their project planning process. Early liaison with the DELWP on the requirements of this section would be beneficial to dam owners.

Licence to construct works

Liaison between the dam owner and DELWP will be required to determine if the decommissioning of a dam is a major work. If it is not a major work, and the dam is located on a waterway, the dam owner will be required to apply for a licence to decommission works on a waterway under section 67 of the Water Act. Dam owners may submit this application to licensing authorities who have been delegated to act on behalf of the Minister for section 67 of the Water Act, namely Goulburn-Murray Water, Grampians Wimmera Mallee Water, Lower Murray Water, Melbourne Water or Southern Rural Water. If the dam owner is also the licencing authority, then the dam owner must submit the application to the Minister for Water.

Where relevant, dam owners are advised to review section 67 of the Water Act and incorporate its requirements into their project planning process. Early liaison with the relevant licensing authority will be beneficial to dam owners. Department of Environment, Land, Water and Planning (2018) provides guidance on current practise relating to small dam safety management and liscencing requirements for the construction and operation of dams.

Water rights

It is important to establish who owns the water prior to drawing down and making any releases from the reservoir. For example, if water needs to be released, there could be diverters downstream who could benefit from the water. If existing water rights would be impacted by a decision to decommission a dam, the owners of these rights should be key stakeholders in the engagement process. The dam owner will also need to liaise with DELWP to determine processes under the Water Act that may be invoked by changes to water rights or ownership.

The dam owner will need to be familiar with relevant sections of the Water Act, including section 44, which refers to amendments of bulk entitlements and section 46, which refers to transfers of bulk entitlements.

If a water right is proposed to be transferred to an asset that is not licensed, an application will be required under section 51 of the Water Act to take and use water. It is noted that the granting of such a licence is not automatic.

Other regulatory processes

A range of site-specific aspects may trigger the requirement for additional regulatory processes. For example, the presence of species of national environmental significance may result in a referral under the *Environment Protection and Biodiversity Conservation Act 1999*.

Environmental concerns may trigger the Planning Minister to request that the project proponent – normally the dam owner or a consultant on behalf of the dam owner – undertake an EES. The EES provides additional opportunities for community involvement at various stages of the planning process. Similarly heritage listings may result in a range of permits being required from relevant agencies.

Case study: Beaconsfield Reservoir

Beaconsfield Reservoir is a 912 ML storage with a 24 m high dam wall located in the suburb of Officer southeast of Melbourne. The reservoir is in a Public Conservation and Resource Zone where the Crown is responsible for the land who in turn have appointed a local committee of management group. Melbourne Water is responsible for the dam and appurtenant structures. The reservoir is over 100 years old and has been disconnected from Melbourne's water supply for approximately 30 years as an alternative reservoir was found to provide a higher quality, more reliable and less costly source. Figure 8 shows the dam wall which does not have the modern design features such as filters or an acceptable factor of safety, because of this it poses an unacceptable level of societal risk.

For the past decade Melbourne Water has been exploring future options for the reservoir which include:

- Do nothing
- Partial decommissioning
- Full decommissioning
- Dam safety upgrade

Initial community engagement was through door knocking community members in the close vicinity of the reservoir. At the time this was considered appropriate as access into the reservoir was restricted. However, after being invited to a local community group meeting and hosting an open day at the reservoir, it was clear that interest in the project spanned further than the neighbouring properties.

Two recurring themes of feedback received from the community during the initial consultation was the visual amenity of the water body as well as the role the reservoir played in firefighting. Both points would mean that the full decommissioning option would never be accepted by the community. It also would mean that the reduced water level in the partial decommissioning option would need to be strongly justified. The original water level for the partial decommissioning option was based on the minimum water level to sustain an ecological wetland. The level was reassessed based on the maximum water level to result in a consequence category of low or very low. This resulted in the water level being raised 2m, significantly increasing the surface area of water and the visual amenity. Melbourne Water then engaged with DELWP's Fire Fighting area to confirm the depth and surface area needed to allow access to firefighting aircraft.

A Multi-Criteria Analysis (MCA) was used to compare the four options and included criteria from the community. The preferred option was for partial decommissioning. In 2019 Melbourne Water met and wrote to the community advising them of the outcome. The project then moved into the detailed design stage.

Lessons Learnt

- Do not underestimate the breadth of stakeholders.
- Speak to the stakeholders to understand what criteria is important to them and incorporate it into MCA.
- Changes to a dam require technical analysis which can be time consuming. Specifically, consider impacts to downstream hydrology.
- Use landscape plans to communicate non-technical information.

Figure 8: Beaconsfield dam wall view from right hand side of crest.



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Appendix A

Assessment criteria for decommissioning

Assessment criteria for decommissioning

This section provides an overview of the assessment criteria for dam decommissioning. These criteria should be considered alongside additional matters or relevant issues.

Social, cultural and heritage aspects

Communities often have a strong attachment to a local dam and the surrounding environs. The dam site may also be of historical significance or may be a venue for broader cultural activities. This means that any plans to decommission the dam can face strong resistance, even if a dam owner decides there is poor justification for maintaining it.

Stakeholders may also have strong opinions about alternative methods of decommissioning. Dam owners should engage with stakeholders and community to understand what the dam means to different groups, and who would benefit from or bear the impact of a future decision on the dam. Table 4 *Issues to consider* (see page 14-15) highlights key questions for the dam owner to consider. For further information about engaging with stakeholders and community see Appendix B.

Protecting and enhancing the environment

Today there is greater environmental awareness of the impact of dams on the biological, chemical and physical properties of rivers and wetlands. Dams alter the natural flow of rivers, cause sedimentation and prevent upstream fish migration (Walls, 2021). These and other effects of dams can lead to significant degradation of the river environment. *Managing sediment* on page 18 provides some discussion on sedimentation.

Dam removal can restore some of the characteristics of the river system that existed before the dam was built. The positive and negative impacts of decommissioning on the environment should be analysed as part of an in-depth assessment of future management outcomes for a dam. Table 4 helps select some relevant environmental factors.

In choosing to retain a dam, it may be beneficial to construct new environmental features such as fish ladders and multi-level offtakes. For water corporations, these features are listed in the Statement of Obligations under clause 7-2.5. Where it is not practical to comply Victorian Water Corporations must write to the Secretary of DELWP seeking an exemption. O'Connor et. al (2017) provide detailed information on the implementation of a fishway and in applying for an exemption the dot points listed in Appendix 3 Implementation Guidelines – Refurbishment of Water Authority assets and provision of the Environmental Water Reserve and fish passage (Department of Sustainability and Environment, 2005a) should be addressed.

Economic viability

The decision will be informed by the economic benefits and costs of different options. The costs of decommissioning a dam can be significant, and potentially comparable to operating and improving an ageing dam. An economic analysis will quantify the net operational costs and the construction costs of each option. It will also take into account how dam decommissioning, upgrading or modification will be funded and consider the financial impacts on the dam owner's business.

The dam may currently play a role in contributing to the local economy, for example by supporting farming activities or tourism. Assessment of how future management outcomes for the dam would reduce or enhance this should also be considered. Table 4 (see page 14-15) provides guiding questions to analyse impacts on economic viability.

Legal requirements and future governance arrangements

In making the decision on dam decommissioning there are various legal aspects to consider. Legal aspects to consider include statutory requirements, and in some cases, the need to secure planning or heritage permits. Where there are rights to water from the dam, future arrangements will need to be clarified.

A related important issue is one of governance and ownership. A transfer of ownership and future management responsibilities for a site may be considered, but doing so will require finding willing parties. The ownership of dam sites can be complex and covered by several types of legal title. There may also be instances where de-proclamation and redefinition of declared water supply catchments are necessary. The *Legislative and regulatory obligations* section (see page 20) provides further discussion on legal and governance while Table 4 (see page 14-15) outlines aspects to consider for in-depth assessment of future management outcomes.

Technical aspects

The decision may be influenced by the technical and engineering difficulty of the options. This includes not just the core task of modifying the dam and related infrastructure, but additional requirements to achieve social or environmental objectives. Examples may be allowance for movement and breeding of aquatic species in engineering designs, or providing greater erosion protection downstream of the dam.

The *Decommissioning project process* section (see page 17) illustrates the structural aspects of dam decommissioning. The main consequences of a more technically difficult project will be increased costs, timescales and construction risk. Sediment management will be a significant component of the construction process (see page 18). Table 4 (see page 14-15) outlines technical considerations for an in-depth comparison of future management outcomes for a dam.

Appendix B

Engaging about dam decommissioning

Engaging about dam decommissioning

In assessing and undertaking a dam decommissioning project, stakeholder and community engagement can occur at a number of different levels, and the requirements of the consultation process can vary depending on the scope and nature of the project. This tip sheet has been developed to support the four guiding steps outlined in this document. For guidance on partnering and engaging with Traditional Owners and Aboriginal communities see Page 6 and 7.

The Department has published guidelines on *Effective Engagement: Building Relationships with Community and other Stakeholders*. These guidelines together with DELWP's *Engaging Communities on Dam Safety: A Guide for Dam Owners* are helpful resources when planning an approach to engaging about dam decommissioning.

Answering this simple set of questions is a good starting point for thinking about engagement:

- **Why** do we need to engage? What is the motivating issue or need?
- **Who** will be affected by the decision to decommission the dam? What are their values and interests?
- **What** type of tools and technics will be used? What resources are available – time, expertise, money?
- **When** will the consultation process run? How will this fit in with the decision-making timeline?
- **Where** will engagement activities take place? How will you encourage participation?

Step 1 – Determining the initial case for decommissioning

Understanding community and stakeholders

Considering the unique values and needs of different groups will help to develop a basis for communicating and engaging with stakeholders. Engagement with these groups is likely to be based on their interest in the dam, their level of influence, and what they may consider to be a successful outcome. Part of this will involve considering what aspects of the dam may be important to them and why. For instance, local farmers may rely on the dam to water crops and they will want to ensure their future supply is secure.

Stakeholders will range from Traditional Owners, interest groups, landholders and neighbouring residents. In some instances, interest groups that go beyond the local community may also need to be engaged, for example the Victorian Farmers Federation. Determining specific groups to engage with will depend on a range of factors including the location, use of the dam and the surrounding area, and associated environmental and social issues. Key stakeholder groups will include all government departments, agencies, and local councils who have an interest in the dam.

Table 5 provides an overview of some of the different groups to consider engaging with as an example.

Table 5: Example stakeholder and community groups

Stakeholders	Community and interest groups	Individuals
<ul style="list-style-type: none"> • Water authorities in the region • Catchment management authorities in the region • Environment Protection Authority • Department of Environment, Land, Water and Planning • Department of Jobs, Precincts and Regions • Parks Victoria • Local government • Traditional Owners (see Page 8) 	<ul style="list-style-type: none"> • Local Indigenous groups • Sports and recreation groups • Recreational fishing groups • Recreational boating groups • Industry groups • Victorian Farmers Federation • Victorian Tourism Industry Council • Conservation groups • Friends of groups • Landcare groups • People and Parks Foundation • Media 	<ul style="list-style-type: none"> • Landowners • Residents • Interested (often single issue) individuals

Step 2 – Making the case to maintain or decommission a dam

Planning the engagement approach

The International Association of Public Participation (IAP2) has developed a spectrum to help groups define the public's role in any public participation process (see Figure 3). The spectrum can be used to provide a basis for 'how' and 'when' stakeholder and community participation would be sought in the process. In moving through the spectrum from the left to right – inform through to empower – there is a corresponding increase in expectation for public participation and impact.

It is important to consider upfront what the different levels of participation are and what the purpose of the consultation is. For example, the removal of an on-stream storage would usually require a more rigorous consultation program than the retention of a small, off-stream storage with a change in function. In identifying stakeholder and community participants it is equally important to determine what types of inputs are required from them and when these inputs are required.

Based on past experience with dam decommissioning projects, the following general guidelines can help determine the level of involvement from the broader community.

- If it has been determined that input is required from individuals or groups, engagement should start early in the decision-making process. It is far better that stakeholders and the community find out about the potential project and their proposed involvement directly from the dam owner than through the media or other stakeholders.
- Provide clear and consistent information about the project, why it is happening, where the process is at, and the role of stakeholders and the community in the decision-making process.
- Going through the process of obtaining a planning permit will allow for public input to the project at a relatively early stage, but this should not be relied on as the only trigger for engaging.

Step 3 – Initial selection of a method of decommissioning

Choosing the right tools and techniques for engaging

Stakeholder and community engagement can take many forms and covers a broad range of activities. As part of tailoring any engagement approach, a mix of tools and techniques that support the required level of participation should be selected.

The IAP2 spectrum reproduced in Figure 3 provides example tools to consider using at each level.

It is important to consider tools and techniques that work with the project's timeline and budget. Like any project component, engagement involves a degree of risk. Planning an engagement approach early, including mapping out the tools and techniques, will help to identify risks, manage stakeholder expectations, and enable strategies to be put in place to best manage them throughout the process.

Figure 3: IAP2 spectrum – example techniques

Inform	Consult	Involve	Collaborate	Empower
Public Participation Goal:				
To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision-making in the hands of the public.
Promise to the public:				
We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and aspirations, and provide feedback on how public input influences the decision.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will look to you for direct advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.
Example techniques to consider:				
<ul style="list-style-type: none"> • Fact sheets • Website • Drop-in sessions • Site tours and field trips 	<ul style="list-style-type: none"> • Comment forms (surveys and polls) • Focus groups • Interviews 	<ul style="list-style-type: none"> • Forums and workshops • Deliberative polling 	<ul style="list-style-type: none"> • Reference and advisory groups • Participatory decision making 	<ul style="list-style-type: none"> • Citizen juries • Delegated decision making • Ballots

The Department’s *Effective Engagement Book 3: The Engagement Toolkit* provides detailed information about tools and techniques.

Step 4 – Deciding on a preferred method of decommissioning

Facilitating participation

Many stakeholders and community groups are already working together, so aim to tap into these networks where possible. Encourage a broad range of people to get involved and bring their perspectives by setting up reference and advisory groups, hosting forums and workshops, or organising site tours and field trips. As part of this, participants could be involved in determining appropriate criteria and developing the weightings for the options assessment. Extra resources or specialist advice may be needed to facilitate these activities. Providing information in a range of ways, including online, will enable participants to be informed and contribute to the process in a meaningful way.

It will be important to ‘close the loop’ in terms of explaining the outcomes of decisions, particularly where the final decision may not be exactly what some parts of the community wanted. The chosen option may be a compromise between contrasting viewpoints taking into consideration a broad cross section of suggestions from stakeholders. Dam owners should take care to explain to stakeholders how those factors led to the decision.

Appendix C

Multi-criteria analysis

Multi-criteria analysis¹

Identify criteria

Criteria should be selected that cover the important aspects of the decision (see Table 4 on page 14-15). These are the measures of performance for assessing options. Stakeholders and community representatives can be involved in helping to select key criteria – a robust and transparent framework will help stakeholders and the community see reasoning in the decision-making process.

Each criterion must be measurable, so it is possible to assess, at least in a qualitative sense, how well a particular option is expected to perform in relation to the criterion. Criteria must also be independent – meaning they do not overlap and each can be assessed in isolation without considering any other criterion.

Rate the criteria

Rate the expected performance of each option by assigning a score for each criterion on a range of -10 to +10. The reasons for the score of each option against each criterion should be documented.

Scoring scales will need to be selected – i.e. define the meaning of the scores of -10, 0 and +10 for each criterion. For example, for community support a score of 10 could be defined as more than 90 per cent of the community supports an option, and a score of -10 means less than 10 per cent supports it.

For all criteria a high score must equate to better performance – so a low cost will attract a high score, and a high cost a low score.

Assign weightings

Once the criteria have been selected, percentage weightings should be applied to each of them. This is a crucial stage as the weightings determine the importance of each criterion to the decision. Weightings are assigned by distributing 100 points across the criteria (see Table 6 on page 37). Weightings are initially decided based on the importance assigned to the selected criteria, incorporating stakeholder and community input (if appropriate). The reasons for the weightings given by stakeholder and community representatives need to be clearly identified and recorded.

Selection of who should be involved in assigning weightings and how weightings are agreed are themselves critical issues. A broad mix of stakeholder and community representation is recommended to minimise the risk of receiving a biased set of responses. The process for testing weightings and achieving agreement should be clearly outlined upfront. Participants should be provided with all the information they need to contribute in meaningful way as part of a well-facilitated process.

If the difference between the highest and lowest score for a criterion across the options is small, then that criterion will not be a central to the decision. If several key strongly weighted criteria have small differences in scores across options, then lesser-weighted criteria could determine a preferred outcome, but the overall difference could also be small. In this situation, key criteria selected should be revisited to ensure all appropriate criteria have been included, and if necessary, repeat the exercise with the revised criteria. When presenting a preferred future management outcome for approval, it will need to be made clear which criteria really selected the preferred outcome, and the difference between options was small.

Calculate Preference Scores

To calculate the preference score for each option:

- For each criterion, multiply the option's score by the weighting (giving the weighted score).
- Add up all the weighted scores to give the overall preference score for that option (divide by 10 for a percentage score – as in Table 6.)

¹ For detailed guidance on multi-criteria analysis see UK Government's Multi-criteria analysis manual for making government policy: <https://www.gov.uk/government/publications/multi-criteria-analysis-manual-for-making-government-policy>.

Examine results

The preference scores suggest a best option, as well as the difference in overall strength of preference – how much the best option surpasses the others. The outcome should be analysed, potentially through a stakeholder meeting, especially if the result is surprising or contrary to the wishes of certain stakeholders. One way of reviewing the outcome is to conduct a sensitivity analysis of the results – applying different scores or weightings to see how this affects the outcome will do this.

This can be a way of resolving differences between groups. However, it must be recognised that approval to a preferred future management outcome is normally not decided by the same stakeholders or community representatives that undertook the weighting assessment, but by others who will initially have their own weighting importance. Accordingly, it is important that the submission clearly identifies the basis and reasons for the criteria and weightings selected.

Table 6: Multi-criteria analysis

Future management outcome	Economic viability	Social aspects	Protection and enhancement of environment	Cultural and heritage aspects	Legal and governance	Water supply	Unweighted score	Preference (weighted) score %
Weighting	25	25	20	10	15	5	-	100
Retaining and maintaining original function	-1	8	1	6	8	2	24	38.5
Decommissioning method 1: Retain the dam and alter its function	-2	7	8	3	6	0	22	40.5
Decommissioning method 2: Partial removal of the dam wall	-4	-1	9	2	5	0	11	15

Three options have been scored out of ten for six weighted criteria. The weightings have then been applied to give a total percentage score. (The meaning of each criterion will be fully described in the final document.) Decommissioning method 1 scores highest.

This example analysis reveals a preference for Decommissioning method 1. The current dam actually has the highest unweighted score (24) but loses out because it performs poorly on environmental benefit, which has a relatively high weighting. A sensitivity test might investigate the impact of lowering the weighting for environmental benefit and increasing it for financial cost, heritage or legal and governance.

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