SNAMP Water Integration Team meeting notes

July 31st, 2012, 10:00 am to 2:00 pm

US Fish & Wildlife Service, 2800 Cottage Way, Room C1003, Sacramento, CA 95825AND

On-line at: http://uc-d.adobeconnect.com/snampwaterit2012/

In attendance:

Jared Aldern, Prescott College
Roger Bales, UC Merced
Steve Brink, CA. Forestry Assoc.
John Buckley, CSERC
Mike Chapel, USFS retired
Walter Clevenger, Sierra Nevada Conservancy
Martha Conklin, UC Merced
Bob Dean, Calaveras County Water District
Matt Dunnahue, Placer County RCD
Dave Eggerton, El Dorado Water Agency
Nicolas Enstice, Sierra Nevada Conservancy
Chris Fisher, USFS American River District
Patricia Flebbe, USFS Region 5
Bruce Goines, USFS Region 5
Barry Hill, USFS Region 5
Kristin Honeycutt, CA Dept. Water Resources
Peter Hopkinson, UC Berkeley
Bob Kirkwood, Sierra Nevada Conservancy
Susie Kocher, UC Cooperative Extension
Jonathan Kusel, Sierra Institute
Kelly Larvie, Cal Fire
Anne Lombardo, UC Cooperative Ext.
Lynn Lorenson, NC Fire Safe Council
David Martin, USFS Bass Lake District
Sarah Martin, UC Merced
Bob Penn, CCWD/ACWA
Mark Rentz, Assoc. of CA. Water Agencies
David Rizzardo, CA Dept. Water Resources
Phil Saksa, UC Merced
Bill Stewart, UC Berkeley

On-line:

Susan Antenen, Center for Biological Institute
Jim Gaither, The Nature Conservancy
Marilyn Jasper, Sierra Club Placer Group
Jerry Jensen, Society of American Foresters
Ram Roy, UC Merced
Randy Wilson, Plumas County Flood Control & WCD

I. Welcome and overview

Susie Kocher gave a brief overview of the Sierra Nevada Adaptive Management Project (SNAMP), its goals, and the science teams involved. Meeting goals were to share the research progress and findings from the UC SNAMP water research team thus far. The desired outcomes are to develop shared understanding about the water team's research, allow for mutual learning

and build a foundation for adaptive management in respects to outcomes from the SNAMP forest treatments. An additional goal is to explain connections between the Water Team research and other projects including the Kings River Experimental Watershed, Stanislaus Experimental Forest, and the Sierra Watershed Ecosystem Enhancement Project (http://ucanr.edu/sweep).

II. Forest Service update:

Last Chance project: Chris Fischer, District Ranger of the American River Ranger District, said that the implementation was at about the same level of completion as reported in the meeting the month before:

- Thinned – 1086 acres
- Small tree removal – 1045 acres
- Mechanical piling – 305 acres
- Hand piling – 142 acres
- Underburning – 386 acres
- Prescribed fire – 326 acres
- Bear grass – 2 acres
- Cable thinning – to begin Sept. 2012
- Road decommissioning – 6.5 miles

Chris said the district has received additional funding to finish another 250 acres of burning this year and so complete all the burning scheduled. They also received funding from the Placer County Resource Conservation District and Resource Advisory Committee to remove piles for energy production, though all piles may not be removed by 2012. About 256 acres had some issues with flagging along streams where thinning cannot be done. Instead mastication will be done on about 100 acres through an agreement with the purchaser. So, a total of about 156 acres have been removed from treatment.

Sugar Pine project: Dave Martin gave an update on the SNAMP treatment being implemented on the Bass Lake Ranger District. There is a lot of activity right now and it is under contract to be completed by October 23rd. The project involved a Limited Operating Periods (LOPs) for a goshawk in residence. The Fish Camp project was just awarded to Sierra Forest Products in Terra Bella and is scheduled to be done in 2012.

Question: Did you get the archaeological issues figure out?
Answer: Yes, about 20 acres had issues with both archaeological sites and lack of access. Less than 10% of acres were affected.

The SNAMP public participation team plans to help host field trips to the Sugar Pine site and to the cable thinning unit on the Last Chance site in October 2012. Details will be announced when available.

III. Introduction to SNAMP Water Research:

Dr. Martha Conklin gave an overview of the water team's hypotheses and research methods. The presentation is posted at http://snamp.cnr.berkeley.edu/documents/474/. She explained that there are three main research questions that the water team is exploring:

1) Where and when is water stored? How is it routed through the forested catchments?
2) What effects do forest treatments have on water quality, quantity (yield), storage & routing through the catchments?
3) What is the transferability of information from plot scale to fireshed response?

Snow in trees tends to melt faster. Long wave radiation from trees melts the snow; some of it sublimates. Fewer trees increase snow retention on the ground if the gaps are not so large as to also increase solar radiation, temperature, and wind which increase melting. This brings to light the importance of the size of the gaps between trees in fuel treatments, as well as their placement. If done improperly, thinning could bring about a later snow melt.

Evapotranspiration (ET) is an important factor in the water cycle. Trees may have twice the rate of ET than previously thought. The team has a new paper out on measured evapotranspiration rates.

The team's hypothesis' are:

1) Fuel treatments will reduce leaf area index (LAI). As LAI decreases, snow accumulation on the ground will increase while evapotranspiration (ET) and snow retention in late spring will decrease. Lower LAI means less interception and more solar radiation. The size and spacing of gaps will also control snow accumulation and melting time.
2) A change in snow accumulation will be seen in the magnitude of peak stream flow. Changes in snow retention will be observed in the recession limb of the hydrograph and soil moisture curves. Changes in ET will affect both the timing and magnitude of late-season base flow.
3) Changes in water quality will be a function of changes in discharge. Increased turbidity will be a function of stream discharge as opposed to hill slope erosion.
4) Using hydrologic models, physiographic and hydroclimatic water thresholds can be defined linking areas treated with aquatic effects and impacts on the forest water cycle. Hydrologic models and spatial data will enable extending responses to the larger watersheds and fireshed scale.

Pre-treatment water data was collected between October 2007 and September 2012. Instrumentation was installed in phases. There are four years of meteorological data, three years of distributed snow depth data, and two years of distributed soil moisture stream water quality and stream level and discharge data. About 200 instruments are continuously monitoring.

IV. Pre-treatment Measurements

Water quality measurements are being used to identify the source of stream water in the watershed. Dr. Martha Conklin described what could be learned about water sources from specific conductivity, isotopes and turbidity data collected to date.

Conductivity: Specific conductivity of stream water which has collected by both through continuous sampling and grab samples. Both are done because mechanized sampling can drift and grab samples can be used to recalibrate. In general snow has low conductivity with not many dissolved salts that occur when water has contact with soils. Conductivity is typically lowest in the winter and highest in summer when water is evapotranspired by trees leaving salts behind.

The data shows that the Speckerman watershed, being used as a control, is an outlier in water routing as it shows no changes in conductivity over the year. This implies that water moves into the stream through fast shallow ground water flows in this long narrow watershed.

Water isotopes*:* Martha has also been looking at the isotopes of water in streams using ion analysis to identify the source of the water. Lighter isotopes of water evaporate in the atmosphere while heavier isotopes fall as rain. By the time precipitation falls as snow and much of the rain has already fallen, we expect snow to be lighter. Looking at stream water however, the team found a large range of light and heavy isotopes showing that there were many types of precipitation events feeding them. In general there was lighter water at higher elevation in the south, and heavier water at lower elevation in the north.

Turbidity: Turbidity may not be only a function of discharge; recent event history may also play a role. Turbidity was extremely low showing a fall "first flush" increase with the beginning of rains. Afterwards there seemed to be a seasonal depletion of sediment especially following multiple storm events. Individual spikes in turbidity seemed unrelated to precipitation events. They may be due instead to disturbances in the channel such as from people, wildlife or livestock. Or, it could be algae or fine organics that accumulate on optical instruments.

Water temperature: Water temperature begins to reflect the changes in air temperature throughout the day once the spring recession begins and evapotranspiration of trees kicks in. This suggests that water reaches the stream through a "piston-type" flow model rather than as surface runoff during snow melt.

Question: Your hypotheses are based on the existing hydrological circumstances. How will you account for current and future climate change with the change in precipitation from snow to rain?
Answer: This study was not developed to look at climate change though the model being

developed can be used to test how stream discharge is affected by changes in climactic variables. With climate change there should be a change in hydrological processes and vegetation. Trees are currently growing year round but could respond by decreasing their evapotranspiration. Areas could also type convert to grasslands which have a dormant period.

Question: Is the fact that Spreckerman is an outlier in terms of hydrology a problem for the study?
Answer: No, since the hydrograph is essentially the same as the other watersheds. The routing mechanism for the water to reach the stream is what is different.

Question: Is any of the post-treatment data available yet?
Answer: No, the data is analyzed by water year and the 2011-2012 year will be complied in October. There may be some preliminary impressions ready by then.

V. Modeling and Scenarios

Phil Saksa presented an overview of climate and water data collected so far including temperature, solar radiation, precipitation, wind, soil moisture, snow depth and stream discharge. The team has collected data during a good range of annual precipitation/conditions. The percentage of average precipitation measured 70% in 2008 and 2009, 100% in 2010, 120% in 2011, and 65% in 2012 so far.

Model calibrations: Calibrations on the CZO basins are near completion while the model for the SNAMP sites still needs improvement. Stream discharge is the integrating variable produced by all the rest. The data has been input to the RHESSys model to predict streamflow and then the modeled streamflow was compared to the actual measured streamflow. This model has been under construction for five years. So far observed streamflow has been less than the amount modeled. This is not the case for the watershed at the Kings River Experimental Watershed where the model is more mature. The SNAMP model for snow water equivalent is comparable to measurements, but needs better calibration with observed soil moisture and streamflow.

Originally researchers allowed the model to decide whether precipitation fell as rain or snow based on the average temperature for the day. However, this led to inaccuracies because temperature can change widely in the course of a day. They are now telling the model the form of precipitation based on information from snow depth instruments, yielding estimates of twice as much snow fall as before. This increased model accuracy from 0.5 to 0.82, which is now acceptable for this type of model.

Phil is trying to work out a few other issues with the model, including snow accumulation. In the Bear Trap catchment, the model predicts snow accumulation to last longer than measured.

Modeling results: Some preliminary modeling results have been developed. The model predicts that removing about 50% of the leaf area index reduces about one month's worth of water removed by vegetation through evapotranspiration.

However, the way the model reduces LAI currently is simplistic. Currently a reduction of 50% LAI could come from reducing the number of trees but leaving 100% canopy, taking all trees out on 50% of the area, or reducing both the density and cover of trees. These differences affect the water cycle and snowmelt and so should lead to differences in stream flow which the model cannot predict. In the future they plan to incorporate a more sophisticated snow process model using high resolution forest structure Lidar data to better estimate differences in water due to spacing.

Scaling up to larger watersheds is the final step in the modeling process.

Question: Are you measuring evapotranspiration on SNAMP sites?
Answer: No, we are measuring ET using a flux tower at the Critical Zone Observatory on the Kings River Experimental Watershed and using that data in this model.

Question: Is it really realistic to consider removing half the trees? If the canopy is at 70%, that would reduce it to 35%.
Answer: Feasibility will be considered in the model.

Question: There would probably not be much vegetation regrowth in year one of the treatment but there would be after. Can this model regrow vegetation?
Answer: Yes, we will be able to do that. This is one reason we are using the team is using RHESSys model.

Question: It looks like you are estimating a linear response between the trees and the hydrology. What if water is limiting? In other words, if you cut trees, won't other trees use it up?
Answer: Phil responded that they were not modeling a true linear relationship as there was not a one to one factor between LAI reduction and increase in stream discharge. Roger Bales explained that one difference in the Sierra compared to other locations where this type of research has been done is the seasonality of precipitation. Soil moisture here stays wet due to repeated rains, and is available to trees. The soil moisture dries out once, in the spring/summer and trees respond by reducing their evapotranspiration needs. Trees cannot use up water that falls as rain because soil moisture stays high throughout the season.

Question: Don't you think that depending on the type of thinning, we may just decrease the small trees that already have the least ET?
Answer: Yes, reductions in LAI reduce the number of leaves which also counts the understory. Some of Malcolm North's work in the Kings River showed that the understory can take out more water from the soil than trees. We need a two layer model.

Question: What about the effect of removing shade? Won't that increase wind and dry out fuels?
Answer: The two parameters being used are LAI and cover. The same number of leaves could cover 50 or 100% of the area. We are melting snow now in the model so we can simulate these effects.

Question: Will you anticipate more overland flow in spring due to climate change?
Answer: We'll be able to show difference in warm/dry years and simulate climate change. In the watersheds in question there is very little overland flow because infiltration rates are so high due to the sandy soils.

Question: What will happen to equipment when SNAMP is done?
Answer: No one wants to lose this source of data. We will work with agencies to find ways of incorporating the instrumentation into other projects.

Working Lunch
Discussion and report back on: How will SNAMP water data and analysis be used for adaptive management? Feedback from the group included the idea that SNAMP modeling conclusions are important in future efforts to make partnerships between those who do vegetation management and the downstream water user. There are many groups already organized that could help including IRWMPs and CFLRPs. Large land owners like SPI and the FS need to be involved.

VII: Other Forest Water Projects

The goal of the next section of the agenda was to discuss other forest and water research in the Sierra Nevada and how they relate to SNAMP. Susie passed out a matrix with information on these projects (available at http://snamp.cnr.berkeley.edu/documents/474/).

SWEEP: Dr. Bill Stewart, UC Berkeley forestry extension specialist gave an overview of the new Sierra Watershed Ecosystem Enhancement Project (SWEEP) funded by the University of California. The project is in the planning phase and is working out the measurements and methods to be used to identify the impacts of forest restoration thinning on water yield, carbon storage and wildfire risk. Bill said that research expect to find a difference in snow retention between different tree species because of their different architecture. That implies there would be a difference in evapotranspiration by species.

The research team is looking managers with treatments coming up to install instrumentation before and after using a study design similar to SNAMP. They are currently focused on the American River watershed. A difference between SWEEP and SNAMP is that in includes an economic valuation component to the study. Bill and Susie Kocher will be working with stakeholders to identify the economic value of the increased water yield, reduced sediment and carbon resulting from forest treatments. They anticipate beginning this process in the fall.

Participants suggested that organizers look at private landscapes managed by timber companies such as Sierra Pacific Industries or Collins Pine in other areas as one option. They also suggested looking at the live crown ratio of trees. It may also be very important to the amount of snow retained.

CZO/Kings River Experimental Watershed: Dr. Roger Bales explained that the extensive instrumentation installed at the Critical Zone Observatory within the Kings River Experimental Watershed over past 5 years is critical to SNAMP because it provides data to parameterize the SNAMP models. The data there is the best available. The key to transferring that data to SNAMP is to analyze its sensitivity. It's especially important to get the evapotranspiration and groundwater component right.

Stanislaus Tuolumne Experimental Forest: This is a new project in collaboration with the USFS Pacific Southwest Research Station where fuels treatment projects are on-going. Water research will involve assessment of snow accumulation effects. Thinning is in progress in summer 2012. Instrumentation will be deployed in fall 2012 so there is no pre-treatment data.

Question: How transferable is the SNAMP model being built to other areas?
Answer: Martha said that the key is to get the relationships between the components of the water cycle and the fluxes. If that can be done than the model is transferable elsewhere by changing these values to what is locally appropriate.

VIII: Wrap up/Evaluation:

The water team will be working on their 2012 data in the coming months. They hope to have an initial report by December. It is a challenge to have the water year data summarized for the annual meeting in October as it runs through October 31st. They plan to develop some conceptual models for the meeting, as well as describe some of the findings from their new paper on evapotranspiration rates.

Next, those in the room were asked what worked well about the meeting. They said:

- The meeting was well organized and on-time
- Everyone was well prepared including the participants
- The food and location worked well

What could be done differently?

- The room was a bit too small for the turnout
- Parking was very limited at the facility
- Participants are looking forward to post-treatment data!

Evaluation: 20 attendees at the meeting filled out evaluation forms. Participants agreed that the meeting was well organized with information and agendas available ahead of time. They agreed that constructive dialog was encouraged and that they learned something new. Their responses are summarized below: