To: Maureen McCarthy
From: Josh Collins
RE: Final responses to UTR panel questions
Date: May 16, 2013

Hi Maureen

Here are my final responses to the questions you posed about the Draft Upper Truckee River Restoration Strategy (dated March 2013). I revised my draft comments provided on April 30 and May 3, based on the workshop concluding that day.

Please extend my thanks to everyone who helped produce the workshop. It was very well organized and conducted. As a panelist, I am grateful for every effort to meet my needs, from making sure I had coffee and a computer, to the kind remarks regarding my contributions, right or wrong as they might be.

I know what it takes to plan and hold an event like this, and its success reflects unusual care, understanding and capability. I am especially grateful for your experienced orchestration and leadership. I hope we get to work together again.

Finally, I want to acknowledge the high level of technical expertise, commitment and professionalism of the staff and other participants. This is a caring community of talented and dedicated people who have created a real opportunity to restore the well-being of the UTR watershed. I hope you succeed, and I hope these comments help.

UPPER TRUCKEE RIVER RESTORATION WORKSHOP

Responses to Panel Questions

Josh Collins, Ph.D.

May 7, 2013

General Comment

My responses to these questions led me to develop this overarching comment. It is in essence the outline of a revised Restoration Strategy. It is based on my experience helping to establish long range, regional ecological goals plus monitoring programs to track progress, understand shortcomings, and adjust the goals for new understanding. The outline is rudimentary. The community of restoration scientists and practitioners can discussion and decide the many necessary details. Funding will always be a concern. I have ignored this critically important aspect of a successful strategy. Suffice it to say that some level of routine costs for regional and watershed-based ecological health care should be shared among the responsible agencies through their coordination, collaboration, and true partnership. Perhaps the EIP has the potential to realize a cost-effective restoration program, based on the finalized Restoration Strategy, if the necessary leadership is available. My answers to the assigned questions appear after this outline and augment it to some degree.

1. Plan and conduct a visioning process with abundant public input at all stages to define the good health of the UTR watershed. The vision should be expressed as the range in distribution, abundance, diversity, and condition of major habitat types, including the river and its tributaries, wet meadows, and terrestrial plant communities that is likely to sustain target levels of selected ecosystem services. The vision must represent the consensus of scientific opinion and be consistent with the missions of all agencies responsible for the health of the watershed. It must be a very broadly shared vision. Disregard cost, property rights, etc. during the visioning process. Answer the question: what would we do if we could? How much of what kinds of habitats in what condition are needed where within the watershed? The answers are the targeted levels of the selected services. The targets should be numerical and place-based (mappable). They are the restoration goals. Define ecological restoration as everything and anything that must be done to achieve and sustain these goals, which in aggregate define the ecological good health of the UTR watershed.

2. Develop conceptual models, based on scientific consensus, that denote the cause-and-effect relationships among the natural and anthropogenic factors and processes that control health status (i.e., that control the distribution, abundance, diversity, and condition of major habitat types). Use these models to identify factors and processes that can be managed, and those that cannot be managed. Incorporate information from other regions of the Sierra or other comparable montane environments. Explicitly incorporate regional climate change forecasts in the models as a driving factor that cannot be managed. Cause-and-effect relationships that are included in the models but are not well understood can be prioritized for research (see Step 5). This research can be guided by hypotheses derived from the models. Revise the models for new understanding as it is acquired.

3. Using the conceptual models as guidance, translate the goals into landscape restoration templates. These templates should indicate the envisioned mosaics of key habitat types that should be distributed along the energy gradient of the river from its headwaters to the Lake. They can be narratives descriptions, but they must be illustrated with sketches and maps. They should depict the acceptable range in composition and condition of the habitat mosaics, based on their natural variability over time. It will be useful in each case for the templates to include the entire environmental moisture gradient lateral to the river, incorporating mountain slopes, alluvial fans, river terraces, wet meadows, active floodplains, the mainstem channel(s), tributaries, depressional wetlands, etc. The templates should collectively illustrate the overarching vision of good health for the watershed as a whole. They should guide restoration designs and plans. They should illustrate restoration success for the entire watershed. They should guide the designs of individual projects

regardless of their sponsors, size, location, or timing. They should be readily understandable by the concerned public.

4. Develop a set of guiding principles and practices for designing restoration projects. These might include such ideas as: minimizing project OM costs by maximizing the utilization of natural processes to form and maintain the river and associated habitat mosaics; maximizing the positive synergies between and among projects over time; distributing habitat types of an ideal landscape mosaic among smaller projects such that they collectively achieve the ideal; using projects as learning opportunities to test new restoration approaches and techniques; practicing persistence and patience to realize goals that can be trans-generational.

5. Develop a cost-effective but comprehensive monitoring program. Use the Wetland and Riparian Area Monitoring Plan (WRAMP) of the USEPA and CA State Water Board as a developmental framework. This will help assure that all monitoring data are directly related to one or more restoration goals. It will also serve to maximize the use of maps and rapid assessment as monitoring tools, while providing criteria to minimize the use of more expensive tools, such as quantitative measures of physical and ecological or biological processes or condition. Furthermore, WRAMP includes tools for tracking and visualizing projects, monitoring data, and overall watershed health that can be applied to the UTR (and elsewhere in the Tahoe Basin) with cost-sharing among other regions for tool development and OM. Using the WRAMP and it toolset will improve chances for funding through the USEPA, USACE, CDFW, and State Water Board. The monitoring program will need a home. A logical possibility is to expand the role of the Tahoe Science Consortium to provide independent, objective, scientific and technical support for restoration planning, permitting, and assessment. The TSC might focus on shortening the distance between environmental science and decision making by helping to identify and format data and information to best fit the decision processes, including regulatory actions. The TSC might consider becoming a Regional Data Center of the CA Surface Water Ambient Monitoring Program to more effectively contribute data to regional and statewide assessments of environmental condition. The Program should include ambient monitoring of watersheds and region-wide, as well as project monitoring. The project monitoring should provide evidence of project status relative to regulatory performance standards; the ambient monitoring should provide evidence of the relative effects of individual projects, multiple projects, and other factors, such as fire, flooding, policy shifts, and climate change, on the overall health of the watershed (as assessed by the difference between existing conditions and the restoration goals). The monitoring program should have a research component to develop and test models and other methodologies, fill data gaps, and better understand cause-and effect relationships (see Step 2 above). Use the results from monitoring and research to revise the monitoring program as needed to maximize its efficacy, and to revise the vision and goals as necessary to keep them realistic and attainable. Careful attention should be given to what should be monitored at the lower limits of the UTR watershed to assess the overall performance of upstream restoration efforts. In this case, given the objectives to improve fine sediment retention, reduce flood hazards, and improve in-stream conditions for cold-water fishes, meters to continuously track river stage, suspended sediment concentration, and temperature should be installed near the river mouth. The same devices might be installed between projects to assess their individual contributions to overall performance.

6. Develop an implementation plan. This should cover conceptual designs of projects, coordination of data collection and interpretation, funding, and communications. Once a vision exists, it can be very helpful to establish a standing group of technical experts and planners that serves to advise and review the conceptual designs of new projects. This is how to assure that new projects are consistent with the vision. Conceptual design should involve decisions about the project-specific objectives. Once a project is conceived and its objectives are established, the same or another group of experts should provide advice on monitoring and assessment, consistent with the monitoring program. The existing multi-agency UTR Monitoring Advisory Group (UTRWAG) might be the beginning of a

conceptual design advisory group. As monitoring data are collected, they should be interpreted. The primary purpose of the interpretation should be to decide whether the project is meeting its performance standards, and whether progress is being made toward the larger restoration goals for the watershed as a whole. It is very helpful to rely on an interpretive team that represents the various disciplines involved and the affected agencies. An essential aspect of any major ecological restoration strategy is a plan to effectively communicate with the affected public, governmental agencies, and private interests. This will involve developing clear massages and staying on message with all communication efforts, from reports and press releases to presentations and on-site signage. The intent should be to both inform and be informed. An emphasis on story telling rather than simple reporting can be helpful. Monitoring reports should be crisp and to the point. Developing public support for restoration of the UTR is complicated by the geographic remoteness of many restoration actions and their technical complexity. Try to answer this question: how do we personalize the UTR? A campaign is needed to raise awareness and engender support. One approach is to use public opinion polls and focus groups to help align restoration activities with public preferences and priorities. Another is to promise a public report on the health of the UTR watershed and then deliver on the promise by telling the story of the river, it's past, present, and possible future. The communication plan should maximize the use of all existing organizations and institutions, including NGOs that have the capacity and are willing to help implement the communication plan.

Answers to Assigned Questions

Q1. The current Upper Truckee River (UTR) strategy and philosophy focuses the design of projects on the restoration of geomorphic and ecosystem functions. In what ways is this approach likely to be effective or ineffective, as a whole, in achieving the projected benefits?

The Strategy is evidently intended to support the use of natural river processes to arrest channel incision and bank erosion within the valleys of the lower reaches of the mainstem of the UTR, while elevating the river bed, such that the valley floors along the river function as floodplains to trap suspended fine sediment and to increase the acreage of wet meadow habitat. This intention is not stated directly in the Strategy, but became evident during the UTR restoration workshop. It is the basis for most of my responses to this question.

A. The Strategy seems to indicate that the overarching goal of the restoration efforts is to restore natural river processes. These processes already exist, however. They are always ongoing in the presence of river flow. They are evident even in the stretches of the river that have been identified as most degraded. It is more appropriate and practical to establish restoration goals as quantifiable conditions or ranges in condition which, based on public input and expert consensus, are patently desirable. In other words, natural processes of the landscape are not restoration goals, but the means by which a set of desired endpoints of condition (i.e., the goals) are likely to be achieved. Understanding the effective processes and employing them through project design is essential to achieve the goals, but the goals should not be the processes themselves. The regional community of environmental scientists and restoration professionals seems to understand this, but it is not clearly stated in the Strategy. It should be.

B. Although the expressed intent of the Strategy is to restore natural river processes, it actually identifies a particular riverine landscape as a restoration template, as evidenced in the sketch of "healthy" and "unhealthy" wet meadows presented at the start of the workshop. This is an inconsistency in the Strategy that must be corrected. As stated above, natural processes are not restoration goals, but the means by which a set of desired endpoints of condition (i.e., the goals) are

likely to be achieved. Once the targeted conditions are defined, they can be represented in one or more restoration templates, such as the one presented in the workshop. The templates should illustrate the spatial relationships of the targeted conditions in a landscape context. They can be an important aspect of a restoration strategy. But, in this case, the single template is probably too restrictive. It only reflects conditions of the lower valleys during the mid-nineteenth century, as reconstructed from scant mid-twentieth century evidence. The template features single-thread channels with broad active floodplains in dynamic equilibrium with seasonal and inter-annual variations in flow and sediment supply that are typical for the current climatic regime. The Strategy should note, however, that the form and structure of the river through its meadows might have been naturally more variable than the single template suggests. It is likely that reconstructions of historical conditions based on sediment cores from the meadows, plus comparisons among meadows in neighboring regions of the Sierra would reveal a natural range in the form and structure of the river-meadow systems that could warrant multiple restoration templates. It is likely that the template would vary with elevation or position along the energy gradients of the mainstem of the river and its tributaries, from the headwaters of the UTR drainage network to the Lake. Multiple templates might be needed to represent the range in river steepness and planform, the influence of large woody debris jams and beaver dams, and the degree of river confinement by arid terraces. The synthesis of multiple templates to capture the full range of natural river form and structure would diversify the restoration palette, broaden the restoration approaches, and make the Strategy more relevant to the watershed as whole, especially in the context of climate change.

C. Climate change is a "game changer." It doesn't seem as though the Strategy fully addresses this fact. It calls for restoring natural process consistent with the present climatic regime. However, climate forecasts include a strong likelihood for lower levels of Lake Tahoe in the dry season (i.e., lowered base level for stream systems like the UTR that drain into the Lake), and more variable seasonal and inter-annual flow patterns with higher peak flows and longer droughts, all of which suggest that the historical conditions may not be entirely suitable as templates for future conditions. Again, it might be very helpful to examine the historical temporal variability in conditions, based on marsh and meadow cores, and the range of conditions along the climatic gradient presented by the north-south length of the Sierra, to identify the full range of suitable and likely restoration endpoints. I note that the allocation of fine sediment sources as presented in the TMDL will likely need to be updated due to climate change. The relative importance of local watersheds as sources of fine sediment is likely to increase, possibly due to channel incision (resulting from lower Lake levels and the increased "flashiness" of the storm hydrographs), plus increased frequency of major floods that scour the river channel and generate large sediment pulses.

Q2. How could the overall restoration strategy be improved to provide the most robust, comprehensive, coordinated, and coherent framework for restoring ecosystem function and resiliency within the UTR stream channel and floodplain?

A. There needs to be an overarching vision of a healthy UTR watershed. It is essential to develop a comprehensive vision for the kinds and levels of ecosystems services that are needed for the watershed as a whole, and how the vision might be achieved over time through coordinated restoration actions at the reach or even smaller scales, in the context of the most credible 100-yr forecasts of future climate change. The vision should answer the questions: how much of what kinds of habitats are needed where within the watershed to achieve and sustain what levels of which ecosystem services?

1. The ecosystem services concept as identified in the Strategy is appropriate and helpful to frame the visioning process because it can connect the restoration efforts to people, in operational

terms. However, the Strategy only presents a list of services, with no regard for their relative importance. The needed levels of service are not always identified.

2. The Strategy presents many restoration goals and objectives, some being numerical and others narrative. However, most of these goals and objectives are stated in terms of trends (e.g., "improve," "increase," or "decrease") without endpoints, so success is not actually defined. Furthermore, not all the goals or objectives are appropriate for all parts of the UTR watershed, and it is unlikely that all of the listed goals and objectives can be achieved. There needs to be agreed upon criteria and process for deciding what services matter most, what levels of those services need to be achieved, and what actions are most needed in what part of the watershed to achieve those levels of the targeted services.

    i. For example, assuming that one suitable service is the retention of fine sediment, and if the goal for that service is twice as much retention per average year (relative to current conditions), then coupling the control of erosion inside and outside of the river channel throughout its length with floodplain restoration in its lower reaches is probably appropriate. Since runoff from roadways in the watershed has been identified as a major cause of the fine sediment supply, BMPs to minimize such runoff might be more fully and explicitly incorporated into the Strategy.

    ii. If another desired service is the support of wet meadow plants and animals by doubling the acres of wet meadow habitats, and if this requires elevating the near-surface groundwater level, then all ways to recharge the groundwater (or to reduce its drawdown) should be considered. This might include, as emphasized at this time, stabilizing the river at a higher bed election to reduce channel erosion, increase recharge due to out-of-channel flooding, and decrease drawdown through the channel banks. However, it might also include alternative or additional approaches, such as using selected areas of some meadows as recharge basins for urban stormwater, recharging some meadows through shallow off-channel depressional wetlands that catch and hold precipitation, and recharging through alluvial fans on ephemeral tributaries at the margins of valleys and meadows. These latter approaches might become increasingly important in the future, given that the annual frequency and duration of flooding is likely to shorten, and that the watershed will tend to be drier longer during most years.

3. The effort to envision a healthy watershed (quantitative, place-based levels of selected ecosystem services stated in lay terms and represented by maps and landscape sketches) must involve the public and must be shared by all agencies responsible for the health and well-being of the UTR watershed.

    i. The vision should be mappable and readily represented in sketches and drawings. The sketch of "healthy and unhealthy" meadow systems that was shown during the introductory presentation of the workshop is an example of how to visualize good health for at least one major component of the watershed, that being wet meadows with active floodplains. Such sketches can help guide the restoration efforts by showing the desired distribution, abundance, and condition of major habitat types for selected areas of the watershed.

    ii. The vision will need to be cross-walked to the TRPA Thresholds Standards and translated into the performance standards and monitoring requirements of regulatory permits.

    iii. The scientific statements of the restoration goals will need to be translated into common language. For example, "floodplain retention of fine suspended sediment" might be referred to as "clear water" or "clean swimming holes." "Elevated near-surface groundwater levels" and "wet meadow restoration" might be termed "more

wildflowers and wildlife" or "better bird-watching." "Hydro-geomorphic dynamic equilibrium" might be called "stable river banks" or "the good kind of flooding."

B. Restoration is defined in the Strategy as a return to pre-disturbance or historical conditions. Enhancement is defined as improvements in process or condition subject to unnatural constraints. This definition of enhancement is reasonable. However, the definition of restoration is too restrictive and probably not realistic. It's more realistic to assume that we can't reach the past; ecosystems don't run backwards; the ecological past does not exactly predict the ecological future; etc. A more practical definition of restoration might be something like the following: ecological restoration is everything done to restore the ecological health of the UTR watershed, where good health is denoted by the science-based numerical goals for needed levels of the watershed's natural goods and services. This definition is consistent with the ecosystems services framework of the Strategy.

Q3. The UTR restoration effort involves a wide range of varying landscapes, impairments, constraints, and opportunities. Considering the significant variations in individual project reaches and the potentially different restoration concepts used in specific settings, what additional guidance can the inter-agency strategy incorporate to ensure that the most efficient and beneficial river-wide effort is implemented?

A. The current vision, as inferred from the Strategy, is river-centric. That may not always be entirely appropriate. The river should be envisioned as part of landscape-scale moisture gradients extending laterally to the river from the river channel or a tributary to its active floodplain, adjacent wet meadow habitats, arid terraces, alluvial fans, valley margins, and dry mountainsides. Such a landscape-scale perspective would be helpful to identify the most effective approaches to achieve restoration goals, which might not always be centered on the river (e.g., see Q2A1ii above). There is a need for conceptual models representing the known cause-and-effect relationships among natural and unnatural (anthropogenic) factors and processes that account for the length and steepness of these moisture gradients, and their component habitat types.

B. One major impediment to UTR restoration at the landscape-scale consists of the engineered crossings that function as bottlenecks for flood flows and bedload transport. The degree of the problem varies from one crossing to another. However, each crossing seems to present a problem, regardless of its location along the energy gradient of the river. Fixing this problem (e.g., widening bridges, replacing them with causeways, or replacing existing culverts with lar5ger ones of wide-enough crossings) might be essential and is certainly very expensive. At the landscaper scale, to what degree can the other problems be effectively fixed if this one isn't?

Q4. Does the monitoring, analysis and reporting as described in the UTR strategy document, adequately provide guidance for measuring success in achieving the stated goals and objectives? In what ways can the monitoring, analysis and reporting be improved?

A. As suggested above, the Strategy should define restoration success in terms of the distribution, abundance, diversity, and condition of major habitat types that are expected to provide the needed levels of selected ecosystem services for the UTR. Then it should state what metrics are needed to track progress, what data are essential to compute the metrics, who will interpret the data, and how they will be used to adjust the goals for changes in priorities, circumstance, and new understanding. To support the effort, there will need to be standing committees with open enrollment of independent experts who can help with conceptual designs for projects, recommend monitoring, and interpret the results. There will need to be a public information delivery system that makes visible the permitted on-the-ground actions and tracks their progress and cumulative effects.

B. Once the vision exists, and after it is translated into goals (i.e., targeted levels of selected ecosystem services), conceptual models should be developed to explain cause-and-effect relationships that account for the services and their levels. These models should be based on what is known as scientific fact, what can be inferred from the facts, and what is based on local expert guesswork. The latter is a very important form of understanding that should not be discounted. When the models account for this understanding, they can be used to identify and prioritize hypothesis-driven research. The models should consider the natural and anthropogenic processes and factors that affect the services of interest. They should also indicate how the targeted services relate to each other, how they might be allocated among the river reaches, and what their emergent, cumulative effects might be for the watershed as a whole. Based on the models, the goals might be adjusted. These models are not products so much as working tools to help the restoration experts understand each other and the systems they are trying to restore.

C. Monitoring is expensive and important in concept but seldom adequate in practice. It tends to be one of the first things to get cut from project budgets. This highlights the importance of knowing what monitoring data are absolutely essential, and acquiring them through coordination, collaboration, and partnership.

- Formation of the monitoring group referred to UTRWAG is an important step toward the coordination and collaboration that is needed. Its membership should be expanded to include all major sources of relevant data. Caltrans and USGS should be full members.
- As stated above, the goals and objectives representing the needed levels of essential ecosystem services must be established. This will guide the identification of data needed to track progress toward the goals and determine when the goals have been reached. There must be an exact, explicitly stated, direct relationship between any monitoring data and the restoration goals.

D. The monitoring framework is probably adequate but not entirely consistent with statewide and national efforts. There are benefits to being more consistent with frameworks implemented in other regions. For example, the interests in this region might look into the Wetland and Riparian Area Monitoring Plan (WRAMP) developed by the CA Wetland Monitoring Workgroup of the CA Water Quality Monitoring Council. The USACE and USEPA and the CA State Water Board seem poised to employ WRAMP to guide monitoring requirements under section 404 and 401 of the USCWA and under the CA Water Quality Improvement Act). The CDFW is exploring how to use WRAMP in the CA Lake and Streambed Alteration Program, and for planning and assessing NCCPs. WRAMP includes statewide data and information management systems for regional and local uses, including the California Aquatic Resources Inventory (CARI) that cab serve as a basemap, "Online 401" for adding project maps to CARI though 401 Certifications, "Project Tracker" for visualizing projects on any kind on CARI, the California Rapid Assessment Method (CRAM) for assessing the overall health of wetlands and streams, The Riparian Zone Estimation Tool ("RZET") for estimating the extent of riparian functions, and "EcoAtlas" as the web-based user interface and visualization tool. In essence, the statewide framework helps planners determine how maps and rapid assessment can be used to meet monitoring needs, and when more rigorous data are needed. I get the sense that much of what needs to be assessed in the UTR to track progress toward goals can be provided through standardized mapping and rapid assessment across projects and for the watershed as a whole, carefully augmented with quantitative measures of selected aspects of condition, such as presence-absence of indicator species, careful surveys of channel form and structure, plus ongoing measures of flow, suspended sediment, and water temperature. It's noteworthy that, as part of a USEPA demonstration of this framework, the CTC has helped to develop CARI for the UTR, more than 30 river scientists in the Tahoe Basin have been trained to use CRAM, and a probabilistic survey of stream health based on CRAM has been conducted throughout the UTR watershed by local interests,

including staff from TRPA, CTC, USFS, USBR, and the Tahoe Regional Water Board. The output from that pilot should inform this Strategy.

E. A web-based, public-access system for managing, visualizing, and delivering data and information is essential to coordinate data collection, interpretation, and reporting. This requires a go-to place to maintain the system, although the data can be provided from any number of sources. There is a need for agency members of the regional environmental protection and restoration community to decide where the system should reside, what it must do, and how it will be supported. Consistency and even partnership with other regions involved in statewide data and information management could be very beneficial. Again, review of outputs from the UTR pilot of state and federal methods and tools as mention above in item Q4D might be helpful.

Q5. Ecosystem resiliency is an overarching restoration goal. How do we more effectively communicate to the public and local government representatives the technical processes undertaken to select project approaches to achieve this goal, such as balancing risk of potential short term construction related impacts of restoration projects with the long term benefits to ecosystem function and resiliency?

Short-term and long term impacts are regulatory terms. This signals the need to align the restoration goals and objectives and monitoring plans with performance standards as indicated in regulatory permits. There is a real opportunity to begin coordinating a variety of permits under the US CWA (NPDES, 404-401, 405, etc.) and under the CA Water Quality Improvement Act (Beneficial Use protection) to improve their positive synergistic effects on conditions at the watershed scale. The state and federal agencies responsible for water quality in the Tahoe Basin are collaboratively developing a watershed approach to avoid, minimize and mitigate temporary/indirect and permanent impacts to state and federal waters. The approach is included in the current guidance from the South Pacific Division of the US ACE for mitigation planning, and in the current draft of phase 1 of the State Water Board's proposed Wetland and Riparian Area Protection Policy. I suggest that the leading agencies of the UTR restoration efforts confer with the US EPA, CA State Water Board, and its Lahontan Regional Water Board to begin exploring ways to use the watershed approach to establish guidance on how to address cumulative impacts and to coordinate permitting across multiple regulatory programs.

Q6. How should new scientific information and technical advice that is obtained as part of program or project development be incorporated to improve and expand the river-wide restoration strategy?

The next generation of watershed planning is upon us. I suggest the modeling of regional climate change, and the modeling of UTR-specific and Trout Creek-specific flow, sediment transport, and floodplain effectiveness that has recently been conducted (and that will probably continue off and on to some degree) should be combined with the existing detailed maps (CARI) into a "desktop watershed" that enables forums of interests to explore the effects of different climate change scenarios, river-lake management, and restoration alternatives on selected ecosystem services such as flood control, wildlife support, water supply, and pollution control. The science and technology to start to create such a system for "landscape scenario planning" exists at this time. "Desktop watersheds" are how choices can be weighed and consensus-based group decisions can be made about what to do, when, and where. Monitoring can be designed in part to calibrate and improve the models, as well as to track progress and adjust goals. This is how to "see through" the uncertainty of the future, define and manage options, and make informed decisions. This approach is inevitable, given its ability to help decision-makers and the public understand and visualize the various possible outcomes of alternative decisions, and because it is technically and scientifically possible, within quantifiable limits of accuracy.

The idea of establishing multi-agency and public forums to plan and guide visioning, goals setting, data development, data interpretation, and reporting should be formalized through institutional arrangements that free-up staff to participate, and that translate outputs from the forums into operational policy for the participating agencies. There is a great opportunity to restore UTR as a critically important component of the Basin ecosystem. But success will require more collaboration and coordination to achieve a consensus-based vision of success. The science is adequate and the public will seems to exist to support the poised political leadership. With some revision, the UTR Restoration Strategy can serve to nurture an effective relationship between science and policy as needed to restore the UTR watershed.