



PCTA Trail Skills College Curriculum Field Reference



Course 302. Drainage Crossings

STUDENT SKILL OUTCOMES:

- Ability to evaluate watersheds for likely water flows
- Ability to choose the right structure for each drainage crossing.
- Practice quarrying, transporting, and installing rock safely.
- Construction experience with at least two of the following: ford, stepping stones, culvert, step-down drain, French drain, or armored swale.

KEY TERMS:

Ford: a wet crossing of a flowing water, ideally at a wide shallow place with a firm base. May be only for horses, with stepping stones or a small bridge for hikers, or in Wilderness for hikers and horses.

Stepping Stone: carefully selected and places large stones that allow hikers to safely cross a stream by stepping from one stable surface to the next. Usually in conjunction with a horse ford.

Culvert: a closed passage under a trail (or road) for water. Can be made using metal or plastic pipe, or constructed of rock, lumber, or logs.

Step-Down Drain: (aka curbed stone channel or open drain) an open drainage structure made of log or rock that allows trail users to either step down into a small stream crossing or simply step over it if small enough.

Armored Swale: (aka armored grade dip, armored dip, stone dip) a natural channel or excavated depression in a trail that has been hardened with rock or (rarely) wood. See also swale and rock armoring.

Wilderness: with a capital W refers to named Federal lands designated by the U.S. Congress under the Wilderness Act of 1964. They may be designated within any category of Federal public land, such as Forest Service, BLM, or Park Service, though management regulations may vary slightly among them. Much of the PCT passes through such Wilderness areas. Most important to trail workers, motorized tools and mechanized transport such as chainsaws, wheel barrows, and bicycles are prohibited, unless a

waiver is obtained from land managers (generally not easily granted). Signs in Wilderness intentionally provide less information, to require more skill of their visitors. Group sizes, including volunteer trail crews, are usually limited to no more than 12 people. Heavily used areas such as alpine lakes may have additional regulations such as no campfires. More can be read about the topic of "Minimum Requirements" and "Minimum Tool Analysis" in Wilderness at <http://www.wilderness.net/MRDG/>. Small wilderness generally refers to any remote area largely undisturbed by motorized vehicles. If not designated by Congress, such areas usually do not limit group sizes or use of mechanized equipment, though may have some interim management restrictions to protect the potential for future designation as Wilderness.

Watershed: (aka hydrological system) the ridge-top to valley bottom landscape from which all the water of a stream originates. Such water originates as rain and melting snow, both running over the land and as ground water. Climate, geology, soils, and vegetation of a given watershed all influence running water including seeps, springs, and streams. Trail workers must understand the particular watershed that leads to a drainage crossing for which a structure is contemplated. Any structure must be designed to accommodate fluctuations in water levels, especially high water.

Mineral Soil: dirt that includes little or no organic material, ideal for trail tread and fill. Ideally it is a mix of grain sizes including sand and small gravel so that it drains well. 100% clay is not a good choice.

Inside Ditch: (aka wing ditch) a ditch running along the inside edge of an insloped section of trail tread. It carries water from seeps in the back slope to a drainage structure (such as a culvert) to carry it across and off the trail.

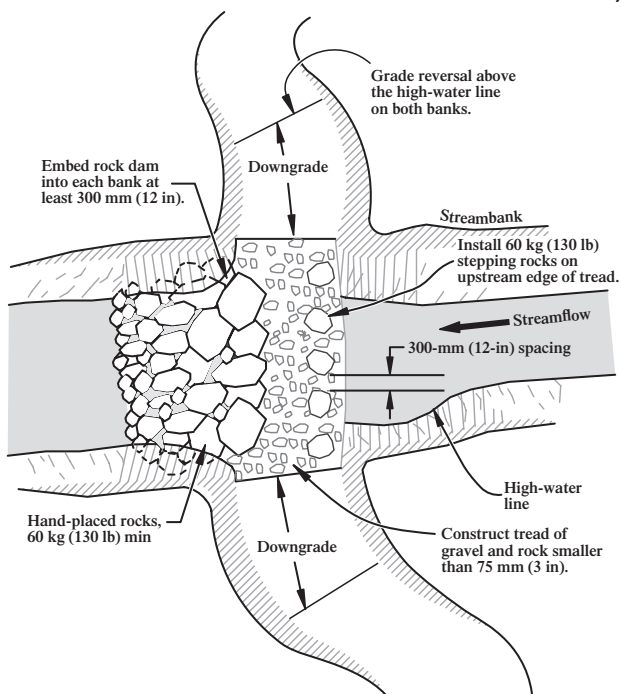
Pressure-treated Wood (posts & lumber): (aka PT) round logs and dimensional lumber that has been through an industrial process to penetrate the wood with chemicals to prevent rot and thereby extend the useful life of the post. For trail work material rated for "ground contact" must be

used. Industry standards claim such materials will last 50 years, whereas most untreated wood lasts only 5-10 years in contact with dirt. Some native materials, such as juniper or locust, can last considerably longer because of naturally occurring chemicals in their fibers. Native wood can also be hand-treated (usually only the portion in the ground) with a preservative such as Copper Napthenate.

KEY CONCEPTS:

- 1) Safety Documents: Pre-trail work paperwork:
 - Personal Protective Equipment (PPE), Job Hazard Analysis (JHA), Tailgate Safety Session (TSS), Emergency Action Plan (EAP)
- 2) Principles of Drainage Crossings:
 - Consult local managers about their preferences
 - Assess carefully if a structure is needed
 - Analyze the watershed to choose the best crossing solution
 - Simpler solutions are generally better
 - Understand working in Wilderness: Keep it Wild!
 - Structures built with rock are usually better than wood
 - Understand use of pressure-treated wood: ground and water contact-rated

Figure 1. Elaborate ford design for a steep gradient stream (fast flowing). Many fords require less manipulation, as long as the stream is not too fast and the bottom is relatively uniform and solid. (IMAGE COURTESY OF THE USFS)



- Work when conditions are dry, but know how wet it gets
- 3) Fords:
 - Best locations are in straight channel with shallow, slow water and solid even base; build only what is needed
 - Gradual non-eroding entrance designed to prevent high water from flowing down the trail
 - Stepping stones needed?
 - Clear out debris washed in or placed by users
 - 4) Step-down Drains:
 - Use big well-fitted rocks that can withstand horses and water flow
 - Bottom must be solid and not too deep
 - 5) Armored Swales:
 - To harden natural or constructed drainage crossings of modest size
 - Sufficient rock to withstand amount of water and horse traffic
 - 6) Culverts:
 - Made of pipe, rock, logs, or lumber (possibly pressure-treated)
 - Handle more water, but not floods, if sized correctly
 - Pipes faced with rock, all have 6" cap of compacted dirt
 - Wood culverts are best capped with pressure-treated to slow rot
 - 7) Place large guide rocks at entrance to drainage crossings wherever needed to keep users (especially horses) in the middle of the trail.
 - 8) An inside ditch can collect several seeps to one drainage crossing.



Figure 2. Fords should be established in a straight and shallow section of a stream. Approaches must climb above the high-water line to prevent water from running down the trail. Note the armored entrance/exit ramp into the ford, constructed of rock and gravel. (IMAGE COURTESY OF THE USFS)

Figure 3. Excavated armored swales can serve as drainage crossings for turnpikes and inside ditches (IMAGE COURTESY OF FHWA)

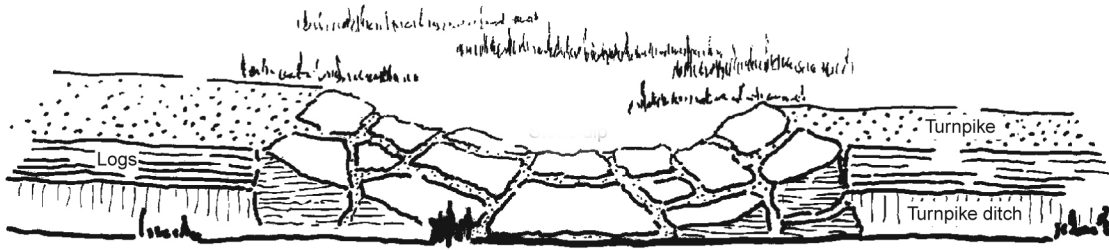


Figure 4. The exposed end of a pipe culvert is shielded from view with rock facing that is stout enough to resist erosion from high water flows. Note rock splash apron. (IMAGE COURTESY OF SCA)

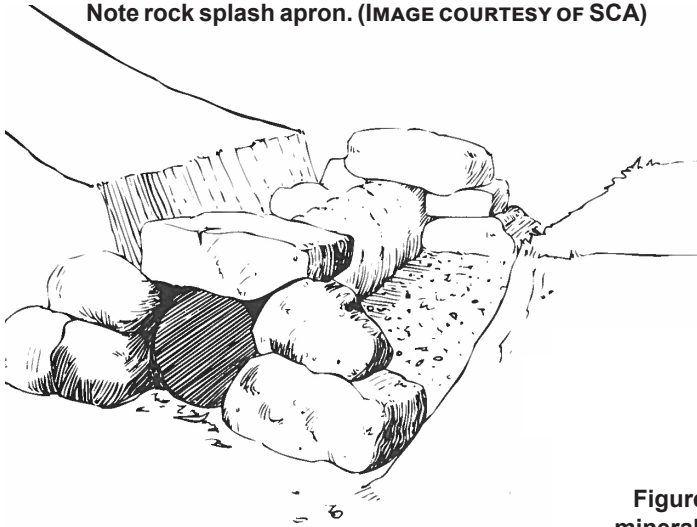


Figure 5. A log culvert is covered with six inches of compacted mineral soil or gravel. If allowed by managers, under the soil cap utilize ground contact-rated pressure-treated poles or lumber, to reduce rot. Notice at left an inside ditch. (IMAGE COURTESY OF SCA)

