Feeling Drainage

August 2006

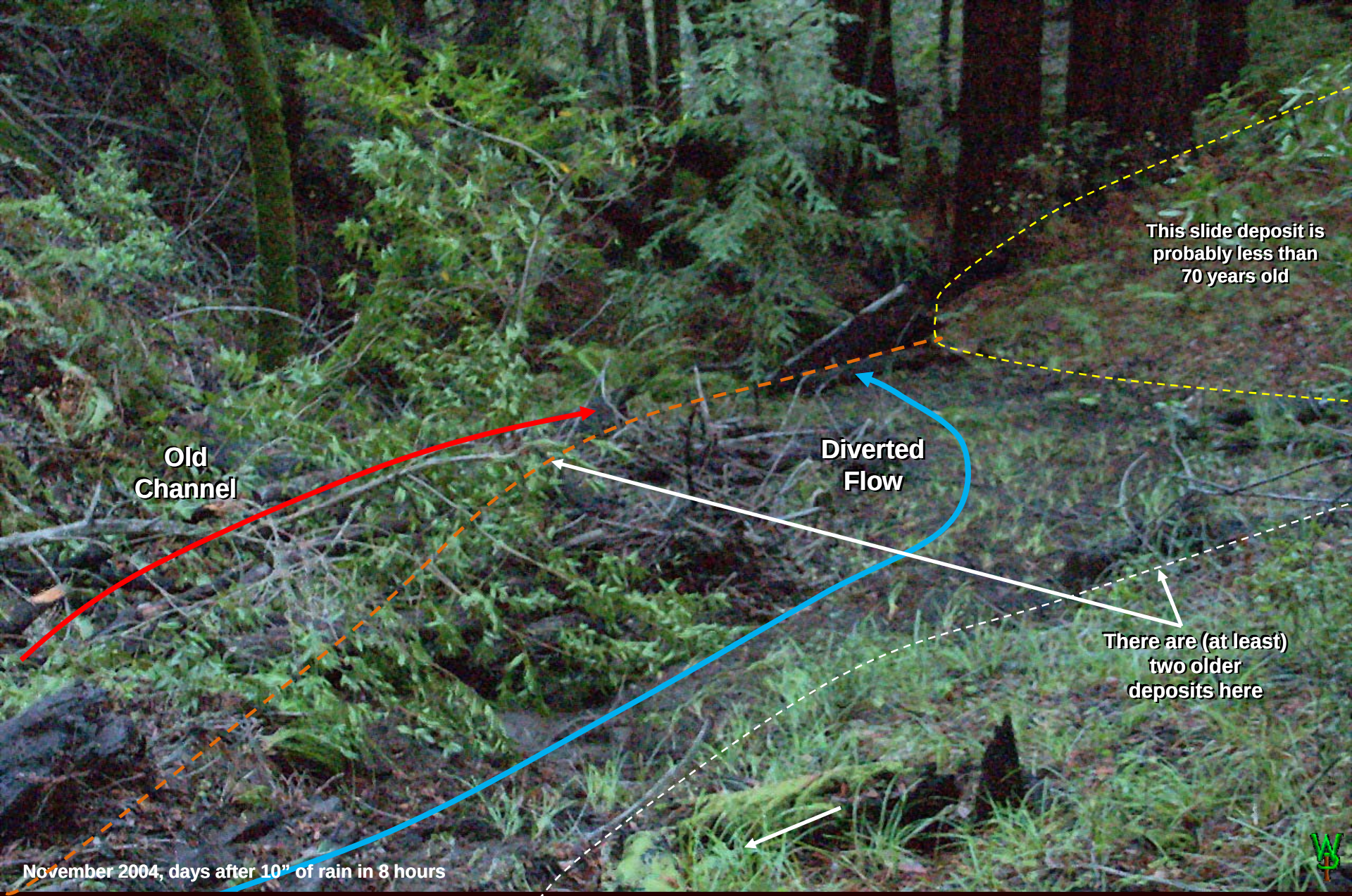
One of the ways in which the sponsors of the environmental industry have driven the domestic timber industry into ruin has been with claims that logging releases sediment into streams, thus harming “endangered" fish (never mind the fact that the fish were more abundant at a time when fishing, timber harvests, grading, and drainage practices were totally unregulated). A logging job surely does release sediment, just as not logging can also do, in a much bigger way. This was one of two spots that taught me why. Can you see it?

Here is the same cluster of redwood trees seen from the other side. It should be fairly obvious that the root mass of these trees inhibited a considerable amount of erosion of the stream bed , also called “channel incision” such as you see below them. From this example, I have learned to reverse that incision process for reasons we’ll get to soon.

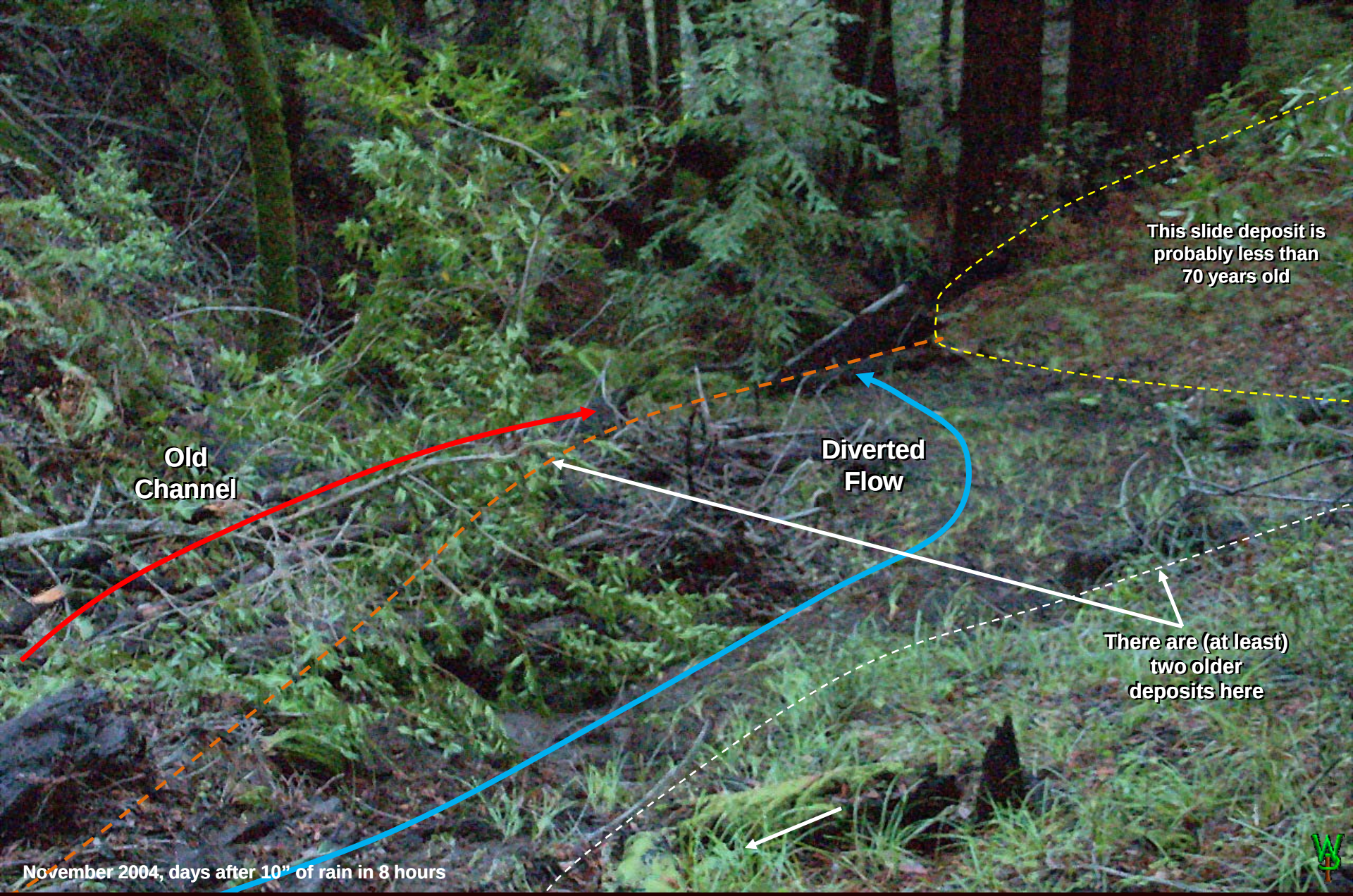
Looking down the channel from the same spot, it isn't hard to see another landslide deposit with trees on top at the lower left. At the top of the draw to the right is a rotational slope failure with a steep headwall. I suspect that the green swath behind the trees is alluvial deposition on top of a colluvial lens. Based upon the stumps I have counted in this area, none of these trees is over 100 years old. Unlike the next draw to the north (TBD), there are no large old stumps. This has probably all happened since it was first logged.

You may remember this image from the repeat photos in the Introduction. The first thing I did to impede channel incision was to cut trees to the right side of this ridge, about 100 feet *above* the channel. Although cutting the bay trees up here was legal (not a timber harvest), it did reduce “stream canopy cover,” which could get you fined on a commercial job. The thing is, “How much shade is the right amount?” It turns out that when it comes to canopy cover, sometimes more is worse.

This location is just downstream of the cluster of redwoods two slides prior and below the ridge on the prior slide. Thinning the trees up above allowed sunlight to stimulate the growth of Santa Barbara Sedge down here. Once it was established, I bucked this log bridging the stream (red arrow) such that it would deflect the flow to the right over the top of a colluvial deposit, just to see what would happen (I could always part it and send the water back into the original channel). The old channel was incising at the base of a steep slope I wanted to stabilize. I knew that if the slope failed, the water would go over the colluvium and carry away a considerable amount of sediment anyway. This dead madrone had gone down by itself, and I wish I'd cut it first as the root ball tore a heck of a hole out of the side of the hill (one of those things I just didn't get to in time). Turns out, I was just in time…



What came that October was the most intense rain event in decades. This was major. The flow blew out leafy duff 6" deep and 10 feet wide within 50 feet of the highest ridgeline. The leaves plugged every culvert and sent the drainage flow out of the main channel and into this one (every major drainage system on this property has an alternative backup). The combined flow of water, 10' wide, boiled right over the Santa Barbara sedge with no damage at all. Ironically, we were in Santa Barbara; there was nothing I could do.



If you look carefully, in the background you'll note that the toe of the slide is cut off. The bulk of it rises above the plane upstream. That suggests there was once a "lake" behind the "dam" until it blew out (probably immediately) with the nose of that slide dumping quite a load into the stream and weeping more for some years. Correspondingly, the area immediately below this stand is nearly flat. There is a very interesting reason why the incision slope went no farther, staying stable long enough for the trees to grow on it.

Here is the other ‘thing that taught me what to do,’ and it is what shaped the toe of that slide. This log is *underneath* the landslide with the trees sitting on top. It is one very substantial log. It was cut by a saw on one end, so it is impossible for the slide to be over 150 years old. From the size of the trees, my guess is that it has been here about 90 years. If the Vaquero sandstone substrate is relatively uniform, it may be that wood has been *the* critical factor in defining channel shape and distribution in this region. Once the channels start, they tend to keep cutting in the same location, unless there is faulting or somebody does something, as we shall see.

Most people would never guess that *reducing* canopy cover has anything to do with reducing erosion, but then, most people do not understand how amazing sedges can be in doing that job. As to the risk of a debris flow in case something goes wrong, there is a big flat area just below the outlet to this stand for the water to fan out and lose energy.

Here it is after five years of winter rains and just after another monster storm. If you look carefully, you’ll see not erosion but *deposition* of sediment in the foreground at the head of the diversion. That material is from all over our property, from the my neighbor across the road, various stumps from fallen trees, etc, but probably the biggest source is gophers, ground squirrels, moles, and rabbits. I use that material to stabilize the draw over time, as you will see in our next example in the next channel in the middle of the property.

So now we are back to the center draw, starting with our now familiar logging job.

On the left is that now-familiar “wall of wood” I somehow discerned needed thinning. The stream ran in front of them and was starting to undercut their support. You will soon see what happens should that process progress.

So now I’m going to show how logging can not only prevent landslides as we have discussed, it can (1) help armor the bottom of the channel and capture sediment to *reverse* channel erosion that would otherwise undermine the trees until they fall over and then keep cutting a deeper and more unstable channel underneath them thus producing more eroded sediment.

There were two aspects to this job. As you’ll recall, I pulled the old stump out of the middle of this cluster. That was not done out of sheer curiosity. First it was to open the cluster to more light. But the main reason was so that I could reroute the water through the middle and away from this trench.

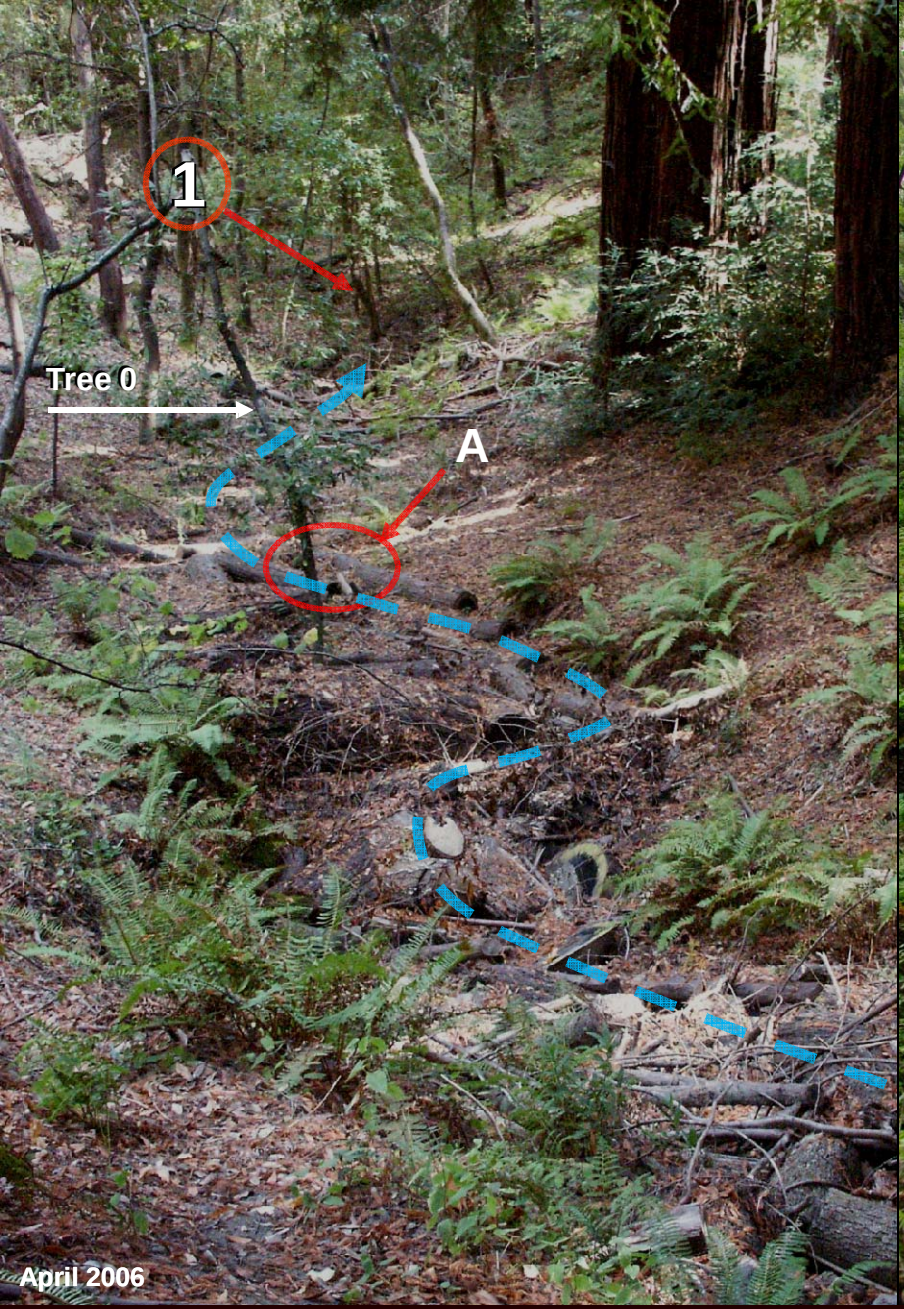
Any logging job entails its “useless” chunks, trunks, and hunks. What to do? Set them carefully into the channel to convolute the path, slow the water and capture sediment. So let us now return to our “after” photos and look at where the water goes now.

As you can see on the left, I broke the flow into two streams, meaning that the total energy hitting any one spot is greatly reduced. The run-out slope “A” is a great deal lower which also reduces water velocity. Flow “B” smacks headlong into a stump, which being redwood will last a good long time, especially because it will re-sprout new trees. Because of the slope, I don’t expect much deposition here.

Here we are just below that cluster. This wood wasn't just 'dumped into the creek;' it was placed carefully with higher outside walls to contain a huge flow inside the channel with the inside pieces triangulated to wedge each other while breaking the flow into a very convoluted path. It isn't hard to see the sediment that it captured.

All those tiny sources of sediment add up to a lot that was once lost off the property every year. This photo was taken six years after my original 'logging job' in 2000. The sediment has almost completely filled a channel 6-8 feet wide and 2-4 feet deep. Note the circled structure “A” for reference from slide to slide.

This is the same channel three yeas later from a little wider view. Logging made the material to line the bed and collect the annual deposition. Logging thinned the slopes so that light could reach the canyon bottom to stimulate the vegetation. It's working, but more thinning is needed for the sedges to really take. More sediment will help too. Note "Tree 0" with the white arrow for location.



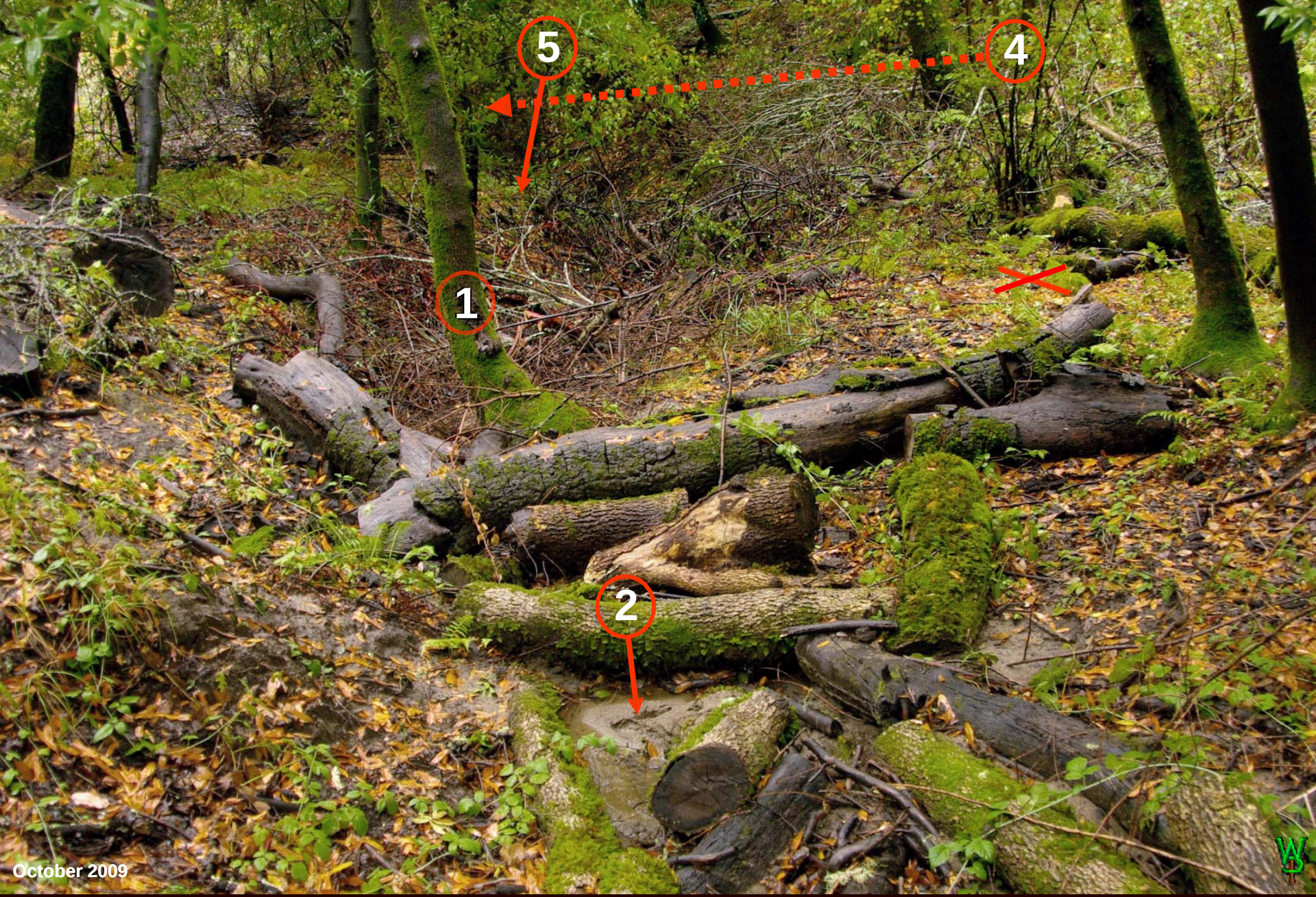
From above, L+6, same channel. This year, I thinned bay trees above the left background and put more wood into the stream along the dashed line down to the circled tree (1).

Here it is L+9 from a spot just to the right (new vegetation was in the way). Thinning the hillside on the left allowed in a lot more light. The stream bed is still filling in and more plants are taking root.

Besides the material filling this channel from all over the property, I also mine some of it from this older alluvial deposition. The pieces of wood you see chocked against the trees steer the flow across the pillow pile of sediment and into the stream. It's slow, but it works.

Here is where it enters the main channel from the left. Note the branches to slow it down and divert it downstream.

This is just downstream on the way to that (1) tree, immediately after that same 12” deluge in as many hours. The logs are chocked to cause the material to drop. When a section fills in, the water carries the sediment down to the next trap. From this storm, the additional buildup was a maximum of about 3” thick. The trees anchor the system but they also make it dark. I want to get the sedges going, so I thinned them a few years later on after this had time to settle and consolidate.



Same day looking downstream. Tree (1) on this photo is the same as that four slides prior. Note deposition beneath the log in the foreground (2). Just beyond the logs, the channel is 4+ feet deep and about 10 ft wide (about what it was when we started). The next photo was taken from the “X” with the camera at (4) looking over the mini-promontory below (5).

Below the property line, the channel now averages fifteen feet wide and 6-8 ft deep, with a secondary embankment two thirds of the way down upon which the tree (5) is sitting. The channel cross section stabilizes from there at about 20-30 ft wide and 10-15 ft deep. What you can't see is the pocket to the left that has probably lost about 60 cubic yards of soil. No thinning, no groundcovers. Without treatment, the incision here will only get worse and the banks will fall in and be carried away.

A valley oak (Q. lobata) had died of old age nearby and in falling took out an old madrone, so I cut up the logs, dropped a couple of bays, and added another layer in 2013. From here on, the material will be redwood if I can afford to thin some of the nearby trees. OK, so this was my way of doing things. Let's take a look at the product of the local competition.

Isn't erosion Natural? What if I had done nothing? That experiment is easy to find! Let's take a look at the "Natural recovery" of a nearby redwood grove. I did not have to go far looking for this mess in order to make people look bad; it's the first one I found down the road about a mile from our place.

The activists' goal is to ban all logging near seasonal streams 'to prevent release of silt and maintain shade to keep the water cooler for endangered coho salmon' (actually introduced). One has to wonder why shade matters so much where there is no summer water. None. The belief is that streams cause logs to fall into the channel and do things similar to what I did artificially on our place. The process is called, "recruitment."

The channel here is 30-40 feet wide and well over 20 feet deep. The culvert in this photo is 24" in diameter (a fairly small flow in these mountains). There is another channel up the road, that was abandoned when this culvert was put in, but it is not nearly so bad (this pipe looks to be about 30 years old). There hasn't been ANY logging here for at least fifty years.

It's shady here, so they've got their canopy cover. As a result, there is no green vegetation. See how the root masses on the left are undercut? That is what would have happened to my "wall of wood." As bank erosion causes the walls to collapse under the weight of the trees, they fall, with the logs hitting the opposite bank while still hanging from their roots. They are *bridging* the channel with the water running *underneath* the logs while the stream washes the now loose soil on the root mass away and the bed keeps cutting. So much for "recruitment."

This particular spot has unusually gentile average slopes around it for this area, so it is an ideal location for such a trial. Were it at the bottom of a steep canyon, there would be significant risk of undercutting the slopes above the channel, thus destabilizing the hillside into an eventual landslide. Despite the culvert modifying the flow, if this method worked, then the water would eventually slow down and the "Natural" method would start to take effect. Well, it doesn't.

This is about 100’ below the culvert outlet, looking downstream. Again, there are no effective groundcovers because it is way too dark. The logs bridge the channel so the stream is still down-cutting beneath them. **This stream bed was not here before the logging.** In fact, this flow was channeled away from a failed culvert into this one long after this area was logged and new trees were well established. This is “preservation,” “recruitment,” and “canopy protection” at its best. What you see is what you *will* get.

This drainage channel is only about 75 yards long. There isn't any part of it where "recruitment" or dark canopy are working. At right is the bottom of the channel at the lower County road, which effectively limits the cutting by making a hard bottom. Here you see a root wad spanning the bottom of the channel. If "recruitment" was going to work, you would see it here. It did not. The belief underlying the regulations that 'Nature can heal anything' is just as dumb as was fire suppression and for the same reason: Suppress fire and you get catastrophic fire; suppress logging to stop erosion and what you will get is catastrophic landslides into incised channels .

February 2004

There are other projects on our property designed to reverse or mitigate historic erosion problems.

First some background. In steep sand-”stone” mountains like these, reversing the damage from poor drainage control is a high priority. The slope up the hill had originally been cleared and terraced for said abandoned apple orchard. The resulting incision required repair, else the slope below our house would have been destabilized. The very expensive soils engineers the County required me to hire for our building permit missed the whole thing because it was buried under thick vegetation.

Drainage control projects like this are so expensive is that the “stakeholders” (bureaucrats, engineers, contractors, and suppliers) reached a “consensus” on permit specifications while ignoring regular public input. Hence, the usual homeowner response is to do nothing while the consequences grow, a mechanism that has wrecked havoc compared to timber harvests.

In this project, I collected surface water into the rock lined stream to preclude rilling in a manner similar to engineering designs over the last 100 years except that this slope was shaped like a watershed with benches mimicking lateral tributaries. It does require monitoring for damage from gophers and ground squirrels just as “natural” slopes also do.

The plastic was stapled to battens, rolled around them, and either screwed to timbers or to steel stakes. This tarp system has survived 50mph winds undamaged, a design that could allow work to be done in the dead of winter between deluges when the soil is damp enough for good compaction. So far, after ten years, there have has been no maintenance needed other than clearing the channel annually of tree branches and other plant debris.

In parts of this project I used the equivalent of a half-sack mix of cement in the soil to reinforce the structure to simulate the attributes of the parent rock and withstand tunneling by ground-squirrels without caving in. It is steep here. Interestingly, the grasses seem to prefer this cemented fill compared to the parent material.

2004

When digging one of these affairs, the process is somewhat iterative. Obviously I had surveyed the slope and laid out the future grade on the computer so that I would have the rate of fall worked out as I dug it. There is also the problem of staging the materials, both those that come out and those that go in. The goal is to have a mass balance between the two to minimize the need to either add or remove fill or rock while simultaneously reducing the need to move it any farther than is absolutely necessary.

2004

Needless to say, while one is lining one of these trenches with rock, the rock stacks going uphill. The substrate was covered with filter fabric to add a tension membrane to the structure. There were cross trenches every 10 feet with rock set in concrete as a means to preclude axial shifting and give the structure a bite into the compacted material. Setting the 5 X 10 granite is something of an art. Then the rock was sealed with sack concrete poured in dry and set with the hose.

One builds the rock liner from bottom-to-top, yet once I got close to the target, I started upward from a cross ditch near the inlet up to meet it and then met that cross ditch from the one immediately below it to assure a smooth transition. Yet at the same time, there is the risk that if it rains during the job, the water comes from the top down, from which there can be a enough of a flow to wipe out the entire job. The technology to manage the water is not terribly difficult, but the discipline required to assure that it is installed in time while simultaneously under the pressure to finish can be demanding, as there are details involved that make all the difference in its ruggedness that do take time to install. The plastic is stapled to the battens, which then are rolled and screwed to stakes. The hose is screwed to the outlet of a pipe collecting surface drains. Once the rock was done, I had to pack the remaining fill from the trench.

The slope was steeper than it looks. The small amount of extra fill I needed was brought down in buckets. Footing was treacherous.

The hand-tamping marks on the face are visible. I don't think I'll ever forget slamming that iron plate into it over and over. Day after day, wrestling that thumper out of the way and on top of the pile, starting it up and getting control on a tiny bench like that. This was one heck of a lot of work.

By the time the job was done, that yellow shovel was worn down to the point that the blade had a reversed curve where it had once been pointed. When it finally cracked, I retired it in honor.

Several years prior, I had attended the "Klamath Bucket Brigade" protest in support of the farmers of the Klamath Basin in their struggle to keep their land from the "green" activists pretending to save a bogus suckerfish listing (actually operating as witless agents for developers and banks). There, I had noted a collective memento**: shovels**, all donated by farmers and ranchers from around the West in support of a similar protest in Jarbridge, NV fighting a road closure. Some of those shovels had been a lot more worn than mine.

I realized at the time how much work it had taken to wear those shovels down that far. What I hadn't considered was what the attachment one develops to such a simple tool. You remember the projects that you did with it. Those shovels were princely gifts.

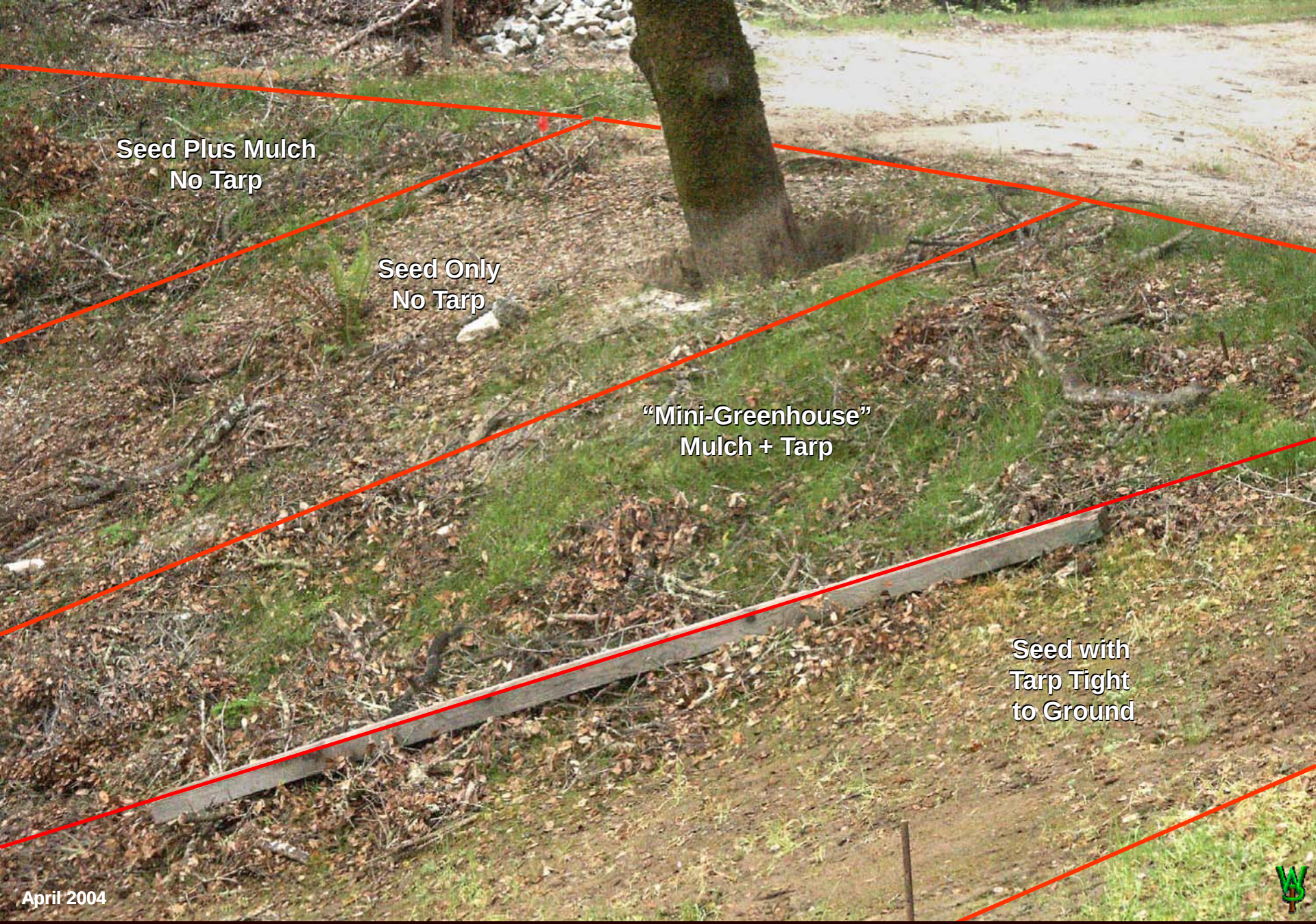
The vegetation on the far side is now native blackberry. So the primary maintenance is keeping it out of the channel so that it won't catch material.

I'll be burning that blackberry soon, and then up will likely come rip gut. Most people doing this sort of work don't have to care about that, but I must.

It is steep here. The arrows indicate the alternating benches to catch and redirect sheet wash to the channel. The plastic was not only to preclude rain impingement and sheet wash but was part of a multivariable revegetation experiment. Then it rained…

This is when one gets to do the final tweaking. It is very hard to predict how the flow will behave when it exits a pipe. So I waited before dry-setting the rock around the outlet until a storm came to know exactly where and how to adjust for splashing.
In this case it only took a couple of hours to reshape the surface.

The plastic was set either tight on the surface or held aloft by a “mulch” of chopped tree branches forming mini greenhouses to improve the establishment of the grasses. Segments were held with rolled battens screwed to 4 X 6 timbers staked to the surface. The sector in black faces south, so I thought it appropriate to kill a year’s worth of seed by solarization, especially as it had yet to be integrated to some re-grading of the road immediately above it.



As long as one doesn’t use too much mulch and there is enough moisture getting under the plastic to keep the grasses going, these tarp-houses at least **triple** grass growth.

You do not always get your choice of routes for runoff because of the history of how the land was used. In this case, there is a series of old benches of perched fills that once supported various out-buildings. This drainage is sized to handle the water off the entire upper north-half of the property. The slope below the road is so steep that if this much water were to go over the outside of those fills, there would be severe damage to the hillside. So I transit the flow above them on a low slope, this area serves as a catchment basin for sediment. About every 10 years, I dig it out; else the water would eventually dump down those erosive fill slopes.

2013 – still under construction

I built this upgrade to that channel to drop the water onto the lower road which acts as a secondary transit and sediment catchment area. The sediment I dug out was packed into what once was a rather ugly eroded hole once cut by water diverted around one of the old structures. The bridge is a way to get the sediment out of the basin on the prior page to a larger water-bar in a safe spot that assures the flow will head in the right direction. Each of these projects deals with history. They are expensive and time-consuming. "We" can either "leave it alone," to allow whole slopes eventually to fail and weep sediment for decades, or we can maintain it. Yet if the policy preference is to leave it alone, then the policy makers should admit that they don't really care about the sediment. Hypocrisy as a matter of policy, as we have today, is a 14th Amendment violation of equal protection.

On the left is a government job. On the right is what a landowners can do, if you let us. Had mine been a commercial job, it would have been a completely illegal modification of a “Natural” stream. Take your pick, the responsibility for the consequences are on you.

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