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UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF CALIFORNIA

ENVIRONMENTAL PROTECTION INFORMATION CENTER, et al, Plaintiffs, v. ANDREA TUTTLE, et al, Defendants.	Case No: 00-0713-SC DECLARATION OF ROBERT R. CURRY IN SUPPORT OF MOTION FOR PRELIMINARY INJUNCTION

I, Dr. Robert R. Curry, do hereby declare as follows:

1. I am a geologist, hydrologist, geomorphologist, professor, and research scientist.

2. I have a Ph.D in Geomorphology & Paleoclimatology from the University of California at Berkeley, Department of Geology and Geophysics. My pre-doctoral science work consists of an M.S. in

Geology from the University of Colorado at Boulder, an M.S. in Plant Ecology from the University of Colorado at Boulder, and a B.A. in Geology from University of Colorado at Boulder. My Curriculum Vitae is attached as Exhibit A.

3. I am a Registered California Geologist. My field of specialization is fluvial geomorphology and sediment transport - the development of watershed systems through geologic time and the balancing of erosion with stream functions. I have published extensively on this subject over the past 35 years. I also have taught and conducted research in the following related subjects: Geologic Hazards, Wetlands and Stream Restoration, Watershed Systems, Mined-land reclamation, Environmental Geology, Soil Erosion and Formation, Climatology, Water Quality Protection, Water and Energy Policy, Sierra Nevada Natural History, and Water Resources Conservation.

4. I have over 40 years of University level teaching experience in Watershed Science and am currently a Research Professor at the University of California Santa Cruz. I am also Research Director of the California State University Watershed Institute, which is affiliated with the Earth Systems Science program at California State University Monterey Bay. There, I teach undergraduate courses in hydrology, geology, watershed restoration, soil science, and water resources.

5. Since 1966, I have published 22 books and monographs in geology, natural history, and wetland and stream ecology. I have also published 60 journal papers and book chapters in my areas of expertise. I have authored over 50 professional reports for committees of Congress, federal and state resource management

agencies, private businesses, and landowners. My CV and publications list are attached as Exhibit A.

6. I am a member of several educational and scholarly associations. I am an elected fellow of the Geological Society of America and sustaining long-time member of the Ecological Society of America, Society for Ecological Restoration, American Geomorphological Field Group, American Geophysical Union, Society for Soil and Water Conservation, and others. I am past president of the Society for Ecological Restoration in California

7. I have had extensive professional experience in the Headwaters Forest area and the Redwood Creek watershed, as well as National Forests in northern California. I helped revise the California Forest Practices Act for the California Legislature in 1964 through 1966, authoring the sections on erosion control, watershed balance, and water quality for the California Assembly Natural Resources Committee’s revisions of the 1945 Forest Practices Act.

8. I have devoted much of my long professional career to the study of cumulative watershed effects, and have participated in much of the debate and development of this field in California and other ~~timber production~~ west coastal states and in the U.S. Forest Service. A substantial portion of my research and teaching has involved coastal watersheds in northern and central California. I conducted a detailed review of the 1998 Pacific Lumber Habitat Conservation Plan and Sustained Yield Plan, specifically focusing on the Freshwater and Elk Creek watersheds. I was also part of the expert legal team that challenged the California Department of Forestry’s (CDF’s) treatment of the Mokelumne Watershed for cumulative effects that degraded water

quality and reservoir capacity for the East Bay Municipal Utility District. I am also the author of many professional papers and reports on cumulative effects associated with forest practices. I currently serve as advisor and consultant to the State of California Water Quality Control Boards on this matter, as well as to numerous public water districts, American Indian tribes, and municipalities.

I submit this declaration to highlight the effects on coastal watersheds caused by logging practices and associated activities such as road-building which take place under the ~~current version of the~~ State of California Board of Forestry's Forest Practices Rules (CFPRs or Rules). I also detail how forest practices of the type routinely approved under the Rules affect the geomorphological processes and attributes of watersheds, stream courses, and salmonid habitats in northern California. I provide the following statements based on my personal experience and expertise. Additionally, I occasionally make reference to selected scientific studies within the wealth of published literature that supports my conclusions.

9. Overall, logging and associated activities have substantially impacted, and continue to substantially impact, the coastal watersheds of northern and central California. Given the geological and climatic setting of this area, its soils and slopes are extremely susceptible to erosion, particularly following soil disturbance or removal of natural vegetation. The forest practices permitted by the current Rules continue to significantly alter these watersheds as described below. The Board of Forestry recently adopted changes to the Rules that will become effective in July 2000. These changes fail to address substantial, crucial problems in the Rules, however, and negative impacts to geomorphological processes

and attributes of watersheds, stream courses, and salmonid habitat are likely to continue from logging operations authorized under these revised rules. I have personally observed and studied, in California watersheds, numerous examples of the impacts I discuss in this declaration.

The Effects of Timber Harvest on Slope Stability and Sedimentation of Watercourses

10. Deposition of sediment in streams, as well as rates of sedimentation, are key factors affecting stream structure and function. Landslides in logged areas typically increase both the amount of sediment reaching streams as well as the rate of sediment deposition. Accordingly, increases in the size and frequency of landslides in a watershed significantly affect the stream itself.

11. Trees and other vegetation help prevent landslides by intercepting rainfall before it saturates deep into forest soil. Water can then be evaporated from the vegetation or evapotranspired through it. Up to 30-50% of rainfall may be intercepted or used by trees and other vegetation in high-rainfall areas. When trees are removed, there is less leaf area to intercept rainfall and less biomass to consume soil water. As a consequence, the removal of trees and reduction in leaf area substantially increases the duration and magnitude of soil saturation.

12. Hillslopes fail when the pressure of water in the soil pores exceeds the cohesive strength of the soil. That is, when soil and bedrock saturate to a degree greater than its internal strength, the combined weight of the soil and saturating water exceed the shear strength of the soil and mass failures (landslides) occur. Soil pore water pressure is a function of the subsurface soil pore volume,

which is determined by soil characteristics, parent materials (geology), root decay, biological activity in the soil, and rate of precipitation and infiltration of water.

13. In addition to regulating the amount of water in the soil and thus affecting soil stability, trees and vegetation also hold soil together through their root systems. Roots of trees and other vegetation play a vital role in the stability of sloped areas, and help prevent landslides and erosion. Roots anchor through the soil mass into fractures in bedrock. Roots also can also connect weaker soils to more stable soil. They do this by providing interlocking long fibrous binders that hold that soil together (called root arching). Timber cutting in most commercial species causes tree roots to die, resulting in less stable slopes. This is especially true where the binding action of roots provide the bulk of the soil's strength and resistance to movement. This is because as roots die and decay, they lose their ability to reinforce the soil. This can happen within a relatively short period. Up to 50% of original root reinforcement is typically lost within 2 years of harvest of the trees themselves (for Douglas fir in the Coast Ranges), and about 90% is typically gone within a decade. For redwoods, the roots die back and rot, although their central root mass can resprout when the canopy is regenerated.

14. Small roots decay most quickly, while large decay-resistant roots can remain for several years or sometimes even decades. The rate of root strength loss varies according to the tree species, root size and the activity of the organisms that cause root decay after harvest. As vegetation begins to grow again in the harvested area, new roots begin to reinforce the soil. In one example, it took about

14 years for a new forest to acquire about 50% of the root strength that existed in the original forest before it was logged. Further, it took 23 years to entirely replace the root strength removed by harvest. In Northwestern California, one study showed that recovery of root strength may take longer. Twenty-five years after one harvest, root reinforcement was only about 40% of that in adjacent uncut areas. **CITE?**

15. Timber harvest also affects soil pore water pressures. Pore water pressure changes seasonally in response to precipitation, and is often the driving mechanism that ultimately leads to slope failure. When pore water pressures change even moderately in combination with loss of root strength, such conditions can lead to dramatic landslides.

16. The Coast Ranges of California are currently undergoing continued uplift that influences the terrain. The steepness of the slopes in this area is regulated, geologically, by the balance between mass failure and downcutting by streams. This process has in turn been influenced by the forest cover under which this area has evolved for several thousand years. The widespread phenomenon of “inner gorges” in steep coastal watersheds is a manifestation of the effect of forest cover on slope stability. As the coastal mountains rise at a rate of 1-3 feet per millenium in California, the streams cut deeper and deeper canyons. Without forest cover to intercept intense rainfall and to hold slopes together through root arching, landslides occur and fill the streams with sediment, thus reducing their erosive power and balancing slope erosion with stream sediment transport capacity. Where continuous forest cover has been in place for 10,000 or more years, slopes can develop which are very much

steeper than would be the case without that forest cover. This condition is almost universal in coastal northern California and Oregon.

17. Landslides occur only episodically, usually triggered by intense prolonged winter precipitation. Because streams are downcutting continuously in forested regions, slopes become "oversteepened." But, because the forest cover provides a factor of safety for these slopes, natural failure in undisturbed watershed occurs with much less frequency than in an area where the forest canopy has been diminished by logging. Once the forest cover is modified, even for a roadway or small patch selective cut, the metastable character of the steeper hillslopes becomes obvious and failure may occur. This usually happens if an intense rainstorm or winter earthquake occurs while the slope vegetation is not yet fully recovered. Because forests regrow full root strength only slowly, the probability that such a 20-year magnitude rainfall event will occur while forest cover is in a state of recovery is almost 100 percent. Landslides, therefore, may occur wherever soil depths, slope steepness, and surface hydrologic conditions have developed beyond that degree that would be stable under historic native vegetative cover conditions.

18. Evaluation of landslide susceptibility for a given area is very demanding. It requires knowledge of the history of hillslopes and their forest growth, the depth and mass of roots, the infiltration capacity of the natural slopes and those that may be altered by management activities, the strength of the slope materials, the intensity of natural precipitation, and the rainfall-to-runoff ratios. However, under the current <u>and recently revised</u>

Rules, timber harvest and related activities are generally restricted only on "failure-prone" slopes, an assessment based on evidence of past slope failures. ~~But~~ <u>T</u>~~t~~his is a far too limited and inadequate a procedure, and one which does nothing to evaluate the effects of the forest itself on the slope stability. Further, the current <u>and revised</u> Rules' identification of slopes at risk for landslides demands that failure has already occurred in order to establish surface conditions that may suggest future failure. The present landslide susceptibility assessment is thus blind to the geomorphic evolution of a particular hillslope or watershed. It is like advising a patient with a bleeding leg to go home and be careful with the other leg because it might bleed too. It treats neither the cause nor the symptom. As a result, <u>both</u> the current <u>and the revised</u> Rules are largely ineffective in identifying areas where logging is likely to substantially increase the incidence of landslides.

19. <u>The current and the revised</u> Rules tend to support logging operations that detain surface rainfall runoff on hillslopes rather than routing it to watercourses. While such an approach may reduce short-term runoff turbidity and sediment delivery to streams adjacent to harvest areas, this is precisely the wrong strategy if one wants to decrease slope loading and pore water pressure increases after logging or roadbuilding. By focussing solely on reducing short-term surface sediment yield, the Rules lead to major long-term increases in sediment yield as a result of mass-wasting (landslides). It is predominantly the coarser, landslide-derived sediment that fills pools and reduces low-flow habitats for salmonids.

20. The <u>current and revised</u> Rules also do not address how removal of vegetation affects flood magnitude and frequency offsite

below the sites that have been harvested of their natural timber. Because rainy-season interception losses by needles and stems of forest trees is decreased when the canopy volume is reduced, and because evapotranspiration in the summer is reduced when the trees are not there to pump out the soil water, harvested sites are wetter and yield a greater percentage of their winter rainfall as runoff. For example, in an area subject to extensive removal of vegetation, an instantaneous increase in runoff of only 20% can approximately double the frequency of mean annual winter floods. Further, this increase in flow in turn also contributes to greatly increased incidence of landslides and mass wasting events. More frequent higher flows erode streambeds and banks, undercutting and destabilizing the adjacent hillsides. Thus, cumulative offsite impacts occur as the result of headwater changes in runoff characteristics. As landslides occur downstream, more sediment is added to the streams. Downcutting, therefore, ceases or decreases and the streams become wider to handle the entire sediment load added by landslides. This further undercuts hillsides, and further exacerbates the disequilibrium. From the standpoint of hillslope evolution over geologic time scales, such cumulative downstream progressive destabilizing will ultimately lead to less-steep streamside hillslopes as the slope materials are carried downstream over several millennia, followed by slow watershed reforestation.

21. Rainfall intensity itself cannot be much modified by timber harvest. That is an inherent characteristic of airmass temperature, saturation, windspeed, and topography. But changes in runoff characteristics associated with timber harvest does change measurably the magnitude of flood runoff for a given magnitude and duration of

rainfall. Compared to fully forested sites, harvested areas will have higher early winter soil moisture because the trees have not been using that soil moisture all summer. The harvest area will thus detain and absorb far less of the rainfall within the forest. Compacted soils in roaded and harvested areas also cannot absorb as much precipitation as they did before harvest, so runoff will occur sooner and for longer duration from the cutover area. Additionally, since harvest activities do not directly change slope steepness, but only forest cover, the increased surface runoff may gully or carry surface soil particles into the watercourses. Until the full height of the original forest cover is achieved, the routing of rainfall that is intercepted in a young recovering forest canopy allows that water to drip off needles and flow down stems to get to the soil faster in higher volumes than it can through closed mature, multi-level forest canopies. There is thus a measurable increase in the frequency, magnitude, and duration of offsite streamflow and flooding below harvested sites. The magnitude of the effects is a function of the percentage of the area of the watershed that is roaded and in a state of forest recovery at any one point in time.

22. When more sediment is delivered to a stream than it is able to carry at the flow-rate and gradient that may exist at a point in time, the stream must aggrade. This build-up of the streambed, or deposition of gravel bars, is a way that the stream system balances its transport capacity with its sediment delivery. The stream cannot alter its sediment supply, but it can store the sediment that it receives in excess of its momentary transport capacity. Sediment build-up in a channel is not inherently bad. Deleterious effects of in-channel sedimentation generally occur only when the rate of

delivery of water from tributaries exceeds the rate of delivery of sediment from bed, banks, and tributaries. Because timber harvest often increases runoff of water, cut-over watersheds may have an increased sediment transport capacity. Problems arise primarily when the *balance* between sediment delivery and transport capacity is changed. In central and northern coastal watersheds in California, the biggest factor that leads to imbalance is landsliding. Slides deliver masses of easily eroded earth materials directly to watercourses without simultaneous increases in water supply to balance that sediment. The Rules do far too little to recognize or assess the need for this balance.

23. A major compounding factor is the spatial distribution and timing of an imbalance between sediment supply and runoff. Runoff generally increases immediately after logging and roadbuilding, while sediment delivery may lag several years. Further, the increased runoff may undercut and trigger sliding offsite, downstream from the harvest area. The result is that the sedimentation effect is cumulative. The more that sediment delivery without balanced runoff increases, the more aggradation of the streambed, and thus the more offsite downstream streambank undercutting and the greater the sediment delivery. Coarse channel-filling sediment moves only during the highest flow events. Pools (often occupied by rearing salmonids) become filled progressively in the years after timber harvest. Spawning gravels (redds) may be covered with finer or coarser sediment, and become unusable to the spawning fish.

24. Based on my experience and observation, the CFPRs promulgated under the California Forest Practices Act fail to adequately address surface soil erosion hazards. The methodology

~~used~~ in the current and revised CFPRs to estimate ~~estimating~~ erosion hazard allows *dead* vegetation such as stumps and slash to be considered "protective cover" to mitigate erosion risks. This is shortsighted and generally only considers rainsplash erosion. Stumps hold the soil by roots that will soon die, decay, and thus cease binding soil mass. Further, dead vegetation may disrupt overland flow, but only for a period until it, too, is washed or rots away. Subsurface movement of water is as important to slope stability as is overland flow. Thus, the most important cover is that which provides live root strength to bind soil, to control the impacts of subsurface flow, and to intercept rainfall to control overland flow. Leaving slash in place does decrease surface erosion for a few years, but increases infiltration that may exceed to slope stability and trigger mass failure. The Rules simply do not restrict activities on those metastable slope areas that are prone to such failure. Since steep metastable slopes are cut regularly without being followed immediately by failures, the Rules' inadequate landslide risk assessment procedure allows timber harvest where other harvest has occurred with "successes" on adjacent steeper or similar slopes. However, failures ultimately occur during major (20-year-plus) storm intensity and duration events. There is also a serious mistaken and unsupported belief that once a forest begins to regenerate, the site is no longer susceptible to failures. While young trees do pump lots of water, they do not provide the mature root and soil characteristics necessary to return a slope to the same risk factor as before cutting or roading.

25. The current and revised Rules also fail to address landslide risk that increases with clearcutting and other "even-age"

logging methods. For example, the Rules allow up to 40 acres of contiguous clearcutting, but do not require an adequate analysis of landslide risk or mass wasting potential before determining whether clearcutting is appropriate. 14 CCR 913.1(a)(2). Additionally, the Rules allow the size limitations of clearcut units to be exceeded by only requiring that THPs demonstrate that it will "create a more natural logging unit." 14 CCR 913.1(a)(2)(C). Clearcut sizes can also be increased if the THP contains measures for offsite mitigation, but that mitigation is not necessarily based upon mitigating harm resulting from increased cut-block size. 14 CCR 913.1(a)(2)(E). Allowing restoration offsite to allow for increased clearcut size only increases the impact to, and below, the clearcut site. Moreover, the current and revised Rules require clearcut units to be separated only by a 300-foot buffer, and allow this buffer to also be clearcut when trees in the prior clearcut units are five years of age. 14 CCR 913.(a)(3) and (4). This effectively permits entire watersheds outside of the riparian areas to be cleared in less than ten years. In short, the current and revised Rules ignore some of the fundamentals of landslide risk and erosion control articulated above. The current Rules have resulted and will inevitably result in increased landslide risk and erosion hazard in cutover areas, and this concern was not addressed in the revisions to the Rules adopted by the Board of Forestry. The current and revised Rules do not mandate competent assessment of the fluvial geomorphologic history and status of a downstream reach that will receive the primary effects of cutting. The buffering capacity of a downstream, offsite watercourse to accommodate increased sediment and/or runoff is simply not assessed. Because most (probably over 80 percent) of harvest lands along the northern and central California coast are characterized by stream channels that are already disequilibrated, this shortcoming of the Rules is very serious.

26. Neither the current or revised Rules ~~do not~~ contain assessment practices that are in accord with basic professional standards for assessing risks of geological hazards. The Rules do not require geologists to review THPs for geologic hazards, and instead permit unqualified foresters to make the important geological and geomorphological assessments of whether proposed logging operations may undermine soil stability and runoff balance. For example, the Rules allow foresters to identify unstable areas within riparian areas, a field of expertise they do not have. 14 CCR 916.4(a). The Rules also allow foresters to determine what mitigations are needed to prevent or off-set impacts from roads constructed across unstable slopes and to allow tractor operations on unstable areas, and yet such determinations require geological knowledge not possessed by a forester. 14 CCR 923; 914.2(d). The revisions to the rules do not include changes to these sections, but only add similar language that perpetuates this problem. For example, one section of the revised rules states that *foresters* must "identify active erosion sites in the logging area, assess them to determine which sites pose significant risks to beneficial uses of water, assess them to determine whether feasible remedies exist, and address in the plan feasible remediation for all sites that pose significant risks to the beneficial uses of water." 916.9(p). Not only does this language limit the types of unstable areas to be identified to those deemed "active," but it continues to allow foresters to make determinations about geological conditions as well

as the types of remediation work that are needed to address erosion concerns. As previously stated, this is a skill that a forester may not necessarily have. It is my opinion that the CFPRs, even with the minor revisions adopted by the Board of Forestry, do not contain adequate measures to ensure that logging operations will not have adverse impacts on slope stability.

27. Additionally, the existing and revised Rules' limitations for tractor operations, hauling operations and site preparation during the winter season are particularly backward and ineffective. The Rules state that these actions cannot take place when the soil is saturated, but measure soil saturation after damage has already begun by providing for evaluation of soil saturation based on visible increases in water turbidity. 14 CCR 895.1. That is, the Rules essentially say that if soil is saturated enough to erode after logging, then the logging should not have happened. Thus, the Rules promote assessment of soil saturation after harm has occurred, obviously precluding consideration of preventative measures. Likewise, the Rules' standards for estimating surface soil erosion hazard are inadequate to prevent increases in mass wasting and resulting sediment delivery to streambeds. The Rules include dead vegetation as cover immediately after logging, even though-- as described above-- dead vegetation is much less effective than live vegetation and tree cover in terms of maintaining deep slope stability and preventing mass wasting and sediment delivery to streams. The Rules' hazard assessment process also fails to address unstable slopes and cumulative effects of past logging operations in a given watershed. Hydrologic balance of the watershed channel system is not a required consideration. Consequently, the Rules

promote inaccurate assessment of soil stability, which allows for inappropriate logging practices on steeper, unstable slopes. This leads to persistent ongoing and future losses of stream function and fish habitat.

28. The rate of landsliding on slopes logged under the Rules demonstrates the inadequacy of the Rules. For example, landsliding on areas logged in the previous 15 years is almost 10 times higher than landsliding rates on lands with forests over 30 years old. L.M. Reid, 1999, *Forest Practice Rules and Cumulative Watershed Impacts in California* at 3, attached as Exhibit B. This shows that the Rules fail to prevent a nearly ten-fold increase in landsliding rates on lands logged according to the CFPRs. *Id.*

29. Roads and watercourse road crossings are primary contributors of sediment input and thus to watershed cumulative effects. Basically, roads are impermeable and are permanently compacted. They thus increase runoff, channel it to low points or stream crossings, and intercept soil through-flow (water flowing in the unsaturated zone of soil just beneath the surface). All three of these characteristics lead to decreased infiltration capacity, increased fast surface runoff, decreased groundwater recharge and thus decreased summer stream flow, and change the ratio between rainfall and runoff to which the topography of the land surface is delicately adjusted.

30. Roads also contribute substantially to landslides and resultant sedimentation. Landslides usually start at road locations where infiltration is altered as a result of road construction. They are frequently caused by drainage concentration from roads, and therefore much of the resulting sediment enters streams.

31. The actual construction of roads is also a source of sediment, and can greatly accelerate erosion rates within a watershed. Cutting roads in a slope sheds sediment into roadside ditches, where it may be transported to a stream by rainfall and roadside runoff.

32. Road construction, in combination with intensive logging, has been proven to produce significant long term increases in peak flow discharges in both large and small basins. J.A. Jones, G.E. Grant, 1996, *Peak Flow Responses to Clear-Cutting and Roads in Small and Large Basins*, Western Cascades, Oregon. In the western Cascades, logging and associated operations increased peak flows by as much as 50% in small basins and 100% in large basins over a fifty year period. *Id*. at 959. Road construction influences the rate and extent of water flow down hillslopes. Roads, in conjunction with clear-cutting, speed the delivery of water to channels during storm events.

33. Road surfaces combine with culverts, cutbanks and ditches to convert subsurface groundwater flow into surface water flow. That surface water flow carries with it sediment and other debris that enter streams. Surface flows from roads and culverts also increase the instantaneous flow of the destination stream, causing erosion along its banks and affecting the stream’s depth.

34. Erosion of gravel road surfaces is an important source of sediment. Most eroded sediment in logged areas enters the stream directly through side drainages that may carry runoff only during storm events. The size of sediment is usually very fine, less than 2 mm in diameter. Gravel surface roads are a key source of this fine sediment. Heavy traffic on these roads exacerbates this source of

sediment. One study has shown that when traffic exceeds more than four trucks per day, roads can contribute up to 7.5 times the sediment production as that of the same roads not being used on a given day. Even when occasional light vehicles are used, the sediment loss from road surfaces only decreases by .8% of the value of heavily used roads. L.M. Reid et al, 1984, *Sediment Production From Forest Road Surfaces,* attached as Exhibit C at 1760.

35. The placement of roads has a lasting effect on water quality and erosion in logged areas. Roads do not cease to exist after a decade of non-use or a decade after abandonment or decommissioning. Road surfaces do not heal and become forest soil again in a fixed short time, or in any predictable fashion. Even where roads are “put to bed” by waterbarring and blocking access to vehicles, the compaction, flow routing, and subsurface flow interception all continue for decades. Only where roadbeds are “pulled” and the surfaces are ripped and backfilled into the cuts do we see hydrologic recovery, as shown in the Redwood National Park studies.

36. Based on my experience and observation, the existing and revised Rules fail to properly address road construction to effectively mitigate sediment loads in streams. For example, the Rules lack any effective requirement against concentrating run-off from roads, which can exacerbate the erosional processes already caused by the existence of the roads. Further, the Rules allow construction to occur in isolated wet areas that already pose a landslide risk. The Rules allow road construction with a high center crown (not fully outsloped) and with inside ditches. Revisions to the rules include that new and reconstructed roads must be "outsloped

where feasible and drained with water breaks or rolling dips," but this does not eliminate this concern. This continues to allow~~s~~ a road to be built that is accessible throughout most of the year, but maximizes deleterious hydrologic effects. The effects of these omissions are substantial, and include increased sediment loads, destabilization of stream banks, increased erosion resulting from construction of the road network, and interruption of hillslope subsurface and surface water flows.

37. The existing and revised Rules also do not encourage landowners to limit the number of roads within watersheds, or require them to develop a transportation plan in the logged area. Perhaps most importantly, there is no limitation on placing roads in wet or unstable areas, such as inner gorges and steep slopes, and no prohibition on placing roads in areas of high overland water flows or other areas that deliver sediment to watercourses. The Rules have resulted in and will continue to result in increased sediment loads and destabilized streambanks.

38. The Rules also fail to address road maintenance to effectively mitigate landslide risk and provide for erosion control. For example, the existing Rules require that roads and landings only be maintained for 1-3 years. The revised rules only change this to 3 years rather than requiring a decommissioning process or annual maintenance. Both the current and revised Rules omit any guidance or instruction as to how to maintain roads, landings, and crossings in a manner that minimizes sediment delivery to streams. Further, there is virtually no accountability for landslides and erosion problems that may arise after the 1-3 year period. Drainage structures associated with road placement need annual maintenance to function

properly. They will ultimately become useless when drainage culverts become clogged. The result is inevitable road failure years after the road was constructed, leading to further landslides and additional increases in sediment loading in streams.

39. The Rules relating to watercourse crossing structures are also insufficient to prevent alteration of stream characteristics. Although the existing and revised Rules require all watercourse crossing structures to withstand a 50-year or a 100-year flood, respectively, they fail to provide guidelines for determining the size of watercourse crossings for the 50-year or 100-year flood. While the CDF has provided state foresters with a technical memorandum that includes culvert-sizing methods, the memo is useless without knowledge of the upslope drainage area, present and future infiltration capacity, and/or channel width. Thus, the Rules establish no baseline from which to judge the adequacy of culvert size. Even if a state forester finds that a drainage structure will not carry the fifty-year flood level, the Rules do not require removal of the inadequate structure. Instead, the Rules allow state agency foresters to use an alternative means, such as breaching of fill, even though such a procedure is substantially less protective and more erosive than actual removal. Also, the Rules do not include provisions to prevent stream crossings from changing channel beds, blocking sediment transport, or altering water velocity. Finally, the Rules set inadequate standards for evaluating the number of watercourse crossings in a particular THP, which means that an excessive number of watercourse crossings may exist in a concentrated area. This inevitably increases runoff routing and other impacts, which substantially alter natural steam conditions. Basically, the

rainfall characteristics and soil and bedrock infiltration capacity determine how many miles of ephemeral or perennial watercourses may exist in a given surface area. Drainage density thus varies as a function of slope steepness, geology, soils, and climatic characteristics. As a general rule, the denser the number of watercourses per square mile, the faster runoff is delivered to streams and the greater the risk of sediment delivery associated with road building. Yet, the Rules do not require that this simple measurement be used as a guide to allowable road density.

40. ~~For temporary roads, the Rules only require that drainage structures be able to carry the anticipated water flow during the period of use. If the road is used the following season, however, the watercourse crossing may be inadequate. By allowing seasonal watercourse crossings to extend beyond one season, the Rules permit use of watercourse crossings that will not prevent watercourses from sustaining substantial impacts.~~ **(NOTE: I AM SUGGESTING THIS BE REMOVED BECAUSE THE RULES (CURRENT) REQUIRE THAT TEMPORARY CROSSINGS BE PULLED BEFORE THE WINTER PERIOD, AND IT SEEMS A LITTLE CONFUSING. PLEASE FEEL FREE TO PUT IT BACK IN IF YOU FEEL IT IS APPROPRIATE.)**

41. In sum, I believe that the Rules' provisions regulating roads and road watercourse crossings are insufficient to prevent significant alteration of watershed and stream conditions. These alterations include loss of pools, changes in flow regimes, bank destabilization, and loss of stream complexity.

The Role of Riparian Buffers in Mitigating Sediments Loads

42. Functions of riparian zones include the maintenance of water quality through filtering of sediment, chemicals, and nutrients from upslope sources; the maintenance of stream bank stability by

providing a root system on the banks and floodplains; and maintenance of channel form and in-stream habitat through provision of woody debris and restriction of sediment input. Riparian zones help capture sediment from logged areas and prevent the sediment from entering streams. Loss of riparian vegetation results in increased sedimentation entering streams from erosion on logged slopes. Loss of riparian vegetation also may destabilize streambanks, leading to increased fine sediment deposition from eroding banks.

43. Trees and vegetation of substantial size that fall into streams and their flood areas are termed “large woody debris” (LWD) Riparian zones serve as the primary source of LWD. In smaller channels, woody debris limits the amount of sediment that can enter a stream by trapping that sediment. It can also stabilize debris and sediment that result from landslides. LWD also helps stabilize stream banks. In larger channels, wood accumulation can trigger the accumulation of spawning gravel for fish, create backwaters, and cause pools to form.

44. The ~~Rules’~~ provisions in both the current and revised Rules ~~setting~~ that set forth timber management standards in riparian zones lack sufficient canopy and understory retention standards to avoid impacts to water quality. The current Rules require loggers to retain 50% overstory and 50% understory within Water and Lake Protection Zones (WPLZs) along fish-bearing (Class I) streams. The revised rules increase this, but only require loggers to retain 85% of the canopy in the first 75 feet of the WLPZ and 65% within the next 75 feet. Both the current and revised rules only require 50% total canopy to remain within the first 50 to 100 feet of nonfish-bearing, or Class II streams, and exclude any canopy retention

requirements along intermittent, or Class III streams. These standards do not sufficiently provide canopy to maintain naturally occurring water temperatures. In fact, the Rules' insufficient definition of canopy allows retention of understory tress and shrubs instead of overstory shade trees. Lack of adequate overstory habitat impacts the streams' microclimates and raises water temperatures.

45. Further studies (Erman and Erman, 2000) corroborate evidence that riparian buffers, as presently defined and as revised, are inadequate for maintaining microclimate conditions in streamside areas. The Rules are based on outdated and unsupported concepts of a buffer width that purported to protect streams from influences elsewhere in the watershed. The Rules scale allowable activities near streams to the size of the stream, excluding equipment entry but not harvest activities as a function of a class of watercourse sizes. The Rules assume some kind of linear relationship between width of equipment exclusion zone and stream impacts that is simply not supported from scientific studies. Instead, it is the canopy closure, air flow, humidity modification, and evapotranspiration in ephemeral and perennial watercourses that need to be protected and maintained for optimum riparian habitat.

46. The current and revised Rules' provisions designed to retain adequate input of large woody debris (LWD) into streams are also ineffective. Although the Rules require loggers to leave individual trees within riparian areas, ~~nothing in the regulations requires the permanent retention of LWD recruitment trees~~ these requirements fall below those needed to provide for adequate recruitment of large trees into watercourses. ~~As a result, every reentry results in the cutting of trees originally left for LWD~~

~~recruitment, which in turn means that the recruitment trees are too small to serve the purposes of large woody debris.~~ The current Rules require retention of only two 16-inch diameter at breast height (DBH) trees per acre along Class I and II streams, and therefore provide insufficient sources of LWD recruitment material. The revised Rules only change these standards for Class I streams, but even these changes are insufficient, requiring the ten largest trees, dead or alive, to be left standing per 330 feet of stream channel. Further, the current and revised Rules only require 25% retention of overstory conifers within Class I and Class II "watercourse and lake protection zones" (WLPZs), even though conifers provide better LWD. As a result, the WLPZs have an depleted and inadequate supply of large woody debris. Finally, even if the provisions mandated retention of more conifers, the Rules would still fail to provide more trees because the defined riparian buffer ~~strips in coastal California and Oregon watersheds~~ in the current and revised Rules are too narrow to contain sufficient amounts of material that could provide for LWD recruitment. Consequently, the standards for maintaining LWD are grossly inadequate in both the current and revised CFPRs.

47. ~~The Rules do not require an adequate width of trees and other vegetation to provide root strength for wet soil stabilization. For example, the Rules allow clearcutting as close as 75 feet from fish-bearing (Class I) streams, and only require a maximum of 150 feet between clear-cut areas and streams on the steepest of slopes. The riparian buffers in the Rules are inadequate to mitigate sediment loading in streams. The buffers in the Rules are not wide enough for any of the classes of streams to provide for adequate riparian values, including those mentioned above.~~

48. Both the current and revised Rules fail to adequately protect Class III (~~non-fish-bearing~~ intermittent) watercourses, primarily because the Rules do not provide for any of the riparian zone protections afforded Class I and II streams. The Rules allow broadcast burning in Class III watercourses, which increases sediment transport into streams and can result in increased stream water temperatures. These sediment inputs move downstream to connected Class I and II waters, affecting these areas as well. The Rules also lack limits on taking overstory trees in Class III watercourses. This allows loggers to remove shade trees and LWD recruitment trees, which ultimately makes the Class III streams hotter and less adaptable to large flow events. Downstream streams therefore likewise become hotter and more susceptible to mass flow events. The Rules permit tree removal from wet areas, and entirely omit provisions for retaining trees that will provide root strength and soil stability. Since wet areas are most susceptible to mass wasting, Class III watercourses become vulnerable to mass inputs of sediment. Finally, although the Rules state that trees must be felled away from streams, the Rules allow for exceptions that state foresters may grant without justification. Felling of trees across streams can damage vegetation and destabilize streambanks, yet the current and revised Rules allow this to occur on Class I, II and III streams.

Analysis of Cumulative Effects

49. National Marine Fisheries Service (NMFS) and State-commissioned scientists have criticized the Rules for inadequate consideration of the cumulative effects of logging and road-building within a watershed. I agree with these criticisms. Specifically,

assessments of timber-related impacts on a watershed must consider a watershed as a whole, evaluating the extent of all the impacts occurring within that system over a time frame greater than the immediate present. To accurately evaluate the impacts of one logging operation on a watershed, one must first have an accurate sense of the baseline conditions in that watershed and the response of that watershed to past stresses, natural or man-augmented. Understanding this baseline can only be accomplished by considering the cumulative impacts of various past and present logging operations as well as other sources of change throughout the basin. By looking only at dots on a map rather and doing so in the time frame of a snapshot, the Rules fail to adequately consider cumulative impacts and therefore fail to accurately assess the impacts of specific permitted logging operations on a watershed.

50. Particularly critical is the cumulative effect of past, present, and anticipated future road-building because these so dramatically affect runoff routing (timing and volume of sediment and rainfall runoff). The Rules take the position that it is unreasonable for a timberland owner to know or accommodate the possible impacts of future activities by another owner in the same watershed or a future owner of the same parcel. Thus, cumulative impacts are virtually assured of non-assessment in any given THP. If the present status of the balance between water runoff and sediment yield and the resulting channel balance were in fact accommodated instead of asking a timber harvester to be all-knowing, one could determine if past, present, and reasonably anticipated future activities were within the acceptable limits of the range of stresses that a watershed system can buffer. The Rules thus ask impossible

forecasting abilities of THP submitters rather than using sound science to assess present watershed status.

51. As noted above, timber harvest operations involving log skidding, road and landing construction, road maintenance, and harvest of trees in riparian areas can increase input of fine sediments into stream channels, increase water temperatures, and reduce long-term recruitment of large woody debris. Other sources than logging may also contribute to these causes of harm. The Rules, however, fail to adequately consider the cumulative effect of the combination of these different logging operations or the contribution of other non-timber-harvest sources of impacts on watershed characteristics or function. This failure to require effective cumulative impacts assessment creates an inaccurate evaluation of impacts to a watershed. Recognizing this inadequacy, CDF promulgated Technical Rule Addendum No 2, ostensibly to provide a mechanism for cumulative impacts assessment. *See* 14 CCR 898. However, like the rest of the Rules, Technical Addendum No. 2 fails to provide useful information or guidance regarding cumulative impacts. The Rules render the cumulative watershed effects (CWEs) analysis an ineffective paper exercise by limiting cumulative impacts analysis to land-use information readily available, without requiring any other relevant information such as the present status of watershed and channel balance. The Rules also limit cumulative impact assessment to the rather arbitrarily defined watershed planning area of the immediate subwatershed and exclude the larger river basin from consideration. Finally, the Rules do not provide for consideration of the historical impacts on watersheds or how proposed logging may

further degrade already-degraded conditions. As a result, the Rules' provisions for cumulative impact assessments are wholly inadequate.

xx. Although the Rules' inadequate requirements for cumulative impact analysis is one of the most crucial problems of the current Rules, it was not addressed by the Board of Forestry in their revised Rules, and thus this fundamental problem persists.

Conclusions

52. My opinions are consistent with those expressed by the National Marine Fisheries Service (NMFS). NMFS identified timber harvest practices regulated by the State of California Forest Practices Act and Forest Practices Regulations as resulting in sedimentation caused by poor timber harvest practices and channel restructuring due to floods. NMFS has stated that timber harvest activities have been documented to result in adverse effects on streams and stream side zones including the loss of large woody debris, increased sedimentation, loss of riparian vegetation, and loss of habitat complexity and connectivity. *See* 64 Fed. Reg. 6966.

53. Based on my experienced observations above, the California Forest Practices Rules have and will continue to result in increased landslides and landslide risk and increased erosion, and consequently increased sediment delivery to streams in excess of transport capacity. The Rules allow extensive clearcut logging without regard to soil saturation and slope stability, resulting in the increased frequency of landslides in logged areas. The Rules also allow road construction and maintenance in a manner that results in excess sediment loading in nearby watercourses. Finally, the rules provide for inadequate riparian buffer zones to mitigate the effects of activities that result in increased sediment loading. These have

had, and will continue to have substantial and long-term negative consequences on watersheds and streams throughout the habitat of coho salmon in California.

54. I declare under penalty of perjury, under the laws of the State of California that the foregoing is true and correct to the best of my knowledge and that this declaration was executed on May _____, 2000 in Monterey, California.

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Robert R. Curry, Ph.D.