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?

Wildergarten 6.4

This book was originally produced under the name *The Responsible Party* for which there were two revisions, 1.0 & 2.0. Major revisions are for complete rewrites. Decimal revisions are for revised chapters or navigational changes and are not archived. Back revs are viewable by the numbered links below.

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Vande Pol, Mark Edward, 1954 –

Other writings by Mark Edward Vande Pol:

Natural Process: That Environmental Laws May Serve the Laws of Nature, ©Wildergarten Press, 2001, 454pp, ISBN: 0-9711793-0-1, LOC Control #2001092201.

Shemitta: For the Land is Mine: ©Wildergarten Press, 2009. Contains: 217pp text, 980pp overall, 14 picture books, 2 tables, 963 photographs, 9 maps, 2 drawings, 2 charts, 145 footnotes, 358 citations, and 216 other source references, not including external Internet links. ISBN 978-0-9711793-1-8

Articles at Wildergarten Press: collected writings on Constitutional history and regulatory racketeering by tax-exempt “charitable” foundations

Wildergarten Press
www.wildergarten.org

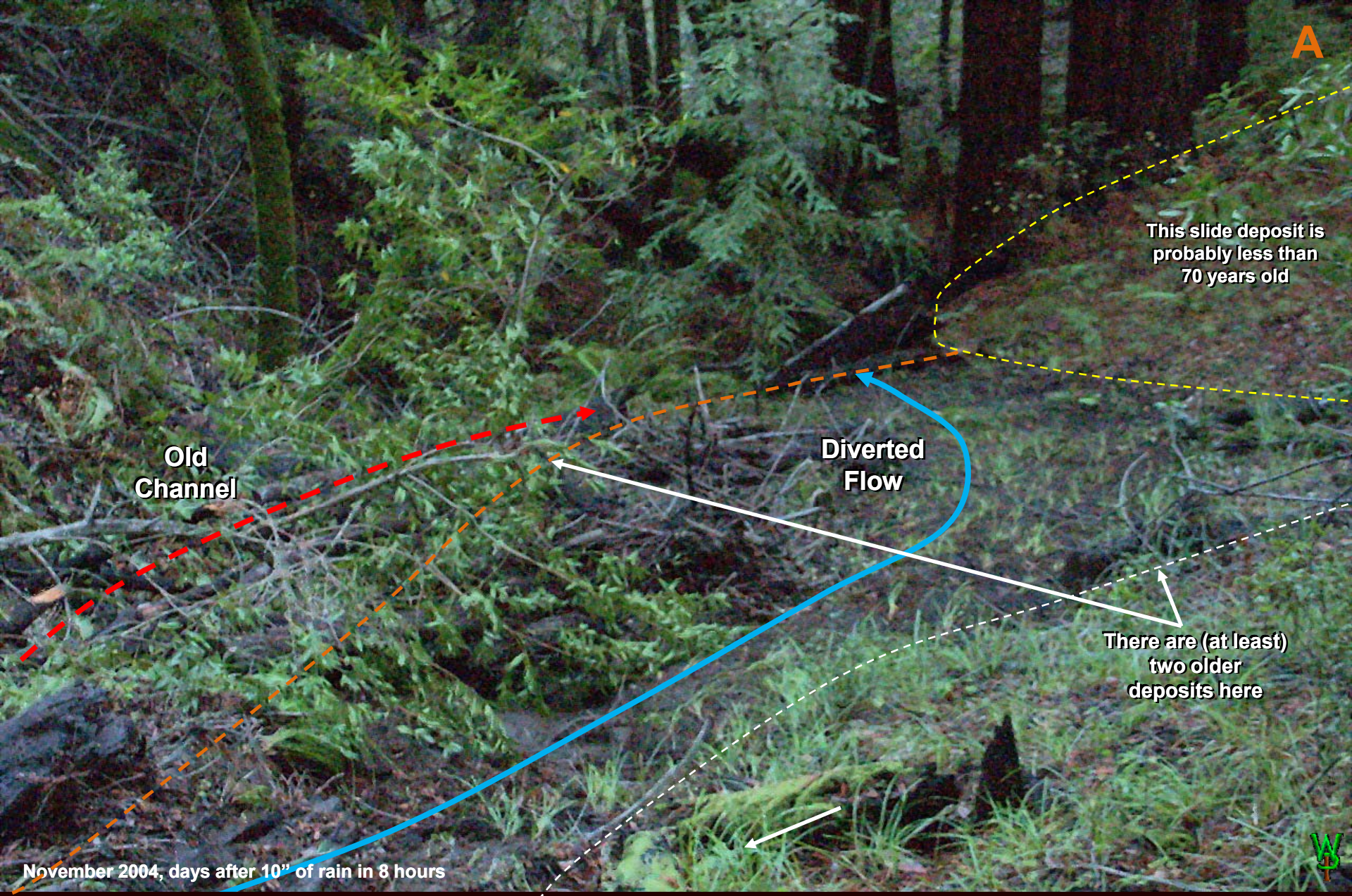
This is a map of all the roads, trails, and drainages on this property. Roads and the drainage features particular to them were covered in the previous chapter. This chapter is about what is done to manage specifically water pathways. Each orange letter on this and the other aerial images in this chapter corresponds to where they were taken on this property (some with an arrow indicating the direction). If you wish to keep track while reading, there is consisting of aerial photos and vegetative maps over time, which you can then keep open in another window as you read. My purpose in documenting them this carefully is for future repeat photos, as vegetation management, and particularly forestry is elemental to many of these drainage management challenges.

Here is a similar cluster of redwood trees just upstream seen from below. 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 learned how to reverse that incision process for reasons we’ll get to soon.

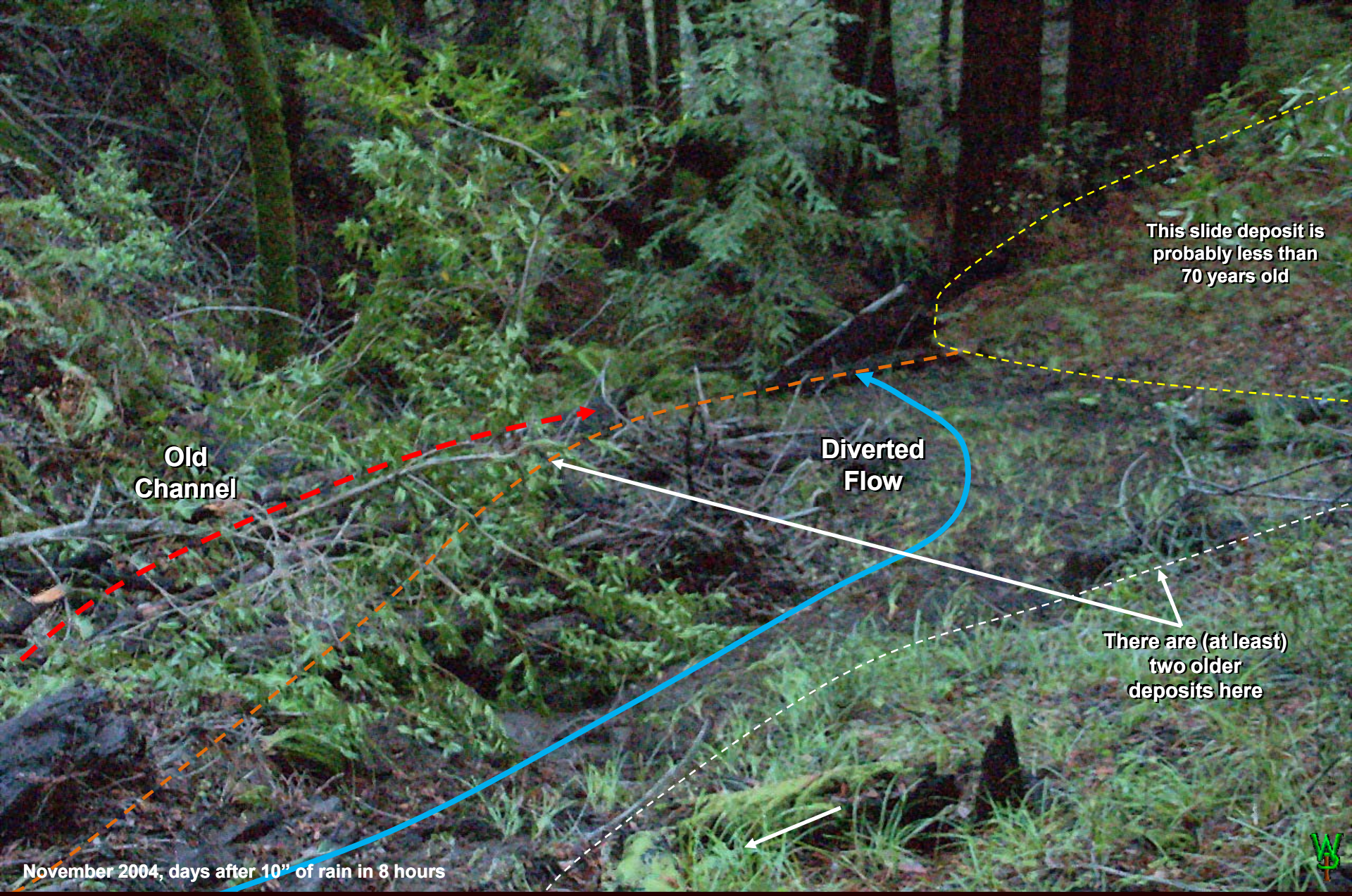
Looking down the channel from the same spot, it isn't hard to see another landslide deposit with trees on top at the lower left. At the top of the draw to the right is the Spanish Gulch, a rotational slope failure with a steep headwall with a second below the road, I suspect was created by vegetation falling into the Gulch. 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 120 years old. Unlike the next draw to the north (TBD), there are no large old stumps. This forest started after the area was first logged.

You may remember this image from the repeat photos in the Introduction. The first thing I did to impede incision in the channel to the right was to cut trees on 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, there may be such a thing as "too much."

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** that was bridging the stream 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 a backup). The combined flow of water, 10’ wide, boiled right over the Santa Barbara sedge with no damage at all. Ironically, when it happened, 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.

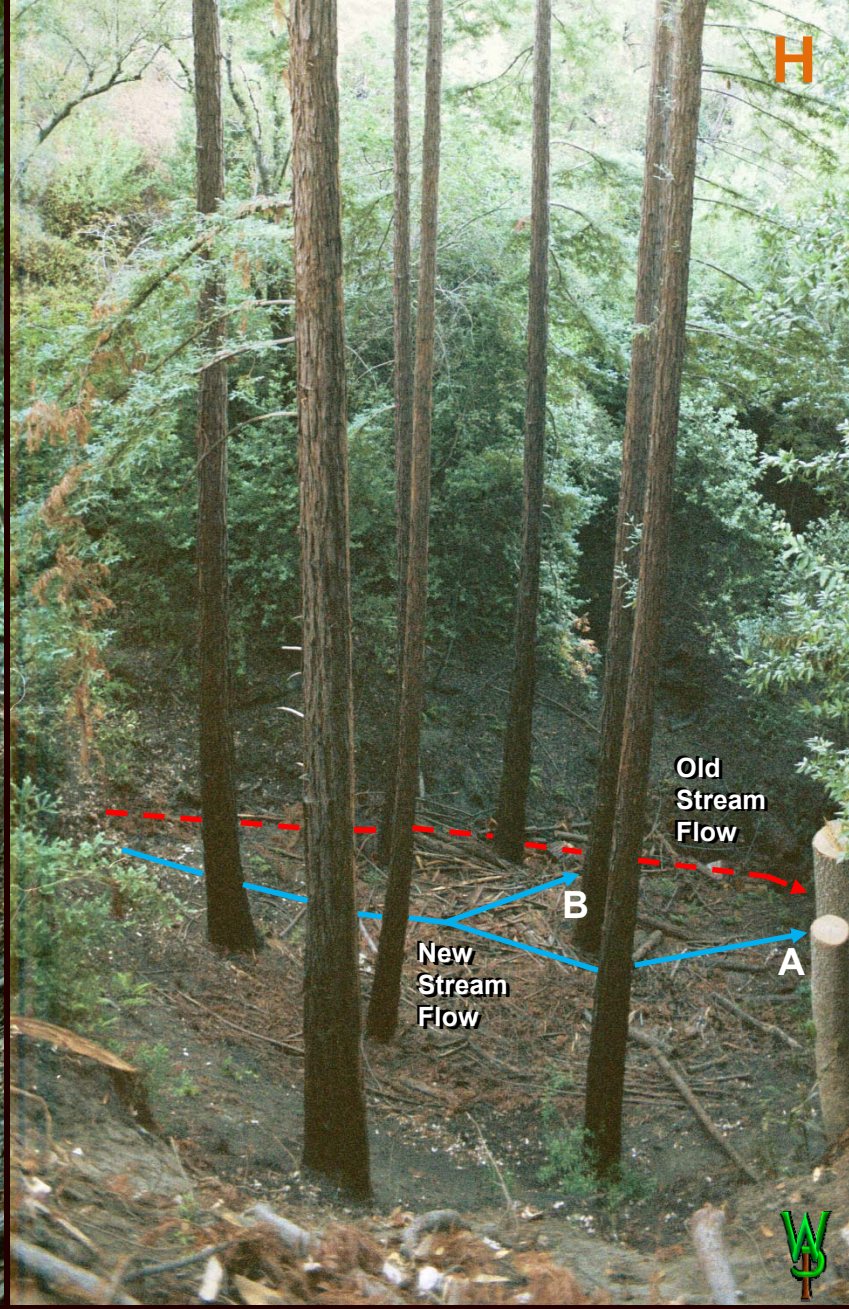
Let's go back to the center draw, starting with our now familiar logging job discussed under Conifer Forestry.

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 (2) capture sediment to *reverse* channel erosion. Otherwise the stream undermines 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 divert the water through the middle of the cluster 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. Flow “A” is a great deal lower in slope which thus 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.

November 1999

This is what the drainage just below that stand looked like before I began that logging job. I had already started removing small trees that would "get in the way" as well as cleaning up the forest in general. Up until that point, this draw was so dark that there was nothing alive on the ground. Not even ferns grew here.

Here you see that I had committed the unpardonable atrocity of tossing all of the extra wood and leafy matter into this seasonal stream. This material is a filter medium to capture sediment, to which I will add material to direct the surface flow. Literally, on a commercial job, an act like this of mine would get the licensed timber operator a tax, er, "fine" of some $25-50,000, with the addition of possible jail time for a misdemeanor. The EPA today wants to declare this kind of stream "waters of the United States." If they win, the fines will get bigger.

As I detail in my 2001 book, *Natural Process*, this bureaucratic hammer has actually worsened conditions for the fish it is supposed to protect in that the bureaucrats removed "large woody debris" from streams and it caused the spawning fish they were supposedly trying to save to tire and their newborn smolts to be washed downstream for lack of refuge from storm-wash. The policy also caused streambeds to incise, thus destabilizing whole slopes. All in the name of "preventing sediment in streams."

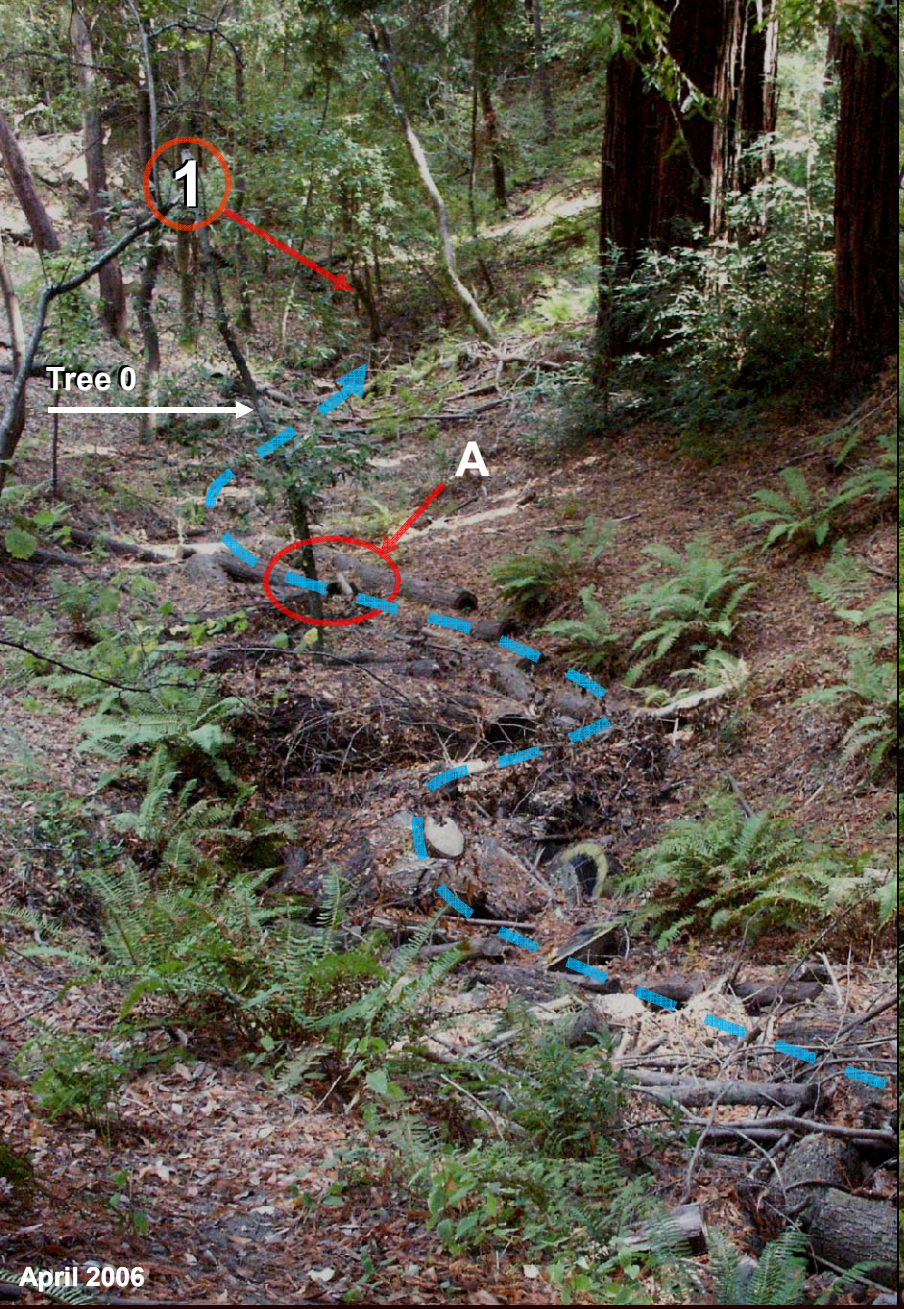
This process captures sediment, stabilizes slopes, and reverses channel incision, not to mention that the forest thinning does remarkable things for the vegetation that feeds the bugs that feed the fish downstream. You will also see how the "streambed protection" process advocated by the environmental activists has actually made these conditions significantly worse. Meanwhile, the bureaucrats are actually forcing timber operators to place large woody debris *back* into the same streams from which the bureaucrats had removed it previously, under permit of course.

Yes, it is that illogical, and you pay for it in every stick of lumber that goes into every house built today, with interest.

This wood was placed on top of what you just saw. As you can see, it 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, but where and how did it originate?

Gophers, ground-squirrels, me tromping around… 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 in the coming slides.

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" (the white arrow) as a reference location.



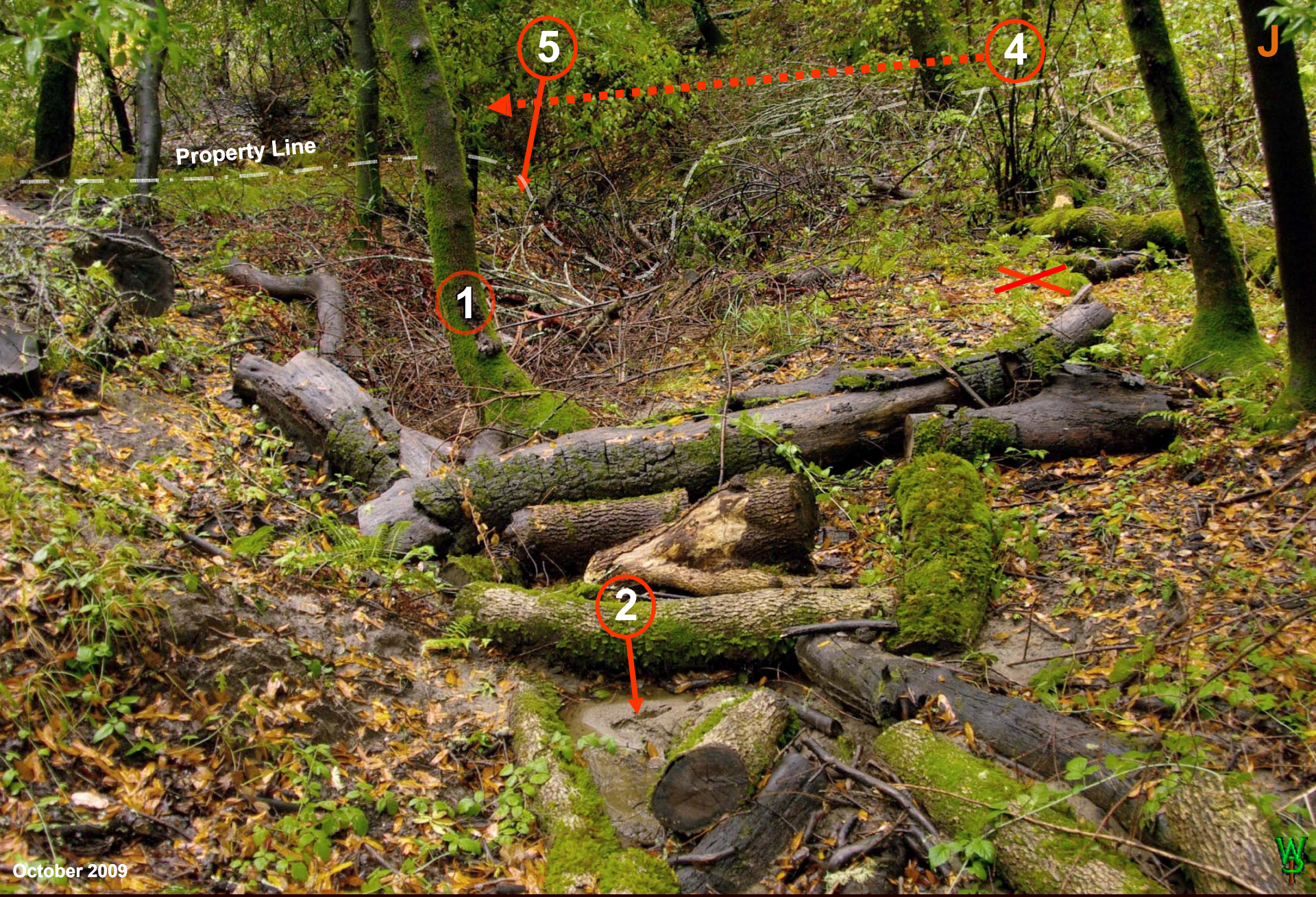
Repeating the series from the end, I had thinned more bay trees above the left background and put *more* wood into the stream between “Tree 0” and the circled tree (1).

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.

This is just downstream on the way to that (1) tree, immediately after that same 12” deluge in as many hours. Besides the material filling this channel from all over the property, I also “mine” more from this alluvial fan of old stream 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.

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 massive storm, the additional buildup was 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. Without treatment, the incision here will only get worse, the banks will eventually fall in, and be carried away. No thinning, no groundcovers, lost soil, in that order.

With regard to our groundcover, this is that same alluvial fan a few years later from below.

Note the logs on the upper right. I thinned this opposite side of the draw last fall. Yes, the cover is 100% native and weeded every year. Note also how dark it gets on the left. That is the property line (white).

I wanted more hazelnuts for wildlife and fewer bay trees on the south side. That means more food, deciduous cover, and less fuel.

A nearby valley oak (Q. lobata) had died of old age 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 when I thin some nearby trees to side the house.

But first I'll need the necessary filter media! This represents about as much as I can use for now. We have some large older bay trees with signs of Gannoderma in their trunks that will probably die in the near future, so I'll burn the tops and use the trunks to divert surface water, although bay decomposes quickly. When I do, I will use those piles as a continuing diagnostic for what might be in the seed bank. I have plenty of decent young trees... now. So, does this really work better than what the anti-logging activists want?

What if I had done nothing? That experiment is EASY to find! Let's take a look at a "Natural " stream bed in a nearby redwood grove. I did not have to go far to find this; it's only the fourth drainage down the road. This stream bed was not here before the original logging; the flow was channeled away from a failed culvert just up the road and into this one long after this area was logged and new trees were well established. This 24" pipe is about 30 years old, a fairly small flow in these mountains. There hasn't been ANY logging here for at least 50 years. Additionally, this particular drainage has unusually gentile average slopes for this area making the risk of bank failure fairly low. So this is as advantageous a location for such a trial as one could find.

The activists' forced a ban on all logging near seasonal streams 'to (1) prevent release of silt and (2) maintain shade to keep the water cooler for endangered coho salmon' (actually introduced). As to silt, the belief is that the streams will cause the logs to fall into the channel and do things similar to what I did artificially on our place. The process is called, "recruitment." As to water temperature, one has to wonder why shade matters so much where there is no summer water.

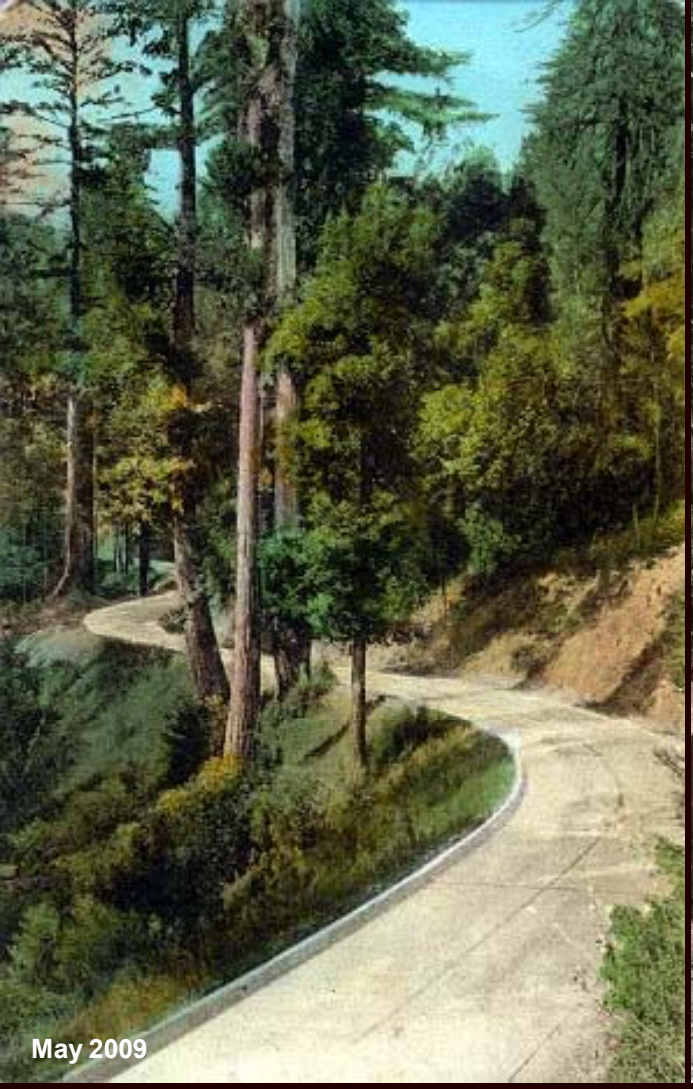
It's shady here, to the point that there are no groundcovers at all . See how the root masses on the left are undercut? As bank erosion causes the banks to collapse under the weight of the trees, they fall, just as planned. So, what happens? The logs hit the opposite bank while still hanging from the roots *bridging* the channel. The stream keeps washing the now loose soil on the root mass away and the bed keeps cutting! The channel here is 30-40 feet wide and well over 20 feet deep. This is what would have happened to my "wall of wood."

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. If this channel had run down the side of a steep canyon, there would be significant risk of undercutting the slopes above thus destabilizing the hillside into an eventual landslide!

This is about 100' below the culvert outlet, looking downstream. We have "recruitment," yet the incision is still getting worse! There are no effective groundcovers because it is way too dark. The logs bridge the channel so the stream is still cutting beneath them. This is "preservation," "recruitment," and "canopy protection" at its best. What you see is what you *will* get in a situation like this.

This 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.

Channel incision gets ever more problematic with scale. This is Bean Creek. The drainage discussed during the last few pages empties directly into this channel not far downstream from here. Within 50 yards of this spot, there are **eight** logs like these bridging this creek. Some end at the edge of the County road just begging some kid to walk atop the log across the creek 20 feet below. As you can see, there is some wood in the creek reducing the scouring and channel incision, but they went in back in the old days when people used to cut them up. But is channel incision a problem here too? You bet, both a destructive and an expensive one too.



At left is a 1922 postcard image of the newly paved Glenwood Highway along Bean Creek. Note the slope of the outer embankment in the postcard image (and the concrete curb protecting it). Note the oak trees and how few and small are the conifer trees, nor are there stumps. This area is almost entirely conifer forest now, fitting the hypothesis in the site history chapter that there were not as many "old growth" trees here as commonly believed. At right is an image of Glenwood Drive about a half mile upstream. Note the log bridging the channel. On this section of the road, one would swear that the outer embankment now consists of half to two-thirds retaining walls. Why? Channel incision. It appears that the channel bottom has eroded some six feet, thus destabilizing support for the road above. So it's not like what I'm talking about has little economic consequence what with the road, many houses, and even a State highway up the slope above. Yes, there are risks to wood in the creek being gathered into a debris flow during a flood. But doesn't that beat mining gabion rock? Yes, there are risks if there is no wood in there. Managing risks is what people can learn to do.

This is another case on our property where I reversed stream channel incision. As you will learn in the chapter on roads, the County reversed the original grade for Charlie McKiernan's Road to reduce very serious channel incision to the southeast that was undermining the road. The new design captured all the water off the ridge into a culvert at the head of this channel. The thought at the time was that the best place to have the water run is a "Natural" drainage channel pursuant to the insane belief that Nature is stable. As a result, this channel now receives far more runoff than originally because in addition to the road collecting the runoff, all the developed "hardscape" from the house up the hill no longer absorbs any rainfall. When we started this project, the culvert had rotted out taking out the roadside embankment, and this channel was opening into a trench four feet deep (arrow in about the middle of this image). But the situation was worse than that. Note the hump of alluvial deposition in the middle of this photo. The culvert had plugged and/or failed and washed out the embankment on this side of the road. That embankment was the source of the hump.

Adding to the collection area, behind the fence (blue line) there is a curb at the lower edge of the driveway to protect the embankment on which it is sitting, now undermined by County ditch cleaning. The driveway, curb, and the road collect and shed nearly an acre of rainwater runoff concentrated here at the corner, more than double what comes off the ridge. The grade of the road once tilted to the left, channeling the water to the culvert. When the culvert plugged, the water went down the embankment on the right and washed the soil away. I know, you see soil here. I fixed it.

I cleared the vegetation (the tree went down that day) and scraped off the organic layer. The County dumped in ditch cleanings as fill (it doesn't get much easier). I had it packed and shaped with an excavator. I rocked in the old culvert ditch on the opposite side and the County paved it next time they came in with a patch crew, making the road wide enough that cars can now pass each other at the corner. I got free fill dirt to repair the damage the culvert had done; they saved money on trucking dirt and the job reinforced the road's stability. Everybody wins… except the engineers, contractors, and inspectors who usually make such projects unaffordable.

To accommodate the water, I built this drainage channel/stairway with recycled slab concrete. The bottom has a domed surface to dissipate the flow into a wall with two side outlets. This allows me to alternate the outlet path with a log placed such the it deflects the flow. I sowed the slope with hand-collected native grass seed. But I needed one more thing to complete the revegetation to hold the seed. I needed mulch and I could not import straw because it would contaminate the area with new weeds. Little did I know.

I transplanted our friend Santa Barbara sedge *(Carex barbarae*) at the drain outlet to dissipate the energy. Below it, wood steers the separated flows to minimize incision. Below that is another tough riparian plant, wire grass *(Juncus patens* - not really a grass but a rush*)*. The functional difference between the rush and the sedge is that the wire grass is better at collecting sediment but does not lay down flat under runoff like the sedge does. Wire grass also grows in clumps, not making as continuous a surface as the sedge. I hope to have a lot more coverage in this drainage now that I thinned it this year, with more to come (I'll probably get rid of the coyote brush). The channel that once ran down the middle of this drainage below was then three to four feet deep. I chocked that with wood and filled it. So with rot and compaction I may yet need to bring in a little more fill and transplant more sedges. Yes, I did all this work to deal with a runoff problem caused by my neighbor and the County long ago. It's cheaper than fighting over it.

On this County road, culverts like this one are not at all exceptional.

October 2002

This photo was taken where I cut the pipe toward the *deep* end of the culvert

I can hear it now… 'We just can't have people fixing old unstable public roads on their own. We pay taxes to have it fixed by professionals.' Well there's a little problem with that. It costs too much for what you get, as said professionals have a rather well-established record of making those few jobs they do anymore cost a bundle. Consider**:** In what was likely a craven act of political corruption to please said contractors, quarries, bureaucrats, and engineers (you know, the "stakeholders" in roads (as if drivers didn't have one), the County now requires 6" of Class II base-rock and 2" of asphalt for private driveways used almost exclusively by automobiles and light trucks. They require turning space on said driveway for a hook and ladder fire truck that couldn't make it up the County road to said driveway even if they had one to douse a fire in a house in an area where it is illegal to build one higher than two stories! They want 12 inches of rock on timber haul roads used only in summer every 10-15 years! They require that culverts be buried at least 12" below the base grade (before adding the base-rock). Now, look at the above photographs. This was the County culvert this "amateur land-hobbyist" replaced AT MOST 10 inches below grade, with less than 1 inch of oil and screens on bare dirt with heavy trucks driving it daily. That culvert and surface survived for over 40 years with a couple of oil and screen jobs in between. Yes, it needed replacing, but guess why that doesn't happen? The County bureaucrats are prisoners of their own game. It gets worse.

Enter the State of California! County culverts are now permitted by the State Department of Fish and Wildlife as point sources of silt pollution to "protect" fraudulently-listed endangered fish from silt suffocating their eggs and clogging the gills of the young. After all, if homeowners can't be trusted to fix a pipe, then neither can the County. "We" (bureaucrats and their activist backers) need real experts to design culverts for each of the tens of thousands of wildly variable local conditions. As a result, plan review and permitting to fix a rotting culvert can now take four years, all to make sure it is sized correctly, has a proper outlet for energy dissipation, etc., in other words, stuff just about everybody who works on culverts already knows to do but surely can't afford with the overhead of all the bureaucracy. What you'll get is a huge plastic pipe that will fail in the first fire. The obvious problem is that the cost of all this expertise is so high that culverts don't get fixed before they fail, a process shown above that usually offers many years of advance notice. At left the water is coming out of the bottom of the pipe because it corroded through and opened a slot at each corrugation. As the webs fail and form a lengthwise slot (left, previous page), what you get is at right, with the soil washing away around the flow. The ditch works its way back to the road. When the pipe breaks, typically the entire embankment incises and fails, taking the road with it.
The fish then suffer MORE silt these rules and regulations were supposed to prevent

Worse yet, DFW specifies use of plastic pipe for culverts, which WILL burn out in a fire. The correct alternative to plastic culverts is to insert a plastic liner into the old galvanized steel pipe as a protective sleeve. Above is Snap-Tite®. It requires no excavation or paving. Simply slide the plastic liner into the rotted steel culvert and seal the inlet with grout (extensions snap together as shown above). If needed, the cavity under the old pipe can be filled with a sand slurry or grout. If desired, a new protective steel outlet sleeve can be installed, hopefully with energy dissipation to slow the water coming out and impacting soil. With a coating of a light-weight gunnite or stucco , the plastic liner pipe is protected until the fire has passed. It beats digging out the old pipe and installing one that will burn.

With the 200% normal rainfall over the winter of 2016-17, the “authorities” deemed it to be a natural disaster. Of the five major failures along the road in 2017, three were caused by failed culverts with the other two by top-heavy leaning trees that fell and took the embankment with them. It’s all so predictable that to call this a “natural disaster” while erecting ever more tangled barriers to fixing these problems is to betray only the “nature” of bureaucratic management. Yes, the roads were badly designed and constructed. Yes, these mountains are geologically unstable and erosive. With a history and baseline conditions like these there will be failures. Yet there is no excuse for failures of this magnitude and frequency. Moreover, these results pale in comparison to what would have happened if there had been a major earthquake in any winter, a standard for which any responsible government would be preparing.

February 2004

The following are projects on our property designed to reverse or mitigate historic channel incision problems.

First some background. In steep sand-"stone" mountains like these, reversing the damage from poor drainage control is a huge job. 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 County required me to hire soils engineers our building permit . They missed the whole thing because the incised channel this project repaired was buried under thick vegetation.

Drainage control projects like this are so expensive because the "stakeholders" (bureaucrats, engineers, contractors, and suppliers) reached a "consensus" on permit specifications without 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 meandering stream, with benches mimicking lateral tributaries. It does require monitoring for damage from gophers and ground squirrels just as "natural" slopes also do.

During construction, 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 13 years, there 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. Interestingly, the grasses seem to prefer this cemented fill compared to the parent material. In the background is a temporary energy dissipater from a small culvert made of plastic wrapped around the pipe several times at the top end. Works great.

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 either to 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. This slope is steeper than it looks. The small amount of extra fill I needed was brought down in buckets. Footing was treacherous. The hand-tamping marks to tighten the surface 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 against a Forest Service road closure in Jarbridge, NV. 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.

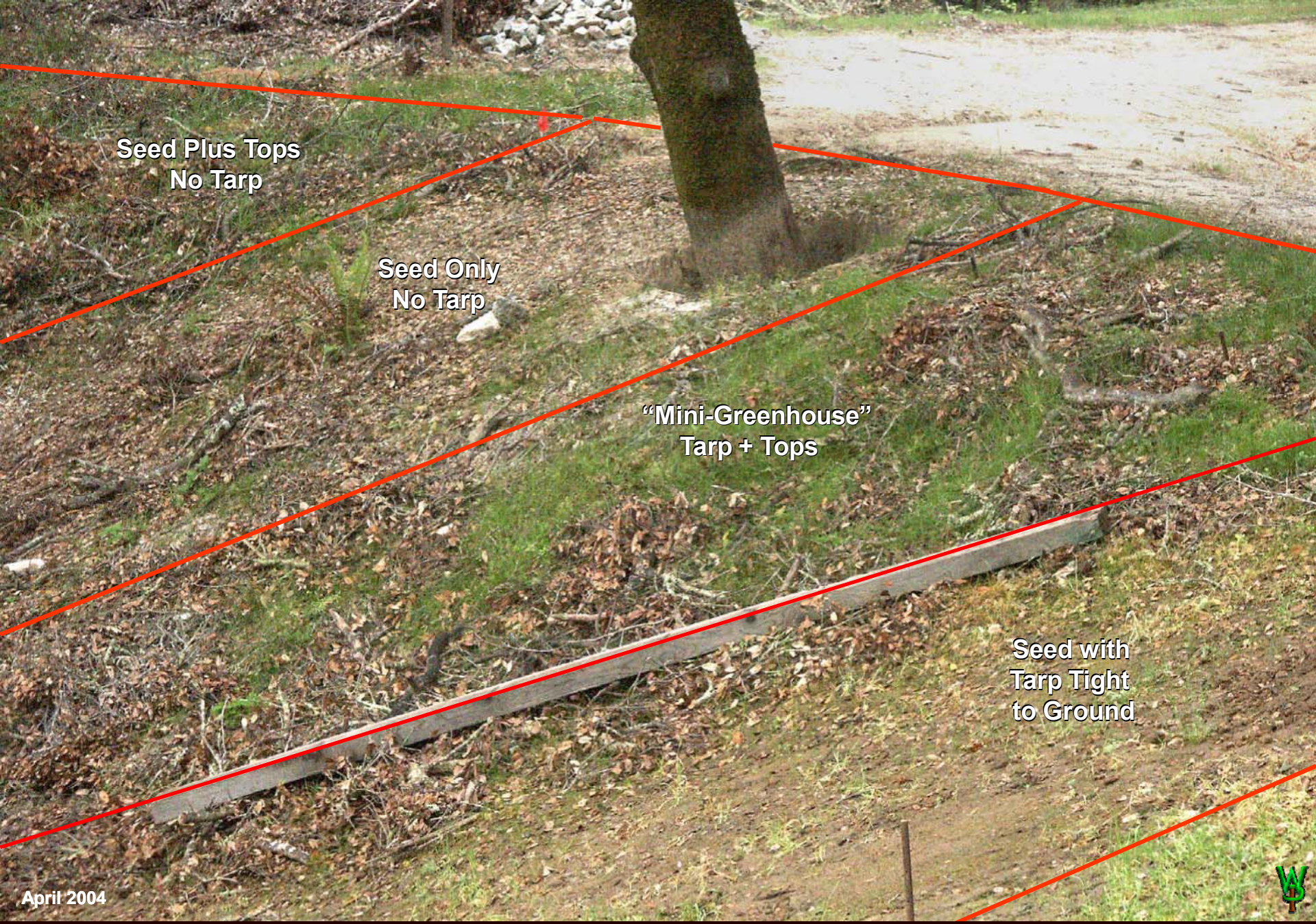
The vegetation on the far side is now native blackberry. So the primary maintenance is keeping it out of the channel so that it won't catch material.

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

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 it 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 and enters the trench. 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 instance it 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 a "mini greenhouse" 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 with a road below them traversing the top edge of a steep slope, 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 from three acres on a low grade along the top of the benches, where this spot 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.

Two years later, the captured sediment is now populated with native sand hill species, primarily *Navarretia atractyloides*. Considering that this is a recently disturbed soil in a settlement area with three acres of runoff contaminated with whatever seed is upstream (it runs below our sand hill area), this is a VERY clean result. In years past, this was an area I would often write off as too populated with exotics to bother weeding at all and just spray it. So this is a very good sign that weed control upstream is working.

May – 2017 Yerba Buena on the left, California Fescue on the right

This outlet from that channel drops the water onto the road below which acts as a second transit and sediment catchment area. The bridge is a way to wheel the sediment out of the basin on the prior page to where the fill serves useful purposes. First, it was packed into what was a rather ugly eroded hole once cut by water diverted around one an old cabin that burned down in 1979. Later on, it will be to give the water bar to the right a more gentle slope. The final drop to the bottom of the property comes next, but it is so steep that it will constructed as stairs and thus double as a trail. Each of these projects deals with history. They are expensive and time-consuming. "We" can either "leave it alone" and allow whole slopes to fail and weep sediment for decades, or we can fix old problems and 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 erosion and sediment, because the resulting larger failures will keep them in power while destroying the wealth needed to fix it.

This was another one of those “things you learn along the way.” Every year, just before it rains, I clean almost four truckloads of leaves out of the drain channel along the driveway. Rather than import non-native straw for my reseeding project, I use that oak leaf litter as a protective mulch for the seed to keep the surface moist and reduce erosion due to rain impingement. Well, it worked for that, but it also brought me a crop of exotic large seeded rattlesnake grass *(Briza maxima*) a patch of which had been not far uphill from the top of the driveway. I learned right there that the old maxim about ‘what goes downhill’ applied to seed too. I’ve since prioritized my native grass reestablishment projects from the top-down in the same manner. Since then, the leaves have been clean.

Modifying our drainage measures for fire is not just good disaster planning; it aids both slope stabilization and weed control. This is the outlet to the main storm drain from our house roof gutters and parking area that empties into the rock lined drainage discussed above. The outlet extends from the concrete to hold an elbow intended to dissipate the energy and direction of that flow as it joins the main channel. Above it is Santa Barbara Sedge, an important plant here for managing rainwater runoff and stabilizing slopes. Burning sedge every 2 years keeps it fresh and dense as well as discourages invading poison oak or blackberry. Unfortunately, there are pipes, usually made of various plastics like this polyethylene, which melts and burns like wax. Obviously, one could remove the pipe before burning, but there's this 'little problem' where it comes out of the ground, or even worse, from out from a concrete headwall.

I have devised two means to manage this type of problem. This 3-inch “triple wall” polyethylene line is protected with an air-insulating sleeve of “**snap duct**” with the pipe suspended inside by two **PVC DWV 4”X3” reducers** with the end stops inside ground out so that the pipe slip go all the way through. One end of the assembly is buried a few inches deep; the other is exposed for easy removal of the surface pipe outside the fence. The reducers fit well enough to keep the inside air chamber from becoming a nesting site for yellow jackets. Being light galvanized pipe, it’s probably good for at most 10 years. The galvanized tube can be upgraded to a section of 4” stainless flue pipe, which fits the DWV bushings perfectly, but one is limited to a single 4’ length of the stainless pipe. We will see if the polyethylene survives the radiant heat from the steel. If it doesn’t, I’ll try ABS and stainless which is thicker and has poor conductivity.

November 2023 – There is 2/3 of a yard of concrete in this with reinforcing steel to form the back wall

We found this old sink when we first moved here in 1990. It now dissipates energy from the pipe inlet. The sink is also fed by the overflow from the patio pond such that wildlife will be able to stop by for a drink! Where the pipe emerges from concrete, the 4” ABS plastic feed line behind the wall is buried, feeding into a **stainless flue pipe** embedded in the concrete. The mating ABS elbow in the soil behind the wall has a seal to the stainless comprised by first greasing the female ABS fitting with silicone stopcock grease, and coating the end of the flue pipe with silicone RTV caulking, making a sort of O-ring that can accommodate soil movement. The goal of such a fancy seal is to inhibit root intrusion by the sedges.

On the left is a government ‘recruitment project.’ On the right is what landowners can do, if you let us. Had this been a commercial job, it would have been a wildly illegal modification of a “Natural” stream with permit costs (or penalties) pushing $50,000. To what benefit? You are paying a bundle for this stupidity. Take your pick, please?

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