AWRA newsletter
Washington Section
AMERICAN WATER RESOURCES ASSOCIATION
May-June 2008

PRESIDENT'S NOTES

Jacque Klug, WA-AWRA Section President

Greetings! In 2005 our Board of Directors developed a long-range plan for WA-AWRA, in which we defined goals and developed strategies for achieving them. Several of the articles and announcements in this issue of the newsletter highlight the progress we have made. The goals established in long-range plan are:

- Continue successful activities, such as the annual conference, student fellowship, newsletter, web site, and dinner meetings.
- Expand the geographic and disciplinary reach of our membership.
- Promote development of water resource policy through dialogue.
- Strengthen student involvement from universities across the state.
- Increase involvement of section members in planning and organizing activities.

The quality of our conferences, dinner meetings, newsletter, website, and student activities continues to be excellent. Our membership continues to be high, and is drawn from all parts of the state. The frequency of dinner meetings in Seattle has increased and we are holding dinner meetings in other locations. Last month we partnered with the Society of Inland Environmental Scientists (SINES) to bring University of Washington Professor David Montgomery to Spokane for a discussion on erosion and soil management. This month Robert Kimbrough, Assistant Director of the USGS Washington Water Science Center, will be presenting at a special dinner meeting in Olympia on record flooding over the past few years.

This year's 2008 annual conference theme is water storage, to be held on October 23 at the Bell Harbor Conference Facility in Seattle. With the numerous storage projects underway in the state, the conference will provide a forum for discussion of the role of storage in adapting to climate change, meeting growing human demands, and restoring streams and aquifers.

We have held several networking social events with the University of Washington student AWRA chapter over the past two years. I encourage all members to attend one of our networking events, or, better yet, sign up to mentor a student or young graduate. You can register for our mentorship program on the WA-AWRA website.

Student fellowships are now worth $2,000 – up from $1,500 in past years. You can read about the 2007 fellowship students and their research projects in this issue. We continue to work toward establishing a self-supporting endowment for the scholarships. Your contributions, and especially those of the annual conference, are making this possible.

We are very saddened to inform you that Stephen Hughes, our Secretary and an active member of the WA-AWRA board, recently suffered a head injury playing tennis. He is recovering but will be in convalescence for several months. We will provide an update on Steve's condition in the next newsletter.

We are making great progress toward our goals, but there is still a lot of work to do. If you have ideas for achieving or updating our long-range goals, please contact me or Cleve Steward, chair of the long-range planning committee.

We would especially like to have more involvement from our membership in planning activities. If there is an issue affecting your part of the state that would make a great dinner meeting presentation, discussion topic in your region or newsletter article, please contact me or any member of our Board of Directors (page 11). We are always looking for new ideas, faces and energy to improve our section!

INSIDE:

Annual State Conference – October 23, 2008 – Bell Harbor

PRESENT & FUTURE OF WATER STORAGE IN WASHINGTON STATE

Groundwater Storage in the Yakima River Basin

By Alyssa Neir, Chris Pitre, and Bob Anderson, Golder Associates

The U.S. Bureau of Reclamation (USBOR) and the Washington State Department of Ecology (Ecology) have prepared the Draft Planning Report/Environmental Impact Statement (PR/EIS), Yakima River Basin Water Storage Feasibility Study, Yakima Project, Washington (USBOR and Ecology, 2008) to evaluate the viability of storage alternatives in the Yakima River Basin (http://www.usbr.gov/pn/programs/storage_study/reports/eis/index.html). The current water supply and storage capacity within the Yakima River Basin does not meet water supply demands in all years and affects the Yakima River Basin's agriculture-based economy. Water resources are also vital to the basin's aquatic resources. Therefore, USBOR's goals for the storage study include:

- Improving anadromous fish habitat by restoring the flow regimes of the Yakima and Naches Rivers to more closely resemble the natural (unregulated) hydrograph.
- Improving the water supply for proratable (junior) irrigation entities.
- Meeting current and future municipal water supply needs.

The Yakima Project was authorized by Congress in 1905 to increase the storage capacity within the basin. Development of the Yakima Project progressed with the construction of Bumping Dam (1910), Kachess Dam (1912), Clear Creek Dam (1914), Keechelus Dam (1917), Tieton Dam (Rimrock Lake, 1925), and Cle Elum Dam (1933). These six federal reservoirs have a total storage capacity of 1,070,000 acre-feet. They provide the water supply necessary to help meet the irrigation and instream flow needs by storing and regulating a portion of the flow of the Yakima River and its tributaries.

Other principal features of the Yakima Project include several diversion dams, two hydroelectric generating plants, and numerous canals, laterals, and pumping plants. The Bureau operates the Yakima Project to meet water delivery entitlements as specified in a 1945 Consent Decree. These entitlements are prioritized, and there are proratable (junior) and non-proratable (senior) entitlements to water from the Yakima project. Proratable water users did not receive their full entitlement in 1992, 1993, 1994, 2001, and 2005.

The USBOR evaluated three potential surface storage options (Black Rock reservoir, Wymer Dam and Reservoir, and Wymer Dam plus Yakima River Pump Exchange) in the Draft PR/EIS. Ecology evaluated three "state only alternatives" in the Draft PR/EIS: enhanced water conservation, market-based water reallocation of water, and groundwater storage. The groundwater storage assessment is described in this article. The assessment is part of a draft document and is subject to revision.

Groundwater Storage Assessment

A basin scale assessment of groundwater storage by direct injection and surface infiltration was performed as part of the state's storage alternatives analysis. Different methods of recharging an aquifer and recovering the water from the aquifer were evaluated. Water can be recovered from underground storage via a well (active recovery, also called Aquifer Storage and Recovery [ASR]) or by allowing the water to discharge naturally to surface water bodies (passive recovery). The groundwater storage alternatives are conjunctive use tools in which the use of surface water and groundwater can be coordinated to minimize impacts to the hydrologic system and provide environmental benefits.

Aquifer Storage via Direct Injection

Aquifers can be used to store water by injecting water via wells into subsurface geologic formations. A direct injection project must meet drinking water standards (federal Safe Drinking Water Act [SDWA], and Washington State Department of Health [WSDOH] WAC 246-290), water rights regulations (RCW 90.03 and 90.44), ASR regulations (WAC 173-157), well construction regulations (WAC 173-160), water quality standards (WAC 173-200), and underground injection control program regulations (WAC 173-218).

The City of Yakima's Naches River Surface Water Treatment Plant – a possible source of water for recharge in the Ahtanum Valley.

Several direct injection scenarios were evaluated with respect to their ability to satisfy out of stream water demand and their ability to increase streamflows to the Yakima River. In the Yakima Basin, deeper aquifers that are suitable for ASR are also in

hydraulic continuity with the Yakima River. Therefore any "inefficiencies" in the recovery of direct injection are transferred to instream flow benefits over the long term.

A three-dimensional groundwater flow model was developed for the Ahtanum-Moxee Sub-basin to simulate the effects of multiple annual direct injection cycles of direct injection to the deeper portions of the Ellensburg Formation. The focus of the model was on the resulting recoverable storage and seepage return flows to the Yakima River. Analysis was based on a water balance approach, as opposed to recovery of the "same molecule." The results of injection to the deeper part of the Upper Ellensburg formation showed:

- Very high recovery efficiencies in the years immediately following injection (*e.g.*, 90%).
- A significant lag time between injection and seepage to the Yakima River (*e.g.*, >1 year).
- Recoverable aquifer storage can be built up over several years of injection without recovery, thereby creating a reserve that could be called upon in a drought year.

The benefits of increased water availability from ASR were evaluated in several ways.

- Summer diversions of surface water could be replaced to immediately improve streamflows.
- Summer future demand could be satisfied without surface water withdrawals. Return flows from the water used will also increase streamflows (*e.g.*, *via* waste water treatment plants).
- Recovered storage could be pumped directly into tributaries or the Yakima River to increase streamflows, and possibly be diverted downstream ("pump and dump").

Seepage of unrecovered water and increase in groundwater levels would increase streamflows (*i.e.*, by passive recovery).

Aquifer Storage via Surface Infiltration

Increasing aquifer storage via surface recharge involves diverting and infiltrating surface water into recharge basins and allowing it to naturally return to a stream. The time lag between infiltration and discharge is a short term groundwater storage effect that can increase stream discharge during periods of low flow.

Water availability for recharge is an important constraint on the feasibility of surface recharge. Because of the short time between infiltration and return to the stream, infiltration has to occur within the irrigation season. The potential water available for surface recharge was based on an evaluation of the potential "excess" reservoir storage. It was assumed that 10,000 AF of water could be released for surface recharge in most (but not all) months during a given water year. The availability was constrained

by existing entitlements so that "excess" water was only available if reservoir storage volume exceeded the total remaining entitlements plus a 20,000 AF buffer. Based on the historical analysis, no excess water was available for infiltration in some years (e.g., 1993, 1994). In other years, excess water was available during May and June, but not July or August.

The City of Kennewick's Badger Mountain candidate ASR site.

The monthly return flow to the river from the water delivered for surface infiltration was calculated using monthly infiltration volumes and a stream depletion factor (SDF). The SDF approach is an established and commonly used method for evaluating pumping effects on streamflows, and was applied in reverse for this study. The SDF factor describes the relationship between recharge to an aquifer and the resulting return flow to a nearby stream based on the distance between the recharge location and the stream, how much water can be stored in the aquifer (specific yield), and how fast water can move through the aquifer (transmissivity). Stream depletion factors of 30 and 60 days were used in the analysis, because they result in the majority of the infiltrated water returning to the river in the first few months after infiltration. This allows available surface infiltration from May to June to return to the river from July to September when water demand is highest for both out-of-stream and instream uses.

The analysis predicted that surface recharge to alluvial aquifers could produce, on average, a total of 23,000 to 26,000 AF of return flow to the Yakima River May-October if an average of 33,000 AF infiltrated. During extreme dry years, benefits were significantly lower, but carry-over effects from previous years were predicted.

Next Steps

The basin-wide assessment of groundwater storage opportunities in the Yakima Basin can be used as a starting point to identify specific groundwater storage projects. In general, the analyses emphasize the need for a programmatic approach whereby recharge (whether as direct injection or surface recharge) is applied year-after year regardless of the climatic cycle. ≈

Municipal Water Law – An Environmental Perspective

By Rachael Paschal Osborn, Center for Environmental Law & Policy

As the municipal water law (2E2SHB 1338) heads into court much is being argued about its purported benefits to water purveyors, along with its disruption of the priority system for water allocation. What is not well understood, however, is the environmental ruin that the municipal water law will soon be causing to rivers around Washington state.

The waters flowing in Washington's rivers and aquifers are over-allocated. For most water bodies, claims and rights to the use of water exceed quantities available, particularly when environmental needs are factored in. The municipal water law exacerbates this over-allocation by allowing increased water use via "inchoate" or "paper" water rights without consideration of what rivers and aquifers are capable of yielding.

A review of basic water law principles helps explain the problem. The prior appropriation doctrine comprises a set of common law and statutory rules: seniority ("first in time, first in right"); loss for non-use ("use it or lose it"); reasonable efficiency; and no waste. In 1917, the Washington Legislature enacted these rules into the state surface water code, and in 1945 extended them to groundwater. Water uses pre-dating these statutes were grandfathered in.

The water codes established an additional set of rules. New water uses required a permit, subject to several tests: water must be available physically; water must be available legally (*i.e.*, a new use may not impair an existing use); the new use must be beneficial (meaning both a productive purpose and reasonable in quantity for that purpose); and the public welfare must not be harmed.

The prior appropriation rules have an important rationale. The first person to access water (User No. 1) possesses the right to demand that those who come later in time curtail their use. This is such a draconian power that User No. 1 has reciprocal obligations: to use water only in quantities actually needed, and to use it with reasonable efficiency. Water that No. 1 does not need then goes to the next user in line.

These rules – priority of right, efficiency, and loss for non-use, and public interest – are correlative. The priority system is by its nature inequitable, imposing a harsh outcome on junior users when water is scarce. The rules inject balance into the equation, prohibiting senior users from water hoarding and wasteful use, thus minimizing the frequency of curtailment for junior water users.

Sadly, these rules have been honored more in the breach than observance. With respect to water availability, the Department of Ecology Water Resources Program (formerly the Department of Water Resources) historically did not formally assess physical water availability (*i.e.*, whether the naturally occurring water budget was adequate to supply new water rights). Instead, the agency assumed that water was available until users complained, at which point an adjudication might be filed or other enforcement action taken. But the agency rarely compared the quantity allocated with the amount of water physically available in the source of supply.

The failure to consider available supply led to over-allocation of water resources, particularly after factoring in the need to maintain instream flows for fish and wildlife habitat, recreation, aesthetics and other public purposes. Compounding the problem was the state's failure to adhere to the beneficial use and non-use rules. As discussed by the Washington Supreme Court in Ecology *v.* Theodoratus, for decades the agency illegally issued water rights to public and private suppliers in excess of need, contravening the beneficial use test which requires that water rights be quantified based on actual use. Instead, the state quantified water rights based on system capacity ("pumps and pipes"). This practice not only violated beneficial use requirements, but is now aggravating the problem of inadequate stream flows by allowing municipal water suppliers to take what water remains in rivers and aquifers. As discussed below, this raises red flags for river restoration programs.

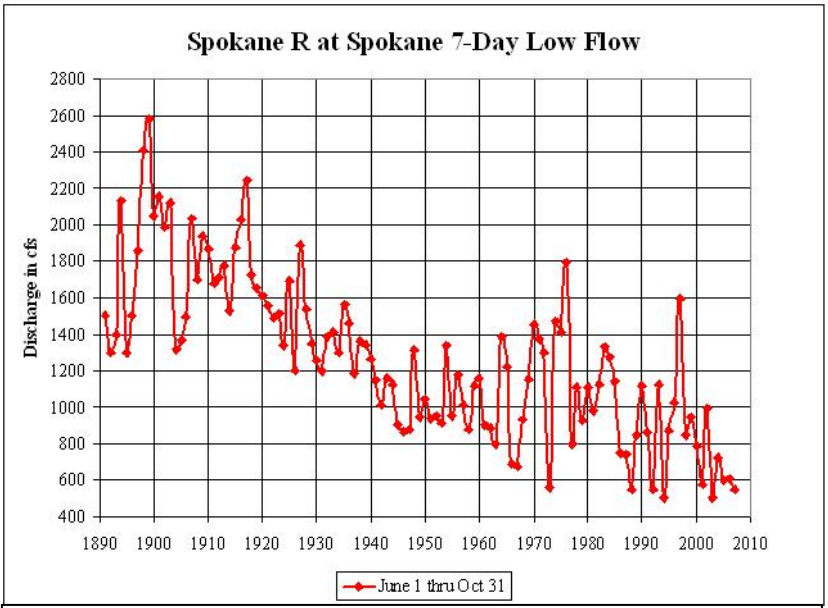
Spokane River @ TJ Meenach Bridge

The Spokane River-Aquifer system provides an example of the problems of the municipal water law. The accompanying chart, showing the lowest 7-day annual flow in the Spokane River each year for the period 1891-2007, starkly illustrates a vanishing river.

Historically, low flows ranged around 1,600 cubic feet per second (cfs), but in recent years have dropped to 600-700 cfs. Blame for the lost 1,000 cfs is likely attributable to three causes: reduced spills from Post Falls dam; decreased snowpack in the upper watershed (caused by loss of forest canopy (*e.g.*, clear-cutting

and climate change); and groundwater pumping. Declining flows in the Spokane River are causing serious and expensive problems, including devastation of the native redband trout population, inadequate flows to dilute wastewater effluent, and loss of recreational opportunities.

How does this connect to the municipal water law?



Provided by John Covert, Washington Department of Ecology

The relationship between the Spokane River and the Spokane Aquifer (sole source of drinking water in the Spokane-Coeur d'Alene region) is intimate, with a series of gaining and losing reaches culminating in substantial spring-fed discharge to the River. Pumping from wells adjacent to the River can cause near-term depletion of instream flows.

The City of Spokane holds 147,000 acre-feet of ground water rights, of which 77,000 acre-feet have never been pumped. Rights to this unused quantity were of questionable validity until enactment of the municipal water law. Recent modeling shows that, as the City grows into its paper rights, Spokane River flows will drop by an additional approximate 220 cfs. Ecology files establish that, when the agency issued massive paper water rights to the City of Spokane, it did not consider whether water was physically available, whether the water was actually needed, nor what the impacts of pumping the City's rights would cause to flows in the River.

Spokane River flows may improve with a new requirement that Post Falls dam increase its minimum discharge. There has also been discussion about creating trust water rights to boost instream flows.

But here's the catch.

No matter how much water is restored to the Spokane River, the improvements cannot be maintained. Rather, the City will take any increase in flows as it expands its pumping. Moreover, despite the municipal water law's 'quid pro quo' – the requirement that water purveyors set and implement conservation goals – the City has made no effort to curb or offset the harm to the River that will result from increased municipal pumping. On the contrary, the City has taken ultra-conservative positions in flow setting negotiations (*e.g.*, proposing 565 cfs as a summer minimum flow), driven by a stated desire to avoid responsibility for mitigating impacts to the Spokane River.

The municipal water law exacerbates the state's long-standing practice of over-allocating water resources – and then makes it impossible to cure the problem. This issue is not limited to Spokane, but repeats itself throughout the state. For example, restoration of freshwater flows in Puget Sound watersheds, a topic of discussion in the Puget Sound Partnership process, will not be possible given the large number of paper municipal water rights in the region, and the loss of stream flow that will result as those rights are put to use.

The water rights that purveyors hold on paper today represent water that is now flowing in rivers or aquifers. Depleted rivers and consequent habitat loss, water quality degradation, and destruction of recreational values – these problems will only worsen as the full impact of pumping paper water rights, allegedly now valid under the municipal water law, removes more water from already over-allocated streams and rivers throughout Washington.

Rachael Paschal Osborn is executive director of the Center for Environmental Law & Policy (CELP), a public interest organization dedicated to protection of rivers and aquifers throughout Washington and the Columbia River Watershed. CELP is a plaintiff in the Burlingame v. State lawsuit. Rachael can be reached at 509-209-2899 or rosborn@celp.org.

From http://wdfw.wa.gov/do/weekendr/weekendr.htm:

On May 10, the Little Pend Oreille National Wildlife Refuge will host an annual bird walk along the ridge overlooking McDowell Lake, with an optional two-mile walk to some beaver ponds. Participants will see and hear yellow warblers, common yellowthroats, vireos, chipping sparrows, red-necked grebes, red-winged blackbirds, and more migratory species. It's also a good opportunity to spot lots of resident birds. Refuge staff say that as a bonus, you may even see a moose. Contact the refuge at 509-684-8384 for more information.

Climate Variability, Water Resource Development, and Socioeconomic Development in Kittitas County

By Jeremy Lieb, Resource Management Graduate Student, University of Washington

Kittitas County is located on the east slopes of the Cascades Mountains mostly within the Upper Yakima River Basin. Because of Kittitas County's situation leeward of the Cascade crest, there is a considerable rain shadow effect in the eastern lower elevation parts of the County. While the mountains in the northwest part of the County receive over 100 inches of precipitation annually and support dense coniferous forests, the shrub-steppe in the southeast receives only 8 inches. Because of the extreme climate gradient of Kittitas County, and the cyclical nature of Pacific Northwest climate, dominated by ocean circulation events such as El Nino and the Pacific Decadal Oscillation, drought is a relatively common occurrence in Kittitas County, but is usually of relatively short duration. Climate models now indicate that future increases in severity and occurrence of drought may occur as a result of greater climate variability.

As a result of potentially increasing climate variability and the relative scarcity of water, some argue that Kittitas County is particularly susceptible to drought impacts. Most of the human population and agricultural production, which has historically been a very important part of the economy in the County, occurs in the lower elevation dry valleys. This population has always depended on the much greater precipitation of the surrounding mountains and the storage of water in mountain snowpack, storage reservoirs, and ground water to sustain irrigated agriculture and domestic water use through the summer months. For example, a reduction of surface water availability of 50% to junior water right holders, which occurs on average once per decade, is estimated to cost the Kittitas County agriculture industry approximately nine million dollars. However, drought impacts are not limited only to the agricultural sector. In many years aquatic species, including several federally listed endangered species, are threatened by low flows because of over-allocation, particularly in small tributaries. Similarly, the city of Roslyn has frequently faced reductions in its municipal water supply during summer months. Despite these examples of drought impacts, the ultimate susceptibility of the Upper Yakima Basin to drought is not fully understood. A 1978 study by Martin Kaatz found that the worst drought on record, occurring in 1977, resulted in only a relatively minor disruption, and in 2005 Marc Dunbar found that the water management institutions of the Yakima Basin may already be capable of effectively managing water resources with consideration for present and future climate variability, and the associated potential for impacts of drought and other severe weather events.

There has been considerable study of the potential impacts of climate change induced drought on water resources in the Yakima and Columbia Basins and elsewhere in the Western U.S., some of which suggest increasing storage as a potential solution. Although these studies have focused on future predictions for water demand and climate change, they have not grounded those predictions in the historic impacts of climate variability and water resource development. There have also been many studies in the U.S. and Canada and elsewhere in the world that have looked at the past socioeconomic impacts of drought and climate variability, many of which have discussed future impacts, based on predicted climate change. However, there has been none focusing on Kittitas County, and none of these studies has considered the past interactions between climate, water resources development, and socioeconomic development.

My thesis research is aimed at augmenting the historical research on the relationships between water resources and climate in Kittitas County, and to assess the historic impacts of water resources development and climate variability on the economy of the County. Using both qualitative and quantitative methods, this research is intended to address the extent to which water resources development, socioeconomic growth, and climate are interrelated. I am seeking to identify the real impacts of past water resource development as well as weather and climate events, especially drought events, in order to provide insight into potential future impacts of climate change and variability and to assess the utility of increasing water storage as a tool for mitigating potential impacts.

My analysis of qualitative data has been conducted through a chronological historical discussion, which compares the socioeconomic development, water resources, and climate histories of Kittitas County. A wide variety of sources have been used to develop that history including: previous literature in water resources, history, economics and other fields, legal and agency documents, court decisions, early written histories of the county, newspapers, and climate, water resources, and socioeconomic data provided by a variety of agencies and organizations. The history of Kittitas County has been divided into six periods based on shifts in the major socioeconomic trends of the county, in each of which the relationships between climate, water resources development, and socioeconomic development for that period is discussed.

The first period is pre-1860, a period dominated by exploration and Indian conflict. During this time there was no permanent settlement, largely because the Yakama Indians were believed to be hostile. Treaties in the 1850s paved the way for Euro-American settlement in the 1860's. Climate, however, impacted early explorers and fur trappers. For example, Lewis and Clark experienced

comparatively wet and cold conditions in the region between 1804 and 1806, possibly because of the occurrence of La Niña conditions combined with a cold Pacific Decadal Oscillation. These wet conditions may have made their winter stay on the coast less comfortable, but increased game, as a result of better forage, and increased stream flows likely aided them on their inland voyage.

The second period is 1861-1880, which saw the first permanent white settlement, and the first irrigation ditches and companies. This period was dominated by open range cattle ranching, an activity very susceptible to weather extremes. The relatively mild period of 1861-1880 came to a dramatic end with the very harsh winter of 1880-1881, which decimated cattle herds and necessitated hay storage in the future. The period of 1881-1910 was economically dominated by mining and lumbering in the mountainous northwestern portion of the county, though significant expansion of irrigated agriculture also occurred. During this period, two railroads were completed through the valley, which opened new markets to Kittitas County crops. It was during this era that severe drought was first experienced. Several major droughts occurred in the 1890s, the impacts of which were exacerbated by the importance and extent of irrigated agriculture and the lack of any water storage.

The 1911-1940 period saw the development of large federal irrigation projects including the 70,000 acre Kittitas Division of the Yakima Project, and the three related major upper county dams. During this time irrigated agriculture became the dominant economic sector as a result of the major addition of new irrigated land, and the relative decline in the importance of coal. The only major droughts during this period occurred in the early 1930s and coincided with the completion of the county's final major dam, Cle Elum Dam, and with the completion of the Kittitas Division irrigation network, which shielded irrigators from especially severe drought impacts that may otherwise have occurred.

From 1941-1970 the importance of agriculture to the County economy began to very slowly decline, while pasture and feed for livestock increased dramatically as a use of irrigated land. Overall this was a relatively wet period, and drought was not a significant problem. Total irrigated land peaked during the early 1940s and declined gradually thereafter, and during this period the City of Ellensburg expanded its use of deep groundwater wells, which ensured a steady supply of water for the city. Since 1970 there has been a major shift away from agriculture as a dominant sector of the economy, though it remains culturally very important. Central Washington University underwent major growth in the 1970s and from the mid 1990s to the present, and is now a major economic force in the county. Real estate development has also boomed, and has replaced former agricultural land. Though there were severe droughts in the late 1970s and several in recent years, none had the extreme impacts that many predicted.

My preliminary historical analysis has lead me to the conclusion that agriculture is the only sector with potential to be severely impacted by drought and climate variability, and that the total economic impacts of drought in Kittitas County have diminished significantly over time as the economy has diversified. It seems likely that our current water use could be supported, even with the moderate increases in severity and occurrence of drought predicted in many climate models. However, the potential for increasing water use through exempt wells is a growing concern. Additionally, agriculture remains an important part of the regional culture, and as a result drought impacts to agriculture are significant irrespective of the overall economic impact of drought.

I am currently working on the quantitative portion of this research, which will include statistical correlations and graphical comparisons of annual precipitation, temperature, evapotranspiration, snowpack, and snow water equivalent, total agricultural product value, total allocated surface water, domestic well use, spring water storage, stream flow, number of farms, total cropland, total irrigated land, per capita income, and population.

In addition to funding from the American Water Resources Association -Washington Chapter, this research has been funded by the Central Washington University (CWU) Office of Graduate Studies and Research, the CWU Environmental Resource Management Association, and the CWU Resource Management Program, and has been supervised by Dr. Anthony Gabriel, CWU Geography Department; Dr. Charles Wassell, CWU Economics Department; and Dr. Thomas Wellock, CWU History Department.

From http://wdfw.wa.gov/do/weekendr/weekendr.htm:

It's the beginning of wildlife reproduction time, and depending on the species, that can mean problems for some homeowners. Skunks and raccoons are the most common "nuisances" as they find crawl spaces, outbuildings, and other nooks and crannies to set up housekeeping for their coming babies. Squirrels, moles, rabbits, marmots, snakes and bats are among the other species preparing to raise families that are potential nuisances around human homes

Several closures to protect wintering elk on WDFW wildlife areas in south central Washington will open again to public access May 1. Gates on the Robinson Canyon and Joe Watt Canyon roads into the L.T. Murray Wildlife Area west of Ellensburg in Kittitas County will be unlocked by May 1.

Seasonal Climate Forecasts for Water Resources Management

By Eric Rosenberg, Department of Civil and Environmental Engineering, University of Washington

The western United States faces the challenge of meeting a variety of demands with limited and uncertain supplies. With snowmelt accounting for roughly 75% of streamflow in the West, snow surveys have provided water supply forecasts for the April-July season of peak demand. But because forecasts are based on conditions known at the time of issue, significant forecast error can result from uncertainty in the amount of precipitation falling through the end of the target season. Even more significantly, their use is limited to three or four months, beginning with the onset of snowfall in December and January.

Our understanding of the influence of oceans on continental climate provide the basis for seasonal climate forecasts, which improves the lead time of water supply forecasts by reducing uncertainty about future precipitation. Perhaps the most recognized of these teleconnections is the El Nino–Southern Oscillation (ENSO), although other phenomena like the Pacific Decadal Oscillation (PDO) have also been shown to have an influence on North American climate. A combination of methods for forecasting ocean temperature and associated atmospheric effects is being used at a number of weather and climate centers, including NOAA's Climate Prediction Center (CPC) that present forecasts as probability anomalies for overlapping three-month "seasons" with up to 13 months forecasts.

(www.cpc.ncep.noaa.gov/products/predictions/90day/).

As in Washington State, California water managers depend on accurate and early water supply forecasts where the nation's largest populace and leading agricultural industry compete for water in a state with an average annual precipitation of 23 inches. Roughly 2/3 of this population and half of its agriculture are served by the state-managed State Water Project (SWP) and federally-managed Central Valley Project (CVP), deriving their water from the Sacramento and San Joaquin River basins. The distribution hub for these systems lies in the Sacramento-San Joaquin Delta, home to the largest estuary on the west coast and 80% of the state's commercial fisheries. It is an ecosystem on the brink of collapse, whose delicate balance was further undermined in the spring of 2007, when plummeting populations of Delta smelt prompted court orders to curtail pumping in what was already a dry water year. With diversions limited by up to 30%, initial allocations to water contractors were estimated at just 25% for 2008, though higher-than-normal snowpack has since raised these allocations.

Drought is a very real threat to the States of California and Washington, but one that could potentially be mitigated with longer-term water supply forecasts. For example, had California's Department of Water Resources (DWR) known in water year 2006, which was wetter than normal, that 2007 would be dry, project operations could have been modified to increase carry-over storage and equalize deliveries over the two years. Had water contractors known that water deliveries would be low, they could have explored alternative water sources like water bank purchases and groundwater pumping, before market prices rose in response to poor hydrologic conditions. Likewise, California's Environmental Water Account, which purchases water on the statewide market to reimburse the SWP and CVP for reduced Delta exports, could have acted earlier to augment instream flows. At the least, seasonal climate forecasts hold the potential to improve DWR's credibility with its long-term contractors, especially in years that start off wet but become dry, or vice-versa.

To determine the value of seasonal climate forecasts for California water, an analysis was conducted on the relative accuracy of forecasts in the Sacramento and San Joaquin River basins, broadly covered by CPC forecast divisions 88 and 91, respectively (Figure 1).

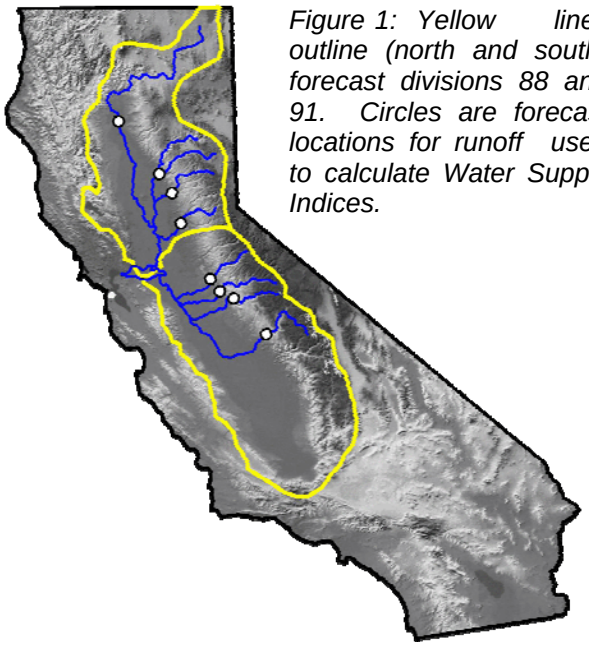


Figure 1: Yellow lines outline (north and south) forecast divisions 88 and 91. Circles are forecast locations for runoff used to calculate Water Supply Indices.

As inputs for the analysis, we employed seasonal precipitation and temperature outlooks archived in two sources – the official dataset of CPC forecasts, which have been generated by a continually changing set of algorithms since their earliest public release in December 1994, and an objective dataset of forecasts, retrospectively generated by the latest methods to January 1982, and more representative of the accuracy of future forecasts.

Among the accuracy metrics evaluated were the "directional hit rate," which we defined as the percentage of forecasts predicted in the correct direction with respect to the climatological (historical)

mean, and the "mean absolute error accuracy score," which compares the difference in forecasted and observed values to that using the climatological mean. Results of the analysis revealed best forecast scores for summer target seasons when precipitation makes up the bulk of the runoff. A breakdown by ENSO and PDO trends yielded slightly higher prediction rates during the warm phases of each cycle, an expected result since these phenomena are the primary drivers of the forecasts. Accuracy was found to be only nominally influenced by lead time, against expectations that it would increase as lead time shortened.

The study discovered that extending the analysis determined not only the percentage of hits and misses, but also the direction of the misses. Water managers are typically less concerned with "false alarms," defined as those misses in which the precipitation forecast was dry but the observation was wet, than "false assurances," defined as those misses in which the precipitation forecast was wet but the observation was dry. When averaged over all target seasons and lead times, false alarms were found to occur 3 to 6 times more frequently than false assurances in some divisions. Precipitation forecasts tended to be conservative in general, with roughly 80-85% calling for below normal conditions. About 65% of temperature observations were higher than the climatological mean over the period of record, an indication of the warming trend that has been detected globally.

The question in assessing the value of these forecasts relates to how well they can predict streamflows within the study region. As indicators of expected water availability for allocation purposes, DWR employs Water Supply Indices (WSIs) for both Sacramento and San Joaquin River basins throughout its planning process. Each index is computed as a weighted average of the previous water year's index, the current water year's October-March runoff, and the current water year's April-July runoff forecast, determined from snow surveys and calculated at each of eight locations (Figure 1). Both systems define one "wet" classification, two "normal" classifications (above and below normal), and two "dry" classifications (dry and critical), for a total of five water year types.

In order to determine if precipitation forecasts can be used as predictor variables for WSIs, contingency tables were created by separating out the April-July runoff component of each WSI, calculating terciles for this component over the historic record, and matching each year's observation with the corresponding objective precipitation forecasts for winter target seasons. Although tabulations performed on all forecasts were inconclusive, those performed on the correct forecasts revealed statistically significant associations. These results will be applied to a decision-tree analysis following dialogue with potential users in order to quantify costs and benefits that would be associated with advanced indication of water availability. The adoption of seasonal climate forecasts will depend on a costs/benefits analysis by decision-makers.

Rod Sakrison Student Fellowship 2008-09 Announcement

The Student Fellowship Awards has been established as a memorial to long time Association member and two-time past president of the State Association Rod Sakrison. Rod was instrumental in establishing the University of Washington AWRA Student Chapter.

The Washington State Section of the American Water Resources Association (AWRA) is seeking nominations for two 2008–09 Fellowship Award of $2,000 each. One award will be to a member of a Washington Section affiliated Student Chapter. The other award will go to a student enrolled in a graduate program at a college or university in Washington State. Institutions of higher learning are encouraged to establish student sections and obtain a preferred status for the awarding of fellowships along with extended support from the state chapter.

Both fellowships are for a full-time graduate student completing an advanced degree in an interdisciplinary water resources subject. In addition to $2,000 in cash, the award includes a one-year membership in both the State and National AWRA, a one-year subscription to the Journal of the American Water Resources Association, and admission to the Washington State Section Annual Conference. The application form is available on the state section website: www.wa-awra.org.

Nominations will be accepted at any time between the date of this posting and October 30, 2008. Students are encouraged to submit application early. Applications will be accepted beginning in early summer. In early November the Fellowship Committee will evaluate all applications received and will recommend recipients for the Open and Student Section winners to the Washington Section Board of Directors. The Board will approve the selections no later than the December 2008 Board meeting. The winners will be notified as soon as the board approves the award. Special recognition will be given to the fellowship recipients at a Washington Student Section function following announcement of the award.

Report from the South Sound Science Symposium

John Konovsky, Squaxin Island Tribe & S4 Steering Committee

On March 26, 2008 over 400 scientists gathered at the Landmark Convention Center in Tacoma to share recent science conducted in South Puget Sound. The day was focused on connecting a range of findings across multiple disciplines to understand current environmental conditions in South Sound. It was organized by representatives from several agencies and nonprofits independent from, but complimentary to the formation of the action agenda for South Sound by the Puget Sound Partnership.

The symposium was moderated by Dr. Joe Gaydos from the SeaDoc Society(www.seadocsociety.org), based in the San Juan Islands. He also presented a summation at the end of the day, some of which is excerpted below. The full text is available online. Twelve other presentations covered a range of subjects from the physical setting and water quality, to biota trophic shifts and human impacts.

Excerpts from Dr. Gaydos' summation:

…We started off with a look at the region's geology. And any good geologist worth their rocks will tell you that geology begets biology. Skip Albertson (Department of Ecology) pointed out that South Sound is quite unique in its physical setting. Reasons for this include the shallow entrance sill just south of the Tacoma narrows and the diversity of small stream systems feeding into South Sound. Interestingly, this sill decreases the flushing in South Sound, and increases the refluxing time. This very simple, unique feature highlights the need to treat areas of Puget Sound differently.

The complex geomorphology, circulation and water stratification of South Sound also create sensitive areas showing us that we really can't even treat South Sound as a whole but need to understand its parts. One example of this is that flushing times can vary from 8 days to 56 days, depending on the location, wind and other influences. So thanks to our basic understanding of the system's physical components we are able to identify sensitive areas that are prone to low dissolved oxygen and high bacteria levels….

…Dr. Tom Mumford (Department of Natural Resources) told us that 35-40% of the shoreline has been modified, which is likely impacting important ecological functions like feeder bluffs, pocket estuaries and riparian vegetation. Thanks to the work that's been done, we are able to identify changes like these or changes that have occurred in the South Sound kelp assemblages, but we are still unable to say what that means ecologically.

On top of physical conditions and nearshore changes that that predispose areas of South Sound to biological stresses or serve as biological stressors, we heard several talks on how toxic contaminants are introduced to South Sound. While air to marine water deposition is probably a key pathway for PBDEs, runoff from land likely delivers the largest share of loadings for most contaminants of concern in South Sound including metals and organic compounds including light PAHs.

And we know, what happens on land directly influences what happens in the marine system. Daniele Spirandelli (University of Washington) pointed out that sometimes how we think about the problems is important. We're just reaching the point where people are realizing we're an integral part of the ecosystem. And while we're still learning, understanding how landscape patterns interact with ecosystem functions is really what's going to allow decision makers, planners, and scientists to craft better management policies and strategies to support ecological and human wellbeing in the Puget Sound….

And finally we heard about a stressor that many people don't even think about so I'd like to thank Dr. Paul Hershberger (USGS) for bringing up disease; the ugly stepchild of stressors. Fifty years ago we didn't think fish, wildlife and invertebrates got diseases. I mean, hey, they're healthy right, eating all natural food, getting lots of exercise. Now we know that disease can structure ecosystems and the role of disease in ecosystems is as complex as the role of predation. And unfortunately, we know very little about the role of disease in shaping the South Sound ecosystem.

So how are all these stressors playing out in the system? What impact are they having on the biota? Aimee Christy (Pacific Shellfish Institute) discussed seasonal phytoplankton trends and really did a nice job of pointing out our limited understanding of plankton, especially for species that are not important as potential human or wildlife health threats. These guys are our primary and secondary producers, yet we know so little.

Duane Fagergren (Puget Sound Partnership) pointed out the South Sound's important role as a forage fish incubator and touched on the issue that with the exception of herring, we really don't have the ability to measure the biomass of most all of our forage fish species like surf smelt and sand lance. So while we can say that there is an apparent recent increase in anchovies in South Sound, we really can't quantify what that means for other important forage fish species. I mean, if we're relying on Duane Fagergren to estimate anchovy populations on the back of a bar napkin, that tells you we need help getting the information we need.

Dave Nysewander (Department of Fish and Wildlife) pointed out that marine bird populations in South Sound can be divided into 2 groups: breeding and wintering bird populations. While some populations are stable, others like surf and white-winged scoters are in decline. While all of the risk factors for bird species in decline have not been worked out, it appears that marine bird declines over the last 30 years seem most significant among the species that spend late summer through late spring in western Washington.

While we heard that 5 species of pinnipeds occur in Southern Puget Sound (John Calambokidis, Cascadia Research), harbor seals have told us a lot about contaminants in the system. We've seen PCB and pesticide levels decrease as new emerging contaminants increase. And seal work has shown us that while PCB levels are higher in South Sound, they tend to decrease as you go north, whereas dioxin and furan levels increase the farther north you go into the Strait of Georgia. And in a time when all of us probably suffer a bit from ecological burn-out, we did hear good news that that some marine mammal populations like harbor seals and harbor porpoise have or are coming back.

We also had two very nice case presentations today that exemplified how we can use science to answer questions. Scott Steltzner (Squaxin Island Tribe) showed us that a trophic shift has occurred in the marine waters negatively impacting coho survival. He also showed us that how modeling can help us evaluate the degree of restoration that will be needed to restore this species. These type of data are going to be very important as we move forward with our action agenda to restore Puget Sound. The Partnership will be asking the Science Panel about the degree of certainty we have from our restoration efforts….

…So, David Dicks (Puget Sound Partnership) talked about needing a baseline. Well I challenge that we know a lot about the physical and biological aspects of South Sound and should use this as our baseline. We should consider ourselves way better off than many coastal areas under pressure around the world where people have little to no scientific understanding of the system and even less trend data for species….

…But we can't become complacent with what we know because today, like at any science symposium, we've heard a lot about what we still have yet to learn. And let me tell you there's no better way to piss off a policy person or a politician than to tell them we need to study something more. But I'll say it, while we know a lot we still have a lot more to learn. That doesn't mean we can't begin to take action, but taking action to improve the situation shouldn't overshadow our need to continue learning. This is going to have to be a flag that the Science Panel will need to keep waiving in front of the Partnership; if we move forward with actions and don't continue to monitor and better understand the system, we're doomed to failure….

The day was well received by everyone in attendance. All agreed that we need to host this kind of symposium focusing specifically on South Sound science on a regular basis, perhaps in years opposite the Puget Sound Georgia Basin Research Conference. Hopefully the next S4 will start to fill in the many data gaps identified here!

Decision-makers, policy wonks and educators were slightly disappointed because there was not room on the agenda to highlight their activities. With such a robust science community in South Sound, one day is not enough to even cover the research, let alone policy, management and biological restoration issues. Any future steering committee will have to consider whether a second day devoted to those topics might compliment the next science symposium.

More information is available at:

www.ecy.wa.gov/puget_sound/symposium.html .

Next time, be there or be square! South Sound, the headwaters of the Salish Sea, is where the action's at!

NEW MEMBERS

GSI Water Solutions, Inc.
Tim Abbe, ENTRIX
Lisa Adolfson, ESA Adolfson
Jon Ambrose, GeoEngineers, Inc.
Amy Carlson, CH2M Hill
Jim Gawel, University of Washington
Katie Kelleher, City of Arlington
Robert Kimbrough, Washington Water Science
Derek McGregor, GeoDesign
David Monthie, King County
Steve Nelson, RH2 Engineering
Jeff Schneider, Golder Associates Inc.
Matt Wells, K&L Gates

2008 AWRA-WA BOARD MEMBERS

President: **Jacqueline Klug**
(425) 649-7124
jklu461@ecy.wa.gov

Vice President: **Jamie Morin**
(206) 493-2323
morin@mentorlaw.com

Secretary: **Steven Hughes**
(206) 438-2159
steven_hughes@urscorp.com

Acting Secretary: **Pete Sturtevant**
(425) 453-5000
psturtev@ch2m.com

Treasurer: **Felix Kristanovich**
(425) 827-3243
fkristanovich@anchorenv.com

Editor: **Chris Pitre**
(206) 267-1166 x. 5007
cpitre@golder.com

Past President: **Cleve Steward**
(360) 862-1255
csteward@stewardandassociates.com

Director: **Jami Carter**
(425) 883-0777
jcarter@golder.com

Director: **Carl Einberger**
(206) 267-1166 x. 5006
ceinberger@golder.com

Director: **John Konovsky**
(360) 432-3894
jkonovsky@squaxin.nsn.us

Director: **Stan Miller**
(509) 477-6024
samillerh2o@comcast.net

Director: **Beth Peterson**
(425) 450-6286
Beth.Peterson@hdrinc.com

Director: **Rebecca Ponzio**
(206) 447.3336
rebecca.ponzio@psp.wa.gov

Director: **Tom Ring**
(509) 865-4946
ringt@yakama.com

UW Student Rep: **Amy Yahnke**
aey@u.washington.edu
206-550-6915

Faculty Advisor: **Anne Steinemann**
(206) 616-2661
acstein@u.washington.edu

Urban Water and Sustainability (April 28, 2008 Dinner Meeting Review)

By Jeff Schneider, Golder Associates, Inc.

Dr. Jim Gawel, Associate Professor of Environmental Chemistry and Engineering and the Environmental Sciences Program Coordinator at the University of Washington, presented the April Dinner Meeting. Gawel presented and discussed excerpts from his documentary "Urban Water: Sustainability in the Balance."

Professor Gawel's work for the documentary began in his post-doc years at MIT, inspired by the Hollywood glamorization, "A Civil Action," about the high profile litigation case involving the contamination of the Aberjona River, that helped propel issues such as water quality, industry responsibility, and public environmental safety, into the public mainstream.

Gawel's documentary covered three continents by exploring issues of water resources of the Tama River (Tokyo, Japan), the Aberjona River (Wooburn, New York), and the Toess River (near Zurich, Switzerland). These three rivers are a small cross section of the world's waterways through urban areas, which Gawel points out, will house an estimated 80% of the world's population by 2050.

Tama River

The Tama River in Tokyo provides an example of the delicate balance between water quantity and water quality provided for a city. The Tama, which supplies around 80% of Tokyo's municipal water, has been stretched to its maximum in terms of supply. The decreased streamflow lowered the ability to handle pollutants. The increasing population of Tokyo has also meant that the river must be recharged with treated waste water if the demand for water supply is to be met.

Gawel includes the Tama River as a case study because it represents one of the first places it was recognized that an urban river must serve the purpose of water supply, recreation and wildlife habitat, and how all of these issues are intertwined.

Gawel explores the innovative ideas used in the Tama such as incorporating park lands into the river system, which also provide natural water treatment. Artificial islands can filter storm water and provide recreational area for the emotional well being of people living in urbanized areas.

Aberjona River

Gawel uses the Aberjona River near New York as a lesson on the effects of unregulated industry and the tenuous relationship between environmental cleanup and the American legal system.

The Aberjona, heavily contaminated with heavy metals such as chromium and arsenic, and organic chemicals from the leather and chemical industry, was the subject of litigation. The suit resulted in a cleanup responsibilities and guidelines. However, Gawel points out the science and methods for the cleanup efforts were frozen in time based on when the settlement was reached. As a result of the unwillingness to "re-open" the case, the science was fixed on the research and methods of the early 1980's, and illustrates the problem of tying the law and science together.

The Aberjona also illustrates the balance between environmental cleanup, the cleanup economics, and the desires of the people who want to use the river. When the river represents one of the only green spaces that people like to use, condemning the river and gating it off to the public because of environmental problems and the costs of remediation, is not a viable option.

Toess River

Gawel chose the Toess River in Switzerland as the final case study. After complimenting the Swiss on their ability to engineer, Gawel uses the Toess as an example of "over-engineering" a waterway. Over time the Toess has been straightened, constrained, and over cut, to prevent flooding and protect valuable land along the banks, leaving it much like a canal channel with no shallow banks for fish and limited habitat protection.

Citizens are driving the "re-engineering" of the river in an attempt to enhance wildlife habitats and bring the river back to "normal". Part of the motivation behind these changes stems from the aesthetic value attached to natural habitats.

Gawel showed examples of success within the river including the engineering of weirs to direct flow to improve fish habitats, and the construction of a ramp through natural steps that allow fish to migrate upstream, revitalizing aquatic life.

Gawel finished his showing by emphasizing the importance of pre-planning when developing around water ways. The simple action of allowing natural set back areas can alleviate many of the problems. Likewise, the involvement of watershed users is imperative to planning, including education and public outreach.

Gawel's video provided excellent examples of many of the problems associated with urban water ways and the balance that must be maintained between water quality, quantity, recreational use, and natural habitat. Gawel illustrated problems and chose rivers on which solutions are beginning to be implemented and can be used as examples of a more sustainable use of urban water ways.

Please see: http://www.uwtv.org/.

Ecosystem Markets: Taking Action
Portland, Oregon — May 22, 2008

A major conference designed to equip environmental professionals with a practical knowledge of current and emerging "Ecosystem Services Market" structures will be held in Portland, Oregon, on May 22nd.

A number of private and public organizations have cooperated to create an integrated ecosystem services marketplace in the Willamette River Valley that will support transactions in "ecosystem services credits." Clean Water Services, a public water-resources utility in Valley's Tualatin basin, has already used a pioneering market-based approaches to restore 35 miles of streams for $6 million instead of spending $60 million on industrial-engineering to meet water quality standards with energy-intensive technology. The Willamette Partnership will be announcing its initial transaction in the next few weeks – a water quality temperature trade designed to meet the Willamette Rivers TMDL for temperature. Under the Governor's "Oregon Plan" an "Ecosystem Services Council" has been formed to further enable market-based efforts that promote clean water and habitat restoration.

Simply put, "ecosystem services" are those services naturally provided by a healthy ecosystem. Such services can include purifying air and water, enhancing fish and wildlife habitat, mitigating droughts and floods, and regulating climate. The importance of ecosystem services for fish, wildlife and water quality is well established. There is a growing interest in finding ways to enable regulated entities faced with increasingly strict regulations intended to protect water quality and fish and wildlife to pay for restoration of these ecosystem services as a way to meet permit conditions — thus offsetting impacts that can't be as cost-effectively avoided on site.

When a land manager repairs a stream by planting and maintaining trees and shrubs along its banks, it shades and cools the water and creates other habitat features fish and wildlife depend on. These improved temperature and habitat conditions can be valuated as ecosystem services. When the specific ecological outputs of these services are translated into value-units relevant to regulatory drivers, such as kilocalories per day for temperature, they can be registered and sold as offset credits. For example, a mile of restored streamside vegetation would produce a significant number of credits that could be used to offset temperature impacts from warm water discharged into a river.

Natural infrastructure (*e.g.*, streamside vegetation, wetlands, and gravel in river channels) creates the habitat conditions fish and wildlife need — including cool water. Such natural infrastructure has the added benefit of producing a wide variety of other ecological benefits including habitat for other species, erosion control, and water storage and filtration. Facilities with permits to discharge warm effluent have not generally had the ability to "build" or acquire natural infrastructure to meet permit requirements or mitigate impacts. At the same time, there are landowners who could "build" such natural infrastructure but do not have the financial capacity or incentive to do so. However, if those required through permits to reduce water temperature impacts could pay for others to create natural infrastructure that create conditions fish need – including cool water – then both permit compliance and significant ecological restoration could occur simultaneously.

The market mechanisms necessary to allow trading ecosystem services credits are now in place in Oregon.

On May 22nd, regional, national, and international experts on Ecosystem Services Marketing will come prepared to impart a working knowledge of how to benefit from this rapidly expanding — and still rapidly evolving — avenue for market opportunities, innovative regulatory compliance, and enhanced environmental benefits.

For Additional Information contact: David Light, Editor, The Water Report, 541/ 343-8504 or email:epi@rio.com.

From: http://www.thewatertrust.org/

In 2002, Washington Water Trust (WWT) began looking for ways to improve stream flow conditions on the Teanaway River in support of fish migration, water quality and recreation. Working with the Kittitas Conservation District, U.S. Bureau of Reclamation and individual landowners, WWT found ways to help to reduce the amount of water needed for irrigation. By changing points of diversions, implementing split-season leases and adjusting irrigation methods, WWT was able to ensure water will flow in streams that might otherwise go dry during summer and early fall. In 2005, more than 30 miles of stream in the Teanaway will benefit from water put into trust to improve stream flows.

From http://wdfw.wa.gov/do/weekendr/weekendr.htm:

After providing several weeks of good fishing in the lower Columbia River, the spring chinook run suddenly stalled out in mid-April, leaving anglers and fishery managers watching and waiting. By month's end, the count of fish passing Bonneville Dam jumped above 3,500 per day, but questions remain whether the run is late or lower than expected.

"We're in kind of a holding pattern right now," said Joe Hymer, WDFW fish biologist. "It should be prime time for the next couple of weeks, and hopefully - with water temperatures warming - the fish will begin to move in the mainstem and into tributaries."

AWRA UW Spring Snowshoe Odyssey

By Theresa Hlavinka, AWRA UW Student Communications & Outreach, & Mark Raleigh, AWRA UW Webmaster

Standing at the 5034-ft summit of Hex Mountain, eight members and friends of the University of Washington (UW) AWRA chapter could observe water in all its phases for miles and miles. Beneath their snowshoes, over 4 feet of Pacific Northwest snowpack rested, waiting for springtime melt to free the water from its frozen state. The water of Cle Elum Lake spanned the land below, while looming clouds to the west brought the possibility of precipitation to Seattle and the Cascade Mountains. The UW group had snowshoed for four hours to reach this vantage point, and copious amounts of water were consumed along the ascent to quench their thirst.

As we looked to the horizon and appreciated the panoramic view, what became clear was the monumental significance of snow to the hydrologic cycle in Washington. Snowpack is crucial to a number of parties who depend on a reliable water supply during the dry summer months, and this winter was especially generous in providing a deep, persistent snowpack. The students intended to experience the snowpack both for educational and recreational purposes. After soaking in the moment, the group found another use for snow as we took to the snow shovels and used them as sleds down the side of the summit.

Earlier that morning, the students met at More Hall on the UW campus and were provided with a university van to transport all eight passengers to the eastern side of the Cascade Mountains in the Wenatchee National Forest. A handful of the students on the trip are currently or previously enrolled in Dr. Jessica Lundquist's Snow Hydrology course, and we sought to gain hands-on experience in the snow while educating their fellow students. For instance, some students observed that the snowpack was melting more rapidly around trees, providing appreciable evidence of albedo effects from vegetation on the melting cycle.

Upon arrival at the trailhead, the group assembled their equipment and strapped into their snowshoes. The weather for the day appeared to be clear and dry – perfect for a springtime hike. During the ascent, group leader Garrett Leque instructed the students on snowshoeing techniques and alpine safety. One particular warning given by Leque was to avoid snowshoeing near cornices along ridges. A cornice is a large deposit of snow overhanging the edge of a ridge. While the cornice may appear safe to traverse, the snow mound may fail and slide down the ridge. Leque explained that in some cases the failed cornice may only travel a short distance down a gentle slope, but some disastrous failures may carry a showshoer down a steep side of the mountain, potentially to their death. Addressing the risk of avalanches, Leque deemed their probability as low on the Hex Mountain trail, but nonetheless provided basic advice for appropriate responses to an ensuing avalanche.

After a strenuous 7-hour roundtrip trek, the tired and hungry students enjoyed a relaxing and fun-filled camp-out at a nearby site in the Cle Elum area along Taneum Creek. Leque cooked spaghetti for the fellow campers while the students divided up to pitch tents and build a campfire. The weather was mostly cooperative, although the area experienced a bit of snow during the night. A hearty breakfast was served before departing the campsite, and fortunately, the rain held out until everyone was packed into the van and on the way home.

The UW-AWRA trip was organized and led by CEE grad student Garrett Leque on April 5-6. Nearly all aspects and details of the trip were the direct result of his vision and hard work. The UW-AWRA chapter is also grateful for financial contributions from the UW College of Forest Resources and the Department of Civil & Environmental Engineering, which minimized the expenses incurred on the students.

WA-AWRA Dinner Meeting
OLYMPIA
May 29, 2008

Atmospheric Rivers: Recent Flooding in Washington

Featuring: Robert Kimbrough, Assistant Director of the USGS Washington Water Science Center

Thursday, May 29, 2008

Water Street Café and Bar
610 Water Street SW, Olympia, WA

Registration and Social Hour 5:30 to 6:15 pm, Dinner 6:15 to 7pm, Presentation Starts at 7pm

The **AWRA-WA** is excited to have **Robert Kimbrough**, speak in a special dinner meeting **Olympia.** Robert Kimbrough is a hydrologist and Assistant Director of the USGS Washington Water Science Center where he manages a network of 270 streamflow gages in Washington and northeast Oregon.

Presentation Summary: Major weather systems delivering streams of moisture-laden tropical air to the Pacific Northwest resulted in significant flooding in western Washington in 2006 and again in 2007. Delivering large amounts of precipitation in a just a few days, these storms pushed numerous rivers above flood stage and resulted in record flood peaks at several USGS streamflow gages. Heavy orographic precipitation led to catastrophic flooding in Mt. Rainier National Park during the 2006 event and in the Chehalis River Basin in 2007. Recurrence intervals for several flood peaks exceeded 100 years. This presentation will highlight flood data collected from a network of more than 150 streamflow gages in Western Washington.

---------- Detach & mail with registration ---------- ----------

May 29, 2008 Dinner Meeting Registration

Registration fee (please circle those that apply):

$25 Member	$35 Non-member
$15 Student Member	$15 No-Dinner Option

Name_____

Affiliation_____

Address_____

City_____State_____Zip Code_____

Phone:(_____)_____Fax:(_____)_____E-mail_____

Checks only payable to "AWRA Washington Section" No credit cards or purchase orders, please.

Please mail checks by May 23, 2008 to:

AWRA Washington Section, Dinner Meeting
P.O. Box 2102
Seattle, Washington 98111

For questions about your membership or the dinner, please contact Jamie Morin by phone or email.

Jamie Morin: (206) 493-2324 morin@mentorlaw.com

2008 Membership / Change of Address Form

(↖ please circle, as appropriate ↗)

Annual membership in the state chapter costs $25.

Name_____Position_____Affiliation_____

Street Address_____City_____State_____Zip_____

Phone(_____)_____Fax(_____)_____E-mail_____@_____

❑ Please indicate if you prefer to receive your newsletter electronically.

❑ Check if you would like to be actively involved on a committee:
You will be contacted by a board member.

2008 Membership Dues: $25.00. **Checks only.** Please make payable to **AWRA Washington Section**.

Mail to: American Water Resources Assoc. WA. Section
P.O. Box 2102
Seattle, WA 98111-2102

The American Water Resources Association is a scientific and educational non-profit organization established to encourage and foster interdisciplinary communication among persons of diverse backgrounds working on any aspect of water resources disciplines. Individuals interested in water resources are encouraged to participate in the activities of the Washington Section.

Special Thanks!
To Golder Associates for word processing and graphics support on this newsletter.

American Water Resources Association, Washington Section
P.O. Box 2102
Seattle, WA 98111-2102

(Change service requested.)

Non Profit
U.S. Postage PAID
Seattle, WA
Permit #1399