TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE   WYOMING   SOIL CONSERVATION SERVICE

Biology No. 30

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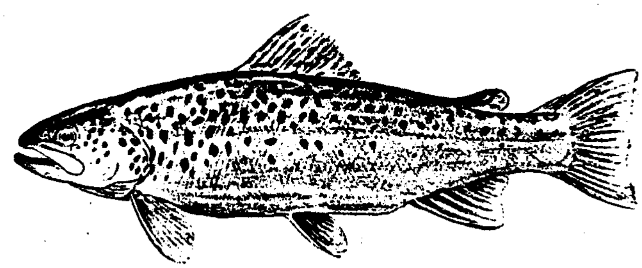
Subject: BOTTOM WATER OVERFLOW FOR FISHPONDS

The decay of organic matter (usually submerged waterweeds, fallen leaves, microscopic algae, etc.) that collects on the bottom of ponds and reservoirs oxidizes, using up the available oxygen supply. This breakdown or chemical conversion process of organic material—including peat and muck soils—produces by-products such as hydrogen sulfide and carbon dioxide. These by-products in solution sometimes accumulate in the deeper areas of ponds because they are heavier than oxygenated water and become lethal to fish life. Hydrogen sulfide in very lethal, and in conjunction with oxygen depletion appears to be the chief cause of fish die-offs in the winter when ponds are frozen over. In warmwater ponds during summer, this breakdown of organic matter occurs at a higher rate and can use up all of the dissolved oxygen, creating similar conditions to those which occur under the ice in the winter. Under both of these conditions it is advantageous to fish live to remove the bottom water from a fishpond or reservoir whenever there is an over-flow or when additional water can be added.



In summer months, the sun and air temperatures cause the top water to become warmer than the bottom waters. Since cold water is heavier, it is on the bottom. (The density of water increases as temperature decreases down to 39°F.) This pattern permits a pond owner to affect pond temperatures significantly if he has the devices to accomplish his objective. Overflow taken from the bottom water will allow the pond to warm up more rapidly in the late spring and early summer; probably retain warmth a few weeks longer in late summer and early fall. Conversely, overflow taken from the surface will keep pond temperatures cooler during the hotter mid-summer months.

In winter months when the pond has an ice covering, the water immediately underneath ice is 32°F., and the bottom water is usually 39°F. (since the warmer water within this 32° to 39°F. range is heavier). Additionally, hydrogen sulfide and carbon dioxide waters are heavier than well-oxygenated waters of equal temperatures.

In the fall, cold weather reduces top water temperatures severely. This temperature change and wind cause bottom-waters to rise and mix through the entire period. From then until late spring, (except under ice cover), water mixes frequently and temperatures range from 40° to 50°F. – a period when temperatures cannot be manipulated satisfactorily by the over-flow devices.

The bottom water overflow feature works effectively and automatically whenever the pond is full and water from springs, irrigation supplies, wells, rainfall, or snowmelt is entering the pond. A pond with year-round flowing water is obviously ideal, as this completely avoids dangerous accumulations of hydrogen sulfide. Ponds with intermittent overflows should also benefit substantially as a result of partial removal of bottom waters. A gate in a drainpipe, however, may be desirable for runoff-fed ponds which seldom fill. Illustrations #1 and #2 are examples of bottom water overflow structures.

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1. Bottom-Water and Top-Water Overflow Installation For an Old or New Dam which had No Trickle-Tube

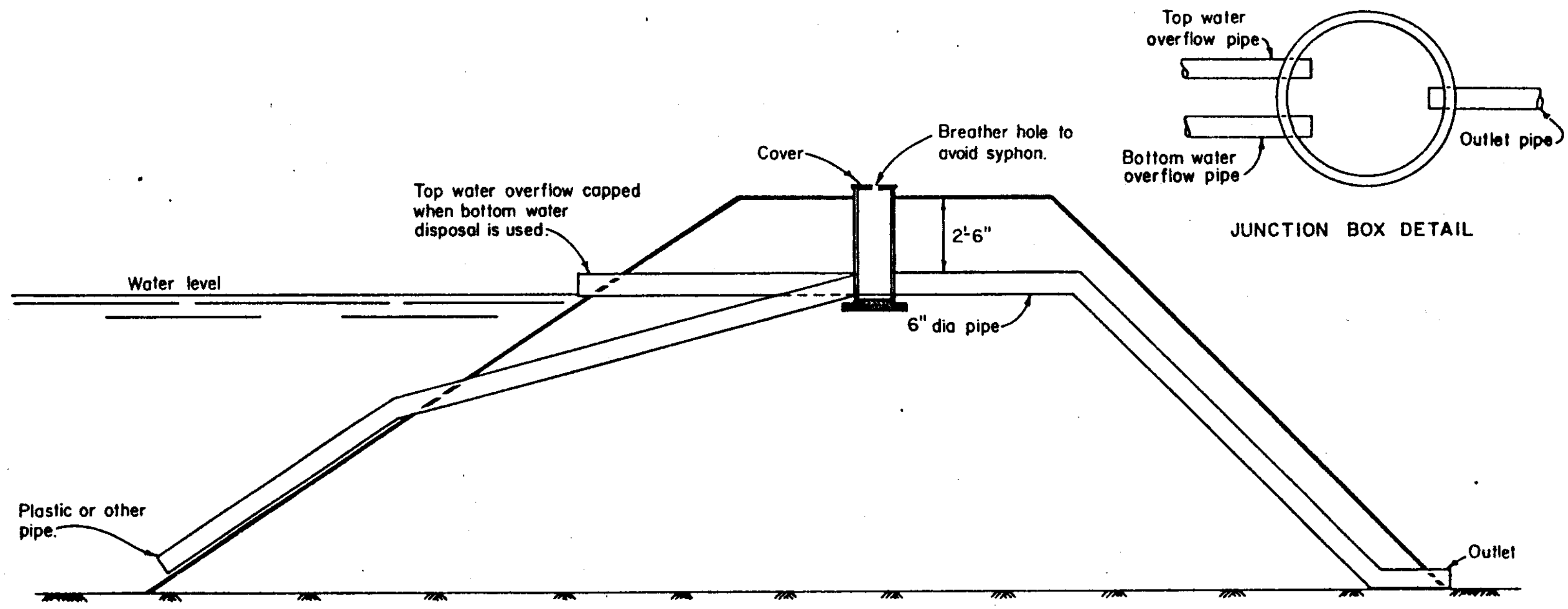

Illustration 1 shows a pipe layout that can be established in an old or new dam. This illustration emphasizes pipe-placement below the freezing levels in a pond and earthen dam, to assure automatic ice-free overflow of water from underground springs, a stream, well, or run-off, when the pond is full. It also shows a second pipe at pond-full water level that can be left open for top-water overflow, or capped so that the bottom-water intake works in summer months. Note that the two intake pipes are placed side-by-side at the same level as they enter the junction box that extends upward to the top of the dam. The outlet pipe controls the pond's water level, and carries the overflow safely to the streambed below the dam. Insulation material can be stuffed in the breather space to prevent freezing; and a loose-fitting cover is placed over the hole.

The same design is also satisfactory for warm-water or cool-water ponds where bottom-waters may be routed in order to retain the warmer top-water in the Spring, Fall, or Summer for fishery management purposes.

2. Bottom-Water and Top-Water Overflow Installation in a New Dam, with Trickle-Tube and Drainpipe.

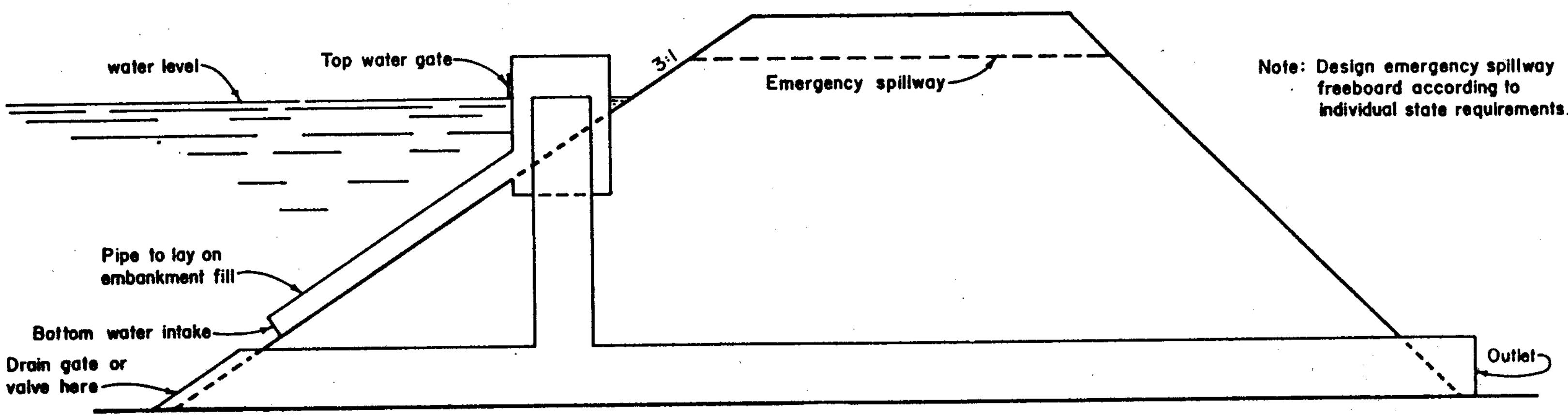

Illustration 2 shows a stand-pipe trickle-tube, with a bottom-water overflow device, connected to a drainpipe that is gated at the forward end. The top of the trickle-tube determines the water level. The standpipe may be located in the face of the dam near the water line (as shown); or completely within the fill (to avoid ice and freezing problems). In either location the dam provides safe support to the standpipe. One conventional design locates the standpipe at the forward end of the drainpipe. Weaknesses in this design are (1) the standpipe is subject to easy breakage and (2) the construction of a walkway is usually required. However, a less expensive vertical draingate or an elbow connection may be used at the drainpipe entrance on this type of installation.

There are various other designs, following this overflow principle, such as a double-channeled half-rounded corrugated standpipe in which two sets of board-planks are manipulated for either bottom- or top-water routing of the overflow.

For large ponds and lakes, with large overflows from streams and flood waters, custom-designed structures can be planned by SCS engineers to route large quantities of water over or through impoundment dams – including bottom-water overflow attachments for normal flows.