

Applied Science to Address Key Management Issues: Round 12 SNPLMA Lake Tahoe Program Science Themes and Sub-themes

Revised TSC Recommendations 3-18-11

All research should leverage previous and existing efforts, data, and information to the extent possible. Synthesis and review work should aim to generate new knowledge and information from the synthesis and analysis of existing data and information. Compilation and summary of previous work is an appropriate step in a synthesis and review effort, but it should not be proposed as the ultimate product. Models should leverage previous and existing efforts to the extent possible, including the use and application of existing data and models or model elements. Proposals should identify which research needs in the Tahoe Science Plan that their proposal helps to address; furthermore, as part of their conclusions, projects should identify appropriate steps to advance scientific understanding, environmental policies, and management activities in the Basin. Stakeholders in the Lake Tahoe Basin should be engaged early and throughout the research. The Pacific Southwest Research Station, as the sponsor of this science program, will work with the recipients of funds and management agencies to help ensure that projects meet these objectives.

Forest Health				\$750,000
Title	Type of Research	Management/Policy Need	Description	
Informing decisions for multi-objective forest management	Conventional Investigations and/or Synthesis & Review	<p>The Tahoe Fire Commission Report (2008) identified a need for resource managers and regulators to obtain tools that help them to better evaluate alternative strategies for reducing fire risk to public safety, property, and the environment. Current and future forest management activities may include hand thinning, cut-to-length harvest, whole tree removal, cable logging, mastication, chipping, understory and/or pile burning, road management, and defensible space practices. Well-designed decision support tools and systems can help to improve the planning and evaluation of forest treatment projects across diverse landscapes. Effective tools and systems also can generate shared understanding between implementers and regulators regarding risks, costs, and benefits of treatment alternatives. Innovative tools are needed to help design projects that meet all relevant forest management objectives including reducing wildfire risk, improving forest health and wildlife habitat, conserving native biodiversity, and protecting or improving of air quality, soil quality, and water quality (especially reducing fine sediment and nutrient loads that threaten Lake clarity).</p>	<p>Research should refine, and/or validate tools, models, or sampling methods designed to improve forest management decision-making, which includes: 1) strategic planning, 2) project-level environmental impact analyses, 3) estimating the effects of treatment programs, and 4) implementation of the Lake Tahoe TMDL. To improve broad-scale long-term planning, research is particularly encouraged that will create linkages among existing decision support tools and result in integrated products that will aid in planning and evaluating forest management projects or programs to best achieve multiple relevant management objectives, while meeting applicable constraints. Research also is encouraged that leads to tools and decision support systems to better evaluate the economics of alternative strategies for managing forest vegetation, considering factors such as access, transportation routes and impacts, regulatory constraints, and potential ecological impacts unique to the Tahoe basin. To improve project-level environmental impact analysis, or to estimate the effects of treatment programs, existing research could be synthesized and/or new field research conducted to validate and improve the accuracy of model outputs used to evaluate project or program effects. Research to improve TMDL implementation should help to better account for the potential impacts of forest management activities and wildfire on lake clarity. Research proposals should include efforts to collaborate with agency representatives and/or other research teams to ensure the products are well-supported and useful.</p>	
Improving WEPP-based analyses of forest management activities at the watershed Scale	Directed Action ¹	<p>Current and future forest management activities may include hand thinning, cut-to-length harvest, whole tree removal, cable logging, mastication, chipping, understory and/or pile burning, road management, and defensible space practices. Well-designed analytical tools, such as the WEPP suite of computer models, can be used to improve the planning and evaluation of forest treatment projects across diverse landscapes, and generate shared understanding between implementers and regulators regarding risks, costs, and benefits of treatment alternatives, particularly with regard to water quality impacts. At present, the WEPP suite of computer models is sufficiently robust to allow relatively rapid completion of complex evaluations of individual hillslopes, but not multiple hillslopes and features forming a complex watershed including roads and landings; the latter can be accomplished only by expert modelers using a research-grade version of WEPP. The management need is to produce and validate a user-friendly, Web-based, Basin-specific, watershed version of WEPP. It must be sufficiently robust to help design and evaluate projects to ensure that they meet all relevant forest management and regulatory objectives related to water quality (e.g. fine sediment and nutrients)</p>	<p>Research should produce and validate a user-friendly, Web-based, Tahoe Basin-specific, watershed version of WEPP. It must be sufficiently robust to help design and evaluate projects to ensure that they meet all relevant forest management and regulatory objectives related to water quality (i.e., fine sediment and nutrients). Proposals under this subtheme must include time and resources to support direct collaboration with both the Forest Service (LTBMU) and regulatory agencies, throughout development of the specific products proposed. Proposals should specifically include tasks to support model validation using existing data, and to run a variety of simulations aimed at informing agencies of model sensitivity and limitations. Any existing data used for model validation or calibration must have been collected using ASTM methodologies, or shown through peer-reviewed studies to have been collected using valid and broadly accepted scientific methodologies. Integration of existing WEPP models, existing and emerging datasets, and other recognized building-blocks are strongly encouraged.</p>	
Impact of climate change on ecological communities and the evaluation of adaptation strategies	Conventional Investigations and/or Synthesis & Review	<p>Climate change is expected to broadly affect the Sierra Nevada in coming decades. Management agencies want to understand how ecological communities within the Lake Tahoe basin, including forest communities, alpine communities, subalpine wetlands and other sensitive communities, will respond to these changing conditions over the next several decades. Current science emphasizes that adaptation strategies should be site-specific. Adaptation strategies could include thinning of forests to increase tolerance to drought and resistance to wildfire or insects, planting species or genotypes that may be more resilient to changing climate, genetic conservation of certain species, preservation of refugial habitats (including wetlands and riparian areas), assisted migration of species to suitable habitat, and development of wildlife corridors to facilitate migration. Such actions could be taken in anticipation of future changes or opportunistically following disturbances such as wildfires.</p>	<p>Proposed projects should conduct new research and/or synthesize previous research to address one or more of the following issues: (1) establish the potential range of key climate conditions relevant to ecological processes and biological communities in the Tahoe basin; (2) identify which ecological processes and biological communities in the Tahoe basin are most vulnerable to the effects of climate change; (3) evaluate the effects of basin-specific adaptation strategies and treatments to conserve particular ecological processes and biological communities; and/or (4) guide the temporal and spatial design of forest treatments to avoid unacceptable ecological impacts while promoting long-term desired conditions (particularly in the Jeffrey pine, mixed-conifer, and lodgepole forest community types).</p>	

Watershed, Water Quality, and Habitat Restoration				\$1,300,000
Title	Type of Research	Management/Policy Need	Description	
Understanding the impacts of aquatic invasive species	Conventional Investigations and/or Synthesis & Review	The prevention of new introductions and the control of established invasive species is a high priority for Tahoe basin resource management and regulatory agencies. Agencies have a need for ongoing quantitative information and clear recommendations to manage established invasive species and minimize their impacts. Information related to prevention is required to assess risks from individual species and to track environmental conditions that may facilitate new invasions. Information related to control of invasive species is needed to assess the effectiveness and potential environmental effects of various control strategies. Long-term status and trend monitoring of priority invasive species' abundance and distribution in near shore habitats and streams in the Tahoe basin and their environmental effects is needed for strategic planning efforts, and for assessment of their potential influence in meeting environmental quality targets.	Proposals are requested that address one or more of the following issues. (1) Synthesize and review existing data and develop a plan to monitor the effectiveness of control and prevention strategies in Lake Tahoe's near shore environment, tributary streams, and other lakes of the region. (2) Develop a predictive model/decision tool to assess the risk of priority invasive species introductions and establishment in the Tahoe basin to inform AIS prevention program policies and management strategies. (3) Determine the ability of quagga and zebra mussels to complete their lifecycle in the waters of the Lake Tahoe basin. (4) Assess the net economic impact and benefit of the Lake Tahoe aquatic invasive species prevention program. (5) Research control techniques and strategies for extant species (e.g., treatment of satellite populations vs. source populations) to improve control program effectiveness, improve techniques to increase treatment efficiency and reduce recolonization rates, mitigating or avoiding the short-term effects of control measures on near shore water quality and aesthetic indicators (biological, chemical, and physical), or mitigating the adverse legacy effects of aquatic invasive species (e.g., removal of Asian clam shells). Researchers should plan to collaborate with agency representatives and other research teams to ensure the products will meet agency information and evaluation needs.	
Quantifying the benefits of urban storm water management	Conventional Investigations and/or Synthesis & Review	Research associated with the Lake Tahoe total maximum daily load (TMDL) indicates that storm water from urban land uses is the largest contributor and presents the greatest opportunity to reduce fine sediment particle (< 16 µm) and total phosphorous loads to streams and Lake Tahoe. Roadways are a land use of primary concern, as these have the greatest pollutant yield potential. Improved characterization of urban storm water is needed for the purposes of modeling both baseline loads and expected load reductions and for linking storm water management actions to expected water quality benefits. In particular, there is a need to evaluate the effectiveness of roadway operations and maintenance practices (i.e. abrasive application and recovery methods) and enhance the ability to rapidly assess maintenance needs.	Research proposals are requested to address one or more of the following issue areas. (1) Improve and/or validate existing tools, models and methods to estimate urban storm water load reductions, including quantifying the effects of actions to reduce sediments and nutrient loads using SEZ's. (2) Investigate the relationship between operations and maintenance activities, road composition, and estimated pollutant loading or load reduction, particularly roadway traction abrasive application and recovery practices. (3) Improve the design of pollutant control/treatment technologies. (4) Test and evaluate the application of innovative or advanced storm water pollution controls within the Tahoe basin.	
Increasing our understanding of special status species and communities	Conventional Investigations and/or Synthesis & Review	The Tahoe Basin has several special status species and communities that are a focus of agency conservation and restoration efforts locally and also nationwide. Management agencies need applied research to help guide and evaluate conservation, restoration, protection, and control measures to conserve and/or restore special status species and communities, including an understanding of the mechanisms contributing to maintenance or decline of these species and communities over the long term. Special status species in the Tahoe basin can serve as indicators of ecosystem health and associated improvements or declines, but this function requires a thorough understanding of their biology and the ecological processes affecting them. Research under this subtheme will aim to identify strategies, techniques, and standards that will best conserve and restore species and communities of special concern for which information is lacking.	Research should focus on sensitive native species and habitats in the Tahoe basin for which little is known, including deepwater plant communities, cushion plan communities, endemic invertebrates (i.e., the Tahoe stone fly and the blind amphipod), and the native freshwater mussel (<i>Margaritifera falcata</i>). Proposed research should address one or more of the following: (1) Evaluate mechanisms maintaining or contributing to the decline of native species and communities; and (2) evaluate approaches to conserve or restore special status plant and animal species, communities of concern, or habitats threatened by invasive species or climate change. Research may incorporate conventional hypothesis driven investigations or synthesis and review. Research on potential indicators should include analyses to assess how the proposed new indicators compare to existing applicable indicators. Researchers should plan to collaborate with agency representatives and other research teams to ensure that agencies can apply the results.	
Technical Review of SEZ definition and classification system	Conventional Investigations and/or Synthesis & Review	Agencies are reviewing the region's stream environment zone (SEZ) policies and updating the SEZ conservation program to improve its consistency with the EPA's Wetland Program core elements, in response to State initiatives, to incorporate new scientific information, and to ensure management actions and policies are protective of desired SEZ functions. A need that underlies the update of all SEZ policies and program elements is the development and adoption of a SEZ classification system that assures the protection and conservation of desired SEZ functions. SEZ functions that agencies are interested in protecting and conserving, include but are not limited to: providing habitat for native, special status, and riparian/wetland associated wildlife, fish and plant species and communities; flood attenuation; sustaining water quantity through ground water recharge; protecting surface and ground water quality through buffering from conflicting land uses and activities; providing water filtering/treatment services (particularly treatment of fine sediment and nutrients); enhancing scenic quality; and providing for high quality low-impact recreation experiences. A classification system would aid agencies in refining the definition of SEZ and the resource criteria used to delineate SEZ for mapping and field verification.	Proposed research should answer the following question: What hydrogeomorphic, vegetation or soils classification system (or combination of classification systems) is most appropriate for protecting and conserving desired functions identified for SEZ in the Lake Tahoe Basin? Agencies are particularly interested in science-informed efforts and products that lead to the selection of a SEZ classification system, including: (1) conceptual models that illustrate the linkages among desired SEZ functions and SEZ structure, geomorphic setting, vegetation species composition and watershed position; (2) GIS mapping and modeling approaches, and data and field verification methods that can be used to map the distribution, functions, relative condition and extent of identified SEZ types; and (3) an empirically-based identification of hydrogeomorphic, vegetation and soil field indicators of different SEZ types that can be used for on-the-ground SEZ delineation. Ultimately, agencies need: (i) maps that depict the aerial extent of different SEZ types and their associated condition across the Lake Tahoe Basin; and (ii) scientifically defensible documentation that supports a field SEZ delineation approach, mapping approaches and products, and selected classification system. Research is expected to be conducted in collaboration with agency representatives to ensure products meet agency needs. Research should utilize all existing data and information. Proposals should include time and effort to revise final products based on comments from independent peer review.	
Air Quality				\$600,000
Title	Type of Research	Management/Policy Need	Description	
Improving the estimates of atmospheric deposition	Conventional Investigations and/or Synthesis & Review	Atmospheric deposition to the Lake is the major source of nitrogen and a substantial source of phosphorous and particulate matter. There is, however, significant uncertainty in deposition flux estimates. Further, the current estimates of atmospheric deposition loads only consider what falls directly onto the Lake and do not consider what falls onto the surrounding watershed and then is subsequently transported to the Lake by wind and water. To reduce this uncertainty, focused studies (i.e., gradient or eddy-correlation studies, along with measurements of key chemical species) should be conducted to determine the sources and pathways of particle deposition. These results will better inform models used to assess future conditions, and will help to inform the prioritization of restoration efforts.	Proposals should focus one of the following issues, although integrated proposals addressing all issues are encouraged. (1) Focused studies of the sources and pathways of particle deposition as well as improved estimates of deposition flux (i.e., gradient or eddy-correlation studies along with measurements of key chemical species). Research should evaluate particulate matter deposition rates in relation to surrounding land-uses and proximity to the Lake. Study results should aim to better inform models, restoration efforts, and load reduction efforts, and provide methodologies to quantify estimates from actions to reduce loading of fine sediment particles and nitrogen to the Lake. (2) Synthesize existing data and information to develop improved estimates of atmospheric deposition in the Lake Tahoe basin. Or (3) Review the existing atmospheric deposition monitoring approach and develop a revised sampling and analysis plan that will facilitate estimating total atmospheric deposition loads of key pollutants onto the Lake coupled with the flux of pollutants from the watershed to the Lake.	
Managing air pollutants	Conventional Investigations and/or Synthesis & Review	Exceedances of the ozone standards have been measured in the Lake Tahoe basin, particularly when measured against CA State Standards. Local emissions due to burning and vehicle transport are known to reduce visibility and impact local air quality. In addition, out of basin transport of greenhouse gases, particulates, organic aerosols, and other airborne pollutants impact both air quality and lake clarity. Understanding these processes requires validated atmospheric models. Validating these models, requires compiling an inventory of available emissions and meteorology data, and incorporating information from ongoing monitoring and focused research. Using SMOKE or other emissions tools, an emissions file should be created for ready input into a Lake Tahoe air quality modeling system (LTAQMS), to include an emissions processing model, mesoscale meteorology model (MMM), and an air quality model (AQM). The LTAQMS needs to be designed to support regional regulation of air quality.	Studies should focus on one or more of the following issues. (1) Inventory available emissions and meteorology data and identify and prioritize monitoring and research data needed to construct and validate a Lake Tahoe Air Quality Monitoring System (LTAQMS). Any proposed sampling plan should consider integration with other atmospheric monitoring needs (e.g., meteorology, visibility, and criteria pollutants). Or (2) Review existing management and regulatory reduction strategies (e.g., TRPA's Blue Boating Program, Federal and State emission standards for watercraft, automobiles, buses and trucks), and use an air quality model to quantify viable alternative strategies for the reduction of ozone and other pollutants in the Lake Tahoe basin. Provide comparisons of the cost effectiveness of each viable strategy and incorporate these actions in the LTAQMS.	

Integrating Science				\$1,100,000
Title	Type of Research	Management/Policy Need	Description	
Tahoe science consortium	Synthesis & Review	Further support is needed to allow the Consortium to continue providing environmental managers and decision makers with comprehensive and well-synthesized scientific findings drawn from research, monitoring, and modeling. Continued support for the TSC also is needed to provide for science community technical support and involvement in agency programs such as the Environmental Improvement Program, the Status and Trends Monitoring and Evaluation Program, and if reauthorized, the Lake Tahoe Restoration Act.	Funding will support continued operations of the Tahoe Science Consortium, whose activities include: 1) science planning 2) research and monitoring synthesis and reporting, 3) technical peer review, 4) technical support and consultation, and 5) science information communication. The Tahoe Science Consortium will host focused workshops and symposia and will assist in or lead efforts to synthesize scientific information to support decision-making in the Lake Tahoe basin.	
Tahoe Science Consortium Rapid Response Research and Monitoring	Conventional Investigations and/or Synthesis & Review	Recent catastrophes in the Tahoe basin including the Kings Beach sewage spill (2006) and the Angora wildfire (2007) have demonstrated the need to rapidly obtain critical information about the effects of catastrophes (e.g., wildfires, sewage spills, or earthquakes), or provide critical baseline information to understand the effects of near-term restoration and remediation efforts undertaken in response to a catastrophe. Creating the capacity to rapidly obtain and communicate information about immediate effects will help in the formulation of agency responses, particularly efforts to maximize the protection and remediation of natural and human resources. Agencies and stakeholders also have expressed the need for the Tahoe Science Consortium to synthesize and communicate research results from the wide array of Tahoe Science SNPLMA projects that will be completed over the next four years.	The Tahoe Science Consortium (TSC) will oversee a separate project to implement a rapid response research effort should a catastrophe occur, as determined through existing written guidelines. This project will be funded by the \$100,000 of rapid response funds previously authorized as part of SNPLMA Round 9 (\$40,000), Round 10 (\$35,000), and Round 11 (\$25,000). Funding for the rapid response research effort will be available over the four Federal fiscal years following the Secretary's approval. If no catastrophe occurs in this four-year period, then the TSC will propose a change in project scope to use these funds for synthesis, review, and communication of scientific information gained through previously completed science projects. Synthesis and review efforts will aim to inform policies and management strategies of Tahoe basin environmental initiatives, particularly the Environmental Improvement Program (EIP). Any change in scope shall require the review and approval of the TREX prior to the expenditure of funding.	
Understanding current and future resource conditions through analysis of remote sensing data	Spatial data analysis & model development	The Round 10 Lake Tahoe SNPLMA capital program included funding to acquire high-resolution LiDAR data and multispectral imagery for the Tahoe basin. Analyses of these datasets and images are needed to develop information that agencies can use in the future planning of capital projects, to characterize current natural resource conditions, and to provide a baseline for comparison of future conditions resulting from the ongoing implementation of forest management and habitat restoration projects. Agencies especially need research results that integrate high-resolution LiDAR and multispectral imagery to further our understanding of land use patterns and current and future natural resource conditions, and elucidate management options.	Research proposals are requested that address one or more of the following objectives. (1) Provide a spatially explicit determination of current forest structural classes across topographic features and model forest structure restoration strategies that include a range of tree density reductions and creation of openings based on (a) a range of opening sizes, (b) frequency distributions of opening sizes on the landscape, (c) rate of application of openings, e.g., number of openings by size per year, and (d) differences between intensity versus extent of openings. (2) Analyze datasets and develop derivative products to: (a) reveal landscape-scale indicators of environmental condition and document remote sensing analysis methodologies to derive indicators; (b) evaluate fire risk and the extent and distribution of defensible space in the urban intermix and Wildland Urban Interface; (c) map hydrologic networks to inform fine sediment and nutrient pollutant load reduction project planning and/or floodplain management; or (d) assess the extent, type, and condition of stream environment zones and wetlands to guide environmental improvement restoration opportunities, (3) Develop spatial models and maps of habitat suitability for special status plant and wildlife species or communities of concern.	
Identifying environmental indicators and development of approaches for monitoring and evaluation	Synthesis & Review	Land management and regulatory agencies need to evaluate whether their actions are effective at meeting environmental targets through the implementation of agency land use and management plans. Credible evaluations require meaningful indicators of appropriate standards, and require development and implementation of monitoring plans to evaluate and report the status and trends of environmental indicators relative to established targets. Credible evaluations also require tools and protocols for consistent and comprehensive data management, analysis and reporting.	Proposed projects should address one of the following topic areas: (i) greenhouse gases emissions, (ii) small lakes, (iii) aquatic special status species and communities, (iv) stream hydrology and sediment/nutrient loading, (v) terrestrial rare plants and special communities, (vi) atmospheric particulate and nutrient lake deposition, (vii) forest ozone impacts, or (viii) noxious weeds. Research proposals should address <u>all</u> of the following tasks: (1) Synthesize and review previous and ongoing research efforts and available data to identify scientifically supported environmental condition indicators and reference conditions for a topic area identified above. (2) Use the synthesized results to develop a topic area specific conceptual model that describes the contemporary understanding of factors and activities that affect the Region's ability to achieve environmental and socioeconomic goals and targets. (3) Prepare a monitoring and evaluation plan that can be implemented to measure the identified indicators and report on long-term status and trends of identified indicators relative to existing or proposed environmental or socioeconomic standards. (4) Conduct pilot implementation of field, data management, evaluation and reporting protocols and procedures documented in the monitoring plan to maximize their utility. And (5) Conduct and document technical analyses that compare and contrast proposed indicators with existing indicators, and identified reference conditions with existing standards. Proposals should include time and resources for the scientists to work collaboratively with agency representatives to ensure the products will meet agency information and evaluation needs.	
Total Science Funding²				\$3,850,000

¹Science work under this subtheme would be pursued as a "directed action." This means the research proposals may be solicited through a competitive RFP or may be obtained through a sole source. The most appropriate approach shall be determined by PSW. All proposals would undergo independent peer review for an evaluation of technical merit no matter what approach is used to obtain the research proposals. Appropriate agencies would need to dedicate technical staff time to work in collaboration with the selected scientists to complete the projects. The intent of this approach is to maximize agency-researcher interactions needed to achieve the products desired by agency representatives in an efficient and timely manner.

²A total of \$3,750,000 of SNPLMA Round 12 funding is requested to support efforts described in the four theme areas. In addition, reallocation of SNPLMA Rounds 9, 10, and 11 science funding (totaling \$100,000) is requested to support the TSC Rapid Response Monitoring and Research subtheme. The full amount available for science has been allocated among four theme areas, with a target level of funding identified for each theme area. Actual funding levels may vary from targeted levels based on the merit of the proposals received and the specific dollar amount of the selected proposals; however, it is intended that all theme areas receive funding close to their targeted funding levels in order to accomplish the objectives identified as priorities by the TSC and relevant agencies. Regardless of the allocation among theme areas, the total funding will not exceed the amount approved by the Secretary of Interior. The cost for the Pacific Southwest Research Station to administer the funding and associated agreements will be calculated as a percent of the total and will be deducted from the final funding for each theme area. Administrative costs will be minimized to the extent possible.