Place Culverts Correctly the First Time

Planning is vital to replace a culvert successfully. If the necessary crew members, equipment, and material are on site, replacing a small culvert is a one-day project. This article will provide information for planning and installing culverts. It is in two parts:

1. Sizing the culvert
2. Correct installation practices

Sizing Pipes Correctly

Culvert Diameter or Cross Section. When an existing culvert has adequately carried water during heavy storms, the manager can use the same size pipe. If unable to observe water flow, the manager can ask adjoining landowners about culvert performance.

Insufficient capacity could be due to prior poor judgment, inadequate installation, or a changed drainage area. Whatever the cause, more capacity is necessary. If a larger or modified drainage area is likely in the future, the manager should consider a larger diameter pipe. When increasing culvert capacity, managers should consider impacts on adjoining property.

For small diameter culverts, installing two pipes of the same size is often an economical solution. A qualified person should calculate water volumes, velocities, and pipe sizes, especially for large capacity culverts. The NHDOT *Manual on Drainage Design for Highways* describes this procedure. Analysts should also consider impacts on upstream and downstream culverts. Finally, mangers should document the reasons for changing pipe size.

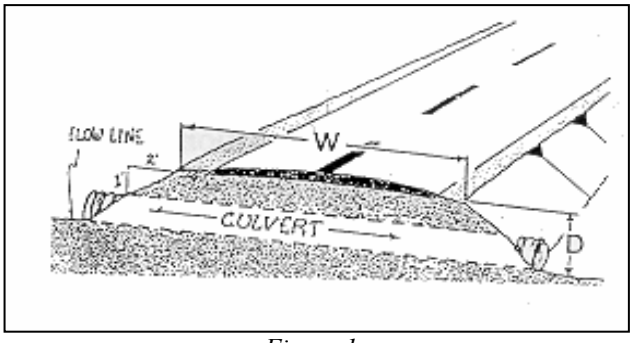

Figure 1

Culvert Length. Pipe length depends on the depth of the culvert. The culvert inlet should be below the bottom of the road base course. If necessary, crews should lower the ditch bottom. A metal or plastic culvert should be entirely below the base course. If that is not possible, managers should consider a concrete culvert. To determine correct length, managers should

1. Calculate the road shoulder height above the streambed or ditch bottom ("D" in Figure 1).
2. Calculate the length on each side beyond the shoulder. The roadside fore slope should be 4:1, or flatter, if right of way permits.
3. Add the length on each side to the road surface and shoulder width ("W" in Figure 1).

When pipes are too short, water will erode the slope at the end of the pipe. In time, it will erode the road shoulder and traveled way. Frequent inspection is required, and repairs often necessary after each heavy rain. Headwalls are a better solution.

Installation Practices

The following practices will result in a culvert installation that will last many years.

Crews should dig a trench wide enough to work alongside the pipe and to compact around it. A qualified person should determine elevations. Culverts should have a slope along its length of 1/2 to 1 inch per foot. A hand level is usually sufficient for this basic surveying.

Qualified personnel should also inspect the foundation soil. Crews should replace poor material with select material. If a poor foundation is likely, supervisors should have material readily available. Engineering, including soils analysis, may be necessary on large pipe installations or in deep fills.

Using hand tools, crews should evenly fine grade the trench bottom to the correct inlet and outlet elevations. They should shape and compact the bottom in an arc to receive the pipe.

They can then set the pipe and align it properly. Supervisors should check inlet and outlet elevations, and record them. They should also record the elevation of the stream bed or ditch.

The National Corrugated Steel Pipe Association's culvert installation manual states:

> Too much emphasis cannot be placed on adequate compaction of backfill. Faulty compaction has led to more trouble with pipe installation, flexible and rigid, than all other factors combined."

Crews should backfill only when the pipe is resting firmly on the foundation, and when heavy rain is unlikely. They should begin with 6-inch lifts of small sized material. Hand tamping is the best method to compact and seal the backfill against the lower half of the pipe.

If excavated material is suitable, crews should use it as backfill. Otherwise, they should use select material. Backfill material must be free of rocks larger than two inches. Crews should place the material carefully, and compact it evenly in no more than 8-inch lifts along both sides of the pipe. They should moisten the materials for compaction, but not so much that it becomes unstable.

Compaction equipment operators should work parallel to the pipe, never against it. They should not over compact, because the pipe could bend out of alignment. To achieve adequate cover over a pipe, two or more pipes might be necessary. (See the Fall 2000 *Road Business* for multiple culvert installation).

For high velocity and volume water flows, slope protection is usually needed. Flared ends are cost effective to funnel water into the pipe and to spread outlet flow. For very high velocity flows, riprap, of a suitable size, is often needed to prevent erosion.

The goal should be to replace a pipe so it will, with minimum maintenance, remain in place for its entire life. Managers and crews can achieve this goal by applying the above information. However difficult to install a culvert properly, it is more difficult to make major repairs later.

The following books provide information for specific situations: *Manual on Drainage Design for Highways*, NHDOT
Drainage, Drainage, Drainage. See page 9

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Welcome Daryle Lamoureux to the UNH T^2 Center Staff

Daryle Lamoureux joined the UNH Technology Transfer Center as the Program Assistant on May 27, 2003. Daryle is a life-long resident of New Hampshire and a graduate of UNH in Russian. Daryle previously worked in software marketing and public relations for Gambit Communications in Nashua and Hasbro Interactive in Beverly, Massachusetts.

Daryle lives in Rollinsford with his wife, Caroline, and their two daughters, Sasha and Zoë.

Many people had the opportunity to meet Darlye at the Mountain of Demonstrations and the New Hampshire Public Works Municipal Engineers Association Spring Meeting. Look for Daryle this fall at the Snow and Ice Control Conference on September 4, 2003 or at one of our workshops.