

Guidelines on dams and water retaining embankments

These Guidelines are intended to make the inquirer aware of the need for a careful approach to any work related to water retaining embankments and the need to assess the level of risk, hence the expertise required to undertake such work. The Guidelines do not go beyond the point of helping to establish the classification of a particular dam / embankment, which then determines the criteria to be followed in the work related to that structure. Depending on the classification established (and the response of the particular regional council) specialist experts need to be involved.

In the following the basis and method for the initial appraisal is outlined:

The *Building Act 2004* is the legislation governing the construction of dams. It defines a “dam” and a “large dam” in *section 7*, as follows:

“**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
 - (iii) [Repealed]
- (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”

“**large dam** means a dam that retains 3 or more metres depth, and holds 20 000 or more cubic metres volume, of water or other fluid”

The Building Act also places a responsibility on dam owners to have their dams classified (s 134), submit certificates for the classification to the regional authority (s 135) and if the classification results in an indication of medium or high potential impact in the event of a failure, the owner must prepare and implement a dam safety programme (s 140).

The Act also provides for promulgating various regulations and the *Building (Dam Safety) Regulations 2008* were published, with a commencement date of 2012, which has now been put back to 2014. While not yet operative, these regulations contain some useful guidelines as to the effect-based approach for the classification of dams related to potential “uncontrolled release” of the contents. The relevant clause and two tables from the Regulations are quoted at the end of this memorandum.

For undertaking the assessment the following information is considered pertinent:

1. Any embankment for the storage of a liquid is to be regarded as a “Large Dam” if the pond’s capacity for liquid retained is in excess of 20,000 m³ and the height from the crest to the toe is 3 metres or more. In the case of wastewater dams, the volume stored is the volume capable of being stored up to the crest of the dam, and not the normal operating volume.

2. A “Large Dam” requires a Building Consent issued by the Waikato Regional Council for any upgrading, demolition or other changes to the embankment or any appurtenant structures.
3. An ‘appurtenant structure’ is deemed to be any associated structure that if it failed, could result in the breaching of the embankment (e.g. a pipe running through an embankment).
4. Under the existing Building Codes related to the Building Act 1991, any dam smaller than a “Large Dam” will not require Building Consent, but it is a requirement to take dam safety assurance principles into consideration. The designer has to show adequate experience and knowledge relative to the structure.
5. For the purposes of the Regulations, “Large dams” are separated into “Referable” and “Classifiable” structures.
6. All Classifiable structures must have a Potential Impact Classification (PIC) undertaken in terms of the Regulations.
7. “Referable” structures may be required by the regional authority (Waikato or Auckland as applicable) to have a classification undertaken, if they have good reason to believe that it may result in either a Medium or High Potential Impact Classification.
8. For the construction or changing of a dam or its appurtenant structure, the designer will need to undertake a Potential Impact Classification, irrespective of the height and volume. It is the Potential Impact Classification (High, Medium or Low) which sets the level of standards / guidelines in the New Zealand Society on Large Dams (NZSOLD) Dam Safety Guidelines for the future performance of the structure, especially in terms of flood capacity and seismic capacity.
9. Additionally, the PIC classification will set the dam operating and dam safety operating requirements for the particular dam

The relevant part of the Regulations is quoted below and the Tables are reproduced on the following pages:

“Dam classification

A dam classification is to be determined by undertaking the following steps:

- (a) 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; and*
- (b) use [table 1](#) of Schedule 1 to determine the assessed damage level by assessing whether the damage level in each of the specified categories is catastrophic, major, moderate, or minimal then selecting the highest damage level; and*
- (c) estimate the population at risk; and*
- (d) use [table 2](#) of Schedule 1 to determine the dam classification by correlating the assessed damage level with the estimated population at risk*

Terms relevant to the above defined in the Interpretation clause of these Regulations:

population at risk means the number of people likely to be affected by inundation greater than 0.5 metres in depth

specified categories are residential infrastructure, critical or major infrastructure (both damage caused and time to restore to operation), natural environment, and community recovery time.”

Conclusions

Watercare's role includes the maintenance, management and potential construction/reconstruction of ponds retained by embankments, where the question of construction standards is likely to arise.

The information in these Guidelines is intended to assist those involved with the activity to comply with the technical and legal requirements of the tasks.

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Dam classification

Table 1—Determination of assessed damage level

Damage level	Specified categories				
	Residential houses ¹	Critical or major infrastructure ²		Natural environment	Community recovery time
		<i>Damage</i>	<i>Time to restore to operation³</i>		
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
Notes					
1	In relation to residential houses, destroyed means rendered uninhabitable.				
2	Includes— (a) lifelines (power supply, water supply, gas supply, transportations systems, wastewater treatment, telecommunications (network mains and nodes rather than local connections)); and (b) emergency facilities (hospitals, police, fire services); and (c) large industrial, commercial, or community facilities, the loss of which would have a significant impact on the community; and (d) the dam, if the service the dam provides is critical to the community and that service cannot be provided by alternative means.				
3	The estimated time required to repair the damage sufficiently to return the critical or major infrastructure to normal operation.				

Table 2—Determination of dam classification

Assessed damage level	Population at risk (PAR)			
	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 a PAR of 5 or more people, it is unlikely that the potential impact will be low.			
2	With a PAR of 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.			