Fact Sheet 2.1: Channels, Aqueducts, and Canals

The mitigation objective of this Fact Sheet is to ensure that channels, aqueducts and canals can meet their purpose in flooded conditions and maintain the movement of water for flood protection, drainage, irrigation, and water supply.

Channels and canals are artificial structures that use gravity to convey water for flood protection, drainage, irrigation, water supply or other purposes. Aqueducts are any system of pipes, ditches, canals, tunnels, and other structures used to convey water.

Table 2.1.1 summarizes some common mitigation strategies for reducing the vulnerability of channels, aqueducts and canals to hurricanes and flooding.

Table 2.1.1. Channel, Aqueduct and Canal Mitigation Solution

Solutions and Options	***Erosion***	***Channel incision/ migration***	***Slope issues***	***Debris damage***	***Clogging/ turbidity/ contamination***	***Washout/ movement of structures***
Mitigation Solution: Armor Channels and Canals						
Option 1: Armor Channels and Canals	✓	✓	✓			
Mitigation Solution: Stabilize Channels and Canals						
Option 1: Stabilize Channel and Canal Bottoms and Slopes	✓	✓	✓			
Mitigation Solution: Lessen the Energy of Flood Flow						
Option 1: Install Energy Dissipation Features	✓	✓	✓			✓
Option 2: Realign or Widen Channels and Canals	✓	✓	✓			✓

Solutions and Options	***Erosion***	***Channel incision/ migration***	***Slope issues***	***Debris damage***	***Clogging/ turbidity/ contamination***	***Washout/ movement of structures***
Mitigation Solution: Prevent Pipe and Tunnel Issues						
Option 1: Plan for and Handle Intake Issues				✓	✓	
Option 2: Consider Distribution Issues					✓	
Option 3: Avoid Structural Issues				✓		✓

Definitions

Bankfull—Conditions where the structure is filled to design capacity during high water or flood events.

Aqueduct—Any system of pipes, ditches, canals, tunnels and other structures used to convey water.

Mitigation Solution: Armor Channels and Canals

Option 1: Armor Channels and Canals with Concrete

Erosion and scour from flood flow can damage earthen channels and canals such as irrigation canals and drainage ditches. Armoring them can protect against this damage. Pumping or spraying cement concrete mixtures (such as shotcrete or gunite) over steel reinforcement are common methods used to armor a channel or canal Figure 2.1.1.

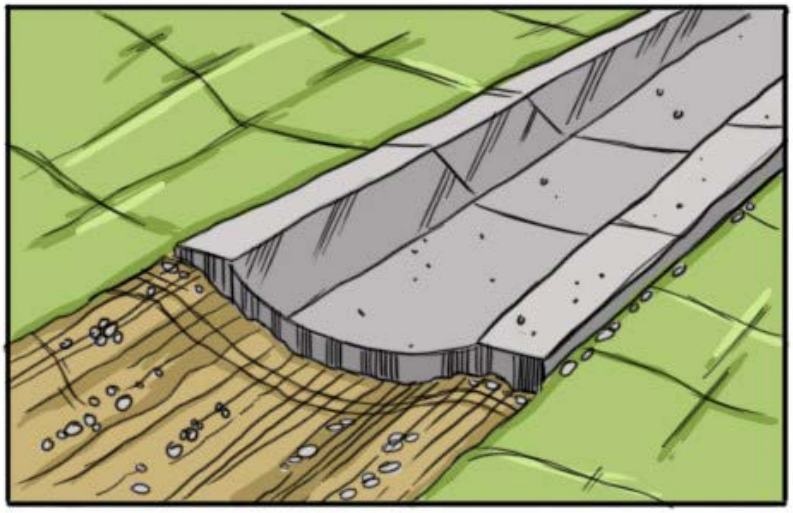
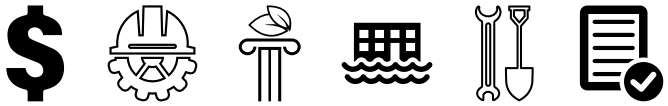


Figure 2.1.1. Concrete lining of a channel.

When evaluating this option, keep these considerations in mind:

- Prevent erosion and scour under the cement slabs by using integrated cutoff walls.
- Lessen the pressure from groundwater underneath lined channels and prevent foundation soil from entering the channel by adding graded filters.

CONSIDERATIONS:



Mitigation Solution: Stabilize Channels and Canals

Option 1: Stabilize Channel and Canal Bottoms and Slopes

Stabilizing channel and canal bottoms and slopes will minimize scour and erosion from flood flows. There are several tools to do this:

- Articulating concrete block (ACB): stabilizes channel and canal bottoms that experience open flow Figure 2.1.2.

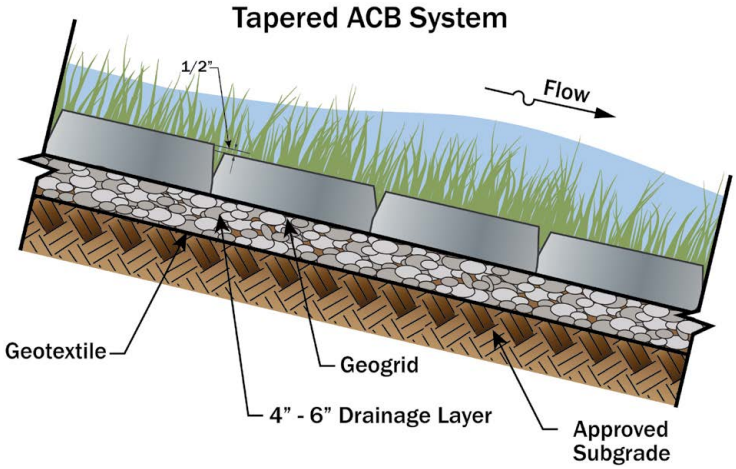


Figure 2.1.2. Typical ACB cross-section.

- Riprap: is used extensively on channel and canal slopes (Figure 2.1.3)

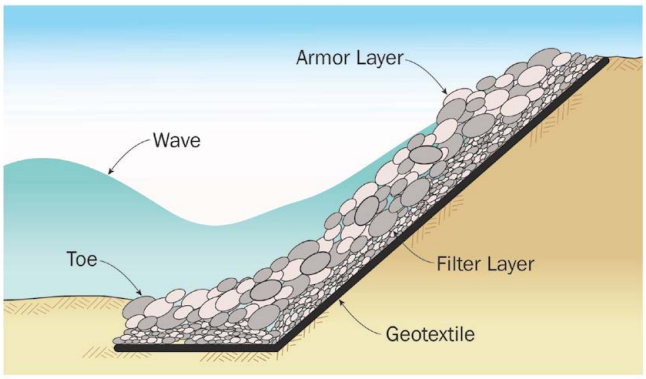


Figure 2.1.3. Typical cross-section of slope protection.

Bioengineered slope and bottom protection: uses vegetation or a combination of vegetation and construction materials such as live fascines, vegetated geogrids, live crib walls, brush mattresses and root wads

CONSIDERATIONS:

Mitigation Solution: Lessen the Energy of Flood Flow

Option 1: Install Energy Dissipation Features

Energy dissipation features, including baffles, stilling basins, drop structures, etc., can slow the movement of flood flow along a channel or canal, which lessens the water's energy and helps minimize scour and erosion (Figure 2.1.4). Supplementary structures such as weirs, tunnels, culverts, siphons, chutes, and sediment or debris basins may be needed to accommodate existing infrastructure (such as roads, bridges, etc.) and maintain ideal flow conditions.

Figure 2.1.4. Energy dissipators such as stone drop structures can help slow the movement of water to decrease erosion and scour.
(NRCS, No Date)

Option 2: Realign or Widen Channels and Canals

To improve flow and minimize erosion and scour, realigning or widening a channel or canal can reduce flood flow's energy and increase capacity to prevent overtopping and erosion. See Fact Sheet 1.3, *Drainage and Culverts,* for additional information about realigning channels and canals to direct flow away from the embankments to reduce erosion.

CONSIDERATIONS:

Mitigation Solution: Prevent Pipe and Tunnel Issues

Option 1: Plan for and Handle Intake Issues

One of the most common issues with structures designed to move water is clogging from silt or debris. Some clogging is from normal wear and tear on the system, but clogging can be an enormous issue after a storm. It can get worse if maintenance of these structures is not done regularly. An operations and maintenance plan should be developed to list inspection and maintenance activities. At a minimum, the plan should include the following activities:

- Inspect the entire length of the channel or canal (including structures and joints)
- Document clogging or debris damage
- Check and unclog sub-drainage systems
- Remove debris
- Repair damaged armoring or stabilization systems

Prevent intake structures from clogging by using screens, barriers or diverters that filter sediment and block or divert debris so these materials cannot cause a clog. Install backflow valves on pipe systems also to ensure that water, sediment and debris do not backflow through the system.

Option 2: Consider Distribution Issues

When large amounts of flood flow hit a channel, canal or aqueduct system, the result can be increased turbidity, which lowers the water quality in the system. Since the purpose of these structures is to distribute water throughout a system, this can create a problem when the water being distributed is poor quality or contaminated.

To handle this problem, consider upsizing the circumference of pipes, channels, canals or culverts in the system to decrease turbidity and maintain better water quality.

Option 3: Avoid Structural Issues

Flood flows can cause structural issues for channel, canal, and aqueduct systems in the following ways:

- Debris impacts
- Tank movement
- Washout of underground piping, accessories, or culverts
- Flooding of pump stations

Anchoring all components that might be subject to movement or washout mitigates structural issues by creating barriers or diverters to protect against debris impact and raising or floodproofing pump stations above flooding.

CONSIDERATIONS:

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