EVALUATING BEAVER GUARDS ON RESTRICTED FLOW RISERS OF FLOOD CONTROL IMPOUNDMENTS

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ABSTRACT

Eight types of guards, designed to prevent plugging of restricted flow risers by beaver, were tested on Soil Conservation Service flood control impoundments. The effectiveness of these guards was studied between August 1975 and September 1976. Four guard types were unsuccessful in preventing plugging of risers by beaver. Risers protected by the other four guard types were not plugged, although some had been plugged prior to the installation of the guards. A guard similar to type 5 showed the most promise for preventing plugging.

The U. S. Department of Agriculture, Soil Conservation Service (SCS), first started construction of Watershed Protection and Flood Control Impoundments in Oklahoma under Public Law 566 during the late 1950's. Beaver were probably already well established in the watersheds at that time. In these impoundments water is released gradually through a restricted flow riser which consists of a concrete or metal tower near the upstream side of the dam. The riser (Fig. 1) has a water inlet near its top and a controlled drawdown orifice at the bottom through which the impoundment can be drained. The top of the riser is equipped with a trash guard to prevent floating debris from entering the structure.

Under normal conditions the bottom orifice of the riser is closed to retain water for livestock or for recreational purposes. The impoundment normally fills to the overflow orifice. Many of the creeks flowing into these impoundments flow throughout the year, resulting in a stable lake level with water flowing out of the riser at the same rate it is entering the impoundment. In addition to the restricted flow riser each impoundment has an emergency spillway to allow water to pass whenever the impoundment level approaches the maximum capacity.

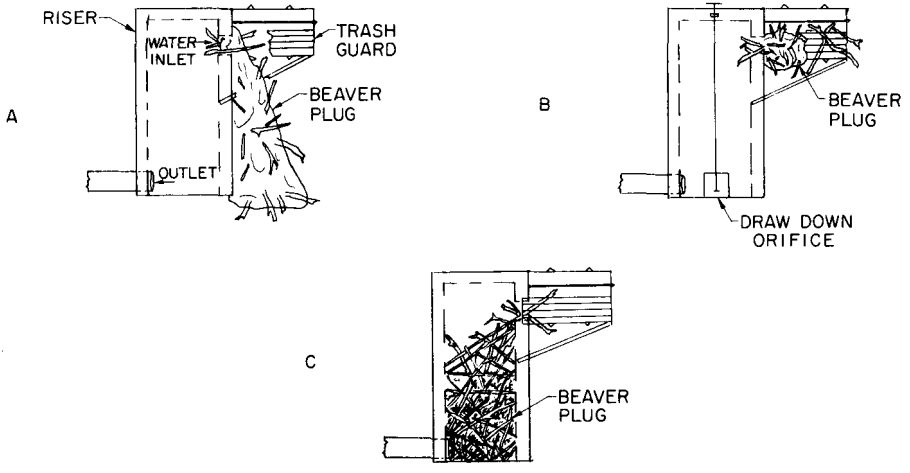
SCS impoundments often create desirable habitat for beaver and the beaver apparently recognize the overflow orifice as a source of water loss. The beaver attempt to plug the orifice, slowing or stopping the flow of water. When successful in this effort, the water level of the impoundment is increased and flooding of crops, pasture, woods or roads may result. These circumstances are viewed with dissatisfaction by residents and landowners and the impoundment is rendered useless as a watershed protection device.

There appear to be three primary methods that beaver use in plugging the overflow orifices. One is to pile mud and sticks around the riser, eventually accumulating enough material to block the orifice (Fig. 1A). A second method is to fill the area within the trash guard with debris (Fig. 1B). The third method is to drop sticks, leaves, and other material through the top orifice into the riser (Fig. 1C). This latter type of plugging is extremely difficult to remove, and hazardous, especially if the water of the impoundment becomes high enough to cover the riser.

The SCS engineers, at the state office in Stillwater, Oklahoma, designed eight types of guards to prevent the plugging of risers by beavers. The Oklahoma Cooperative Wildlife Research Unit was chosen to evaluate the effectiveness of these guards. The authors acknowledge the cooperation and assistance of all SCS personnel involved in this project, in particular Jim Hill, Jerry Sykora, Neil Price, Charles Melton, and Walter Hogue. Mr.

Robert Stratton, Manager, Sequoyah National Wildlife Refuge, provided living quarters for the senior author during field studies in Sequoyah County.

Figure 1. Three primary methods used by beaver to plug overflow risers of flood control impoundments in Oklahoma. A, debris mounded up to cover water inlet; B, plug inside trash guard; and C, plug inside riser.



MATERIALS AND METHODS

The beaver-guard evaluation was conducted on SCS impoundments located primarily in eastern and southeastern Oklahoma. During the summer of 1975 the SCS installed 11 guards of eight types, one each, on 11 overflow risers of flood control impoundments. These impoundments, selected by SCS personnel, are located within five watersheds in four counties. The guards were designated numbers 1 through 7A. Each guard type was designed to present a different plugging problem to the beavers or to fit a particular type of riser. For the convenience of the readers, each guard type will be described when results of the experiments are discussed.

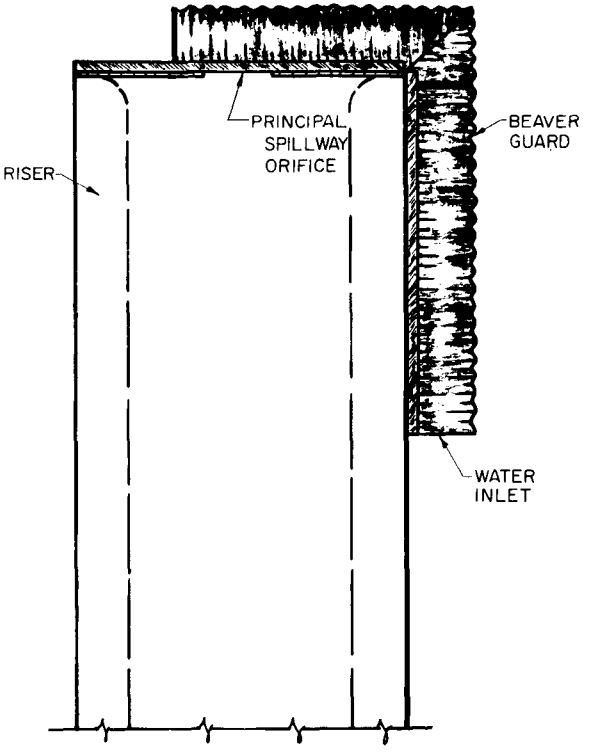
Impoundments with beaver guards were visited periodically by the senior author from August 1975 to September 1976 to determine if beaver had plugged or attempted to plug the water inlets or orifices. On guards with inlets below water, risers were checked for proper rate of flow to determine if the riser was plugged. SCS personnel also inspected study impoundments occasionally between visits by the senior author. Their visits were necessary to insure that plugging was discovered quickly and the problem corrected. When a riser was found plugged, the plugging materials were removed. The amount and type of materials were noted as well as the possible origin of the materials. Plugged guards were then modified or changed to see if a design could be developed that the beaver could not plug.

RESULTS AND DISCUSSION

Guard types 1 and 2 are functionally the same, differing only in modifications to fit a particular riser type. Guard type 1 (Fig. 2) is constructed from a corrugated metal culvert cut in half lengthwise and bolted onto the side of the riser. Type 1 covers an orifice in the top of the riser and consists of two sections of culvert joined at a 90° angle. Type 2 covers an orifice in the side of the riser and consists of only one section of culvert. Use of these guards is restricted to risers having orifice openings smaller in size than the diameter of

the culvert guard. The only water inlet in each guard is at the bottom end of the culvert. When the impoundment is at normal pool level the water inlet on the guard is about 1.5 m below the water surface. The engineers hoped that beaver would not be able to identify the underwater inlet as the source of water loss and would find it difficult to plug this vertical entrance.

Figure 2. Beaver guard type 1 which was unsuccessful in preventing plugging by beaver.



Guard types 1 and 2 were each installed on two SCS impoundments. They functioned properly until late January 1976 when district SCS personnel discovered that the risers on Sallisaw Creek sites 27 (type 1) and 6 (type 2) had been plugged. By 4 February beaver had restricted waterflow 90 percent on site 6 and 100 percent on site 27. Site 27 was then drawn down to expose the guard orifice for inspection. Mud, sticks, leaves, rocks, and aquatic vegetation had been piled about 1 m high at the base of the guard.

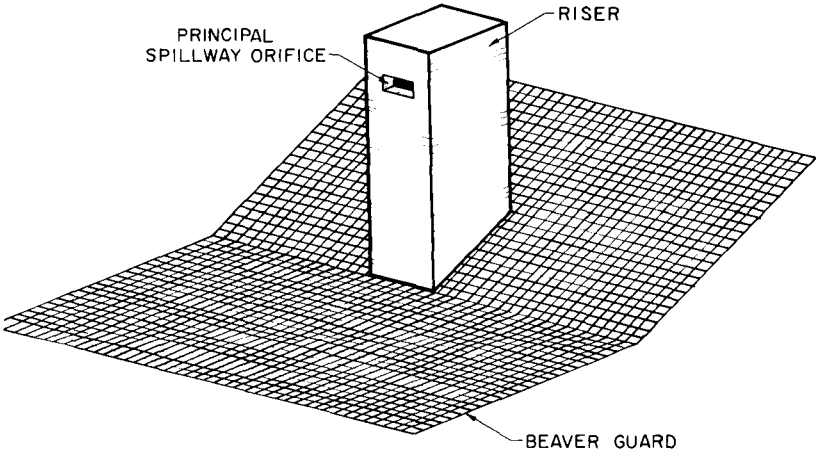
Signs of digging near the dam clearly indicated that mud, some leaf litter, and aquatic plants were obtained within 8 m of the side of the riser. This area is under water when the impoundment is at normal pool level. A problem encountered with guard type 1 was that the pond had to be drawn down to facilitate removal of the plugging materials. Drawing a pond down is especially difficult when water covers the drawdown valve control on the riser.

Site 6 was not drawn down, but similarities between guard types on sites 6 and 27 suggest plugging methods were similar. On 6 March several slits were cut near the top of the guard on site 6 to allow for proper waterflow. Plugging of guard types 1 and 2 followed rains that caused waterflow through the principal spillway orifice.

Guard type 3 (Fig. 3) consists of a 10-guage wire of 15.2 cm square mesh, approximately 18 m wide by 13 m long. This mesh is laid on the bottom of the impoundment and is

designed to prevent beaver from mounding up debris until it covers the riser orifice(s). SCS personnel also believed that beaver needed mud to stop up the inside of the risers and that the mesh would prevent them from gathering this mud within a workable distance of the riser. The mesh guard could be installed around all types of risers. Guard type 3 was placed at one site. This riser was plugged in late December 1975. Beaver had deposited approximately 2 m^3 of sticks and leaves of various sizes, through the principal spillway orifice.

Figure 3. Guard type 3 is only designed to prevent beaver from plugging a riser by mounding debris (Fig. 1A) and must be used in association with another guard designed to prevent other methods of plugging (Figs. 1B and C).



This material, apparently deposited by beaver from inside the trash guard, formed a tight plug compacted by the force of water. The outflow of water was not completely stopped, but if the watershed had received sufficient rains to fill the impoundment it would have been several weeks before the water level dropped to normal pool. When operating properly this drawdown should require only several days. The absence of mud in the plugged riser indicates that mud is not necessary for the type of plugging found on site 14. A bar mesh guard, similar to beaver guard type 5, was then installed around the trash guard and has been successful in preventing further blockage by beaver.

One problem associated with guard type 3 is that it becomes silted over or sinks into the substrate. Eleven months after installation one-fourth of the mesh was covered with mud and it is likely that eventually the entire mesh will be covered. Another problem with this guard is the possibility of livestock entangling their feet in the loose mesh if the guard is used where they will enter the water. Because of these problems, guard type 3, when used without any other beaver guard, seems not only unsuccessful in preventing beaver plugging, but may also be dangerous to livestock.

Guard type 4 is functionally similar to type 3. It consists of a rock riprap 18 m by 13 m laid on the bottom of the impoundment surrounding the riser. The riprap, like the wire mesh, is designed to prevent beaver from gathering mud within the immediate vicinity of the riser. This guard can be used around risers of any design.

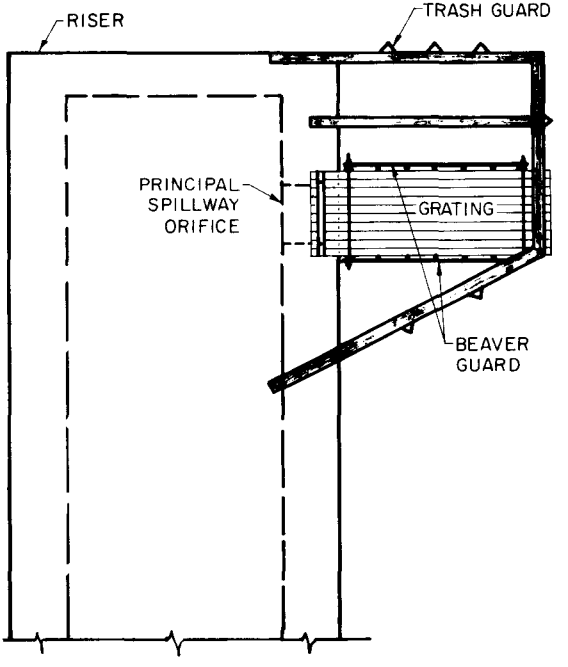
Guard type 4 was installed on two sites and these guards functioned properly until May 1976 when beaver plugged the riser at Upper Clear Boggy Creek site 6. The riser was completely filled with sticks, leaves, and algae. The sticks were believed to be driftwood similar to that recently deposited along the dam near the riser after high water receded. Algae and leaves were available in the water near the riser. Mud was not used in this

plugging. The riser was cleaned out and a wire mesh guard was installed enclosing the trash guard of the riser. No further plugging has occurred.

The rock riprap of the two sites has not silted over, probably because the ripraps were constructed higher than the surrounding bottom. With the wire mesh in place around the trash guard on site 6, further investigation will be needed to see if beaver can mound debris around the riser over the riprap.

Guard type 5 consists of a 12.7 square-cm mesh bar placed over the top and bottom of the grating on the trash guard of the riser (Fig. 4). This mesh prevents beaver from getting inside the trash guard and dropping material into the riser. Guard type 5 can be used on any riser equipped with a trash guard similar to the one shown in Fig. 4.

Figure 4. Beaver guard type 5 which shows the greatest promise of preventing beaver from plugging the riser orifice.

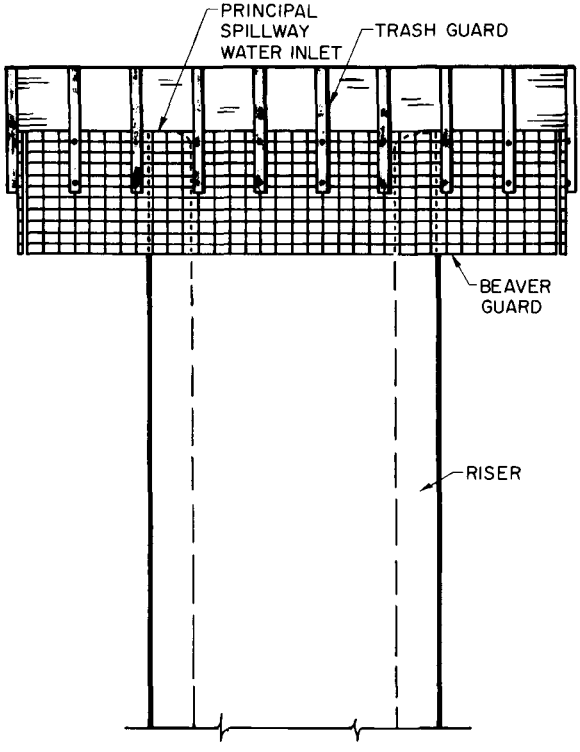


This guard was installed on one site and has not been plugged, however, there is no evidence that beaver attempted to plug it. This guard is very similar to guards placed on over 40 impoundment risers by the Coal County Conservation District. Some of these guards have been in use longer than three years without being plugged. Beaver have been successful in mounding up debris around many of these guarded risers and in some cases have partially covered the trash guards, but waterflow was not restricted. Because of their numerous successes, these guards similar to type 5 have more supportive evidence for preventing riser blockage than any other guard examined in this study.

Guard type 6 was designed to fit risers with inlets on all four sides, protected by a trash guard made of angle iron. The beaver guard is an aluminum grating (Borden type A, size 1 or equivalent) that is attached to and extends below the trash guard, surrounding the water inlets (Fig. 5). This guard type prevents beaver from getting inside the trash guard and dropping material through the inlet to the inside of riser.

Guard type 6 was installed on one site and has not been plugged. The habitat at this site is not ideal for beaver and there is no evidence that beaver have tried to plug the riser.

Figure 5. Beaver guard type 6 has not been plugged, however there is no evidence that beaver have tried to plug it.



More testing is needed before the value of this guard can be determined.

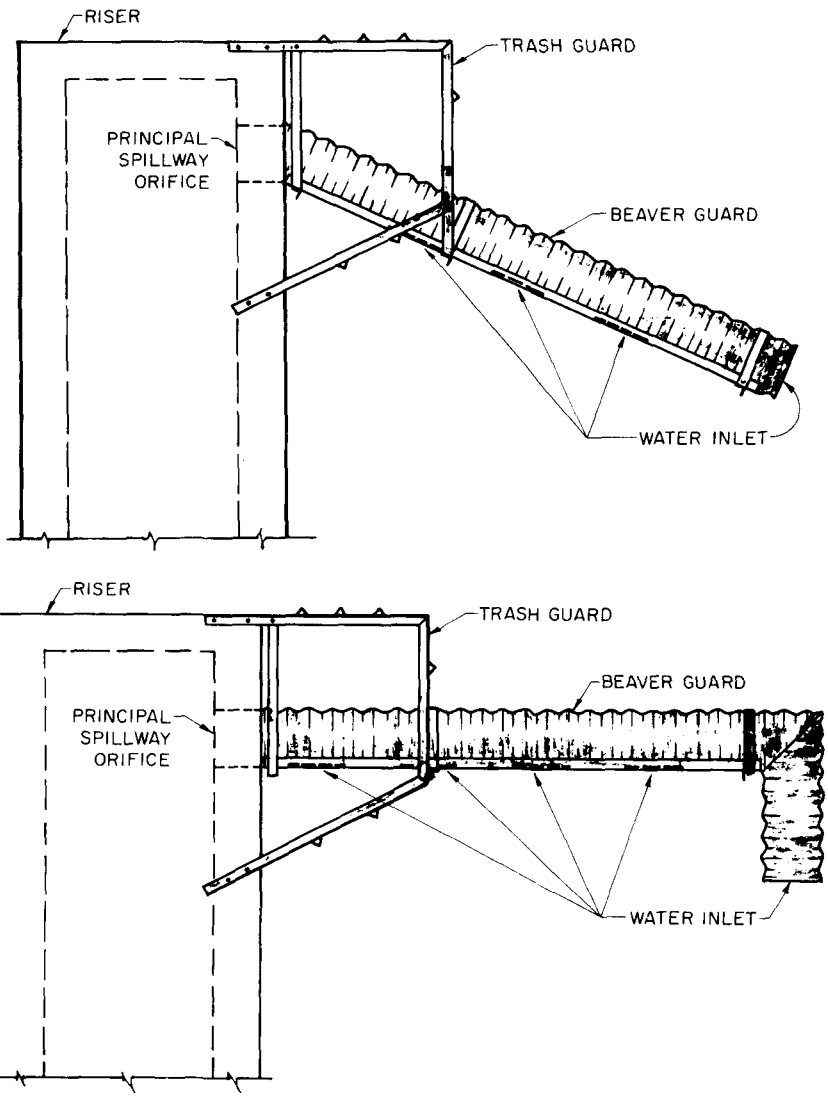
Guard type 7 consists of a corrugated metal culvert approximately 3 m long with a 90° elbow extending 1 m from the main pipe (Fig 6A). One end of the culvert is placed over the principal spillway orifice with the opposite end extending away from the riser. The open end below the elbow is pointed down into the water, allowing water to enter the opening approximately 60 cm below the water surface when the impoundment is at normal pool. Four openings, 7.62 cm x 35.3 cm were cut along the bottom of the culvert to allow for additional water flow. By positioning the principal inlet away from the riser, and under the water, the engineers hoped that beaver would not be successful in locating the source of water loss. If the source of water loss was discovered, the beaver would presumably find the vertical inlet difficult to plug. This type of guard could be used on any riser that has an orifice opening small enough to be covered by the open end of a culvert.

Guard 7 was installed on two sites. When the SCS first installed guard type 7 on Upper Clear Boggy site 53 in July 1975 there were no beaver living at that site. Only once during the study were signs of beaver found at this impoundment. In June 1976 the riser on Sallisaw Creek site 3 was fitted with guard type 7. This riser had been plugged by beaver just prior to the installation of the guard and it has not been plugged since the guard was installed. More time and further tests are needed before any conclusions can be made about the guard's effectiveness.

Type 7A is a corrugated metal culvert approximately 3 m long extending away from the riser at a 20° angle (Fig. 6B). One end of the culvert covers the principal spillway orifice

and the other end is the water inlet. This design places the water inlet away from the riser and about 60 cm below the water surface. In addition, openings similar to those in guard 7 have been cut along the bottom of the culvert. This device is similar to the one described by Laramie (1963) and Webster (Personal communication 1976) used to control water level in beaver ponds or small impoundments. Like type 7, this guard may be used on any riser with an orifice opening small enough to be enclosed by a corrugated culvert.

Figure 6. A, Beaver guard type 7 has not been plugged, although it was installed on a riser which had been plugged by beaver just prior to installation of guard; B, Beaver guard type 7A has not been plugged, although it was installed on a riser which beaver had attempted to plug just prior to installation of guard.



Type 7A was placed on a site having a very active beaver colony and beaver had mounded mud around the riser up to the trash guard prior to the installation of the guard. This mound of material was removed before installing the guard. The riser has not been plugged, however, there is no evidence that beaver have tried to plug it. Guenther (1956) reported that beaver completely covered a culvert, similar to guard type 7A, that was 3 m above the pond bottom and placed through a beaver dam in the state of Washington. Further study is needed to determine the value of guard type 7A.

CONCLUSIONS

Risers protected by guard types 1, 2, 3, and 4 were plugged by beaver during the study. Because of the problems and ineffectiveness of guard types 1, 2, and 3 they should not be used in the future. Guard types 5, 6, 7, and 7A were not plugged, but further tests are needed before they can be adequately evaluated. Guards similar to type 5 were used successfully in preventing riser blockage on more than 40 SCS impoundments; some have been in place more than three years. The riprap guard (type 4) may prove to be effective in preventing beaver from mounding material around the riser, but more trials are needed to conclusively determine this. The riprap, used with one of the successful orifice guards may be the solution to prevent both mounding and blockage of the principal spillway orifice by beaver.

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