

Center for Watersheds and Environmental Sustainability (CWES) *Science Plan*

July 1, 2006

Purpose and scope of the science plan

The purpose of this science plan is to provide programmatic direction for development of research associated with the Center for Watersheds and Environmental Sustainability (CWES). This science plan is written specifically to provide direction for the upcoming year, but many elements of the plan extend over a 5-year time frame. CWES was created in 1999 to promote interdisciplinary watershed research within the Desert Research Institute (DRI), and the center has a history of success in completing a wide range of initiatives primarily associated with the Lake Tahoe basin. The scope of this plan includes providing a brief history of the evolution of CWES, defining the CWES vision and mission, identifying goals and approaches, and projecting expected outcomes of planned research activities. The plan also includes sections on new faculty hires and interaction between CWES and DRI Divisions. This science plan is a living document that will be revised as research needs and directions related to CWES change. The science plan provides a framework for primary CWES research areas. The plan, with its proposed research programs and activities, will be implemented to the level of funding and support that CWES receives.

History and evolution of CWES

Since its creation, CWES has been involved in developing a research program at Lake Tahoe that has included faculty from all three of DRI's divisions. CWES has provided an integration of information from many different projects. These projects include numerous atmospheric projects identifying atmospheric nutrient and fine sediment sources in the Lake Tahoe basin, the flux of nutrients and fine sediments deposited directly on the lake surface, and an inventory of basin nitrogen and phosphorus compounds that enter the lake from the atmosphere. Numerous hydrologic projects in the Lake Tahoe basin include, evaluating the effectiveness of different types of best management practices (BMPs) in removing fine sediment and nutrients from surface water runoff; nutrients and fine sediment loads associated with stormwater runoff and land use, surface-water quality, groundwater nutrient loading to the lake, source identification of nutrients and fine sediment in watersheds within the lake basin, and adsorption of nutrients on sediments beneath infiltration basins. DRI scientists have also been involved in geomorphology projects, habitat restoration projects, and adaptive management projects in the basin. CWES has also played a critical role in fostering collaboration between DRI scientists and scientists from other research organizations doing research in the Lake Tahoe basin. These collaborations have enhanced DRI research opportunities illustrated by DRI's Lake Tahoe atmosphere and hydrology projects.

CWES has also been involved in the Walker Lake watershed. DRI scientists conducted an EIS project that involved personnel from all three of DRI's divisions. The scope of this project included hydrologic, atmospheric, ecological, and policy projects. CWES coordinated these efforts with the end product being an EIS document. Since the conclusion of the EIS study, DRI faculty have been involved in a geomorphology project and a groundwater nutrient loading project in the Walker Lake watershed.

DRI faculty are also involved in studies in watersheds other than Lake Tahoe and Walker Lake, including the Truckee River watershed below Lake Tahoe, the Carson River watershed, the Colorado River watershed in Nevada, and watersheds outside of Nevada and in West Africa. Projects in these watersheds have ranged from nutrient dynamic studies, to restoration projects, to water sustainability. Historically and to date, CWES has played a only a minor role in these watershed studies as compared to the Lake Tahoe and Walker Lake watersheds.

Vision and mission

The vision of CWES is to develop research programs that integrate hydrologic, geologic, and atmospheric processes, water quality and nutrient dynamics, ecology, sustainability, and environmental policy. From these interdisciplinary research efforts, new information will be gained on watershed processes and restoration effectiveness and new predictive approaches will be developed for understanding watershed processes. This new information will be used to inform the planning and management policy process.

The mission of CWES is to facilitate development of interdisciplinary and interdivisional research teams that address science issues needed for policy decisions at the watershed scale. The information gained from these research programs will be disseminated to land managers as well as policy and regulatory decision makers to provide guidance to help set policy.

Goals, approaches, and outcomes

The major goals of CWES are to advance watershed science and provide scientific information throughout the policy development process to inform decision-making. CWES provides a reservoir of expert knowledge for advancing the understanding of processes at the watershed scale, particularly through development of integrated approaches to addressing major scientific questions. CWES is oriented toward information dissemination focused on transferring the results of scientific research to support the needs of policy-makers and managers in making appropriate and effective policy decisions. Information will be disseminated by presenting findings from studies at meetings, conferences, and workshops attended by land managers, regulatory agencies, other scientists, legislators, and the public. CWES-related research will be published in reports and information also will be available on the CWES web site.

Expected outcomes of the proposed CWES goals will depend on: (1) level of funding CWES has to pursue the goals, (2) availability of the CWES Director and DRI researchers to develop integrated research programs, and (3) unforeseen opportunities that may arise that CWES can play a role in developing. Additionally, new faculty hires by DRI Divisions will play an important role in helping CWES achieve the proposed

goals. CWES has identified the following major goals for the period covered by this plan:

Goal 1: Play a leading role in developing and integrating watershed science for decision-making in the Lake Tahoe basin. Help develop interdisciplinary research programs (see Table 1) that will advance the understanding of watershed processes needed to provide the science required to support sound policy decisions in the Lake Tahoe basin.

Approach: One of the major issues facing the Lake Tahoe watershed is the average annual one-foot decline in lake clarity. Approximately one billion dollars will be spent on restoration projects in the watershed to help slow and hopefully even reverse this decline in lake clarity. An integrated scientific approach is needed to help land management and regulatory agencies determine the most effective restoration projects and policies in the watershed to meet the goal of reducing suspended sediment and nutrient loads entering the lake to slow the decline in lake clarity. This will be a significant CWES priority. Many other important environmental issues in the basin—such as forest health, wildfire fuel reduction, and invasive species—also will need an integrated, comprehensive scientific approach to help understand the processes important to these issues. CWES has and will continue to help coordinate DRI research activities in the basin to provide an integrated DRI science program in the Lake Tahoe watershed. In addition, CWES will work to disseminate easily understandable scientific information on watershed research activities to the public, land management and regulatory agencies, legislative delegations, and the scientific community. This information will be used for an adaptive management approach in the basin. As new scientific knowledge is acquired, policies will be adjusted to reflect this new understanding.

The CWES Director position provides a DRI contact for Lake Tahoe. The position is needed to integrate ongoing and future DRI research so that land managers, regulators, and governmental personnel can interface with an individual who has comprehensive knowledge of integrated research within the basin. The CWES Director and DRI researchers supported by CWES will be significantly involved in writing the Lake Tahoe Science Plan that will guide the future direction of research within the watershed. This science plan will be focused on meeting policy maker needs. CWES will build upon DRI's presence at Lake Tahoe with DRI offices in the new Tahoe Center for Environmental Sciences at Sierra Nevada College in Incline Village, Lake Tahoe. DRI faculty conducting research in the basin will have office space and equipment storage and preparation space at the new building as well as have access to University of California, Davis laboratory facilities in the building. DRI faculty will also interact with other research institution scientists, such as University of California, Davis and University of Nevada, Reno faculty, whom will also be doing research at the new building. With DRI faculty present on the Sierra Nevada College campus, future plans include DRI faculty developing and teaching courses at Sierra Nevada College.

Outcomes: Implementation of Goal 1 will lead to development of new projects that will be part of the larger Lake Tahoe research program designed to provide scientific information for policy decisions in the Lake Tahoe basin. This will increase support for DRI faculty, create new research opportunities, and advance integrated approaches to

watershed-related projects. Such activities also have the potential to contribute to improved science-based policy setting and management decision-making in the Lake Tahoe watershed. CWES will focus its efforts to obtain funding for both Southern Nevada Public Land Management Act (SNPLMA)-funded projects and other projects funded by sources such as the U.S. Forest Service, the State of Nevada License Plate fund, Lahontan Regional Water Quality Board, Nevada Department of Transportation, and USEPA. The SNPLMA program is a special program funded specifically to provide applied science input to land managers and regulators to determine the most effective restoration strategies in the Lake Tahoe basin. CWES will help coordinate interdisciplinary projects that include faculty from more than one DRI Division and also provide contacts, and where appropriate introductions, for potential non-DRI collaborators on these projects.

Goal 2: Help develop interdisciplinary research programs to advance the understanding of watershed processes in the Walker Lake watershed. Play a leading scientific role to support decision making in the Walker Lake watershed.

Approach: Develop interdisciplinary research programs and research teams in the Walker Lake watershed to provide the information needed for decisions in restoration efforts for the Walker River and Walker Lake. This includes establishing a DRI research program as part of the proposed new Nevada System of Higher Education (NSHE) virtual research center in the Walker Lake watershed. For example, scientific information will be needed to understand the effects of increasing surface water flows on the ecology of the watershed; determine the most effective and cost efficient means of reallocating current water use toward lake restoration efforts, and predict long-term environmental responses associated with removing water from irrigated lands and maintaining higher flows in the Walker River. CWES will work to disseminate easily understandable scientific information on watershed research activities to the public, land management and regulatory agencies, legislative delegations, and the scientific community by presenting information at workshops, conferences, public meetings, and meetings with legislative staff.

Projects that could be initiated include, but are not limited to: (1) cloud seeding to add additional water to the Walker Lake watershed; (2) watershed modeling of the West Walker River, East Walker River, and Mount Grant watersheds to evaluate the effects of cloud seedling on water supply; (3) riparian restoration on the Walker River or Cottonwood Creek in the Wassuk Range; (4) development of a GIS framework for linking water rights with individual parcels, water distribution networks, points of diversion, and place of use information to inform potential water rights acquisitions; (5) development of a set of recommendations to manage water delivery to Walker Lake to ensure maximum benefit while minimizing environmental degradation; (6) evaluating how changes in river discharge will influence its biological communities and health, and the impact of down cutting the lower Walker River channel; and (7) evaluating the current limnological state (physical, chemical and biological) of the lake to identify potential refugia or fatal areas for biota.

CWES can also support decision making in the Walker Lake watershed through involvement with policy issues. Projects such as evaluating past changes in land use over the last 30 years and projecting future land use changes with respect to water and land acquisitions; determining reasonable and plausible land use options given water and land purchases; and evaluating the consequences of alternative land uses on system sustainability, water resources, lake health, and agricultural sustainability are critical to understanding the potential effects of water rights purchases in the Walker Lake watershed.

Outcomes: The primary outcome of goal 2 will be development of an integrated DRI research program and interdisciplinary research teams for the Walker Lake watershed. This will increase support for DRI faculty, create new research opportunities, and advance integrated approaches to watershed-related projects. Such activities also have the potential to contribute to improved science-based policy setting and management decision-making in the Walker Lake watershed. Most of this program will be associated with the re-allocation of water for the restoration of Walker Lake. The decline in lake volume from about 10 to less than 2 million acre-feet, as the result of water diversions for irrigation, has produced a dramatic increase in total dissolved solids (TDS) in the lake. This high TDS level is threatening the lake's ecosystem. The native Lahontan Cutthroat trout is at the brink of extinction in the lake due to increasing TDS. Development of an integrated science program should position DRI researchers to obtain funding to provide the information that policy makers need to help preserve Walker Lake. An outcome of this effort will be to establish DRI as a strong partner in the newly proposed NSHE virtual research center for the Walker Lake watershed. This pro-active partnering will foster collaborative research with other NSHE campuses, establish teams that can apply their methodology and expertise to projects in other watersheds, and provide DRI researchers with funding to contribute information for water and land acquisitions in the Walker River basin needed for Walker Lake restoration.

Goal 3: A long-term goal of CWES is to help develop new DRI research programs in watersheds where DRI researchers are not currently active and expand existing DRI research programs in watersheds where DRI researchers are active, as opportunities arise and resources are available. However, the focus of CWES activities will remain on the Lake Tahoe and Walker Lake watersheds.

Approach: As opportunities arise, primarily DRI researchers supported by CWES, and to a limited extent the CWES Director, will attend important meetings with other researchers, managers, and regulators to develop the contacts required for developing integrated research programs. For example, ongoing DRI research projects in the Truckee, Carson, and Colorado River watersheds may be better integrated and even expanded by having CWES help support development of more integrated research programs in these watersheds. Additionally, CWES may help develop existing international projects and programs into more integrated research programs, such as the ongoing watershed sustainability projects in West Africa. Developing integrated research programs in watersheds other than Tahoe and Walker is a long-term goal of CWES. While this goal has a lower priority than supporting integrated research in the Tahoe and

Walker watersheds, as opportunities arise, and provided the CWES Director and/or DRI researchers have resources available, they will be pursued.

Outcomes: CWES will help DRI develop integrated research programs in watersheds other than Tahoe and Walker. This will increase support for DRI faculty, create new research opportunities, and advance integrated approaches to watershed-related projects. Such activities also have the potential to contribute to improved science-based policy setting and management decision-making in these watersheds. Because this goal is a lower CWES priority than maintaining and expanding integrated research programs in the Tahoe and Walker watersheds, the goal will be met only as opportunities arise from existing projects and programs and as time and resources are available.

Planned new faculty hires that would benefit CWES

In addition to relying on current faculty in the three DRI Divisions to develop integrated research programs, CWES needs to be pro-active in guiding new hires by the Divisions by promoting those faculty positions that would be beneficial to CWES research. For example, a preliminary science plan for the Division of Hydrologic Sciences (DHS) identifies new faculty hires in the research areas of stream restoration and water resources assessment. Potential stream restoration hires that DHS is proposing to meet their science needs include an ecological engineer (spring 2006), an environmental hydrogeophysicist (summer 2006), and an aquatic ecosystem modeler (spring 2007). All of these proposed hires could benefit CWES. In addition, potential DHS water resource assessment hires including an urban hydrologist (fall 2007), large scale watershed modeler (fall 2009), hydroinformatics (fall 2009), and water resources economist (fall 2010) could be beneficial to CWES as well.

A new faculty hire research area not currently included in DHS or DEES science plans that would be beneficial to CWES would be in the area of policy. A person filling this position would need a science background in order to be able to effectively interact with research scientists, land managers, and regulatory personnel. If CWES funding is provided for hiring new faculty, it would be used to support faculty positions beneficial to the development of CWES programs.

CWES and division interactions

CWES should be complementary to DRI's Divisions. CWES can provide direction, coordination, and help in developing interdisciplinary research programs, such as programs in the Lake Tahoe and Walker Lake watersheds. With the CWES Director serving as a gathering point for program-related research findings and as a contact for agencies, coordination and integration of disparate DRI research projects is more likely to occur than if there was not a director. It is recognized, however, that the Divisions control the majority of faculty funding needed for proposal development and equipment purchases, so CWES will work with the Divisions to foster Center program and proposal development efforts. In turn, when programs and projects are funded through Center efforts, the indirect cost recovery flows back into the divisions, so there is a significant payback to the Divisions for supporting faculty to work on Center programs and initiatives. The relationship between Centers and Divisions will be symbiotic, with CWES providing a coordinating role. An example of how CWES and Divisions can

interact to develop an integrated research program is the NSHE funding for applied research in the Walker Lake watershed associated with water rights purchases to deliver water to Walker Lake to help maintain and restore the Walker Lake watershed ecosystem.

Table I
CWES 2006 Science Plan

Goals	Research Areas	Approaches	Outcomes
<p>#1) Play a leading role in developing and integrating watershed science for decision making in the Lake Tahoe basin. Help develop interdisciplinary research programs that will advance the understanding of watershed processes needed to provide the science for policy decisions in the Lake Tahoe basin.</p>	<p>Atmospheric Sciences Hydrology Water Quality Environmental Policy Ecological Sciences Near shore water quality and ecology Stream Channel erosion Stormwater runoff Forest management Water treatment and source control Climate change Restoration effectiveness Paleohydrology and paleolimnology</p>	<p>Develop an interdisciplinary research program at Lake Tahoe by writing proposals to obtain research funding</p> <p>CWES Director will be the lead contact for DRI Tahoe issues to help develop and integrated DRI's Lake Tahoe research program</p> <p>Meet with regulatory and policy agency personnel to develop research projects in the basin</p> <p>Provide information to be used for slowing down the decline in Lake Tahoe clarity</p> <p>Help write the Lake Tahoe Science Plan that will direct future research in the basin</p> <p>Disseminate information by attending meetings, workshops, and publishing reports, and communicating with legislative delegations</p> <p>Have a DRI member on the Committee of Scientists of the Tahoe Science Consortium (TSC) and support DRI researchers to work with the TSC</p> <p>Establish a physical presence in the basin by establishing an office in the basin</p>	<p>Obtain research funding SNPLMA funding Other sources of funding</p> <p>Advance integrated watershed research</p> <p>Develop the CWES web page to provide an easy place to find information on Lake Tahoe</p> <p>Publish reports on research in the Lake Tahoe basin</p> <p>Complete initial draft of Tahoe Science Plan</p> <p>CWES Director will attend appropriate meetings to provide DRI input to agencies in the basin, or provide support for appropriate researchers to attend these meetings</p> <p>Establish a DRI research office at the Sierra Nevada College campus at Incline Village, Lake Tahoe</p> <p>A long-term outcome of having an office at the Sierra Nevada College also includes potential teaching opportunities for DRI faculty at the college</p>

<p>#2) Play a leading scientific role in support of decision making in the Walker Lake watershed. Help develop interdisciplinary research programs that will advance the understanding of watershed processes needed to provide the science for policy decisions in the Walker Lake watershed.</p>	<p>Atmospheric Sciences Environmental Policy Ecological Sciences Restoration or effects of removing water from agricultural land Decision support modeling Watershed surface water modeling Stream Channel erosion Water Quality Climate change Paleohydrology and paleolimnology</p>	<p>Write proposals to obtain research funding Meet with DRI scientists to develop research needed to answer water right acquisition and environmental restoration questions Disseminate information by attending meetings, workshops, and publishing reports, and by communicating with legislative delegations Provide needed scientific information for purchasing the most cost-effective water rights for Walker Lake restoration efforts Perform watershed and decision modeling to understand the hydrology of the watershed and for water rights acquisition decisions CWES Director will be the lead contact for DRI science projects in the Walker Lake watershed</p>	<p>Obtain research funding Develop a DRI research program that advances integrated watershed research in the Walker Lake watershed as part of the NSHE virtual research center Develop the CWES web page to provide an easy place to find information on Walker Lake Publish reports on research conducted in the Walker Lake basin Develop watershed and decision making models to be used by agencies to purchase water rights and evaluate restoration options CWES Director will attend appropriate meetings to provide DRI input to agencies in the watershed, or CWES will support appropriate researchers to attend these meetings</p>
<p>#3) As opportunities arise, help develop new DRI research programs in watersheds where DRI researchers are not currently active and expand existing DRI research programs in watersheds where DRI researchers are active.</p>	<p>Atmospheric Sciences Hydrologic Sciences Ecological Sciences Water Quality Environmental Policy Climate Change Restoration effectiveness</p>	<p>Write proposals to obtain research funding Meet with regulatory and policy agency personnel to develop research projects CWES Director, or appropriate staff supported by CWES, as lead contact for DRI science programs in watersheds as opportunities arise Disseminate information by attending meetings, workshops, and publishing reports, and by communicating with legislative delegations</p>	<p>Obtain funding for DRI projects in watersheds other than Tahoe and Walker to increase support for DRI faculty, create new research opportunities, and advance integrated approaches to watershed-related projects CWES web page to provide an easy place to find information on watersheds of interest, where DRI has ongoing research</p>