MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Proposed Regulatory Framework
for Dam Safety

June 2019

MBIE 4363

New Zealand Government

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Ministry of Business, Innovation and Employment (MBIE)

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The proposal outlined in this discussion paper does not represent a consensus view from the working group, nor should it be assumed that members endorse the proposal as set out. Members and their organisations are entitled to make submissions in support of or against the proposal.

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MBIE is consulting on post-construction dam safety regulations

MBIE seeks your feedback on proposals for a new regulatory framework for dam safety under the Building Act 2004. The proposed regulatory framework in this discussion paper aims to establish a nationally consistent approach to dam safety that better manages the potential risks of dams without imposing undue compliance costs.

The proposals will provide better assurance that dams are being managed appropriately and will enable a better understanding of the number, size, location and ownership of all classifiable dams in New Zealand.

The Government welcomes your feedback on this discussion paper, and anyone is welcome to make a submission. Your feedback will be considered in refining and improving the proposal before Government makes final decisions.

Document structure

This proposal is likely to be of interest to a range of audiences. This paper is structured with an executive summary, an easy-to-understand introduction for the general reader and in-depth information for those who want more detailed discussion. The discussion paper is set out as follows:

- **Section 1** provides a summary of the proposal
- **Section 2** provides a summary of proposed definitions
- **Section 3** outlines the aim of the proposed dam safety regulations
- **Section 4** provides background to the proposed dam safety regulations
- **Section 5** provides an overview of the proposed dam safety regulations
- **Section 6** sets out the core elements of the proposed dam safety regulations
- **Section 7** sets out the elements for dangerous, earthquake-prone and flood-prone dams in the dam safety regulations
- **Section 8** outlines the proposed guidance and forms for compliance with the dam safety regulations
- **Section 9** outlines the regulatory impacts.

How to provide your feedback

MBIE invites written comments on the proposals in this document by 5:00pm, Tuesday 6 August 2019.

Key questions are provided throughout the document to guide your responses. They are a guide only, and all comments are welcome. You do not have to answer all the questions.

There are three ways you can make a submission:

1. fill in the online survey at:
   www.mbie.govt.nz/damsafety
2. download a submission form to complete and return to us. This is available at www.mbie.govt.nz/damsafety. If you do not have access to a computer, we can post a copy of the submission form to you.
3. type up or write out your own submission.

Please include the following information in all submissions:

- your contact details – name, postal address, phone number and email address (if applicable)
- organisation, if applicable
- the title of this discussion paper
- whether you support or oppose the proposed dam safety regulations and your reasons
- your submission, and the reasons for your views
- any changes you would like made to the proposed dam safety regulations.

Please send your submission by:

Filling in the online survey at www.mbie.govt.nz/damsafety

OR

Email to DamSafety@mbie.govt.nz, with subject line "Dam Safety Consultation"

OR

Post or courier to:
Dam Safety Consultation 2019
Building System Performance
Ministry of Business, Innovation and Employment
15 Stout Street PO Box 1473
Wellington 6140

Submissions close at 5.00pm on Tuesday 6 August 2019.

Contact for queries

Please direct any queries to:

Email: DamSafety@mbie.govt.nz

Post: **Dam Safety Consultation 2019**
Building System Performance
Ministry of Business, Innovation and Employment
15 Stout Street, PO Box 1473, Wellington 6140.

What happens to your feedback?

Your feedback will contribute to the development of a nationally consistent approach to dam safety that aims to protect people, property and the environment from the potential impact of a failure of a dam.

It will become official information, which means it may be requested under the Official Information Act 1982 (OIA).

The OIA specifies that information is to be made available upon request unless there are sufficient grounds for withholding it. If we receive a request, we cannot guarantee that the feedback you provide us will not be made public. Any decision to withhold information requested under the OIA is reviewable by the Ombudsman.

The Privacy Act 1993 will apply to all submissions. MBIE may publish a report summarising the submissions received. If you don't want your name or any personal information to be included in anything we publish, please make this clear in the submission or in your covering letter or email.

Minister's foreword

Building and Construction Minister, Jenny Salesa

The safety of New Zealanders is a priority for me as the Minister for Building and Construction. All buildings, including dams, must be safe and durable. Ensuring dams are well maintained is one of a number of initiatives this government is putting in place to support the sustained transformation of the building and construction industry.

The impact of a dam failure can be immense. There is potential for loss of life, damage to property, and damage to the environment.

To protect our people and our taonga, we need to be sure that the dams we rely on and live around are being maintained and monitored appropriately after they are constructed.

To achieve this, an efficient regulatory scheme for dam safety is required. The proposed new scheme pulls post-construction regulatory requirements together into a single, consistent nationwide framework. The owners of dams will be responsible for ensuring that their dams are being managed appropriately; proportionate to the risk they pose.

The proposals in this paper will ensure that dams are well maintained and regularly monitored, and that potential risks are reduced. The scheme provides a framework for classifying dams according to the potential impact the dam would have on people, property and the environment in the event of failure. It also recognises that risk factors for a dam can change over time due to factors such as site conditions, urban development, hazards such as flood events or earthquakes, and the effectiveness of maintenance.

A wide range of stakeholders have been consulted in developing the proposed regulations, including regional councils, water supply authorities, professional engineers, dam owners, farmers and irrigators. I sincerely thank these people for their time, patience and expertise.

To achieve our goals, we now need your input and feedback. I encourage you to participate in the consultation process and help us to get the scheme right.

1. Executive summary

A consistent and effective dam safety framework

There is no comprehensive scheme to monitor and maintain the structural integrity of dams in New Zealand. In the absence of a dam safety scheme, some regional authorities have placed maintenance conditions in resource consents. However, this practice lacks consistency, as some dams have fewer conditions than others, while some older dams have no conditions at all.

As dams in New Zealand age, there is growing recognition of the scale of hazards that dams are exposed to, such as earthquakes, floods and storms. In addition, there has been a proliferation of agricultural dams, and new infrastructure is being developed downstream of dams.

The special nature of dams, particularly the potential risk they pose to people, property, and the environment downstream of the dam, often remote from the dam site, means that a unique regulatory approach is required.

Dams that present a potential risk to people, property, and the environment need to be identified and appropriately managed. A dam safety scheme is required to ensure that dams are being managed appropriately proportionate to the potential risk they pose.

The Building Act provides a framework for dam safety management, but regulations are needed to bring this scheme into full effect. The proposed dam safety regulations are intended to provide a consistent and effective regulatory framework for dam safety. Dams included in this framework will be known as 'classifiable dams' and will meet the following classifiable threshold:

- at or above 4 metres in height and 20,000 cubic metres in volume; or
- less than 4 metres in height, but at or above 30,000 cubic metres in volume.

The regulations proposed in this discussion paper place responsibilities on owners of dams to ensure that their dams are maintained to an acceptable level of safety. The proposals have been designed to align with elements of industry best practice for dam safety and to exclude small dams, such as those used for stock drinking water or small-scale irrigation.

The proposed regulations take a risk-based approach

The proposed regulations take a risk-based approach to safety management and place obligations on owners of dams proportionate to the risk their dam or dams are likely to pose. The proposed regulations do this by targeting classifiable dams that in the event of failure could harm downstream populations, and damage property and the environment (including flora and fauna).

The owners of classifiable dams will be required to assess the Potential Impact Classification (PIC) of the dam. The PIC can be understood as a system for classifying dams according to the consequences of dam failure. This is an estimate of the likely impact on downstream populations, property and the environment if a dam were to fail.

If the PIC is assessed as Low, the owners of dams will have limited regular ongoing obligations. If the PIC is assessed as Medium or High, owners of dams must:

- develop a Dam Safety Assurance Programme (DSAP) to monitor the safety of their dam, and undertake periodic reviews of their DSAP
- take actions identified as necessary to maintain the safety of their dam, such as regular surveillance and monitoring or the inspection and maintenance of appurtenant structures
- report compliance with the DSAP to their regional authority through an annual dam compliance certificate.

Information is incomplete on dams that exist across New Zealand, and currently there is no system in place nationally to collect data on dams. The proposed regulations will help to address this by requiring the owners of classifiable dams to provide basic information on their dam(s), as well as their PIC, to the relevant regional authority.

Regional authorities will monitor and enforce compliance

Though the onus will be on owners of dams to provide the correct information to regional authorities, the Building Act creates tasks for regional authorities.

Regional authorities will be required to:

- establish and maintain a register of dams
- approve, or refuse, DSAPs for Medium and High PIC dams
- develop dam safety policies for dangerous dams, earthquake-prone dams and flood-prone dams.

Regional authorities will also enforce compliance with the proposed regulations and the Building Act. Owners of dams who fail to comply with their responsibilities under the Building Act face committing a number of offences. The penalties for these offences range from fines of $5,000 to $200,000.

Most of the information submitted by owners of dams as evidence of compliance with the proposed regulations will need to be prepared or signed off by a ‘Recognised Engineer’. The proposed skills and competencies of these engineers are described in section 4 of this paper.

Benefits are balanced against costs

Any system of new regulation involves striking a balance between risk management and avoiding unnecessary costs. In proposing a new scheme for managing dam safety, the Government has sought to appropriately balance the risks of dam failure against compliance costs created by new rules.

For the owner of a small dam, compliance will be limited to assessing whether their dam meets the classification threshold. If the dam does not meet the threshold, no further action will be required.

Compliance costs will mainly affect Medium and High PIC dams that do not have adequate management and maintenance plans in place. These may, for example, include urban flood detention dams, which have not been classified and have no dam safety management systems in place. These owners will face initial set-up costs to comply with the regulations and ongoing compliance costs. Owners who already comply with industry best practice will face only minimal increases in their current administrative costs. The costs of the scheme are documented in section 9 of this paper.

Based on the current New Zealand Inventory of Dams (NZID), the proposed classification threshold would capture an estimated 903 dams or approximately 27 per cent of dams in the NZID, including all known High PIC dams (89) and an estimated 115 Medium PIC dams. However, a further 1,562 dams out of a best available data set of 3,284 dams lack sufficient height and volume data to be tested against the proposed classification threshold. Further information on these dams will only be made available to regional authorities if the dams meet the proposed classification requirements.

MBIE will complete a cost–benefit analysis informed by the feedback received from this discussion paper.

2. Summary of proposed definitions

The Building Act requires a number of terms be defined in the regulations. Feedback is invited on the proposed definitions of these key terms.

Table 1: Proposed definitions of key dam safety terms

Term	Proposed definition
Classifiable dam	A dam that has either: (a) a height of 4 or more metres and holds 20,000 or more cubic metres volume of water or other fluid; or (b) a height of less than 4 metres and holds 30,000 or more cubic metres volume of water or other fluid.
Recognised Engineer	A 'Recognised Engineer' is an engineer described in section 149 of the Building Act, and has some or all of the following competencies: • geotechnical principles • design principles including structural, geotechnical, seismic, hydrologic and hydraulic principles • dam construction techniques • operation and maintenance of dams • surveillance processes • response to dam safety issues • emergency planning and emergency response • resolution of potential dam safety deficiencies • dam safety critical plant systems.
Moderate earthquake	Moderate earthquake means, in the context of dams, an earthquake that would generate shaking at the site of the dam that would occur with a 1 in 50 annual exceedance probability* (determined by normal measures of acceleration, velocity and displacement), but not less than shaking determined using a z factor of 0.13**.
Moderate flood	Moderate flood means, in the context of dams, a flood of water or other fluid flowing into the reservoir that has a 1 in 50 annual exceedance probability.
Earthquake threshold event	Earthquake threshold event means, in relation to a: (a) High potential impact dam, an earthquake that would generate shaking at the site of the dam with a 1 in 500 annual exceedance probability (determined by normal measures of acceleration, velocity and displacement), but not less than shaking determined using a z factor of 0.13 (b) Medium potential impact dam, an earthquake that would generate shaking at the site of the dam with a 1 in 250 annual exceedance probability (determined by normal measures of acceleration, velocity and displacement), but not less than shaking determined using a z factor of 0.13.
Flood threshold event	Flood threshold event means, in relation to a: (a) High potential impact dam, a flood of water or other fluid flowing into the reservoir that has a 1 in 500 annual exceedance probability (b) Medium potential impact dam, a flood of water or other fluid flowing into the reservoir that has a 1 in 250 annual exceedance probability.

*Annual exceedance probability refers to the probability of an event of a given size or larger occurring in any one year. For example, a one per cent AEP event has a 1 in 100 chance of occurring in any one year.

**The z factor (or seismic hazard factor) is a measure of ground shaking.

Questions on the proposed definitions in the dam safety regulations:

1 **Do you think the proposed definitions of key dam safety terms are appropriate?**

2 **If you do not think any of the proposed definitions are appropriate, can you make suggestions on how any of them can be improved?**

3 **Do you have any comments on how these proposed terms will work in practice?**

3. Background

This section provides background information on the proposed regulations. It includes:

- what we know about dams in New Zealand
- the gaps in the regulatory framework
- the relevant legislation in the:
  - Building Act 2004
  - Resource Management Act 1991
  - Health and Safety at Work Act 2015
- the New Zealand Dam Safety Guidelines.

Dams are critically important to the New Zealand economy, and investment in dam infrastructure is worth billions of dollars. Dams can be used to store water for municipal water supply, irrigation, hydroelectricity generation, enhancing fisheries, and recreation. Dams can also be used for effluent storage, flood management, and mine tailings.

Dams fail for many reasons, and failures can arise at any stage in a dam's life. Failures can be caused by human error or natural events, and include:

- movement or failure of the foundations or supporting structures
- settlement or cracking
- internal erosion
- overtopping
- inadequate maintenance
- acts of deliberate disturbance.

Dam safety requires ongoing active management, inspection and maintenance proportionate to the dam's potential impact of failure. Inspection and maintenance activities are already undertaken by some owners of dams across New Zealand.

These activities are covered by a number of regulatory schemes, but there is no single comprehensive scheme governing dam safety.

What we know about dams in New Zealand

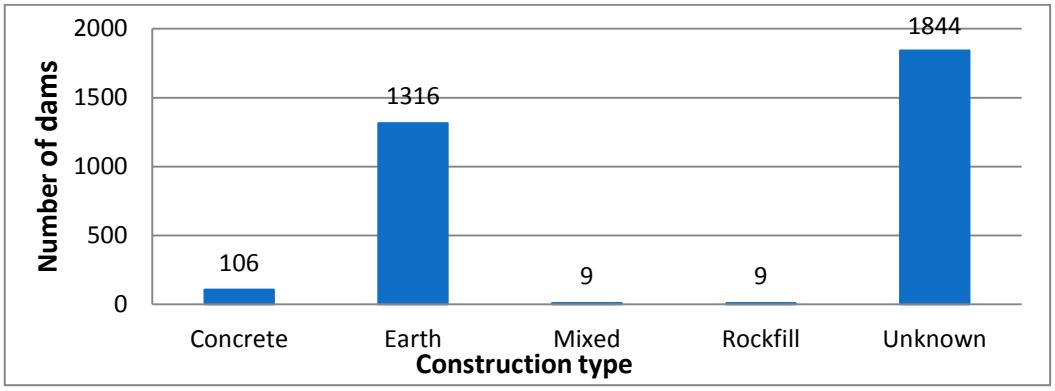
Information on the size, type, downstream geography, and the potential impacts of a dam failure is critical for designing a nationally consistent scheme for dam safety management. Having good information on dams helps owners, regional authorities, and neighbouring communities understand the associated benefits of dams and the potential consequences of dam failure.

Owners of dams need this information to plan and undertake appropriate safety activities. Regional authorities need this information for quality building management decisions, and communities need access to this information to anticipate, and plan for, the potential consequences of a dam failure.

The analysis presented in this discussion paper is based on the best available information from the New Zealand Inventory of Dams (NZID)[1]. The latest NZID contains information on known dam structures varying in size from 0.5m to 118m, though heights are recorded for under half of the dams in the inventory. As of April 2018, incomplete height and volume data is available for over 3,000 dams. Ongoing stewardship of the NZID data set is required to improve overall understanding of the dam portfolio for regulatory oversight, asset management and research.

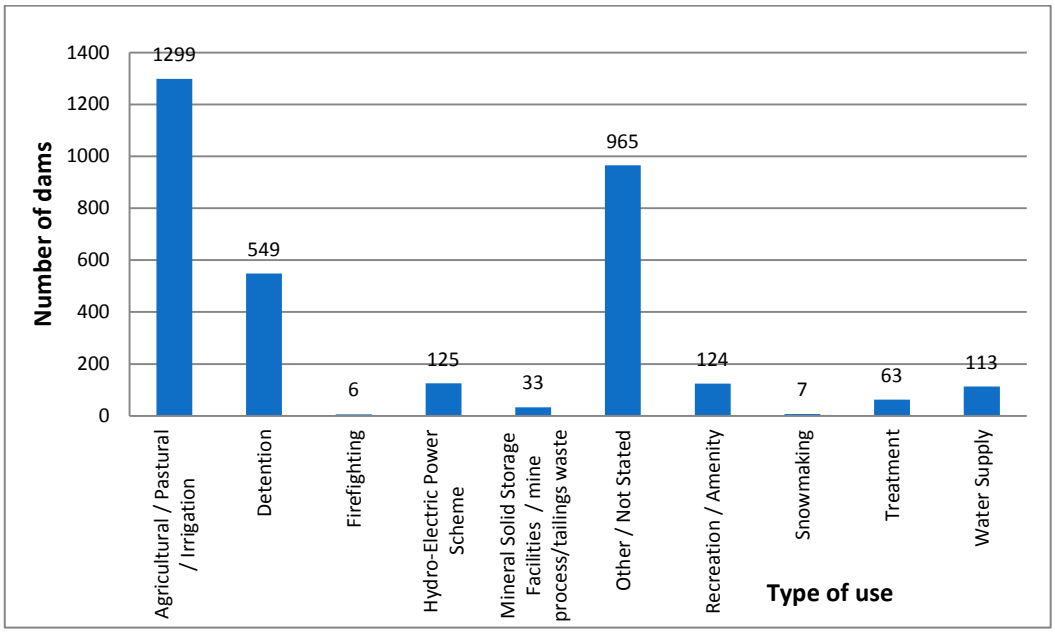
Figures 1 and 2 illustrate how known dams across New Zealand vary by construction type and use.

Figure 1: Number of known dams in New Zealand by construction type



[1] The NZID information is based on a data set initially collated by the Government's then-Ministry of Commerce. It was subsequently extended by the Otago Regional Council with assistance from other regional councils and updated in 2018 by the University of Canterbury's Quake Centre following funding from the Ministry for the Environment.

Figure 2: Number of known dams in New Zealand by type of use



Gaps in the regulatory framework

A framework for dam safety is set out in the Building Act, but regulations are needed to give full effect to this framework. The lack of a full dam safety framework is problematic for the following reasons:

- *Risk to downstream people, property and the environment:* the regulatory framework does not specify the safety-related activities that owners should carry out. A lack of monitoring, or loose monitoring processes, and/or deferring maintenance can create the potential for dam failure.
- *Lack of certainty and difficulties for owners of dams to ascertain obligations:* there is a lack of certainty about what ongoing safety-related assurance activities owners of dams are required to carry out.
- *Inconsistencies in compliance conditions across dams:* in the absence of specific dam safety regulations, some regional authorities use conditions on resource consents as a way to manage dam safety. This practice can mean that dams posing the same level of risk are facing different dam safety requirements. Older consents may have fewer conditions relating to dam safety, while newer consents tend to have more detailed conditions. Some of the more recent resource consent conditions refer to the *New Zealand Dam Safety Guidelines* (2015).[2] This inconsistency can be confusing for operators who are responsible for more than one dam, other participants in the resource consent process, and authorities who manage these processes.

[2] *New Zealand Dam Safety Guidelines*, 2015, The New Zealand Society on Large Dams IPENZ, Wellington.

- *Lack of reporting requirements*: the Building Act requires regional authorities to keep a register of dams in their region. However, regulations are needed to give effect to the parallel requirement for owners of dams to provide regional authorities with their dams' potential impact classifications and dam safety assurance programmes.
- *Enforcement challenges:* conditions that vary across similar dams, or that are loosely specified e.g. "compliance with the *New Zealand Dam Safety Guidelines* (2015)" may be difficult to enforce.

Relevant legislation

The Building Act, the Resource Management Act 1991 (RMA) and the Health and Safety at Work Act 2015 (HSWA) all contain legal responsibilities that affect the construction and ongoing operation of dams.

Building Act

All dams are buildings under the Building Act. Dams that have a height of four or more metres and hold 20,000 or more cubic metres volume of water or other fluid require building consent for construction, alteration and/or demolition work. Regional authorities are responsible for managing the Building Act's consent process for new dams.

The information included in a new dam's building consent application may vary regionally, but it must contain any information that the building consent authority reasonably requires, including evidence of compliance with the Building Code[3].

The Building Act also provides a framework for the regulation of dams - including post-construction dam safety. Regulations are required to bring this framework into full effect. This framework includes regional authorities collecting information from owners of 'classifiable' and 'referable' dams based on prescribed criteria and standards, maintaining regional dam registers, and developing policies on dangerous dams.

Resource Management Act 1991

Section 13 of the RMA places restrictions on certain uses of beds of lakes and rivers, including erecting any structure or part of a structure. Section 14 places restrictions on taking, using, damming and diverting water. The management of these activities is a regional authority function.

Under the RMA, regional authorities use:

- regional policy statements to provide an overview of the resource management issues of the region and policies to achieve integrated management of the natural and physical resources of the whole region
- regional plans to set rules about managing resources such as soil, fresh water and the coastal environment.

[3]The Building Code is set out in Schedule 1 of the Building Regulations 1992.

If a dam is doing any one of the following activities, and it is not expressly permitted, the activity will need resource consent:

- activities in and occupation of the bed of a lake or river
- taking, using, damming, or diverting water
- discharging of water into water
- discharging of contaminants into water.

Earthworks associated with the construction of a dam are also likely to require resource consent.

Overlap of the proposed regulations with the Resource Management Act

Regulations made under the Building Act may duplicate conditions on resource consents which have been used as a way to manage dam safety.

Owners of dams have the ability under section 127 of the RMA to apply for a change or cancellation of a consent condition. Additionally, in a small sample of resource consents for dams processed between 2005 and 2015, most consents had conditions that could be reviewed by the relevant council under section 128 of the RMA. Any council-led review could result in the removal of conditions relating to dam safety that are covered by the regulations under the Building Act.

Health and Safety at Work Act 2015

The HSWA applies to all workplaces. As a result, owners of dams have obligations to identify, assess and manage risks posed by their dams if the dams are workplaces. Owners of dams need to ensure risks to dam workers are identified and that steps are taken to mitigate these risks in order to provide a safe working environment.

New Zealand Dam Safety Guidelines 2015

In 2015, the New Zealand Society on Large Dams (NZSOLD)[4] published the *New Zealand Dam Safety Guidelines* (2015)[5] (the Guidelines). The Guidelines are necessarily relevant to any discussion of dam safety because they are current, credible and represent industry good practice amongst dam safety engineers.

[4] NZSOLD is a Technical Interest Group within Engineering New Zealand. NZSOLD seeks to "promote best practice in the development, operation, maintenance and refurbishment of dams and their associated impoundments throughout New Zealand; integrate best practice into the regulatory process associated with the dam and impoundment management industry in New Zealand; be recognized as a credible and respected professional body, and the national focus for all matters relating to dams and their associated impoundments in New Zealand; provide a forum that brings industry representatives and associated stakeholders together for the benefit of all."

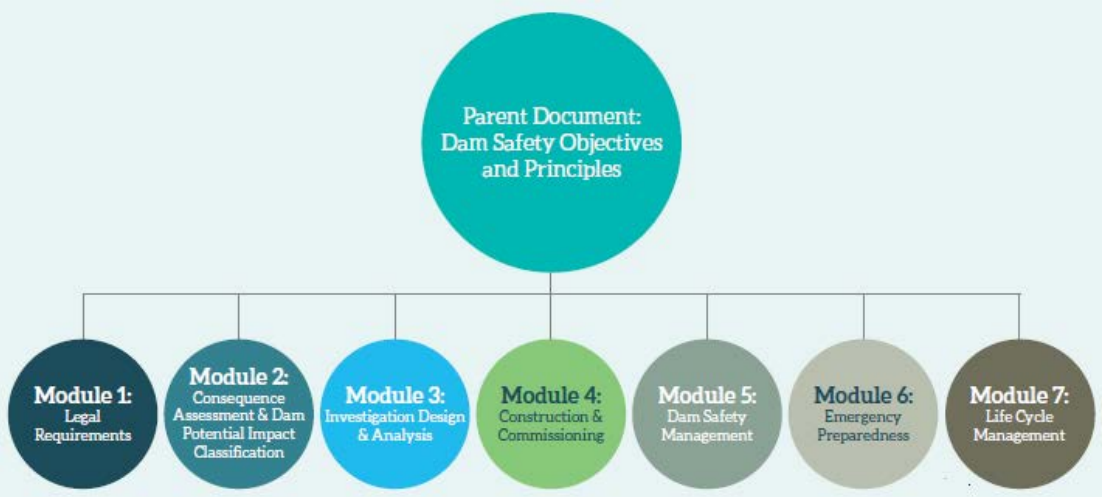
[5] *New Zealand Dam Safety Guidelines,* New Zealand Society on Large Dams IPENZ, 2015. Available at https://www.ipenz.nz/docs/default-source/PublicationsLibrary/nzsold_dam_safety_guidelines---may-2015.pdf?sfvrsn=2

The Guidelines represent a body of collaborative work undertaken by dam engineering construction experts, dam safety experts, owners of dams and other stakeholders. The Guidelines are consistent with advice issued by the International Commission on Large Dams, and have been internationally reviewed as representing good practice. Furthermore, insurers have confidence in owners and operators of dams who can demonstrate compliance with the Guidelines.

The Guidelines are not incorporated into law, meaning that best practice advice is not legally binding. However, the elements of the Guidelines have, in part, been reflected into the proposed regulations detailed in section 6 of this discussion paper.

The Guidelines are made up of a parent document that "defines dam safety objectives and principles applicable to the investigation, design, construction, commissioning, assessment, rehabilitation and operation of dams in New Zealand",[6] and a series of separate supporting modules that outline processes and criteria for the management of dam safety. The breadth of the Guidelines is shown in **Figure 3**.

Figure 3: New Zealand Dam Safety Guidelines structure and contents



Source*: New Zealand Dam Safety Guidelines,* New Zealand Society on Large Dams IPENZ, 2015

[6] Ibid

4. Aims and overview of the dam safety regulations

This section provides the aims of the proposed regulations and an overview of the proposals. This section seeks your views on the proposed Recognised Engineer requirements as well as the implementation timeframes. This sections includes:

- How the proposed regulations for dam safety will work
- The roles and responsibilities for those in the scheme, including:
  - owners of dams
  - regional authorities
  - Recognised Engineers.

The dam safety regulations proposed in this discussion paper aim to ensure that people, property and the environment are protected from the harmful effects of a dam failure. The proposals have been designed to align with elements of existing industry best practice for dam safety and to exclude, from regulation, small dams, such as those used for stock drinking water, or small-scale irrigation. These small dams are unlikely to cause significant damage to downstream life, property or the environment.

The proposed regulations will:

- provide a framework for the classification of dams, according to the potential impact the dam would have on people, property and the environment if it were to fail
- place responsibilities on the owners of dams to ensure that their dams are maintained to an acceptable level of safety
- include the owners of dams who are not already following elements of best practice
- specify criteria and standards to ensure that dams are being managed appropriately proportionate to the potential impact of the dam's failure
- ensure that there are appropriate procedures in place for the management of dam safety incidents or emergencies
- ensure that regulators have better information on the number, size, location and ownership of dams that would have the potential to have a significant impact on people, property and the environment in the event of failure.

A dam safety scheme will bring New Zealand into line with the majority of the Organisation for Economic Co-operation and Development countries that already have dam safety schemes in place. The proposed regulations will mean that the number, size, location and ownership of all classifiable dams in New Zealand is better understood.

The criteria for assessing the proposed dam safety scheme are outlined in **Table 2**: Assessment criteria for the design of a new dam safety scheme**.**

Table 2: Assessment criteria for the design of a new dam safety scheme

A scheme that is…	… means the regulations will…	To achieve this, the regulations:
Certain	be transparent and clear: owners of dams and regulatory authorities understand exactly what is expected from them and when.	clearly specify owners' obligations in regard to monitoring, maintenance and reporting requirements clarify that responsibility for compliance rests with the owners of dams provide clarity on the roles and responsibilities of owners of dams and regulators (the regional authorities administering the regulations).
Pragmatic	be feasible to implement.	align with existing Building Act requirements, insurance requirements and the *New Zealand Dam Safety Guidelines* (2015).
Efficient	support administrative efficiency and allow owners of dams to act efficiently too.	create an effective approach to dam safety without creating unnecessary new red tape for owners of dams or regional authorities.
Proportionate	be fair and balanced, without unnecessary costs on owners of dams.	ensure the risks of dam failure – particularly the risks to people – are appropriately balanced against compliance costs to owners of dams and the regulatory authorities.
Consistent	require owners of dams and regional authorities across New Zealand to apply and comply with the same standards.	create a nationally consistent framework.

Will the dam safety regulations apply to your dam?

The dam safety requirements will apply to all dams that meet the definition of a classifiable dam in the regulations.

All owners of dams will be required to assess whether their dam is classifiable against a classification threshold (height of the dam and volume of the reservoir at its peak operating level). Only owners of classifiable dams will be required to undertake subsequent steps.

For the owner of a small dam, compliance will be limited to considering whether their dam is below the classifiable dam classification threshold. If it is, no further action will be required.

Roles and responsibilities

Owners of dams

The responsibility for the safety of the dam remains with the owners.

Owners of dams range from regional authorities, territorial local authorities, private owners, irrigation companies and farmers, through to electricity retailers and hydroelectric power generators[7].

Under the proposed regulations, owners of dams will be responsible for:

- assessing their dams against the classification threshold
- determining the potential impact classification (PIC) of their dam
- submitting the PIC to a Recognised Engineer for certification
- providing the PIC to the regional authority
- preparing Dam Safety Assurance Programmes (DSAPs) for audit by suitably qualified experts
- providing certified DSAPs to the regional authority
- reviewing their dam's classification.

Regional authorities

Under the Building Act, regional authorities perform the functions of a building consent authority relating to dams (including the issue of building consents). Regional authorities also carry out the following functions in relation to dam safety maintenance requirements:

- receiving information on classifiable dams related to the size and location of these dams
- approving or refusing dam classifications
- approving or refusing DSAPs and approving any changes to these
- receiving annual dam compliance certificates and maintaining a register of dams
- enforcing compliance with any dam safety regulations using Building Act enforcement powers if necessary. It is an offence for owners of dams who fail to comply with dam safety requirements under the Building Act. The penalties for these offences range from fines of $5,000 to $200,000
- adopting a policy on dangerous dams. This approach must meet the requirements of the Building Act, but the policy itself is to be determined by the individual regional authority.

[7] Of the 3,284 dams in the NZID there is information available on the owners of around 1,600 dams (noting that about 100 have the owner listed as private).

Recognised Engineers

Under the Building Act, Recognised Engineers:

- audit and certify the classification of a dam
- audit and certify the DSAP
- certify compliance with the approved DSAP
- certify reviews of the classification of a dam
- certify reviews of the DSAP.

The Building Act's requirements for the involvement of Recognised Engineers are intended to ensure a dam is correctly classified and that a DSAP meets the prescribed criteria and standards for dam safety.

Owners of dams will need to ensure that the engineer they engage has the necessary experience and qualifications relating to dam engineering and safety assurance. The proposed regulations will specify the competencies that the Recognised Engineers must be able to demonstrate.

Under the Building Act, a 'Recognised Engineer' is an engineer who:

(a) has no financial interest in the dam concerned; and

(b) is registered under the Chartered Professional Engineers of New Zealand Act 2002; and

(c) has—

(i) the prescribed qualifications; and

(ii) the prescribed competencies.

Proposed prescribed qualifications

It is proposed that the qualification requirement is met by the existing requirement (under the Chartered Professional Engineers of New Zealand Act 2002 or any future statutory equivalent) to be a registered engineer. This legislation requires an engineering qualification from an accredited programme recognised under the Washington Accord[8].

[8]The Washington Accord is an international agreement between bodies responsible for accrediting engineering degree programmes.

Proposed prescribed competencies

It is proposed that a Recognised Engineer meets all or some of the following competencies:

- geotechnical principles
- design principles including structural, geotechnical, seismic, hydrologic and hydraulic principles
- dam construction techniques
- operation and maintenance of dams
- surveillance processes
- response to dam safety issues
- emergency planning and emergency response
- resolution of potential dam safety deficiencies
- dam safety critical plant systems.

Engineering New Zealand will develop and oversee an assessment process to determine whether an engineer fulfils the proposed competency requirements required to be a Recognised Engineer.

Questions on the proposed Recognised Engineer requirements:

4 Do you agree with the proposed qualification requirements for a 'Recognised Engineer'?

5 Do you agree with the proposed competencies for a 'Recognised Engineer'?

6 If you do not agree with the proposed qualifications and competencies, please comment on what they should be.

7 What evidence should be attached to the certificate provided by the engineer (for example a CPEng registration number) to show the engineer is a 'Recognised Engineer'?

Implementing the proposed dam safety regulations

The proposed date for regulations to come into force is 12 months from the date that they are gazetted.

Owners of dams must then notify their regional authority of the:

- size and location of a dam (only applies to classifiable dams)
- potential impact of a dam failure – within three months of the regulations commencing.

Questions on the proposed dam safety regulations:

8 The proposed timeframe for regulations to come into force is 12 months after they are gazetted. Do you think this timeframe is adequate?

9 If you do not think the timeframe is adequate, please tell us how much time you would prefer.

5. Core elements

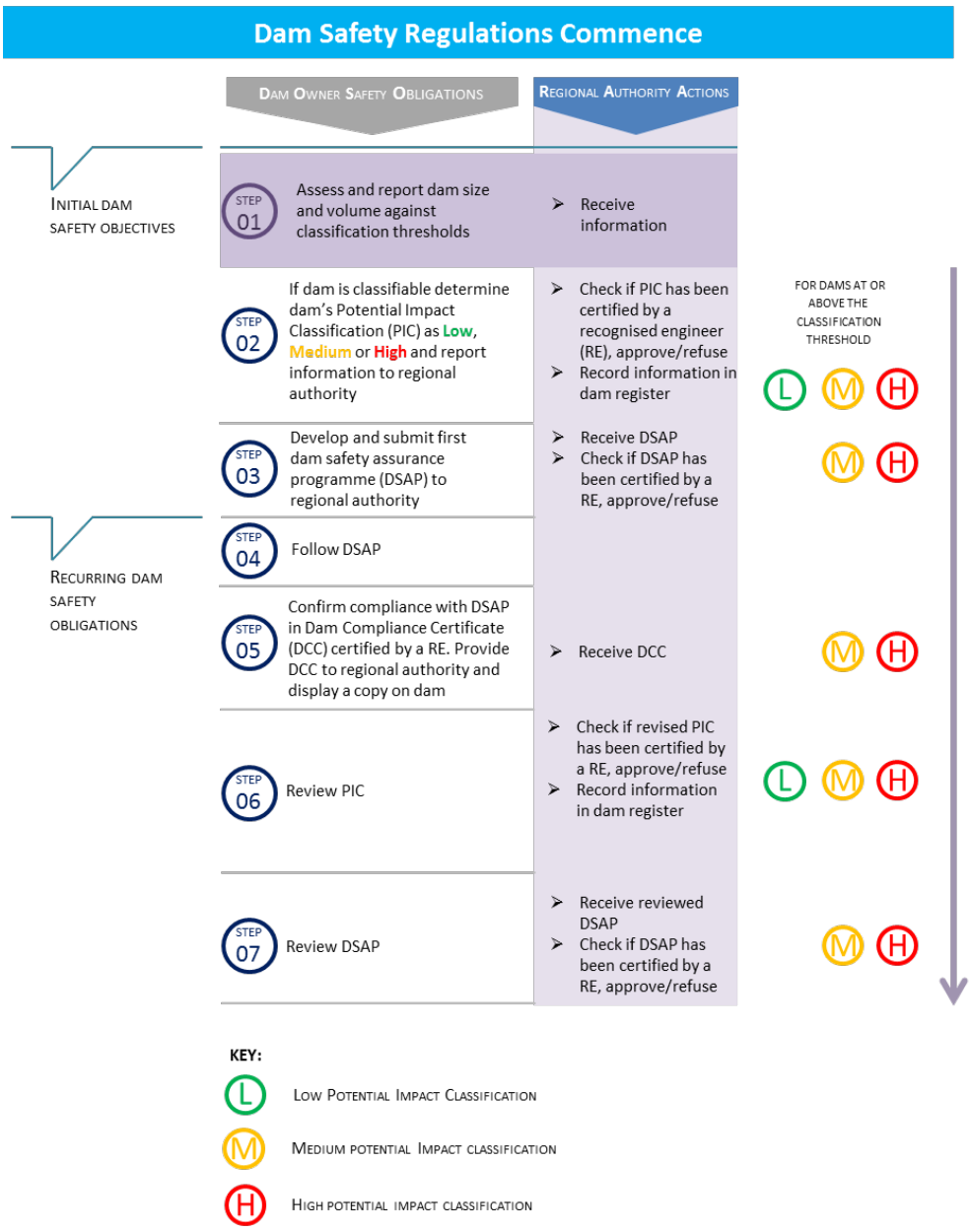
This section describes in seven steps how the core elements of the proposed dam safety regulations will work. This section seeks your views on:

- the proposed method of classification to determine if a dam is classifiable
- the proposed method to determine a dam's potential impact classification
- the proposed criteria and standards for a dam safety assurance programme.

Overview

Consistent with the framework laid down in the Building Act, the proposed dam safety regulations will require seven steps, as shown in **Figure 4.**

Figure 4: Overview of the key steps in the proposed Dam Safety regulations



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Explaining the seven steps

Step 1: Assess whether the dam exceeds the dam classification threshold

All owners of dams will be required to assess whether their dam is classifiable against a classification threshold (height of the dam and volume of the reservoir at its peak operating level). This assessment must be carried out within three months of the proposed regulations coming into force.

If a dam meets the classification threshold, owners are required to notify the local regional authority of the size and location of the dam. If the dam does not meet the threshold, no further action will be required.

Classifiable dams

It is proposed that a classifiable dam is a dam that meets or exceeds the following classification threshold (**Figure 5**):

- meet the Building Act's definition of a 'large dam' (a height of 4 or more metres and holds 20,000 or more cubic metres volume of water or other fluid); OR
- a height of less than 4 metres and holds 30,000 or more cubic metres volume of water or other fluid.

Using the definition of 'large dam' in the Building Act means that all large dams are captured. Analysis of a range of height and volume scenarios identified 'a height of less than 4 metres and holds 30,000 or more cubic metres volume of water or other fluid' as best striking the balance of capturing high-risk dams while excluding low-risk dams. This classification threshold is also less subjective than other alternative threshold indicators, making it relatively simple and low cost to assess.

In 2013, MBIE consulted on a classification threshold of:

- a height of eight or more metres and holds 20,000 more cubic metres of water or other fluid in volume; OR
- a height of four or more metres and holds 100,000 or more cubic metres of water or other fluid in volume.

MBIE does not consider the 2013 threshold sufficiently captures the right dams that have a potential medium or high impact on people, property and the environment.

Illustrating the volume of a classifiable dam

To illustrate the volume of a classifiable dam, imagine eight Olympic-sized swimming pools, or a rugby field with water up to the crossbars of the goalposts as illustrated in **Figure 6**.

Figure 5: Proposed height and volume threshold for a classifiable dam

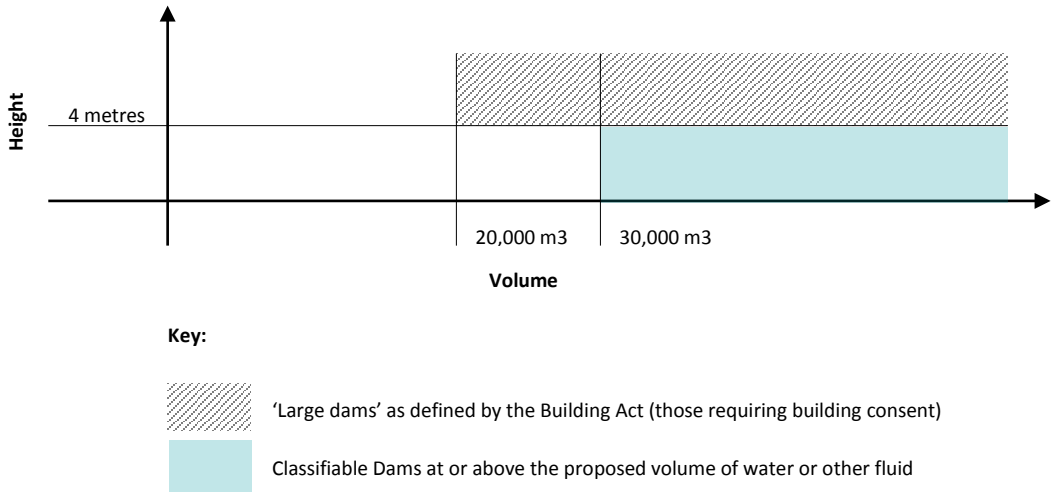
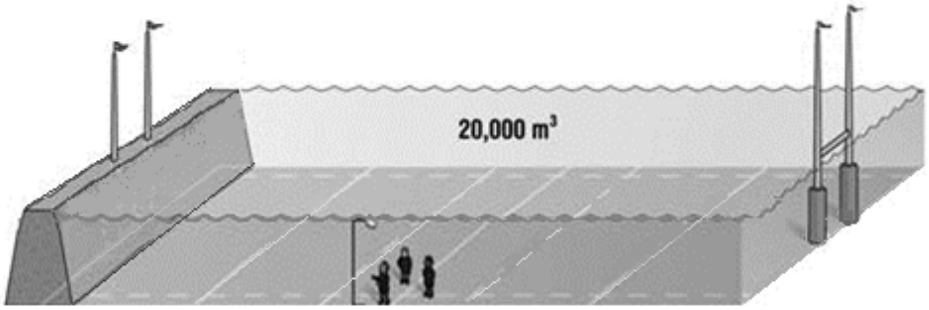


Figure 6: A dam's volume



Measuring dam height and retained volume

A dam's height and volume will already be captured in its building consent or any resource consent documents. If not already known, the owners of dams should obtain information on the dam's size.

The method for measuring the height of a dam is set out in the Building Act. The height of a dam is the vertical distance from the crest of the dam[9], and must be measured:

- for a dam across a stream: from the natural bed of the stream at the lowest downstream outside limit of the dam
- for a dam not across a stream: from the lowest elevation at the outside limit of the dam
- for a canal: from the invert of the canal.

[9] A dam crest is the uppermost surface of the dam, not taking into account any structures that are not part of the water-retaining structure (e.g. curbs, parapets, guard rails). Any freeboard is part of the water-retaining structure for the purposes of this definition.

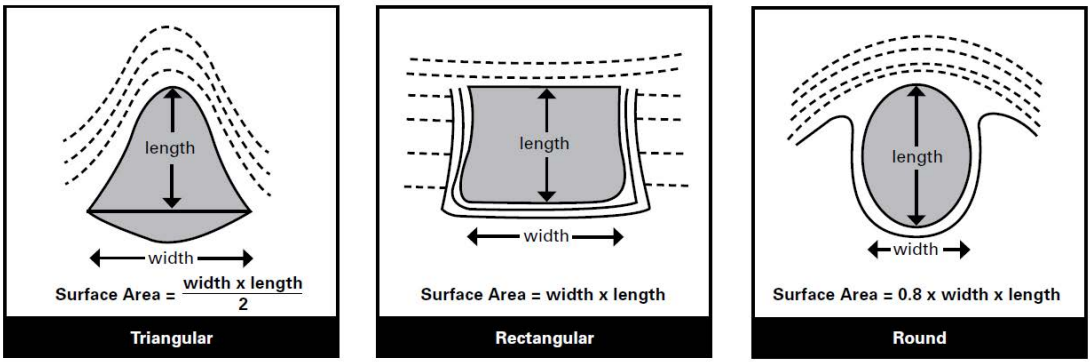
Guidance on calculating reservoir volume

For detailed guidance on calculating reservoir volume, refer to Module 1 of the *New Zealand Dam Safety Guidelines* (2015). MBIE will publish guidance advising on the measurement of reservoir volume, and will likely include a simplified method to calculate a dam's reservoir volume as shown in **Figure 7**. Owners of dams will be able to use the method to calculate the approximate volume of the reservoir behind a dam.

Owners of dams may engage someone who is competent to measure reservoir volume, such as any civil engineering technician or a surveyor.

Figure 7: Simplified calculation of a reservoir's retained volume

Volume (m^3) = 0.4 x Surface Area x Depth (0.4 is a conversion factor that takes into account the slope of the sides of dams)



Source: *New Zealand Dam Safety Guidelines,* New Zealand Society on Large Dams IPENZ, 2015

Other dams that are built up around a 'hole' may hold a large volume of water and have low man-made dam walls constructed above ground level.

Smaller dams that are altered to increase capacity may trigger the need for a building consent. The regulatory requirements will apply if the altered dam subsequently meets the classification threshold described above.

Referable dams

The Building Act provides for a 'referable dam' category to acknowledge that smaller dams may still present a potential risk to public safety. The original intent of this category was to ensure that dams outside the classifiable dam category (but which may still pose a risk to public safety) could be identified and referred for classification.

MBIE proposes not to define 'referable dam' at this stage. MBIE is of the view that the classification threshold is sufficient to capture dams that present a potential risk of harm to people, and damage to property and the environment.

In previous consultation on a dam safety scheme, MBIE proposed the following definition for 'referable dam':

…has a height of 4 or more metres or holds 20,000 or more cubic metres volume of water or other fluid and is not a classifiable dam.

However, the previous consultation also proposed that the classifiable dam classification threshold be much larger than that proposed in this consultation document – a classifiable dam was to be either 8 or more metres and hold 20,000 or more cubic metres of fluid, or be a height of 4 metres or more and hold 100,000 cubic metres of fluid. Proposing such a large threshold for a classifiable dam meant smaller dams that still proposed a potential risk were not captured. Therefore, the category of 'referable dam' was useful to capture dams that were smaller than the proposed classification threshold, but still represented a potential risk. Those smaller dams are now captured under the proposed classification threshold for classifiable dams, removing the need for the referable dam category.

Regional authorities will still have the ability under section 157 of the Building Act to take action on any dam, whatever the size and volume, if immediate danger to the safety of people, property and the environment is likely.

Questions on step 1

10 Do you agree with the proposed classification threshold to determine if a dam is a classifiable dam?

11 If you do not agree, what other measure could be used?

12 Do you agree that it is unnecessary to have a separate category for referable dams (considering the proposed classification threshold and regional authorities' powers under section 157 of the Building Act)?

Step 2: Classify the dam according to the potential impact of failure of the dam, and report

Step 2 requires dams to be classified according to the potential impact of a failure of the dam on people, property and the environment. This classification requires an assessment of the potential impact of a hypothetical breach of the dam, or other uncontrolled release of the reservoir[10].

This assessment must be certified by a Recognised Engineer who states that the classification of the dam meets the prescribed criteria and standards for dam safety, which will be based the following:

- Identify the effect that an uncontrolled release of the reservoir due to a failure of the dam, when full, would have on each of the specified categories as shown in **Table 3**
- Using **Table 3,** determine the assessed damage level by assessing whether the damage level in each of the specified categories is catastrophic, major, moderate or minimal and then select the highest damage level
- Estimating the population at risk as shown in **Table 4**
- Using **Table 4** to determine the dam classification by correlating the assessed damage level with the population at risk, being the number of people likely to be affected by inundation.

Section 7 of this discussion paper proposes the form and content of a dam classification certificate.

This assessment allows a dam to be classified as having a Low, Medium or High PIC. The PIC forms the basis for the requirements of the DSAP. A dam's PIC is critical information for owners of dams, as it forms the basis for ongoing operational safety and maintenance requirements.

Table 3 and Table 4 are from the *New Zealand Dam Safety Guidelines (2015)*. Guidance for considering and assessing potential impacts for people, property and the environment is included in these guidelines.

Table 3 demonstrates how the damage level (on property and the environment) of a dam is determined. **Table 4** demonstrates how the assessed damage level, the population at risk, and the potential loss of life are combined to determine the PIC of a dam.

[10] *New Zealand Dam Safety Guidelines*, New Zealand Society on Large Dams IPENZ, 2015

Table 3: Determination of assessed damage level

Damage Level	Specified categories				
	Residential houses	Critical or major infrastructure		Natural environment	Community recovery time
		Damage	Time to restore to operation		
Catastrophic	More than 50 houses destroyed	Extensive and widespread destruction of and damage to several major infrastructure components	More than 1 year	Extensive and widespread damage	Many years
Major	4 to 49 houses destroyed and a number of houses damaged	Extensive destruction of and damage to more than 1 major infrastructure component	Up to 12 months	Heavy damage and costly restoration	Years
Moderate	1 to 3 houses destroyed and some damaged	Significant damage to at least 1 major infrastructure component	Up to 3 months	Significant but recoverable damage	Months
Minimal	Minor damage	Minor damage to major infrastructure components	Up to 1 week	Short-term damage	Days to weeks

Table 4: Determination of Potential Impact Classification

Assessed damage level	Population at risk (the number of people likely to be affected by inundation)			
	0	1 to 10	11 to 100	More than 100
Catastrophic	High potential impact	High	High	High
Major	Medium potential impact	Medium/High (see note 4)	High	High
Moderate	Low potential impact	Low/Medium/High (see notes 3, and 4)	Medium/High (see note 4)	Medium/High (see notes 2 and 4)
Minimal	Low potential impact	Low/Medium/High (see notes 1, 3, and 4)	Low/Medium/High (see notes 1, 3, and 4)	Low/Medium/High (see notes 1, 3, and 4)

Notes:

1. With the population at risk at 5 or more people, it is unlikely that the potential impact will be Low.

2. With the population at risk at more than 100 people, it is unlikely that the potential impact will be Medium.

3. Use a Medium classification if it is highly likely that a life will be lost.

4. Use a High classification if it is highly likely that 2 or more lives will be lost.

Questions on Step 2

13 Do you agree with the proposed Potential Impact Classification system in Step 2?

14 If you do not agree with the proposed Potential Impact Classification system, what alternative system, or changes, do you suggest for classifying the potential impact of a dam's failure?

Step 3: Develop and submit first dam safety assurance programme (Medium and High PIC dams only)

Step 3 is a requirement of the Building Act for owners of Medium and High PIC dams to prepare and submit a DSAP to the relevant regional authority. Low PIC dams are not required to prepare a DSAP.

The requirement for a DSAP compels owners of dams to plan for and commit to the safe operation of their dam, and provide processes for the overall management of dam safety.

The DSAP must be audited and certified by a Recognised Engineer. The onus will be on the owners of dams to ensure the information provided to the regional meets the prescribed criteria and standards for dam safety.

Content of a DSAP

It is proposed that each DSAP will be required to include the criteria and standards shown in **Table 5**. A DSAP must be consistent with the dam safety management principles provided in the New Zealand Dam Safety Guidelines for a DSAP and be appropriate for the type and size of the dam and the dam classification. Section 7 of this discussion paper proposes the form and content of a DSAP.

Timing for submission of the DSAP

In the Building Act, the required completion date for the DSAP is related to the dam's classification.

For a High PIC dam, the first DSAP must be received by the regional authority no later than one year after the classification was first approved.

For a Medium PIC dam, the first DSAP must be received by the regional authority no later than two years after the classification was first approved.

Accredited dam owner

The Building Act enables MBIE's Chief Executive to appoint a dam owner accreditation body. The Chief Executive would specify (through the New Zealand Gazette) the minimum frequency of audits that the dam owner accreditation body must conduct on accredited dam owners. Under regulations, a dam owner accreditation body may accredit the owner of a dam according to prescribed criteria and standards.

It is proposed that the 'accredited dam owner' provisions in the Building Act are not implemented for the time being. There would be complexities and costs implementing a new accreditation scheme. MBIE's preferred approach is to allow sufficient time to monitor and review the effectiveness of the regulations before considering accreditation options.

Table 5: Content of a dam safety assurance programme (for Medium and High potential impact classification dams)

Elements of a DSAP	***New Zealand Dam Safety Guidelines* (2015) Reference**	**Why?**
The DSAP must contain procedures for the following elements: • Dam and reservoir operation and maintenance (see Element 1) • Surveillance (Element 2) • Appurtenant structures and gate and valve systems (Element 3) • Intermediate dam safety reviews (Element 4) • Comprehensive dam safety reviews (Element 5) • Emergency preparedness (Element 6) • Identifying and managing dam safety issues (Element 7).	Module 5 Dam Safety Management	The Building Act requires that the owner of the dam must prepare, or arrange for the preparation of a DSAP for the dam. The DSAP must meet the prescribed criteria and standards for dam safety.
Element 1) Dam and reservoir operation and maintenance		
Sub-elements: • Procedures and protocols for dam and reservoir operation • Operator experience and training • Reservoir operation records • Dam and reservoir maintenance.	Module 5 Dam Safety Management Section 4.1	Understanding how a dam and its reservoir are designed to operate and how they are actually operated is a foundational element to their safe management. Owners should ensure that dams and reservoirs are appropriately operated and maintained and that accurate records of operational parameters are kept.
Element 2) Surveillance - monitoring dams and reacting quickly to inadequate performance or to danger signals		
Sub-elements: • Documented surveillance processes and procedures • Quality assurance • Visual inspections • Performance monitoring instrumentation • Monitoring data management • Dam performance evaluation • Escalation and reporting of issues.	Module 5 Dam Safety Management Section 4.2	A robust surveillance process is the owner's front line of defence for the safe operation of their dams and reservoirs. Surveillance provides the cornerstone for effective management of dam safety and operational risks. Owners should ensure that appropriate procedures are in place for dam performance evaluation, and escalation and reporting of issues identified during surveillance.

Element 3) Appurtenant structures and gate and valve systems		
Sub-elements: • Identify appurtenant structures and gate and valve systems with dam and reservoir safety functions • Inspection and maintenance of appurtenant structures • Inspection, maintenance and testing of gate and valve systems • Inspection, maintenance and testing of other dam and reservoir safety systems.	Module 5 Dam Safety Management Section 4.3	Appurtenant structures are important in fulfilling dam and reservoir safety functions. They are structures other than the dam itself that are designed and are required for the safe control of the reservoir contents and reservoir discharges under all loading conditions[11]. Owners should ensure appropriate procedures are in place for inspection, maintenance and testing of gate and valve and other systems with dam and reservoir safety functions.
Element 4) Intermediate (annual) dam safety reviews		
Sub-elements: • Selection of Technical Adviser • Scope • Reporting requirements.	Module 5 Dam Safety Management Section 4.4	Intermediate dam safety reviews (IDSRs) would be completed annually by a Technical Advisor (external to the owner's organisation) for Medium and High PIC dams. The purpose of the IDSR is to complete a site inspection, review operation, surveillance, maintenance and testing records, complete a dam performance evaluation and identify any dam safety issues. The IDSR fits between routine surveillance and the Comprehensive Dam Safety Review (CDSR)(see Element 5) in frequency and in its level of detail and is largely based on a visual inspection by a technical advisor.

[11] Note that this differs from the definition of "appurtenant structure" in the Building Act: *appurtenant structure, in relation to a dam, means a structure that is integral to the safe functioning of the dam as a structure for retaining water or other fluid.*

Element 5) Comprehensive dam safety reviews		
Sub-elements: • Selection of review team • Scope • Reporting requirements.	Module 5 Dam Safety Management Section 4.5	Comprehensive dam safety reviews (CDSR) would be completed every 5 years for Medium and High PIC dams. The CDSR is a comprehensive, periodic, independent review of the design, construction, operation and performance of a dam, and all systems and procedures that affect dam and reservoir safety. The CDSR identifies any dam safety issues and categorises them into physical infrastructures issues, potential or confirmed dam safety deficiencies and non-conformances.
Element 6) Emergency preparedness		
Sub-elements: • Development of an emergency action plan • Integration with territorial, regional and emergency authorities • Emergency equipment and resources • Exercise and review of emergency action plan.	Module 6 Emergency Preparedness	The owners of dams should have emergency action plans in place that minimise the potential for dam failure through pre-planned or pre-conceived intervention actions should a dam safety emergency event arise, and in the event that a dam failure cannot be prevented, to limit the effects of a dam failure on people, property and the environment.
Element 7) Identifying and managing dam safety issues		

Sub-elements:
• Identification and categorisation of the following dam safety issues:
  • Physical infrastructure issues
  • Potential dam safety deficiencies
  • Confirmed dam safety deficiencies
  • Non-conformances
• Dam safety issue recording, prioritising and tracking
• Dam safety deficiency investigation, assessment and resolution.
	Module 7 Life Cycle Management	The identification and management of dam safety issues is an essential part of dam safety management for any dam. Dam safety issues are a broad set of issues that affect dam safety and they should be categorised as physical infrastructure issues, potential or confirmed dam safety deficiencies and non-conformances, so that the issue is clearly identified and the appropriate response can be determined. Owners should have a systematic and auditable approach to recording, updating and tracking their dam safety issues, and clear and defined procedures for the investigation, assessment and resolution of dam safety deficiencies.

Step 4: Follow the DSAP (Medium and High PIC dams only)

The owners of dams will need to follow their DSAP according to certain timing requirements (shown in **Table 5**).

The level of surveillance will be dynamic and adaptive such that the surveillance can be varied in response to changing conditions and circumstances. The inspection and review of appurtenant structures would be appropriately included in routine dam surveillance, intermediate dam safety reviews (IDSR) and comprehensive dam safety reviews (CDSR). Emergency preparedness would also be reviewed during the completion of IDSRs and CDSRs.

Owners of dams will also be required to perform a number of scheduled and unscheduled reviews of dam safety activities. These are:

- *Annual Dam Compliance Certificates*. The Building Act requires owners of dams for which a DSAP has been approved to provide the regional authority with an annual Dam Compliance Certificate on each anniversary of their DSAP having been approved.
- *Other reviews.* The Building Act also requires that the owner must review their DSAP if building work is done on the dam that requires a building consent and could result in a change to the PIC. The owners of large dams that are earthquake-prone or flood-prone must review their DSAP if requested by the relevant regional authority.

Question on steps 3 and 4

15 Do you agree with the proposed content of a Dam Safety Assurance Programme?

16 Do you think there are any elements in the Dam Safety Assurance Programme that are missing or are too onerous?

17 Do you agree that there is no need for an accreditation regime at present?

Step 5: Confirm compliance with DSAP (Medium and High PIC dams only)

The annual Dam Compliance Certificate must include confirmation from a Recognised Engineer that, except for identified, minor items of non-compliance, all procedures in the DSAP have been complied with during the previous twelve months.

By submitting the annual Dam Compliance Certificate to the regional authority, the owner provides ongoing evidence of surveillance and maintenance in line with the approved DSAP.

The Building Act also requires the owner to publicly display a copy of the Dam Compliance Certificate in a prominent place on the dam. An owner commits an offence if they knowingly fail to display a certificate as required or display a false or misleading certificate.

Section 7 of this discussion paper proposes the form and content of the Annual Dam Compliance Certificate.

Step 6: Review PIC (Low, Medium and High PIC dams)

The potential downstream impact of a dam failure can change as the people, property and environment downstream changes. Given these potential changes in the dam's surroundings, Step 6 ensures that the regulations continue to require safety-related activities appropriate to the PIC of a dam.

The Building Act and the proposed regulations aim to ensure that the PICs of dams remain current. Owners of dams above the classification threshold (Step 1) will need to periodically review their PIC. These reviews must be certified by a Recognised Engineer.

For all dam classifications, the Building Act requires that the first PIC review is carried out within 5 years of the regional authority approving the classification, and after the first review, at intervals of not more than 5 years. A PIC review must also be carried out when any building work that requires a building consent, and could result in a change to the dam's PIC, is done on the dam.

If a dam's PIC increases from Low to Medium as a result of a PIC review, the owner of the dam will have to create a DSAP and submit it to the regional authority within two years of the Medium classification being approved. If a dam's PIC increases from Low or Medium to High, the owner of the dam have to prepare a DSAP and submit it to the regional authority within one year of the High classification being approved.

Step 7: DSAP review (Medium and High PIC dams only)

The Building Act states that the owners of High and Medium PIC dams must review their DSAPS.

The owner of a High PIC dam must review their DSAP:

- within five years of it being approved by the regional authority
- after the first review, at intervals of no more than five years.

The owner of a Medium PIC dam must review their DSAP:

- within 10 years of it being approved by the regional authority
- after the first review, at intervals of no more than seven years.

Owners of dams must, at all times, review their DSAP whenever building work is done on the dam that requires a building consent and could result in a change to the PIC.

Owners of dams that are earthquake-prone or flood-prone must also review their DSAP at the request of the regional authority (see section 6 of this discussion paper).

6. Dangerous, earthquake-prone and flood-prone dams

The Building Act requires 'moderate earthquake', 'moderate flood', 'earthquake threshold event' and 'flood threshold event' to be defined in regulations. This section proposes definitions of these terms. This section is divided up into the following parts:

- Dangerous dams
- Earthquake-prone and flood-prone dams
- Climate Change.

Dangerous, earthquake-prone, and flood-prone dams need to be managed to keep people safe

The Building Act provides regional authorities with powers to require that dangerous dams are repaired to reduce or remove danger[12]. Regional authorities also have the power to take action on any dam, whatever the size and volume, if immediate danger to the safety of people, property, or the environment is likely. Furthermore, the Building Act requires each regional authority to develop a region-specific policy about dangerous, earthquake-prone and flood-prone dams[13].

The Building Act defines dangerous, earthquake-prone and flood-prone dams as High or Medium PIC dams that are likely to fail in certain situations. Those situations are:

- for a **dangerous dam**, in the ordinary course of events or in a 'moderate earthquake' or a 'moderate flood'
- for an **earthquake-prone dam**, in an 'earthquake threshold event'
- for a **flood-prone dam**, in a 'flood threshold event'.

Due to the technical nature of these key terms, they have been developed in conjunction with suitably qualified engineers who specialise in the construction and safe management of dams in New Zealand. The thresholds have been set at a level considered appropriate by these specialists.

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[12] Under section 154(1c), a regional authority may give written notice requiring work to be carried out on the dam, within a time stated, to reduce the danger. Under section 156, if the owner of the dam does not carry out the required work, the regional authority may apply to the District Court for an order authorising the regional authority to do the work. If the regional authority carries out the building work under the authority of the District Court order, the owner of the dam is liable for the cost.

[13] This policy must be adopted using the special consultative procedure under the Local Government Act 2002. It will include the approach that will be taken by a regional authority in exercising its dam safety functions and priorities in exercising those functions.

In 2013, MBIE consulted on proposed definitions for the key terms. The definitions were broadly supported. MBIE welcomes feedback on the reasonableness of these definitions, or alternative definitions.

Each of the proposed definitions below includes a specified annual exceedance probability (AEP). AEP refers to the probability of an event of a given size or larger occurring in any one year. For example, a one per cent AEP event has a 1 in 100 chance of occurring in any one year. Using AEP provides for consistent application across New Zealand.

Dangerous dams

Dams that are classified as 'dangerous' present a more immediate threat to people, property and the environment. A dangerous dam is likely to fail in the ordinary course of events or in a moderate earthquake or flood.

MBIE considers that if a dam is likely to fail within a 50-year period, it should be classed as a dangerous dam. Earthquakes and floods with an AEP of 1 in 50 are events that are likely to occur within this 50-year period and are therefore proposed as the definitions of 'moderate earthquake' and 'moderate flood'.

Moderate earthquake

MBIE proposes that the definition of a 'moderate earthquake' for dams is:

An earthquake that would generate shaking at the site of the dam that would occur with a 1 in 50 annual exceedance probability (determined by normal measures of acceleration, velocity, and displacement) but not less than shaking determined using a z factor of 0.13.

A 'moderate earthquake' as it relates to earthquake-prone buildings is defined in regulations[14], but that definition is not suitable for dangerous dams. The existing definition of 'moderate earthquake' for buildings is used to identify buildings that are earthquake-prone, not dangerous. For dams, however, the term 'moderate earthquake' is used to identify dams that are dangerous, not earthquake-prone.

If the existing term 'moderate earthquake' for buildings (essentially 33 per cent of new dam design shaking) were used to identify dangerous dams, some dams that are not dangerous would be inadvertently captured by the term. The term 'moderate earthquake' for dams should therefore be set at a lower level of shaking than that used for buildings.

The z factor (or seismic hazard factor) is a measure of ground shaking. A minimum z factor of 0.13 corresponds with ground shaking associated with a magnitude 6.5 earthquake occurring 20 km from the site of the dam. This is consistent with the current minimum Building Code requirements for new buildings.

[14] See Building (Specified Systems, Change the Use, and Earthquake-prone Buildings) Regulations 2005 in relation to earthquake-prone buildings

Moderate flood

MBIE proposes that the definition of a 'moderate flood' is:

A flood of water or other fluid flowing into the reservoir that has a 1 in 50 annual exceedance probability.

Advice received from engineers is that assessing a structure against this threshold (whether water or other fluid flowing) is relatively straightforward and information on assessing against AEP is readily available.

This definition allows factors such as the location, type of dam, hydrology, nature of the catchment area, retention and run-off characteristics in the catchment area, and rainfall to be taken into account.

The proposed definition does not distinguish between natural floods and man-made floods (such as the controlled discharge of an upstream dam, which increases the flow into a downstream reservoir to flood level).

Questions

18 Do you agree with the proposed definition of 'moderate earthquake'?

19 Do you agree with the proposed definition of 'moderate flood'?

20 If you do not agree with the proposed definitions of 'moderate earthquake' and 'moderate flood', what definitions do you consider more appropriate, and why?

21 For owners of dams: What impacts (if any) would the proposed definitions of 'moderate earthquake' and 'moderate flood' have on the management of your dams?

22 For regional authorities: What (if any) potential issues do you see in applying the definitions of 'moderate earthquake' and 'moderate flood'?

Earthquake-prone and flood-prone dams

Unlike dangerous dams, earthquake-prone and flood-prone dams are not at risk of failure in the ordinary course of events. However, these dams still present a risk over the longer term that needs to be managed. The deficiencies of earthquake-prone and flood-prone dams should be identified and managed as part of a dam's dam safety assurance programme (DSAP).

These definitions are necessary to enable regional authorities to develop policies on earthquake-prone and flood-prone dams.

Earthquake threshold event

MBIE proposes 'earthquake threshold event' means, in relation to a:

(a) High potential impact dam, an earthquake that would generate shaking at the site of the dam with a 1 in 500 annual exceedance probability (determined by normal measures of acceleration, velocity and displacement) but not less than shaking determined using a z factor of 0.13.

(b) Medium potential impact dam, an earthquake that would generate shaking at the site of the dam with a 1 in 250 annual exceedance probability (determined by normal measures of acceleration, velocity and displacement) but not less than shaking determined using a z factor of 0.13.

Flood threshold event

MBIE proposes that 'flood threshold event' means, in relation to a:

(a) High potential impact dam, a flood of water or other fluid flowing into the reservoir that has a 1 in 500 annual exceedance probability

(b) Medium potential impact dam, a flood of water or other fluid flowing into the reservoir that has a 1 in 250 annual exceedance probability.

Climate Change

The New Zealand Dam Safety Guidelines do not recommend the inclusion of the effects of climate change in the estimation of extreme flood events, as the understanding of these effects on dam safety was considered to be in its infancy. However, knowledge on the effects of climate change in the estimation of extreme flood events is an area of rapid progress.

The International Commission on Large Dams (the Commission) has an active technical committee on global climate change. Future amendments to the proposed dam safety regulations could take into consideration any recommendations by the Commission and other relevant bodies of knowledge on this topic.

The proposed definitions for moderate flood and flood threshold events are related to annual exceedance probabilities and would not need to be amended to accommodate climate change. The proposed regulations only refer to post-construction dam safety management, so any future changes to the estimated magnitude of moderate flood, flood threshold event, and the most severe inflow floods due to climate change will be affected through the hydrological methods that are used to determine these events.

The proposed DSAPs will include an element that requires comprehensive dam safety reviews (CDSR) to be completed every five years for Medium and High potential impact dams. A CDSR includes regular review of the currency of Inflow Design Floods (IDFs) and whether the dam meets appropriate flood performance criteria. The IDF estimate can change with time due to more rainfall data and river flow monitoring, improved understanding of rainfall run-off characteristics and improved methods for modelling floods. Whether changes in rainfall estimations due to climate change have been adequately addressed in the IDF, determination would be expected to be considered in a CDSR. DSAPs would therefore be progressively adapted to include the effects of climate change.

Questions

23 Do you agree with the proposed definition of 'earthquake threshold event'?

24 Do you agree with the proposed definition of 'flood threshold event'?

25 If you do not agree with the proposed definitions of 'earthquake threshold event' or 'flood threshold event', what definitions do you consider more appropriate and why?

26 For owners of dams: What impacts would the proposed definitions of 'earthquake threshold event' and 'flood threshold event' have on the management of your dams?

27 For regional authorities: What (if any) potential issues do you see in applying the definitions of 'earthquake threshold event' and 'flood threshold event'?

7. The provision of guidance and forms for compliance

This section seeks your feedback on what guidance MBIE should provide owners of dams and regional authorities, as well as the content of the prescribed forms.

Guidance

The main aim of the guidance will be to help regional authorities and owners of dams understand the size and type of dam that is classifiable, and the requirements that the owners of classifiable dams must comply with. Guidance may include:

- advice on the measurements of a dam's height and reservoir volume
- methods for evaluating a dam's potential impact classification (PIC)

Feedback is welcome on any information you think should be included in guidance material.

Prescribed forms

The Building Act requires forms to be prescribed for:

- a dam classification certificate
- a dam safety assurance programme (DSAP)
- an annual Dam Compliance Certificate.

The Dam Classification Certificate

The following information is proposed to be included in the dam classification certificate:

- information about the dam: this will include: the dam name, the location of the dam, date of construction, any applicable building consent or resource consent reference, purpose of the dam, type of dam, height of the dam, maximum reservoir volume (in cubic metres), description of spillway or flood control facility, flood capacity, changes in design or operation since construction, relevant regional authority.
- the dam's PIC.
- name of the owner of the dam, name of the operator of the dam (if different from the owner), appropriate contact person and contact details.
- a certificate from a Recognised Engineer certifying that the classification of the dam accords with the criteria and standards for classifying a dam as Low, Medium or High.
- evidence that the engineer is a Recognised Engineer.
- the Recognised Engineer's signature, name and Chartered Professional Engineer registration Number (or any future statutory equivalent).

The dam safety assurance programme

The proposed information to be included in a DSAP form is:

- information about the dam: this will include: the dam name, date of construction, any applicable building consent or resource consent reference, location of the dam, purpose of dam, type of dam, height of the dam, maximum reservoir volume (in cubic metres), description of spillway or flood control facility, flood capacity, changes in design or operation since construction, relevant regional authority
- the dam's PIC
- name of the owner of the dam, name of the operator of the dam (if different from the owner), appropriate contact person with respect to the DSAP, and contact details
- a brief description and summary (to be attached) of how each of the dam safety elements in **Table 5** have been adequately addressed for the dam, and indicating where these are addressed in the DSAP
- a list of all supporting documentation, manuals and publications referred to in the DSAP and the location of this material
- the documents and procedures that form the DSAP are attached
- a statement on the location of the DSAP
- a statement on the appropriate contact person and contact details with respect to the DSAP
- a certificate from the Recognised Engineer that the DSAP meets the prescribed criteria and standards for the dam safety assurance programme
- evidence attached that the engineer is a Recognised Engineer
- the Recognised Engineer's signature, name and Chartered Professional Engineer registration Number (or any future statutory equivalent).

The Annual Dam Compliance Certificate

The annual dam compliance certificate will state that, except for identified, minor items of non-compliance, all procedures of the DSAP have been complied with over the previous twelve months.

The proposed information to be included in an annual Dam Compliance Certificate is:

- information about the dam: the dam name, date of construction, any applicable building consent or resource consent reference, location of the dam, purpose of the dam, type of dam, height of the dam, maximum reservoir volume (in cubic metres), description of spillway or flood control facility, flood capacity (including metres per second), changes in design or operation since construction, relevant regional authority
- date of approval of DSAP, expiry date of approved DSAP
- the dam's PIC
- name of the owner, name of the operator (if different) and appropriate contact person and contact details
- a compliance statement that all procedures in the DSAP have been complied with during the previous 12 months, with the name, date, and signature of the dam owner.
- a certificate from a Recognised Engineer that they have reviewed the owner's reports and other documents relating to the procedures in the DSAP that the owner has followed in the previous 12 months, and that all procedures in the DSAP have been complied with during the previous 12 months.
- Evidence attached that the engineer is a Recognised Engineer
- the Recognised Engineer's signature, name and Chartered Professional Engineer registration Number (or any future statutory equivalent).

Questions

28 For regional authorities: What information would you need to ensure the regulations are implemented effectively?

29 For owners of dams: What information would you need to ensure the regulations are implemented effectively?

30 Do you have any comments on the proposed content of the forms for a Dam Classification Certificate, Dam Safety Assurance Programme or Annual Dam Compliance Certificate?

8. Regulatory impact

This section outlines, and seeks your views, on the high-level costs and benefits of the proposed regulations.

The proposed dam safety regulations are needed to bring the dam safety scheme in the Building Act into full effect. The proposed regulations have been designed to capture the 'right' dams so that the Building Act's obligations on owners of dams are proportionate to risk.

Identifying impacts and affected parties

The proposed dam safety scheme will affect owners of dams, regional authorities and downstream neighbours or communities. The proposed regulations will affect the number of dams captured by the initial dam classification and the requirements of ongoing safety assurance programmes.

Targeted application

The proposed regulations are intended to ensure compliance costs are proportionate to the potential impact classification (PIC) of the dam.

The regulations target dam safety assurance, monitoring, maintenance and reporting at Medium and High PIC dams, without creating onerous dam safety obligations on smaller, Low PIC dams.

Smaller dams, such as those used for stock drinking water or small-scale irrigation will not fall under these regulations. Dams that meet the classification threshold, but are assessed as having a Low PIC are excluded from the dam safety assurance programme (DSAP) obligations under the Building Act.

Using the New Zealand Inventory of Dams (NZID) data, it is estimated that a classification threshold of at or above 4 metres in height and 20,000 or more cubic metres volume of water or other fluid or less than 4 metres in height but at or more than 30,000 or more cubic metres volume of water or other fluid would capture 903 dams (27 per cent) of the 3,284 known dams including all High PIC dams, most Medium PIC dams and over half of the low PIC dams.

However, 48 per cent of dams in the NZID lack sufficient height and volume attributes to be tested against the proposed threshold. Further work on the dataset may be undertaken to improve our overall understanding of the asset portfolio. Information collected by the regional authorities will help.

The assessment in Step 1 and the follow-on requirements in Step 2 (potential impact classification assessment) will only create regular obligations for dams deemed to have potentially Medium or High impacts from dam failure. Based on current NZID data, MBIE estimates this to be around 200 known dams.

The owners of dams assessed as having a Low PIC will be required to review their PIC every 5 years (or when any building work requiring a building consent is carried out on the dam and the building work results, or could result, in a change of the PIC of a failure of the dam on people, property and the environment).

The costs for owners of dams and regional authorities are summarised in **Table 6** and are indicated in more detail in **Tables 7** and **8.**

Table 6: High-level qualitative assessment of costs and benefits

REGIONAL AUTHORITIES	Costs	Regional authorities will face the administrative and staffing cost of setting up systems for the activities specified under the Building Act and carrying them out, namely approving or refusing dam classifications, approving or refusing dam safety assurance programmes, registering information, monitoring and enforcement activities.
	Benefits	Lower likelihood that regional authorities will need to intervene regarding dangerous dams. Better information on the number, size, location and ownership of classifiable dams. Knowing that dams meet appropriate dam safety criteria will help ensure that the risks of development in potential dam break inundation zones is acceptable.
OWNERS OF DAMS	Costs	Many owners of dams are already voluntarily consistent with the *New Zealand Dam Safety Guidelines* (the Guidelines), meaning that compliance with the dam safety provisions in the Building Act will not be onerous. Owners of dams not already following the Guidelines may face costs to comply with the provisions in the Building Act. While hydroelectric owners and other owners of dams that are already observing the Guidelines are likely to have good systems in place, it is likely that some urban flood detention dams have not been classified and have no dam safety management systems in place. Many of them may have a high PIC. The Building Act excludes all owners of Low PIC (usually smaller sized) dams from DSAP-related requirements.
	Benefits	Avoiding dam repair costs, ability to get insurance, protecting reputation and maintaining the confidence of affected communities. Owners of dams' assets are better protected as dam failures are also costly for owners of dams.
DOWNSTREAM COMMUNITIES & WIDER SOCIETY	Benefits	Brings New Zealand into line with the majority of OECD countries that already have dam safety schemes in place. Assurance to the public that dams are managed appropriately. Over time, the increased application of effective dam safety management practices may reduce the overall risk of dam failure. Savings of not incurring damage to downstream life, property and the environment. For every dam failure that is avoided as a result of the proposed regulations, the benefits (avoided loss of life or damage) may include the preservation of infrastructure, agriculture, horticulture and/or a range of values such as cultural values, heritage values and recreation values.

Indicative compliance costs

Determining the Potential Impact Classification

Table 7 provides indicative costs for a PIC assessment, depending on the anticipated level of dam failure consequences. These are one-off costs for an individual dam.

A dam's PIC is informed by a dam-break flood hazard and consequence assessment, which will be done at either an initial, intermediate or comprehensive level depending on the anticipated level of consequence. There are three levels of assessment, as in some cases the dam failure consequences may be obvious and only a simple (i.e. an initial) assessment is required to determine the PIC. In other cases, the dam failure consequences may be complicated or difficult to define and a more detailed (i.e. intermediate or comprehensive) assessment would be appropriate. This is influenced primarily by the population exposed to the potential dam failure, the amount of downstream development, and the severity of the anticipated inundation.

There is potential for reasonable cost savings if multiple dams in a given area are assessed at the same time. Generally, an increasing level of practitioner experience is required as the assessment level increases.

Table 7: Indicative costs for a potential impact classification assessment

Level of assessment	indicative range of cost to conduct assessment	Notes
Initial	$3,000 to $7,000	Topographic survey not normally required for an initial assessment and not included in the cost range.
Intermediate	$10,000 to $20,000	Topographic survey may be required, and this is reflected in the cost range. Cost includes production of flood maps suitable for use in an emergency action plan.
Comprehensive	$25,000 to $50,000+	Topographic survey may be required, and this is reflected in the cost range. Cost includes production of flood maps suitable for use in an emergency action plan. Detailed hydraulic modelling is usually required.

Dam Safety Assurance Programme Preparation and Audit (annual Dam Compliance Certificate)

Table 8 provides indicative costs for preparing a DSAP and annual Dam Compliance Certificate. It is less costly to prepare a DSAP for a dam that already has dam safety procedures in place. If safety procedures are already in place, the DSAP preparation is more about summarising and referencing those procedures to tie them together.

Preparing a DSAP for a dam that has no dam safety procedures in place will be more costly because the procedures need to be written as part of the DSAP preparation.

A DSAP can generally be prepared more efficiently for an owner of a dam who has multiple dams with common procedures. Generally, an increasing level of practitioner experience is required as the PIC increases.

These indicative costs do not include the ongoing cost to owners of implementing the DSAP content shown in Table 5. These costs are likely to vary depending on the extent of existing dam safety practices and if any existing dam safety programmes meet the principles of the NZSOLD dam safety guidelines. We welcome feedback on the likely range of these costs.

Table 8: Indicative costs for a Dam Safety Assurance Programme and Dam Compliance Certificate

Dam PIC	Prepare DSAP (dam safety procedures exist)	Prepare DSAP (no dam safety procedures exist)	Audit DSAP (annual Dam Compliance Certificate)
Low	$6,000 to $8,000	$10,000 to $15,000	$3,000 to $4,000
Medium	$8,000 to $10,000	$15,000 to $20,000	$4,000 to $5,000
High	$10,000 to $15,000	$20,000 to $30,000	$5,000 to $6,000

Questions on regulatory impact

31 Can you describe any other costs and benefits not discussed in Table 6?

32 For regional authorities: In your experience what will be the likely cost of administering the proposed dam safety regulations e.g. additional resource requirements?

33 For owners of dams: Are you following the NZSOLD dam safety guidelines?

34 If you are following the NZSOLD dam safety guidelines, please tell us about any additional costs you may incur from implementing a Dam Safety Assurance Programme?

35 If you are not following the NZSOLD dam safety guidelines, please tell us about any additional costs you may incur from implementing a Dam Safety Assurance Programme?

A full regulatory impact analysis will be undertaken prior to final policy decisions

Before the proposed regulations can be made a regulatory impact analysis (RIA) and cost benefit analysis will be undertaken. The RIA will estimate the impact of the proposed regulations across all dams in New Zealand, all affected regional authorities and other affected stakeholders.

Appendix 1: Consultation questions

Your submission can address any issue relating to the proposed national dam safety regulations discussion paper. The questions listed below are a guide only.

1 **Do you think the proposed definitions of key dam safety terms are appropriate?**

2 **If you do not think any of the proposed definitions are appropriate, can you make suggestions on how any of them can be improved?**

3 **Do you have any comments on how these proposed terms will work in practice?**

4 **Do you agree with the proposed qualification requirements for a 'Recognised Engineer'?**

5 **Do you agree with the proposed competencies for a 'Recognised Engineer'?**

6 **If you do not agree with the proposed qualifications and competencies, please comment on what they should be.**

7 **What evidence should be attached to the certificate provided by the engineer (for example a CPEng registration number) to show the engineer is a 'Recognised Engineer'?**

8 **The proposed timeframe for regulations to come into force is 12 months after they are gazetted. Do you think this timeframe is adequate?**

9 **If you do not think the timeframe is adequate, please tell us how much time you would prefer.**

10 **Do you agree with the proposed classification threshold to determine if a dam is a classifiable dam?**

11 **If you do not agree, what other measure could be used?**

12 **Do you agree that it is unnecessary to have a separate category for referable dams (considering the proposed classification threshold and regional authorities' powers under section 157 of the Building Act)?**

13 **Do you agree with the proposed Potential Impact Classification system in Step 2?**

14 **If you do not agree with the proposed Potential Impact Classification system, what alternative system, or changes, do you suggest for classifying the potential impact of a dam's failure?**

15 **Do you agree with the proposed content of a Dam Safety Assurance Programme?**

16 **Do you think there are any elements in the Dam Safety Assurance Programme that are missing or are too onerous?**

17 **Do you agree that it is unnecessary to have an accreditation regime at present?**

18 **Do you agree with the proposed definition of 'moderate earthquake'?**

19 **Do you agree with the proposed definition of 'moderate flood'?**

20 **If you do not agree with the proposed definitions of 'moderate earthquake' and 'moderate flood', what definitions do you consider more appropriate, and why?**

21 **For owners of dams: What impacts (if any) would the proposed definitions of 'moderate earthquake' and 'moderate flood' have on the management of your dams?**

22 **For regional authorities: What (if any) potential issues do you see in applying the definitions of 'moderate earthquake' and 'moderate flood'?**

23 Do you agree with the proposed definition of 'earthquake threshold event'?

24 Do you agree with the proposed definition of 'flood threshold event'?

25 If you do not agree with the proposed definitions of 'earthquake threshold event' or 'flood threshold event' what definitions do you consider more appropriate and why?

26 For owners of dams: What impacts would the proposed definitions of 'earthquake threshold event' and 'flood threshold event' have on the management of your dams?

27 For regional authorities: What (if any) potential issues do you see in applying the definitions of 'earthquake threshold event' and 'flood threshold event'?

28 For regional authorities: What information would you need to ensure the regulations are implemented effectively?

29 For owners of dams: What information would you need to ensure the regulations are implemented effectively?

30 Do you have any comments on the proposed content of the forms for a Dam Classification Certificate, Dam Safety Assurance Programme or Annual Dam Compliance Certificate?

31 Can you describe any other costs and benefits not discussed in Table 6?

32 For regional authorities: In your experience what will be the cost of administering the proposed dam safety regulations e.g. additional resource requirements?

33 For owners of dams: Are you following the NZSOLD dam safety guidelines?

34 If you are following the NZSOLD dam safety guidelines, please tell us about any additional costs you may incur from implementing a Dam Safety Assurance Programme?

35 If you are not following the NZSOLD dam safety guidelines, please tell us about any additional costs you may incur from implementing a Dam Safety Assurance Programme?

Appendix 2: Glossary of terms

Terms used in this document are summarised below. Key dam safety terms are summarised in Section 2 of the Discussion paper *Summary of proposed definitions,* ***Table 1****: Proposed definitions of key dam safety terms.*

Table 9: Glossary of terms

Term	Proposed definition
Annual exceedance probability	Annual exceedance probability refers to the probability of an event of a given size or larger occurring in any one year. For example, a one per cent AEP event has a 1 in 100 chance of occurring in any one year.
Appurtenant structure	In relation to a dam, means a structure that is integral to the safe functioning of the dam as a structure for retaining water or other fluid.
Consequence of failure	The downstream and upstream effects that would result from a failure of the dam or its appurtenant structures.
Crest	In relation to a dam, means the uppermost surface of a dam, not taking into account any camber allowed for settlement, or any curbs, parapets, guard rails, or other structures that are not part of the water-retaining structure; and for the avoidance of doubt, any freeboard is part of the water-retaining structure for the purposes of this definition.
Dam	(a) means an artificial barrier, and its appurtenant structures, that— (i) is constructed to hold back water or other fluid under constant pressure so as to form a reservoir; and (ii) is used for the storage, control, or diversion of water or other fluid; and (b) includes— (i) a flood control dam; and (ii) a natural feature that has been significantly modified to function as a dam; and (iii) a canal; but (c) does not include a stopbank designed to control floodwaters
Dam height	The vertical distance from the crest of the dam and must be measured— (a) in the case of a dam across a stream, from the natural bed of the stream at the lowest downstream outside limit of the dam; and (b) in the case of a dam not across a stream, from the lowest elevation at the outside limit of the dam; and (c) in the case of a canal, from the invert of the canal.
Dam safety incident	Any condition that develops naturally or unexpectedly, but does not endanger the integrity of the dam and downstream property or life.
Emergency	A situation that poses an immediate risk to life, health, property or the environment, and requires a coordinated response.
Freeboard	The vertical distance between the still water surface elevation in the reservoir and the lowest elevation of the top of the dam or other containment structure.
Potential impact classification (PIC)	A system of classifying dams according to the incremental consequences of dam failure, so that appropriate dam safety criteria can be applied. In classifying a dam, the owner must— (a) apply the prescribed criteria and standards for dam safety; and (b) give the dam one of the following classifications: (i) low potential impact; or

	(ii) medium potential impact; or (iii) high potential impact; and (c) submit the classification of the dam to a Recognised Engineer for audit.