The Clemson Beaver Pond Leveler

Gene W. Wood, *Department of Aquaculture, Fisheries and Wildlife, Clemson University, Clemson, SC 29634-0362*

Larry A. Woodward, *Department of Aquaculture, Fisheries and Wildlife, Clemson University, Clemson, SC 29634-0362*

Abstract: The Clemson beaver pond leveler (leveler) was developed as an instrument to suppress the adverse effects of beaver activity that results in flooding timberlands and agricultural crops and damage to road drainage and water-control structures. It has also proven to be useful in manipulating beaver pond levels for waterfowl habitat management. Nine case studies involving 25 test sites have shown the Leveler to be successful over a moderate range of conditions in the lower Coastal Plain and upper Piedmont regions. Based on the previous success scenarios, several public agencies and 1 corporate forest landowner are deploying the Leveler as a management tool.

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The beaver (*Castor canadensis*) was once a symbol of wilderness. Its decline and local extirpations were directly attributed to progress in taming the wild landscape. Ironically, the species is now recognized for its ecological resilience and as an agent of frustration for several types of economic land use. Presently, Southeastern foresters, farmers, and highway maintenance personnel typically characterize the beaver as a pest species. Losses of timber and agricultural crops caused by flooding due to beaver dam construction is common throughout the Southeast as are road maintenance problems that result from plugging road culverts (Godbee and Price 1975, Hill 1976, Woodward et al. 1976, Arner and DuBose 1982, Woodward 1983, Woodward et al. 1985, Wigley and Garner 1987).

Both direct and indirect methods have been used in attempts to suppress the adverse impacts of beaver activities (Laramie 1963, Arner et al. 1966, Hill 1976, Woodward 1983). Explosives, heavy equipment, and hand tools have been used to destroy dams, but dam destruction without animal removal rarely has been effective. In addition to dam destruction, an array of devices has been developed to pipe water through the dam to lower the pond level without the beaver detecting the avenue of water loss (Laramie 1963, Arner et al. 1966, Roblee 1984*a*, *b*, 1987; Jamieson 1990). These devices have not been generally successful when deployed at sites where beavers were actively working.

We describe here the Clemson beaver pond leveler (leveler) that was developed and first deployed in 1988. It has been tested under a variety of conditions in both the lower Coastal Plain and upper Piedmont of South Carolina. It has been found to be effective over a moderate range of conditions, and it is useful in meeting several management goals. Currently it is being deployed by public agencies in several states to alleviate flooding problems and for waterfowl habitat management.

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Leveler Design

The sensation of rapidly flowing water and the sound of rushing or falling water both appear to stimulate beavers to repair dams. The leveler is designed to minimize the likelihood that a beaver will detect the avenue of water loss from a pond through the sensation of flowing water. In addition, the design either eliminates the sound of rushing water or moves the source of the sound downstream, substantially away from the dam site.

The principal feature of the leveler is the intake device (Fig. 1). In our standard configuration, the intake device is a 3-m section of 25-cm diameter schedule 40 polyvinyl chloride (PVC) pipe perforated with 160 5-cm diameter holes. One end of the pipe is capped, the other is fitted with a 25- to 20-cm diameter reducer sleeve. The total potential for water intake through the perforations exceeds the flow capacity through the 20-cm sleeve opening by a factor of 10. Thus, the flow rate through a given perforation is relatively small. It should be noted, however, that due to a Venturi effect, flow rate through perforations near the mouth of the intake pipe exceed those near the capped end.

The intake pipe is suspended inside a cylinder formed from 5- x 10-cm galvanized welded-wire. The wire cylinder is closed at the capped end of the intake

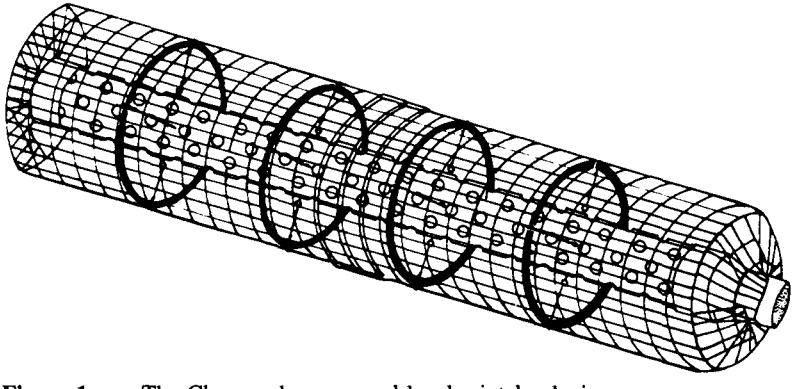

Figure 1. The Clemson beaver pond leveler intake device

pipe and fitted to the reducer sleeve at the mouth end. The purpose of the wire cylinder is to prevent the beaver from closely investigating the intake pipe for water flow.

The outflow end of the carrying pipe may or may not be modified (Fig. 2). Where the objective is to simply lower the pond level as low as possible, no modification is necessary. The terminus end of the pipe may be either above or below the water surface. However, as much submergence as possible is desirable so that the sound of falling water is minimal.

Where the leveler is used to alternately lower and raise pond levels, such as in waterfowl habitat management, the downstream end of the carrying pipe is fitted with a T-joint. A stand pipe is fitted vertically to the T-joint and set at a height corresponding to the desired pond level under flooded conditions. The outlet portion of the T-joint is fitted with a cleanout expansion plug that can be removed when the pond level is to be lowered.

Water pours from the top of the stand pipe with a fountain-like effect. This, of course, is accompanied by the sound of falling water. While we have never had a situation where beavers tried to bury a stand pipe in response to the sound, that possibility may exist.

Installation

The leveler is installed by first opening 1 or more troughs through a dam. The number of troughs is appropriate to the number of levelers that will be needed to take water out of the pond faster than it is receiving water from a stream or springs. For plugged road culverts, all debris is removed from the culvert before the leveler is installed.

When installing the leveler, several points should be kept in mind: (1) orient the intake device parallel to the stream channel whenever possible, (2) the intake pipe should be submerged to the extent possible when the pond is at its lowest level, (3) the outflow end of the intake device should be 1.5–3 m from the dam or culvert

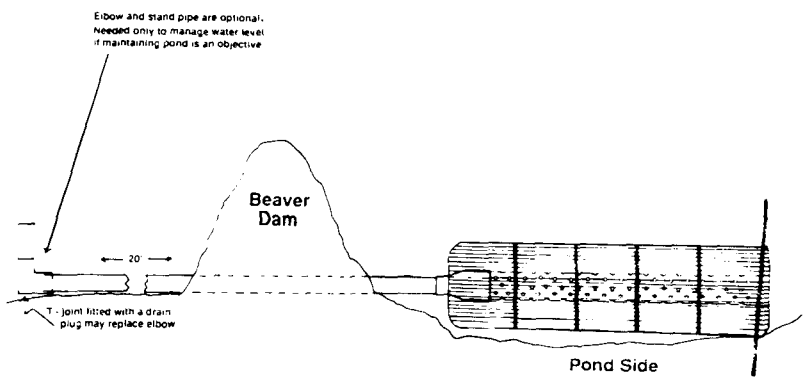

Figure 2. The Clemson beaver pond leveler

entrance, if possible, (4) the capped end of the intake pipe should be slightly higher than the outflow end, (5) the carrying pipe should be on a slight downward slope away from the intake device, and (6) the terminus of the carrying pipe should be located at least 6 m downstream from the dam. In the case of road culverts the carrying pipe should extend completely through the culvert, preferably terminating underwater. (See Wood et al. 1991 for construction and installation details.) Sites that accommodate all of the above points are uncommon. Usually, some amount of plumbing using pipe elbows will be required to configure the leveler to fit the site conditions.

Levelers can be installed at any time of year. However, in many areas of the Southeast, beaver activity involving dam repair is minimal from June through September. During this period, if water level is to be raised following draining for installation, the dam will have to be repaired by hand. This also applies to dam sites that have been abandoned by beavers but are managed for waterfowl habitat. In cool seasons and at active sites, beavers normally will repair the dams after the leveler has been installed.

A normal installation scenario is for 2 workers to open an appropriate number of troughs through the dam. This job typically requires 15 to 30 minutes per trough when using a Pulaski fire fighting tool and assuming no tree stumps are obstacles to installation. Once the pond is drained to the desired level, 2 workers can position the levelers in place at a rate of 1 leveler per 30–60 minutes depending upon the complexity of the configuration.

Test Results

Detailed case histories follow with test results summarized in Table 1.

Lower Coastal Plain Sites

Case 1.—The leveler was first deployed at Hobcaw Barony Plantation, Georgetown County, South Carolina, in April 1988 to solve a road culvert problem. Beaver activity at this site was intense. Drainage from a watershed approximately 200 ha in size needed to pass through 1 culvert that was being plugged on a daily basis. Two levelers were installed and have remained effective in controlling the problem for 4 years without maintenance.

Case 2.—In February–March 1990 the leveler was deployed on International Paper Company (IPCO) lands in Georgetown County at 4 road culvert problem sites and at 1 dam site. Locations usually had more than 1 problem dam requiring 1 or more levelers. Only 1 leveler was installed at 2 points, 2 were installed at each of 6 points, and 4 were installed at 1 point.

The levelers on IPCO lands were challenged by beavers only at 2 sites. One 60-cm diameter culvert site had 2 levelers. The beavers plugged the culvert immediately following installation, but the levelers were not disabled and continued to be effective in maintaining adequate drainage. The beavers at the dam site were active, but they only lightly challenged the leveler with a modest attempt to restore the dam.

Table 1. Summary of Clemson Beaver Pond Leveler test results.

Case No.	Location	Date of installation	*N* culvert sites	*N* dam sites	*N* culvert sites levelers challenged by beavers	*N* dam sites levelers challenged by beavers	*N* of levelers disabled by beavers	*N* of levelers disabled by siltation
	Lower Coastal Plain Locations							
1	Hobcaw Barony	Apr 1988	1		1		0	
2	International Paper Company	Mar–Apr 1990	4	1	1	1	0	0
	Upper Piedmont Locations							
3	Six-mile Creek	Jan 1990		5		5	0	
4	Wildcat Creek	Jan 1990[a]		4		3	1	
5	Camp Hope	Jan 1991	1		1		0	
6	Clemson Univ. farms	Apr 1990	2		2		0	1
7	Hartwell Lake, Ga.	Apr 1991		1		1		
8	Anderson County, S.C.	Sep 1991		4	0	4	0	
9	Anderson County, S.C.	Sep 1991	2		0		0	1
		TOTAL	10	15	5	14	1	2

[a]Date of first installation. Additional installations were made in Jan 1990, Sep 1991, and Mar 1992.

Upper Piedmont Sites

Case 3.—On the Clemson University Experimental Forest, Clemson, South Carolina, a total of 7 levelers were deployed at 5 dam sites on Six-Mile Creek in January 1990. The watershed encompassed about 77 km^2. All troughs through the dams were left open at the time of installation. Beavers repaired all of the dams, but did not disable any levelers. The levelers failed to lower pond levels following dam repair because the stream flow volume was too great. On 17 March 1990 a 12.5-cm rainstorm caused a storm flow surge that reached a level of 2.5 m above normal flow. While most of the dams were washed out, all of the levelers remained in place and without notable damage.

Case 4.—One leveler was installed at a dam site on Wildcat Creek, also located on the Clemson Forest, in January 1989. The watershed encompassed about 100 ha. The dam was not repaired by the beavers in 1989, but it was rebuilt in 1990. The dam site had existed for at least 10 years (S. Perry, pers. commun.), and siltation behind the dam had raised the stream bed about 1.5 m. The leveler kept the pond drained even though the intake device was not totally submerged.

In winter 1991 the beavers constructed a second dam about 50 m upstream from the original dam. This dam diverted water through a break in the stream bank and flooded about 2 ha of a timber regeneration area. Two additional levelers were installed. One was placed at the new dam and the second at the lowest point in the flooded regeneration area. Both levelers were effective.

In fall 1991 the beavers built a third dam another 50 m upstream. Water was again diverted into the regeneration site, but the leveler in that area suppressed the damage. A fourth leveler was installed at the newest dam site although only a small portion of the intake pipe was under water because of the shallowness of the stream. The terminus of the carrying pipe was about 1.2 m below the mouth of the intake pipe. While the leveler kept the pond drained, the configuration in this situation resulted in an audible "gurgling" noise at the intake device. The beavers responded by building a dike around the intake device and effectively prevented water flow to it.

This problem was addressed by adding a T-joint with a standpipe and expandable cleanout plug to the terminus of the carrying pipe. By slightly raising the pond level, the mouth of the intake pipe was submerged and the sound was eliminated. However, within 1 month the beavers returned to the site and reconstructed the dike near the leveler. It appeared that the animals likely would replace a structure out of habit irrespective of noise or current flow stimuli.

Case 5.—In January 1991, 2 levelers were installed at a 90-cm diameter culvert on a horse trail near Camp Hope on the Clemson Forest. The culvert had been installed 2 months previously and had been almost totally plugged for about 1 month. Subsequent to installation of the leveler, beavers abandoned the culvert but continued work on nearby dams in 1991. In winter 1992 they partially replugged the culvert, but they made no attempt to disable the levelers.

Case 6.—In April 1990, the manager of the Clemson University farms reported

a problem with beavers plugging 2 road culverts on a drainage ditch critical to the management of a 100-ha cornfield. One leveler was installed at each culvert. The beavers partially replugged the largest (90-cm diameter) culvert immediately after installation, but did not disable the leveler. The smaller (30 cm) culvert was not replugged until 1991, but the leveler continued to function.

By the end of summer 1991 a substantial problem with siltation had occurred at the 90-cm culvert site. When the water level dropped below the silt bar around the leveler, smartweed (*Polygonum punctatum*) began growing on the exposed soil. The combination of silt and vegetation substantially disabled the leveler. Some maintenance work was necessary to keep it functional.

Case 7.—In June 1991, the U.S. Army Corps of Engineers, with our help, installed 2 levelers at 1 beaver dam site near Hartwell Lake Dam, Hartwell, Georgia. Beavers repaired the dam within 1 month after installation, but they did not disable the levelers. The 4-ha pond was drawn down about 1 m below its previous level and Japanese millet was planted on the exposed soils. In September 1991 the pond was raised to its previous level by placing standpipes at the ends of the carrying pipes and about 6 m downstream from the dam. Following installation of the standpipes, the beavers, apparently stimulated by the sound of falling water, built a dike around the standpipes, but their secondary pond did not affect the level of water in the primary pond (S. Strotman, pers. commun.). However, this situation will be a problem when the summer 1992 draw-down is attempted.

Case 8.—In fall 1991 the South Carolina Wildlife and Marine Resources Department (SCWMRD) installed 1 leveler at each of 4 dam sites in Anderson County, South Carolina. Beavers repaired all of the dams, but they did not disable any levelers. All 4 ponds were drawn down in mid-April 1992 without interference from beavers (H. Stihl, pers. commun.).

Case 9.—In fall 1991 the SCWMRD installed 1 leveler at a highway culvert site and 1 at a water control structure site in Anderson County. Beavers abandoned the highway culvert site. Silt accumulation from agricultural fields disabled the leveler at the water control structure.

Deployment for Management

Information on the construction and use of the leveler has been made available through the Cooperative Extension Service of Clemson University. Interest in this management tool has been widespread in the eastern United States and particularly in the Southeast. At present, Tennessee Valley Authority is deploying the leveler in Tennessee and Alabama. U.S. Army Corps of Engineers is using the leveler in northern Georgia. The U.S. Fish and Wildlife Service in cooperation with the South Carolina Waterfowl Association are deploying the leveler on a management scale in South Carolina. In addition, USDA, APHIS, Animal Damage Control is deploying the leveler in Alabama, Mississippi, and Arkansas (F. Boyd, pers. commun.). The South Carolina Wildlife and Marine Resources Department is using the leveler as a management tool in South Carolina (H. Stihl, pers. commun.). International Paper

Company is using the leveler on its lands in South Carolina and plans deployment in Arkansas and Maine. WESVACO had deployed the leveler in South Carolina and Georgia-Pacific Corporation is using it in Arkansas and Louisiana.

Summary

Four years of testing involving 9 case studies in lower Coastal Plain and upper Piedmont sites have shown the Clemson beaver pond leveler to be a useful management tool over a moderate range of conditions. It is primarily useful in situations where small streams or springs feed beaver ponds or flow through road culverts that beavers may plug to create a pond. Beavers apparently are unable to detect water flowing into the intake device. Noises associated with water flow at the intake device may stimulate beavers to attempt to disable the device by diking around it. On 1 of 24 test sites, beavers attempted to dike the outflow from a standpipe. The sound of falling water was the apparent stimulus. The management purpose best served by the leveler is suppression of problems associated with road culvert plugging. It appears to also have substantial potential for beaver pond level manipulation for waterfowl habitat management.

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