Detention Dams and Drop Structures

Introduction

The volcanic ash soils of the Bay of Plenty are very susceptible to erosion by flowing water. Since the mid 1970's, small on-farm floodwater control dams (detention dams) and drop structures have been used to control rill and gully erosion caused by floodwater flows. Detention dams are designed to moderate peak floodwater flow rates during high intensity rainfall events (flash floods). They impound floodwater and release it at a controlled flow rate through a small diameter outlet pipe.

Drop structures are designed to carry floodwater flows over abrupt changes in channel gradient where plunge pool formation occurs. This is because turbulence in plunge pools will undermine and collapse the upstream channel floor. This process, known as headward erosion in permanent streams and gully head erosion in (normally) dry gullies, can rapidly migrate upstream under flood conditions.

Environment Bay of Plenty designs and builds these flow control structures in accordance with specific technical standards and the provisions of the Regional Land Plan.

Detention Dams

Detention dams are constructed in dry watercourses that only carry water during heavy rainfall events. They are designed to cater for a 1 in 10 year rainfall event and an emergency spillway is incorporated to allow for larger storm events. The catchment size for such dams is generally 40 hectares or less. Outflows from larger catchments can be controlled by the use of several smaller dams sited throughout the watercourses within the catchment.

Detention dam under construction, topsoil being spread prior to sowing grass seed

Completed dam; spillway is at left of embankment. Pipe intake can be seen at base of embankment.

Where a dam site is identified upstream of a gully-head erosion site, a survey is undertaken to estimate the water storage volume. A minimum storage volume of 60 m^3 per hectare of catchment and a spillway height of two metres or less is the general criteria for a dam site based on experience with the use of these structures in the Bay of Plenty. The spillway height is kept below two metres to minimise the cost of construction. The volume of water stored by such detention dams is generally up to 2,600 m^3.

Construction takes between three and five days using a motor-scraper and a digger, and/or bulldozer depending on the site and size of the dam. Around 2,000 m^3 of material is required to construct an average sized dam.

Dam embankments are constructed with a compacted freeboard of 800 mm, and a batter of 3:1 is used to minimise potential surface erosion. The dam is topsoiled and oversown with a grass/legume seed mix. Properly constructed detention dams with the pipe intake protected from animal treading by a small headwall, require minimal maintenance. Where there is a risk of leaf litter or other debris collecting at the intake, the pipe will require an intake grill which should be checked regularly.

Impounded stormwater in a detention dam. Dams take 12-24 hours to drain depending on volume of water and flow rate of the outlet pipe. Embankment is at centre left of photo and truck is parked in dam spillway.

Drop Structures

Box flumes, pipe flumes and reinforced embankments are all examples of drop structures. Flumes are designed to carry

water flow away from the face of a gully head escarpment, and drop it into a plunge pool far enough downstream to prevent undercutting of the escarpment. Reinforced embankments are used in dry gully floors to control scouring by flood water, where there is a difference in gully floor levels of 1.0 m or less.

Box Flumes

Box flumes are generally constructed from timber, using tongue and groove linings or resin bonded plywood. They are built as a chute comprising floor, sides and cross bracings. At the intake of the flume, wing walls are extended into the sites of the channel and an apron extending from the floor of the flume is embedded into the floor of the channel. The extent and placement of these features is critical for the stability of flumes built on ash soils. High flows can otherwise outflank the flume intake and rapidly undermine the whole structure.

Box flumes have high design and construction standards and are expensive. They usually work best in small permanently flowing streams where there is a headward erosion problem. For gully head erosion on most sites in the Bay of Plenty other flow control methods are generally cheaper and more reliable.

Pipe Flumes

Rigid pipe flumes fulfil the same function as box flumes but are generally not suitable for permanently flowing streams. They require large pipe sizes, adequate pipe support, and the formation of a bund (embankment) at their intake. As

Boxflume and plunge pool

with all embankments intended to impound floodwater, the bund should be located where a spillway can be incorporated into the structure to accommodate high flows. Spillways should be positioned to discharge onto stable ground where there is no risk of creating secondary erosion problems.

Flexible pipe flumes duct water directly to the lower channel level, thereby avoiding the formation of a plunge pool. This type of arrangement is commonly used for the outflow of detention dams.

Reinforced Embankments

These are used for short drops in dry gully floors (not permanently flowing channels) of 1.0 m or less and comprise a sand bag wall or a geotextile fabric apron. A vital component of the reinforced embankment is a level sill which distributes flow (and energy) evenly across the embankment.

The maximum flow rate for reinforced embankments is

Flexible pipe flume (twin 160mm novacoil) carrying flow from a detention dam to the lower channel level.

2 m/sec. If flood waters are likely to exceed this velocity some other form of flow control will be required.

Environment Bay of Plenty REGIONAL COUNCIL

For further information and advice, contact your local land management officer at Environment Bay of Plenty:
Telephone: 0800 ENV BOP (368 267)
Facsimile: 0800 ENV FAX (368 329)
Pollution Hotline: 0800 73 83 93
Email: info@envbop.govt.nz
Website: www.envbop.govt.nz
Address: 5 Quay Street, P O Box 364, Whakatane, New Zealand

This factsheet was prepared by Nick Johns
Photographs by Nick Johns and Colin Stace

This factsheet was last updated June 2003