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Impacts of Animals on Earthen Dams

Course Number: CE-02-205

PDH: 10

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1.0 Introduction: Animal Impacts on Earthen Dams

By the end of this section, you will be able to:

- **Explain** why animal intrusion is a dam safety concern for earthen dams.
- **Describe** how animal activity can affect the hydraulic, structural, and operational performance of an earthen dam.
- **Summarize** the key FEMA and ASDSO survey findings that led to formal guidance on nuisance wildlife and dam safety.
- **Recognize** why animal identification, timely repair, preventive measures, and regulatory compliance are important parts of dam safety management.

Executive Summary

Animal activity at earthen dams is not merely a nuisance or routine maintenance issue. Burrows, dens, blocked spillways, loss of vegetation, and animal-created erosion pathways can affect the engineered function of an embankment dam. These conditions can create seepage paths, weaken compacted fill, reduce surface protection, interfere with spillway or outlet function, and contribute to unsafe dam operation. In some cases, animal intrusion has been identified as a cause or contributing factor in dam failures.

Because earthen dams rely on compacted soil, stable slopes, controlled seepage, adequate freeboard, and reliable hydraulic structures, animal damage must be evaluated as part of the dam safety inspection and maintenance process. Effective dam management requires inspectors, dam owners, and engineers to identify wildlife damage, understand its dam safety significance, determine the likely responsible species, and implement appropriate repair, prevention, and mitigation measures.

1.1 Animal Intrusion as a Dam Safety Concern

Earthen dams are engineered structures that depend on the integrity of compacted soil embankments to store and control water. When animals burrow into an embankment, remove vegetation, create trails, block outlets, or alter drainage patterns, they can interfere with the basic functions that allow the dam to operate safely.



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Animal burrows are especially important because they may be much more extensive than the visible opening suggests. A small entrance on the upstream or downstream slope may connect to a larger internal void, tunnel, or den. These openings can weaken the embankment, create preferential seepage paths, shorten seepage routes through the dam, and increase the potential for internal erosion. If water begins to carry soil particles through a burrow or other void, the process can progress into piping, which is one of the most serious failure mechanisms for earthen dams.

Animal activity can also affect the dam surface. Grazing, repeated animal traffic, and loss of vegetative cover can expose soil to rainfall and runoff. Over time, this can lead to rills, gullies, erosion channels, and loss of embankment cross section. These surface defects may appear minor at first, but they can worsen during storm events and reduce the dam's ability to perform as designed.

Wildlife can also affect hydraulic structures. Beavers, for example, can block spillways, culverts, risers, and outlet channels with sticks, mud, and other debris. A blocked spillway or outlet can raise the normal pool level, reduce available freeboard, reduce discharge capacity, and increase the risk of overtopping or erosion during high-water events.

⚠ Safety Constraint: Animal damage should not be dismissed because the visible defect appears small. Burrows, dens, vegetation loss, blocked hydraulic structures, and erosion features can indicate developing dam safety problems that require further evaluation.

1.2 Development of National Guidance

Animal intrusion damage to earthen dams has been recognized as a national dam safety concern. In 1999, the Federal Emergency Management Agency (FEMA) and the Association of State Dam Safety Officials (ASDSO) conducted research and a workshop to examine animal intrusion damage and the safety issues associated with it. This effort brought together dam owners, engineers, state and federal regulators, wildlife managers, foresters, and academic specialists.

The goal was to improve understanding of how nuisance wildlife affects earthen dams and to develop a more consistent approach for identifying, repairing, preventing, and managing animal-related damage.

The workshop and related surveys showed that many state dam safety officials recognized animal intrusion as a problem, but formal guidance was limited. Many dam owners and local operators were not fully aware of how animal activity could affect embankment safety. Without practical guidance, animal damage might be overlooked, misidentified, or treated as a minor maintenance issue rather than a potential dam safety concern.



FEMA and ASDSO determined that dam safety professionals needed practical guidance addressing nuisance wildlife in the earthen dam environment. The central issue was not simply whether animals were present. The engineering concern was whether animal activity could adversely affect seepage, slope stability, embankment integrity, surface protection, spillway capacity, outlet function, inspection visibility, or long-term dam operation.

💡 **Design Tip:** Wildlife activity should be treated as part of the dam safety inspection process. The key question is not only “What animal is present?” The more important question is “What dam safety function could this activity affect?”

1.3 Survey Findings and Scope of the Problem

To better understand the needs of the dam safety community, FEMA and ASDSO conducted a survey in 1999. The survey included input from 48 state dam safety officials and 11 federal agencies represented through the Interagency Committee on Dam Safety (ICODS). A second survey was conducted in 2003 to identify current state needs, determine which nuisance wildlife and damage mechanisms were being encountered, and identify which mitigation methods were being used successfully or unsuccessfully.

The survey results showed that animal intrusion was a widespread dam safety issue.

Out of 48 responding states, 25 documented nuisance animals as the cause of dam failures or unsafe dam operations within their states. Only 9 states were aware of information or guidance on the effects of animal activity on dams. Similar cases were also documented at the federal level by the U.S. Bureau of Reclamation, the National Park Service, and the U.S. Department of Agriculture.

These findings showed that dam safety officials understood the seriousness of animal damage, but many owners and local operators lacked the practical guidance needed to identify and respond to the problem. The surveys also showed that states wanted to learn how other states were successfully mitigating wildlife-related damage.

The guidance developed from this work addresses 23 nuisance wildlife groups or species that may affect dam safety. These include muskrat, beaver, mountain beaver, groundhog, pocket gopher, North American badger, nutria, prairie dog, ground squirrel, armadillo, livestock, crayfish, coyote, moles and voles, river otter, gopher tortoise, red fox and gray fox, Canada goose, American alligator, and ants.

The survey findings support several important conclusions:

- Animal intrusion can contribute to unsafe dam operation and dam failure.
- Many animal-related dam safety problems begin as small, localized observations.
- Dam owners and operators may not recognize the significance of wildlife clues unless they are trained to look for them.



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- Correct identification of the responsible species is important because different animals cause different types of damage.
- Repair and prevention methods should be selected based on the damage mechanism, dam location, species involved, and dam safety risk.

1.4 Engineering Significance of Animal Activity

Animal damage affects earthen dams in several ways. The most important engineering concerns include hydraulic alteration, structural integrity loss, surface erosion, and interference with hydraulic structures.

Hydraulic Alteration

Burrows can change how water moves through an embankment. An upstream burrow may allow reservoir water to enter the dam farther than intended. A downstream burrow may allow seepage to exit higher on the downstream slope. Either condition can shorten seepage paths, increase seepage gradients, and increase the risk of internal erosion.

Internal erosion, also called piping, occurs when flowing water carries soil particles out of the embankment. If the process continues, the internal void can enlarge and progress toward the reservoir. Piping is a serious dam safety concern because it can develop rapidly and may lead to breach of the dam.

Structural Integrity Loss

Burrows, dens, and tunnels create voids within the dam embankment. These voids can weaken the compacted fill and may collapse under rainfall, snowmelt, traffic loads, or continued animal activity. A collapsed burrow can create a sinkhole, depression, or localized slope instability. If the crest is affected, the dam may lose freeboard. If the downstream slope is affected, the embankment may lose strength and confinement.

Surface Erosion

Vegetation protects the surface of an earthen dam from rainfall, runoff, and erosion. Grazing animals, burrowing animals, and repeated animal traffic can remove vegetation, disturb the soil surface, and create erosion pathways. Rills and gullies can deepen over time and reduce the embankment cross section. Surface erosion may also make it easier for animals to create burrows or expand existing damage.

Hydraulic Obstruction

Some animals can directly interfere with spillways, outlets, and other water-control structures. Beaver activity is a common example. Beaver dams, sticks, mud, and debris can block spillways or outlet works, raise pool levels, reduce discharge capacity, increase tailwater, and contribute to erosion near the downstream toe. Any obstruction that affects the ability of the dam to safely pass water should be treated as a dam safety concern.

⚠️ **Safety Constraint:** Animal damage is most serious when it affects seepage, internal erosion, freeboard, slope stability, spillway capacity, or outlet function. These conditions should be prioritized for evaluation and repair.

1.5 Regulatory and Professional Practice Considerations

Animal damage management may involve both dam safety requirements and wildlife management requirements. A technically effective control method is not automatically lawful or appropriate for use at a specific dam.

Wildlife management methods may be regulated by federal, state, or local requirements. Depending on the species and location, restrictions may apply to trapping, relocation, exclusion, shooting, habitat disturbance, use of toxicants, use of fumigants, work in or near water, and disturbance of protected species or wetlands.

In addition, dam repair work may require coordination with the state dam safety official, state water resources agency, wildlife agency, or other regulatory authority. Repair activities that involve excavation, placement of fill, dredging, work near wetlands, shoreline disturbance, or modification of hydraulic structures may require additional review or authorization.

Professional judgment is also required. Repairing a burrow is not simply a matter of filling a hole. The repair must consider the location of the damage, whether seepage is present, whether soil migration has occurred, whether the slope has been weakened, whether the repair material is compatible with the embankment, and whether the repair could affect future seepage or inspection visibility.

💡 **Design Tip:** Animal damage management should combine engineering judgment, species identification, repair design, prevention planning, and regulatory compliance. Each part supports the others.



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