Trail Tread and Drainage Renewal on Rocky Properties

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Introduction

Trails constructed on rocky properties, unless they have been constructed in an expensive and time-consuming fashion, will inevitably exhibit issues after long periods of use. Rocks that were considered not worth removing when the trail was constructed begin to become large obstructions while rocks embedded below the surface of the trail will begin to poke above.

Any rocks that are above the trail surface are potential trip hazards for hikers and, more tragically, for runners. I've tripped while running a few times, falling each time, and once I should have broken my nose but was lucky enough to emerge with only a cut across the bridge of my nose from my glasses being forced into my face. Trail rocks are hazardous. Having said that, on rocky properties they are also inevitable, and hikers and runners know that they will encounter them. Our goal is to create as safe an environment as we can given the circumstances we are laboring under.

Besides smoothing the trail and creating a safer hiking and running environment it's also a great time to assure that the trail is draining water appropriately. If possible, use trail smoothing work as a good time to recreate an outward slope to the trail so that rain and low on-trail flow can simply flow off the trail and downhill. If that isn't possible, see if there is a location to put in a rolling drain dip (a gentle dip in the trail that guides the water off the trail). For me, the cardinal rule of trail maintenance is "if you don't control the water you don't control the trail."

Below is a description of what I've come to develop over a period of years doing this "rock work" on two very rocky properties above the City of Sonoma: Sonoma Overlook Trail and the contiguous Montini Open Space Preserve. If your property is similar to these (they both used to be rock quarries) you may find some advice below useful. Otherwise, your mileage will vary.

Stage 1: Removing or Reducing "Icebergs"

In my personal trail parlance, I call any rock sticking above the trail surface an "iceberg." Perhaps obviously because you never know how much bulk of the rock is below ground. On one infamous occasion during the rock work I've done, my team had begun removal of a rock roughly a foot-and-a-half wide that was sticking up into the trail about two inches. This rock was smack in the middle of the 18-24" tread that I was hoping to make smooth, so I really felt like it had to come out. As we dug into the trail with our rock bar we soon realized it was much larger than we imagined. We tried breaking it into chunks with our cordless rock chisel, but no luck. We considered putting it back where it was (too late, it would make things worse), or repositioning it to the side of the trail (this didn't work). That only left one possible strategy—we had to take it out completely.

The problem is that we eventually estimated it to be a quarter-ton monster of a rock. Luckily, I knew just the thing that would allow the three of us to remove it. Being a whitewater river guide, I had the gear that would be needed to pull a boat off a rock that was trapped by the current of the river, which requires a great deal of pulling pressure. Essentially, with a static line (rope that doesn't stretch like a climbing rope does), several pulleys, some carabiners, and a couple prusiks, you can set up what is called a "Z-pulley system" (also called "Z-drag" or Z-rig") that increases the mechanical advantage you have while pulling. With this particular setup you can achieve a 5:1 mechanical advantage. That is, for every pound of pulling effort on a straight rope, it provides *5 times* as much pulling effort in the end.[1]

I quickly set up the Z-pulley system anchored to a nearby tree and one of us helped to lever the rock out of the hole while the other two of us pulled the rock across the trail to the edge where it was out of the way. Easy-peasy. But without that knowledge and equipment we would have been in quite a pickle.

This tale of major iceberg rock is rare. Large rocks can usually be rolled out of the hole and off the trail with enough hands.

Thankfully, most rocks are much smaller and much more manageable and can be easily handled by the set of strategies below.

First Strategy: Wholesale Removal

Perhaps obviously, the first thing to try is to remove the entire rock as one piece. For small to intermediate sized rocks this may be relatively straightforward and easy. For any given section of trail, unless I see that all of the rocks are quite large, I prefer to begin rock removal with a standard rock hammer—the kind that "rock hounds" use to dig up and crack rocks. For larger rocks, I'll tend to reach for a cordless rock chisel. Finally, for the true monsters I will use a rock bar.

Rock Pick or Spade

With experience you will get to know on sight which rocks are most likely to come out with a rock pick or spade (pointed shovel). A spade is more useful for rocks not firmly embedded, whereas a rock hammer can sometimes get these. If a rock is not coming out, leave it alone for the next tool in the arsenal, the cordless rock chisel.

Cordless Rock Chisel

We have found a cordless rock chisel to be absolutely essential for this kind of work. Unfortunately, it isn't inexpensive, costing around $500 (or more) as of this writing (late 2024). However, it can save you untold hours of sweaty work. For wholesale removal, the rock chisel can easily dig up small-to-medium-sized rocks (often in a second or two per rock) and

[1] https://www.google.com/search?q=z-pulley+system+5%3A1+mechanical+advantage

potentially large rocks depending on the situation. It is often my first choice for large rocks and if it doesn't work well, then I move to the rock bar.

To use it, you place the chisel at the side of the rock pointed down into the soil of the trail and run the chisel and push down on the handle to use the chisel as a lever to lever the rock out of the trail. If one side doesn't work, try another. If it doesn't work, move on the rock bar.

Rock Bar
A rock bar is my first choice for wholesale removal of very large rocks. Drive the rock bar (typically I use the chisel-like end for my first attempts, but if the soil is too hard for that to be effective I switch to the pointed tip end) into the soil right beside the rock and try to get purchase on the rock in a levering motion (push the end of the bar you're holding down toward the trail). You may need to strike the bar beside the rock several times or more to get enough purchase on the rock to be able to lever it enough to break its contact with the soil.

Second Strategy: Breaking and Removal

If wholesale removal is not possible (for example, the rock is too large), then breakage and removal is the next thing to try. This requires using a cordless rock chisel (preferred) or a small sledgehammer and a rock chisel to break the rock into pieces and remove the rock piece by piece.

Third Strategy: Reduction

If the previous strategies have failed (for example, it's bedrock), then you may need to use either a cordless rock chisel or a small sledgehammer and chisel to chip off the top of the rock either to the surface of the trail, or below the trail so aggregate can be packed above it to create a new trail surface (preferred).

Stage 2: Mining Rocks

After removing "icebergs" in the trail, to more completely renew the tread you should remove as many rocks as possible to a depth of two-to-three inches below the surface of the trail. This extra depth will enable the trail to wear for several years or more before it will need to be revisited. First use a rock pick or hammer to dig these out, but if they are larger than a pick can handle use a rock bar or cordless rock chisel.

Stage 3: Recovering Drainage

After removing the rocks from the trail bed, take time to inspect how water can move off the trail. This is the best time to fix any drainage issues this trail section may have. Perhaps you only need to cut berm (a built-up outer edge that should be trimmed down), and/or build up the trail slope so that water will naturally slide off the trail to the downhill slope. If that isn't sufficient for guiding water off the trail, a rolling drain dip or a drain may be required.

Stage 4: Applying Aggregate

Once all of the rocks have been removed from the trail bed and any adjustments to drainage have been made, aggregate can be applied to the trail to re-smooth the trail and create an appropriate out-slope.

Stage 4: Watering and Packing

To properly pack the loose aggregate, first smooth it out where it needs to be and stomp on it. Then apply enough water using a watering can until the smallest constituents liquefy. Allow it to sit for a minute, then stomp it with your feet (your shoes are less likely to make it clump up than a tamping tool) until you see wetness appear on the surface. This indicates a mud that will help to solidify a hard surface when it dries.

About Aggregate

Perhaps obviously, not all aggregate is the same. Some aggregate has too many large constituents that will not pack down and will end up at the margins of the trail. For a trail surface you will want aggregate of half-inch or less, with enough soil-sized particles to create a mud-like constituent that will help keep the larger gravel in place. Aggregate of three-quarter-inch will typically not pack into a consistent trail surface. It can be used as a trail *bed*, but not as a trail *surface*.

About Equipment

All of the above can be accomplished with some combination of the following equipment:

- Rock pick/hammer
- Cordless rock chisel
- Gorilla wagon (or similar)
- Five gallon buckets (for aggregate)
- Spade
- Rock bar
- Aggregate
- Water
- Watering can
- Water canister
- Backpack

- Helmet with face shield and ear muffs

All of the above equipment can be carried in an SUV or truck or van.