



Course 102. Tread and Drainage: Protecting Trails from Erosion

STUDENT SKILL OUTCOMES:

- A basic understanding of hillside hydrology and how trails should work.
- How to identify cupped tread and restore it to appropriate outslope by removing slough and berm.
- Ability to identify and clean drain dips and water bars effectively and how to upgrade old school water bars.
- Developing “trail eyes” and an eagerness to hike on a rainy day to learn to “think like water”.

KEY TERMS:

Berm: the mound of soil that develops at the outside of tread. Berm disrupts tread out-slope and prevents water from leaving the tread to the down-slope.

Cupped Tread: trail tread that is dished out by users feet loosening the soil and then water (&/ or wind) carrying the soil away. Such tread holds water on the trail leading to cupping erosion on grades above a few percent.

Drain Dip: (aka **dip, drainage dip, earthen water bar, and rolling grade dip;** a close cousin but different from a **grade dip, Coweeta dip, knick, swale and bleeder.**) A broad, gradual excavated trail feature to shed water off the trail at regular intervals to prevent tread erosion by interrupting the normal grade of a section of trail. Soil excavated is mounded and compacted down the trail from the dip. Ideally 15-30' long and 8-12" deep. To withstand horse use, drain dips should only be built in very durable soil with trail grades below 10-12%, ideally in the late fall when the soil is moist and just before winter, allowing snow to compact the dip before use in the spring.

Grade Reversal: regular ups and downs designed into a trail alignment is the best way to shed water from a new trail. Such ups and downs can be added to an existing trail with great labor by constructing water bars and drain dips (aka **rolling grade dip**) imba link

Out-Sloped Tread: a trail surface that tilts to the

downhill side of the trail to shed any water that arrives from above. Trails should be constructed and restored with 8-16% outslope (1-2" of drop per 12" of tread width) so that they will age to hold 5-10%. Less durable soils require greater outslope. On rare occasions tread is in-sloped, shedding water to an inside ditch just uphill of the trail, later crossing the trail through a culvert or other drainage structure.

Tread: the surface of a trail, on which users walk or ride.

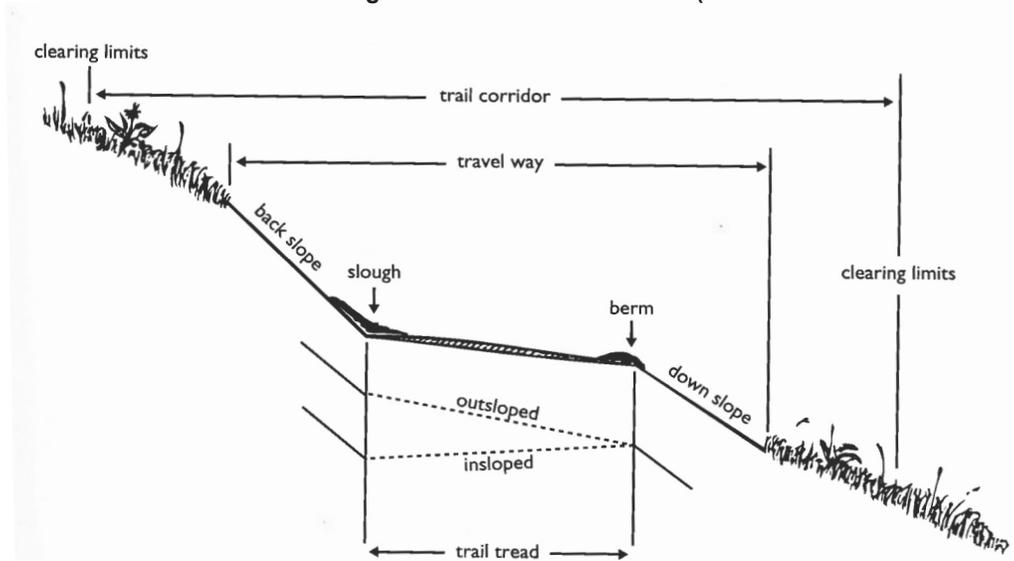
(Rock or Log) Waterbar: (aka **(rock or log) reinforced drain dip**). As constructed by the PCTA, this trail drainage structure includes a drain dip reinforced by a peeled log or row of large rocks. The reinforcing log or rocks are buried securely at about a 45 degree angle across the tread and 36" down the trail from the bottom of the dip—thus water leaves the trail well before it reaches the log or rocks. Waterbars are generally required on trail grades in excess of 15%, rather than drain dips. See also, “Old School Waterbar.”

Slough: the debris deposited on the inside of tread at the base of the back-slope, primarily delivered by gravity from the back-slope above. Its accumulation causes the tread to narrow, forcing users to the out side of the tread, which can lead to collapse or tread slip.

KEY CONCEPTS:

- 1) Safety Documents and Concerns:
 - Personal Protective Equipment (PPE), Job Hazard Analysis (JHA)/ Tailgate Safety Session (TSS), Emergency Action Plan (EAP)
- 2) Trail Crew Leave No Trace: Have a positive impact on the land through trail work and be sensitive to off trail and camping impacts.
- 3) Proper/ Improper Tool Care and Use:
 - Shovel, McLeod, Pulaski, adze hoe, Rheinhard, pick mattock, rock bar
- 4) Develop “Trail Eyes”:
 - Suggest hiking in rain to better understand

Figure 1. Trail Structure Terms (IMAGE COURTESY OF THE SCA)



water on trails

- Have people critique drainage structures and tread features

5) Hillside Hydrology/How Trails Work:

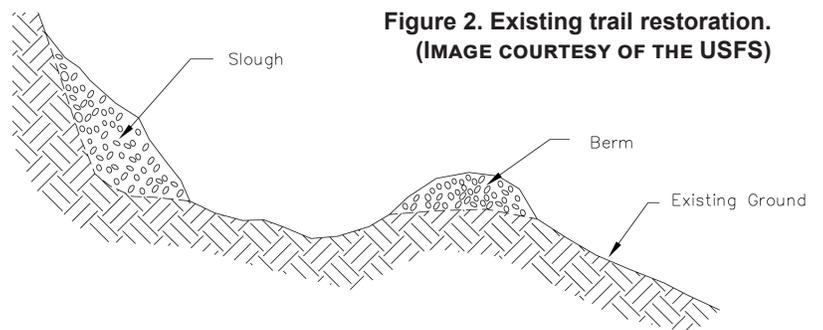
- Effects of water in diverse soil types
- Ideal tread conditions:
 - Sustainable grade
 - Proper out-slope and sheet flow > no trail cupping, berms, or slough
 - Frequent drainage structures > grade reversal, drain dip, or waterbar (rock or log)

6) Tread Work and Cleaning Drainages:

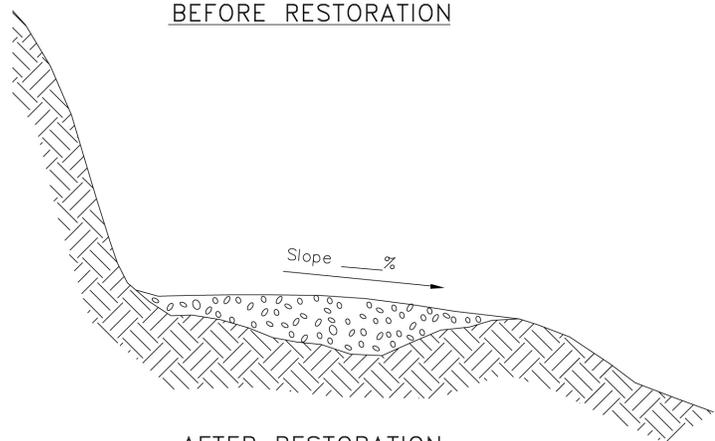
- Reestablish proper outslope by removing berm and slough
- Cleaning of Drainage structures:
 - Drain dip and waterbar (rock or log):
 - Clear dip and outfall ditch of any plants, roots, debris
 - Reestablish the apron and backramp, pack soil well
 - If possible, replace any “old school” waterbars with newer design
 - Inside ditch: if present, keep clear and reestablish insloped tread

7) Report Work Promptly

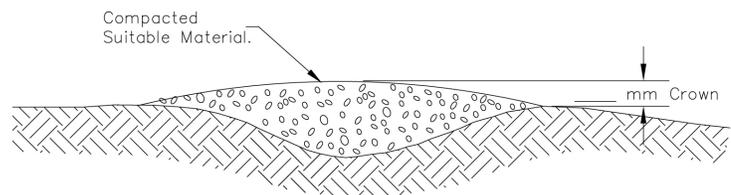
Figure 2. Existing trail restoration. (IMAGE COURTESY OF THE USFS)



BEFORE RESTORATION



AFTER RESTORATION



FLAT SLOPES

Figure 3. Diagram of modern waterbar construction

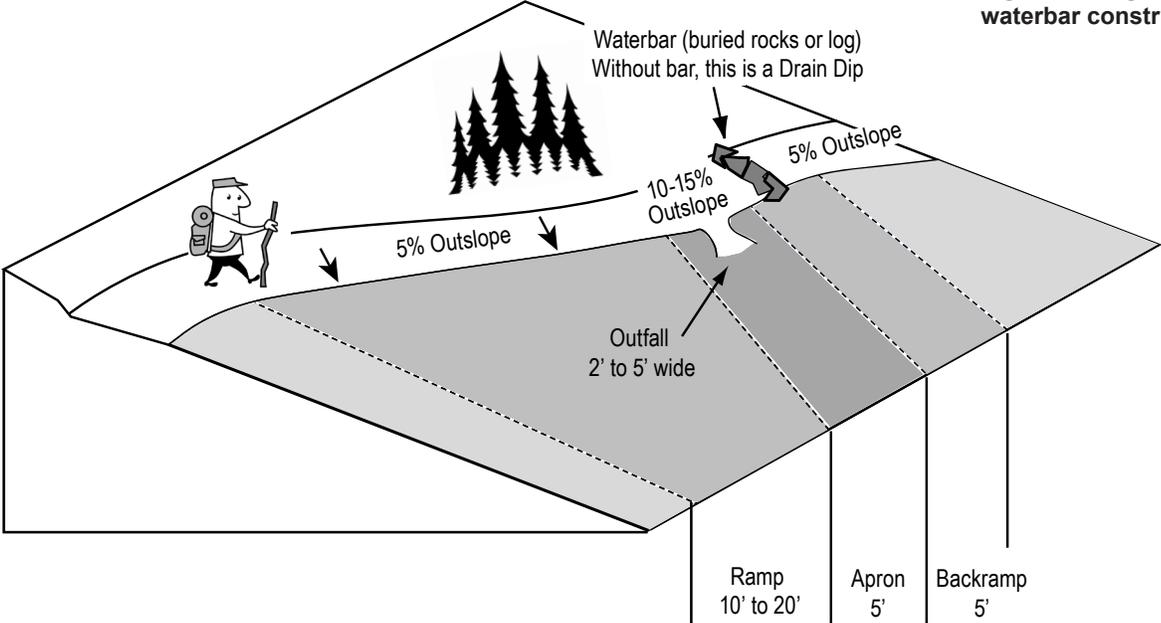


Figure 4. "Old School" rock water bar. (IMAGE COURTESY OF THE USFS)

