Section II: Drainage

An often-repeated adage in the road construction and maintenance business is that "The three most important things to understand in building and maintaining roads are drainage, drainage, and drainage!" This certainly does get an important message across. But, too often, this critical issue is ignored when building and maintaining local roads. When drainage is poor, the best efforts to rehabilitate or maintain roads will bring disappointing results. When water can be drained off of road surfaces and out of roadbed soils, the road will invariably become easier to maintain.

This can hardly be emphasized enough. But this is not a drainage manual and therefore the discussion will only cover basic drainage matters. A good reference is Roadway and Roadside Drainage by the Cornell Local Roads Program at Cornell University. (27) Call the LTAP center in your state to obtain a copy.

Too often the maintenance team deals with surface problems that really come from wet and weak soil conditions below the road. Since gravel roads generally carry low volumes of traffic and do not have large budget allocations for maintenance, a maintenance operator must do what it takes to reestablish and/or keep drainage working on gravel roads. Previous sections of this manual have already discussed the road profile which is the first line of defense for good drainage. The discussion will now continue with three more basic drainage topics: ditches, culverts, and underdrains.

Lack of a roadside ditch has caused major drainage problems on this road.(Courtesy of Road Research Ministry of Roads/Transportation,Sweden)

This road located in Poland has very poor cross section.Consequently, drainage and overall driving conditions are bad. (Courtesy of Mary O'Neill, Office of Remote Sensing, South Dakota State University, USA)

Remarkable difference in these two roads that carry similar volumes of traffic. They are located in the same region of the country and the photos were taken on the same day. The major difference is drainage. The upper photo shows a well-drained road while the lower photo shows a poorly maintained ditch that resulted in a poor performance.

An example of work with a grader to reshape a ditch on a mountain road.

Ditches

The most important and common drainage structure needed is the roadside ditch. Every effort must be made to maintain a minimal ditch. If the ditch becomes obstructed from eroded soil or debris, it must be cleaned. Sometimes this can be a major project requiring loaders, excavators, trucks or other equipment. However, during a dry period, a maintenance operator with nothing more than a grader can do wonders to restore ditch drainage.

A nicely reshaped ditch that meets the shoulder line of the road and allows good drainage.

An Egyptian gravel road which is heavily travelled with limited access. Notice that despite the lack of ditches the surface performs well.The reason is that in the arid region of Egypt rainfall averages less than three inches per year. (Courtesy of Ali Selim,SD LTAP, USA)

Culverts and Bridges

These drainage structures are critical to carry the natural flow of water under the road so that it may continue on its natural course. Small pipes and box culverts can easily become plugged from eroded soil and debris. It becomes part of road maintenance to inspect them at reasonable intervals and clean them so that drainage is unobstructed. Eventually, they will have to be replaced.A good maintenance and replacement program is too often lacking on gravel roads. (15, 27)

New culverts installed well and at correct elevation are essential for carrying water under a road.A reasonable maintenance schedule is required to keep them functioning well.

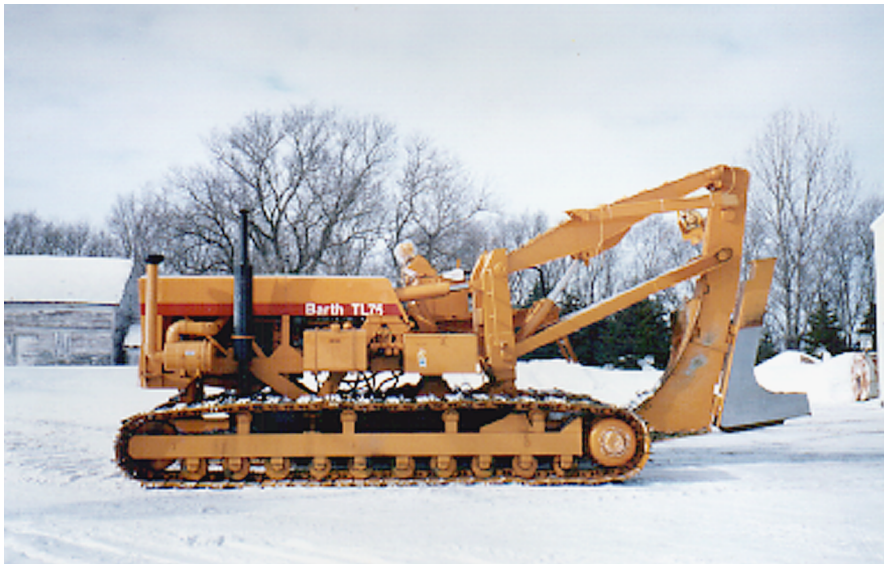
This road could fail if debris is not cleared before the next heavy rain.

Underdrains

When a road is built over water bearing soils or over natural springs which continually want to wick water upward toward the surface, the road is invariably weak and will perform poorly. It may be cost effective to consider installing either a "fabric," technically known as a geotextile, to stabilize the road, or a perforated pipe to carry water out of the roadbed. The use of fabrics has been discussed earlier in this manual. This discussion will briefly focus on the use of perforated drainage pipe.

This method has been used in several areas throughout the country. It is similar to field tile used for drainage of wet farmland. The product most commonly used is a flexible polyethylene pipe. The pipe is installed longitudinally, generally on the center line of the gravel road. It is often plowed into the roadbed with a laser-leveling device to keep the machine on grade. This method generally works best when the pipe has a fabric wrap or "sock" to keep very fine soils from infiltrating the pipe and plugging it.A trench can also be excavated to grade, pipe placed and small stone or clean fine gravel placed around the pipe. A geotextile lining in the trench can enhance the long-term performance of these drains. In either case, the pipe has to be brought out to an open end at or near the ditch bottom. Therefore, this method will not work if the ditch itself frequently fills with water and holds it for a period of time. This can actually cause the pipe to work backwards and carry water back under the road and weaken it further.

This drainage method may not be effective in all soil types, however it has proven effective in many areas.



Example of a machine called a tile plow that is commonly used in some regions to install polyethylene pipe into farm fields for drainage purposes. This type of machine has also been used to plow drain tile into gravel roads with great success in some areas.