Technical Memorandum

March 4, 2013

Review of Study: Inspection of Sierra Pacific Industries' Ponderosa Post-Fire Sediment Study, Shasta County, California

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The Ponderosa fire burned a significant portion of the Battle Creek watershed including portions owned and logged by Sierra Pacific Industries (SPI). Between November 28 and December 2, 2012, the area received a rain that had been forecast to be as much as 20 inches. One analysis suggested that the December 2 flow on Battle Creek at the Coleman gage had 5-year return interval[1] which would indicate the storm was substantial. Another observation was that the Shingletown rain gage received 5 inches in a 3-hour period. Prior to the storm, SPI had installed sediment fences on ten swales draining small watersheds that had received four different types of treatment: (1) control, (2) logged and standard salvage, (3) logged and clearcut, and (4) logged, standard salvage, and contour ripping. The Central Valley Regional Water Control Board released a site inspection report[2] that suggests that unlogged control sites produced more sediment from the rainstorm than did other sites with various logging and stripping treatments. This technical memorandum reviews the subject inspection report and discusses its preliminary conclusions.

The pictures and estimated sediment amounts in each of the swales suggest that more sediment was deposited behind the fences on the control sites than on the sites that had received the logging treatments. If the sites were comparable it could be evidence that the logging treatments had actually reduced sediment reaching the fences, but the sites may not be comparable for the following reasons.

- The assumption that all of the sites are burned equally may be inaccurate and a source of error in the interpretation, due to the usual patchiness of fire. If the control sites contain more burned area, they would produce more sediment.

[1] Email from Don Lindsay, CGS, to Pete Cafferata, 12/14/12, Re: Return interval estimate for the Ponderosa fire.
[2] Memorandum from Drew Coe to Angela K. Wilson, Central Valley Regional Water Quality Control Board. Subject: Inspection of Sierra Pacific Industries' Ponderosa Post-Fire Sediment Study, Shasta County California. Hereinafter referred to as the inspection report.

- Control sites may not be appropriate as controls because they are too dissimilar to the treated sites. They are steeper (10-15% more than the treated sites) and more convergent and have a different aspect[3]. The inspection report acknowledges these differences. Figure 3 in the inspection report shows a slope that appears much steeper than 15%. The tree coverage on the control sites is not dense; the trees look small and not dense. All of these factors could lead to more runoff and erosion.
- Steeper swales have more stream power to erode the soils. Typically, there will be a threshold below which little erosion occurs. Once the stream power increases or the threshold decreases beyond a certain point, erosion becomes much more likely. Steepness could increase the power of the runoff to move sediment. Less runoff could generate more sediment due to the steepness.
- The inspection report also fails to provide the area draining to a specific location. Unless the controls have approximately the same drainage area as the drainages receiving a treatment, the controls could have more erosion simply because they have more runoff.
- The inspection report does not describe the site selection process. Typically, there would be a randomized selection of sites and treatments. The sites should have been chosen to be adequately similar based on geology, slope, aspect, area, and elevation to be certain that the study sites are all drawn from the same population.

Setting aside the statistical suitability of the study sites, a question to be resolved is whether the 10 to 15% additional slope in the control sites could have caused sediment movement at rates an order of magnitude higher than in swales that were treated. Photos of the treated sites (inspection report Figures 15, 17, 19, 20, 22, and 23), except for clearcutting, show very little difference in the canopy coverage of the drainage. There simply may have been little difference in the rainfall intensity reaching the ground, which means the overland flow would be relatively the same. If this is correct, the steeper slope on the control sites could be the primary cause of additional runoff.

The clearcut site #4 has almost no ground cover. Because it received almost no treatment to minimize erosion, it essentially proves that characteristics of the control site and clearcut site differs substantially enough to cause this additional erosion.

Well-constructed contour ripping or furrowing may capture some sediment. That appears to be observed in inspection report Figure 16; Figure 23, contour ripping above site #5, does not show much sediment capture. If the amount of runoff or sediment in the runoff does not overwhelm the furrows, they may capture some of the overland flow sediment. They cannot be a long-term treatment because they will fill with sediment rendering them useless.

[3] Email from Drew Coe to Joe Croteau, Stacy Stanish, 12/9/12, Update on experimental swales. Also in the inspection report, page 2.

Additionally, just after logging, the soil furrowing and ripping may cause areas to have a higher infiltration rate than existed pre-logging. This increased infiltration does not last long into the future due to rain splatter and wetting/drying cycles. This was the first significant rain after logging so the soil was receptive to infiltration. The logging occurred after the fire any hydrophobic tendencies of the soil due to fire would have been removed.

Regarding the furrowing, a geologist working for the California Geological Survey wrote: "I suspect the increased ground disturbance is breaking up the hydrology, reducing the erosive power (kinetic energy), and promoting infiltration/sedimentation compared to the control basin, but I would never have thought to that degree".[4] He may have been correct for some sites, but as noted it will not last forever. Studies have found that the most erosion from logged sites may occur up to 15 years after logging because it takes that long for the root network to decay and actually allow more erosion to occur[5].

In conclusion, the inspection report and the study it reports on proves nothing. The study design is inadequate because the control sites are too steep, not comparable to the sites that received a logging treatment. The inspection report does not provide sufficient data with which to assess their comparability, such as drainage area or canopy density. The storm being considered occurred soon after the logging prior to most organic matter in the soil breaking down. The furrowing and even logging may have broken the surface and allowed more infiltration in the same way that hoeing allows infiltration in the garden. To be representative, the sites and treatment must be randomly selected from a set of drainages that pre-treatment shared a similar set of requirements including slope, area, aspect, and elevation.

[4] Email from Don Lindsay, CGS, to Drew Coe, 12/4/12, Re: Update on experimental swales.
[5] Klein, R.D., et al. 2011. Logging and turbidity in the coastal watersheds of northern California, Geomorphology, doi:10.1016/j.geomorph.2011.10.011