Aftermath of the 1997 Flood: Summary of a Workshop

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Watershed Analysis Center
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Introduction

The general purpose of this workshop was to conduct an initial evaluation of the effects of the recent floods in California and to plan post-flood assessment to aid adaptive management. The 1997 flood was different from previous large floods (e.g., 1964 flood) in several ways: (1) land uses have changed since the last large flood and, possibly, the response of the landscape was affected; (2) we now view the ecosystem in a more integrated way at larger spatial scales. Perhaps we can look at this event in relation to the "ecoscape." There is a large amount of money that will be spent "undoing" the effects of this flood. Hopefully, the direction towards ecosystem management explicit in documents such as the Northwest Forest Plan will not be forgotten in the rush to repair.

Specific Purposes

- To foster evaluations of questions raised by the New Year's Flood of 1997:
- Where were the magnitude and effects of the flood greatest and why?
- What does this flood tell us about the functioning of natural watershed processes in the affected provinces?
- What does it tell us about the legacy of managing watersheds and waterways?
- How effective are broad land-management strategies such as fire control, Best Management Practices, and the Northwest Forest Plan?

Recommendations

This workshop included a series of brief presentations, small-group discussions, and general discussion. It closed with a series of recommendations:

The ecosystem view is that large magnitude infrequent events are not only expected, but are required to maintain a "healthy" ecosystem. Those that undertake "repairs" following such events must understand the role of catastrophic changes in long-term ecosystem function.

After a storm, there should be an initial quick mapping of landslides and erosion that is done in conjunction with assessments to infrastructure (such as was done by De La Fuente's group on the Klamath National Forest after the January 1997 storm). Then, a more carefully planned assessment program would target particular watersheds or sub-watersheds to address particular issues from a more academic or research viewpoint. The objective of this second part would be to gain an understanding of the response of managed watersheds to major storms so that in the future after each large storm there was not the same willy-nilly shot-gun approach to post-storm assessment. The approach would be to learn something fundamental after each storm and use what is learned to modify infrastructure over time.

Post-flood assessments should be aimed at improving management through "adaptive management." Assessments should address:

Effectiveness of practices, both pre- and post-flood.

Ecosystem processes, magnitude and effect and system architecture.

Anticipation of effects through analysis.

Another model for assessment protocol is the Burnt Area Emergency Response (BAER) procedure. The advantages of the BAER model are that it is in place and is understood, it is interagency, and it has made positive changes in the way in which emergency response to fires has been handled.

Repair of storm damage from large, infrequent events is normally done under two programs. ERFO (Emergency Relief Federally Owned) funds are used in qualifying areas to repair damage to the road infrastructure. EWP (Emergency Watershed Protection) funds are used for general watershed repair. The legislative purpose of the ERFO program is to implement expedient repair of essential transportation access to National Forest lands when access has been damaged by large, infrequent storms. ERFO is not intended to fix any past gross design and construction errors; those are the responsibility of the Forest Service. However, ERFO-funded repairs should be designed, to the extent possible, to be compatible with prevailing ecosystem management policy and direction.

ERFO regulations have emphasized "in-kind" replacement of damaged facilities but have allowed "betterments" under certain justified conditions. What justified a betterment has sometimes been a subjective interpretation of individual ERFO inspectors and FS employees. ERFO regulations have also emphasized work done within the road prism. A current proposed revision of the ERFO manual will allow payment for some work done outside of the road prism, for example for landslide repairs. This revision will also make it easier to relocate roads to prevent repetitive ecological damage from highly vulnerable sites. The revision also attempts to more objectively define allowed betterments. The current and proposed revised ERFO regulations allow changing the design of destroyed culverts to accommodate ecological needs: for example, changing to an open-bottomed structure for fish passage or increasing the slope (and thereby lengthening) of a culvert to better match the prevailing stream channel slope. Current and revised regulations also allow reimbursement for road abandonment and obliteration up to the cost of the alternative of repairing the existing road.

An assessment protocol for flood damage to areas not covered by ERFO, which is low-cost and coordinated with other activities, should be developed and implemented. Emergency Supplemental Funding is a potential source of support for this work.

State and federal agencies other than the Forest Service should be involved in the assessment of flood effects on Na tional Forest lands. Agencies that fund emergency response on federal lands should be made more aware of ecosystem management policies and procedures. We recommend that an interagency Province-level assessment be conducted by a team of physical and biological scientists for the purpose of producing a set of guidelines for addressing flood-damaged roads

Representative watersheds that were identified during the assessment process as extensively affected by the flood should be further examined to determine relations between management and flood effects on ecosystems and impacts on infrastructure. The ultimate aim is to reduce land-use impacts on ecosystems and infrastructure during large floods.

Coordination with local Weather Service (Woodley Island, Eureka) on storing Doppler radar images during storm periods should be explored so that the areas of high intensity/long duration precipitation can be subsequently inspected for damage after the storm. This would be an alternative to the rather random "look around" procedure that is presently undertaken after a major storm.

Workshop Summary

The workshop focussed on three topics: 1) flood magnitude and watershed processes, 2) effectiveness of management practices; and 3) effectiveness of ecosystem and watershed management strategies.

Topic 1: Flood Magnitude and Watershed Processes

Mike Nolan summarized what was known about the magnitude of flooding in major river basins of the Sierra, Klamath and North Coastal Provinces. The massive tropical storm that triggered the floods (the "Pineapple Express") moved in a southwest to northeast pattern. Rainfall occurred at elevations up to 11,000 feet in the Sierra. The magnitude of flooding mirrored this storm pattern. In some Sierra basins the flows equaled or exceeded the highest flows of record.

The Cosumnes River basin seemed to be particularly hard hit. Flows were lower, but still significant, in the Klamath basin. Flow in the Klamath River at Orleans was less than a 50-year recurrence interval (Watershed Management Council Networker 7(1) Spring, 1997). Coastal rivers sustained high flows but most were below the 50-year recurrence interval event. Caspar Creek, a 2 mi^2 watershed on the coast in Mendocino County, experienced about a 9-year event. Mike indicated that the flow frequency data are available on the USGS website and that, time permitting, magnitude frequency diagrams could be assembled for sites where there is a gaging station. The USGS is involved in a modeling study in the Truckee River basin. It is also doing a flood routing simulation on the Cosumnes River to aid in re-mapping the 100-year floodplain.

The California Department of Water Resources will soon publish a 118-page manuscript by Jim Goodridge titled "Historic Rainstorms in California" that concentrates on 46 storms from 1850 to 1993. Jim has subsequently written an April 14, 1997 draft manuscript "Data Supplement to a Study of Historic Rainstorms in California" that includes data and an analysis of the 1997 Flood. Jim can be reached at P.O. Box 970, Mendocino, CA 95460 (e-mail jmgd@mcn.org).

Gordon Grant reported on the results of post-1996 flood assessments in Oregon. He termed the events as "wild floods in managed landscapes." Landscapes in Oregon exhibited variable responses due to multiple interacting processes, spatial variability in susceptibility of watersheds to impacts, the legacy of past management (e.g., roads), "cascading" disturbances and amplification or suppression of response due to differing environmental conditions. Gordon described a process of "integrated watershed assessments", one-shot comprehensive studies aimed at separating people's effects from natural effects. A variety of basins were studied. Findings indicated that management changed the rates of natural processes and modified their behavior. Management also introduced "non-native" processes such as road drainage systems. On the H.J. Andrews Experimental Forest in the central Cascades the 1996 storm was a large rain-on-snow event. Runoff from snowmelt and rain were synchronous at lower elevations, but offset at higher elevations; higher unit-area hydrographs were therefore associated with the lower elevation streams. Precipitation and high flows generated many landslides in the Lookout Creek basin. Debris slides (39) translated to debris flows (24) which then impacted larger channels (13). Slides were concentrated in areas of weak rock types at lower elevations. Many slides were associated with roads. Clear-cuts had twice the rate of landslides as uncut areas. Sediment was routed from higher elevation roads to lower elevation roads that acted as "sediment sinks." Channel storage of sediment was hypothesized to be a function of supply, stream power, bank erodibility, and channel geometry.

After Gordon's talk the group broke up into three "provincial" sub-groups: Sierra, North Coast, and Klamath Provinces. The aim of the breakout sessions was to develop specific information on flood effects in each province as a basis for comparison.

The **Sierra Province** group focused on effects of the flood on Eldorado NF, specifically discussing the massive landslide that closed Highway 50. Flows in the South Fork of the American River exceeded 30,000 cfs, well above the 17,000 cfs recorded in 1964. The magnitude of flooding declined with increasing elevation. Most observed landslides occurred at 6000-7000 feet elevation and many were associated with roads and past fires. No comprehensive inventory has yet been done for the Eldorado or apparently, any other Sierra Province National Forest.

The Highway 50 slide was preceded by nearly two months of high precipitation. In December 1996 precipitation was over 300 percent of normal. In January 1997, it was twice the normal level. Forest Service geologists had observed signs of movement in the slide over a year before it happened. Much of the Highway 50 corridor is naturally unstable. There have also been numerous fires over the years. The vicinity of the landslide burned in 1959 and again in 1992. Little is known about the possible effects of the fires on encouraging the landslide. At the present time, a number of monitoring stations (10) have been set up on other earthflows in the corridor to evaluate soil moisture and movement.

Several people had anecdotal information about flooding effects such as observations of scoured channels and diversions caused by roads. It was suggested that the process by which woody debris and sediment accumulated at the margins of Lake Tahoe might represent a basis for explaining the origin of alluvial deposits (Reid). All group members agreed that some conceptual framework for understanding events such as the Highway 50 slide was needed. Specifically, there should be investigation of the interactions between fire, extreme flooding and precipitation events and mass movements. A sampling approach evaluating these relationships in different watersheds seemed appropriate.

Reports from the **North Coast Province** indicated that this event was significant, but of lower magnitude than in other Provinces. Local damage was reported for the Mattole and Eel Rivers. Redwood Creek experienced its highest peak since 1975, equivalent to a 12-year recurrence interval. This storm may have tested the effectiveness of rehabilitation efforts in that basin. A "fair" amount of mass movement was observed. At Caspar Creek, which has 35 years of streamflow records, the event caused substantial channel changes but upland landsliding was not significant. Helicopter reconnaissance indicated local areas in Humboldt and Mendocino Counties with concentrations of landsliding. Group discussion focused on the need for better detection and monitoring approaches. Data quality both before and after the storm was questioned. Real-time data on storm intensity and duration are needed. The use of Doppler radar images for identifying storm patterns and designing appropriate responses was suggested. The response of aquatic ecosystems may have been positive. For example, wood was introduced into channels that had formerly been deficient in large woody debris. The mechanisms for recruitment of large wood are not fully understood. Models for predicting landsliding and earthflow activities in relation to duration and intensity of precipitation are not well developed. Monitoring within the context of the EPA TMDL (total maximum daily load) regulatory procedure was discussed. Suggested follow-up: investigate the possibility of coordination with local Weather Service (Woodley Island, Eureka) on storing Doppler radar images during storm periods so that the areas of high intensity/long duration precipitation can be subsequently inspected for damage after the storm. This would be an alternative to the rather random "look around" procedure that is presently undertaken after a major storm.

In the **Klamath Province** there is a diversity of watersheds that are generally geologically unstable. The South Fork of the Trinity River cleared quickly. The Trinity Reservoir extended peak flows and many flood-plain roads were lost. *(Editor's Note: Trinity Lake Reservoir also* ***greatly*** *extended the duration of turbidity / fine sediment concentration in the Trinity River. The Trinity is STILL pea-soup turbid (as of June 26), resulting from release of unsettled colloidal sediments from the flood stored in the lake . This is a flood / reservoir effect; we don't see this in non-flood years.)* The Rogue River peaked quickly, twice, at levels near peaks of record in some places (Medford). On the Klamath River, a 60-year recurrence interval was calculated. Erosion exposed Indian burial sites along the river. Disturbances to uplands were spotty but many small streams were scoured to bedrock. Landslides were observed to originate in burned areas, especially in steep upper slopes (4000-6000 feet elevation). A substantial amount of wood was delivered to both the Klamath and Trinity Rivers, in some cases causing crossing failures. The group expressed concern over ongoing removal of large woody debris from stream channels and an apparent lack of understanding by managers of the ecological role of woody debris. On the Salmon River, pool habitat was lost and riffle habitat gained. Many salmon redds were either scoured or buried. Assessment methodologies, including the use of Doppler radar, LANDSAT images and aerial photographs were discussed.

Description of 1997 flood effects on the Klamath National Forest: Juan de la Fuente reported that on the Klamath National Forest, the storms of December and January produced precipitation that was 2-3 times the monthly average. The 4-day storm at the end of December produced rain above 7000 feet. Based on anecdotal accounts, the snow pack in mid-December extended down to about 3500 feet on gone on lightly vegetated south slopes up to 6000 feet in elevation. Stream gauge data reveals that stream flows ranged from 4th to 2nd highest on record. The majority of the damage to facilities and alteration of stream channels occurred in a northeast trending band extending from the northern margin of the Forest in Oregon through the lower Scott River and on the north and west flank of the Marble Mountain Wilderness.

The flood of 1997 involved the movement of soil, rock, and organic debris from hillslopes to stream channels at a scale not experienced since about 1974 on the Klamath National Forest. Hillslope processes that had major effects on channels were dominated by landsliding, though surface erosion played an important role locally. Surface erosion was most evident on poorly vegetated sites and on road cuts and fills. Scour and deposition are evident in many ephemeral channels that previously lacked this effect. With the exception of Deep and Walker Creeks, most streams retained the majority of their 30-year-old alder stands. These stands served to trap sediment and large logs.

A sample of 194 Emergency Relief Federally Owned (ERFO) Sites was stratified into six categories (Table 1), and it was found that stream crossing failures were by far the biggest problem in terms of number of sites, cost to repair, and volume of sediment contributed to the stream system.

Table 1. ERFO sites and related costs

Type of Site	Number	Cost to repair ($1000)	*% of road sediment to streams*
Stream crossings	103	3511	70
Landslides	36	1691	21
Road fill failures	24	420	1
Road cut failures	12	73	0
Gullies	3	121	0
Stream undercutting	18	1329	8

Of the 103 stream crossing failures, 40 were the result of debris flows originating higher up in the watershed. At 21 stream crossing failures, the failure resulted in drainage diversions that caused gullies and fill failures downslope. Several houses and other buildings were damaged or destroyed near the mouth of Walker and Grider Creeks. Highway 96 was extensively damaged. Of the total 760 ERFO sites, 109 (14% of the total) occur in areas which burned at high or moderate intensity by wildfire since 1977. These lands make up 9.3% of the land base. Similarly, 152 ERFO sites (20% of the total) occur in plantations, while plantations make up 8% of the west-side land base.

Walker and Deep Creeks exemplify the most severe channel alterations caused by the flood. In these streams, the entire inundated floodplain (that portion under water during the 1997 flood) was significantly altered. Effects included removal of all vegetation, and scour or deposition of coarse sediment throughout the inundated floodplain. At the other end of the spectrum, streams like Clear and Dillon Creeks were little affected by the flood. In these streams, only a small amount of riparian vegetation was removed, and scour and deposition was mostly limited to the bankfull channel.

The Klamath River appears to have permanently changed courses in some areas to occupy channels that had previously carried water during high flows only. Many large boulder clusters and weirs (fish habitat improvement structures) in Elk and Indian Creeks as well as the South Fork Salmon appear to have weathered the high flows, but cabled log structures were more often damaged, raised out of the channel, or removed. The flood of 1997 provided a real test of the effectiveness of recently applied slope stabilization measures. Preliminary information indicates that virtually all of the reinforced fills installed over the past 5 years survived the flood. Similarly, structures such as Hilficker welded wire retaining walls, drained rock fills, and cellular retaining walls survived in good condition. Only 2 failures of such structures are known.

Field observations in several watersheds revealed that large slumps and earthflows were mobilized within older landslide deposits, and generated debris flows. These landslides occurred high in the watersheds, most often above 4000 feet in elevation. Most of these landslides occurred in areas which were either harvested or burned at high or moderate intensity since 1977, and are roaded. The debris flows that they generated were typically very fluid, making them capable of traversing long stretches of gentle terrain to reach steep stream courses. Once they reached channels, they mobilized bed and bank material. In bedrock channels, there was little debris available, but in alluvial reaches or areas where channels traversed landslide deposits, large volumes of material were mobilized. This mobilized bed material often greatly exceeded the volume of the initiating landslide. For example, in Walker Creek, one 4,000 cubic yard debris slide mobilized about 280,000 cubic yards of channel deposits as it traveled down a faint draw.

Topic 2: Effectiveness of Management Practices

Bruce McCammon discussed the post-1996 flood assessment in Oregon, specifically reporting on the durability of instream fish habitat structures. The overall assessment was two-phased with the first phase at a reconnaissance level and the second concerned with evaluation of management-associated effects. Phase 2 involved synoptic "snap-shots", detailed evaluation of stream crossings and instream structures and integrated watershed studies as previously described by Gordon Grant. Of 4000 instream structures in over 100 watersheds, over 60 percent survived the floods. This was much better performance than expected.

Jim McKean estimated that road damage in Region 5 due to the holiday storms of 1997 would be about $35,000,000 (ERFO-qualified damage). For perspective, the average Region 5 ERFO program has been about $9,000,000 per year. The Klamath National Forest had much more damage than other Forests. There have been several reports of in-channel debris (a combination of water, sediment, boulders, and large organic debris) toppling bridges. The Forest Service has been contacted by several private landowners asking for an assessment of the risk of further movement of specific slides that have traveled from Forest Service land onto private property. Legal issues of liability and possible compensation for private landowners have been informally raised.

Mary Ann Madej reported that post-storm road inventories were conducted in Redwood National and State Parks to see how rehabilitated roads behaved after being "tested" by a large flood. Preliminary analysis indicates that for 20 miles of rehabilitated roads, fluvial erosion (from previously excavated crossings and gullies) produced 140 yd^3/mi and mass movement produced 585 yd^3/mi, totaling 725 yd^3/mi of treated road. Much of the mass movement was from side cast failures where fill material moved downslope but did not reach a stream channel. Minimally treated roads (ripped and drained, but no outsloping) eroded more than fully treated roads. An inventory of 80 miles of untreated roads showed less fluvial erosion at crossings (38 yd^3/mi), but greater mass movement (1288 yd^3/mi) and total erosion (1326 yd^3/mi). Many of the untreated-road failures were debris torrents initiated in road fills that crossed headwater swales, with the sediment delivered into perennial stream channels.

There are two possible reasons for the low failure rate of culverts and crossings in this storm. 1) The "untreated" roads in Redwood National Park were those considered to be less critical when rehabilitation projects were first prioritized 15 years ago and may have been built to better standards than the general sample of roads in northwestern California. 2) Short-term rainfall intensities were not great. The maximum 6-hr rainfall intensity was 2.5 in (2-yr rainfall event), and the maximum 24-hr rainfall intensity was 7.6 in (10-yr rainfall event). It's probably the short-term high intensity rainfalls that cause most crossing failures. However, this was the wettest December on record. The 60-day antecedent precipitation index (API) for this storm was 5.5 in. Although not as high as the 1953 and 1964 storms, it was higher than the API from the 1972 (4.5 in) and 1975 (4.9 in) storms which initiated many streamside landslides.

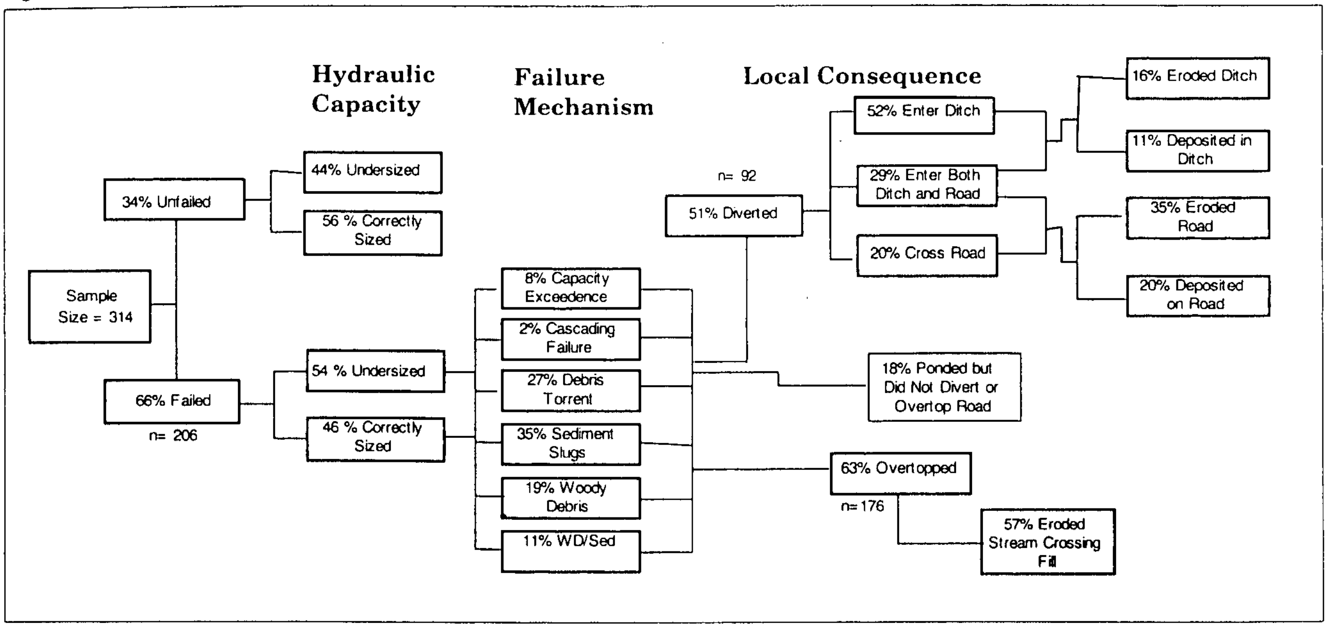
Mike Furniss reported on an examination of the effects of the 1996 Oregon/Washington flood events on road-stream crossings *(by Flanagan, Ledwith, Love, Furniss, and Ory)*. The objectives of the study were to 1) identify the common mechanisms and consequences of road-stream crossing failures; 2) determine how road-stream crossing design, construction, and maintenance influences failure; and 3) determine the degree to which specific failures and consequences could have been predicted using watershed-scale screening methods currently under development.

The study was conducted between April and December, 1996 in three physiographic regions: the Blue Mountains of eastern Washington and Oregon, the Cascade Range, and the Coastal Mountains of Oregon. The study focused on areas heavily affected by the flood events. Priority was given to road systems with a high frequency of failed culverts in which evidence of failure mechanisms was still intact. The survey was limited to road-stream crossings with definable channels and excluded bridged crossing and cross-drains. Road-stream crossing failure was defined as the overtopping of the top (crown) of the culvert inlet (exceedance of headwater depth/culvert diameter = 1). Field observations and measurements were used to determine the primary mechanism of failure and the local consequences of exceedance.

Figure 1 (next page) shows the distribution of failure mechanism, hydraulic capacity, and local consequences for the sampled crossings.

Woody debris and sediment plugging were the primary causes of road-stream crossing failures. In the Cascade Range the most common failure mechanisms were debris torrents (30%), followed closely by sediment slugs (25%) and woody debris (23%). Sediment slugs were the principal failure mechanism for the Blue Mountains (68%) and the Coastal Mountains

Figure 1. Distribution of samples, hydraulic capacity, failure mechanisms, and local consequences of failure for OR/WA crossing performance study



(39%). Hydraulic exceedence was not a prevalent cause of failure, accounting for 8% of the failures in the study. The size and intensity of storm events influences the distribution of failure types. Large storm events (i.e., February 1996) will initiate more debris torrents and will transport larger-sized and increased volumes of culvert plugging material. Study areas that experienced lower intensity storms had fewer debris torrents and more failures due to hydraulic exceedence and woody debris plugging.

The consequences of road-stream crossing failure included erosion of the crossing fill due to overtopping, diversion of streams onto the road or ditch producing severe erosion, and routing of runoff to adjacent watersheds. Fill erosion was found at 49% of the failed crossings, with the greatest erosion associated with debris torrents. Diversion of streams occurred at 51% of the failed crossings, resulting in erosion of the ditchline and road surface, and gullying of the sidecast road fill. In addition, 69% of the diversions left the originating watershed and delivered runoff to an adjacent watershed and stream. Cascading failures occurred where stream diversions were routed to adjacent crossing structures, causing them to fail.

The hydraulic capacity and the return period of the flow event required for hydraulic exceedance of each surveyed crossing was calculated. We found a relationship between hydraulically undersized crossings and failure due to hydraulic exceedence, but hydraulic capacity did not predict other failure mechanisms. We think that our ability to rapidly screen crossings for chance of exceedance will remain poor, while our ability to anticipate serious consequences of capacity exceedance is good. Priority for crossing mitigation should be based primarily on consequences rather than capacity.

The group then broke up into three groups to discuss various topics, including woody debris, roads and vegetation change effects on watershed response to floods. The latter group discussed the effect of changes in vegetation (e.g., clear-cutting, fire, grazing) on the response of hillslopes and stream channels to large floods. It focused on vegetation on hillslopes but also discussed the relation between riparian vegetation and its contribution to coarse woody debris in channels during large floods. Four main points were raised:

The major controlling factor of vegetation on flood response is the degree of departure from natural conditions of the distribution, type, density, and size of vegetation over the landscape. Any flood of a given magnitude in a watershed produces a unique and complex mosaic of hillslope disturbance that overlays and is dependent upon the mosaic of vegetation. One of the major ecological questions that we need to answer is "What level of departure is needed to significantly change watershed response to a flood of a given magnitude (e.g., the degree and extent of channel aggradation)?" Clearly, an ecologically significant change occurred in many watersheds in the three Provinces.

There is a mirror image of concerns for effects of vegetation on flood response: 1) how does vegetation affect the production and delivery of runoff and sediment to stream channels? 2) if a failure occurs, what is the contribution of vegetation incorporated in the failure to organic debris downslope and downstream?

Effects of vegetative change during a flood are propagated downslope and downstream through a series of linked (and often lagged) processes. In order to understand how vegetative change affects a downstream beneficial use, this hierarchy of process must be analyzed according to the distribution of vegetation over the landscape. For example, a clear-cut may increase the volume and rate of runoff during a rain-on-snow event. This may increase surface erosion of some soils but infiltrate and increase pore pressures that produce landslides in others, creating a great difference in type and volume of erosional products and effects on downstream resources. Analyses of this sort are required to understand large-scale effects of vegetation change (point #1).

A key management issue that could be investigated in the aftermath of this flood is the appropriate allocation and function of riparian buffer zones ("riparian reserves" in FEMAT parlance, "stream protection zones" in California Forest Practice rules). These zones are set aside to maintain the natural flow of watershed products to stream channels. How do patterns of inputs from riparian zones (e.g., landslides into stream channels) correspond to these designations? The Klamath National Forest is preparing to map streamside landslide and flood-altered channels and compare these to riparian reserves. However, issues other than floods converge in riparian zones. For example, dense riparian forests along steep, low-order channels may create fire ladders that encourage rapid upslope spreading of wildfires.

Woody debris is obviously recruited during large flood events. What recruitment mechanisms are amenable to management? The temporal and spatial scales of woody debris input would vary by region. Removing wood that is recruited to channels should be avoided if at all possible. It is important to raise the awareness of managers to the issue of woody debris recruitment and ecological functions. Would it be advisable to take a "woody debris show" on the road to managers? At the present time, biologists are having a greater say in how woody debris is managed but the likelihood of this influence continuing into the future is unknown—particularly given the organizational dynamics that accompany "post-disaster" emergency programs.

The legacy of past roads is the most durable effect on the landscape. The influence of roads may worsen in the future unless actions are taken to improve, maintain or remove roads. The costs of removing roads are very large and many recreationists demand that the roads stay in place. Design, location and maintenance are all important. Who is the audience for concern over roads and better road standards? A recommended action item is to develop a set of useful guidelines for repairing flood-damaged roads.

Topic 3: Effectiveness of Ecosystem and Watershed Management Strategies

Tom Lisle discussed the implications of large floods for ecosystem management strategies. Floods are not just disasters; they have effects on ecosystems that must be separated from impacts on infrastructure. Any given ecosystem effect may be positive, negative or neutral, depending on the resource being considered.

The recurrence of large floods provides occasions for adaptive management for disturbances that can have widespread effects on ecosystems and infrastructure. Unfortunately, up to now the prevailing motivation of managers after a large flood has been to rapidly repair damage to infrastructure and to prevent future damage, with little regard for possible beneficial ecological effects of floods, such as recruitment of large woody debris into riparian and aquatic ecosystems. Large floods should be considered as an opportunity to evaluate management and adapt practices to influence the disturbance regime. Understanding of the ecological effects of large floods should be integrated into land management practices, such as the design and maintenance of roads, which influence the response of watersheds to floods. It should also be integrated into post-flood repairs to infrastructure.

The process of evaluation, re-evaluation and adaptive management pertains to any large natural disturbance, e.g., wildfires. Operating rules are different during emergencies; laws and procedures may be temporarily suspended. To properly respond during such times, appropriate behavior should be defined in advance. There is some effort afoot to ascribe much of the flood damage to wildfires that occurred in 1987. Care must be taken to competently evaluate cause and effect, before operational "fixes", such as prescribed burning target acres are recommended.

FEMAT provides a format and policies that should apply to both "normal" and emergency situations. It stresses collaboration between land management agencies and other regulatory agencies like the Corps of Engineers and FEMA. Agencies that fund emergency response are potential targets for education. Most of these agencies do not participate now. The situation with respect to emergencies and proper responses is not unique to California. It is an ongoing problem. The Interagency Regional Ecosystem Office in Portland is a vehicle for promoting discussions. It is supposed to be responsive to implementation issues. The Regional Forester's office would have to bring it forward on the basis of a perception that the actions of funding agencies are not consistent with FEMAT. Other Forest Service Regions might need to be involved and specific instances of inconsistency would have to be identified.

Any effort at changing current procedures to be more consistent with ecosystem management would have to proceed simultaneously from the "top down" and "bottom up." Regional direction should define what "should" be done but individual Forests and departments would have to implement that direction. The Endangered Species Act and the EPA TMDL process could be used to advantage here. For the most part, standards and guidelines are in place. The question is: how do they fit with the regulations and procedures of the emergency response agencies such as FWHA?

Probably neither FEMAT nor SNEP have dealt effectively with large-scale disturbance events, although this flood has come soon after the inception of these analyses. Evaluation of past and potential disturbances such as large floods is one of the goals of watershed analyses under FEMAT, but it is questionable whether this has been done yet effectively. There needs to be a process in place that includes assessment and incorporation of ecosystem management into emergency response. Large-scale ecosystem analyses such as FEMAT, SNEP, etc. propose visions to improve response to disturbances. Lessons should be distilled for conditioning a pro-active response to further, inevitable, large-scale disturbance events. Large floods or wildfires generally occur someplace every year.

With respect to assessment, two scales are necessary: the project and the landscape. Regional assessment at a requisite lower level of resolution is also needed.

Considering private lands, the California Forest Practice Act has no jurisdiction over roads that are not associated with or used in a Timber Harvest Plan. In streamside zones, the protections afforded by California rules are primarily oriented to retention of shade canopy. Shade retention targets are generally met or exceeded. In an emergency situation, a landowner can take steps to repair damage or reduce economic losses but the rules still must be met. *Continues on next page* ☞

Where do we go from here?

The meeting concluded with a general discussion of how to get assessments done, including the assignment of tasks to individuals.

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Net Drainage: Some Flood-Related WWW Sites

California Flood Information from the Ceres site: http:// ceres.ca.gov/topic/flood2.html"

USGS 1997 Northern California Floods: http://water.wr.usgs.gov/flood97/

USGS California Water: http://water.wr.usgs.gov/index.html

Remember the Red River Floodplain: http://www.ncdc.noaa.gov/rcsg/dakotaflood/dakotaflood.html

California Data Exchange Center: http://cdec.water.ca.gov/

Historical Storms Strike Oregon: http://nimbo.wrh.noaa.gov/Portland/history.html

Oregon/Washington 1996 flood: http://www.ocs.orst.edu/reports/flood96/flood96.html

The Flood(s) of '96 (PNW): http://www.teleport.com/~samc/flood1.html

About doppler radar: http://www.met.tamu.edu/class/Metr475/lab6.html

Bruce McCammon's PDF: Flooding in the Pacific Northwest: http://watershed.org/wmc/flood.html

Editor's favorite weather site: http://www.nws.mbay.net/home.htm

Advancing the Art and Science of Watershed Management: the Role of the Watershed Management Council

Sari Sommarstrom
President-Elect, Watershed Management Council

Excerpts from a presentation at the California Watershed Symposium, on April 23, 1997.

What is the role of our organization, the Watershed Management Council, in better managing California's watersheds?

What the Council does

First, I want to describe WHAT the Council is. We're the youngest of the professional organizations represented here, founded in 1987 by a motley group of agency, university, and water utility professionals after the first California Watershed Management Conference in 1986. This conference was held in Sacramento as a forum to discuss issues and technical problems associated with the "multiple uses" of California's watersheds; instead of the estimated 100 attendees, almost 300 people came. This intense interest prompted the organizers to convene future conferences and to create a professional or collegial organization concerned with watershed management; thus, the WMC was born.

From an initial membership of 100, we have now grown to over 650 members in 28 states and 3 countries. Our sphere of influence has expanded beyond California into the western region where watershed management issues have much in common. Our members represent a broad range of watershed management interests and disciplines. Membership is open to anyone interested in watershed management. As we have no survey of the disciplines represented by our membership, I can only tell you that the WMC Board's composition is currently heavy with hydrologists (6 of our 9); with other professions being a forest ecologist, a plant ecologist, and myself - a generalist in resource management and planning. In fact, it is because I am both a generalist and a specialist that I became interested in the WMC as my preferred professional organization - so many disciplines are involved in it. It is a very comfortable fit. Another reason I enjoy the WMC is that it seeks out the Movers & Shakers—Idea People Questioning the Status Quo—as speakers and contributors, so as not to grow old and stale and to help keep the subject evolving.

The Council can best be described by its:

1) Objectives, 2) Functions, 3) Activities.

We had our 6th Biennial Conference last October on the subject of "dynamic equilibrium". The Proceedings will be out in about 3 weeks. WMC now has a part-time, professional staff that we share with the Centers for Water and Wildland Resources at U.C. Davis, who also publishes our Proceedings.

I believe the Council can play a significant role in education and communication of proper watershed management to all disciplines and to the public as well as help bring diverse views together through our conferences and field trips.

Now I need to clarify what the Council is not. It is:

* Not an advocacy group

* Not a certification society, as some of our co-sponsors are

* Not for professionals only, though a good chunk of us are

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The Sierra Nevada Ecosystem Project

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Centers for Water and Wildland Resources, UC Davis

In 1993, Congress requested a scientific review of the remaining old growth in the National Forests of California and a study of the entire Sierra Nevada ecosystem by an independent panel of scientists. With major funding from the U.S. Forest Service, the study was managed by the University of California and conducted by a team of 38 scientists from UC, other universities, private consultants, and state and federal agencies. The final report to Congress of the Sierra Nevada Ecosystem Project (SNEP) was released in June 1996. The emphasis of SNEP was to assemble and assess comprehensive data necessary to assist Congress and others in making important policy decisions for future management. Additionally, SNEP examined alternative management strategies to help meet the broad goal of maintaining the health and sustainability of the ecosystem while providing resources for human needs.

Many Sierra Nevada problems result from the impacts of an exploding human population estimated to become 2 million in the Sierra Nevada by 2040 (triple the 1990 population). Many ecosystem declines reflect institutional incapacities to capture and reinvest true resource values. Live and dead fuels are more abundant than in the past. Timber harvest practices, fire suppression, and other factors in this century have increased fire severity. Foothill, riparian, and aquatic habitats are especially altered, thus leaving many of their associated plant and animal species threatened. Structural complexity of forests is greatly reduced. Most of the remaining late successional forests are in the National Parks. Severe impacts of historic grazing still exist although current trends show some improvements. Air quality of the middle and southern range suffers from Central Valley sources. Most of the problems of the Sierra can be solved, although the time scale and

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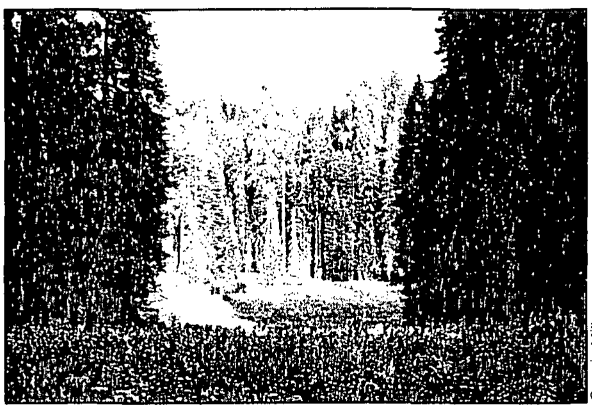

Connie Millar

Sierra Nevada Ecosystem Project

Watershed Issues in the Sierra Nevada Ecosystem Project

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Beginning with the original legislation that led to the Sierra Nevada Ecosystem Project, the condition of watersheds and aquatic systems was recognized as a critical part of an environmental assessment of the mountain range. As the project evolved, attention given to water-related topics continued to grow. Eventually, about one-third of the chapters in the final report directly concerned water resources and aquatic ecology (see list elsewhere in this issue). In addition, most of the subjects in other parts of the report influence and/or are influenced by aquatic resources. The short articles related to SNEP in this issue of the Networker are intended to provide a brief introduction to a sample of the chapters contained in the thousands of pages of material in the SNEP final reports.

The various aquatic efforts of SNEP found that development of streams and other resources of the Sierra Nevada over the past 150 years has impaired the quality and availability of water for both ecological and social needs in many parts of the mountain range. As human activities have altered characteristics of streams, such as volume of water, flood peaks, duration of low flows, seasonal timing, sediment supply, amounts of nutrients and organic matter, and water temperature, aquatic and riparian ecosystems have been forced to change. Other ecological changes have been deliberate, such as introduction of exotic species, conversion of streams to lakes, and conversion of riparian zones to roads and structures. The net results of a century and a half of these disturbances to the Sierra Nevada are greatly simplified and impaired aquatic ecosystems.

Continues on Page 4