

**DSC3E**

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# **FLOOD RETARDING BASINS**

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## 1. INTRODUCTION

The normal requirements of the NSW Dams Safety Committee (DSC) are set out in its guidance sheets with its principal guidance sheet, *DSC Background, Functions and Operations - DSC1A*, outlining the DSC's general operations and authority.

The DSC has statutory functions under the *Dams Safety Act, 1978* to ensure that all prescribed dams in NSW are designed, constructed, maintained and operated to a standard where risks to the community are tolerably low. The level of risk is determined by the likelihood and consequences of failure. Retarding basins act as dams during floods and are forming an increasingly important component in the minimizing of flood risks in urban catchments.

Owners, and their professional advisers, have full responsibility for ensuring the reliable safety management of their retarding basins, each with their own individual and specific issues. However, the DSC also has a responsibility to draw owners' attention to any DSC requirements (see section 2.2) for prescribed retarding basins, as well as general issues or findings that may provide guidance to assist owners in their operational responsibilities. Accordingly the DSC has prepared this guidance sheet outlining relevant matters required to achieve *good practice* for the safety management of retarding basins.

The DSC Retarding Basin Safety Goal and Key Requirements (Section 2) at the start of the sheet are a summary - the whole sheet is to be read for a proper understanding of DSC considerations on retarding basins.

## 2. DSC RETARDING BASIN SAFETY GOAL & KEY REQUIREMENTS

### 2.1 DSC Retarding Basin Safety Goal

The DSC's goal regarding prescribed retarding basins is to ensure they are appropriately designed (e.g. have adequate flood capacity) and managed to result in tolerable risks to community interests.

It is for the dam owner to determine how this goal (including DSC requirements) will be achieved and to demonstrate to the DSC that the goal is achieved or will be achieved following safety improvements. The following sheet sections aim to provide guidance to assist dam owners in achieving this DSC goal.

### 2.2 DSC Key Requirements

This section summarises the DSC requirements outlined in this sheet.

## 4. PRESCRIPTION

Owners, or their consultants, should inform the DSC of proposals for new basins (or unnotified existing basins) so that the DSC can consider their need for prescription. The DSC prescribes all basins whose failure could cause loss of life. The DSC requires assessment of the incremental consequences of failure of the basin.

## **5. DESIGN**

The consequences of a storm exceeding the basin operating design storm should be considered in the design and operation of a retarding basin the DSC requires that basins be designed to safely pass appropriate extreme storms commensurate with the consequence category of the basin.

The extent of existing and future development in an urban catchment should be considered during design of a retarding basin.

In Mine Subsidence districts the effects of mining on the performance of the structure should also be taken into account.

Each basin within a catchment should be investigated, not only individually, but collectively with the catchment, including all basins, modeled as a whole.

The embankments/walls forming retarding basins are to be designed as dams using appropriate stability analyses and practices. In particular appropriate foundation treatment and bonding of the embankment to the foundation should be specified. For earthen embankments suitable compaction levels should be specified and protection provided to cater for cracking or dispersive soils (e.g. intercepting filters or outer zones comprising dimensionally stable, non-dispersive soils). Embankment slopes and their protection should take into account long term maintenance of the structure.

Trees should not be planted on earthen embankments. Preferably, embankments should be protected by a uniform, robust, grass cover that can be routinely mowed.

Where embankments are designed for overtopping in extreme storms, the DSC requires that the protection system be properly designed, that it be of proven performance, that the design be in accordance with any manufacturer's requirements, and that it will provide effective protection in the long term.

Outlets should preferably be concrete encased within a rock foundation or appropriately filtered in the natural earthen material under the basin and sealing of an outlet within an embankment merits specific attention to prevent piping under flood loadings.

## **6. CONSTRUCTION**

The owner is to comply with the submission of information requirements set out in the DSC's guidance sheet on *Documentation and Information Flow over Dam Life Cycle (DSC2B)*.

## **7. MAINTENANCE**

The DSC considers regular maintenance as a critical factor to ensure long term safe operation of basins.

## **8. SURVEILLANCE**

The DSC requires that all prescribed retarding basins that permanently store water be inspected by trained personnel to ensure the ongoing safety of the basins.

## **9. EMERGENCY MANAGEMENT**

Owners are required to develop an appropriate emergency plan in conjunction with the relevant emergency authorities outlining procedures for owners to follow to mitigate the effects of extreme flood events at their basins.

### 3. BACKGROUND

Flood retarding basins are urban holding ponds which temporarily store some, or all, of the stormwater runoff from a catchment. They reduce downstream flow rates for small to moderate flood events. Such basins are constructed to reduce the cost of downstream channel upgrades, to reduce downstream flooding impacts or to meet requirements restricting urban catchment outflow peaks.

These basins may have considerable benefits other than flood control for the community (e.g. recreation areas, scenic pond, pollution control etc) and are usually designed to mitigate floods up to the 1 in 100 Annual Exceedance Probability (AEP) flood level. However, when these basins store water they act as dams. Basins which could pose a potential threat to communities downstream are “prescribed” by the DSC under the *NSW Dams Safety Act 1978*. The DSC then maintains continuing oversight of their safety. It should be noted, however, that the DSC does not prescribe road and rail embankments unless they are designed to act as retarding basins.

From a review of the behaviour of a large number of these basins in NSW over recent years, the DSC has highlighted several areas that require special consideration. This guidance sheet has been prepared by the DSC to inform basin owners of these matters and so ensure that basins are designed, constructed, operated and maintained in an appropriate manner.

### 4. PRESCRIPTION

Owners, or their consultants should inform the DSC of proposals for new basins (or unnotified existing basins) so that the DSC can consider their need for prescription. The DSC prescribes all basins whose failure could cause loss of life. The DSC requires assessment of the incremental consequences of failure of the basin noting the difference between pre and post failure flood levels downstream of a basin at its potential failure flood level (e.g. at overflow level for earthen embankments). This “consequence assessment” should be based on the judgment of an experienced dams engineer. Where there is doubt a more detailed determination will be required, taking into account such matters as dambreak studies, predicted headwater / tailwater differences and depth / velocity / risk curves.

When a basin is prescribed, the DSC requires owners to notify the DSC of their actions at all stages of the development and operation of the basin to enable appropriate oversight of the safety standards employed. (See DSC2B for details of documentation requirements).

### 5. DESIGN

The DSC requires that prescribed basins be designed by suitably qualified persons (i.e. dams engineers or urban drainage engineers with suitable experience) and that appropriate dam design concepts are employed. The CV's of designers are to be submitted for the approval of the DSC (see DSC2B for details). The DSC

essentially relies on the knowledge, skill and diligence of the owner's designer(s) for aspects of detailed analysis and design and their conformance with current practice. However the DSC may require further assessment of any aspect of design to ensure adequate protection of the community and environment. The following areas, in particular, require detailed consideration by designers:

#### 5.1 Flood Capacity

The consequences of a storm exceeding the basin operating design storm should be considered in the design and operation of a retarding basin. Although such an occurrence may be rare, it is still possible, and the consequences of the sudden failure of a large basin can be catastrophic because of their proximity to residential areas. Accordingly, the DSC requires that basins be designed to safely pass appropriate extreme storms commensurate with the consequence category of the basin, as is the case for conventional dams (Refer DSC3B for normal requirements on acceptable flood capacity).

#### 5.2 Degree of Development

The extent of existing and future development in an urban catchment should be considered during design of a retarding basin as future extensive development within the catchment could significantly alter catchment response at the basin. In addition future development downstream of the basin could significantly affect the outflow characteristics of the basin, increase the hazard presented by the basin (affecting the DSC's requirements) and also increase the legal liability of the owner.

#### 5.3 Mining Effects

In Mine Subsidence districts the effects of mining on the performance of the structure should also be taken into account and the approval of the Mine Subsidence Board obtained.

#### 5.4 Multiple Basins within a Catchment

With increasing urbanisation there are now many catchments in NSW which contain a series of retarding basins. This introduces two further aspects which must be considered. The consequences of one basin failure cascading downstream into lower basins should be evaluated. In addition the effect of long period releases from upper basins superimposing on flows through lower basins may require a revision of the basins' operations throughout the catchment. Overall each basin within a catchment should be investigated, not only individually, but collectively with the catchment, including all basins, modelled as a whole.

#### 5.5 Embankments

The embankments/walls forming retarding basins are to be designed as dams using appropriate stability analyses and practices. In particular appropriate foundation treatment and bonding of the embankment to the foundation should be specified. For earthen embankments suitable compaction levels should be specified and protection provided to cater for cracking or dispersive soils (e.g. intercepting filters or outer zones comprising dimensionally stable, non-dispersive soils). Embankment slopes and their protection should take into account long term maintenance of the structure. Trees should not be planted on earthen embankments. Preferably, embankments should be protected by a uniform, robust, grass cover that can be routinely mowed.

The DSC does not usually permit designs that envisage the overtopping of earthen embankments at flood peaks less than the design flood required by the DSC's guidance sheet on *Acceptable Flood Capacity for Dams (DSC3B)*. Where embankments are designed for overtopping in extreme storms, the DSC requires that the protection system be properly designed, that it be of proven performance, that the design be in accordance with any manufacturer's requirements, and that it will provide effective protection in the long term.

## 5.6 Outlets

Outlets should preferably be concrete encased within a rock foundation or appropriately filtered in the natural earthen material under the basin and sealing of an outlet within an embankment merits specific attention to prevent piping under flood loadings. Outlet covers should be designed to prevent harm to people while permitting flow passage without trash build up. Inlets should be designed to minimise blockage and facilitate clearing of debris.

## 6. CONSTRUCTION

The owner is to comply with the submission of information requirements set out in the DSC's guidance sheet on *Documentation and Information Flow over Dam Life Cycle - DSC2B*, in particular those relating to design variations, construction certificate and work-as-executed drawings. The owner is to arrange for the work to be supervised by a suitably qualified engineer.

## 7. MAINTENANCE

The DSC considers regular maintenance as a critical factor to ensure long term safe operation of basins. One of the DSC's biggest concerns, revealed in its inspections of retarding basins throughout NSW, is the standard of retarding basin maintenance. In many instances outlets have been allowed to clog up with trash, and/or become completely overgrown, severely limiting the capacity of the basin and increasing the probability of its failure under flood conditions, with increased potential liability for the owner. In addition tree growth has been allowed in overflow sections which would restrict outflow and encourage scouring in these sections and trees have been allowed to grow on embankments which would compromise the safety of these embankments by providing leakage paths along the root system. In other areas, grass cover has not been maintained allowing cracking and erosion and scour of the embankment during storms, thus reducing the embankments' stability and increasing the possibility of its failure. These aspects should be attended to in a regular maintenance program for each basin to maintain the integrity of the basin and its value as an asset to the owner.

## 8. SURVEILLANCE

The DSC requires that all prescribed retarding basins that permanently store water be inspected by trained personnel to ensure the ongoing safety of the basins. The inspection frequency is to align with the frequency outlined in the ANCOLD *Guidelines on Dam Safety Management - 2003* pertinent to the 'sunny day' consequence category of the basin (e.g. a monthly inspection schedule is usually required for all 'dry' prescribed basins).

All basins are to be inspected after significant storm or earthquake events to evaluate performance and determine any requisite maintenance/remedial works.

In addition, in line with its requirements for all prescribed dams, the DSC requires a surveillance report from the owner, one year after construction and then at five yearly intervals, detailing the performance of the basin and any remedial requirements (see DSC3C for details of report content).

## 9. EMERGENCY MANAGEMENT

Owners are also required to develop an appropriate emergency plan in conjunction with the relevant emergency authorities outlining procedures for owners to follow to mitigate the effects of extreme flood events at their basins (see DSC2G for details).

This Guidance Sheet is one of a series available from our Website at:

<http://www.damsafety.nsw.gov.au>

In order to read this file you need a Portable Document Format (PDF) reader. A free PDF reader is available from <http://www.adobe.com/>

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