Final Report Demonstration Watershed Assessment For the Tahoe Basin Using the Wetland & Riparian Area Monitoring Plan

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Executive Summary

A team of public agencies led by the Lahontan Regional Water Quality Control Board (RB6), Tahoe Regional Planning Agency (TRPA), and the California Tahoe Conservancy (CTC), with technical assistance from the San Francisco Estuary Institute and Aquatic Science Center (SFEI-ASC), has completed a three-year demonstration pilot of the CA State Water Resources Control Board's Wetland and Riparian Area Monitoring Plan (WRAMP) in the Upper Truckee River and Third Creek Watersheds, using a USEPA Wetland Program Development Grant. The Project team developed a charter for itself and identified six questions to address, as summarized below.

Question 1: Should the California Aquatic Resources Inventory (CARI) serve as a common basemap for aquatic resource planning, permitting, management, and assessment in the Basin?

Need. A common base map is the primary tool for coordinating resource protection and management activities across agencies at all levels of government. The Tahoe Basin lacks a common base map that is both sufficiently accurate and detailed to visualize local actions in a regional or watershed context.

Approach. CARI protocols were used to map aquatic resources in the Upper Truckee River and Third Creek watersheds. CARI protocols were adjusted to meet regional needs.

Answer. A regional version of CARI is needed as a common basemap. It should include features and areas of special concern in the region, such as wet meadows and Stream Environment Zones (SEZs). The regional version of CARI should be called the Tahoe Aquatic Resource Inventory (TARI). To this end, Round 12 SNPLMA funds have been awarded to map the aquatic resources and SEZs throughout the Tahoe Basin, based on TARI protocols.

Question 2: Does TARI and the Riparian Width Estimator tool of WRAMP provide an adequate map and classification system of SEZ?

Need. The TRPA "SEZ Roadmap" explains the need for a regional SEZ map and classification system.

Approach. The Project Team compared the best available SEZ map for the lower reaches of the Upper Truckee River Watershed to a "WRAMP map" of SEZ for the same area based on TARI and WRAMP tools, especially the "Riparian Width Estimator." The draft California Aquatic Resource Classification System (CARCS) of CARI was reviewed as a possible SEZ classification system.

Answer. The WRAMP map shows much more SEZ than the best available map, mainly because TARI provides a much more complete map of aquatic resources, and because the Riparian Width Estimator indicates areas of SEZ in undeveloped settings that are not usually the focus of land use decisions involving SEZ. The efficacy of the WRAMP map of SEZ needs to be further assessed. To this end, the Round 12 SNPLMA funds awarded to map the aquatic resources and SEZs will also be used to further compare the WRAMP approach and present approach to SEZ mapping. CARCS was useful for classifying aquatic resources as habitat, but did not provide the SEZ classification needed by TRPA. A crosswalk should be developed between CARCS and the SEZ classification system currently being developed by TRPA.

Question 3: Is the California Rapid Assessment Method useful for assessing the health of wetland and stream systems and projects?

Need. The costs of monitoring and assessing aquatic resources can be prohibitively expensive. One way to reduce costs is to make sure monitoring and assessment efforts only provide the data essential for sound regulatory or management decisions. In many cases, data regarding the overall health of aquatic resources or the overall performance of projects are most needed. Rapid assessment methods can provide these kinds of essential data.

Approach. The Project Team trained more than fifty CRAM practitioners and conducted ambient surveys of stream health for urban and rural areas of the Upper Truckee River and Third Creek watersheds using CRAM.

Answer. The surveys showed that local practitioners could use CRAM to produce very cost-effective profiles of stream health. The surveys also provided scientific evidence that SEZs help protect in-stream resources. The Project Team decided that CRAM could be used to assess the overall performance of restoration and mitigation projects, relative to ambient conditions at multiple spatial scales, such as watershed, the region, and statewide. However, the Team also noted that other measures of particular aspects of health, such as fish and wildlife support, might be used in conjunction with CRAM, depending on the key management questions.

Question 4: Can any existing CRAM module be used to assess the health of wet meadows?

Need. Wet meadows are an especially valuable class of wetlands in the Tahoe Basin because they increase the capacity of watersheds to store water and sediment, and because they provide unique habitats and cultural services. Agencies charged with protecting wet meadows need a scientifically credible, repeatable, cost-effective method of assessing their overall health.

Approach. The Project Team established a sub-team of wet meadow scientists to evaluate the efficacy of existing CRAM modules for assessing wet meadows, and to develop a wet meadow module of CRAM if needed and appropriate.

Answer. The wet meadow team found that no existing CRAM module provided adequate assessments of wet meadow health, but that a set of CAM modules could and should be developed. The team calibrated four new modules for forested and non-forested slope wetlands, with and without channels (wet meadows are termed non-forested slope wetlands in CARCS).

Question 5: Should the EcoAtlas information system be used to plan, permit, and track efforts to protect aquatic resources in the Basin?

Need. Watershed planning and protection requires coordinating efforts among many responsible interests, including many agencies at all levels of government. The needed coordination depends on a common basemap (see Question 1 above) and a way to visualize and share essential data and information. The information system should be online, publically accessible, and map-based. No such system exists for the Tahoe Basin at this time.

Approach. The Project Team decided to explore the use of the California EcoAtlas as an information sharing and delivery system for the Tahoe Basin. The existing CARI base maps for the Upper Truckee River and Third Creek watersheds was replaced with the TARI maps produced through this project, all CRAM data from the ambient surveys of stream condition in these two watersheds were made accessible through CRAM database of EcoAtlas, and five stream or wetland restoration projects within the Basin were added to the project tracking module of EcoAtlas. The Project Team reviewed these modules and other functionality of EcoAtlas, including especially the Landscape Profile Tool, and identified their possible uses within the Basin.

Answer. The SRT found that EcoAtlas could and should be used to share and deliver data and information about aquatic resources and riparian areas, with an emphasis on project planning and tracking in the watershed and regional context. However, the Team also found that the existing Lake Tahoe Basin Information Exchange (aka Tahoe Integrated Information Management System, or TIIMS) contains important data that should be made accessible through EcoAtlas, and that other kinds of data of particular importance in the Basin, such as maps of SEZ, and that are not currently in EcoAtlas should be added to it.

Question 6: What next steps, if any, should be taken to implement the WRAMP framework and toolset in the Basin?

Need. This Project resulted in a general consensus among the Project Team that the WRAMP framework and toolset have potential to significantly improve the health of local watersheds over time through improved planning, permitting, and coordination of environmental improvement projects in the watershed and regional contexts. However, the Team also recognized that realizing this potential would require implementation through existing programs, and that such implementation would require programmatic adoption and consistent guidance to project sponsors and their consultants.

Approach. The Project Team planned and held a final meeting for itself, plus other interests including the public, to discuss the findings of this project and what existing programs might further explore implementation based on the findings.

Answer. The TRPA expressed an interest in promoting TARI as the common basemap of aquatic resources in the Basin, with the addition of SEZ maps as they become available. CTC and TRPA expressed interest in further exploring EcoAtlas as their environmental information management and delivery system, with links to the TIIMS data base as needed. Participating private consultants indicated that EcoAtlas would be useful for acquiring existing information about project sites, and that CRAM and EcoAtlas would be especially useful for comparing projects to each other and to ambient condition over time. The Regional Water Board expressed interest in working with the State Water Board and USEPA on a follow-up demonstration project focusing on using CRAM and EcoAtlas to support Phases I and II of the State Board's Wetland and Riparian Area Protection Policy. With the encouragement of the SRT, SFEI-ASSC will submit a proposal to TRPA to develop the EcoAtlas for tracking and assessing activities of the regional Environmental Improvement Program (EIP).

Project Purpose

The primary purpose of this Project was to evaluate the efficacy of the Wetland and Riparian Area Monitoring Plan (WRAMP)[1] developed by the California Wetland Monitoring Workgroup (CWMW[2]) and endorsed by the California Water Quality Monitoring Council (CWQMC)[3] for assessing the distribution, abundance, diversity, and condition of wetlands, streams, and their riparian areas in the Sierra Nevada. WRAMP supports the monitoring component of the proposed Wetland and Riparian Area Protection Policy (WRAPP)[4] of the CA State Water Resources Control Board (State Board). A separate, follow-up project is being conducted through the Lahontan Regional Water Quality Control Board (RB6) to foster WRAPP implementation in the Sierra Nevada with routine applications of selected WRAMP tools.

[1] http://www.mywaterquality.ca.gov/monitoring_council/wetland_workgroup/docs/2010/tenetsprogram.pdf
[2] http://www.mywaterquality.ca.gov/monitoring_council/wetland_workgroup/
[3] http://www.mywaterquality.ca.gov/monitoring_council/
[4] http://www.waterboards.ca.gov/water_issues/programs/cwa401/wrapp.shtml

Two secondary purposes were identified for this Project after its inception. One was to transfer the WRAMP toolset to selected regional agencies and other interests within the Tahoe Basin. The other was to explore the ability of one of these tools, the Riparian Width Estimator, to identify and classify the Stream Environment Zone (SEZ), based on remotely sensed data. The SEZ is an integral part of the regional, inter-agency framework for protecting aquatic resources in the Tahoe Basin. A separate, follow-up project is being conducted by an independent science team funding through the Southern Nevada Public Lands Management Act (SNPLMA) to apply the California Aquatic Resource Inventory Standard Operating Procedures and further develop methods of mapping and delineating aquatic resources and SEZ across the entire Lake Tahoe Basin.

Project Participants

The Project established a multi-agency Sierra Regional WRAMP Team (SRT) to guide and review Project outputs and to further inform the Sierran community about WRAPP and WRAMP. The SRT met five times to select two demonstration watersheds, participate in the assessment design, coordinate training activities, help perform assessments in two watersheds, review and interpret the assessment results, and design this report. The Project also developed special teams for training, mapping, and for additional tool development. More than a hundred people participated in this Project as team members or trainees. A separate team of experts convened on four occasions to develop the slope wetlands CRAM module. A brief summary of the roles and responsibilities of the Project participants is presented below, and a comprehensive list of the participants is presented in Appendix A.

Principal Investigator

The San Francisco Estuary Institute and Aquatic Science Center (SFEI-ASC) served as the primary contractor and principal investigator for the Project. SFEI is a registered 501c3 non-profit, science organization established in 1992 through the Comprehensive Conservation and Management Plan of the San Francisco Estuary Project of USEPA to help coordinate environmental research and monitoring for the San Francisco Estuary and its watersheds. The Aquatic Science Center is a Joint Powers Authority (JPA) established in 2007 by the State Water Quality Control Board and the Bay Area Clean Water Agencies (BACWA) to assist with the efficient delivery of financial, scientific, monitoring, and information management support functions. Dr. Josh Collins is the Chief Scientist at SFEI, and member of the CWMW, and served as the technical lead for this Project..

Sierra Regional WRAMP Team

The SRT consisted of agency and non-government groups who work in the Tahoe Basin or have an interest in the region. The SRT provided Project oversight and review via email and at meetings throughout the Project. The SRT Charter is presented in Appendix B.

The SRT included a core group of participants who provided overall project planning and administrative support. Public agencies or JPAs serving on the Administrative Team of the SRT include: the U.S. Environmental Protection agency (USEPA), Tahoe Regional Planning Agency (TRPA), State Water Resources Control Board (State Water Board), Lahontan Regional Water Quality Control Board (RB6), the California Tahoe Conservancy (CTC), and SFEI-ASC.

Wet Meadow Team

The Wet Meadow Team (WMT) led the development of a new CRAM module for assessing forested slope wetlands and non-forested slope wetlands (i.e., wet meadows) in riparian or non-riparian settings. The team consisted of wetland scientists from academia and the private sector, as well as local, state, and federal agencies. The Project developed the new CRAM module for slope wetlands through the calibration step of the module development process adopted by the State Water Board. The calibrated slope wetland module of CRAM (v6.0) can be downloaded from the CRAM website for use by trained CRAM practitioners (www.CRAMwetlands.org).

CRAM Trainees

Two three-day CRAM training sessions were held for wetland and stream scientists and managers practicing in the Sierra Nevada. These sessions focused on increasing the regional capacity for assessing the overall health of wadeable streams using CRAM. A total of 55 environmental scientists, managers, planners and regulatory staff completed CRAM practitioner training through this Project.

Basic Description of WRAMP

The Need

The Wetland and Riparian Area Monitoring Plan (WRAMP) is a framework and toolset for assessing the performance of public policies, programs, and projects intended to create, restore, or enhance wetland and stream habitats in California by tracking their distribution, abundance, diversity, and condition.[5] Reasons for a standardized approach to wetland and stream assessment include, but are not limited to:

- Objectively compare projects to each other and over time, such that they can be used to improve future project performance;
- Maximize the efficacy of assessment data by assuring they meet the information needs for project siting, design, and permitting;
- Assure that assessments of ambient condition and project performance inform each other as learning opportunities;
- Understand changes in ambient condition and project performance due to natural processes, such as fire, flooding, and drought, as well as climate change;
- Evaluate the performance of governmental programs and policies intended to protect wetland, stream, and riparian resources.

Statewide plans to assess wetland, stream, and riparian resources is a key recommendation in the California Natural Resource Agency's second State of the State's Wetlands Report[6], is crucial for implementing the CA Governor's Wetland Conservation Policy[7], and is consistent with the central mandate of CA Senate Bill 1070 that created the CA Water Quality Monitoring Council[8] (CWQMC).

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[5] WRAMP is focused on wetlands because California lacks a coherent statewide plan for their assessment. Aspects of WRAMP pertaining to streams complement the Perennial Stream Assessment Program (PSA) of the CA Surface Water Ambient Monitoring Program (SWAMP) by providing standards for mapping streams, a method to estimate riparian areas, a method for rapidly assessing stream health, and a means to manage PSA data.

[6] http://resources.ca.gov/ocean/SOSW_report.pdf

[7] http://ceres.ca.gov/wetlands/policies/governor.html

[8] http://www.mywaterquality.ca.gov/monitoring_council/

The Framework

The CA Wetland Monitoring Workgroup[9] (CWMW) of the WQMC is developing WRAMP to answer the basic question: "where are the wetlands and riparian areas and how are they doing, relative to the past conditions and future goals?" WRAMP is based upon the often heralded recommendation to carefully align environmental monitoring data with environmental management and regulatory decisions, and upon the "1-2-3" system developed by USEPA to help efficiently achieve this alignment[10]. According to the "1-2-3" system, environmental data and the management questions or regulatory decisions that the data should inform can be assigned to one of three levels, as described below.

Level 1: Maps and other data that are remotely sensed or field-based that can answer questions about the distribution, abundance, diversity, and location of environmental resources and related projects.

Level 2: Field-based rapid assessment data that can answer questions about overall condition or health of environmental resources.

Level 3: Field-based data to answer questions about specific aspects of environmental resource condition or about its causes or effects.

WRAMP augments this basic 1-2-3 system with standardized methods and guidance for Level1-3 data collection, sampling design, data management and synthesis, and information delivery (Figure 1).

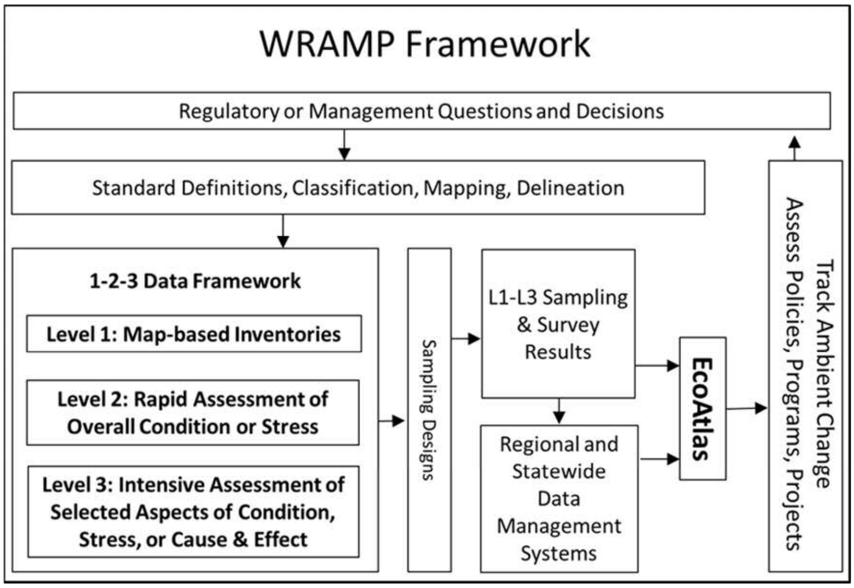

Figure 1: Schematic diagram of the WRAMP framework linking environmental data to information needs through standardized monitoring procedures and information delivery. See the following section on the WRAMP Toolset for simple descriptions of the basic elements of this framework.

9 http://www.mywaterquality.ca.gov/monitoring_council/wetland_workgroup/
10 http://water.epa.gov/grants_funding/wetlands/upload/2006_4_19_wetlands_Wetland_Elements_Final.pdf.

The WRAMP Toolset

The WRAMP toolset, as presented below, continues to be developed as needed to meet the needs of environmental policies and programs. At this time, the tool development is focused on supporting WRAPP, with an emphasis on the information needs of the State Water Board for its watershed approach to mitigation planning and integrated water quality control. However, as directed by the CWMW, the tools are being developed to have broad applicability across the environmental planning, permitting, and management efforts of many agencies at all levels of government.

Standard Definitions

WRAMP includes proposed definitions of wetlands, streams, and riparian areas as needed by the WRAPP. It also includes a proposed wetland delineation methodology and it can accommodate methods to delineate streams and riparian areas.[11]

Standard Classification Systems

WRAMP will include the CA Aquatic Resources Classification system (CARCS) that is currently being developed by a federal-state technical team, and it can accommodate other systems for classifying natural resources. The intent is to develop and implement mapping protocols for terrestrial and aquatic natural resources that enhance federal maps of the same subjects and that will support many different classification systems.

Level 1 Tools

The primary Level 1 (L1) tool of WRAMP is the CA Aquatic Resource Inventory[12] (CARI). It is a set of detailed protocols for mapping surface aquatic features including wetlands based on remotely sensed data and for quantifying the accuracy of these data and the resulting maps. Implementation of the CARI protocols can yield intensifications of the National Wetlands Inventory[13] (NWI) of the US Fish and Wildlife Service and the National Hydrological Dataset[14] (NHD) of the US Geological Survey. CARCS and some other natural resource classification systems, including the stream classification system of the CA Forest Practices Rules,[15] can be supported by CARI. One important L1 tool that is being developed as an application of CARI is the Riparian Width Estimator. It generates maps of the approximate extent of selected riparian functions based on vegetation structure and topography.

Level 2 Tools

The primary Level 2 (L2) tool of WRAMP is the California Rapid Assessment Method for wetlands and streams[16] (CRAM). CRAM is a cost-effective and scientifically defensible rapid assessment method for assessing the overall condition or health of wetlands and streams within watersheds, regions, and throughout the State. It can also be used to assess the performance of compensatory mitigation projects and restoration projects. CRAM consists of a set of modules designed to assess the different classes and subclasses of wetlands identified using CARCS. CRAM development and training is overseen by the L2

[11] Recommended State definitions and delineation methods can be found at http://www.waterboards.ca.gov/water_issues/programs/cwa401/wrapp.shtml
[12] http://www.sfei.org/it/gis/cari
[13] http://www.fws.gov/wetlands/
[14] http://nhd.usgs.gov/
[15] http://calfire.ca.gov/resource_mgt/resource_mgt_forestpractice.php
[16] http://www.cramwetlands.org/

Committee of the CWMW, with concurrence from the Surface Water Ambient Monitoring Program SWAMP.

Level 3 Tools

WRAMP defers to other state and federal monitoring plans and programs operating in California for Level 3 methods of data collection, based on the exact information needs of regulatory and management agencies. For example, with regard to determining the impairment of streams and wetlands relative to water quality objectives, WRAMP defers mainly to SWAMP for L-3 methods. With regard to assessing the status of wildlife species of special concern, WRAMP defers to the agencies most responsible for wildlife protection and recovery.

Sampling Designs

WRAMP includes guidance of how to assess ambient condition and project performance using either targeted (fixed station) or probabilistic sampling designs. The Perennial Stream Assessment (PSA) Program uses CRAM as part of its probabilistic regional surveys of steam condition. A variety of local agencies and special districts have employed probabilistic sampling designs to assess overall watershed health using WRAMP tools.

Data Management Systems

Some of the WRAMP tools for data collection are supported by online data management systems. "eCRAM[17]" is a system that is dedicated to entering, viewing, and downloading CRAM assessment data and is used statewide by CRAM practitioners. "Online 401" is a system dedicated to informing the 401 Certification Program of the State Water Board. This system has been developed but is not yet publically available online. Once released, information about approved 401 projects will be available in EcoAtlas (see discussion of Data and Information Delivery below). At this time, CARI is maintained as the base map for EcoAtlas (see discussion of Data and Information Delivery below) and for the Wetlands My Water Quality Portal[18] of the CWQMC. The data management systems of WRAMP are being designed with the intent to visualize data from many sources including especially the California Environmental Data Exchange Network[19] (CEDEN). CEDEN was created by the State Water Board with support from SWAMP and includes available statewide water quality monitoring data (such as that produced by SWAMP, and other research and volunteer organizations). Federal environmental regulations require each state to periodically assess the condition of its surface waters, and CEDEN is a centralized database that serves to provide access to the California's water quality monitoring data.

Results Syntheses

Data can be extracted from the online data management systems of WRAMP and loaded into any appropriate analytical procedure. However, WRAMP emphasizes three procedures for summarizing and synthesizing data about streams and wetlands across watersheds, landscapes, regions, and statewide. One of the procedures is the Cumulative Distribution Function (CDF). As used in WRAMP, a CDF describes the relative abundances of different conditions within the geographic scope of a probabilistic survey. Another emphasized procedure is the Project Performance Curve (PPC). PPCs quantify the relationship between the performance of ecological restoration or compensatory mitigation projects

[17] http://www.cramwetlands.org/about
[18] http://www.mywaterquality.ca.gov/eco_health/
[19] http://www.ceden.org/

and their age. They enable project managers to estimate the rate at which the performance of a project will likely improve over time. WRAMP emphasizes PPCs based on CRAM. PPCs are being developed for each major class of wetland for which there is a CRAM module. The third analytical procedure emphasized by WRAMP is the Landscape Profile. This is an automated tool available in EcoAtlas (see discussion of EcoAtlas immediately below) that can synthesize information from multiple data sources, including existing and historical aquatic resource maps, CRAM assessments, CEDEN, wetland restoration project information, threatened and endangered species, land use, and population census data for user-defined landscape areas (e.g. watersheds, counties, congressional districts, etc.).

Data and Information Delivery

WRAMP features the California EcoAtlas[20] as a data and information delivery system to support a watershed approach to environmental planning, management, and regulation. The online tool provides free public access to information about the distribution, abundance, diversity, location, and condition of California wetlands, streams, and riparian area. It lets the user visualize the condition and extent of surface aquatic features throughout California. EcoAtlas presents CRAM assessment results (from eCRAM) and wetland restoration project information (from 401 permits in some regions of the state) on a statewide, interactive, aquatic features base map. EcoAtlas uses web services to retrieve and present data from other online information systems, including StreamStats of the US Geological Survey[21]and water and sediment toxicity data from CEDEN. These toxicity data are an example (proof of concept) of water quality data that could be retrieved and presented in EcoAtlas to help with local and larger scale evaluations of environmental conditions. EcoAtlas services will continue to be developed in support of WRAPP, providing environmental interests with essential scientific information to support environmental management and regulatory decisions.

Project Approach and Workplan

SFEI-ASC assisted RB6, TRPA, and CTC in establishing the Sierra Regional WRAMP Team (SRT). The SRT developed a Charter and finalized the Project workplan. The SRT decided to pilot WRAMP in two watersheds within the Tahoe Basin, while concurrently developing the Slope Wetland Module of CRAM through a dedicated technical team, and while training selected regional agencies to use CARI, CRAM, and EcoAtlas. The SRT decided not to incorporate L3 data into this project, due to the prohibitively high cost of developing an adequate L3 database. However, the SRT realizes the importance of using the WRAMP to prioritize L3 data, of using standardized methods of collecting L3 data, and incorporating it into CEDEN and EcoAtlas. In this regard, SWAMP is exploring how EcoAtlas could be used to deliver L3 data on stream macroinvertebrate community structure from the California Perennial Stream Assessment (PSA) program, which has been annually collecting such data throughout the Tahoe Basin since 2009.

[20] http://www.ecoatlas.org/about/
[21] http://water.usgs.gov/osw/streamstats/

Methods and Results

Demonstration Watershed Selection

The SRT developed criteria for selecting two watersheds to assess using the WRAMP framework and toolset (Table 1). The Upper Truckee River (UTR) and Third Creek watersheds were selected (Figure 2). The UTR watershed (including the Trout Creek Marsh area) covers 36,370 acres (about 57 mi^2), and is located in California. The Third Creek watershed covers 3,860 acres (about 6 mi^2), and is located in Nevada.

Table 1. Demonstration watershed selection criteria.

Sierran Location Both watersheds should be located within the Tahoe Basin.
State Representation Both Nevada and California should be represented.
Environmental Complexity Each watershed should exhibit as wide variety of wetland types and stream sizes.
Projects Each watershed should have at least 4 permitted restoration and/or mitigation projects.
Political Context Each watershed should be of high interest to many stakeholders but not be embroiled in controversy; the pilot WRAMP Project should not attempt to resolve a major local issue.
Logistics and Accessibility Each watershed should be reasonably accessible.
Available Information Fundamental environmental data, such as soils maps, vegetation maps, digital elevation models, land use maps, project monitoring reports, and research reports should be readily available for each watershed.

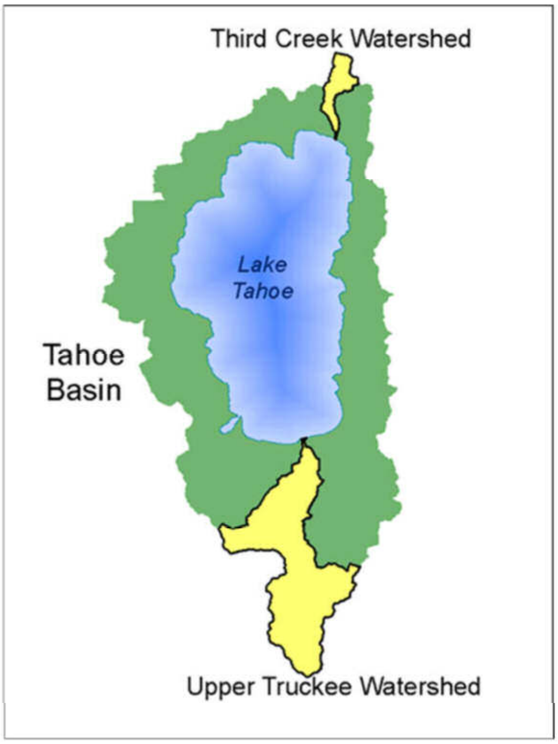

Figure 2. Locations of the demonstration watersheds within the Tahoe Basin.

Level 1 Survey

Tahoe Aquatic Resource Inventory

The Tahoe Aquatic Resource Inventory (TARI) is the Tahoe Basin version of CARI. Regions of the State can enhance CARI by adding particular typologies and nomenclatures that reflect regional interests, if the regional versions do not curtail the ability of CARI to achieve its statewide purposes. Some of the particular enhancements of CARI that might be provided by TARI are maps of SEZs and a hierarchical classification of slope wetlands. TARI has also enhanced CARI by providing guidance on the use of a Digital Elevation Model (DEM) derived from Light Detection and Ranging data (LiDAR).

One objective of the Project was to introduce the CARI methodologies and transfer them to regional partners. To meet this objective, TRPA, CTC, RB6, and SFEI-ASC co-produced TARI for the two demonstration watersheds. The resulting base maps for the two watersheds were vetted with the inter-agency CARI Advisory Group, which includes representatives from NHD and NWI. With the input of the CARI advisors, the SRT compared TARI to NHD and NWI (Table 2 and Figure 3). Based on this comparison, the SRT decided that TARI was more useful than the standard NHD dataset and the standard NWI dataset, especially if LiDAR is used to develop the DEM, but that TARI could be enhanced by incorporating local place names.

Table 2. Comparison of NHD and TARI (Part A) and NWI and TARI (Part B)

Part A (comparison between NHD and TARI)

NHD	TARI
Pros: — Designates seasonality of flow — Is a nationwide dataset — Designates USEPA used reach codes — Provides stream names — Designates flow direction	**Pros:** — 1:5,000 scale — Highly accurate based on LiDAR — Provides flow direction and stream order — Is generally more realistic — Has QAQC system vetted with SWAMP — Can be an intensification of NHD
Cons: — Tends to exclude first-order streams — Misaligned streams more common — Inaccurate confluences more common — 1:24,000 scale — Does not designate stream order	**Cons:** — Does not designate seasonality — Does not designate USEPA reach codes — Does not provide stream names — Is not a national dataset

Part B (comparison between NWI and TARI)

NWI	TARI
Pros: — Nationwide standard dataset — Automated QAQC procedures — Is basis for CARI when no other dataset is available	**Pros:** — 1:2,500 to 1:5,000 scale — Highly accurate based on LiDAR — Serves as CRAM sample frame — Is generally more realistic — Can be an intensification of NWI
Cons: — Has higher rates of omission and misclassification — 1:24,000 scale — Does not serve as CRAM sample frame	**Cons:** — Is not a national dataset

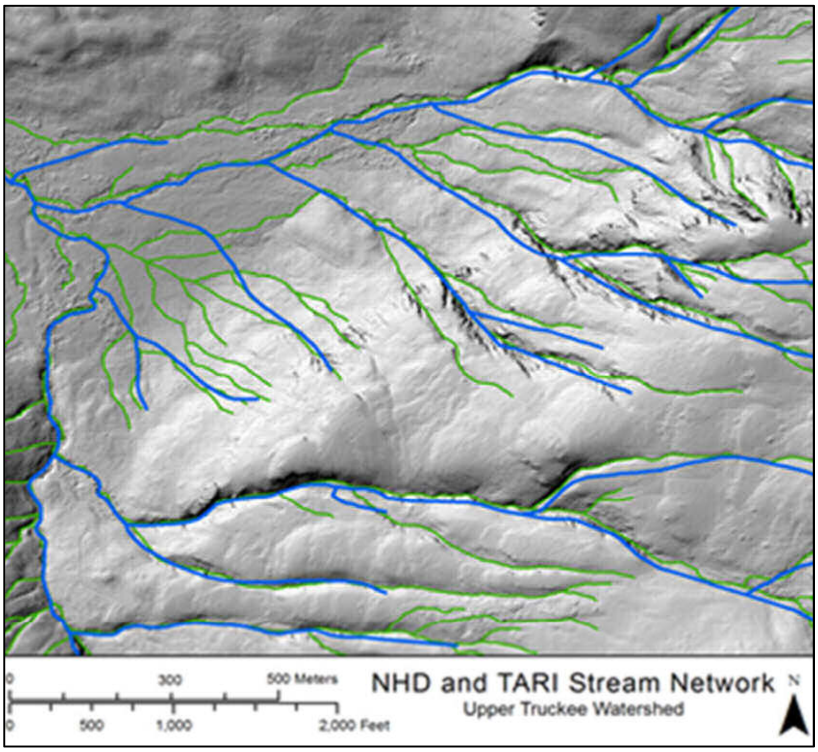

Figure 3. Visual comparison of the stream network for a portion of UTR Watershed based on NHD (blue lines) and TARI (green lines). Note the much greater channel density of represented by TARI, which is also better aligned with topography, and which is generally more accurate according to field validation.

The TARI maps for the UTR and Third Creek watersheds were co-produced by TRPA, CTC, RB6, and SFEI-ASC. The procedures specifically developed for these maps, such as the procedure for using LiDAR, have been incorporated into the CARI Standard Operating Procedure (CARI SOP). The LiDAR data were acquired with SNPLMA grant funding, and provided by Watershed Sciences as three 0.5-m pixel DEMs with a vertical accuracy of 3.5 cm: a highest-hit DEM, bare earth DEM, and a Hydrologically-Enforced DEM. These products were used to create hillshades for topographic visualization, vegetation elevation and an automated flow network. This dataset matched closely with the pre 2009 aerial imagery provided by the National Agriculture Image Program[22] (NAIP).

To maximize the benefits of CARI (and TARI), a crosswalk has been developed between the CARI and NWI classification systems. This will enable CARI to be utilized by USFWS as an intensification of NWI. However, the use of CARI as an intensification of NHD depends on incorporating NHD attributes into CARI. This might be accomplished over time through future regional and local CARI projects.

Distribution, Location, Abundance and Diversity of Aquatic Resources

The UTR Watershed is about 9.5 times larger than the Third Creek Watershed. Both watersheds support the same major classes of aquatic resources based on the CRAM classification system: streams, forested slopes, wet meadows, depressional wetlands, and lacustrine wetlands. Figures 4 and 5 are maps developed in GIS, using the TARI basemap, that show the aquatic resources in each watershed. Users can use EcoAtlas to interact with these maps online. Figures 6 and 7 show the relative proportions and total acres of each wetland class in each watershed as a whole, and within the urban and rural areas of the each watershed (for an explanation of rural and urban settings, see the section on Level 2 sampling design below).

[22] http://www.fsa.usda.gov/FSA/apfoapp?area=home&subject=prog&topic=nai

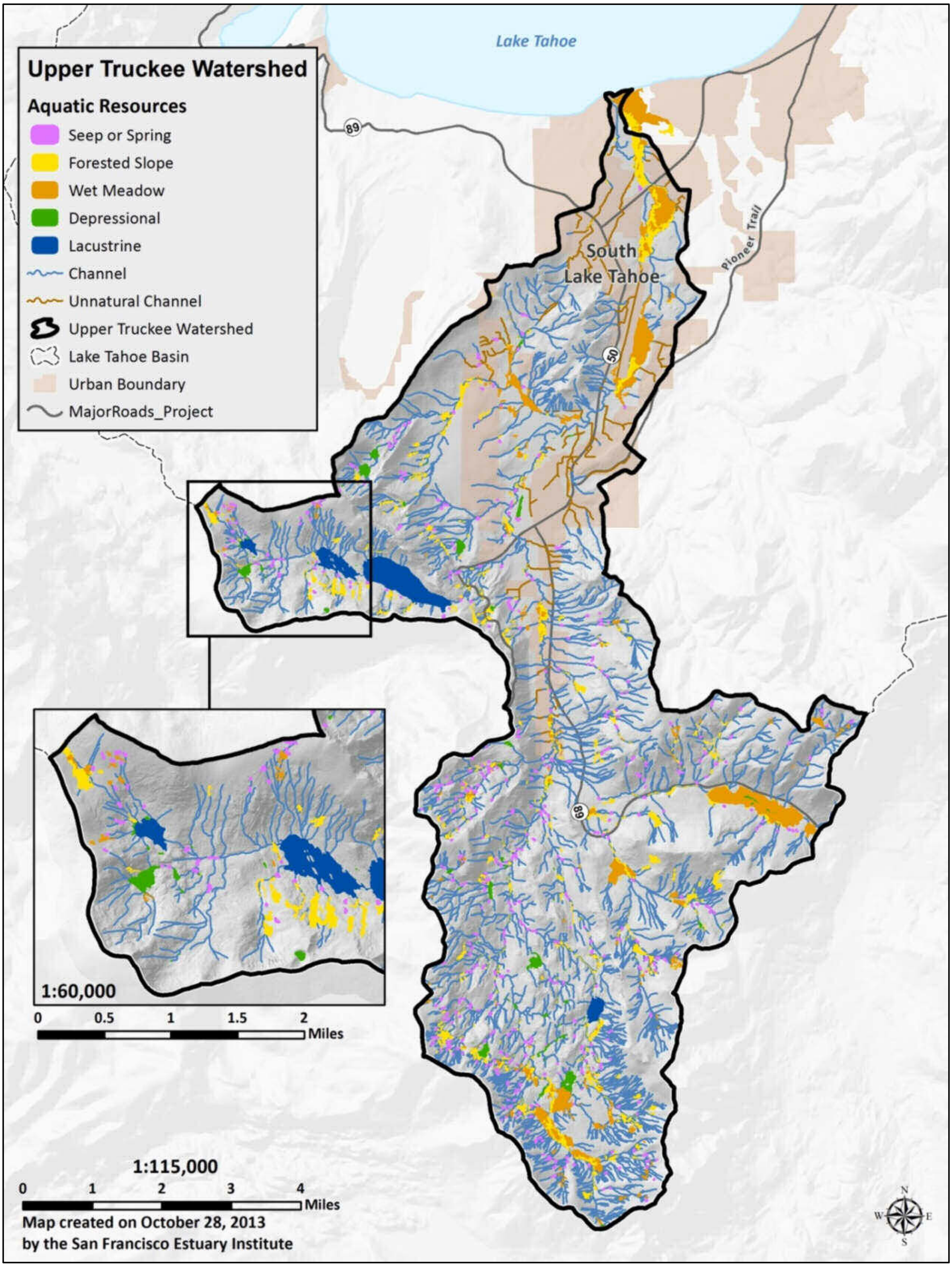

Figure 4. Urban boundaries and aquatic resources in the Upper Truckee River watershed.

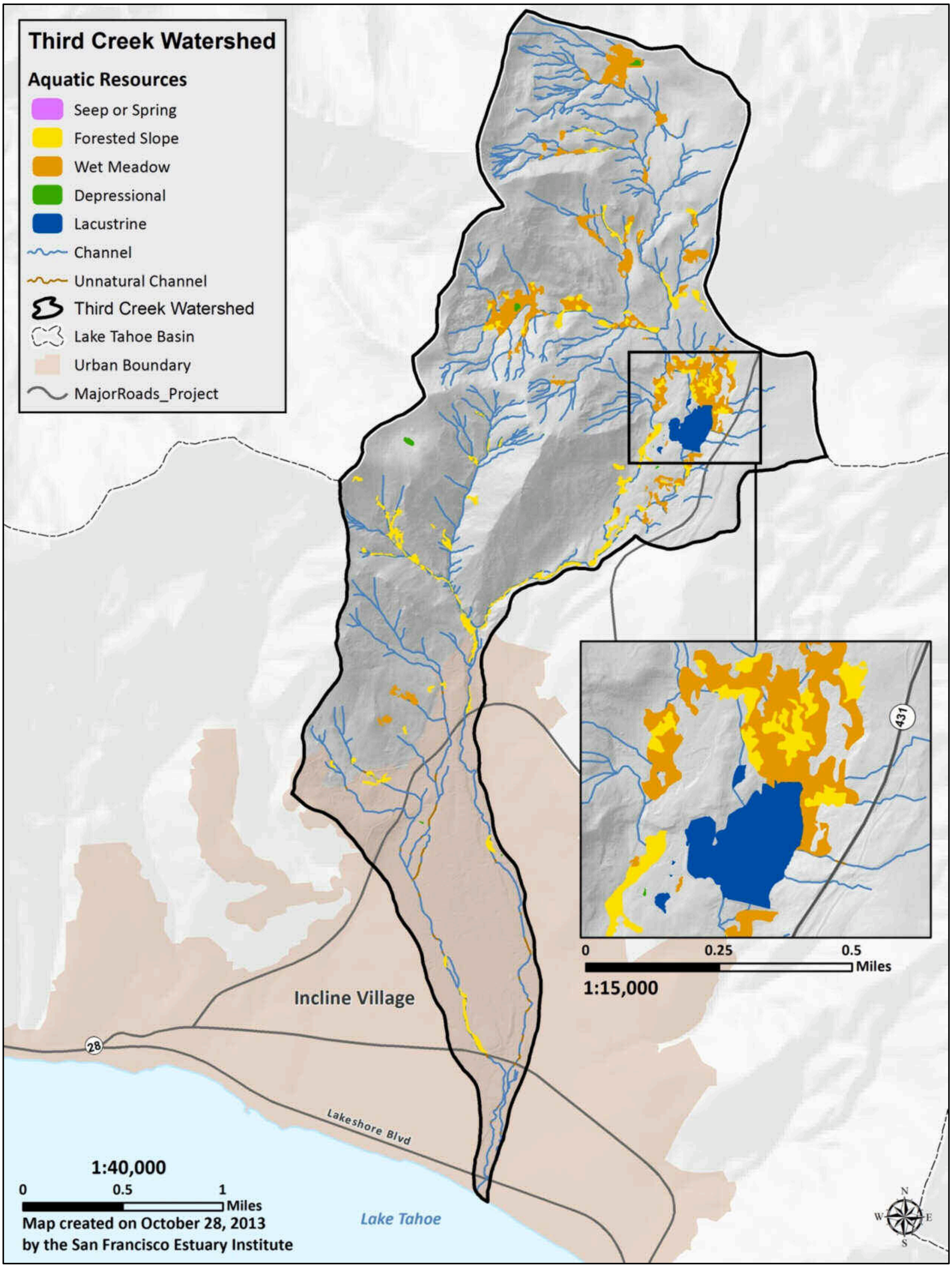

Figure 5. Urban boundaries and aquatic resources in the Third Creek watershed.

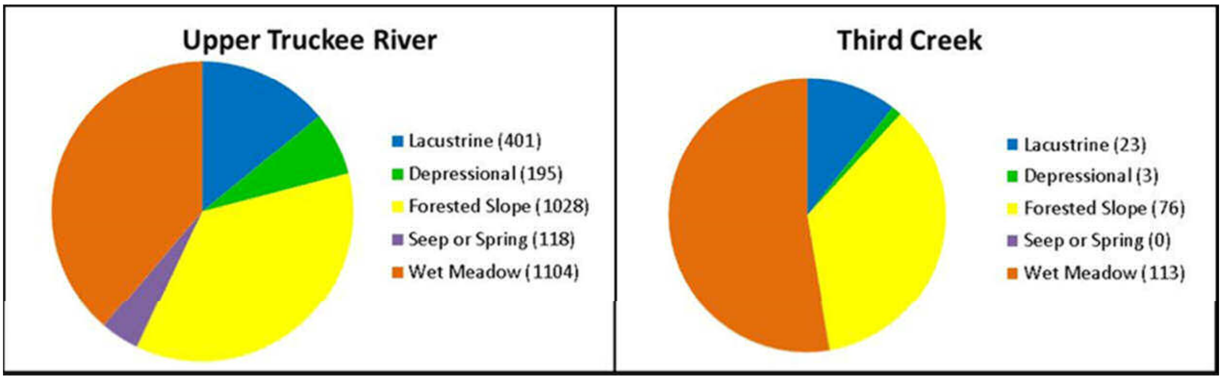

Figure 6. Proportions (and total acres) of aquatic resources in the Upper Truckee River and Third Creek watersheds. The Upper Truckee River watershed (including the Trout Creek Marsh area) covers 36,370 acres (about 57 square miles) and the Third Creek watershed covers 3,860 acres (about 6 square miles).

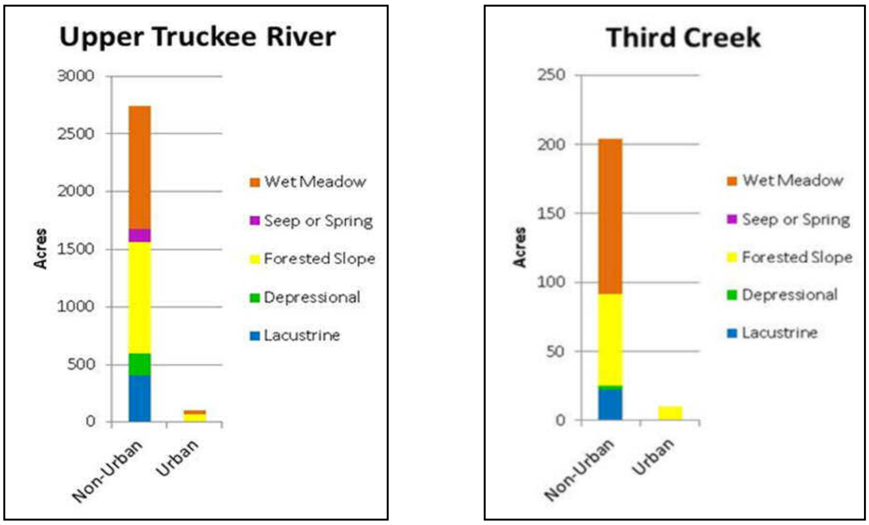

Figure 7. Acres of aquatic resources in the Upper Truckee River and Third Creek watersheds within the non-urban and urban settings. Most of each watershed is rural (i.e., non-urban). The lesser acreages in the Third Creek watershed reflect its smaller overall size.

Extent of Riparian Functional Areas

Riparian areas adjoin all surface waterways and water bodies including streams, lakes, and wetlands (Brinson *et al.* 2002, Collins *et al.* 2006). The width of a riparian area is measured landward from the adjoining stream bank, lake shore, or wetland edge. Riparian width varies with riparian function, as mediated by vegetation structure, land use, and topography (Collins *et al.* 2006). Areas that adequately support functions requiring greater width also tend to support functions requiring lesser width. Every riparian area provides some level of one or more functions, but wider areas tend to provide higher levels of more functions. Table 3 presents the general relationship between riparian width class and riparian function, as summarized by Collins *et al.* (2006).

Table 3. Generalized relationships between riparian width classes and riparian function, as summarized in Collins *et al.* (2006). A function is only assigned to a width class if the class is likely to support a high level of that function. Terrigenous sediment input depends on topographic steepness and can therefore be associated with any riparian width class.

Width Class (m)	Shading	Bank Stability	Allochthonous Input	Runoff Filtration	Flood-water Dissipation	Groundwater Recharge	Terrigenous Sediment Input	Riparian fauna Support
0 - 10	■	■	■				■	
10 - 30	■	■	■	■			■	
30- 50	■	■	■	■	■		■	
50 - 100	■	■	■	■	■	■	■	
>100	■	■	■	■	■	■	■	■

Riparian functional widths were estimated for each watershed using a beta test version of the Riparian Width Estimator. This tool generates different widths for different suites of functions based on remotely sensed information about the distribution and planform of surface aquatic features, the height of the associated vegetation overstory, and the steepness of the adjoining hillsides. In this application of the tool, widths were generated for two suites of physical functions, those associated with vegetation structure and overstory height (i.e., shading, bank stability, allochthonous input, runoff filtration) and those associated with hillslope processes (i.e., sediment delivery and the effect of hillside steepness on allochthonous input). It is expected that the riparian areas representing these two suites of functions might underestimate the widths required to fully support some ecological functions (e.g., dispersal and migration of amphibians, nesting and foraging by riparian avifauna, etc.), or to accommodate functions related to water height relative to the land (e.g., flood water storage, suspended sediment deposition, riparian vegetation rejuvenation, flood routing, flood stage desynchronization, etc.). The modules of the tool that can estimate riparian widths for these latter two suites of functions are still being developed. The results of the applications of the beta test version of the Riparian Width Estimator are summarized in Table 4 and in Figures 8 and 9 below.

Table 4. Estimates of riparian length by riparian width class for UTR and Third Creek watersheds, for physical functions of vegetation structure and hillslope processes.

Stream Riparian Width Class (m)	Upper Truckee River		Third Creek	
	Length		Length	
	Mi	Km	Mi	Km
0-10	151	94	17	11
10-30	57	36	13	8
30-50	79	49	14	9
50-100	301	187	33	21
> 100	200	124	6	4
Unnatural Channel	60	37	2	1
Total Lengths	**849**	**528**	**86**	**53**

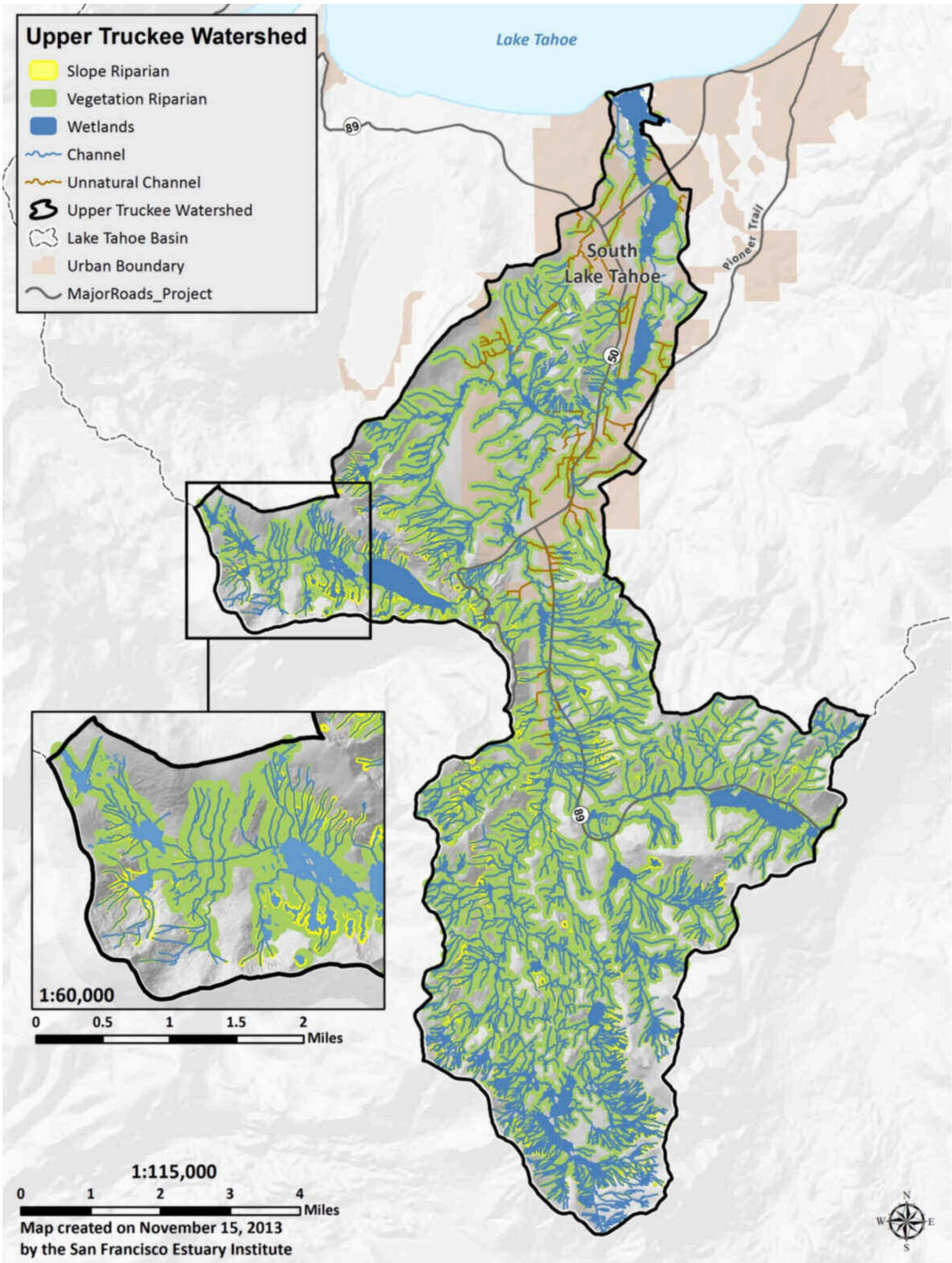

Figure 8. Maps of the estimated extent of riparian physical functions associated with vegetation structure (green) and hillslope process (yellow) for streams and wetlands in the Upper Truckee River watersheds, based on the Riparian Width Estimator.

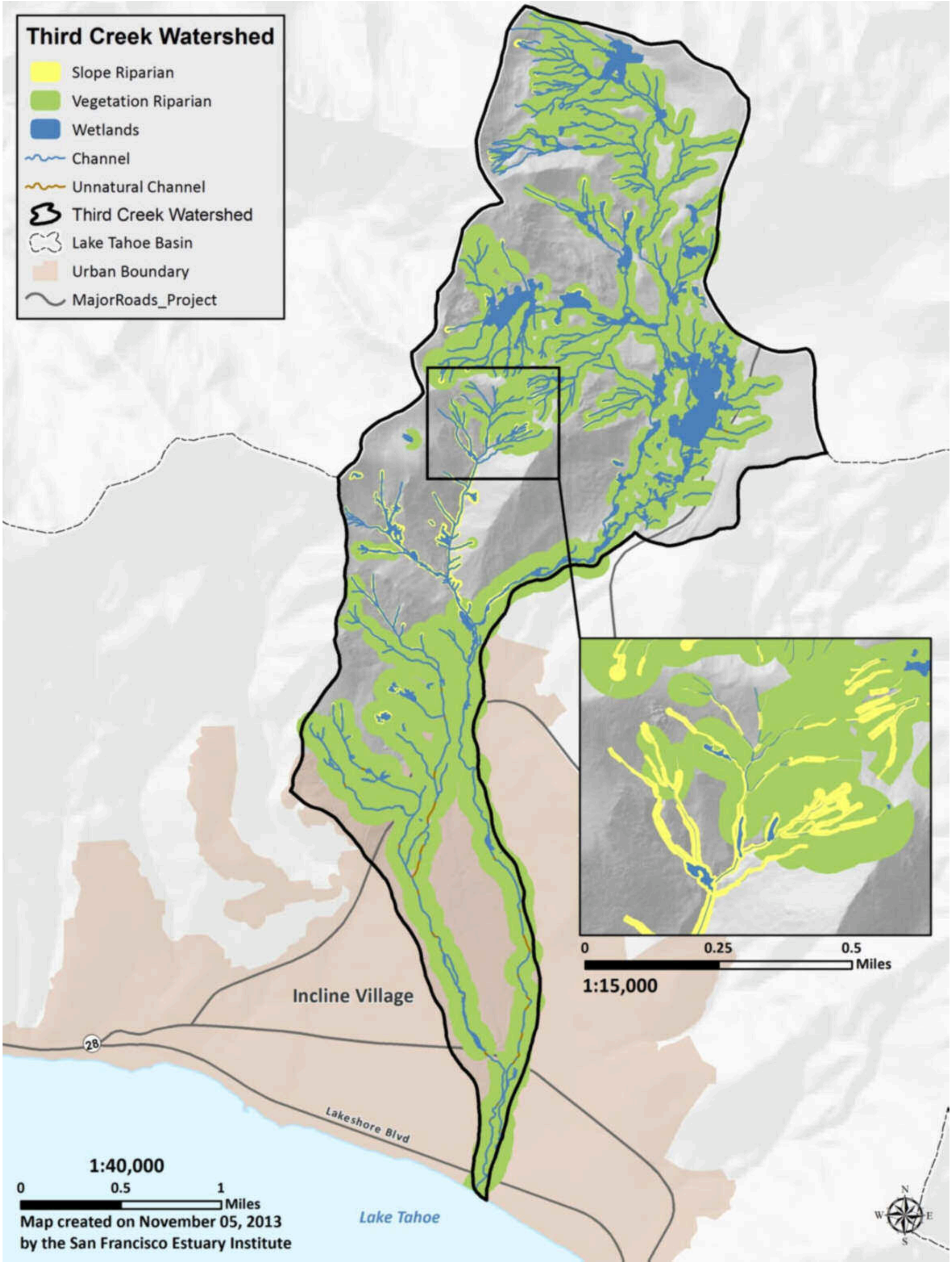

Figure 9. Maps of the estimated extent of riparian physical functions associated with vegetation structure (green) and hillslope process (yellow) for streams and wetlands in the Third Creek watersheds, based on the Riparian Width Estimator.

Table 5 shows the total riparian areas estimated to support the physical riparian functions associated with vegetation structure and hillslope process. The riparian areas for these two suites of functions were calculated separately, but they can actually overlap in the field. The simple sum of the areas calculated separately can therefore represent an over-estimate of the total riparian area. To correct for this, the two different sets of polygons representing these different suites of functions were merged in the GIS, such that the total area supported only one suite of functions or the other could be calculated, as well as the total area supporting either suite of functions (i.e., the total riparian area).

Table 5. Total riparian areas of streams and wetlands in the Upper Truckee River and Third Creek watersheds for vegetation-related and hillslope-related functions.

Area	Upper Truckee River						Third Creek					
	Wetland			Stream			Wetland			Stream		
	Vegetation-related Functions	Hillslope-related Functions	Total	Vegetation-related Functions	Hillslope-related Functions	Total	Vegetation-related Functions	Hillslope-related Functions	Total	Vegetation-related Functions	Hillslope-related Functions	Total
acres	8,478	157	8,635	19,855	801	20,656	679	26	705	1,877	90	1,967
mi^2	13	0.2	13.2	31	1.3	32.3	1	0.04	1.04	3	0.1	3.1
km^2	34	0.6	34.6	80	3.2	83.2	3	0.1	3.1	8	0.4	8.4

The total non-overlapping riparian extent for both streams and wetlands combined (based on merged GIS data) in the UTR and Third Creek watersheds are 21,486 acres (34.57 mi^2, or 87 km^2; Figure 8), and 2,045 acres (3.2 mi^2, or 8.3 km^2; Figure 9) respectively.

Stream Condition Assessment

The workplan developed by the SRT called for regional WRAMP partners to collaboratively assess the overall condition of streams in the two demonstration watersheds, and to compare the overall condition of urban and rural streams in these watersheds, using CRAM in a probabilistic sample design.

CRAM Trainings.

As part of the effort to build regional capacity to implement the WRAMP framework and toolset, SFEI's CRAM trainers from the L2 Committee of the CWMW conducted two (2) three-day CRAM Riverine Module practitioner-level trainings in the Tahoe Basin. The curriculum was the same for both sessions. Fifty-five trainees completed the training. Some Project partners from TRPA, CTC and the RB6 who participated in the first training session received additional training by assisting the trainers during the second session. Over half the trainees also participated in the probabilistic survey of stream condition in one or both demonstration watersheds. A list of the trainees is presented in Appendix A.

Figure 10. CRAM trainees (second Tahoe WRAMP training session July 10-12, 2012).

Sampling Design

The Level-2 stream assessments in both demonstration watersheds employed a probabilistic sampling design, following the Generalized Random-Tesselation Stratified (GRTS) design approach developed by the USEPA for the National Environmental Monitoring and Assessment Program.[23] In this approach, CRAM assessment sites (termed Assessment Areas or AAs in the CRAM manual) are randomly selected from the study area, while accounting for the proportion of the resource that each AA represents. The approach provides estimates of environmental condition with known levels of confidence. The CRAM survey data can be used to calculate CDFs, from which the proportion of the total resource being surveyed that is likely to have any particular CRAM score can be estimated.

For the two demonstration watersheds, the SRT decided to compare streams in urban settings to streams in rural settings. The definitions of rural and urban were provided by the SRT, and maps of these two classes of streams were created, based on these definitions. Within each of these two classes of streams, the AAs were distributed across third-order and larger streams, as determined from TARI. This eliminated any bias due to stream size. The SRT decided to omit first-order and second-order streams from the sample frame because they are expected to have similar condition to each other, are generally expected to have good condition overall, and few of them exist in urban settings. Also, CRAM tends to generate artificially low scores for these small channels because of their general lack of physical and biological complexity.

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[23] http://www.epa.gov/nheerl/arm/designing/design_intro.htm

The final parameters and assumptions of the GRTS sample draws for the UTR and Third Creek watersheds are as follows.

- **Sample Frame**: Wadeable streams in the UTR and Third Creek Watersheds of Strahler stream orders 3-7, as represented by TARI, and that meet the Riverine CRAM assessment criteria.
- **Stratification**: AAs were allocated to two classes (or strata), urban and non-urban (i.e. rural), as defined by TRPA. The sample draw distributed the number of AAs per stream order proportionally to the length of the streams within the urban and non-urban settings.
- **Sample Size**: The maximum affordable number of AAs was divided between the two watersheds based on their different sizes, while meeting the minimum sample size recommended by GRTS:
  - 42 AAs in the UTR;
  - 20 AAs in the Third Creek Watershed.
- The GRTS probability design anticipates that some portion of the initially selected AAs might be inaccessible or misclassified relative to the defined sample frame. Therefore, the sample draw was much larger than necessary (3 times the maximum affordable sample size for each watershed), such that, if a AA from the list of AAs had to be rejected, it could be replaced by the next AA of the same stream order and stratum listed in the oversample. It was assumed that rejected AAs were randomly distributed and that they were rejected for unbiased reasons, such that the AAs drawn from the oversample maintained the spatial balance of the sample across the study area.

Assessment Areas

The Level 2 assessment sample for the UTR watershed consisted of nine urban and thirty-three non-urban AAs (Figure 11), and the sample for the Third Creek watershed consisted of seven urban and thirteen non-urban AAs (Figure 12). Five AAs in the Upper Truckee River watershed were rejected because of access issues (3 sites), or because they did not meet all the AA selection criteria (two sites), and were replaced with suitable AAs from the oversample list. There were no AAs rejected in the Third Creek watershed.

CRAM Field Work

About forty people who were trained to use the CRAM Riverine Module under this project also participated in the CRAM stream condition surveys in the two demonstration watersheds. To ensure that field teams were using the same approach and were obtaining consistently collected information throughout the surveys, each field team included at least one SFEI CRAM trainer. The UTR and Third Creek surveys were conducted during the months of July & August in 2011 and 2012, respectively. All assessments in each watershed were completed in one month, and all results have been uploaded into eCRAM and can be viewed in EcoAtlas.

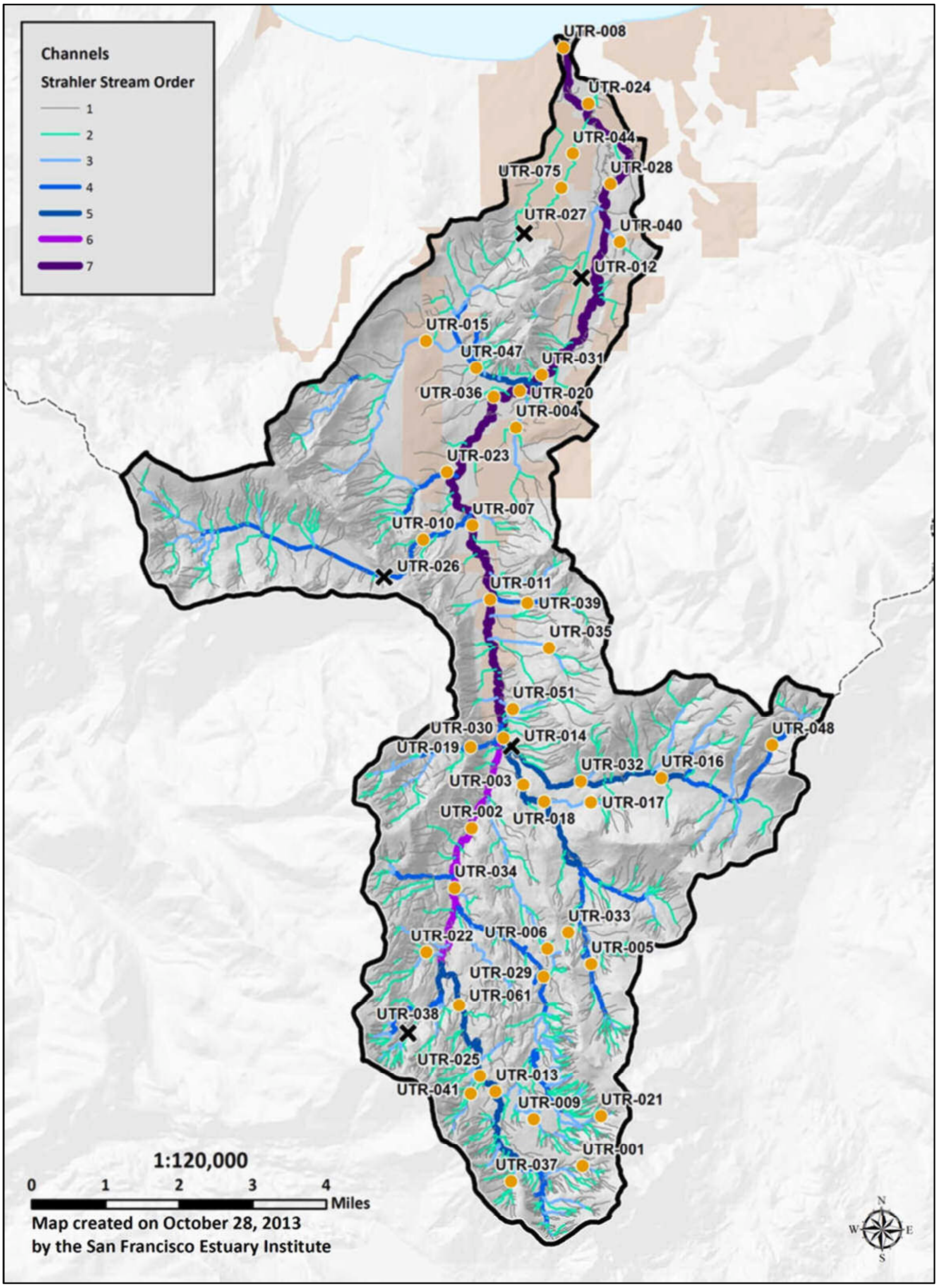

Figure 11. Locations of CRAM Assessment Areas (AAs) in the Upper Truckee River watershed. The "**X**" marks AAs that were replaced using the overdraw. A total of 42 AAs were assessed. The light pink shading indicates urban areas.

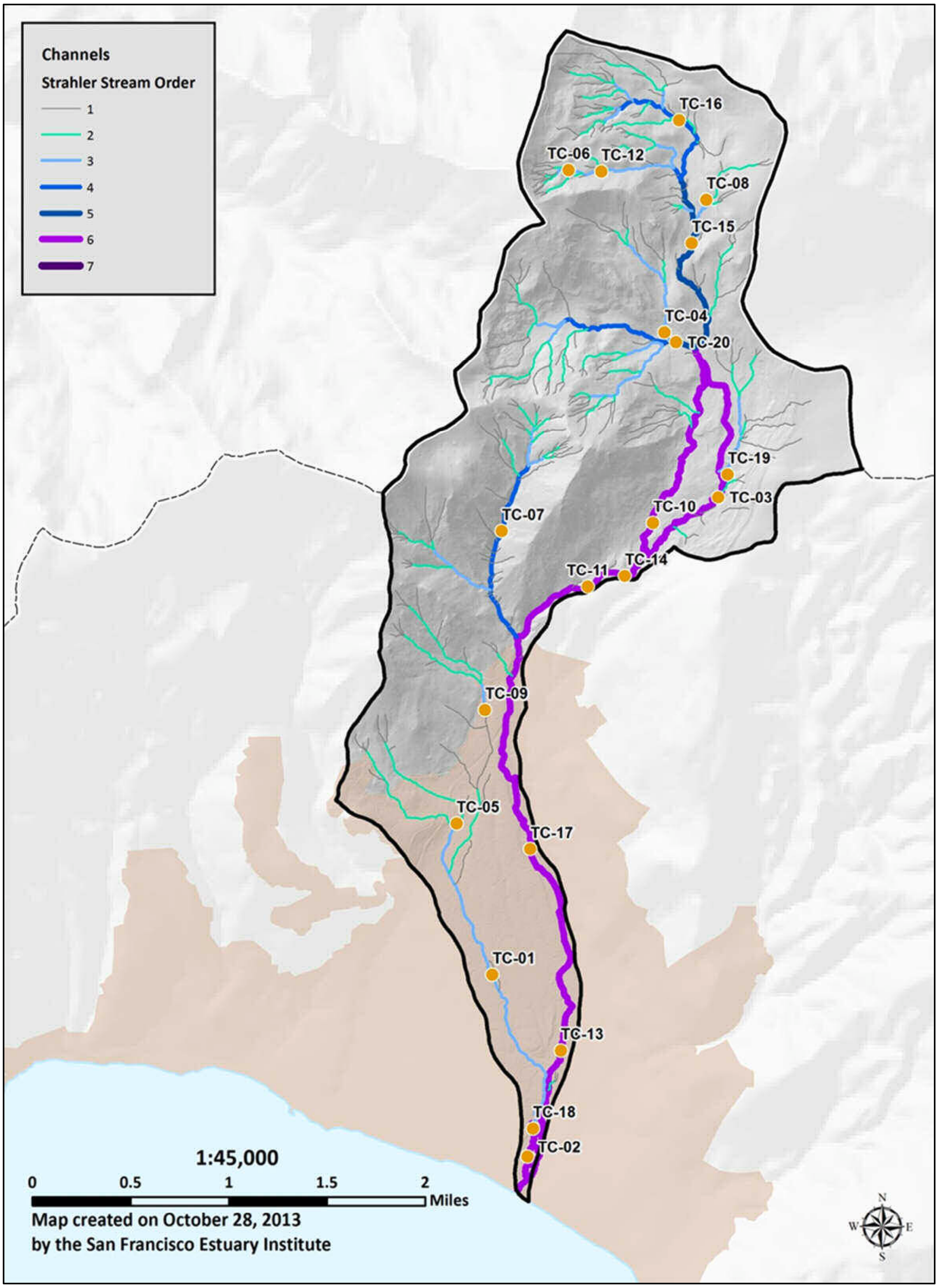

Figure 12. Locations of CRAM Assessment Areas (AAs) in Third Creek watershed. A total of 20 sites were assessed. The light pink shading indicates urban areas.

Assessment Results

Table 6 presents the summary statistics for the CRAM Index Scores and Attribute Scores for the AAs that were assessed in the probabilistic surveys of the two demonstration watersheds. . A table of the final CRAM scores is presented in Appendix C of this report. These summary statistics only pertain to the AAs that were actually assessed. However, since these scores resulted from a probabilistic survey, they can be used to estimate summary statistics for each watershed as a whole, based on their probabilities of occurrence in the watersheds.

Table 6. Summary statistics of the actual Overall and Attribute CRAM Scores for the Upper Truckee River (2011) and Third Creek (2012) watersheds.

CRAM Score	Statistic	Upper Truckee River			Third Creek		
		Watershed Overall	Rural Stratum	Urban Stratum	Watershed Overall	Rural Stratum	Urban Stratum
Index	**N**	42	33	9	20	13	7
	Range	52-99	64-99	52-87	60-94	61-94	60-73
	Mean	81	83	72	76	80	67
	St Dev.	11	9	13	10	8	5
Buffer and Landscape Attribute	**Range**	38-100	50-100	38-96	33-100	100-100	33-88
	Mean	92	97	73	89	100	68
	St Dev.	17	10	25	20	0	22
Hydrology Attribute	**Range**	58-100	58-100	58-92	67-100	83-100	67-83
	Mean	86	88	76	88	95	75
	St Dev.	14	14	12	12	6	8
Physical Structure Attribute	**Range**	38-100	38-100	38-88	25-88	25-88	25-63
	Mean	70	72	66	58	62	50
	St Dev.	19	18	21	16	17	13
Biotic Structure Attribute	**Range**	39-100	39-100	61-97	36-89	36-89	64-83
	Mean	75	75	75	68	65	74
	St Dev.	13	14	11	16	18	7

The statistical analyses of the CRAM survey results were conducted using the *Spsurvey* library for the R programing language (version 2.13.0),[24] originally developed for designing and analyzing probabilistic environmental surveys (Diaz-Ramos *et al.* 1995). The outputs of *Spsurvey* analyses for this Project include Cumulative Distribution Function plots (CDFs), percentile tables of CRAM scores, and median CRAM Index Scores and Attribute Scores for each watershed. These analyses allow direct comparisons of urban and rural streams within and between watersheds.

An example of how to read a CDF is presented in Figure 13. It shows the estimated proportion of total stream length in the UTR study area (all stream orders ≥ 3) having scores less than or greater than any particular score. For example, the straight arrows in Figure 13 indicate that the median Index Score for the UTR watershed is about 83. This suggests that half of in the streams in the watershed are likely to have Index Scores above 83, and half below 83. Given the 95% confidence band calculated for this CDF, it is more accurate to infer that 50% of the streams have a 95% chance of having a CRAM Index Score between about 78 and 87.

[24] (http://www.epa.gov/nheerl/arm/analysispages/software.htm

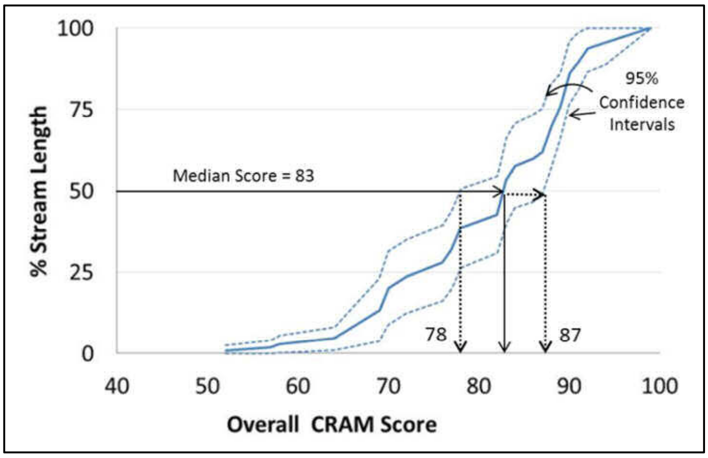

Figure 13. Cumulative Distribution Function (CDF) of the CRAM Index Scores for the Upper Truckee River watershed, showing the median score (83) and the 95% confidence band.

Figures 14 and 15 show the CDFs of the CRAM Index Scores and Attribute Scores for each watershed, and for the urban and rural (non-urban) areas of the watersheds, respectively. Note that the shapes and associated confidence limits of the plots are less defined and broader for the Third Creek survey, mainly because of its smaller sample size.

The CDFs of the CRAM Index Scores indicate that, for both watersheds, overall stream condition tends to be better in rural than urban areas. However, for the UTR watershed, the confidence bands for these strata overlap for much of the range in scores, suggesting that the differences in overall condition between rural and urban areas are slight. For the Third Creek watershed, the confidence bands for urban and rural areas only overlap for the lower range of scores, indicating that overall urban stream condition is much lower than overall rural stream condition in the Third Creek watershed.

For both watersheds, scores for the Buffer and Landscape Context Attribute and for the Hydrology Attribute were clearly lower in the urban areas, whereas scores for the Physical Structure Attribute and Biotic Structure Attribute were generally indistinguishable for rural and urban areas. The field notes indicate that the low scores for the Hydrology Attribute in urban areas reflect local impacts of hydromodification due to ditching, storm drains, and artificial flow control structures. The relatively low scores for the Landscape and Buffer Attribute in urban areas reflect the negative effects of land development on the naturalness of landscapes. For example, development that encroaches into the historical SEZ can diminish its ability to protect natural stream functions.

Some understanding or insights about the Index Scores can be inferred from an examination of the component Attribute and Metric Scores. The Biotic and Physical Structure Scores, which represent in-stream conditions, are generally positively correlated to the Hydrology and Landscape Context Metrics Scores, which represent landscape-scale stressors, at least in part. Good buffer conditions can disrupt this general relationship by mediating the effects of stressors on in-stream conditions. For both pilot watersheds, the Biological and Physical Structure scores are comparable and relatively high for rural and urban areas alike, despite the urban areas having lower scores for Hydrology and Landscape Context. We can hypothesize from these results that the SEZs are serving to buffer streams from stressors that are common in urban areas. This is supported by the moderately high Buffer Metrics Scores for the urban areas.

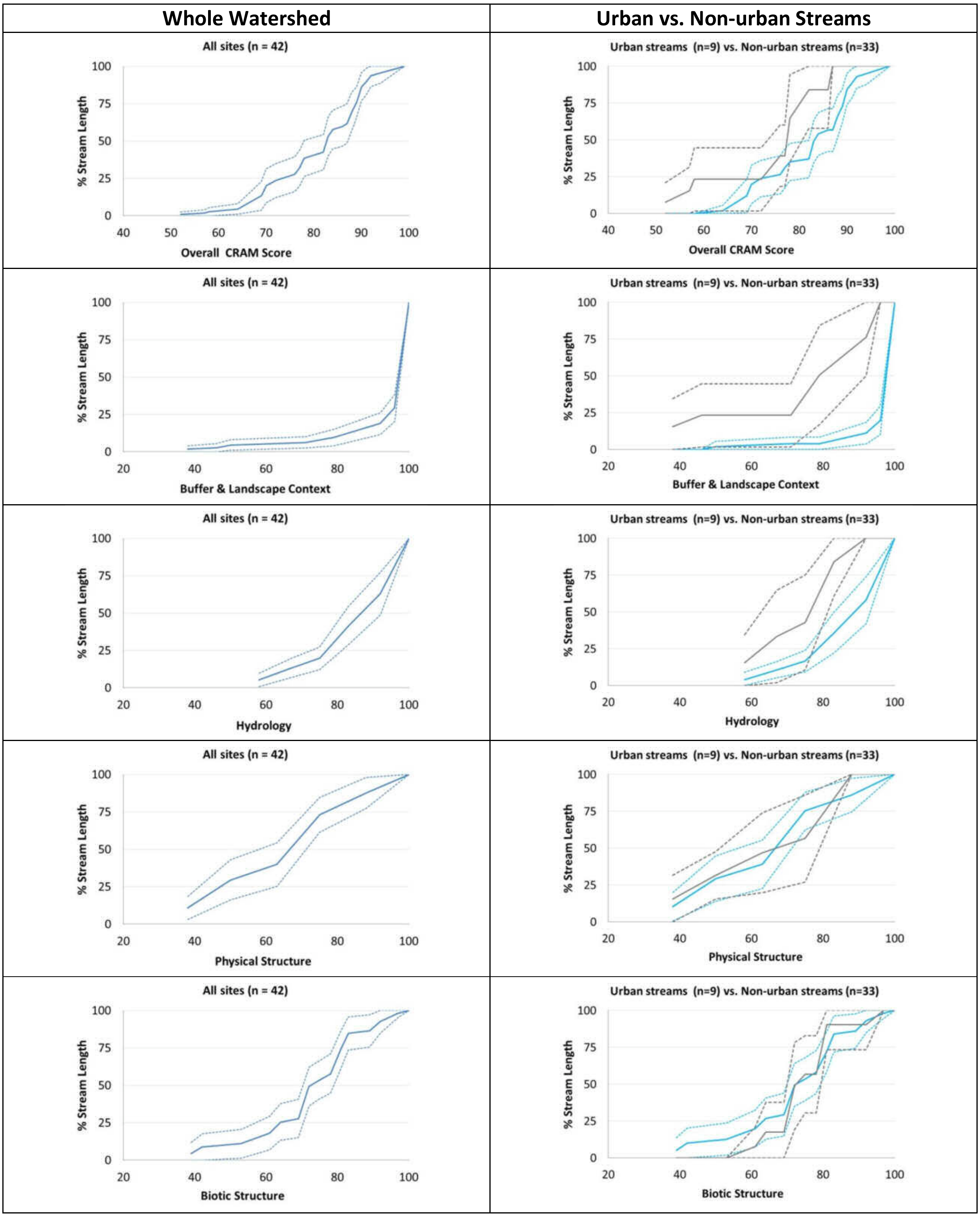

Figure 14. Cumulative Distribution Function Plots (CDFs) of 42 Random Probability CRAM Assessments in the Upper Truckee Watershed (assessments conducted in August-2011). Note that Overall CRAM Score is synonymous with CRAM Index Score. The proportion of urban to non-urban stream lengths is 12% and 88%, respectively.

Whole Watershed	Urban vs. Non-urban Streams

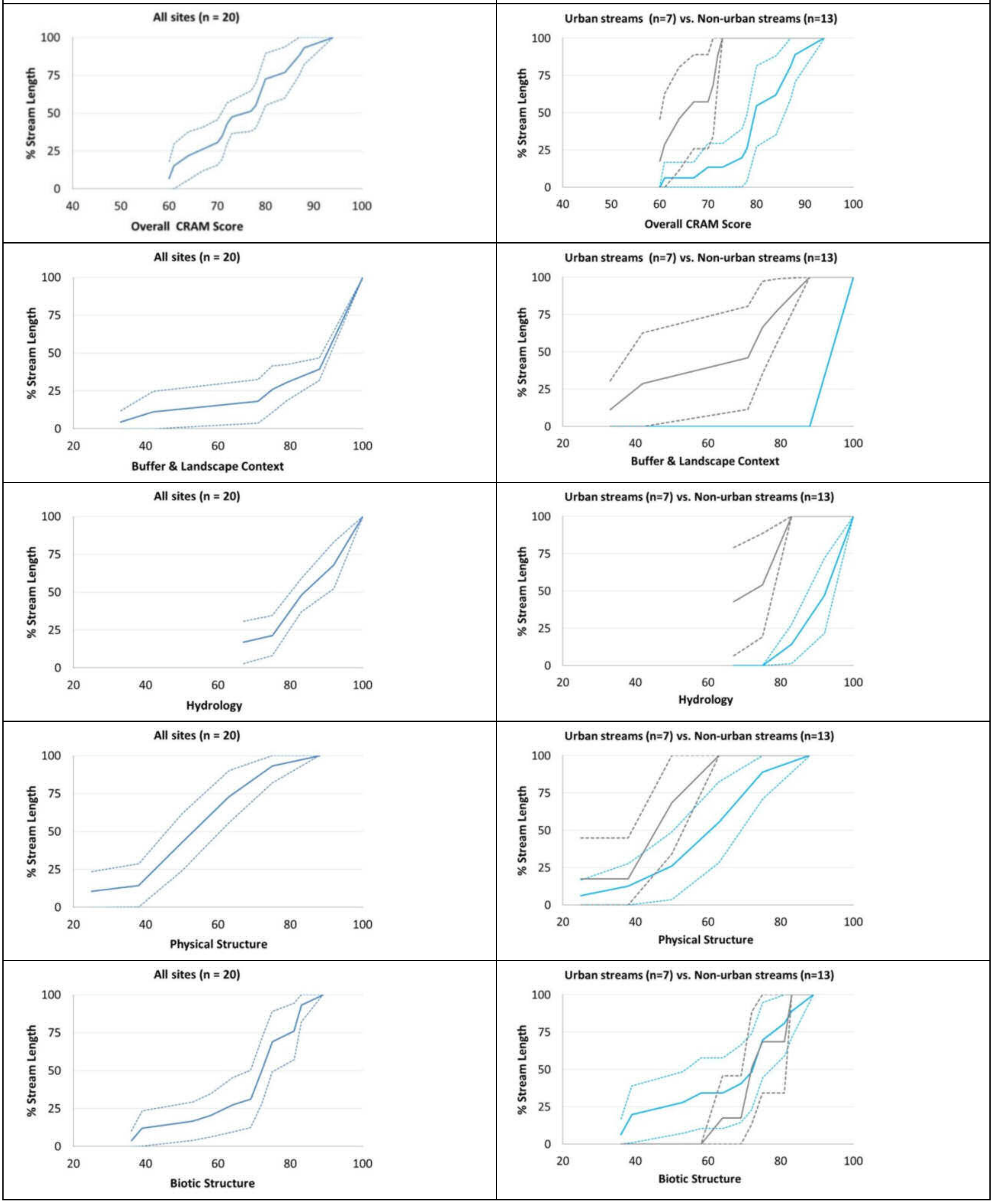

Figure 15. Cumulative Distribution Function Plots (CDFs) of 20 Random Probability CRAM Assessments in the Third Creek Watershed (assessments conducted in July-2012). Note that Overall CRAM Score is synonymous with CRAM Index Score. The proportion of urban to non-urban stream lengths is 40% and 60%, respectively.

Tahoe Stream Environment Zones (SEZ)

SEZ Definition

The Stream Environment Zone (SEZ) is a term unique to the Tahoe Basin. The SEZ concept was developed by TRPA to denote areas of natural surface waters and their adjoining areas that function to protect the surface waters. In concept, the SEZ is therefore generally consistent with the concept of riparian buffers being considered by the State Water Board for incorporation into WRAPP.

The precise definition of an area that meets the SEZ criteria is described in TRPA's Code of Ordinances (November 16, 2011; Chapter 37). The physical SEZ components that have established field indicators that can be mapped and are used to identify and delineate SEZ in the field include:[25]

- Lakes
- Ponds
- Beaches
- Wetlands
- soils ("1b" soils)
- Wet montane meadows
- Natural rivers and streams
- Native riparian vegetation
- Floodplains *(100-yr and lesser)*
- Land areas having high water tables

Physical, mappable SEZ components with established field indicators used to identify and delineate SEZs

Efficacy of WRAMP SEZ Map

This Project compared the best existing map of SEZ for the lower portion of the UTR watershed to the "WRAMP SEZ Map" for the same area. The SRT provided the "Sinclair Map" produced for TRPA in 1998 as the best available SEZ map. It is based on NHD (circa 1998) and soils that meet TRPA criteria for SEZ indicators (i.e., "1b soils"), plus abundant field investigations. The WRAMP SEZ Map is based on TARI and output from the Beta test version of the Riparian Width Estimator. Both maps were augmented with public data used by TRPA to help identify SEZs. Based on recommendations of the SRT, the Sinclair map was augmented with a fixed buffer width of 25 ft around all NHD streams, NWI wetlands, an NRCS map of high watertable, and the current FEMA 100-yr floodplain. The WRAMP SEZ Map was augmented with the maps of the 100-yr floodplain, areas of high watertable, and 1b soils. The results of the comparison of these augmented maps are presented in Figure 16 and 17. Some of the key observations made by the SRT related to the differences between the augmented Sinclair SEZ Map and the augmented WRAMP SEZ Map are outlined below.

- Except for NHD and 1b soils, existing maps of SEZ indicators, such as wetlands and flood-prone areas, do not seem to extend much upstream of urban areas.
- Adding a fixed buffer around channels, wetlands, and areas of high water table add small amounts of acres to either the Sinclair map or the WRAMP map.
- The difference between the augmented WRAMP SEZ Map and the augmented Sinclair SEZ Map is mainly due to (a) the greater length of channel included in the WRAMP map, and (b) the inclusion of areas of soils in the Sinclair map that do not overlap with the WRAMP riparian areas.

[25] Some indicators that have been used pertain to components that are not listed in the TRPA Code of Ordinances.

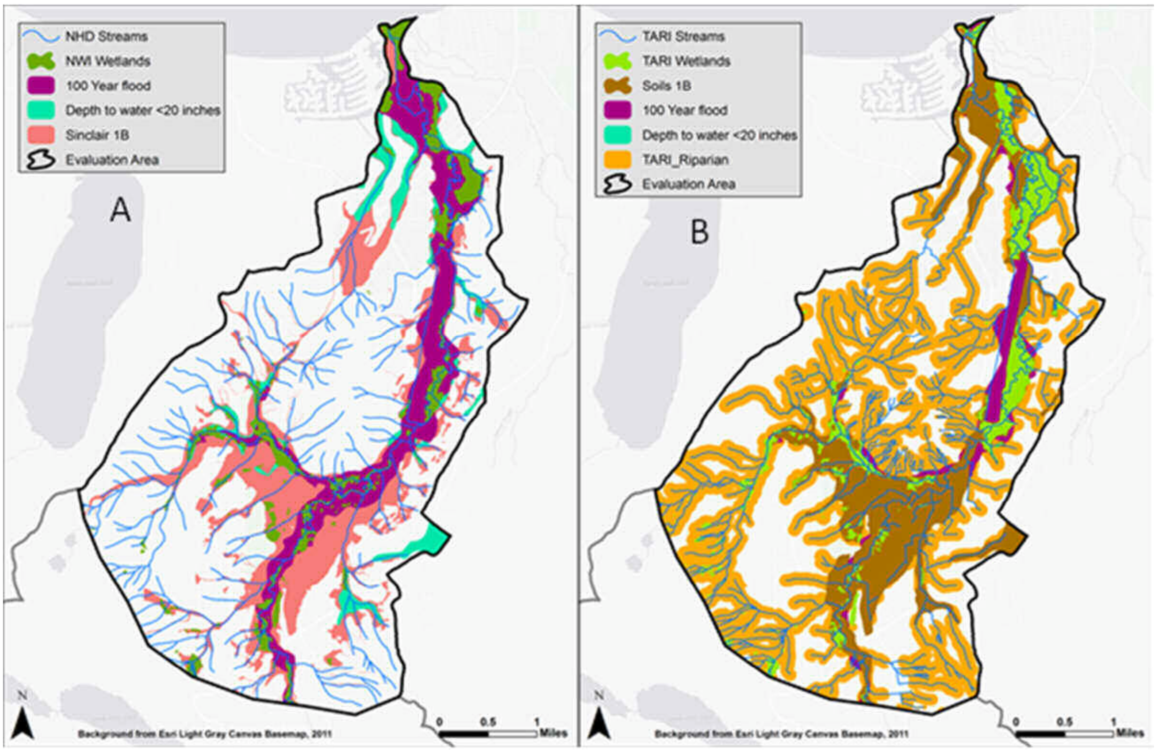

Figure 16. Visual comparison of an existing SEZ map (A, Sinclair 1998) and the WRAMP SEZ Map (B) for the lower portion of the Upper Truckee River watershed.

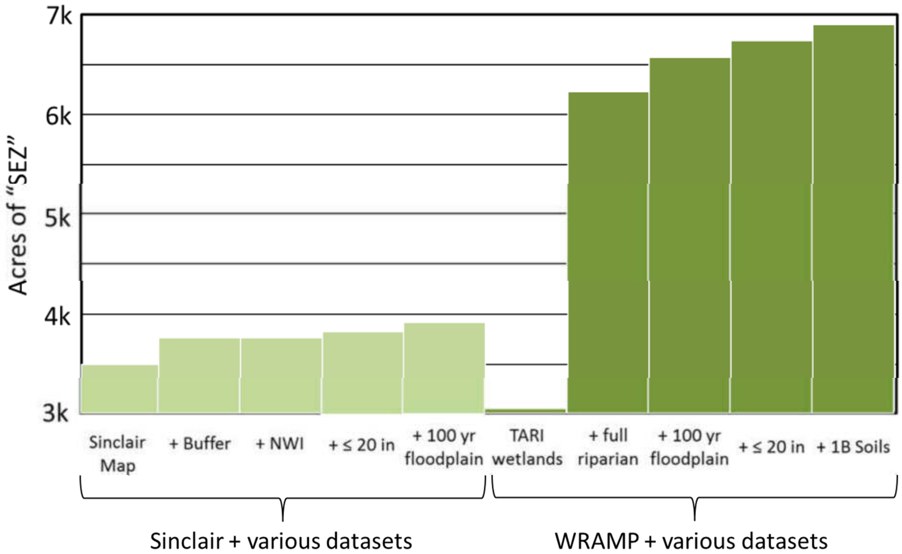

Figure 17. Estimated acres of SEZ in the lower portion of the Upper Truckee River resulting from augmenting the Sinclair SEZ Map based on NHD and augmenting the WRAMP SEZ based on TARI. The fully augmented WRAMP map yields the most acres of SEZ due to the greater abundance of channels and wetlands represented by TARI as compared to NHD.

Having compared the WRAMP SEZ Map to the Sinclair SEZ Map, the SRT came to consensus on the following results of the comparison.

1. The Lake Tahoe Basin needs a comprehensive map of SEZ.
    a. A "Comprehensive" map would estimate the maximum extent of SEZ throughout all the watersheds draining into Lake Tahoe, based on methods of mapping that are repeatable and scientifically defensible.
    b. While there are at least two different maps of SEZ (, 208 Plan 1988, Sinclair circa 1998) plus a pertinent predecessor map (Foster 1971) for some portions of some Tahoe watersheds, there is no comprehensive SEZ map that estimates the distribution of SEZ throughout the Tahoe Basin. The existing maps are not strictly comparable in terms of what was mapped or how they were mapped, and current maps do not classify the different types of SEZ (e.g., meadow, deciduous riparian, marsh, lacustrine, etc.).
    c. The use of the term "SEZ" to describe areas delineated on various "SEZ" maps is perhaps misleading as the areas that are depicted include more than just stream zones. A more appropriate title for the map might be a "landuse constraints map" or "sensitive area map." However, the term "SEZ" in planning and regulatory documents and will continue to be used.
2. The regional community of regulatory agencies has 5 main uses for a regional SEZ Map.
    a. It is needed to inform public and private land development and management interests about the likely location of SEZ so that those interests can consider SEZ protection from the beginning of any development plans. This will reduce planning costs by helping to prevent conflicts between development plans and aquatic resource protection.
    b. It is needed to inform public and private land management including forest management, stormwater management, and erosion control.
    c. It is needed to maximize the benefits of environmental restoration and mitigation projects, including SEZ restoration, by identifying opportunities and priorities for such restoration projects to enhance or restore sensitive areas and not impact existing SEZ.
    d. It is needed as a baseline for tracking changes in SEZ extent and condition, at the scale of local watersheds and for the Basin as a whole, based on remapping.
    e. It is needed to help educate the public about the distribution, abundance, location, and values of SEZ.
3. The SEZ map will be used as a planning and analysis tool and would not replace field-based delineation of SEZ.
4. The existing SEZ map that is most consistent with the current set of SEZ indicators/definitions is the "Augmented Sinclair Map" generated as part of the Tahoe WRAMP Project. It consists of the "Sinclair Map" (ca 1998; also known as the "1998 Map") plus additional reputable data for the 100-yr floodplain (FEMA digitized in 2009), wetlands (NWI – digitized in 2004) and depth to watertable (NRCS 2006) that were not available in 1998.
    a. Further written documentation of the Augmented Sinclair Map is warranted, as to its comprehensiveness, production and validation methods, aerial extent, etc. Given the importance of this map, especially in terms of assessing change in existing and future

SEZ extent since 1998, it would be useful to develop an oral history of Tom Sinclair' as the author of the map. Some email communications with Tom Sinclair has clarified many questions that have emerged amongst the Tahoe WRAMP Project Team.

5. The Augmented Sinclair Map and the Augmented WRAMP Map are both intended to map the following operational definition of SEZ, as developed through this pilot:

   > *SEZ is the extent of surface aquatic resources, including wetlands, plus the adjoining non-aquatic land surfaces that owe their biological and physical characteristics to the presence of surface water or near-surface groundwater.*

   Both maps rely on remote imagery plus field-based calibration of the imagery to depict surface waters plus the adjoining lands that serve to buffer and protect the surface waters from the negative impacts of human activity.

6. There are 5 main differences between the non-augmented Sinclair Map and the non-augmented WRAMP Map. The latter 4 differences (b-e) are due to differences in SEZ indicators.
   a. The non-augmented WRAMP Map includes more detailed depiction of stream channels, wetlands, and other aquatic resources. This is because of differences in mapping methods and supporting data, rather than differences in SEZ indicators. There is general agreement that the ideal SEZ Map should incorporate TARI.
   b. The non-augmented Sinclair Map does, and the non-augmented WRAMP Map does not regard the 100-yr floodplain (entirely or in part) as an SEZ indicator, be it a secondary or other class of indicator as defined by the TRPA.
   c. The non-augmented Sinclair Map does, and the non-augmented WRAMP Map does not, regard soil type, per se, as an SEZ indicator.
   d. The non-augmented Sinclair Map does, and the non-augmented WRAMP Map does not, regard groundwater level relative to the ground surface as an SEZ indicator.
   e. The two maps use different methods to estimate riparian buffer areas, and they apply the methods to different sets of landscape features. The WRAMP approach estimates the functional width of riparian areas for all surface water features evident using the CARI mapping SOP. The augmented Sinclair map uses a fixed buffer width for fewer surface water features based on the NWI mapping SOP.

7. These four differences in SEZ indicators raise four fundamental questions that need to be answered before the use of the WRAMP tools for SEZ mapping can be specified.
   a. Does the Comprehensive SEZ Map need to include the 100-yr floodplain? Probably. The Ordinance stipulates that designated floodplains are included as a secondary indicator and when two or more secondary indicators are present, the outer bounds of the two indicators are used to establish SEZ boundaries (from which additional setback buffers are applied). The difference between the map (Level 1 output of the WRAMP) and delineation (on-the-ground application of field indicators) must be emphasized. The map is an approximation of the SEZ extent based on remote sensing of indicators that have been ground-truthed. Delineation is based on site-specific field investigation. Regarding the map, the following might also be considered.

i. There are prohibitions (RB6 Basin Plan and TRPA Ordinances) that adequately regulate development with the SEZ, and on lands within the extent of the 100-yr floodplain, regardless of SEZ.

ii. The existing FEMA maps of the 100-yr floodplain were due to be revised in 2012, at least for some areas of the Tahoe Basin, and will need future revisions due to changes in stream hydrology caused by development, climate change, etc.

b. Should the ideal SEZ Map incorporate fixed riparian buffer widths, or should it incorporate variable buffer widths based on riparian functions? The SRT recommends the latter, based on the following considerations.

i. The current set of fixed riparian buffer widths or setbacks does not reflect the existing scientific consensus that riparian areas vary in width depending on their functions, and that, for any given function, the width varies with structure, especially topography and vegetation height. Of particular interest is the fact that the fixed buffers are narrower for confined than non-confined channels, which is inconsistent with the riparian function of sediment and large woody debris input to confined channels.

ii. Using one or more fixed buffer widths based on SEZ type or setting may be a useful default approach but it does not make efficient use of modern mapping technology and data, such as GIS and LiDAR, that make it possible to estimate the lateral extent of riparian areas based on selected riparian functions.

c. Should the ideal SEZ Map incorporate soil type? Probably, but the use of soil type as a Level 1 SEZ indicator should be further explained. The following considerations seem relevant.

i. Based on the adopted SEZ definition (paraphrased in no. 5 above), for a soil type to be a good indicator of SEZ, it should closely correspond to biological and physical conditions of the land surface that are due to the presence of surface water or near-surface groundwater. One possible refinement of the use of soils to estimate or delineate the SEZ is provided by the method recommended to the CA State Water Board to delineate "aquatic support areas" as well as wetlands.[26] An aquatic support area is any area satisfying one or two of the three criteria of the CA wetland definition (wetland hydrology, wetland vegetation, and hydric soils).[27] According to this approach, any area meeting all three criteria is SEZ because it is a wetland, and any area meeting only one or two of the criteria is also SEZ because it is an aquatic support area. This approach would incorporate into the SEZ all areas of hydric soils (as defined by the National Technical Committee for Hydric Soils) that adjoin any aquatic feature (as mapped using the TARI SOP). .

[26] Technical Memorandum No. 4:Wetland Identification and Delineation. September 1, 2012. Technical Advisory Team for the California Wetland and Riparian Area Protection Policy. http://www.waterboards.ca.gov/water_issues/programs/cwa401/docs/wrapp/memo4.pdf

[27] TAT Memorandum No. 3: Landscape Framework for Wetlands. Revised September 1, 2012. Technical Advisory Team for the California Wetland and Riparian Area Protection Policy http://www.waterboards.ca.gov/water_issues/programs/cwa401/docs/wrapp/memo3.pdf

d. Should the ideal SEZ Map incorporate areas of high watertable (i.e., as defined by NRCS)? Probably, but the use of this as a Level 1 SEZ indicator should be further explained. The following considerations seem relevant.

   i. Most areas having the watertable within 20 inches of the ground surface are going to be wetlands, unless of course the site has been developed or otherwise prevented from developing wetland conditions. A reasonably accurate map of wetlands might therefore duplicate some uses of watertable height as an SEZ indicator. However, it is likely that areas of such high watertable might also be hydric, and might therefore be included in the SEZ, as aquatic support areas, even if they are not wetlands or other aquatic areas (see section "ci" above).

   ii. There might be an interest in including aquatic support areas (see section "ci" above) in SEZ as areas where the watertable tends to be high enough to limit water percolation/infiltration rates, and therefore constrain low impact development (LID) or other stormwater best management practices (BMPs). Development in such areas could have negative impacts on aquatic resources due to groundwater contamination and increased non-point source runoff leading to stream hydromodification.

e. Should the ideal SEZ Map identify areas of historical SEZ that no longer exist? Yes. The following considerations seem relevant.

   i. Once agreed to, the SOP for mapping SEZ can be applied in the future to show change in the extent of SEZ.

   ii. The term "historical" needs to be defined. It might be useful to develop a map of the extent of SEZ prior to European contact to understand the natural distribution and abundance of SEZ, the tendencies of landscapes to support SEZ, and where SEZ has been lost due to land uses.

   iii. Previously drawn maps (208 Plan 1988 and Sinclair ca 1998) show the aerial extent of "SEZ" within the developed context and could possibly be used to resolve locations and rates of SEZ loss for different historical periods. Any comprehensive effort to map the historical SEZ could be organized to elucidate the losses occurring during major historical land use episodes, such as logging, agriculture, and urban development.

8. Based on discussion points 1-7 above, the following recommendations seem reasonable.

   a. TARI (Tahoe Aquatic Resource Inventory) is a sound basemap for developing a comprehensive map of current SEZ.

   b. The Riparian Width Estimator is a more scientific approach to mapping riparian buffers (aka SEZ setbacks) than fixed setback distances. It should provide a better representation of the likely width of riparian areas needed to protect their intrinsic functions and to protect their adjoining aquatic resources. This would not preclude the use of the fixed setbacks as part of SEZ ordinance application in the field at the parcel scale, and it could inform the selection of the fixed setback distance.

   c. TRPA and others should consider that a reasonably accurate, comprehensive SEZ map that meets all of its main purposes might be produced by adding the FEMA 100-yr floodplain map (plus the areas of hydric soils as defined by NRCS and the National

Technical Committee for Hydric Soils) to the TARI base map (to which the Riparian Width Estimator has been applied). This would be a repeatable, scientifically defensible, yet flexible SEZ mapping approach, and it would be consistent with the CARI mapping standards.

d. TRPA and others should consider conducting an Historical Ecology Project to develop maps of the regional distribution of surface waters and SEZ prior to European contact. The purpose of this map would be to better understand the natural distribution and abundance of SEZ to help identify opportunities for SEZ restoration.

Wet Meadow CRAM Module

Need

Efforts to assess slope wetland including montane wet meadows using the Depressional Module of CRAM revealed that some metrics of the module did not generate sufficiently broad ranges of scores to adequately discern difference in slope wetland condition across common environmental stressor gradients. The CWMW therefore asked the L2 Committee to develop a Slope Wetland Module.

Development Process

The Slope Wetlands Module was developed by a dedicated team of wetland scientists led by SFEI's L2 Committee member and CRAM trainer Sarah Pearce (SFEI) and assisted by Cara Clark (Moss Landing Marine Laboratories). The Slope Wetland Team met four times in 2012 and participated in many other dialogues to guide development of the new module through its initial design and verification phases, with oversight by the L2 Committee of the CWMW. The team tested the module at 15 slope wetland sites selected by team members and local experts to represent a broad range of Sierran conditions from Modoc County to Kings Canyon National Park. Based on the results of this field test, the team concluded that the new module has passed the validation phase of module development.

Implementation of EcoAtlas in the Tahoe Basin

The EcoAtlas (www.ecoatlas.org) was publicly released on June 26, 2013, based in part on lessons and ideas gleaned from this Project. The primary purpose of EcoAtlas is to provide access to essential information for effective wetland and stream management and regulation. Its content is growing to achieve this purpose through the guidance of the CWMW of the CWQMC.

One objective of the Tahoe WRAMP Project has been to initiate the use of EcoAtlas in the Tahoe Basin. The SRT decided to focus the initial use of EcoAtlas on visualizing and tracking stream and wetland restoration and mitigation projects. More specifically, the SRT decided to upload five wetland restoration projects into EcoAtlas. This involved adding a map of each project to the EcoAtlas project map, completing project information forms, and adding additional project files as desired by the SRT or the project sponsors. Projects in different stages of completion were selected to demonstrate the use of the project description forms, and to demonstrate how the online project information pages can be utilized to access general information about the project and any associated documents.

Table 7. List of five Tahoe Basin restoration projects that have been added to EcoAtlas.

Project Name	Project Status	Project Type	County
Cookhouse Meadow stream and floodplain restoration project	Completed	Restoration	El Dorado
Upper Truckee River and Golf Course Re-Configuration Project	TBD	Restoration	El Dorado
Incline - Third Creek Restoration	TBD	Restoration	Washoe
Upper Truckee River and Marsh Restoration Project	Planned	Restoration	El Dorado
Upper Truckee River Reach 5 Restoration Project	In-progress	Restoration	El Dorado

Key Findings and Next Steps

Key Findings

Wetland & Riparian Area Monitoring Plan Framework

The WRAMP framework has potential to align monitoring and assessment to specific environmental management or regulatory decisions within the Tahoe Basin. It is simple but comprehensive. The concept of classifying management and regulatory decisions based on the kinds of scientific data they most depend upon is useful. And, the process laid out for collecting and delivering the needed data seems appropriate and general enough to be broadly applicable. However, it is not clear if there is the political will within the region to implement the framework. Incentives are needed for the framework to be incorporated in the day-to-day activities of selected management and regulatory programs. One state regulatory program with influence on others, such as the 401 Program, probably needs to champion the framework as a continuing demonstration of its value.

Tahoe Aquatic Resources Inventory

TARI in concept seems to be fundamental to the success of planning and permitting programs designed to protect aquatic resources. These resources cannot be protected if their locations are not known. TARI provides the best evidence yet of their distribution, abundance, diversity, and actual locations. TARI can also serve as a common basemap to visualize and coordinate many kinds of aquatic resource management and regulatory activities that are, at this time, not well coordinated. However, the cost of developing TARI basin-wide may be too great for any one agency or program. A current project funded by SNPLMA is evaluating alternative methods for mapping aquatic resources relative to the TARI SOP. In any case, cost-sharing among programs might be required to fully realize TARI. Once TARI has been developed for the Tahoe Basin, it will need to be maintained. TARI maintenance will be much less expensive than its development, given that changes in the distribution and abundance of aquatic resources are fairly slow to occur and that they can be tracked through permitting. It is not clear, however, what agency or program will be responsible for maintaining TARI.

California Rapid Assessment Method

CRAM has large potential to be the go-to, cost-effective and scientifically defensible rapid assessment method for monitoring the overall ecological conditions of wetlands and streams throughout California. The statewide data base and training programs are laudable. Having a dedicated committee (the L2 Committee) linked to a legislated advisory body (the CA Water Quality Monitoring Council) through one of its main inter-agency workgroups (the CA Wetland Monitoring Workgroup) probably provides the best chance for CRAM to continue to be improved technically and to grow a substantial user community. But, using CRAM in day-to-day activities will require ongoing training of line staff within the context of specific management and regulatory programs. This suggests that CRAM is unlikely to be routinely used by any agency unless it is required or strongly encouraged as a condition of grants and permits, and unless there are dedicated funds to maintain and improve eCRAM such that it continues to meet the evolving needs of the user community. To reach this level of use and support, the value of CRAM will need to be further demonstrated to regional decision makers and practitioners.

EcoAtlas

EcoAtlas is one of many similar, online, map-based systems for managing, sharing, and delivering environmental information. The description and objectives of the Lake Tahoe Information Exchange [28](aka "TIMMs") are very similar to that of EcoAtlas. A working relationship between EcoAtlas and Lake Tahoe Information Exchange should be defined.

However, EcoAtlas has a variety of new and unique tools, such as the project tracking tool, the pending Online 401 tool, and the Landscape Profile tool, that could be of substantial value to planning, management, and regulatory agencies because they will enable the agencies to better track and coordinate their activities. The Online 401 tool may be a model for how to use the permitting process to acquire essential information about the distribution and extent of restoration and mitigation projects.

Individual agencies may see enough value in EcoAtlas for internal project tracking and management that they will try to employ it for those purposes. However, such use will require that these applications of EcoAtlas be carefully tuned to the specific needs of the willing agencies.

As with TARI, realizing EcoAtlas as a Tahoe Basin-wide data and information management tool will probably require cost-sharing. Spreading the costs among participating agencies across the State will help reduce the costs for any one agency operating in the basin, but it is not clear at this time who will be responsible for maintaining the tools or where EcoAtlas will reside. This needs to be decided by the participating agencies.

Of all the tools in the WRAMP Toolset, EcoAtlas might be the most readily useable by the most agencies responsible for protecting the natural resources of the Tahoe Basin. However, although EcoAtlas provides added value as a database of aquatic resources information, there is a variety of important environmental data that EcoAtlas does not currently deliver, some of which reside within the Lake Tahoe Information Exchange. Any effort to expand the use of EcoAtlas in the Tahoe Basin should identify important regional data that are available through other information systems, such as the Lake Tahoe Information Exchange, and should consider which of these data should be included in EcoAtlas. Important existing data that could be added to EcoAtlas include Lake Tahoe water clarity measurements, nearshore water chemistry data, and measures of in-stream macroinvertebrate community structure. Further demonstrations of the utility of applying EcoAtlas for tracking regulatory and management actions in the watershed or regional context, and to support the Environmental Improvement Program (EIP), seems warranted.

[28] http://www.tiims.org/

Next Steps

This report concludes the three-year demonstration project of the Wetland and Riparian Area Monitoring Plan (WRAMP) for the Tahoe Basin. The final SRT meeting focused on potential next steps. SRT members and others were asked to identify ways they might use the WRAMP tools. As summarized below, many possible uses were identified and a few specific next steps toward WRAMP implementation were discussed.

Pilot implementation of CRAM as a project performance measure

In 2014, USEPA and the State Water Board will work with the Lahontan Regional Water Quality Control Board to further explore the utility of encouraging the use of CRAM for assessing selected restoration and compensatory mitigation projects.

Pilot use of the Online 401 tool and EcoAtlas project tracking tools

The Lahontan Regional Water Quality Control Board has expressed interest in piloting implementation of these two tools based on their successful use by the San Francisco Bay Area Regional Water Quality Control Board.

With the encouragement of the SRT, SFEI-ASC will submit a proposal to TRPA to assist in developing EcoAtlas as a system for tracking and visualizing capital improvement actions permitted by TRPA, and to help assess the performance of the regional Environmental Improvement Program (EIP).

Regional development of TARI and SEZ mapping

A research project funded through SNPLMA is testing automated methods of producing more detailed maps of aquatic resources and SEZ for the Tahoe Basin as a whole, using the TARI maps for the UTR and Third Creek watersheds as the reference base map standard.

Implementation of Slope Wetland CRAM Module.

This CRAM module is currently being used in probabilistic surveys of wetland condition in the Sacramento-San Joaquin Delta and at the Laguna de Santa Rosa Plain in Sonoma County, CA. The module has been vetted with the L2 Committee of the CWMW and will continue to be developed and used throughout the State. The L2 Committee recently received a new 104(b)3 USEPA Wetland Program Development Grant to validate the CRAM modules for depressional wetlands, slope wetlands, and vernal pools during 2014-2015. The SRT expects that the slope wetland module has the potential to fill an information gap in the Lake Tahoe region by generating more defensible information on the ecological condition of wet meadows and other slope wetlands. Filling this information gap will improve the ability of many agencies to assess current conditions relative to adopted standards, and could be used to aid in documenting the effects of restoration and mitigation projects on ambient conditions within watershed throughout the region.

Implementation of the WRAMP Framework.

The success of the next steps identified above and the overall implementation of the WRAMP framework to better coordinate aquatic resource planning and protection in the Tahoe Basin will require continued oversight by an inter-agency group such as the existing Sierra Regional WRAMP Team (SRT). The Administrative Team of the SRT should update the SRT Charter to reflect the future role of the SRT in advising and coordinating implementation activities.

Citations

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List of Acronyms

Bay Area Clean Water Agencies (BACWA)

California (CA)

California Aquatic Resources Inventory (CARI)

California Environmental Data Exchange Network (CEDEN)

California Rapid Assessment Method (CRAM)

California Tahoe Conservancy (CTC)

California Water Quality Monitoring Council (CWQMC)

California Wetland Monitoring Workgroup (CWMW)

Cumulative Distribution Function (CDF)

Digital Elevation Model (DEM)

Generalized Random-Tesselation Stratified (GRTS)

Joint Powers Authority (JPA)

Lahontan Regional Water Quality Control Board (RB6)

Light Detection and Ranging data (LiDAR)

National Agriculture Image Program (NAIP)

National Hydrological Dataset (NHD) of the US Geological Survey (USGS)

National Wetlands Inventory (NWI) of the US Fish and Wildlife Service (USFWS)

Perennial Stream Assessment (PSA)

Perennial Stream Assessment (PSA)

Project Performance Curve (PPC)

San Francisco Estuary Institute-Aquatic Science Center (SFEI-ASC)

Sierra Regional WRAMP Team (SRT)

Standard Operating Procedure (SOP)

State Water Resources Control Board (the State Water Board or SWRCB)

Stream Environment Zone (SEZ)

Surface Water Ambient Monitoring Program (SWAMP)

Surface Water Ambient Monitoring Program (SWAMP)

Tahoe Aquatic Resource Inventory (TARI)

Tahoe Integrated Information Management System (TIIMS)

Tahoe Regional Planning Agency (TRPA)

United States Environmental Protection Agency (USEPA or EPA)

Upper Truckee River (UTR)

Wetland and Riparian Area Monitoring Plan (WRAMP)

Wetland and Riparian Area Protection Policy (WRAPP)

Appendix A: Project Participants and Their Roles

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[29] Participated in the first (T1) or second (T2) three-day Riverine CRAM training
[30] Participated in the Upper Truckee River (UTR) and/or Third Creek (TC) CRAM surveys for this demonstration project
[31] Participated in the Wet Meadow Team (WM) to develop the Slope Wetland CRAM Module

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Appendix B: Regional Team Charter

Tahoe Regional Team Charter
For the
Tahoe Wetland and Riparian Monitoring Program (WRAMP) Pilot Project

April 7th, 2011

DEFINITION

The Tahoe Wetland and Riparian Monitoring Program Team (Regional Team) is comprised of agency, stakeholder and science community representatives who together oversee, advice and contribute to the implementation of the EPA-funded Tahoe WRAMP Pilot Project. This document describes the Regional Team's purpose and composition, roles and responsibilities, and operating guidelines. Together these components comprise the Regional Team charter.

PURPOSE

The purpose of the charter is to document the operational guidelines, organizational structure, and roles and responsibilities for the grantor, grantees and Regional Team members to successfully implement the Tahoe -WRAMP Pilot Project and satisfy the grant requirements.

BACKGROUND

The Tahoe Regional Planning Agency (TRPA), Lahontan Regional Water Board (Lahontan), and the Aquatic Science Center/San Francisco Estuary Institute (ASC/SFEI) received a grant from the EPA to pilot test the efficacy of the California Wetland and Riparian Area Monitoring Program (WRAMP) for the Sierra Nevada ecoregion in the Tahoe Basin. Tasks included in this Project include: 1) establish a multi-agency Regional Team, to 2) test the draft wetland and riparian mapping protocol ability to depict the Tahoe Basin's Stream Environment Zones (SEZs), 3) use the mapping protocol to assess the distribution, abundance, and size-frequency of wetlands and other aquatic habitats in selected demonstration watersheds, 4) integrate the Sierra Nevada ecoregion into the California Wetlands Portal by adding the base map and selected wetland Projects to the "Wetland Tracker" portal, and 5) begin development of a montane wet meadow module of the California Rapid Assessment Method (CRAM). The Regional Team will be represented on the statewide multi-agency workgroups for CRAM and for aquatic resource mapping. Members of the Regional Team will be trained to teach others how to use CRAM, and the regional GIS community will gain capacity to contribute to the California Aquatic Resources Base Map. The Project will enable the TRPA, Lahontan, and other regional interests to implement the WRAMP through local and regional wetland and SEZ protection and restoration programs and Projects.

SIERRAN REGIONAL TEAM COMPOSITION, ROLES AND RESPONSIBILITIES

The Regional Team consists of 3 interacting workgroups – an administration workgroup, a core workgroup and a stakeholder workgroup. Members of the Administrative Workgroup participate in all workgroup meetings while the Core Workgroup participates in the core and stakeholder workgroup meetings. The Stakeholder Workgroup only participates in Regional Team meetings.

Administrative Workgroup

This workgroup is comprised of the grantees, which includes Lahontan, TRPA, and ASC/SFEI, and the California Tahoe Conservancy, which will be managing and performing analysis of existing geospatial data using Geographical Information System (GIS) in support of the production the Tahoe Aquatic Resource Inventory (TARI). The primary responsibility of this workgroup is to provide Project oversight. Specific responsibilities include: product review and approval, data coordination, field and meeting logistics and Project management such as staffing and finance oversight. The Administrative Workgroup is also responsible for presenting progress reports, findings and recommendations to USEPA (Grantor) and Tahoe Basin Agency Executives.

Core Workgroup

In addition to the grantees named above (Lahontan, TRPA, ASC/SFEI, CTC), this workgroup is made up of selected staff from agencies, academic institutions or consulting firms that can significantly contribute time and effort toward fulfilling the objectives of this Project and/or are significant contributors of needed data or information. Core Workgroup members are also selected based on their knowledge of the two watersheds selected for this Project, Upper Truckee River (UTR) in California and Third Creek in Nevada. The Core workgroup is responsible for 1) producing Project products and synthesizing information, 2) contributing data, 3) providing review of products and input to the administrative workgroup. The Core Workgroup will be depended upon by the Administration Workgroup to deliver necessary products and existing data when requested.

Stakeholder Workgroup

The Stakeholder Workgroup is comprised of selected members of the Administration Workgroup and the Core Workgroup, plus a variety of interested stakeholders and public, professionals and wetland restoration practitioners who will be able to provide expertise on a wide range of subjects, including: wetland restoration science, biology, chemistry, toxicology, ecology of special status species, plant ecology, and hydraulic and restoration engineering. Because of the overlapping areas of expertise commonly observed in science and in restoration work, one member can cover more than one area of expertise. Individuals selected are anticipated to represent one to many of a variety of constituencies, including local, state, and federal agencies, universities, non-governmental organizations, public and the private sector. The primary responsibility of the Stakeholder Workgroup is to 1) provide review and input on Project products, 2) participate in Regional Team meetings and/or trainings as requested, 3) raise issues or concerns with the direction of this Project, 4) share progress and findings from this Project with their respective constituents and 5) aid in identifying opportunities to coordination with other efforts.

The final selection of members, including any changes made to the team throughout the course of this Project, will be at the discretion of the Administrative Workgroup. However, the list of designated members will be submitted to the entire Regional Team for comments and discussion, and the list will be updated as needed.

DECISION MAKING

Decisions and recommendations for the Project shall be based on consensus whenever possible. However, if consensus is not possible then the Regional Team and its Workgroups shall use a simple majority voting structure to reach a decision or recommendation. A motion for a specific decision or recommendation shall carry if it obtains a simple majority of the representatives present at the meeting. Both the majority and minority opinions will be communicated to the Grantor and Executives in cases requiring a vote.

MEETINGS

There will likely be at least one annual meeting of the full Regional Team and The Administration Workgroup will meet every 1 to 2 months to plan and coordinate Project activities and finances. The Core Workgroup will meet as needed to coordinate data sharing, product development and product review.

MEETING GROUND RULES

1. One person speaks at a time, letting others finish without interruption.
2. Each person is responsible for coming to the meeting prepared and having completed tasks as agreed to in advance.
3. Encourage each other to speak freely and safeguard confidential statements.
4. Confine your discussion to the present agenda topic.
5. Issues raised within the Tahoe WRAMP belong to its whole membership that is responsible for discussing and resolving the issue.
6. Check your own assumptions.
7. If and when disagreements arise, agree to disagree respectfully.
8. There can be no personal attacks; be hard on the issues, soft on the people.
9. Respect time limits; arrive on time; start and end on time; and come back from breaks on time.
10. Always fully comply with the purpose of the Regional Team and its Workgroups as set forth in this charter.

GROUND RULES FOR ACTIVITIES CONDUCTED OUTSIDE REGULARLY SCHEDULED MEETINGS

A. In accordance with work plans and any scopes of work developed, members are expected to review the relevant documents focusing on elements required in the scope of work or work plan that fall within the members' areas of expertise. The Team is not a decision-making body; its findings are solely for advisory purposes. The tasks for a member may vary as the Project progresses and there is a change of needed expertise.

B. Members may consult as necessary with colleagues.

C. Members are expected to attend the meetings required to conduct the scope of work.

D. Members are free to contact each other to discuss findings and analyses, or to ask administrative questions.

E. Members shall refrain from divulging to agencies, colleagues or associates outside the Team, or to the general public technical information under review or the results of individual or collective Team reviews until such time as the related reports are finalized by the Core Team.

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Appendix C: Upper Truckee River and Third Creek CRAM Survey Results

Site information and Overall CRAM and final Attribute Scores for the Upper Truckee River (UTR) and Third Creek (TC) stream condition assessments conducted under this project in 2011 and 2012 respectively. Wetland Class: RNC = Riverine Non-confined and RC = Riverine Confined as defined in the CRAM Riverine Field Book v6.0.

Watershed	Site Code	Site Name	Longitude	Latitude	Strahler Stream Order	Stratum	eCRAM GID	CRAM Visit Date	Wetland Class	Index Score	Buffer and Landscape Context	Hydrology	Physical Structure	Biotic Structure
TC	TC-01	TC-01	-119.9495	39.2552	4	Urban	3583	7/26/2012	RNC	72	75	67	63	83
TC	TC-02	TC-02	-119.9462	39.2418	6	Urban	3584	7/26/2012	RNC	73	88	83	50	72
TC	TC-03	TC-03	-119.9280	39.2905	6	Non-urban	3593	7/23/2012	RNC	80	100	83	63	75
TC	TC-04	TC-04	-119.9331	39.3027	3	Non-urban	3596	7/23/2012	RNC	77	100	100	38	69
TC	TC-05	TC-05	-119.9529	39.2664	3	Urban	3588	7/26/2012	RC	60	42	83	50	64
TC	TC-06	TC-06	-119.9422	39.3147	3	Non-urban	3601	7/29/2012	RNC	78	100	100	75	39
TC	TC-07	TC-07	-119.9486	39.2880	4	Non-urban	3590	7/25/2012	RC	70	100	92	50	39
TC	TC-08	TC-08	-119.9291	39.3125	3	Non-urban	3598	7/25/2012	RC	80	100	100	63	58
TC	TC-09	TC-09	-119.9502	39.2748	3	Urban	3589	7/25/2012	RNC	64	71	83	25	75
TC	TC-10	TC-10	-119.9342	39.2886	6	Non-urban	3602	7/25/2012	RNC	88	100	92	75	83
TC	TC-11	TC-11	-119.9404	39.2839	6	Non-urban	3591	7/27/2012	RC	79	100	100	63	53
TC	TC-12	TC-12	-119.9391	39.3146	3	Non-urban	3600	7/24/2012	RNC	79	100	92	50	75
TC	TC-13	TC-13	-119.9430	39.2496	6	Urban	3586	7/27/2012	RNC	61	33	67	63	83
TC	TC-14	TC-14	-119.9369	39.2847	6	Non-urban	3592	7/27/2012	RC	87	100	100	75	72
TC	TC-15	TC-15	-119.9305	39.3093	5	Non-urban	3597	7/24/2012	RC	87	100	92	75	81
TC	TC-16	TC-16	-119.9317	39.3184	4	Non-urban	3599	7/24/2012	RNC	84	100	100	63	75
TC	TC-17	TC-17	-119.9459	39.2645	6	Urban	3587	7/27/2012	RNC	67	79	67	50	72
TC	TC-18	TC-18	-119.9457	39.2438	6	Urban	3585	7/26/2012	RNC	71	88	75	50	72
TC	TC-19	TC-19	-119.9271	39.2922	3	Non-urban	3594	7/23/2012	RNC	61	100	83	25	36
TC	TC-20	TC-20	-119.9320	39.3020	5	Non-urban	3595	7/23/2012	RNC	94	100	100	88	89
UTR	UTR-001	Snowbridge Creek	-119.9965	38.7193	3	Non-urban	2730	8/18/2011	RC	69	100	83	50	42
UTR	UTR-002	Branching	-120.0244	38.7857	6	Non-urban	2645	9/1/2011	RNC	90	100	100	88	72

Watershed	Site Code	Site Name	Longitude	Latitude	Strahler Stream Order	Stratum	eCRAM GID	CRAM Visit Date	Wetland Class	Index Score	Buffer and Landscape Context	Hydrology	Physical Structure	Biotic Structure
		Truckee												
UTR	UTR-003	Gooseberry Reach	-120.0114	38.7943	5	Non-urban	2766	8/31/2011	RC	91	96	83	100	83
UTR	UTR-004	Ute Street Reach	-120.0133	38.8645	3	Urban	2710	9/1/2011	RNC	58	38	58	63	72
UTR	UTR-005	Shady Creek	-119.9943	38.7590	4	Non-urban	2663	8/24/2011	RNC	92	100	100	88	81
UTR	UTR-006	Maryland Creek	-120.0054	38.7620	3	Non-urban	2729	8/24/2011	RC	83	100	100	50	83
UTR	UTR-007	UTR Cirugu Reach	-120.0243	38.8452	6	Non-urban	2712	8/17/2011	RNC	82	100	58	88	81
UTR	UTR-008	UTR Tahoe Keys	-120.0013	38.9391	6	Urban	2711	8/11/2011	RNC	76	92	92	50	72
UTR	UTR-009	Spring Creek	-120.0088	38.7285	3	Non-urban	2613	8/18/2011	RNC	83	100	83	75	72
UTR	UTR-010	Chiapa Drive Reach	-120.0367	38.8424	4	Non-urban	2723	8/17/2011	RNC	76	96	67	63	78
UTR	UTR-011	UTR Han Street Reach	-120.0198	38.8306	6	Urban	2713	8/12/2011	RNC	87	96	83	88	81
UTR	UTR-013	Beaver Creek	-120.0184	38.7339	5	Non-urban	2727	8/19/2011	RNC	78	100	100	50	61
UTR	UTR-015	Angora SEZ Restoration	-120.0360	38.8815	4	Urban	2709	8/27/2011	RNC	82	92	83	88	64
UTR	UTR-016	Grass Lake Outlet	-119.9767	38.7956	5	Non-urban	2618	8/25/2011	RNC	89	96	100	75	83
UTR	UTR-017	Forest Chicken Site	-119.9944	38.7908	3	Non-urban	2652	8/31/2011	RNC	84	100	100	63	72
UTR	UTR-018	Cookhouse Meadows Restoration	-120.0062	38.7909	5	Non-urban	2768	8/31/2011	RNC	88	100	100	75	75
UTR	UTR-019	Benwood Cascades	-120.0247	38.8016	5	Non-urban	2666	8/17/2011	RNC	88	100	100	75	78
UTR	UTR-020	Hole 18 Golf Course	-120.0123	38.8717	6	Non-urban	2659	8/26/2011	RC	72	71	67	63	89
UTR	UTR-021	Highest Site in the Watershed	-119.9919	38.7291	3	Non-urban	2612	8/18/2011	RC	89	100	100	75	81
UTR	UTR-022	Most Remote Sites	-120.0358	38.7613	4	Non-urban	2662	8/25/2011	RNC	90	100	100	75	83

Watershed	Site Code	Site Name	Longitude	Latitude	Strahler Stream Order	Stratum	eCRAM GID	CRAM Visit Date	Wetland Class	Index Score	Buffer and Landscape Context	Hydrology	Physical Structure	Biotic Structure
UTR	UTR-023	San Bernadino Rd	-120.0307	38.8557	4	Urban	2653	8/27/2011	RNC	82	79	75	75	97
UTR	UTR-024	UTR Michael Street Reach	-119.9950	38.9281	6	Non-urban	2705	8/11/2011	RNC	72	100	75	50	64
UTR	UTR-025	Trout!	-120.0223	38.7370	5	Non-urban	2610	8/19/2011	RNC	92	100	100	75	92
UTR	UTR-028	UTR Johnson Meadow	-119.9895	38.9123	6	Non-urban	2706	8/26/2011	RNC	78	92	75	75	72
UTR	UTR-029	Tiger Lily	-120.0063	38.7565	5	Non-urban	2724	8/24/2011	RC	90	100	92	88	81
UTR	UTR-030	Grass Valley Rd Mainstem	-120.0164	38.8034	5	Urban	2665	8/17/2011	RNC	78	79	67	88	81
UTR	UTR-031	UTR Elks Club Bridge US	-120.0068	38.8748	6	Non-urban	2708	9/1/2011	RNC	64	50	58	75	72
UTR	UTR-032	Upper Grass Lake Creek	-119.9969	38.7950	5	Non-urban	2650	8/31/2011	RC	83	100	83	75	72
UTR	UTR-033	Yampah Creek	-120.0001	38.7652	3	Non-urban	2664	8/24/2011	RNC	90	100	92	75	92
UTR	UTR-034	Remote Upper Mainstem	-120.0287	38.7739	6	Non-urban	2671	8/11/2011	RNC	94	100	75	100	100
UTR	UTR-035	Steep Alder Site	-120.0049	38.8211	3	Non-urban	2667	8/12/2011	RNC	99	100	100	100	97
UTR	UTR-036	Hole 14 Golf Course	-120.0189	38.8705	6	Non-urban	2657	8/26/2011	RNC	77	96	67	75	72
UTR	UTR-037	Conglomerate Creek	-120.0145	38.7163	3	Non-urban	2726	8/18/2011	RC	70	100	92	50	39
UTR	UTR-039	Round Rock Waterfall	-120.0104	38.8299	4	Non-urban	2725	8/12/2011	RC	86	100	100	75	69
UTR	UTR-040	Goldenbear Tributary	-119.9871	38.9009	3	Non-urban	2707	8/26/2011	RNC	69	92	83	38	64
UTR	UTR-041	Hemlocks	-120.0247	38.7335	3	Non-urban	2611	8/19/2011	RC	88	100	92	100	61
UTR	UTR-044	Eloise/Third St. Reach	-119.9990	38.9183	3	Urban	2925	9/1/2011	RNC	52	38	58	38	75
UTR	UTR-047	Angora Washoe Meadow	-120.0233	38.8762	4	Non-urban	2672	8/12/2011	RNC	70	100	92	38	53

Watershed	Site Code	Site Name	Longitude	Latitude	Strahler Stream Order	Stratum	eCRAM GID	CRAM Visit Date	Wetland Class	Index Score	Buffer and Landscape Context	Hydrology	Physical Structure	Biotic Structure
UTR	UTR-048	Downstream of Boulder Creek	-119.9487	38.8020	4	Non-urban	2620	8/25/2011	RNC	77	100	92	38	81
UTR	UTR-051	Iron Rich Creek	-120.0141	38.8091	3	Urban	2644	9/1/2011	RNC	78	96	83	63	72
UTR	UTR-061	Beaver Dam Site	-120.0276	38.7509	5	Non-urban	2660	8/25/2011	RNC	91	100	100	88	75
UTR	UTR-075	B street	-120.0019	38.9116	3	Urban	2981	8/31/2011	RNC	57	46	83	38	61