

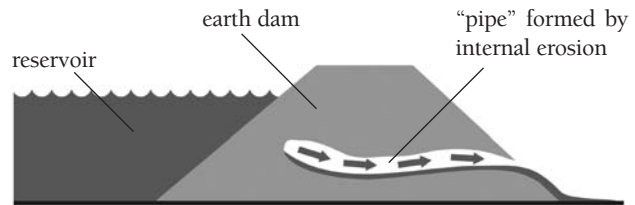
WHAT IS INTERNAL EROSION?

Internal erosion of an earth dam takes place when water that seeps through the dam carries soil particles away from the embankment, foundation or abutments of the dam.

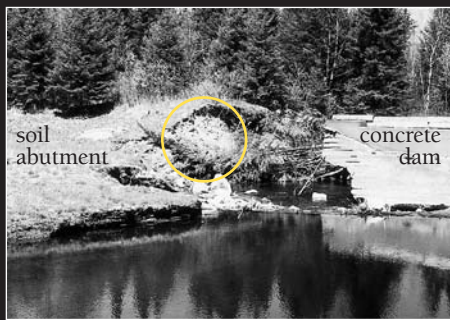
If the seepage that discharges at the downstream side of the dam carries particles of soil, an elongated cavity or “pipe” may be eroded backward toward the reservoir through the embankment, foundation or an abutment.

When a backward-eroding pipe reaches the reservoir, a catastrophic breaching of the dam will almost certainly occur. A pipe that was discovered before it reached the reservoir is shown in the photos on the cover of this brochure.

Internal erosion usually takes place in episodes of erosion and discharge of muddy water interspersed with periods of clear-water discharge or no discharge at all. Internal erosion may be taking place even if there is no visible discharge of water or if the water that is discharging from the soil on the downstream side of a dam is not muddy.



Schematic view of internal erosion in an earth dam embankment.



Failure at a concrete dam caused by internal erosion of the soil abutment (shown by circle).



FEMA

The Federal Emergency Management Agency has provided financial support for the publications of this brochure.

Mr. A. Peter Barranco, Dam Safety Engineer of the state of Vermont, provided valuable input and many of the photos in this brochure.

This document is dedicated to the memory of
Ronald C. Hirschfield.

THE FOLLOWING PUBLICATIONS ARE AVAILABLE from the Association of State Dam Safety Officials (ASDSO) or your state dam safety office.

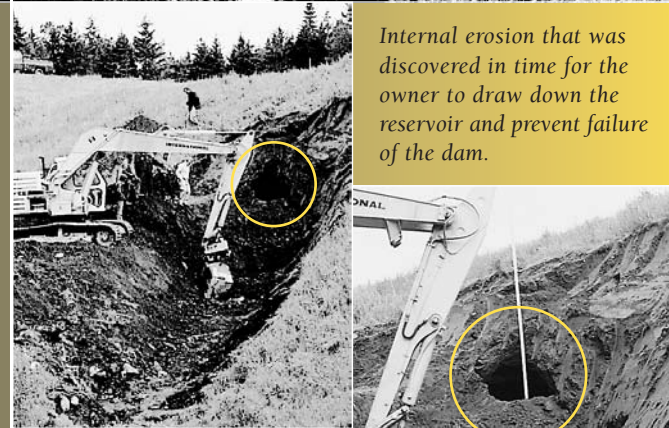
- Responsibility and Liability
- Procuring the Services of a Professional Engineer
- Dam Safety: An Owner's Guidance Manual, FEMA Publication 145

ASSOCIATION OF STATE DAM SAFETY OFFICIALS

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Internal Erosion of Earth Dams



Internal erosion that was discovered in time for the owner to draw down the reservoir and prevent failure of the dam.

INTRODUCTION

Internal erosion of soil particles form within a dam by water that seeps through the dam (called piping by dam engineers) is one of the most common causes of failure of earth dams.

Internal erosion is especially dangerous because there may be no external evidence, or only subtle evidence, that it is taking place. A dam may breach within a few hours after evidence of the internal erosion becomes obvious.

Internal erosion may develop the first time water is impounded behind a dam, or it may develop over many years. You cannot assume that your dam is safe against internal erosion just because it has performed satisfactorily for many years.

Internal erosion failures are often associated with “penetrations” of dams, such as outlet pipes buried in the embankment and concrete spillways that cross the embankment.

An experienced dam engineer may be able to detect the subtle signs of internal erosion during routine periodic inspections, but you should be aware of what signs to look for between inspections. If you do observe signs of internal erosion, you should get help from an experience dam engineer.



COVER PHOTOS

- Top: Shallow subsidence on the downstream slope of the dam.
- Middle: A cavity in the dam, revealed when the embankment was excavated with a back-hoe in the vicinity of the subsidence after the reservoir was lowered.
- Bottom: Close-up of the cavity, 6 feet wide and extending 85 feet into the embankment from the downstream toe of the dam.

DAM OWNERSHIP

WHAT TO LOOK FOR

SIGNS OF IMMINENT DANGER

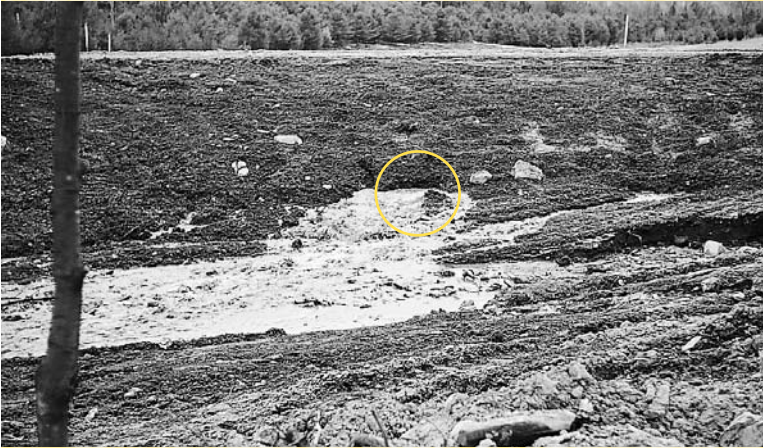
- Muddy water discharging from the downstream side of a dam or from a drain or low-level outlet pipe, which may indicate that the dam is failing.
- Sinkholes or subsidence anywhere on the embankment or an abutment. Water flowing into a sinkhole below the reservoir surface on the upstream slope of a dam is especially dangerous.

SIGNS OF POTENTIAL DANGER

- Water discharging on the downstream slope of an earth dam or with a few hundred feet downstream from the dam. Look for any accumulation of sediment downstream from the discharge.
- Water flowing along the outside of a pipe, concrete spillway, or other structure that penetrates the embankment.
- Trees that are uprooted on the embankment or abutments or in the valley bottom immediately downstream from the dam.
- Dead trees (the rotting roots of which may become avenues of internal erosion) on the embankment or abutments or in the valley bottom immediately downstream from the embankment.
- Animal burrows on the embankment.



A spring discharging at the downstream toe of the embankment.



Within two hours, the spring became much larger...



...and later the dam failed!

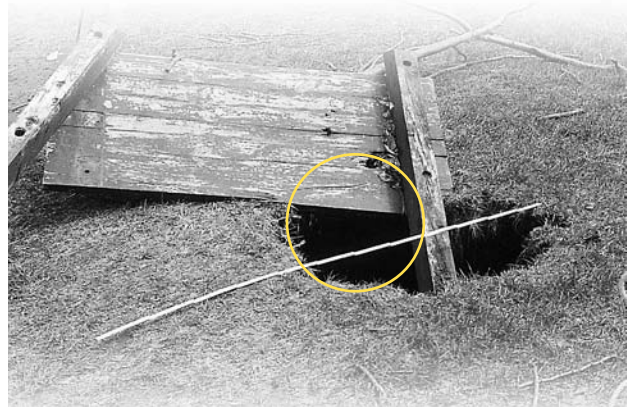


Corroded corrugated-metal outlet pipe removed from a dam that had developed large sinkhole.

WHAT TO DO

Immediately, call 911, call the emergency number of your state dam safety office, and implement your emergency action plan if you see:

- Muddy water or large flow of clear water discharging (1) from soil anywhere on the downstream side of the dam, (2) next to a spillway, pipe or other structure that penetrates the embankment or abutments, or (3) from drain pipes in the embankment.
- A large new sinkhole (more than 8 inches in diameter) or new subsidence anywhere on the embankment or abutments.



Sinkhole on the crest of an earth dam. The reservoir was lowered, and a 10-foot-diameter cavity was found under the sinkhole.



Spring (rust-colored water) that developed where the root ball of a tree pulled out of the ground near the downstream toe of a dam.

IF YOU SEE SIGNS OF POTENTIAL DANGER

As soon as possible, contact your state dam safety engineer or other qualified profession dam engineer to inspect the dam if you see:

- Springs that discharge a small quantity of clear water on the downstream slope of the embankment or in the valley bottom within a few hundred feet downstream from the dam.
- A small quantity of clear water flowing next to a pipe, spillway, or other structure that penetrates the embankment.
- Water discharging near the roots of a living or dead tree.
- Corrosion or deterioration of the visible portion of a low-level outlet pipe or other structure that penetrates the embankment.
- A tree uprooted on the embankment or in the valley bottom within a few hundred feet downstream from the dam.
- A small new sinkhole (less than 8 inches in diameter) or animal burrow or an old sinkhole or subsidence anywhere on the embankment or abutments.



Failure of an earth dam by internal erosion along concrete outlet pipe.