E NERGY WORKS

izing a hydro-electric installation

By Michael Hackleman

Note the snow cleared off the land, I was able to walk the newly-installed pipe track to inspect for damage. The wet, heavy snow had blanketed the area, felling scores of trees or their branches. The temperate climate had permitted an aboveground pipe track for this hydro system, increasing its vulnerability to falling debris or slides. Luckily, all 300 feet of pipe track were unscathed. I was ready to finish the hydro-electric system begun many months ago.

This article will cover the installation of the water diversion system at the culverts (the source of water for the system), electrical connections to the existing RE (renewable energy) system's batteries, fabrication

> and siting of a basic monitoring system, and first operation of the hydroelectric unit.



This is the fourth in a series of articles and hardware involved. In Do-it-Yourself

on hydropower which details the processes and hardware involved. In Do-it-Yourself Hydro Survey (BHM, Jan/Feb 2001), a site survey established the potential to generate power from the seasonal flow of water in two streams. In Restoring A Hydro Unit (BHM, Mar/Apr 2001), the alternator of a Burkhardt turbine was rebuilt and a simple, practical control unit was fabricated for it. In Installing a Hydro System (BHM, May/Jun 2001), most of the system's components—pipe track, hydro unit, wiring, and sediment barrel—were installed and connected together.

This article reflects the completion of the actual installation at Motherland outside Willits, California.]

1. Donna D'Terra and PV system (roof panels to right of stovepipe) will get wintertime help from the hydro unit.

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2. Safety belt attached, Michael Hackleman installs the culvert dams.

3. The hydro unit is temporarily sited for a season's use.

Water diversion

I left the method to tapping the culvert for the water that would feed the system to the very last. I've been intrigued with this idea for some time. A culvert's job is to collect a flow of runoff and safely pass it under a road. Need a source of water for a hydro system? Why not siphon off most of this water while it's still all gathered together?

There are challenges to tapping a culvert for its water. The water may be accelerated through the culvert. It will vary considerably in flow rate. The water may be transporting debris, sometimes large rocks and tree parts. Somehow the water must be diverted into a pipe while letting the bigger stuff move on.

I'm not afraid of benefitting from the experiences of others. Unfortunately, every hydro installer I knew had *not* tried to tap a culvert as an inlet for a hydro system. Darn, I'd have to figure out everything by myself. I sketched out possible designs. Clearly, I wanted any debris to move on *without* accumulation. At the same time, the water must freely find its way through the diversion pipe to the sediment barrel, through the filter, and into the intake of the pipe track.

I considered and rejected many ideas for tapping the culverts. One was a multi-holed metal pipe running along the floor of the culvert for some distance. Or several of them. Or extending a lip out from the culvert with its lower portion screened to funnel water into a pipe. Or some kind of partition (dam) to block part of the flow. Each had its merits and shortcomings. The fact that a sediment barrel existed in the systemand that it incorporated two stages of filtering for the intake-helped me see that whatever system diverted the water could also initially handle mud, sand, and rocks up to 1 inch in size. For this reason, I elected to fab-



ricate what I've come to refer to as a culvert dam.

The culvert dam assembly consists of 4 pieces: the dam plate, the intake tee, the deflection grate, and a weir (Fig. 7). Briefly, the dam plate seats against the inside curve of the culvert and pools the water. The intake tee collects the water and channels it through a pipe that penetrates the dam plate, runs 20-30 feet to the

sediment barrel, and shoots the water out across the screened top. The deflection grate is designed to assist large rocks over both the intake tee and the top of the dam plate. A weir is cut into the top of the dam plate to lower the dam height and provide a means of measuring overflow.

The dam plate. Both of the 18inch culverts I would tap had a spiral form to them, like the threads of a screw. This gives the culverts strength *and* slows the water that passes through them. The spiral is

coarse (sharper angled) in the middle and finer (more round) toward each end. I wanted my dam to fit down into one of these grooves so it could benefit





4. Old Hibachi grills were used for the deflection plate in the culvert dam.

5. A flattened and hot soldering



tip slices its way through plastic refrigerator shelves that are recycled into dam plates.

6. The grills are fastened to the 2-inch intake tees with plastic ties.



7. The culvert dam for the south culvert is ready to install.

8. Front and rear views of the culvert dams show few differences between the two assemblies.

from the support it got all through its curve against the flow of water. Working from the culvert's end and measuring from the *inside* of the spiral on each side, the diameter was close to 18 inches. Measuring from the *outside* of the spiral on each side, it was about 19.2 inches. A 9.5-inch *radius* (half of a 19-inch diameter) of dam curvature, then, allowed for a snug fit and some allowance for a gasket.

While I was tempted to use thin steel plate for the dam, I elected to first try plastic material. Why? With prototypes, it's best to build fast and modify as needed. Plastic can be worked with simple tools. I searched first my own house and shop for suitable materials to no avail. I had no luck at hardware stores, either. I fared better at a local surplus store, finding two heavy plastic shelves sal-

9. A split rubber hose acts as a gasket for the culvert dam.

10. Holes are drilled for the barrel bolts that secure the



11. PVC pipe attached to the culvert dam is not glued so that it may be easily removed.





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12. With my old tower safety belt secured to a bolt I had added to the northern culvert, I worked hands-free adding the culvert dam.

13. The diversion pipe from the culvert dam can be removed and tied off when not in use.

14. ... or slipped into its fitting to route water to the intake of the hydro system.

15. Water in pipes from the culvert dams shoots across the barrel's brass screen.