TRUCKEE RIVER REVITILIZATION ASSESSMENT

TOWN RIVER CORRIDOR, TRUCKEE, CALIFORNIA

Prepared for:

foriver

TRUCKEE RIVER WATERSHED COUNCIL

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EXECUTIVE SUMMARY

The Truckee River Watershed Council (TRWC) is conducting the Truckee River Revitalization Assessment to provide the science, policy, and background information needed to understand the sediment sources to the Truckee River and direct restoration and conservation projects within the Town of Truckee River Corridor. TRWC has contracted with a team assembled by Balance Hydrologics (Balance) which includes Dudek and Dr. Susan Lindström (consulting archaeologist) to conduct this assessment.

The Truckee River corridor has been a focus of previous investigations, monitoring and improvement projects to address its 303(d) listing as an impaired water body for suspended sediment concentration (SSC). The Lahontan Regional Water Quality Control Board has adopted a Total Maximum Daily Load (TMDL), which includes indirect indicators such as implementation of best management practices (BMP) and restoration. The purpose of this assessment was to identify and address areas where legacy site restoration and BMP implementation can lead to meaningful reductions in Truckee River sediment concentrations. The project area is focused within the Town of Truckee in the Middle Truckee River Watershed, referred to as the Town River Corridor.

Sediment movement is a natural process but human impacts have generated excessive sediment loads to the river. Excessive sediment has been shown to have a negative effect on riparian habitat and aquatic life. The natural and human impact of sediment to the river is found to be influenced by; 1) river system stability, 2) impacts of flow regulation, 3) historical impacts, 4) urbanization impacts, and 5) restoration and access opportunities.

Sediment sources to the Truckee River originate primarily from stormwater runoff and erosion hotspots both inside and outside the Town River Corridor, including tributary watersheds between the Lake Tahoe outlet and the study area.

Geology and geomorphic influences have resulted in a stable river system with limited channel migration or active meandering during the past 20,000 years. The majority of soils within the Town River Corridor have a low erosion hazard, resulting in a generally stable river system.

Extreme floods are important for flushing fine sediment to help create healthy ecosystems. Streamflow in the Truckee River is regulated by major dams or impoundments, which result in more consistent flows and less frequent extreme events.

Downstream of the Truckee River Corridor, effective discharge was estimated to range between 4,300 cfs and 4,800 cfs, with a recurrence probability of between 7 and 10 years. This suggests that flushing flows within the corridor may only occur once or twice in a decade, on average. Lower peak flows and relatively infrequent flushing flows, combined with chronic delivery of sediment to the River, has caused physical habitat to become impaired by fine sediment.

Since the 1800's, the Town River Corridor has experienced physical and ecological impacts, in part due to anthropogenic disturbances associated with logging, ice harvest, dairy and cattle ranching, recreation, modern transportation, and land and community development. The Town River Corridor was a focal point and historical urban land-uses were concentrated along the Truckee River. As a result, much of the historical floodplain and sections of channel were subject to alteration or fill placement. Historical features in the Town River Corridor add potential for increased sediment delivery as the associated disturbance has altered natural drainage patterns and floodplain functions.

Most of the historical sites appear to be stable and are not active sources of sediment. However, extensive disturbance and fill placement has taken place as part historical land development. The fill has resulted in a loss of floodplain, which limits sediment sequestration processes. Several sites were identified where historical disturbance has contributed to increased sediment source delivery and limited floodplain functions.

Urbanization along the Town River Corridor has had a significant impact on water quality. The increase in population and associated urban and suburban development has altered drainage patterns and increased impervious surfaces. Construction of roads and railways has required massive earthwork, modifying flow patterns. Cut and fill on hillsides can generate sediment when slopes are not properly stabilized for erosion control. Union Pacific Railroad, Interstate-80, and other transportation corridors have significantly altered natural flow paths, concentrating flows into culverts and channels and increasing sediment delivery to the river. Stormwater infrastructure within the study area was evaluated to establish whether direct flow connections exist between stormwater infrastructure and the Truckee River. 'Hot spot' or problem areas were identified according to sub-watersheds where stormwater best management practices (BMPs) could provide improvement to urban stormwater entering the River.

Winter deicing measures along roadways include the application of road sands for improved traction. Based on review of traction sand application and recovery rates, it appears that annually 224 tons of road sand remains within the Town River Corridor and has the potential for transport to the Truckee River.

The work presented in this report recognizes the need to balance environmental restoration with restoration and preservation of historical features, urbanization and public access. Improved river access has the potential to raise awareness and generate a connection to the people to help maintain and preserve the natural quality and function. Potential projects where historical interpretation, education, and public access can be achieved in concert with restoration of ecological functions should be prioritized. Areas where natural recovery is taking place are considered to be a lower priority than areas that are still responding or impaired from historical disturbance. Similarly, restoration actions that will disrupt existing land uses or regional and national transportation infrastructure are not considered to be a high priority.

Based on the assessment findings, we have identified 13 potential restoration areas that, if appropriately designed and implemented, would reduce sediment loads to the Truckee River. The restoration sites are generally close to the river as these are expected to have the highest potential for sediment reduction. The restoration elements presented aim to recover floodplain function, reduce suspended-sediment concentration in stormwater runoff, improve habitat functions and values, and improve river access. These potential restoration sites can be used in concert with other planning efforts being carried out in the corridor so that water quality improvements can be achieved as Truckee continues to grow and improve.

1 INTRODUCTION

The Middle Truckee River is listed as impaired for suspended sediment concentration (SSC), and the Lahontan Regional Water Quality Control Board has adopted a Total Maximum Daily Load for SSC (TMDL; Lahontan RWQCB, 2008). This study has been carried out to identify potential sediment sources to the Truckee River within the Town River Corridor, and identify restoration opportunities to reduce human influenced sediment loads to the Truckee River.

Figure 1-1. Example: Sediment Conveyance by Stormwater Infrasructure (Legacy Trail by Truckee River Regional Park)

The Middle Truckee River Corridor has a history of anthropogenic impacts and urbanization. Historical land use practices such as grazing, water diversions and dams, logging and milling, industry and lumber yards, roads, and railroads have over time negatively affected watershed functions, riparian habitat, and water quality. Stormwater infrastructure associated with the built environment, and the continued development of the Town of Truckee continues to threaten water quality (Figure 1-1) and a specific concern is excessive fine sediment in the Truckee River.

The project area is focused on the Mainstem of the Truckee River within the Town of Truckee (referred to herein as the Town River Corridor and shown in Figure 1-2), from mouth of Donner Creek downstream to Boca Bridge. The project area includes portions of the Town of Truckee and unincorporated areas of Placer and Nevada Counties. An approximate project boundary was provided by the TRWC and was refined during this assessment based on topography and sub-watershed boundaries.

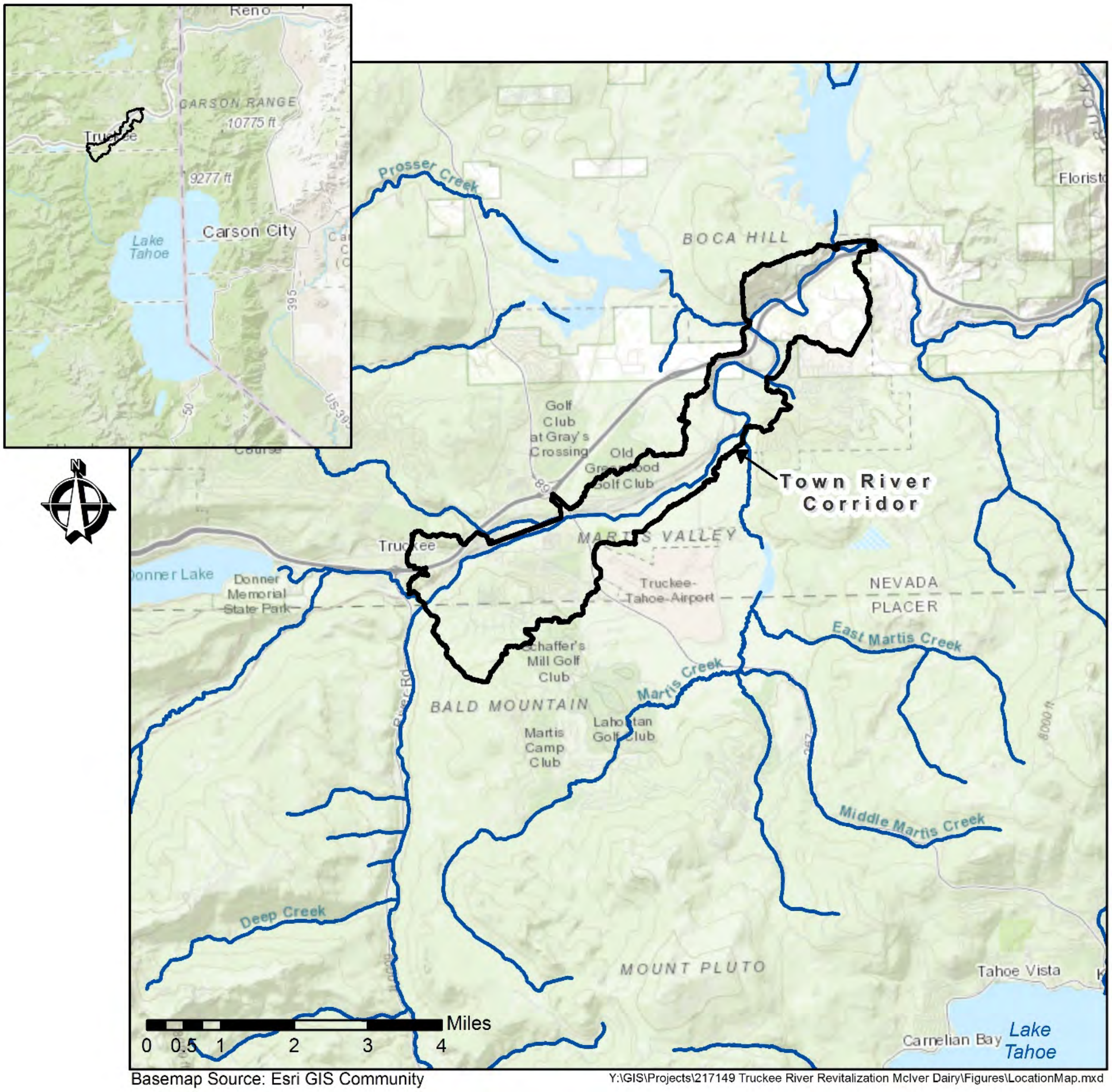

Figure 1-2 Truckee River Revitalization Assessment Project Location and Boundary

1.1 Purpose

The purpose of the assessment is to identify sources of sediment and other pollutants to the Mainstem Truckee River and describe potential restoration-based projects that will reduce those sources. The population and urban development within the watershed has rapidly increased since the 1960 Olympics and major development and population growth are expected to continue in the near and extended future, especially in formerly undeveloped areas. Increased sedimentation has been linked to rapid population growth and urbanization in erosion-sensitive landscapes (Lahontan RWQCB, 2008). This document is intended to provide a framework for use in addressing sediment sources to the Truckee River through stormwater infrastructure improvements, floodplain restoration, ecological enhancement, river access improvements, and historical site preservation.

1.2 Overview of Work Conducted and Structure of this Assessment

A number of watershed assessments have been completed in sub-watersheds adjacent to the Town River Corridor, but a comprehensive assessment of the Truckee River and the intervening drainage areas within the Town of Truckee has not been completed. This Truckee River Revitalization Assessment (Assessment) identifies potential improvement and restoration areas within the Town River Corridor not yet addressed in other contributing watershed assessments.

The assessment followed a simplified version of the California Watershed Assessment Methodology (Shilling and others, 2005) that focused on review of readily available background information. An important challenge in developing our approach was interpreting existing information and studies in the context of sediment source reduction and restoration potential— not necessarily the original primary purpose of those studies — so that sediment source reduction and restoration potential may be meaningfully evaluated. We also attempted to emphasize certain sub-basins or general areas of information where new interpretations seemed most needed, or where river access opportunities have already been identified. Development of the Assessment has drawn on our team's collective professional and local experience in the watershed, and included the following specific elements:

- Reviewing previous local and regional investigations;
- Reviewing watershed physical characteristics;
- Evaluating existing hydrologic data;
- Identifying historical and landscape-altering events; and
- Reviewing historical aerial photographs to identify patterns of disturbance.

The structure of this report is as follows: The remainder of this section (Section 1) outlines goals, objectives and critical questions addressed in this assessment. The project watershed setting is presented in Section 2 of this report, including a review of prior studies, climate, hydrology, geology, geomorphology, soils mapping, historical and current land-use, habitat, and water quality. Section 3 of the report outlines reconnaissance work carried out during Fall 2017, including: a) evaluations of urban runoff impacts using a flow accumulation analysis, b) review of historical features impacts, c) a sediment source inventory, and d) evaluation of river access locations. Section 4 summarizes conclusions and provides recommendations for projects which will restore river processes and help control the delivery of sediment to the Truckee River.

1.3 Acknowledgements

The work and information presented in this assessment draws on information, data, and efforts kindly provided by a number of individuals and organizations, including: The Town of Truckee, Truckee Donner Public Utility District, Tahoe Forest Hospital District, California Department of Transportation (Caltrans), Truckee Donner Historical Society, and the Truckee River Watershed Council.

This project was guided by a technical advisory committee that includes representatives from the California Department of Fish and Wildlife, Tahoe Sanitary District, Tahoe Donner Recreation and Parks District, Tahoe Donner Public Utility District, Lahontan Regional Water Quality Control Board, and the Town of Truckee.

This Project has been funded wholly or in part by the United States Environmental Protection Agency (USEPA) and the State Water Board. The contents of this document do not necessarily reflect the views and policies of the USEPA or the State Water Board, nor does the US EPA or the State Water Board endorse trade names or recommend the use of commercial products mentioned in this document.

Funding for this project was also provided by the Martis Fund, a collaborative project of Martis Camp landowners, DMB/Highlands Group (the developers of Martis Camp), Mountain Area Preservation Foundation (MAP) and Sierra Watch, Our Truckee River Legacy Foundation, Tahoe Truckee Community Foundation, Town of Truckee, and the Donors of the Truckee River Watershed Council.

1.4 Goals, Objectives and Critical Questions

The assessment goal is to identify and contextualize sediment sources and evaluate those sources locations to prioritize continued efforts of improvement and restoration for overall sediment reduction.

The primary objective of this assessment is to describe historical and present-day watershed and reach-scale hydrologic and geomorphic conditions in the Town River Corridor that influence sediment delivery to the Truckee River (Figure 1-3). This assessment is intended to be a compilation of findings from existing technical studies and site-specific reconnaissance to be used by the project team and other stakeholders as a watershed characterization document. When combined with direct observations and field documentation of conditions in the watershed, this assessment should provide a clear basis for prioritization of land management needs and restoration priorities to address sediment reduction. In this report, we seek to address the following questions:

- What are the primary factors and processes affecting sediment sources reaching the Town River Corridor?
- What and where are the main sediment sources, and to what degree have land-use and management practices introduced or exacerbated these sources?
- What is the range and recurrence of peak flows in the Truckee River that transport the most sediment over time?
- Where and to what degree could restoration reduce the anthropogenic portion of the sediment load?
- Where can river access be created or improved to reduce sediment loading?

Figure 1-3. Example of a Historical Site and River Access Location, Boca Bridge.

1.5 Existing Regulatory Requirements and Planning Framework

The existing regulatory environment and planning documents guide this assessment and provide a framework for implementation of restoration and management actions. Regulations and plans pertinent to this assessment include the following:

Total Maximum Daily Load (TMDL). *(Lahontan RWQCB, 2008)*

The Middle Truckee River is impaired by fine sediment and the Suspended Sediment Concentration (SSC) TMDL was established in 2008 by the Lahontan Regional Water Quality Control Board (RWQCB). The objective of the Middle Truckee River sediment TMDL is to attain sediment-related water quality objectives that focus on the protection of in-stream conditions and aquatic insect populations. The TMDL establishes a water column indicator and target value as an annual 90th percentile (SSC) of less than or equal to 25 milligrams per liter (mg/L) as measured on the Truckee River at Farad (USGS 10346000). Additional implementation-based indicators for the TMDL include road sand application BMPs and recovery tracking, ski area BMPs and maintenance, dirt road improvement or decommissioning, and legacy site BMPs and restoration. The estimated time frame for meeting the numeric targets and achieving the TMDL is 20 years (Lahontan RWQCB, 2008).

Recent measurements of fine sediment load within the Town River Corridor indicate that the water column indicator and target value standard is being met (Hastings and Shaw, 2014), however, biological studies continue to show impairment and increases in fine sediment deposition on the river bed (Herbst 2001, 2013) suggesting that suspended sediment concentration may not be the most effective metric for understanding impacts to the Truckee River ecosystem. Studies of aquatic insect populations in the river show that as deposited fine sediment increase, the diversity and structure of these communities shift toward more sediment-tolerant species (Lahontan RWQCB, 2008), species not preferred by local and native fish, including Lahontan cutthroat trout (LCT). The Truckee River has historically provided important spawning habitat for LCT, which was listed as a threatened species in the 1970s under the federal Endangered Species Act (Lahontan RWQCB, 2006). Sediment reduction is an important goal in restoring the Truckee River as a choice spawning grounds.

Town of Truckee MS4 Permit / Town Stormwater Management Plan (SWMP).
(Lahontan RWQCB, 2006, and Town of Truckee, 2007)

Similar to the TMDL, the Town of Truckee Stormwater Management Plan (SWMP) and Truckee River Water Quality Monitoring Plan (TRWQMP) were developed to maintain compliance with the Town of Truckee's Phase II MS4 General Permit, as issued by the Lahontan RWQCB. The MS4 permit (Order No. 2013-0001-DWQ) requires the Town of Truckee to submit annual reports summarizing activities and certifying compliance with all requirements. The Stormwater Management Plan calls for implementation of stormwater control measures and assessment of those measures ('assessment tasks and measurable goals'), and the TRWQMP identifies areas of concern.

The TRWQMP has generated a wealth of data that are useful for this assessment. As an example, TRWQMP monitoring data collected by Balance and CDM-Smith (2017) in water year[1] 2013 (WY2013) and water year 2014 (WY2014) suggest that approximately 31 to 54 percent of the total annual suspended-sediment load was delivered to the Mainstem Truckee River from the Town River Corridor. Reductions in these relative values can be used as the basis for setting restoration objectives and monitoring the effectiveness of improvements to water quality.

Town of Truckee Public Improvement and Engineering Standards. *(Town of Truckee, 2003)*

The Town of Truckee Public Improvement and Engineering Standards (PIES) are minimum design, construction and improvement standards for public and private improvements affecting the public infrastructure under the jurisdiction of the Town of Truckee. All restoration projects and improvements to Town of Truckee infrastructure will be required to meet the requirements within the PIES.

Town of Truckee 2025 General Plan. *(Design, Community and Environment, 2006)*

The General Plan provides many policies relevant to improvements associated with this assessment. The General Plan emphasizes preserving and improving open space and natural resources to maintain Truckee's sense of community and identity, which is heavily linked to its natural resources (General Plan Chapter 7). Guiding principles in the General Plan as they relate to this assessment are:

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1 Water year is defined as the 12-month period beginning October 1, for any given year through September 30, of the following year. The water year is designated by the calendar year in which it ends.

- Increase the amount of permanently protected, connected, and publicly accessible open space in and around Truckee for the use and enjoyment of all Truckee residents.
- Preserve the Truckee River corridor, its tributary drainages, and associated riparian habitat to enhance their role as critical open space and as a biological and scenic resource.
- Increase public access to the Truckee River.
- Improve Truckee's parks and recreation facilities and ensure the availability of a diverse range of recreational opportunities for Truckee's existing and future population.
- Make the Town of Truckee a leader in environmental conservation and sustainability, and strive to reduce the Town of Truckee's impact on the local and global environment.
- Put into action "low impact development" planning and design practices and technologies to simultaneously reduce infrastructure costs, conserve and protect natural resource systems, and reduce potential environmental impacts.

Downtown Truckee Specific Plan (1997). *(Town of Truckee CDD, 1997)*

The Downtown Specific Plan overlaps the Town River Corridor from the Donner Creek confluence to the just west of the Olympic Heights neighborhood. Downtown Specific Plan Objectives that relate to this assessment include:

- Encourage a mix of land uses within the Historical Downtown and surrounding commercial area.
- Phase out industrial land uses along the Truckee River Corridor.
- Provide additional public open space linked with pedestrian and bicycle trails.

Downtown River Revitalization Strategy (Strategy). *(Winter and Company, 2005)*

The Strategy is a guideline and vision that the Town of Truckee and stakeholders have for the Truckee River where it flows through downtown. It focuses on revitalizing underutilized land, improving environmentally-degraded areas and supporting specific redevelopment projects and strategies. The Strategy identifies areas where access improvements could be made, and was used in this assessment to initially identify areas of importance.

Trails and Bikeways Master Plan. *(Town of Truckee CDD, 2015)*

The Trails and Bikeways Master Plan implements General Plan policies that direct the establishment of a town-wide multi-use public trail system designed to increase recreational, educational and alternative transportation opportunities. An update to the Trails and Bikeways Master Plan initially adopted in 2002 was approved in September 2015. The system outlined in the Plan is intended to link the historic downtown, residential, commercial, recreational and educational areas, natural and historic resources, and regional public lands with trails. Many of the plan's policies are pertinent to this assessment and selection of priority areas for river access and interconnectivity between public centers and recreation areas. Many improvements and restoration areas identified in this strategy will need to address key concepts from the Trails and Bikeways Master Plan including: pedestrian and bicycle networks for multiple users; establish links between land use types and various locations in the Town of Truckee; minimize conflicts and provide safe recreation opportunities.

Town of Truckee Development Code. *(Town of Truckee, 2018)*

The Development Code sets the zoning districts and allowable land uses with in the Town of Truckee. The Development Code should be reviewed in context for each improvement project and restoration area to identify specific requirements, permits and plans that may be needed for that area.

2 WATERSHED SETTING AND STUDY AREA

2.1 Overview

The Town River Corridor, as defined for the Assessment, encompasses roughly 8.5 square miles and 11.6 linear miles of the Truckee River located within the Middle Truckee River Basin, most of which is within Town of Truckee Boundary. The elevation of the corridor ranges from 5,480 feet to 6,760 feet above mean sea level (msl). In addition to runoff from the Study Area, the Corridor also receives runoff from tributaries including Donner Creek, Trout Creek, Union Creek, Prosser Creek, Martis Creek, and Little Truckee River. These tributaries are regulated by dams, and with the exception of Trout Creek and Union Creek, have been assessed to varying degrees under separate efforts and/or watershed assessments. Figure 2-1 illustrates the Town River Corridor location and watersheds contributing to the Town River Corridor.

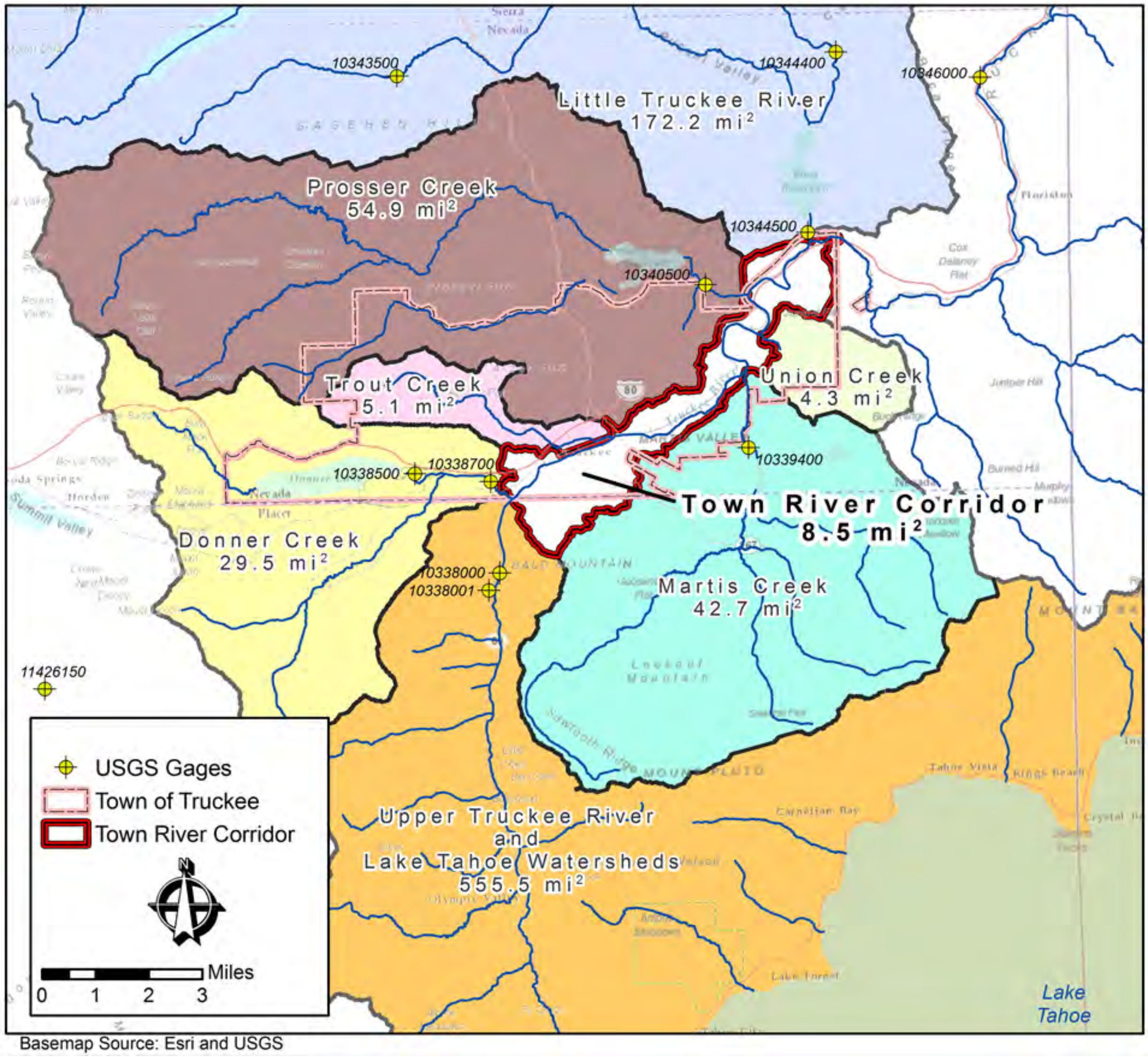

Figure 2-1 Town River Corridor Study Area, Adjacent Watersheds, and USGS Stream Gaging Stations.

2.2 Climate

The Tahoe-Truckee region experiences warm and dry summers, and cold, wet and snowy winters. The location of the Town River Corridor, east of the Sierra Crest, plays a major role in the spatial distribution of temperature and precipitation. Precipitation is highest at upper elevations in the western portion of the basin, toward the Sierra Crest, and lowest at lower elevations in the eastern portion of the. Mean annual precipitation ranges from approximately 23 inches at the east end of the study area to over 35 inches at the western boundary (California Department of Water Resources, 2017). Precipitation falls mostly as snow between October and April and annual peak streamflow often coincides with spring snowmelt in April, May or June. Streamflow also responds to fall frontal rain events, periodic mid-winter rain-on-snow events, and thunderstorms. Average monthly precipitation is shown in Figure 2-2, as recorded at the USFS Truckee Ranger Station, near the center of the watershed (California Data Exchange Center Station TKE). Monthly temperatures include mean daily lows of 15ºF in December and January to mean daily highs of 82ºF in July, as recorded at SNOTEL Station Truckee #2.

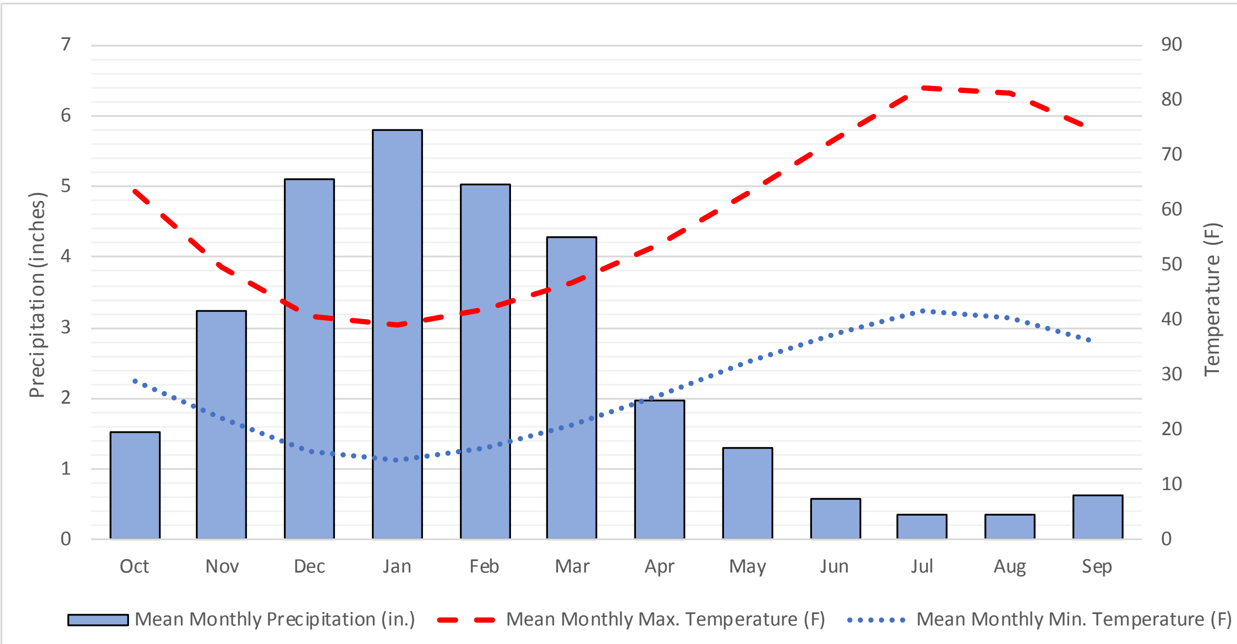

Figure 2-2 Mean Monthly Precipitation and Temperature, Truckee, California. (California Data Exchange Center Station TKE; SNOTEL Station Truckee #2).

2.2.1 CLIMATE CHANGE

The National Oceanic and Atmospheric Association (NOAA) and Coats and others (2010) have predicted a future shift from snowfall to rain of the next century in this region because of projected increases in minimum and maximum air temperatures. Associated changes in surface water hydrology include potential increases in the frequency and magnitude of rain-on-snow events and major flooding, such that more water may leave the basin as runoff, rather than infiltrating and recharging groundwater resources.

The U.S. Bureau of Reclamation completed the Truckee Basin Study (USBOR, 2015) and as part of that work, Truckee River flows were modeled under expected climate change scenarios. Model results indicated that the probability of any given peak flow is expected to increase. The Truckee Basin Study also concluded that the likelihood of moderate flood events will also increase by 10 to 20 percent by 2050 and increase again by 30 to 50 percent by 2099.

A change from a snow-dominated to rain-on-snow regime and increased frequency of rain-on-snow events will increase the peak runoff rates, and increase the potential to discharge sediment into the Truckee River. Hastings and others (in preparation) have identified higher sediment loads in the Truckee River and tributaries during a single rain-on-snow event when compared to loads measured during the entire snowmelt runoff season.

Floodplain corridor restoration and increases in floodplain storage have the potential to offset these increases. Planning for future development in the face of climate change should therefore include LID components to help mitigate for higher-runoff rates through infiltration and water retention (US EPA, 2015). The Town of Truckee is already adapting for climate change as they work to update their stormwater infrastructure (requirement of the Stormwater General Plan) and work to update the Town of Truckee Public Improvement and Engineering Standards (Town of Truckee, 2007).

2.3 Town River Corridor Geology

The Town River Corridor is located within a transition zone between the Sierra Nevada and Basin and Range Geomorphic Provinces. The corridor is characterized by the northern part of the Tahoe-Truckee graben, a down-dropping block situated between the Sierra Nevada block and the Carson Range block. Lithology is comprised of Tertiary and Quaternary andesitic and basaltic lava flows and andesitic volcaniclastic rocks (Saucedo, 2005), as well as interbedded river-transported and lacustrine deposits of the Truckee Formation, all overlain by the pre-glacial Prosser Formation. The most recent geologic units result from glacial activity during the past 100,000 to 150,000 years. Figure 2-3 is a geologic map of the Truckee River Corridor.

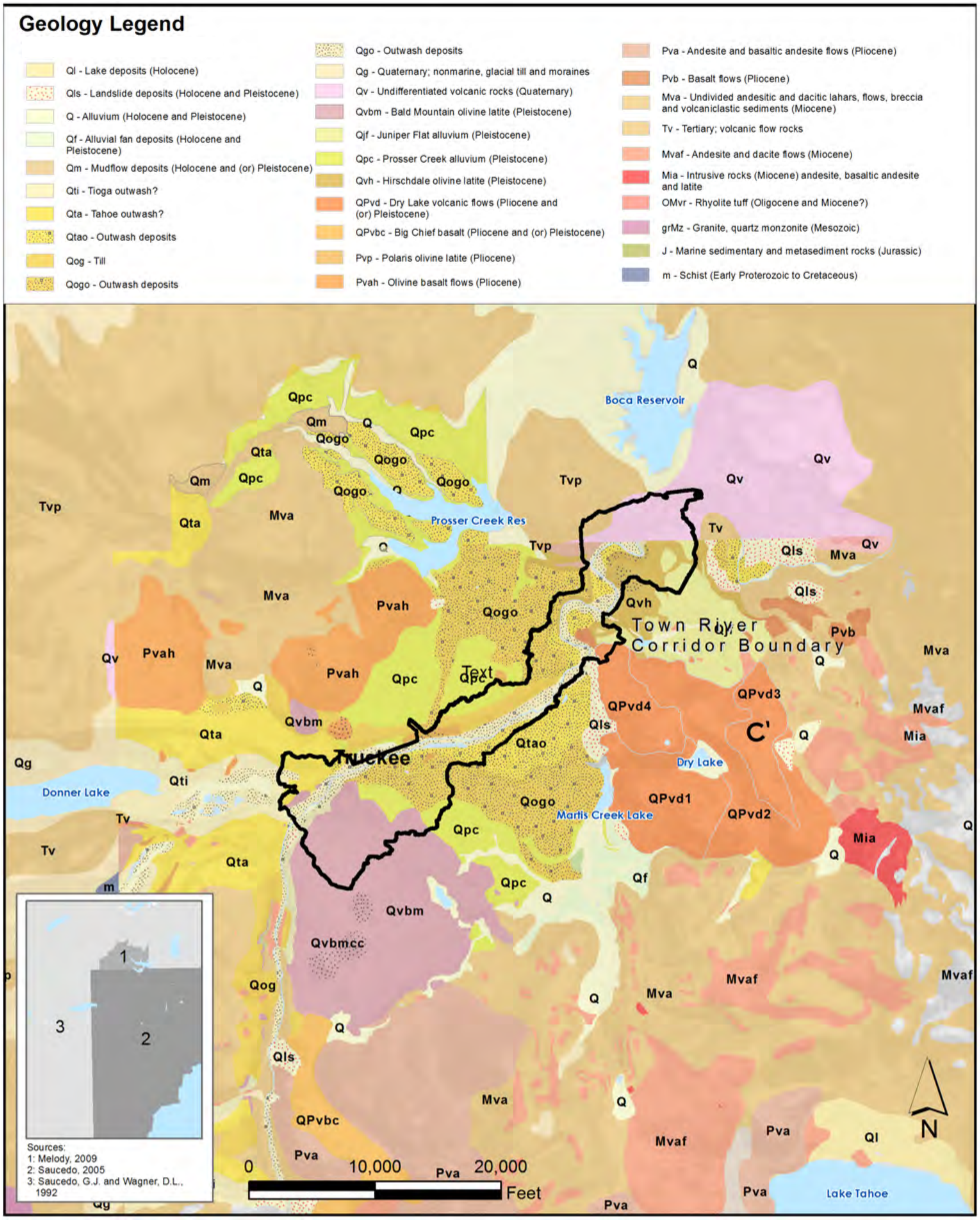

Figure 2-3 Geology within the Town River Corridor and Adjacent Areas.

2.3.1 Glaciation

The Middle Truckee River retains a history and landscape of multiple glaciations, most recently in the late Pleistocene (from about 250,000 to 15,000 years ago). Glaciers moved large amounts of material from surrounding peaks of the Sierra Crest and Mount Pluto to the valleys where till and glacial outwash were deposited. The glacial deposits consist of loose and unconsolidated boulder, cobble, gravel, sand, and silt. In the vicinity of the Truckee River within the Town River Corridor, three distinct outwash deposits are mapped, and form terraces along the course of the Truckee River. Glacial moraines were also deposited near Donner Creek at the Truckee River, McIver Dairy, and intermittently downstream along the Truckee River to Martis Creek.

The Town River Corridor is mostly comprised of floodplains and terraces formed during glacial outwash episodes. Terraces nearest the river are associated with outwash from the most recent glaciation, and are commonly mistaken for abandoned floodplains of recent fluvial activity; however, they formed during glacial-fluvial processes between 14,000 and 26,500 years ago (Birkeland, 1964). Older terraces form many of the nearly-flat areas at higher elevations south of the Truckee River. For example, the Tahoe outwash terrace (70,000 years ago) forms the area above the Truckee River where Truckee Tahoe Sanitary Agency and Teichert Aggregates are located. The highest glacial terrace was formed during the Donner glaciation, likely more than 130,000 years ago (Older Glacial Outwash (Qogo) of Birkeland, 1964; Yount and La Pointe, 1997) and today is occupied by the Tahoe-Truckee Airport south of the Truckee River and Interstate-80 (I-80) and open space (Airport Flats) north of the Truckee River.

2.4 Geomorphology

The Truckee River through the Town River Corridor is an alluvial system but its position and dynamics are heavily influenced by the glacial history, and have been relatively static since glaciers retreated and melted. Much of the glacial outwash terraces and river features that define the Town River Corridor today were derived by glacial outburst floods ('jokulhlaups' of Birkeland, 1964), which left behind large boulders that now control the locations of riffles and pools in the system. As a result, the Truckee River forms a relatively straight channel through the Town River Corridor with very limited or no active channel migration or meandering occurring since that time.

Farther downstream, the eastern segment of the Truckee River through the Town River Corridor expresses increased sinuosity. Like upstream reaches, this sinuous form was created in the Pleistocene as the result of fluvial and volcanic action under a different climate and sediment regime. Downstream volcanic bedrock in the Truckee River Canyon formed a constriction in the corridor and likely influenced this meander pattern. Today, this entrenched sinuous pattern remains confined within glacial and volcanic terraces. Under the current hydrologic flow regime, floods encourage only minor, inset meander migration, with limited bank erosion and slope instabilities through this reach; large-scale meander migration is not observed anywhere in the Town River Corridor. Within the Study Area, two landslides are mapped by Birkeland (1964) and Sylvester and others (2012): one on the right bank just above the confluence with Donner Creek, and one on the right bank downstream of the confluence with Martis Creek and just upstream of the Glenshire Drive bridge. In most cases, erosion of landslide deposits and terraces of outside river bends are natural sources of sediment to the Truckee River.

Truckee River channel bed material appears to have a bi-modal grain size distribution. Relatively steep boulder riffles are separated by lower-gradient gravel and cobble reaches that exhibit a more dynamic riffle-and-pool morphology within the confines of the entrenched channel. Channel gradient varies from 1.2 percent in the steeper boulder riffles to 0.6 percent in the gravel and cobble reaches. Scour pools have formed in gravel and cobble substrate at the tail of many boulder riffles and around very large immobile boulders. In many boulder riffles, cobbles and small boulders have become arranged to form step pools and natural weir structures, while the very large immobile boulders induce localized scour in many locations. The gravel-cobble reaches appear to be more dynamic than the boulder riffles and follow a riffle-pool-glide/run form in many locations.

Human disturbances to the Truckee River over time have introduced instabilities and impacts to the river system, sometimes not visible to the common observer. River and flow regulation from upstream dams has modified the natural flow and sediment regime of the Truckee River through the Town River Corridor, reducing the frequency of high flows that can transport sediment. Historical logging and ice harvesting practices included other temporary dams on the Truckee River and their operations altered the channel conditions over significant distances. Embankments and abutments for the Union Pacific Railroad and I-80 crossings were built within the channel in many places, and are not consistently maintained for sediment and erosion control. Gravel and exposed sediment along these features are readily available for transport and deposition during storm conditions in the winter and from dry ravel during the summer.

2.5 Soils

Figure 2-4. Example: Sandy Loam Soils with Glacial Outwash Boulders (downstream of Legacy Trail Bridge).

Soils within the Town River Corridor are mapped by the Tahoe National Forest (NRCS, 2002; NRCS, 2018). Soils are heavily influenced by underlying geology, and have been disturbed by current and historical land uses. Soils adjacent to or near the Truckee River formed on glacial outwash terraces and floodplains derived from volcanic rock. These soils include the Euer-Martis Series and are well-drained, coarse sandy loams (Figure 2-4). Other low-gradient areas farther from the Truckee River are more developed and are mapped as part of the Inville-Martis soil series. Upland areas, ridges and steeper slopes includes thin, young soils derived from Quaternary volcanic rock, part of the Waca-Meiss, Aldi-Kyburz, and Kyburz-Trojan complexes, and rock rubble in steep areas at the base of cliffs. Areas upgradient of glacial moraines and depressions along terraces have developed wetland soils with persistent elevated groundwater conditions and are mapped as Aquolls-Borolls, specifically at McIver Dairy and in the Hilltop (Site of TRWC's Truckee Meadows Wetland Restoration Project) Areas.

2.5.1 Soil Loss Hazard

The USDA Web Soil Survey (NRCS, 2018) provides a rating of soil loss hazard. The rating was used to evaluate areas along the Town River Corridor where natural erosion would be exacerbated from legacy soil disturbance activities (e.g. roads, logging, grazing, mining or other) that expose the soil surface (Figure 2-5 and Appendix A). The ratings are based on slope and the soil erosion K factor from the Revised Universal Soil Loss Equation. The soil loss hazard is rated as slight, moderate, severe, and very severe.

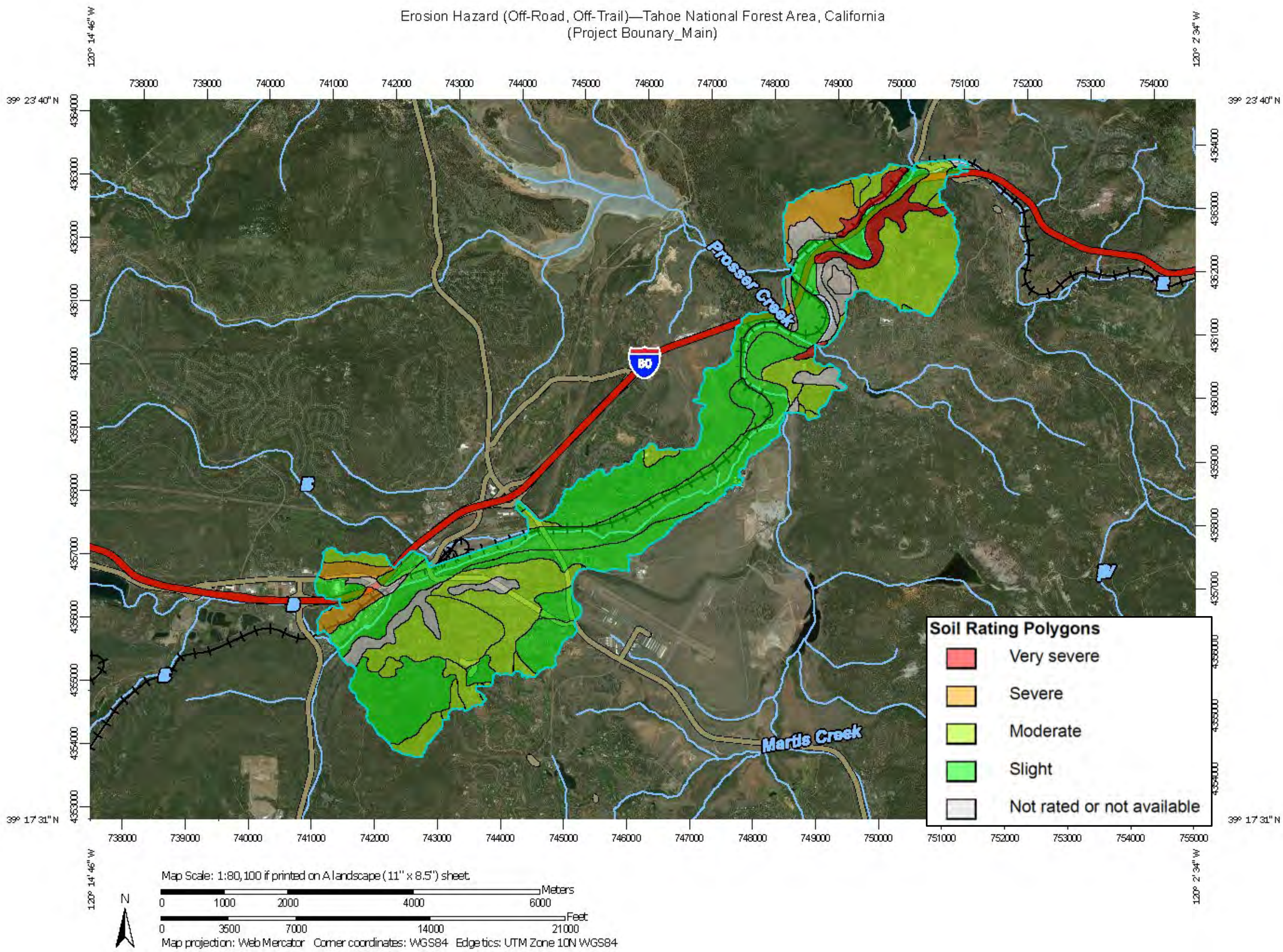

Figure 2-5 Soil Loss Hazard Rating for the Town of Truckee Corridor based on Mapped Soil Erosion factor (NRCS, 2018).

51.7 percent of the Town River Corridor include soils with slight soil loss hazard. These areas include soils adjacent to the Truckee River through the Town River Corridor between Donner Creek and Prosser Creek, upland soils between State Route 267 (SR 267) and Martis Creek, and soils of the Bald Mountain area including outwash deposits with low slopes near the intersection of SR 267 and Brockway Road.

31.7 percent of the Town River Corridor includes soils with moderate soil loss hazard. These areas are steeper with soils formed on Prosser Creek alluvium (Figure 2-6) and Donner Creek Outwash deposits, and include portions of the Sierra Meadows Residential Area and Ponderosa Pines Golf Course. Other soils with moderate erosion hazard include portions of Juniper Flat (aka Glenshire).

5.4 percent of the Town River Corridor includes soils with severe erosion hazard. These areas include steep soils underlain by glacial till of the Tahoe glaciation near the Gateway Residential-Commercial area of Truckee, and steep volcanic soils of Boca Hill, north of I-80 and east of Prosser Creek.

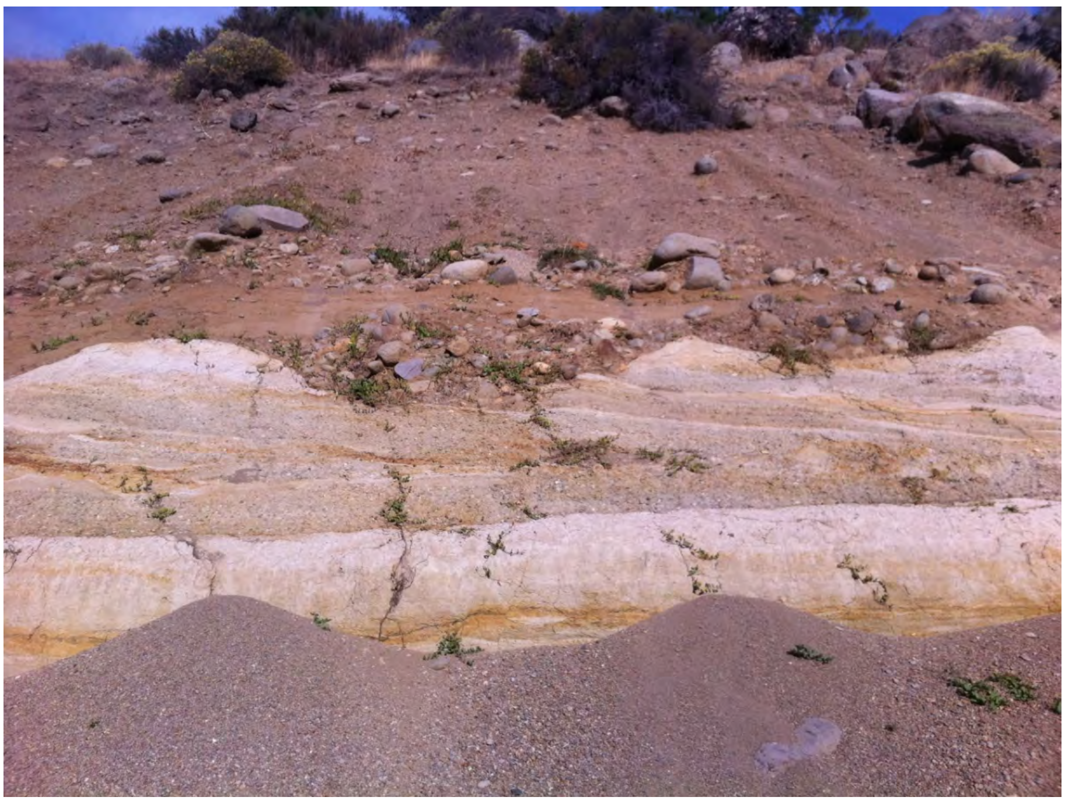

Figure 2-6 Prosser Formation Outcrop with Overlying Glacial Outwash.

3.5 percent of the Town River Corridor includes soils with very severe soil loss hazard. These soils are typically underlain by glacial till and outwash deposits of the Tioga glaciation and can be seen in Figure 2-6. These areas are generally located on steep soils adjacent to the Truckee River between Prosser Creek and the Little Truckee River. A small area is also mapped as having very severe soil loss hazard at the confluence of Union Valley and the Truckee River. These areas coincide with historical disturbance associated with the Union Pacific Railroad, quarry operations, and historical highway routes.

The remaining 7.7 percent of the Town River Corridor includes soils with no rating and typically consist of exposed bedrock or rock outcrops, colluvial slopes, pits, and wetland soils.

2.6 Hydrology

2.6.1 Surface Water Hydrology

The hydrology of the Middle Truckee River Basin has been described in detail by others (Amorfini and Holden, 2008, Nichols Consulting Engineers, 2008; McGraw and others, 2001; Brown and Caldwell, 2012, Hastings and Shaw, 2014, Shaw and others, 2012, Shaw and Donaldson, 2011). The Truckee River enters the Town River Corridor upstream of the Donner Creek mouth and flows west to east across the valley before exiting the Study Area at Boca Bridge, just downstream of the mouth of the Little Truckee River. Below Boca, the river descends into the Truckee River Canyon and Nevada before flowing through the cities of Reno and Sparks, Nevada, before discharges to Pyramid Lake, where is terminates.

Streamflow from Lake Tahoe, and Truckee River tributaries including Donner Creek, Martis Creek, Prosser Creek, and Little Truckee River is regulated by major dams or impoundments under the Truckee River Operations Agreement (TROA), signed in 2008 and implemented in 2017. Rates and timing of releases is guided by a number of court decrees, agreements, and regulations that govern the flow rate from California to Nevada. TROA governs the operations of the Truckee River system to accommodate water supply, flood control, multiple beneficial uses, endangered and threatened fish species, and water quality. TROA attempts to balance water management for human use but also allows for flexibility in operations to enhance riparian habitat, re-establish river canopy, enhance reservoir releases, maintain water quality and aquatic habitat, and improve recreational pools in reservoirs.

Average monthly streamflow is shown in Figure 2-7 at a number of gaging stations in the Middle Truckee River Basin. These data illustrate how the regulation of flows in the basin alters the timing of discharge. Unregulated streams in this region tend to experience seasonal low flows in the late summer and early fall, with higher peak flows from rain on snow events and snowmelt runoff in the spring. This pattern is illustrated by monthly streamflow data collected at Sagehen Creek, an unregulated watershed approximately 5 miles north of Truckee and tributary to the Little Truckee River. In contrast, regulated streams in the Truckee River Basin have more uniformly distributed streamflow during the year, due to timed releases. This shift in timing also alters peak flows in the Town River Corridor, influencing the sediment loads and limiting flushing flows.

Lake Tahoe is not operated for flood control but for water supply, and may not exceed lake elevations above 6,229.1 feet (USBOR, 2015). Donner Lake is regulated for flood control, storage requirements and operating restrictions to comply with California licensing requirements and dam safety criteria (USGS, 2001). Martis Creek Lake, and Prosser, Stampede, and Boca Reservoirs are operated for flood control under U.S. Army Corps of Engineers (USACE) regulations. As much as possible, operations at these reservoirs restrict reservoir releases when Truckee River flows through Reno are above 6,000 cfs (State Water Resources Control Board, 2002). In general, flood control operations vary by season.

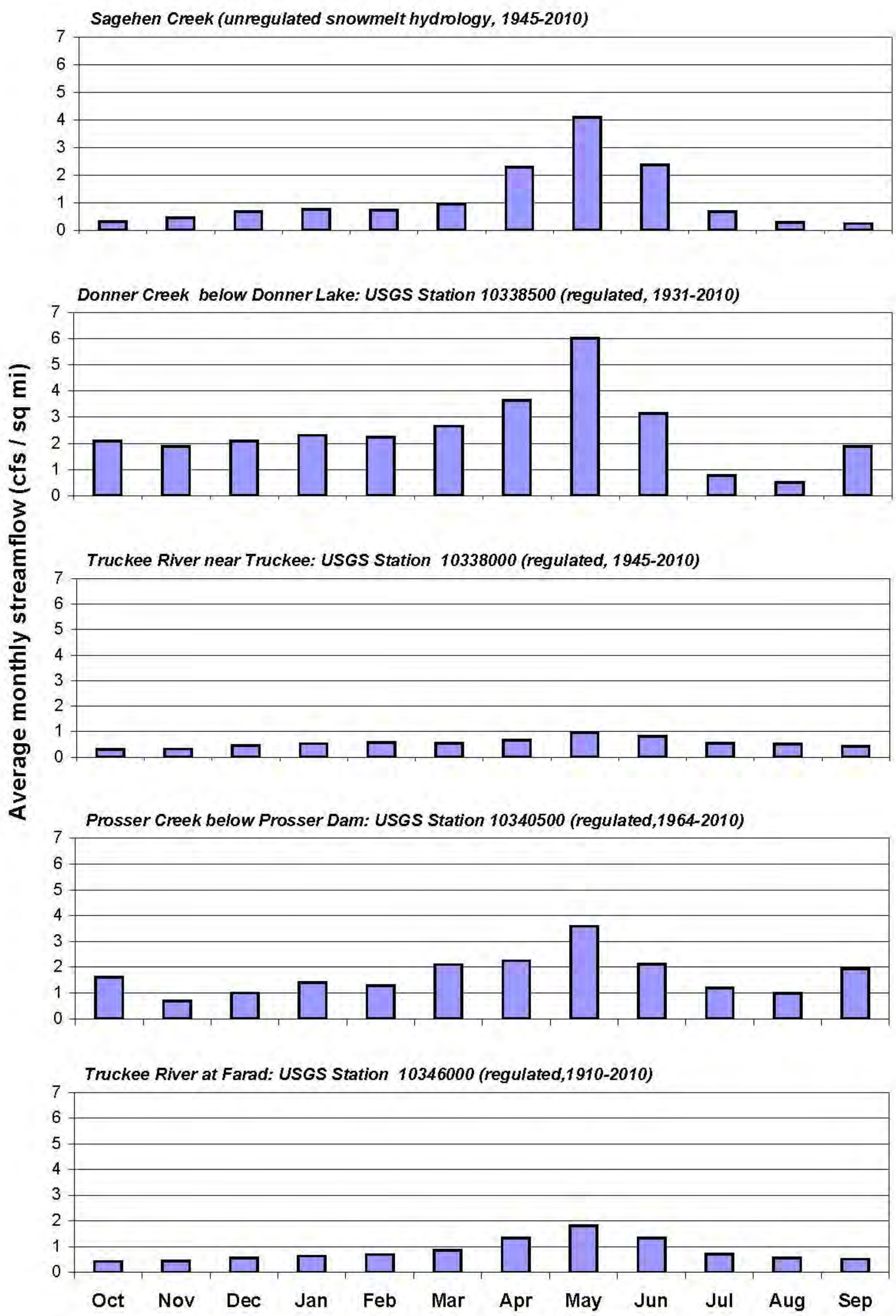

Figure 2-7 Average Monthly Streamflow: Truckee River and Selected Tributaries. (Adapted from Brown and Caldwell, 2014).

2.6.2 PEAK FLOWS AND FLOODING

Peak flows along the Truckee River were evaluated to provide an estimate of the range of peak flows for future restoration design purposes. The significance and importance of floods to watershed functions is well-established.

Table 2-1 shows the historical peak annual flows for the Truckee River at the Truckee, near Truckee USGS gaging station (USGS 10338000). A frequency analysis of the data below indicates that the 2-year flow at the Truckee gage is between 970 cfs and 1,530 cfs, and the 100-year flow is between 10,700 cfs and 28,800 cfs.

Table 2-1. Annual Peak Flow Summary, Truckee River near Truckee (USGS 1033800), California.

Water Year	Instantaneous Peak Flow (cfs)	Peak Stage[1] (ft)	Date
1945	1,110	3.34	February 2, 1945
1946	838	2.95	April 25, 1946
1947	677	2.70	November 23, 1946
1948	708	2.75	October 16, 1947
1949	*671*		May 14, 1949
1950	*700*	*5.00*	January 22, 1950
1951	6,480	7.62	November 20, 1950
1952	2,640	5.08	June 5, 1952
1953	1,990	4.40	June 23, 1953
1954	1,540	3.88	March 9, 1954
1955	552	2.51	August 8, 1955
1956	7,760	7.92	December 23, 1955
1957	2,040	4.24	June 5, 1957
1958	2,920	5.31	May 18, 1958
1959	576	2.58	September 18, 1959
1960	1,190	3.38	February 8, 1960
1961	390	2.25	October 1, 1960
1963	11,000	9.25	February 1, 1963
1977	268	1.83	June 29, 1977
1978	627	2.52	May 14, 1978
1979	763	2.74	January 11, 1979
1980	4,900	6.79	January 13, 1980
1981	471	2.34	August 15, 1981
1982	4,760	2.70	December 20, 1981
1993	936	3.10	May 31, 1993
1994	340	2.09	May 11, 1994
1995	1,620	4.05	May 1, 1995
1997	11,900	9.97	January 2, 1997
1998	2,600	4.62	June 13, 1998
1999	2,140	4.08	March 3, 1999
2000	943	2.88	May 28, 2000
2001	468	2.24	May 15, 2001
2002	690	2.58	April 14, 2002
2003	827	2.76	May 29, 2003
2004	564	2.40	April 4, 2004
2005	2,370	4.29	May 19, 2005
2006	6,030	6.97	December 31, 2005
2007	390	2.32	November 14, 2006
2008	634	2.74	May 15, 2008
2009	1,260	3.52	May 5, 2009
2010	1,060	3.27	June 6, 2010
2010	1,840	4.08	October 24, 2010
2012	1,140	3.41	January 21, 2012
2012	1,810	4.12	December 2, 2012
2014	724	2.91	February 9, 2014
2015	1,130	3.42	February 8, 2015
2016	1,520	3.85	January 31, 2016
2017	5,040		January 8, 2017

Notes:
1. "stage" is w ater level in the creek as read against the staff plate; the staff plate is set at an arbitrary datum, so stage is relative and does not represent the absolute depth of w ater in the creek
2. Gage is located 39 17'47"; 120 12'16" (NAD27); drainage area 553 square miles; gage datum 5,860.00 feet above mean seal level (NGVD29)
3. Discharge is affected by regulation or diversion (Tahoe City).
4. Discharges for WY1949 and WY1950 are estimates.
5. Period of Record based on USGS published values: WY1945-WY1963, WY1977-WY1982, WY1993-WY2010, WY2012, WY2014-Current.

The extreme flood flows have historically been from rain on snow events. The largest recorded flow on the Truckee River upstream of Truckee was 11,900 cfs on January 2, 1997[2], which falls within the expected range for a 100-year event. This storm was the result of an exceptionally large snowpack (180 percent of normal) in December 1996 that was subjected to a sub-tropical storm which brought unseasonal warm rainfall into the Sierra Nevada mountain with rainfall seen up to 10,000 feet (USGS, 1997). Figure 2-8

[2] Peak flows for the 1997 event are not available for the USGS Boca station.

shows the peak annual flows into and out of the Town River Corridor at the Truckee (USGS 1033800) and Boca (USGS 10344505) gage site. Based on the available data the tributaries add an additional 30 to 40 percent to peak flows across the study area.

Water Year 2017 was one of the wettest years on record, with a peak flow of 5,040 cfs and 8,020 cfs for the Truckee near Truckee and Boca gages, respectively. Based on the frequency analysis for the upstream station, the 2017 peak flow was between a 10 and 12-year return period. This event caused inundation of floodplains and provided an opportunity to observe the Truckee River during and after moderate flood conditions. We have used high-water marks to address the impact of flooding on channel and bank conditions in the Study Area.

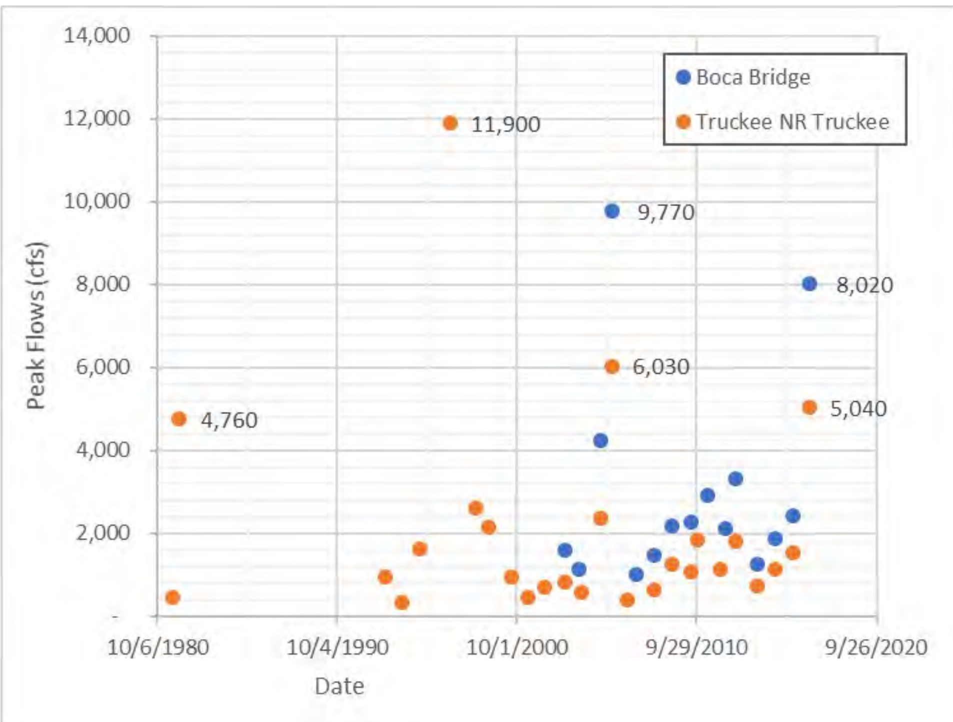

Figure 2-8 Annual Peak Flows Above (Truckee NR Truckee, USGS 1033800) and Below (Boca Bridge, USGS 10344505) the Town River Corridor.

2.7 Cultural, Land Use and Historical Land Use

Since the 1800's, the Town River Corridor has experienced physical and ecological impacts, in part due to anthropogenic disturbances associated with logging, ice harvest, dairy and cattle ranching, recreation, modern transportation, and land and community development (Lindstrom, 2017). These impacts have altered the hydrology, geomorphic processes, water quality, and biological resources in the Town River Corridor.

As part of this assessment, we assessed the Town River Corridor in terms of the current and historical land uses that have the potential to contribute sediment to the Truckee River. Working with Dr. Susan Lindstrom, Consulting Archaeologist, we reviewed historical land-uses and activities and conducted a field reconnaissance to evaluate their legacy impacts on sediment supply.

The project area falls within the center of Washoe (*Wa She Shu*) territory. Three general settlement areas have been reported from the confluence with Donner Creek, east to Boca and the confluence of the Little Truckee River (Appendix B). In the 20th century, the Washoe would make long treks across the Sierra passes for hunting, trading and gathering acorns. These aboriginal trek routes, patterned after game trails, are often the precursors of our historic and modern road systems. In the high valleys, permanent base camps are indicated by stone flakes, tools, grinding implements, and house depressions. As such, any restoration activity within the Town River Corridor will require careful consideration of cultural resources.

Several dates mark the progression of the Town of Truckee as an urban frontier;

- The arrival of Joseph Gray in 1863 created the first station;
- In 1868, the town was formally named the Town of Truckee; and
- Completion of the transcontinental railroad in 1869.

With the completion of the transcontinental railroad Truckee was a resource rich landscape ripe for harvesting. The logging railroads came in the 1870's and persisted through late 19th century. Truckee thrived on the industries of lumber, railroading and ice. The associated infrastructure permanently transformed the landscape; however, roads, railroads, flumes, drainage ditches, and diversions over a de-forested landscape created flow paths, erosion, and fine sediment transport delivery from the hillsides to directly to tributary streams and the Truckee River. Diversions for the Truckee lumber yard and ice works near Polaris are among the most significant of the in-channel modifications that took place at that time. Railroad construction and development along the Truckee River corridor through downtown consisted of mass grading in many areas, with fill placement directly in the channel and floodplain. By the 1920's, many of the railroad features were relocated to the Roseville transfer station, and Truckee soon developed into a recreation-based economy, facilitated by completion of the transcontinental highway over Donner Pass in 1963 (Lindstrom, 2017).

Two photograph comparisons are presented below to show change in the Town of Truckee and the Truckee River over time. Figure 2-9 shows the Town of Truckee in the late 19th century with a view of the Bridge Street Bridge. Figure 2-10 shows the Truckee River as viewed from Hilltop (the hill south of Bridge Street) looking northwest down on the Truckee River. Development directly on the riverbanks is shown in both photos, and bank vegetation appears to be limited in both photos.

During the 1950s, 60s, and 70s, the rural ranching- and timber-based economy began shifting to more recreational and community development, specifically after the Olympics in 1960. The Town of Truckee experienced rapid population growth in the 1990's upwards of a 56% increase from 1991 to 2000 (Town of Truckee, 2015). Today, primary land uses consist of residential-commercial development, on-going road improvements, some timber operations, and recreational uses.

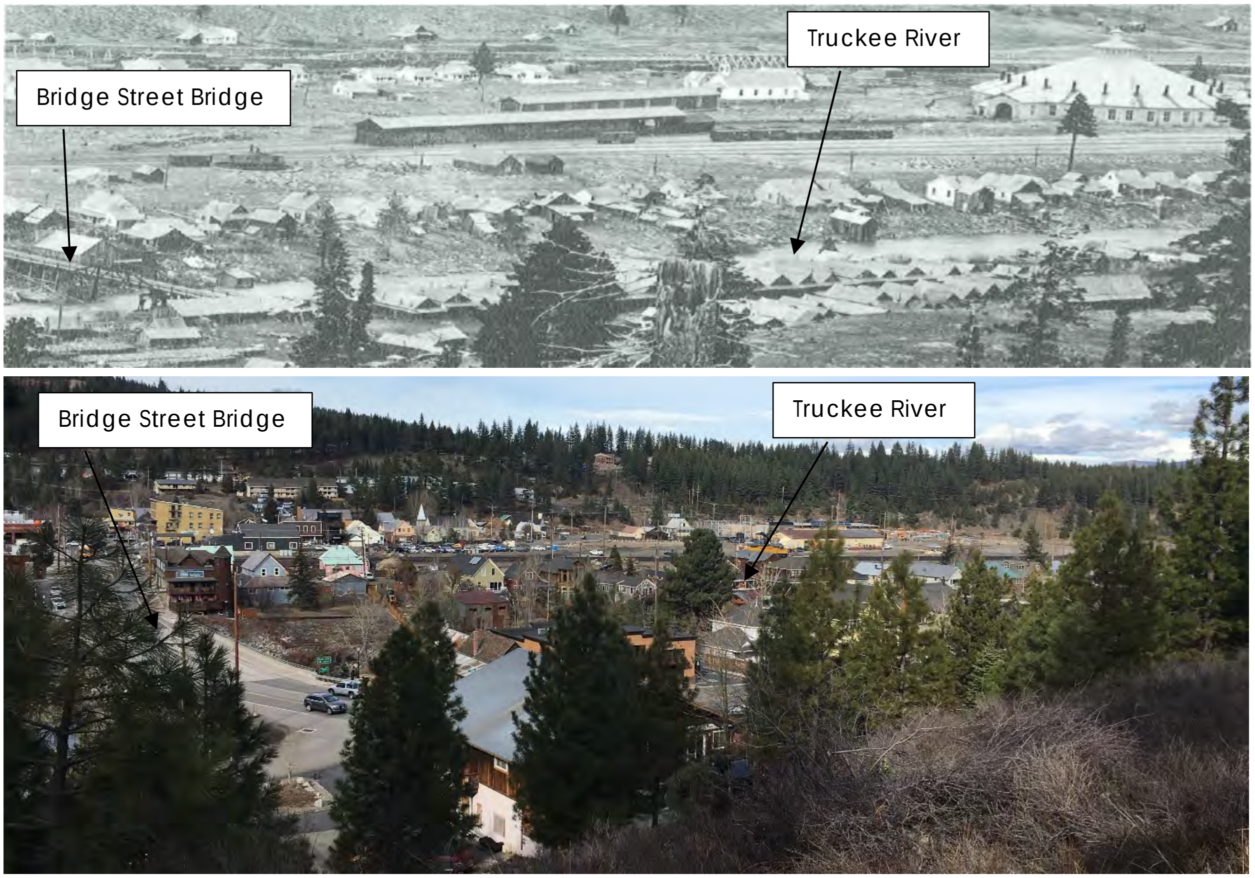

Figure 2-9 Development on the Truckee River Banks, Comparison of Historical and Existing Conditions, from Hilltop Looking Northeast Towards the Truckee River. Top: Late 19th Century Truckee. Bottom: 2018.

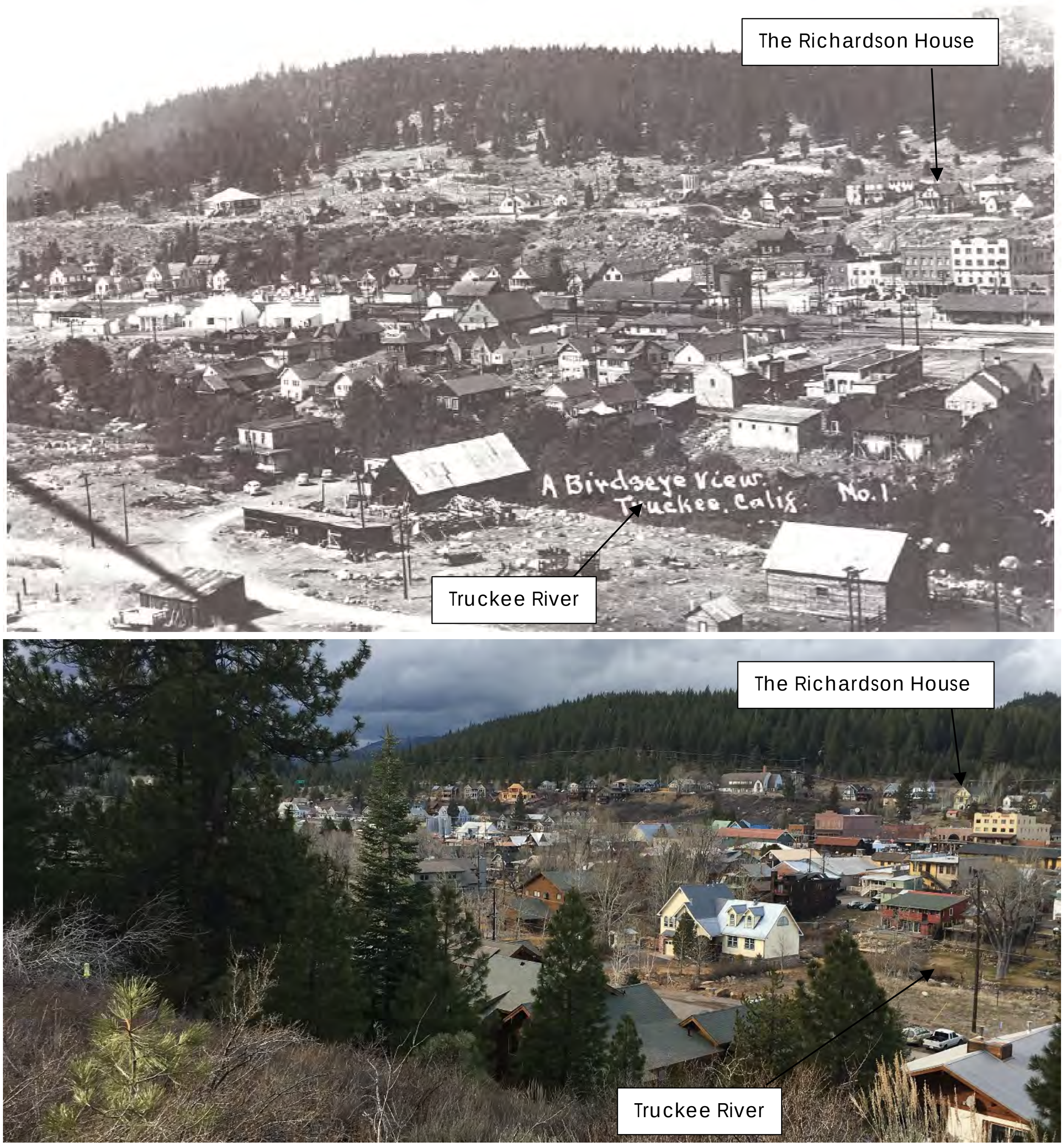

Figure 2-10 Comparison of Historical and Existing Conditions, from Hilltop looking Northwest towards the Truckee River and High Street. Top- 1935. Bottom- 2018.

The USDA Natural Resource Conservation Service has mapped land use (development related) and land cover (natural vegetation) across the country. The percentages of each category within the Town River Corridor are presented below in Table 2-2 and Figure 2-11. Although the Town River Corridor today is majority forest and shrub land, there is a high concentration of developed areas and historical impacts directly along the length of the Truckee River within the entire Study Area.

Table 2-2 Land Cover Percentages within the Town River Corridor (USDA NRCS, 2011).

Land Cover	Percent
Open Water	0.6%
Developed, Open Space	3.6%
Developed, Low Intensity	13.1%
Developed, Medium Intensity	5.8%
Developed, High Intensity	1.7%
Evergreen Forest	29.2%
Shrub/Scrub	41.5%
Herbaceuous	4.4%
Emergent Herbaceuous Wetlands	0.2%

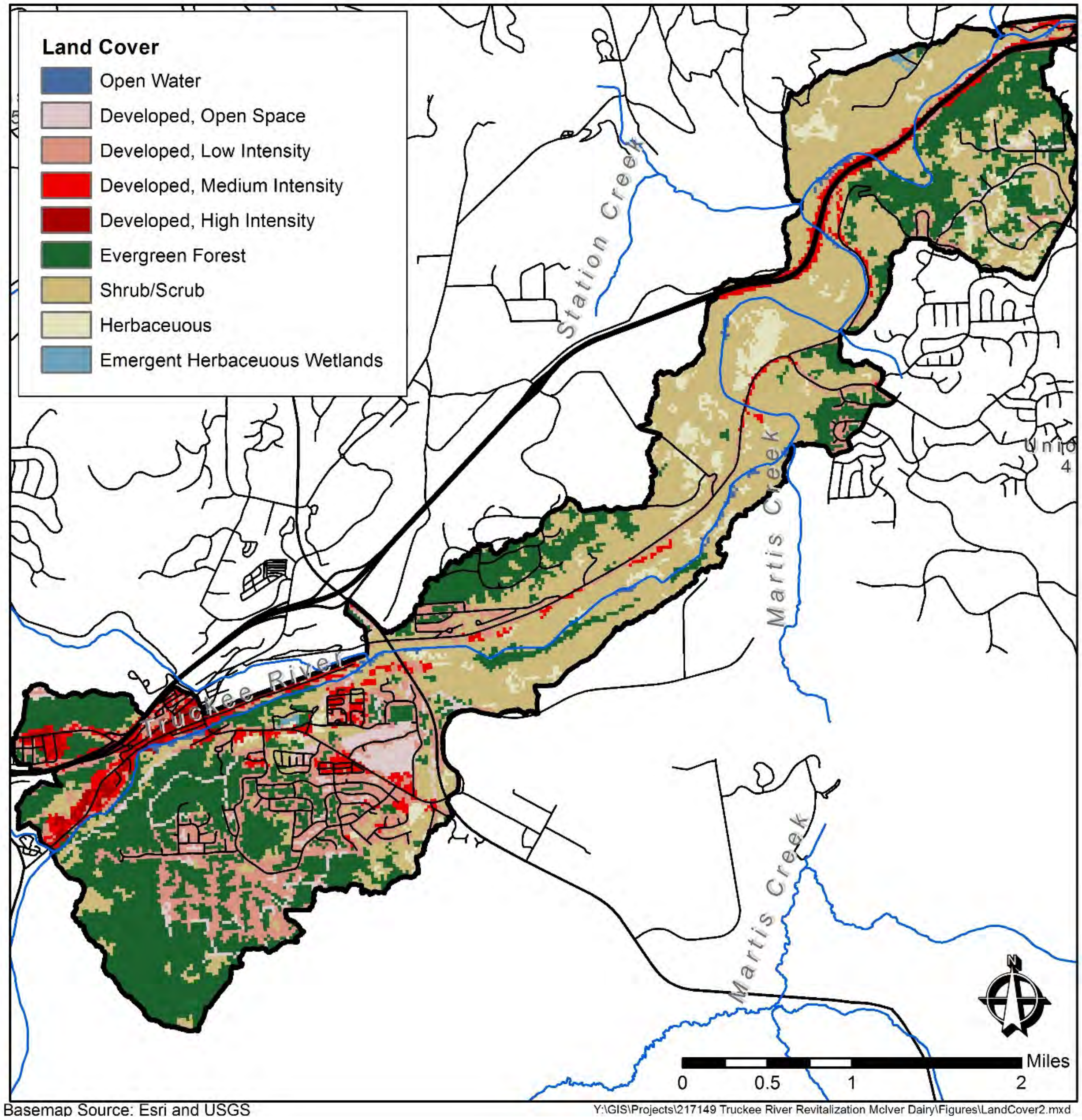

Figure 2-11 Existing Land Cover in the Town River Corridor (USDA NRCS, 2011).

2.8 Transportation Impact

Urbanization of a watershed can degrade both the form and function of the downstream rivers (Booth and Jackson, 1997, Burton and Pitt, 2002). Roads and impervious surfaces alter the natural infiltration and flow paths of stormwater runoff, and change the hydrology of slopes and stream channels (Trombulak and Frissell, 2000).

2.8.1 Interstates, Highways and Roads

The Town River Corridor includes a 4.8-mile segment of I-80, and a 1.3-mile segment of SR 267, both operated by California Department of Transportation (Caltrans). Figure 2-12 show a comparison between a 1963 photo after the completion of I-80 and the conditions observed today (2017). Most of the disturbance to the downtown corridor is associated with historical land uses, including massive earthwork and modification of flow patterns associated with construction of I-80. Both images show the realigned Trout Creek at the bottom left corner and the railroad balloon track. The stream that flows through the historical McIver Dairy was also significantly altered due to the construction of I-80, which confined the drainage to a culvert under the interstate.

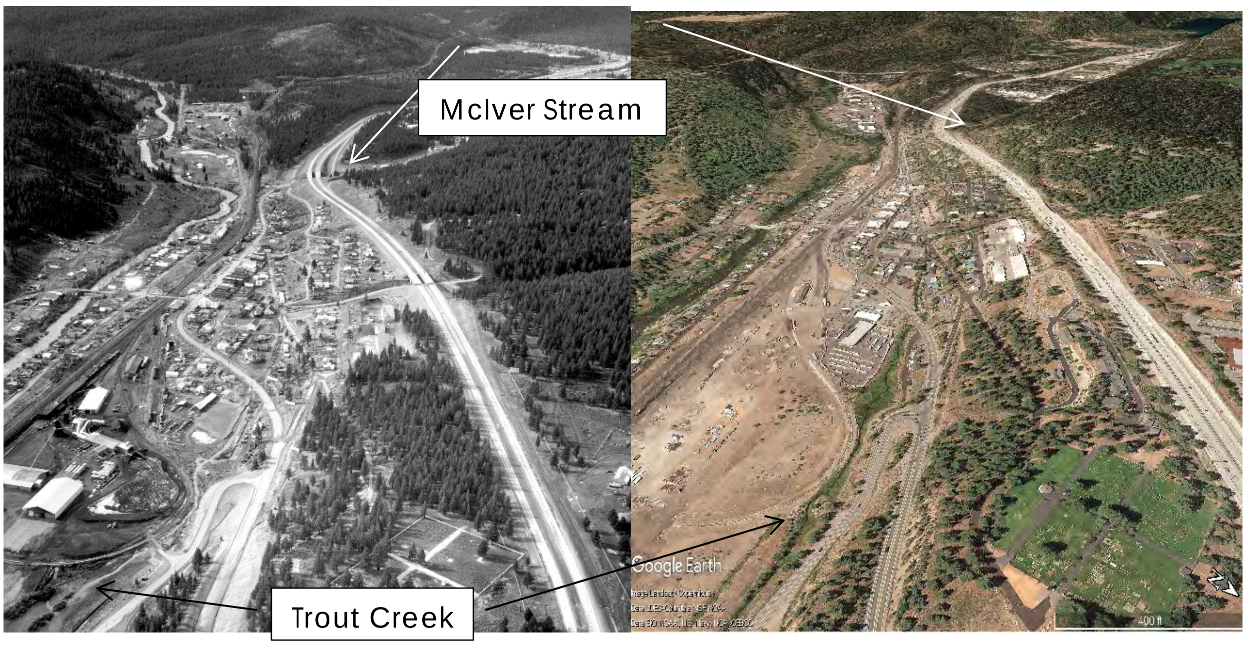

Figure 2-12 Comparison of Downtown Truckee in 1963 and 2017.

Snow removal operations are required for safe travel, and continue to have an impact on water quality and watershed health, Caltrans' Office of Emergency Management and Infrastructure Protection, under the Maintenance Division, oversees the Winter Operations Program for state highway and interstate maintenance. In the Town River Corridor Caltrans maintains I-80, SR 267, and SR 89. Winter operations include the use of road abrasives such as sand or lava rock cinders to provide better traction on highways. Where road drainage flows untreated to local waterways, traction sand accumulates on streambeds and impairs water quality and aquatic habitat. Caltrans actively works to reduce the environmental impact from salts and abrasives, either by using more effective natural products in smaller amounts, use of brine salts in place of road sand or employing newer technology such as road temperature gauges on vehicles so treatments can be applied more selectively. Part of routine operations involves sand recovery with street sweeping between and before storm events and annual clean out of sand traps and catch basins.

Additionally, Caltrans is currently investigating the use of mechanical Ice Breakers to improve snow removal operations to help reduce brine and sand application (Caltrans DRISI, 2016). A preliminary investigation was done in February 2016 and Caltrans was looking to test out prototypes of mechanical ice breaking equipment in Winter 2017/2018.

The standard Caltrans abrasive application rate is 1,000 lbs. or less per lane mile (0.5 tons per lane mile). Up to 2,000 lbs. per lane mile (1.0 ton per lane mile) may be required on super-elevations or under unusual conditions. Application of material is repeated as necessary to maintain safe travel ways (USDOT, 2014). Recorded road sand application rates provided by Caltrans for WY2013 through WY2017 on I-80 and SR 267 indicate an annual average of approximate 38 tons per lane mile over a 22.6-mile section of I-80 and a 2.8-mile section of SR 267, both within the study area.

Road sand recovery rates up to 74% can be expected (USDOT, 2006) from using street vacuum sweepers but recovery rates tend to average closer to 33% to 50% (Gaddis-Brown and others, 2014) for general recovery techniques across the United States. Caltrans does not keep records of recovery rates specifically for the Truckee area but numbers were available for the Lake Tahoe Hydrologic Unit. A deicer Report from 2012, of roads within the Lake Tahoe Hydrologic Unit indicated that road sand application rate was reduced to 600 lbs (0.3 tons) per lane mile within the Lake Tahoe Hydrologic Unit. For WY1996 to WY2012 the recovery of road sand for this area ranged from 27% to 193%, with an average of 71% over the 17 years of record (Caltrans, 2012).

Similarly, the Town of Truckee has also reduced the use of road sand applications. As part of the Town of Truckee's Stormwater Management Plan the application and recovery of road sand has been recorded. Over the five-year period of record (WY2013 to 2017) 6,000 tons of sand was applied and 5,650 tons was recovered from road sweeping operations (94% recovery rate). Similar to the Caltrans data, in some years the recovery rate was higher than the application rate.

2.8.2 RAILROAD IMPACTS

The completion of the transcontinental railroad gave rise to a range of land uses from logging to tourism, and has directly affected the Truckee River channel throughout the Study Area.

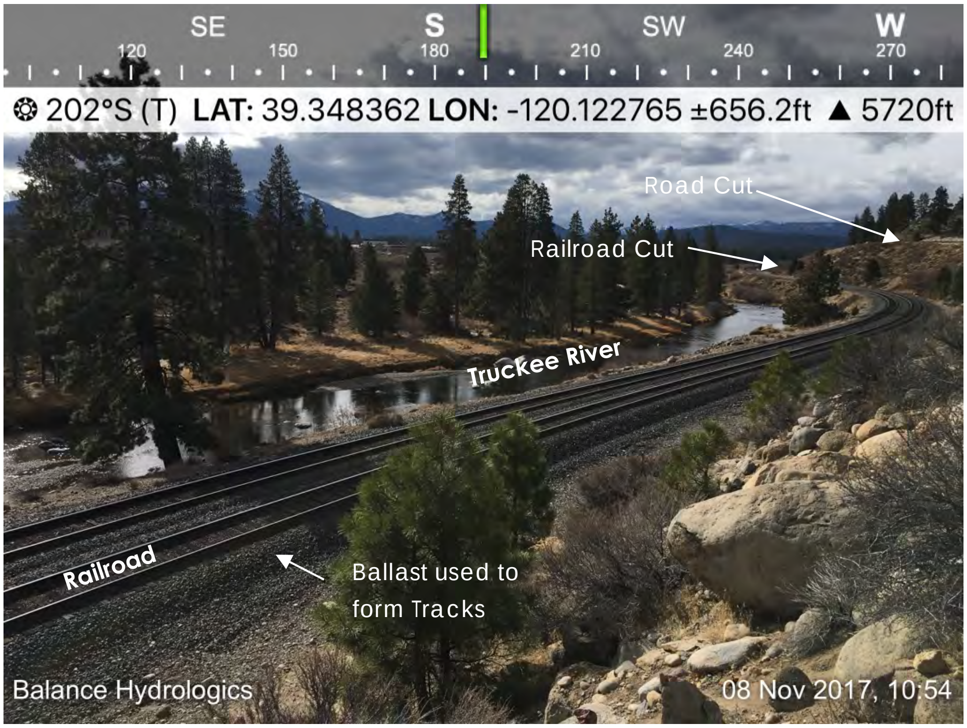

Figure 2-13 Examples of Railroad Features Impacting the Natural Hillslopes and Introducing Sediment Sources to the Truckee River. Near Glenshire Drive Looking West Towards Town of Truckee.

The railroad was positioned parallel to the Truckee River to gain access to the available resources and utilize the Truckee River's relatively uniform gradient. The railroad required major earth movement and grading to establish a steady grade through the Corridor. Natural slopes were cut and additional material was added to form the tracks (Figure 2-13). Where the railroad had to be cut into the hillside, the cut material was also used as fill, partially filling active sections of Truckee River and floodplain, most notably from Glenshire Drive to Boca. The nature of this erosion is difficult to quantify but can be visually identified throughout the corridor (e.g. Figure 2-14). Cut and fill on hillsides appear to provide chronic sediment supply to the Truckee River where slopes are unstable. Future restoration projects could potentially focus on stabilizing these eroding slopes and future studies should examine the contribution of the railroad grades to excessive sediment loads in the Truckee River.

Furthermore, the railroad grade has dissected natural drainages and require that every left bank tributary be confined to a culvert or bridge before entering the Truckee River. Each crossing has required modification of the tributary and in some cases, ongoing maintenance, often resulting in erosion and excessive sediment transport to the stream, especially where crossings are undersized.

Figure 2-14 Active Erosion Along the Railroad. Truckee River Tail Downstream of Legacy Trail Bridge.

2.9 Habitat

The Town River Corridor is home to forest, meadows, wetlands, and riparian areas. Native plant communities include montane riparian scrub, montane black cottonwood forest, montane wet meadow, montane freshwater marsh, lodge pole pine forest, Jeffrey pine-white fir forest, and Great Basin sagebrush scrub (EDAW, 2006). The California Department of Fish and Wildlife considers areas of riparian, meadow and freshwater marshes to be classified as sensitive areas. These areas are monitored through the California Natural Diversity Database.

Riparian habitat is generally very narrow and patchy along the Town River Corridor. Riparian habitat provides for aquatic and terrestrial organisms such as aquatic insects, insectivorous birds, aquatic reptiles, amphibians, and mammals. Riparian habitats are among the most productive and species-rich areas having high ecological importance (Moyle el al. 1996). The riparian habitat in the Town River Corridor is limited by natural river constrains or land use, reducing its current habitat value. Sediment loading has been shown to have a negative effect on riparian habitat; McGraw and others (2001) concluded that willow flycatcher habitat can be damaged by geomorphic change induced by excessive sediment.

Both non-native and native fish species are found in the Truckee River and its tributaries. Common native fish include Paiute sculpin, Lahontan redside shiner, Tahoe sucker, specked dace, mountain whitefish, and mountain sucker. The cui-ui and Lahontan cutthroat trout (LCT) are also found in the Truckee River; these species are federally-listed as endangered and threatened, respectively (Amorfini and Holden, 2008). The Middle Truckee River between the Trout Creek and Gray Creek tributaries has been designated a Wild Trout Waterway by California Department of Fish and Wildlife (CDFW) to support regulated angling of non-native rainbow and brown trout.

Cold freshwater habitat is impaired by an increase in sediment loads in a variety of ways (McGraw and others, 2001). Lahontan cutthroat trout depend upon physical and biological system components adapted to a sediment regime in balance with its hydrologic regime. Changes in sediment discharge, frequency, magnitude, and timing outside the expected range of variability can induce threshold geomorphic events, resulting in unsuitable habitat (McGraw and others, 2001).

2.10 Water Quality

Water quality affects the overall health and function of an ecosystem. TRWC has been running a volunteer-based program to measure ambient water quality conditions within the Middle Truckee River Watershed. Samples are collected as grab samples and submitted for analysis of basic physical parameters, turbidity, nutrients, and bacteria. Data from 2003 to 2016 were available and reviewed as part of this assessment. Dissolved Oxygen (DO) and pH data are illustrated in Figure 2-15, and Figure 2-16. DO levels are above acceptable levels through the Town and pH is trending upwards. Figure 2-17 shows turbidity levels at times exceeding the 3 NTU standard as set by the Basin Plan (Lahontan RWQCB, 1995). Because volunteer-collected data are grab samples representing instantaneous single values, it is difficult to compare some results to the water quality standards established in the Basin Plan (Lahontan RWQCB, 1995), which are based on the arithmetic mean of 30-day averages. Data collected and continuation of the program does allow for tracking of long term trends, however.

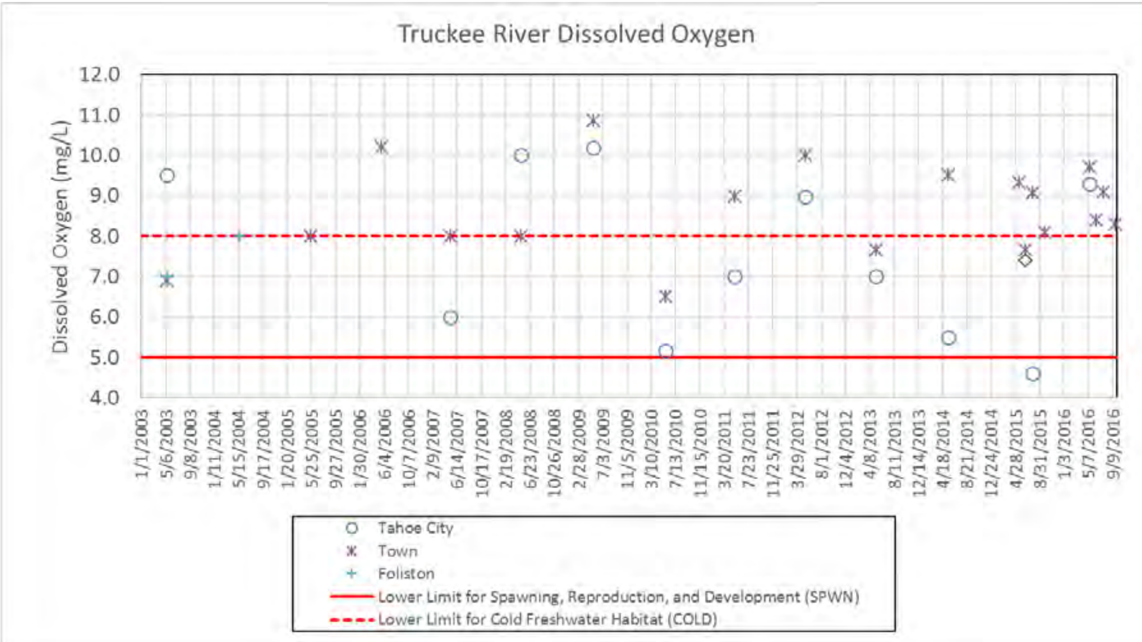

Figure 2-15 Truckee River Dissolved Oxygen Levels (2003 to 2016).

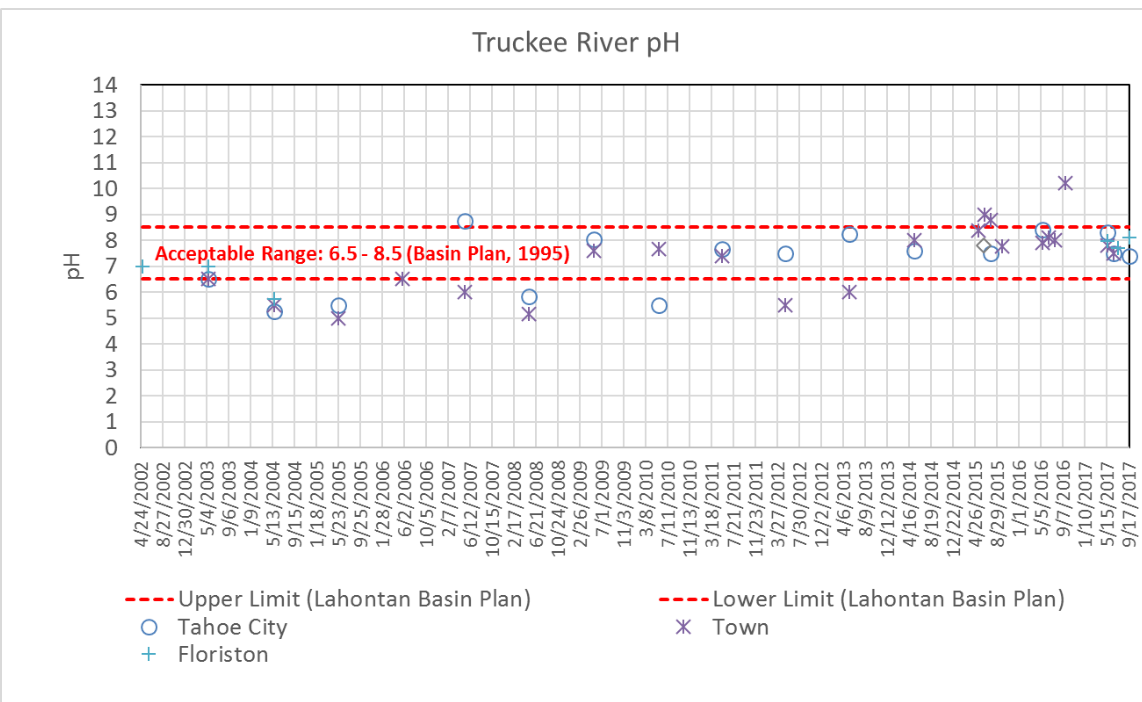

Figure 2-16 Truckee River pH Levels (2003 to 2016).

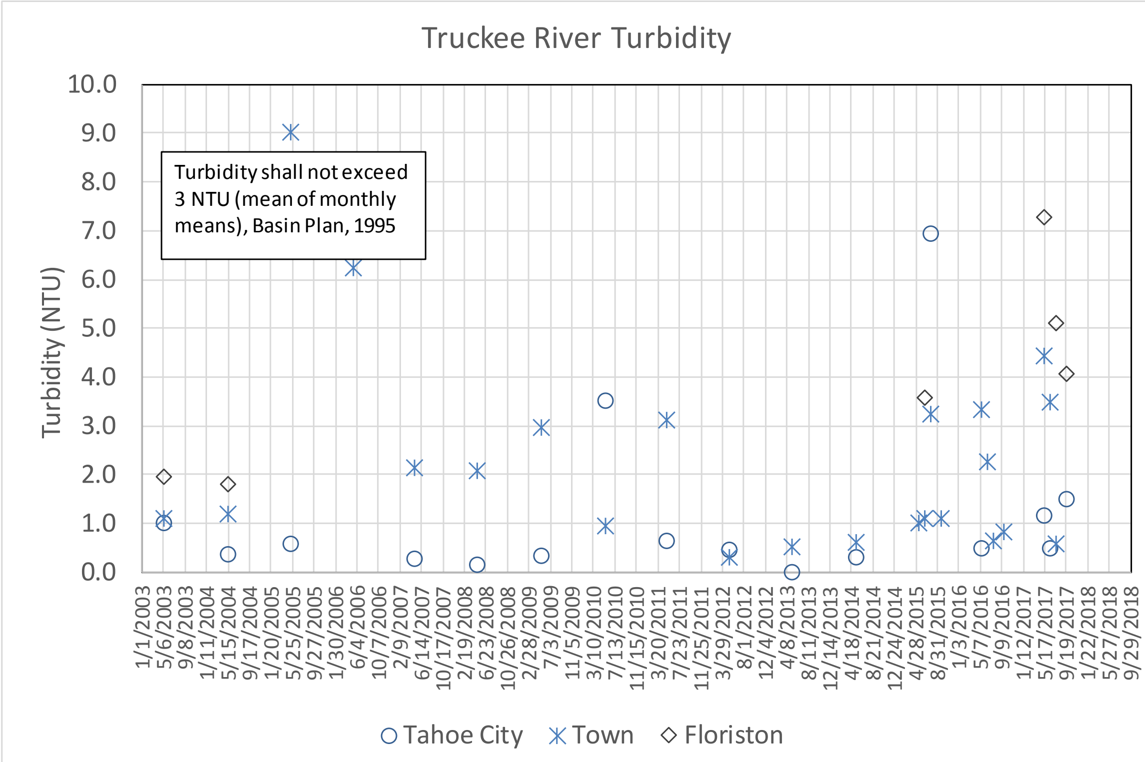

Figure 2-17 Truckee River Turbidity Levels (2003 to 2016).

2.10.1 SEDIMENT

Excessive sediment overwhelms the transport capacity of a river and can damage its biological components (Waters, 1995). Sediment problems in Eastern Sierra rivers are typically associated with the fine inorganic particles that either flow in the water column, causing turbidity (suspended sediment), or that are deposited on the streambed causing loss of benthic productivity and fish habitat (Herst and Kane, 2006). Evaluation of sediment sources, sediment loading, and aquatic habitat conditions in the Truckee River through and upstream from the Town River Corridor has been well-studied by others (McGraw and others, 2001; River Run Consulting, 2007; Herbst, 2011; Shaw and others, 2011; Shaw and others, 2014; Hastings and Shaw, 2014, CDM-Smith and Balance Hydrologics, 2014, 2015, 2016 and 2017; cbec, 2016; and USFS, 2016). Some of these studies are briefly summarized below.

In a study of water quality of the Middle Truckee River, McGraw and others (2001) found that 1) areas closer to the river have a greater effect on sediment concentrations than areas distant from the river, and 2) areas with steeper slopes tend to produce higher sediment per unit area. Based on previous studies, multiple sediment sources were identified from roads, legacy land-uses, ski area development, and winter use/snow management activities in tributaries between Lake Tahoe and the Town River Corridor (USFS, 2016). These sources have been prioritized and rehabilitation prescriptions are planned. River Run Consulting (2007), and cbec (2016) identified Donner Creek and Cold Creek tributaries as prone to naturally high sediment yields due to their easily erodible soils and glacial history. Historical and existing land-uses have magnified these sediment source issues. Management activities and restoration projects have been planned or designed, and some implemented in recent years (TRWC, pers. comm., 2018).

A more direct understanding of sediment loads in the Truckee River through the Middle Truckee River Watershed was assessed by Hastings and Shaw (2014) and CDM Smith and Balance Hydrologics (CDM Smith and Balance Hydrologics, 2014, 2015, 2016, 2017). Suspended-sediment loading through the Town River Corridor was measured at USGS stream gaging stations upstream (USGS 10338000, Truckee River near Truckee, CA) and downstream (USGS 10344505, Truckee River at Boca Bridge) of the Town River Corridor during a 4-year period. Sediment loading was also measured from two main tributaries including Donner/Cold Creeks, and Trout Creek near their confluences with the Truckee River in water years 2013 and 2014 (Hastings and Shaw, 2014). Results allowed for an accounting of the total load as measured at Boca, the eastern boundary of the Town River Corridor, and suggested that 31 to 54 percent of suspended-sediment loading originated from the ungaged areas, which includes the Town River Corridor, during these average to dry years (Figure 2-18).

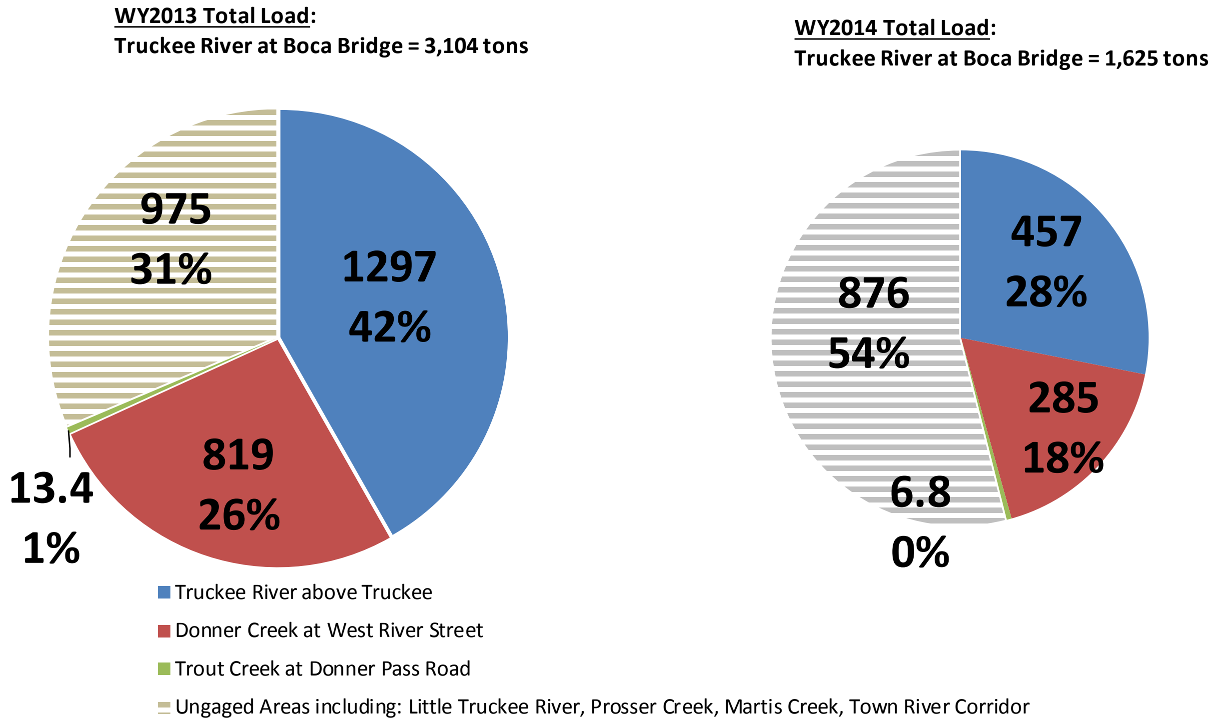

Figure 2-18 Suspended-Sediment Loads in the Middle Truckee River During WY2013 and WY2014 (Hastings and Shaw, 2014).

Hastings and Shaw (2014) also calculated watershed sediment yields. Yield calculations normalize suspended-sediment loads by watershed area to identify areas that contribute more sediment per unit area. Figure 2-19 shows suspended sediment yields in the Truckee River Watershed above and below the Town of Truckee and from Donner/Cold Creek and Trout Creek. Assuming a constant sediment yield from intervening areas, approximately 167 to 320 tons of fine sediment would be expected to be generated from the 8.5-mile study area during WY2014 and WY2013, respectively.

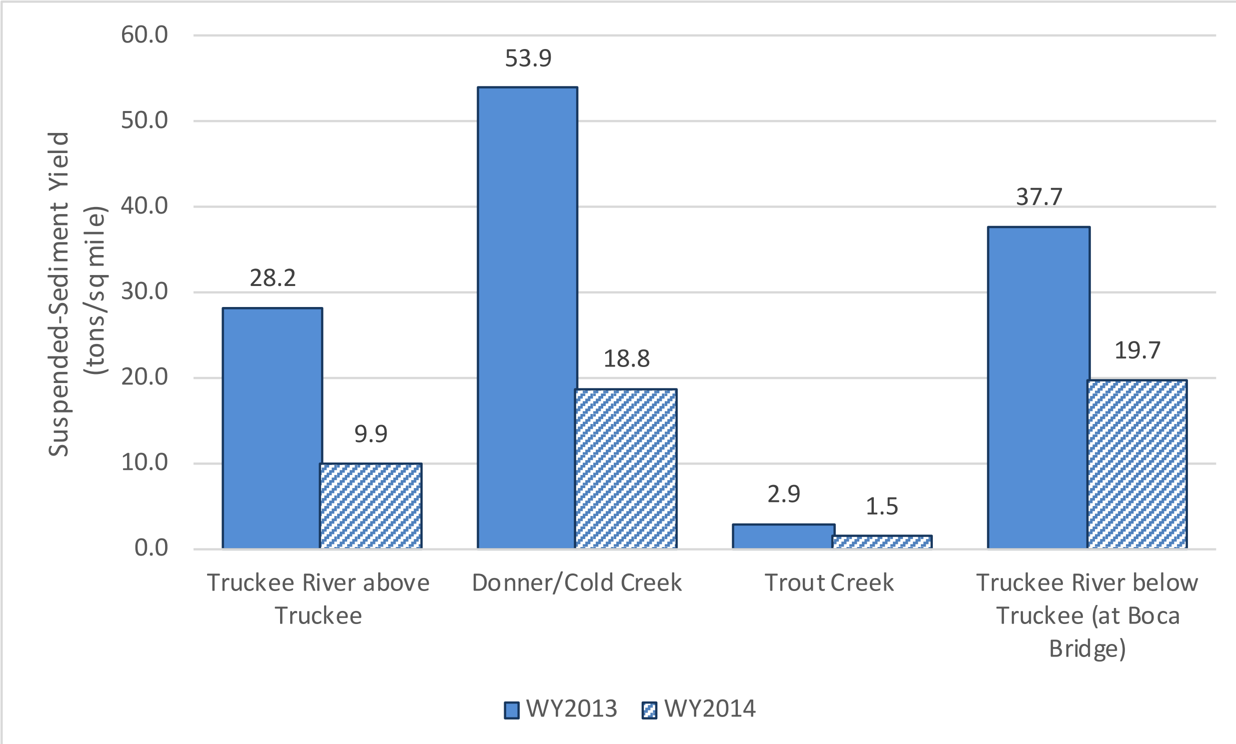

Figure 2-19 Suspended-sediment yields for the Truckee River and Select Tributaries During WY2013 and WY2014. (Adopted from Hastings and Shaw, 2014).

2.10.2 Floodplain Function

Floodplains provide one of the most important storage spaces for sediment as it moves discontinuously through the drainage basin (Knighton, 1998). They preserve an extended record of the changing climate and buffer conditions which have affected drainage systems over time. Flood plains are also important for river management of downstream flooding, providing critical flood storage space before reaching populated areas.

Flooding is a natural attribute of alluvial rivers and is usually a relatively frequent event, occurring roughly once or twice per year (Knighton, 1998). During floods there is interaction between the deep, fast flowing channel and the shallow, slow flowing floodplain. As a result, velocity and shear forces decrease along the floodplain, allowing for suspended sediment to be deposited. The rate of sediment deposition on floodplains is largely dependent on the frequency of inundating flow, the suspended sediment loads in the river, available floodplain area and vegetation. In the Town River Corridor, sediment deposition functions are limited where floodplain area have been limited by fill placement, modifications for ice harvesting, or where the channel has been disconnected and/or incised.

3 SEDIMENT SOURCE INVENTORY

Observations during Fall 2017 and interpretation of aerial photography were used to generate an overall picture of the watershed's current condition and sediment sources. After review of current and historical maps and aerial photographs, Balance hydrologists, geomorphologists, and water resource engineers, along with Dudek's landscape architect and biologist, conducted a field reconnaissance of likely sediment sources. We evaluated both natural and anthropogenic sediment sources and developed strategies to improve river access in concert with restoration and erosion control opportunities (Error! Reference source not found.). Our efforts are documented in this section along with additional analyses which support proposed restoration and management actions.

Figure 3-1. Example: Truckee River Access Area with No Formalized Trails or Bank Stabilization (Legacy Trial).

3.1 Flow Accumulation Analysis

The purpose of the flow accumulation analysis was to evaluate the sub-watersheds within the Town River Corridor and their potential as sediment sources or sediment delivery pathways. A flow accumulation analysis is a GIS modeling process that uses high-resolution topographic data to calculate the natural flow direction of stormwater runoff throughout a watershed. This process allowed us to divide the Town River Corridor into smaller drainages or sub-watersheds. The model results were adjusted based on the stormwater infrastructure data provided by the Town of Truckee (2017), aerial imagery interpretation, and field verification in select areas where feasible. The flow accumulation analysis is an initial assessment of sub-watershed areas for watershed planning purposes, and should not be used for any other purposes.

The flow accumulation analysis allowed us to generate 54 sub-watersheds and a more accurate Town River Corridor boundary for all water that drains directly to the Truckee River in the Study Area. Tributaries to the Truckee River, such as Trout Creek, Donner Creek, Prosser Creek, and the Little Truckee River, were excluded from the accumulation analysis. Plate 1 shows the resultant sub-watersheds from the flow accumulations analysis. The flow accumulation analysis had two main purposes for the sediment source assessment;

- To evaluate the sub-watersheds for direct connection of stormwater infrastructure to the Truckee River and identify sub-watersheds with limited or unmitigated stormwater runoff; and
- To evaluate the road sand application routes within the Town River Corridor and identify areas of high concentrations of road sand application.

The results of the flow accumulation analysis allowed us to identify priority locations for restoration and/or enhancement projects that would reduce sediment delivery to the Truckee River. Potential restoration sites were identified, in part, based on the results of the flow accumulation analysis and are presented in Section 5.

3.1.1 Stormwater Infrastructure

The Town of Truckee provided the most current mapped GIS stormwater infrastructure information in December 2017 and with the help of the Public Works Maintenance Department, generated a database of stormwater infrastructure that requires regular attention and maintenance. From the flow accumulation analysis and the stormwater infrastructure data, each sub-watershed was qualitatively evaluated for the sub-watershed's stormwater treatment potential. Sub-watersheds in urban areas with no stormwater treatment can generate localized erosion and increase sediment transport.

Stormwater infrastructure that requires regular attention or maintenance were referred to as 'hot spots' and are presented in Plate 2 (top frame). The hot spots are areas with excess sediment or debris loads which causes water to back up and generate flooding problems. The historical downtown area is a main area that requires repeated maintenance with a cluster of storm drain inlets and culverts identified in sub-watersheds 10, 11, and 13. Additional maintenance problems were identified along West River Street in sub-watershed 3.

The storm drain system in the downtown area is historical and elements of the infrastructure are unknown. The downtown was also built during a period when stormwater was considered a nuisance and the design mentality was to remove stormwater from the area as fast as possible. However, we now understand that peak flow attenuation and treatment are all important, so more recent stormwater improvements have focused on slowing down and retaining flows.

For assessment purposes, treatment potential consists of two elements; 1) the presence or absence of stormwater detention basins, and 2) stormwater pipes with a direct connection to the Truckee River. Stormwater basins located within the watershed at locations where stormwater flow naturally accumulates or where pipes have directed flow to the basins is considered to provide appropriate treatment. It was assumed that detention basins are designed, constructed, maintained and are functioning appropriately to meet the required water quality standards. The stormwater pipe direct connection is a qualitative assessment of how efficiently the storm drain or flow path delivers water (and by extension, sediment) to the receiving water body, in this case, the Truckee River. The direct connection of stormwater infrastructure allows for pollutants to be transported to the Truckee River without treatment. A stormwater network of many pipes with direct connection is assumed to provide little or no treatment. Stormwater treatment and detention facilities along I-80 were not mapped in the GIS software but identified through aerial imagery where possible.

The lower frame of Plate 2 shows the sub-watersheds categorized based on their stormwater treatment potential. The sub-watershed's ability to treat stormwater runoff through detention basins and peak flow attenuation, infiltration, and also limit the direct connection of stormwater to the Truckee River. Sub-watersheds that have pipes or ditches that ended significantly upstream from the Truckee River, were assumed to offer other forms of treatment, like infiltration, as a means of stormwater control. The sub-watersheds were separated into categories as follows:

- Natural: Areas with natural drainage patterns that have generally not been affected by development.
- Good: Presence of stormwater detention basins or culverts and drainage channels that do not provide direct connection to the Truckee River.
- Fair: Stormwater detention in some, but not all areas; some areas having stormwater pipe direct connection to the river.
- Limited: sub-watersheds with very little to no stormwater infrastructure; limited stormwater detention basins; direct connections of stormwater infrastructure to the Truckee River.

Table 3-1 shows the sub-basins identified as limited; these areas have the highest treatment potential. These sub-watersheds were further evaluated in terms of restoration potential.

Table 3-1 Town River Corridor Sub-watershed with Unmitigated Stormwater Infrastructure.

Sub-watershed No.	Description	SW Infrastructure Notes
1	East of Donner Creek	Commercial developments along West River Street lack stormwater infrastructure, no detention basins (Figure 3-2 and Figure 3-3)
10	Western portion of downtown	Stormwater is conveyed in storm drain network directly to the Truckee River; limited treatment provided.
13	Eastern portion of downtown	All stormwater is conveyed in storm drain system directly to the Truckee River, limited treatment provided.
14	Residential area along South River Street	No detention for runoff from building or roads. Sub-watershed is directly connected to the Truckee River
17	Drainage along Estates Road and River View Drive	Signs of erosion in channel and no detention basins (Figure 3-4 and Figure 3-5)

Figure 3-2. Sub-Watershed 1: Disturbed Sand Bar on Floodplain from Vehicular Access.

Figure 3-3. Sub-Watershed 1: Sediment Accumulation in Stormwater Culvert.

Figure 3-4. Sub-Watershed 17: Concentrated Stormwater Runoff Leading to Erosion in an Area with No Stormwater BMPs.

Figure 3-5. Sub-Watershed 17: Erosion at Estates Drive Culvert with Limited Downstream Treatment.

3.1.2 ROAD SAND ANALYSIS


Figure 3-6. Example: Road Sand Accumulation.

Traction or road sand can be readily mobilized and delivered to the storm drain system. Figure 3-6 shows an example of road sand accumulation in a street gutter within the Town of Truckee. We analyzed road sand application and recovery data provided by the Town of Truckee and Caltrans to identify road sand routes and quantify the amount of sand applied and not unrecovered in each of the sub-watersheds. This analysis identifies sub-watersheds that have a high potential to deliver excess sediment to the Truckee River.

Town of Truckee road applications routes were provided along with application and recovery rates. Caltrans provided application rates for sections of I-80 and SR 267. We then used a GIS-based analysis to calculate the length of road where traction sand is applied by sub-watershed, so that each sub-watershed could be identified in terms of potentially unrecovered road sand. Based on the information provided and our analysis, roughly 985 tons of sand are applied within the Town River Corridor for winter maintenance and safety operations. Approximately 225 tons was not recovered, and remains within the Corridor for potential delivery to the Truckee River.

The Town of Truckee applies a range of 500 to 1,700 tons of abrasives within the Town of Truckee per year, based on data provided by the Town of Truckee for water years 2013 to 2017. In some years, more sand is recovered than is applied and in other years, more sand is applied than is recovered (Appendix C). Over the 5 years of available data, the Town of Truckee applied approximately 6,000 tons of abrasives, and recovered approximately 5,650 tons, a roughly 94% recovery rate. The Town of Truckee applies road sand to 68.5 miles of roads, which equates to an average annual sand application rate of 17.5 tons per year per mile of road[3]. Based on the Town of Truckee's recovery rates, an average of 1.0 tons of traction sand per year per mile of road is not recovered after it is applied.

[3] For the analysis it was assumed traction sand is evenly applied throughout the routes, and one mile of road includes both lanes of traffic.

Of the roads where the Town of Truckee applies sand, 15.2 miles (22% of the total route) are located within the Town River Corridor. Without more detailed data regarding spatial variability in road sand application rates, we assume that a long-term fine sediment delivery rate of approximately 15.2 tons per year (1.0 tons per mile) is generated from road sand application and non-recovery in the Town River Corridor.

Sub-watersheds with more than 1 mile of road sand route include sub-watershed 6 (the McIver Dairy watershed), sub-watersheds 20 and 55 (both draining Sierra Meadows and Ponderosa Palisades neighborhoods), and sub-watershed 22 (the Olympic Heights neighborhood).

Caltrans (DOT, 2018) provided sand usage data for the section of I-80 from Donner Lake exit to the California Nevada State line and for the section of SR 267 from I-80 to the Place Nevada County line for five years for water years 2013 to 2017. GIS software was used to estimate the associated lane miles along these roads to develop an estimated application rate. Based on the information provided Caltrans applies an annual average of 37.7 tons of sand per lane mile on I-80 and 37.5 tons per lane mile along SR 267. Specific recovery data for these sections of highways is not recorded by Caltrans, so in lieu of site-specific data, the documented Caltrans recovery rate of 71 percent for the Tahoe Hydrologic Unit was applied for the analysis. The analysis indicates that roughly 10.9 tons of sand per lane mile remain on the Interstates and State Routes within the general area for which data were provided.

The GIS analysis indicated that approximately 19.1 lane miles of Caltrans-operated roads are within the Town River Corridor, equating to roughly 720 tons of sands being applied annually. Applying the 71 percent recovery rate indicates that an estimated 210 tons of sand will remain with the Town River Corridor and is available for transport to the Truckee River.

Finally, in order to identify sub-watersheds with higher sand application rates, sand route densities were calculated in GIS and the estimated recovery rate was applied (Table 3-2). Plate 3 identifies the sub-watersheds according to the estimated amount of road sand applied in each watershed area (Plate 3: top frame). Additionally, the quantity of road sand potentially remaining in each sub-watershed was also calculated and is shown graphically in Plate 3 (bottom frame). Based on this analysis, sub-watersheds that include longer sections of Caltrans-maintained roads have higher probabilities of delivering road sand sediment to the Truckee River.

Table 3-2 Sub-watershed Application and Unrecovered Road Sand Analysis Results.

Sub-watershed Id	Sand Applied *(tons)*	Area *(acres)*	Area Density *(tons/acre)*	Sand Remaining *(tons)*
1	4.7	62.0	0.08	0.3
3	1.0	10.2	0.10	0.1
5	0.2	24.3	0.01	0.0
6	189.3	228.7	0.83	48.7
8	2.1	2.7	0.79	0.1
9	3.3	7.0	0.47	0.2
10	8.0	17.6	0.45	0.5
11	2.7	4.2	0.66	0.2
12	4.5	96.1	0.05	0.3
13	19.7	27.6	0.71	2.2
14	1.9	3.7	0.52	0.1
15	2.1	53.3	0.04	0.6
16	0.7	57.3	0.01	0.0
17	3.8	12.0	0.31	0.2
18	5.7	22.8	0.25	0.3
19	2.2	52.3	0.04	0.1
20	39.8	284.0	0.14	3.8
21	16.4	20.2	0.81	4.2
22	37.7	178.2	0.21	2.5
23	6.4	168.9	0.04	0.4
24	1.9	340.3	0.01	0.1
26	25.0	518.9	0.05	1.5
27	0.5	48.1	0.01	0.0
28	3.7	64.4	0.06	0.2
29	4.3	21.1	0.20	0.3
30	1.9	86.1	0.02	0.1
31	19.9	135.5	0.15	1.2
33	9.1	35.1	0.26	2.6
34	138.7	42.1	3.29	40.2
36	55.3	20.1	2.75	16.0
40	6.4	34.5	0.19	1.9
41	42.5	5.7	7.47	12.3
44	38.6	10.0	3.86	11.2
45	26.4	4.9	5.38	7.7
49	21.9	13.3	1.64	6.3
51	47.2	25.4	1.86	13.2
52	5.6	21.2	0.27	0.3
54	106.6	757.1	0.14	21.5

Overall, road sand routes within the Town River Corridor have the potential to contribute an estimated 224 tons per year of sediment to the Truckee River.

Comparing[4] this estimated potential delivery rate (unrecovered road sand tons) to measured suspended-sediment loads presented in Section 2.10.1 (Figure 2-18)shows that the unrecovered road sand may account for between 7 and 14 percent of the total suspended-sediment load in the Truckee River at Boca Bridge. Comparing to the ungaged areas of the study (the Town River Corridor, Little Truckee River, Prosser Creek, and Martis Creek) unrecovered road sand may account for between 23 to 26 percent of the suspended-sediment load delivered to the Truckee River. Obviously, not all the unrecovered road sand is delivered to the river, and not all is transportable as suspended-sediment, so these values represent maximum potential delivery rates from road sand application.

The sediment yield associated with remaining road sand in the Town River Corridor watershed is equal to 26.2 tons per square mile. Figure 3-7 compares this maximum road sand yield to the suspended-sediment yield data measured by Hastings and Shaw (2014) in the Middle Truckee River Watershed. Again, assuming all the road it could be delivered to the river, this would make up a significant portion of the sediment transported in the Truckee River at Boca.

[4] This is not a direct comparison but for a general understanding of sediment quantities. Not all unrecovered road sand will be transportable as suspended-sediment thus the comparison presented is a maximum estimate of loading rates and yields. The percentage of road sand that become suspended-sediment could be investigated in future studies.

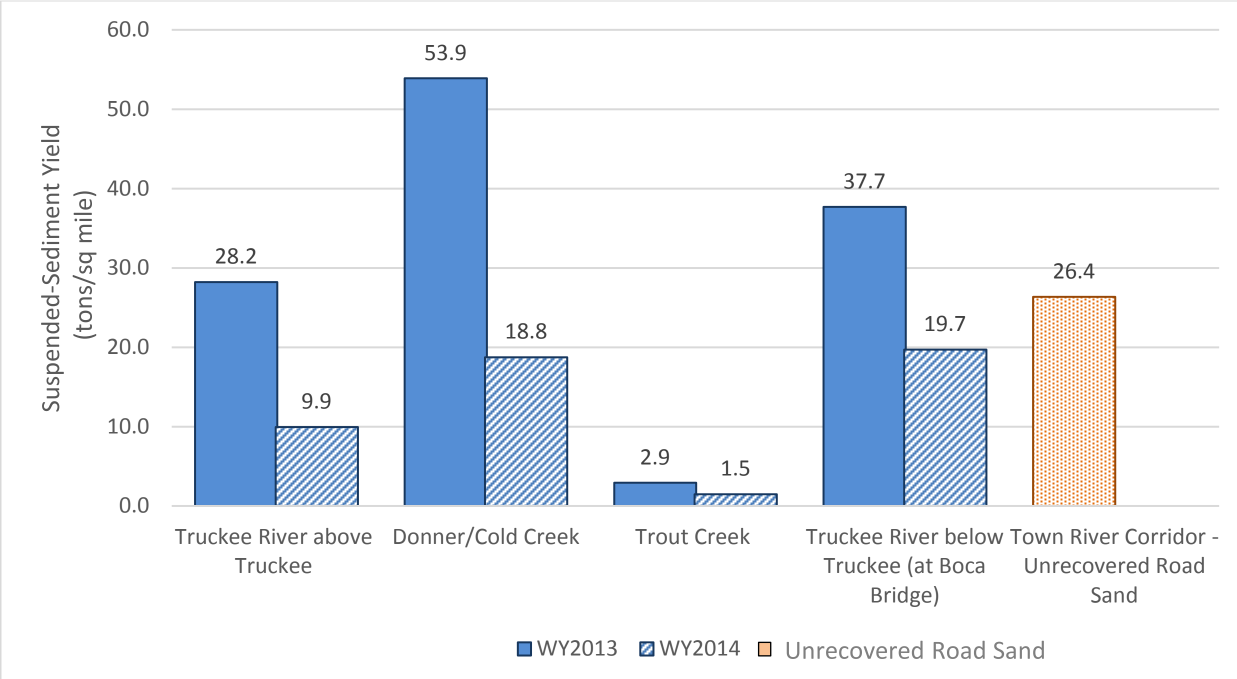

Figure 3-7 Estimated Unrecovered Road Sand as Compared to Measures Suspended-Sediment Yield in the Truckee River. For general comparison purposes only, not all unrecovered road sand will be transported as suspended-sediment to the Truckee River.

3.2 Historical Features Impacts

Historical features have the potential to increase sediment delivery, as historical land use can alter natural drainage patterns and reduce floodplain function. Equilibration is often a natural process the river undergoes after experiencing a dramatic shift. The shift could be natural episodic event, like a landside, or anthropogenic, like a dam. The ability for an ecosystem to equilibrate is not yet fully understood, but factors such as geology and flow regime are believed to play a role. The historical features described above were investigated as part of this assessment to evaluate the degree to which the Truckee River is equilibrating following extensive disturbance, or if some historical sites remain unstable and as significant sediment sources.

As described by McGraw and others (2001), areas closer to the river have a greater effect on sediment concentrations in the river, so this assessment focused on historical features near the Truckee River. The historical features assessment was conducted with help from Dr. Susan Lindstrom, Consulting Archaeologist. Plate 4 provides a map of the Town River Corridor and the location of major historical sites along the river. Dr.

Lindstrom's full report on historical context and features in the project area can be found in Appendix B.

The Truckee River was a focal point of development in the region and historical urban land-uses were concentrated along the river. As a result, much of the historical floodplain and sections of channel were subject to alteration or fill. Figure 3-8 shows a photographic comparison of condition of the Tacoma Smelter Plant in the 1870s, compared with the same location today. In both photographs, and based on field investigations, it appears that the property was developed by filling the floodplain to the water's edge. The Tacoma Smelter Plant is but one of many locations along the Truckee River where fill placement on the floodplain has been observed. The photo comparison and field evidence indicate that the floodplain was filled but that the bank appears to be stable under current conditions. Therefore, this site is not considered to be an active source of sediment.

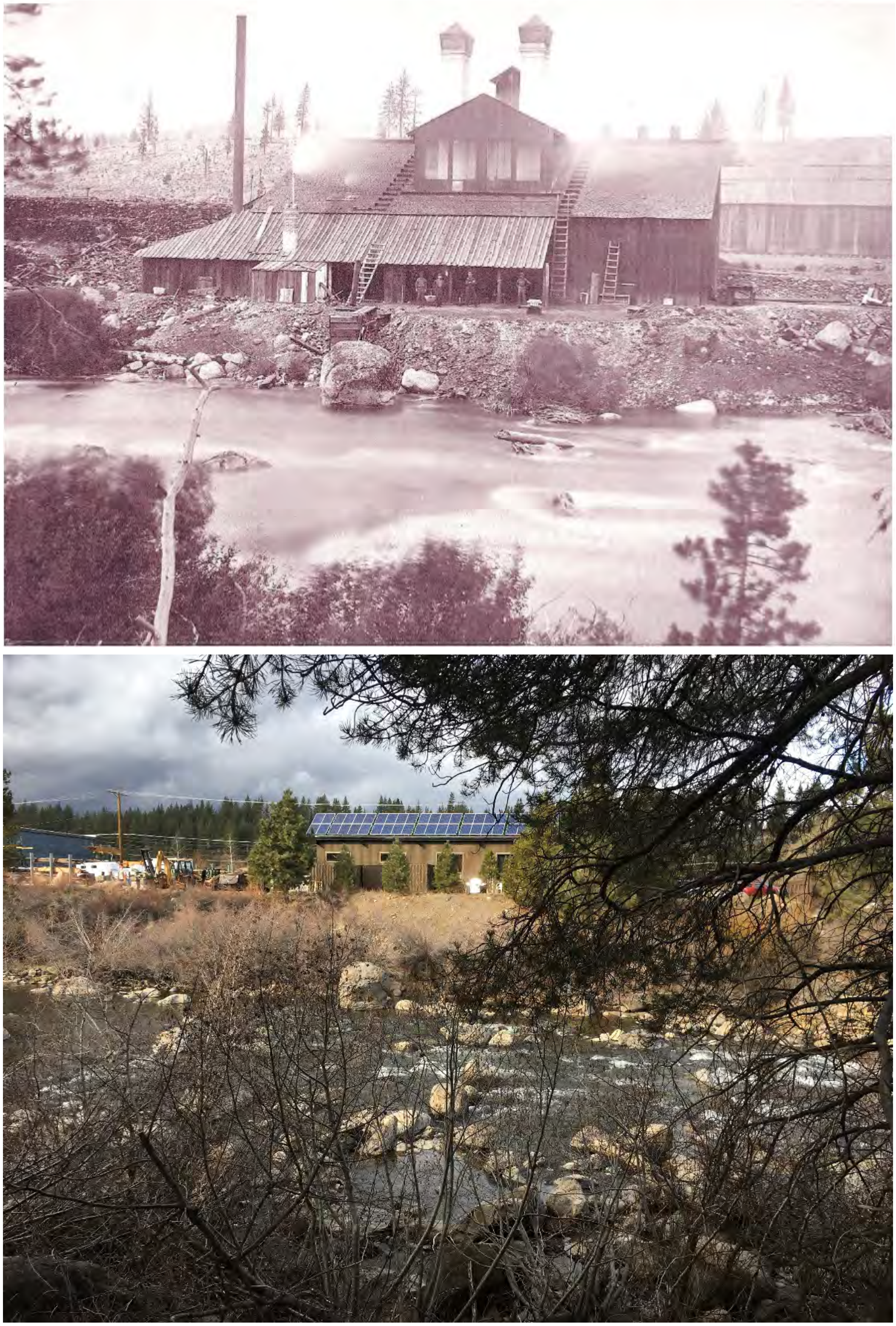

Figure 3-8 Comparison of Conditions Along the Truckee River. Top- Tocoma Smelter (1872 -1875). Bottom: Historical Site (2018).

The Tacoma Smelter Plant is a good example of conditions observed along the Truckee River Town Corridor. Plate 5 shows comparison of historical aerial photography from 1939, 1972 and 2017. The majority of the historical sites appear to be stable and are not active sources of sediment. However, extensive fill has been placed along the Truckee River. The fill has resulted in a loss of floodplain, which affects the natural sedimentation process with in the river.

A number of locations have been documented, however, where the historical land use or features have adversely affected the Truckee River and may be an active source of sediment. Five areas are presented below:

1. The large left-bank bar and floodplain deposits associated with the mouth of Donner Creek appears to have been channelized prior to 1939, with extensive disturbance also visible on the 1972 aerial photograph. Stormwater from this area flows untreated into the Truckee River.
2. The Legacy Trail Bridge Parking Area and portions of East River Street appear to have been built on fill that was placed in the Truckee River Floodplain.
3. Bank erosion is present on the dog-leg channel bend downstream from the former Tahoe Ice Company Site. 1939 aerial photography shows this area to have been widely disturbed, with diversion works for ice harvesting operations.
4. The Tahoe Ice Company Dam Site has bank erosion on the right bank, loss of floodplain from the dike and reduction in habitat upstream along the riverbank and within the location of the ice pond.
5. The CDFW River Bend (aka Horner's Corner or the Loop) includes an historical rail spur associated with the Nevada Ice Company, which was constructed immediately adjacent to the river channel. The railroad grade appears to have constricted the channel downstream of the present day I-80 bridge. In-channel physical habitat and structure are limited at this location and floodplain functions have been limited by the constriction.

Historical aerial photographs were used to compare conditions at these sites over time, as shown in Plate 6 and Plate 7.

The Donner Creek Confluence area has seen a restriction from the historical railroad crossing and now the West River Street bridge (Plate 6: Left), though most of the impacts appear to have taken place prior to 1937, when the earliest aerial photographs were taken. West River Street was constructed immediately adjacent to the Truckee River and appears to have constricted the floodplain in areas near the Donner Creek mouth. The site is currently affected by vehicular access, generating bare spots and compacted soils. Field observations during a November 2017 storm included significant runoff from the road, with direct and untreated connectivity to the Truckee River channel (Figure 3-9).

Figure 3-9 Donner Creek Confluence. Left: Compacted Soils Along Floodplain. Right: Stormwater Runoff from a November 2017 storm.

The Legacy Trail Bridge and Parking area (Plate 6: right) is part of the historical Trout Creek alluvial fan. Since the construction of the Transcontinental Railroad, Trout Creek has been confined to a channel and single discharge point, and significant earthmoving throughout the railyard and along East River Street have resulted in a loss of alluvial fan habitat and floodplain functions along the Truckee River. On the left (north) bank of the Truckee River, up to 15 feet of fill appears to have been placed on the floodplain, though detailed investigations or excavation would be required to establish the extent and depths of fill. Historical land uses in this area include the Tacoma Smelter Plant (Figure 3-8) until 1875 and then the Truckee Electric Company until around 1888. The aerial image from 1939 shows a wide-open area with limited vegetation, interpreted as placed and compacted fill over the historical Trout Creek Alluvial fan (Plate 6: right). (Figure 3-10) Most recently, the improvement and extension of East River Street increased and expanded parking areas for the Legacy Trailhead, creating additional impervious surfaces, there appears to be a small swale or detention basin to treat stormwater runoff in this area, however it appears that stormwater still flows directly toward the river.

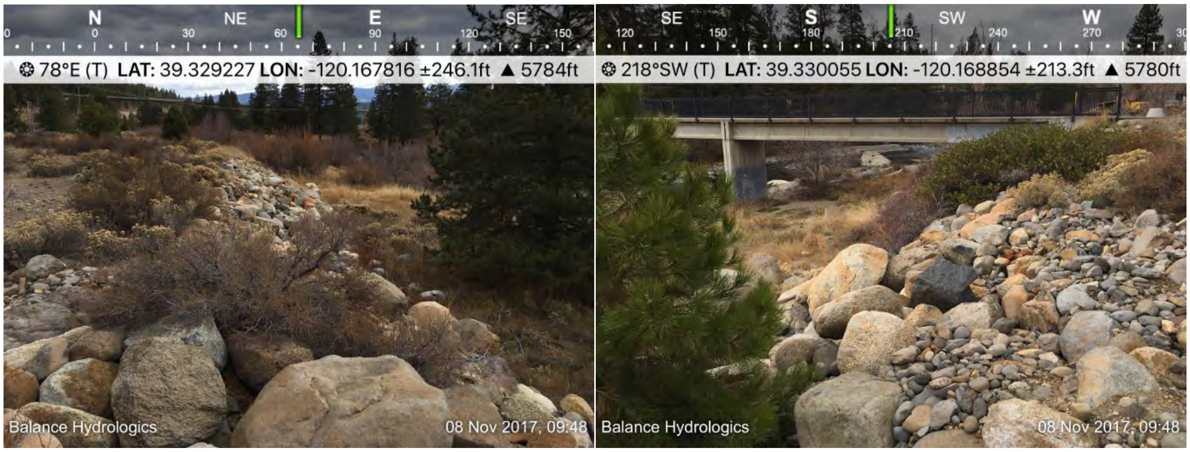

Figure 3-10 Fill Slope at Legacy Trail Bridge and Parking Area.

Plate 7 shows where the Tahoe Ice Company installed a dam across the Truckee River which backed up the flows and caused water to overflow into a shallow pond where it would then freeze and the ice would be harvested (Figure 3-11). The figure shows the exposed left bank with erosion; however, based on the topography of the area this appears to be a naturally steep bank. The aerial photo from 1939 (Plate 7: left) shows the extents of the ice pond by the barren land, which may have been altered from pre-existing floodplain areas. Upstream of the dam site, the river channel is relatively wide and shallow, with little in the way of physical habitat and structure, as is typical for aggraded areas upstream of diversion dams.

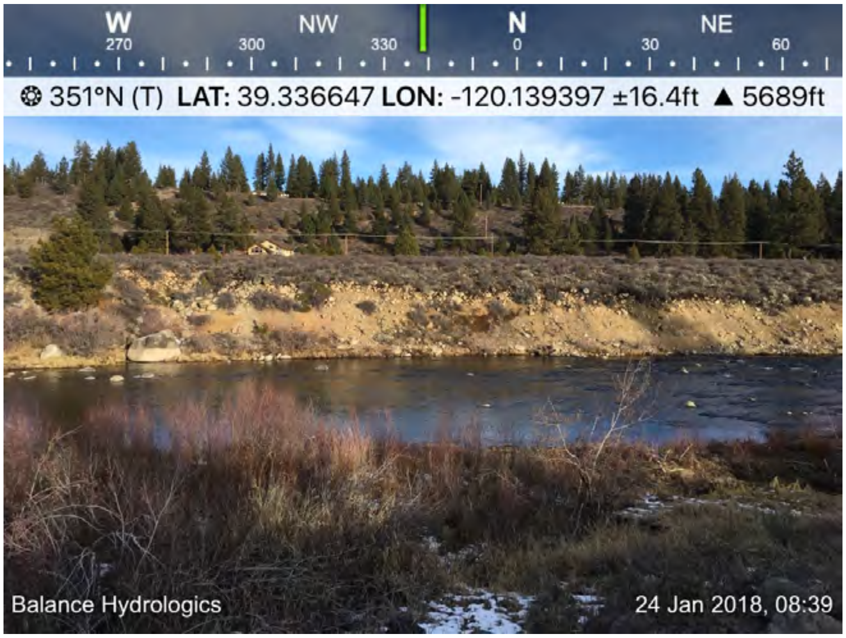

Figure 3-11 Tahoe Ice Company Historical Dam Site Impacts.

The CDFW River Bend site (Plate 7: right) is the historical location of Pacific Shingles Co. (ca. 1874), the Nevada Ice Company (1872-1875) and Camp 16 Pacific, a station on the Central Pacific railroad (ca. 1868) (See Plate 4: Historic Sites). Although the historical elements identified above are not visible in the 1939 aerial image, field observations and mapping completed by Shaw and Donaldson (2011) noted a steep bank and berm where the rail grade was once located (Plate 7: right). The historical land use appears to have straightened the river leading up to the bend, which has increased velocities and shear stresses enacted upon the outer edge of the bend as the river makes the turn to the left. The outside bank is steep and shows signs of erosion. Although, this area of erosion appears natural, we believe the rate of erosion has been increased due to the historical features.

Habitat in the CDFW River Bend reach is also limited, and we understand that construction of in-channel boulder structures is planned by Trout Unlimited to enhance fish habitat in this area (D. Lass, personal communication).

3.3 Effects of Floods

Sediment sources within the Town River Corridor may be exacerbated by floods. Balance geomorphologists examined historical aerial photographs that bracket years with moderate to large flood events (e.g., 1997, 2006, 2017) to identify mass wasting erosion or visual changes in bank stability, channel morphology and planform that might have resulted from a flood. We also conducted a reconnaissance of the Truckee River after the multiple moderate floods of 2017 to examine possible fresh sediment sources relative to high-water marks (i.e., lines of sediment or debris along the channel marking the highest flood stage). We found that the Truckee River through the Town Corridor, under current climate and vegetation conditions, did not exhibit visual changes such as bank failures, landslides, channel bed scour during the 2017 floods, and limited evidence exists of significant bank erosion from floods in previous years. Our observations during the flood events in 2017 and early season high flows in November 2017 indicate that sediment sources to the mainstem Truckee River from within the project area originate primarily from stormwater runoff and erosion hotspots both inside and outside the Town River Corridor, including tributary watersheds.

A largely immobile bed in a watershed with insufficient climate and flow conditions to alter the channel results in a generally stable system. The stable system is also inferred because the post-flood observations did not appear to generate new areas of erosion or sediment release.

Within the corridor, extreme floods are important for flushing fine sediment from spawning gravels and scouring pool habitat. Furthermore, 2017 flood flows inferred by high-water marks indicate that floodplains which are currently impacted by fill placement, could serve as important sediment sequestration and ecological functions if restored.

3.4 Suspended-sediment Effective Discharge

Effective discharge is defined by Wolman and Miller (1960) as the streamflow that transports the most sediment over time. Bedload or total sediment effective discharge is often also interpreted as the streamflow that maintains the channel form and drives geomorphic and ecological processes. Once a natural flow regime is modified by dams or watershed processes are altered by urbanization, the effective discharge may be changed and channel condition, ecological integrity, and water quality may be affected.

Sediment transport in mountain rivers includes both bedload (gravels, cobbles and coarse sand) and suspended load (fines, silts, clays). The Truckee River through the Town River Corridor is dominantly a suspended-sediment transport system; however, limited data are available to estimate the percent of the total load comprised by suspended-sediment. Herbst (2013) found that more than 50 percent of sampling sites in the Truckee River, downstream from Truckee, had greater than 80 percent fine sediment coverage. Shaw and Donaldson (2011) and Kulchawik and others (2014) observed limited movement of coarse bed material in years with average annual floods, but found that fine sediment cover on the river bed changed by orders of magnitude from one year to another. These observations and findings suggest that the Truckee River is predominantly a fine-sediment transport system under the existing flow regime.

We examined the effective discharge of the Truckee River using recently-collected data to better understand current channel conditions as they relate to fine sediment. Near-continuous turbidity monitoring on the Truckee River at USGS gaging stations upstream and downstream of the Town River Corridor in water years 2013, 2014, 2015, and 2016 allowed for computation of suspended-sediment loads during dry and average year types and over a range of streamflow (CDM Smith and Balance Hydrologics, 2017). Using guidance from Biedenharn and others (2000), we estimated a range of effective discharges by extrapolating the suspended sediment rating curve to longer-term flow rates at two USGS gaging stations on the Truckee River. Peak daily streamflow was used from the last 19 years (as presented in Figure 2-8) of record to better characterize sediment transport conditions as measured during the 4-year study (WY2013-WY2016). Results for the two gaging stations are shown in Table 3-3.

Table 3-3 Estimated Range of Effective Discharge for Two Locations on the Truckee River, near Truckee, California.

USGS Gaging Station	Gaging Location	Recorded Peak Flow for Period of Record Used in this Analysis	Effective Discharge Range		Suspended Sediment Load Range	
		cfs	*cfs*	*cfs*	*tons/day*	*tons/day*
10348000	Truckee River near Truckee	3,830	2,760	2,910	930	4,760
10344505	Truckee River at Boca Bridge	6,400	4,325	4,835	1,422	8,760

Upstream of the Town River Corridor, effective discharge was estimated to range between 2,800 cfs and 2,900 cfs, with a recurrence probability between 5 and 6 years. Downstream of the Truckee River Corridor, effective discharge was estimated to range between 4,300 cfs and 4,800 cfs, with a recurrence probability of between 7 and 10 years. This suggests that flushing flows within the corridor may only occur once or twice in a decade. Truckee River operations under TROA may offer some flexibility in increasing the frequency of flushing flows in this range, but a detailed analysis of this opportunity is beyond the scope of this assessment.

3.5 Truckee River Access Points

The Truckee River is a focal point of the Town of Truckee and the community strives to make better use of the lands and resources along the river (Winter and Company, 2005). Generating or improving public access to the river would facilitate increased utilization of the river as a community focal point. As part of this assessment, river access sites were evaluated to highlight areas where restoration improvements and public access could coincide. For this assessment, the analyzed river access sites were limited to public lands. However, several sites located along West River Street and South River Street have been noted to have public access potential, but are on private lands and are therefore not addressed in this assessment.

Balance staff worked with a Dudek landscape architect to review the Town of Truckee River Revitalization Strategy and Truckee Trails and Bikeways Master Plan and carry out a field-based assessment of potential river access locations. From this work and local knowledge of the area, we generated a list of 8 river access sites and two potential bridge locations. The locations are shown in Plate 8 and numbered upstream to downstream, B for Bridge and RA for River Access. The sites are briefly described in , indicating the River Access site number, a brief description of the site, the river bank location, left, right or both (looking downstream with the flow of water) and how the site the was identified.

Table 3-4 Truckee River Access and Bridge Sites Identified within the Town River Corridor.

No.	Description	River Side	Source
B-1*	Potential pedestrian bridge crossing location at County line.	Across	1
RA-1	Existing informal river access location by the mouth of Donner Creek	Left	2
B-2	Potential pedestrian bridge crossing at the Central River Village (Old County Corp Yard)	Across	1, 2
RA-2	Truckee River Regional Park, riverside parking lot	Right	3
RA-3	Legacy trail bridge parking and access area on East River Street	Left	2
RA-4	Intersection of Legacy Trail and Martis Creek confluence with Truckee River	Right	3
RA-5	Glenshire bridge access area	Right	3
RA-6	South of I-80 and upstream of the Prosser Creek confluence	Right	3
RA-7	Between two I-80 bridges as the river bends back north; "The Loop"	Left	3
RA-8	Historical Boca Bridge	Both	3

*Outside project boundary, site identified but not assessed

Source Key:
1 Truckee Trails & Bikeways Master Plan, 2015
2 Downtown River Revitalization Strategy, 2005
3 Identified as part of this study

Balance and Dudek staff conducted a reconnaissance of Truckee River access sites on November 8, 2017, with the exception of sites RA-6 and RA-7. The main findings are provided below and a complete summary developed by Dudek can be found in Appendix D. The objective of the river access site reconnaissance was to provide qualitative observations and input on the sites which could be used in the final evaluation and selection of restoration projects within the Town River Corridor. Each site was considered for its opportunities and constraints to access, potential access benefits, and linkages to other recreational trails or facilities.

In assessing public access and recreation at a reconnaissance level, sites RA-1 and RA-3 offer the highest potential benefits for implementing public access improvements linked with restoration; these sites provide the best overall value for public access and recreation, with minimal site constraints and high associated restoration potential. Several sites appear to provide moderate benefits with fair feasibility for public access and recreation improvements, including Bridge 2, RA-2, RA-5, and RA-8. The remaining restoration sites (RA-4 and RA-7) offer medium benefits, but have limited opportunities for public access and recreation improvements.

All of the river access sites provide opportunities for interpretative and educational signage. Interpretative themes can include natural resources, cultural resources and land use. All the sites can benefit from the addition of directional and safety signage, dog stations (except RA-2, and RA-3 where dog stations exist), and trash cans (except RA-2 and RA-4 where they already exist). All sites, except RA-5, have utilities along the Truckee River that are considered a constraint to extensive public access improvements.

4 CONCLUSIONS

The Truckee River is an iconic and a defining element of the community and attracts visitors to the area. Being able to utilize and restore the Truckee River to the fullest extent possible is a main objective for the community. The Truckee River is therefore recognized by town leaders, planners, regulators and the public as a resource that should be preserved and enhanced.

The Truckee River corridor has been a focus of previous investigations, monitoring and improvement projects to address its 303(d) listing as an impaired water body for suspended sediment concentration (SSC). The Lahontan Regional Water Quality Control Board has adopted a TMDL, which includes indirect indicators such as implementation of best management practices and restoration. The town of Truckee Stormwater Management Plan (SWMP) and Truckee River Water Quality Monitoring Plan (TRWQMP) were developed to maintain compliance with the Town's Phase II MS4 General Permit. Our objective was to identify and address areas where legacy site restoration and BMP implementation can lead to meaningful reductions in Truckee River suspended sediment concentrations.

Sediment movement is a natural process but human impacts have generated excessive sediment loads to the river. Excessive sediment has been shown to have a negative effect on riparian habitat and aquatic life. The natural and human impact can be summarized in terms of river system stability, the impact of flow regulation, the historical impacts, urbanization impacts, and restoration and river access opportunities.

4.1 Stable System Impacts

The geology and geomorphology of this system is unique. Glacial outburst flooding has left behind a largely immobile and static bed in a watershed with insufficient climate and flow conditions to alter the channel. As a result, the Truckee River forms a primarily straight channel through the Town River Corridor in a form that was created roughly 20,000 years ago, with very limited or no active channel migration or meandering occurring since that time.

The majority of soils within the Town River Corridor have a low erosion hazard, further contributing to a fundamentally stable river system. Low erosion hazard soils are unlikely to become significant sediment sources to the Truckee River.

Sediment sources to the Truckee River originate primarily from stormwater runoff and erosion hotspots both inside and outside the Town River Corridor, including tributaries watersheds upstream of the corridor to the Lake Tahoe outlet.

4.2 Impacts from Flow Regulation

Flow regulation along the Truckee River has a significant impact on the natural flow regime and suspended-sediment transport. Excessive sediment overwhelms the capacity of a river to transport and damages its biological components. Extreme floods are important for flushing fine sediment to help create healthy spawning gravels and high flow scouring out pools for fish habitat. Large flow events are needed to provide effective discharge to flush the fine sediments from the system. Historically, the extreme flood flows have been from large rain on snow events.

Upstream of the Town River Corridor, effective discharge was estimated to range between 2,800 and 2,900 cfs, with a recurrence probability between 5 and 6 years. Downstream of the Truckee River Corridor, effective discharge was estimated to range between 4,300 and 4,800 cfs, with a recurrence probability of between 7 and 10 years. This suggests that flushing flows within the corridor may only occur only once or twice in a decade.

Streamflow in the Truckee River is regulated by major dams or impoundments from Lake Tahoe, Donner Creek, Martis Creek, Prosser Creek, and the Little Truckee River. Dam construction and regulation of flows have fundamentally altered the hydrology of this system. Prior to dam construction, peak flows were likely higher, and low-flows were likely much lower. Changes to this flow regime is among the chief impacts to native fish habitat in the system. With lower peak flows and relatively infrequent flushing flows, chronic delivery of sediment to the Truckee River has caused physical habitat to become impaired.

4.3 Historical Impacts

The history of this area plays pivotal role in defining the Town of Truckee's character, along with the character of the Truckee River. Since the 1800's, the Town River Corridor has experienced physical and ecological impacts, in part due to anthropogenic disturbances associated with logging, ice harvest, dairy and cattle ranching, recreation, modern transportation, and land and community development. Much of the historical floodplain and sections of channel were subject to alteration or fill. Historical features in the Town River Corridor add potential for increased sediment delivery as the associated disturbance has altered natural drainage patterns and floodplain functions.

Many historical sites appear to be stable and are not active sources of sediment. Extensive fill, however, has been placed along the Truckee River, apparently from historical land development. The fill has resulted in a loss of floodplain functions affecting the natural sedimentation process within the river.

4.4 Urbanization Impacts

Urbanization along the Town River Corridor has had a significant impact to water quality. The increase in population and associated urban and suburban development has altered drainage patterns, increased impervious surfaces, and generated a need for urban stormwater management as part of routine road maintenance and snow removal.

Transportation, roads and railways, and construction can require massive earthwork which results in modification of flow patterns. The construction of I-80 and the railroad were significant transportation elements within the Town River Corridor that have affected the natural drainage of tributaries and directed runoff to the Truckee River. The McIver Dairy drainage is among the most impacted sub-watersheds.

The transcontinental railroad is positioned parallel the river. The railroad has required major earth movement and grading to establish a steady grade through the Corridor. Cut and fill on hillsides provides chronic sediment supply to the Truckee River where constructed slopes are unstable. Future studies should be conducted to examine railroad grade and embankment contributions to excessive sediment loads in the Truckee River.

High-elevation road safety plays an important factor. Winter maintenance and safety measures include the application of road sands for improved traction. Based on the analysis conducted, roughly 224 tons of road and annually is left unrecovered within the Town River Corridor. Additional research is required to refine this analysis to estimate the portion of the road sand that is available for transport as suspended sediment. Additional studies could include sub-watershed and tributary sampling and gaging to calculate loading rates from road surfaces.

Road sand can be reduced through street sweeping or substituting deicing approaches. Road sand and other pollutants can also be captured though improvements to the stormwater infrastructure, including detention basins for sedimentation and collection areas. Additionally, direct connections from the storm drain system to the Truckee River could be disconnected to distribute flows, decrease velocities, and provide sediment deposition opportunities. The direct connection of stormwater infrastructure is exacerbated in areas with limited treatment of stormwater runoff. Room for improvement to stormwater infrastructure was identified in the downtown area and several other sub-watersheds. Additional studies could be completed to assess the effectiveness of the Caltrans-related stormwater BMPs.

4.5 Restoration and Access

There is a need to balance environmental restoration with restoration and preservation of historical features, urbanization and public access. Improved river access has the potential to reduce erosion and sediment transport, raise awareness, and generate a connection between people and the river to help maintain and preserve the natural quality and function. If river access is done incorrectly, however, erosion potential could increase. A challenge for restoration planning will be to establish areas where restoration will provide improvements, maintain historically significant areas, limit erosion and sediment transport, and blend with the Town of Truckee's General Plan.

Potential projects where historical interpretation, education, and public access can be achieved in concert with restoration of ecological functions should be prioritized. Restoration priorities in areas where natural recovery is taking place after historical disturbance should be lower than areas that are still responding to or impaired from historical disturbance. Similarly, restoration actions that will disrupt existing land uses or regional and national transportation infrastructure are not likely to be a priority.

Based on the results of the assessment, several potential restoration projects have been identified (see Section 5). Restoration sites were focused on reducing sediment loads to the Truckee River. Unofficial public access locations have generated localized instability and increased erosion, and provide opportunities for improvement. Similarly, improving the quality of existing and proposed public access locations can reduce erosion and sediment transport to the Truckee River.

Based on the assessment findings, we have identified 13 potential restoration areas that if designed and implemented would reduce sediment loads to the Truckee River. The restoration sites are generally close to the River as these are expected to have the highest potential for sediment reduction. The restoration objectives include: recovering floodplain function, reducing concentration of stormwater runoff and improving river access. These potential restoration sites can be used in concert with other planning efforts being carried out in the corridor so that water quality improvements can be achieved as Truckee continues to grow.

Future restoration projects not identified here could potentially focus on stabilizing eroding slopes along the river associated with the railroad and I-80 corridors.

5 RESTORATION RECOMMENDATIONS

From the Sediment Source Inventory presented in Section 3, a final list (Table 5-1) and map (Plate 9) of potential restoration projects and management actions were developed. A total of 13 potential restoration (PR) projects were identified through this assessment and are numbered upstream to downstream through the Study Area. Project rankings are based on the absence, presence, and severity of a range of potential functional uplift, which include:

- Stormwater Infrastructure Improvement: The project's ability to improve stormwater infrastructure to reduce velocities, increase infiltration and reduce sediment loads (including road sand) to the Truckee River.
- Historical Impact Recovery: The potential for the restoration project to offset and recover from negative historical impacts and/or provide access and interpretive opportunities.
- Improve Floodplain Function: The potential for the restoration project to improve floodplain and waterbody functions to offset fine sediment impacts to the Truckee River through sediment sequestration or deposition.
- River Access Improvements: The project's ability to improve river access and public use.

Each site was ranked as low, medium, or high, relative to how well the site meets the criteria. The final list and ranking of potential restoration sites is presented in Table 5-1.

Below is brief description of the restoration concepts that could be applied at each of the potential restoration sites. Three of the site were selected for additional project sheets to provide more detailed information for those select project (Appendix E). Each site would require additional investigation, topographic survey, and design advancement to evaluate feasibility, detailed design elements, and estimated costs. The restoration concepts presented are based on limited research under this assessment and select field observations and should therefore be used as a preliminary evaluation of potential restoration opportunities.

Table 5-1 Potential Restoration Project Locations and Improvement Rankings.

No.	Description	River Bank	SW Infrastructure Improvement	Historical Impact Recovery	Improve Floodplain and Waterbody Function	River Access Improvements
PR-1	Existing informal river access location by the mouth of Donner Creek	Left	Full star	Half star	Full star	Full star
PR-2	Triangular corner of private property between West River Street and the Truckee River	Left	Half star	Half star	Full star	Full star
PR-3	Potential pedestrian bridge crossing by the west end of Riverside Drive	Left	Half star	Full star	Full star	Full star
PR-4	Truckee River Regional Park, riverside parking lot	Right	Half star	Empty star	Half star	Empty star
PR-5	Sub-watershed drainage point of discharge along Estates and River View Drive.	Right	Full star	Empty star	Half star	Empty star
PR-6	Legacy trail bridge parking and access area on East River Street	Left	Full star	Half star	Full star	Full star
PR-7	Bank erosion upstream of Tahoe Ice Company historical dam site	Left	Half star	Full star	Half star	Empty star
PR-8a	Glenshire Drive informal parking areas on private property adjacent to railroad tracks	Left	Full star	Half star	Empty star	Empty star
PR-8b	Glenshire Drive informal parking areas on private property adjacent to railroad tracks	Left	Half star	Half star	Empty star	Empty star
PR-8c	Glenshire Drive informal parking areas on private property adjacent to railroad tracks	Left	Full star	Half star	Empty star	Empty star
PR-9	Polaris Fault wetland on private property along Glenshire Drive	Left	Full star	Half star	Half star	Empty star
PR-10	Runoff from west portion of Glenshire along private property	Right	Half star	Empty star	Empty star	Empty star
PR-11	I-80 bridge stormwater erosion downstream of Prosser Reservoir	Right	Half star	Half star	Empty star	Half star
PR-12	CDFW river bend with access parking between I-80 bridges downstream of Prosser Reservoir ("The Loop")	Left	Half star	Full star	Full star	Half star
PR-13	I-80 runoff and drainage channel upstream of Boca	Right	Half star	Empty star	Half star	Empty star

Notes:

Full star means site is good canidate for meeting restoration element.

Empty star means site does not have restoration element.

1) River Bank as looking downstream with the direction of flow.
2) All sited as evaluated in fall of 2017.

PR-1: Truckee River at the Donner Creek Mouth

The Truckee River at the Donner Creek Mouth site is located along the Truckee River at the downstream (northeast) bank of where Donner Creek enters into the Truckee River. The site is owned by the Town of Truckee and the CDFW. The site has historical elements of the old rail road bridge cross Donner Creek as shown in the historical images (Plate 6). The site is currently an unimproved public access area with vehicular access possible directly onto the left bank bar.

Potential restoration concepts would include re-establishment of floodplain vegetation, installation of stormwater BMPs, and improved river access elements. The floodplain would be enhanced to promote sediment deposition. Stormwater BMPs may include sediment basins and bioswales at culvert outfalls. Drainage from private parcels on the north side of West River Street could be addressed as part of this project. Public access elements could include parking zones at the site, with a dedicated boat launching location, consistent with the Downtown River Revitalization Strategy (2005). Limiting parking and controlling vehicular flow would reduce sediment generation at the site. Making this area a formal public access area could also help to keep the site free of dumped trash.

This site was selected for a project sheet to provide additional information and a stand along document. The project sheet can be found in Appendix E.

Figure 5-1 Donner Creek Mouth Potential Restoration Boundary.

Figure 5-2 Donner Creek Confluence Site Existing Conditions. Top-left: Trash on river bank. Top-right: sediment build up at culvert. Bottom-left. vehicular path generates secondary flow path. Bottom-right: compacted vehicular access road.

PR-2: West River Street and Truckee River Triangle

The West River Street site is located adjacent to West River Street and the Truckee River roughly 0.3 miles downstream from Donner Creek. The site receives storm drain discharge from West River Street and is located on private property.

Potential restoration elements on this portion of private property would require landowner cooperation and could help to reduce sediment transport to the Truckee River. Improvements would include stormwater infrastructure BMPs to trap sediment before reaching the Truckee River. The site also appears to include fill placement on the floodplain, so fill removal could re-establish the floodplain and associated habitat and sediment deposition functions. The site could provide a pocket park with river access as identified in the Downtown River Revitalization Strategy (2005).

Figure 5-3 Donner Creek Confluence Site Existing Conditions. Left: Sediment basin at base of stormwater culvert at filled with road sand. Right: Runoff leaving basin and picking up sediment through parking area.

PR-3: Riverside Drive Bridge Crossing (Old Corp Yard)

The Riverside Drive Bridge Crossing is a potential location for a pedestrian bridge crossing identified as part of the Downtown River Revitalization Strategy. A crossing at this location would provide access to open space and the proposed Legacy Trail on the south side of the Truckee River. The site is along West River Street west of Riverside Drive and at the former Nevada County Corp Yard. The site is flat and appears to consist of placed fill, roughly 20 to 30 feet up from the river on a steep (approximately 1:1 slope) bank.

Potential restoration concepts would include removal of fill to re-establish the floodplain and associated habitat and sediment deposition functions. Restoration of the site could provide opportunities for historical interpretation of the historical riverside structure. Restoration of the site could be completed as part of the bridge project.

Figure 5-4 Riverside Drive Bridge Crossing Site Existing Conditions. Left: Historical building that could be preserved. Top-right: River access location. Bottom-right: Fill at river left bank, area of the old corps yard.PR-4: Truckee River Regional Park Riverside Parking Area

The Riverside Parking Area is located in the lower portion of the Truckee River Regional Park for access to the riverside picnic areas. The site is accessible to the public seasonally and under the jurisdiction of the Truckee-Donner Recreation and Parks District.

Potential restoration concepts would include improvements to the existing dirt parking area within the Truckee River Regional Park, with improved parking drainage and treatment of runoff from compacted surfaces. Informal access to the Truckee River is currently available at this location, but could be formalized by trails and designated river access points.

Figure 5-5 Truckee River Regional Park Riverside Parking Area Existing Conditions. Top-left: road material leaving parking area and towards slope above Truckee River. Top-right: Bank erosion along river access points. Bottom: Entrance to parking area along legacy trail.

PR-5: Estates Drive and River View Drive Sub-watershed

The Estates and River View Drive site is located on the south side of the Truckee River, along the intersections of Estates and River View Dive. The sub-watershed is a small watershed that drains the westerly portions of Estates Drive and River View Drive to the Truckee River. Currently, stormwater is collected in a road side ditch along River View Drive and conveyed to the corner of the Truckee River Regional Park, where it is conveyed directly to the Truckee River

Potential restoration concepts would include improvements to the existing stormwater infrastructure to reduce urban runoff and erosion and reduce direct sediment and water delivery to the Truckee River. Installation of BMPs such as step pools, bioswales or infiltration trenches would help encourage infiltration and reduce runoff velocities that generate erosion. The lower portion of the site should be evaluated for potential restoration of a wet meadow habitat, and could further provide stormwater infiltration and treatment opportunities. A portion of the sub-watershed is located on private property and coordination with the landowner will be needed to fully implement restoration and stormwater improvements.

Figure 5-6 Estates and River View Drive Sub-watershed Boundary.

Figure 5-7 Estates and River View Drive Existing Stormwater Drainage Conditions. Top-left: Erosion along Estates Drive into culvert. Top-right: Erosion and path channelization at drain pipe inlet. Bottom-left: Stormwater draining and channelizing at the lower portion of Truckee River Regional Park, by the disk golf course. Bottom-right: Erosion and sediment from stormwater flows heading towards Truckee River.

PR-6: Legacy Trail Bridge Area

The Legacy Trail Bridge is a pedestrian bridge located at the end of East River Street and connects the north side of the Truckee River to the Legacy Trail on the south side of the river at the base of the Truckee River Regional Park. The parking and bridge area is located between the railroad and the river, upstream from the Trout Creek confluence. The land is owned by the Truckee Sanitation District.

Parking for this popular area could be modified and existing informal river access trails could be improved to reduce erosion. Further investigations are warranted to evaluate the extent of fill on the floodplain, and would provide guidance for fill removal and re-establishment of floodplain habitat and sediment sequestration functions. River access concepts could include improved trails, boat launch ramp and/or stable river access landings.

Figure 5-8 Legacy Trail Bridge Existing Site Conditions. Top-left: Fill and vegetation stripping near bridge. Top-right: Erosion from makeshift public access trail. Bottom-left: Existing stormwater detention basin. Bottom-right: Fill material.

PR-7: Tahoe Ice Company Historical Dam Site

The Tahoe Ice Company Dam site is located directly on the Truckee River, downstream of the SR 267 bridge crossing and upstream from the Tahoe-Truckee Sanitation Agency (T-TSA) wastewater treatment facility. The Tahoe Ice Company was in operation at this location from 1886 to 1919 with a dam and diversion works to direct flows into a shallow ponding area for ice harvesting. The dam disrupted riparian vegetation, altered flow paths and limited floodplain area. Several sections along the left river bank are unstable, due to historical land uses, and appears to be a chronic source of sediment to the Truckee River.

Potential restoration of this legacy impacted site would target the bank failures and floodplain restoration. The bank failures can be stabilized through bioengineering techniques, such as a willow mattress, log crib walls, or rock and rootwad toe protection. Bioengineering techniques can reduce erosion and enhance fish habitat within the River. Additional research and investigations should be conducted to further evaluate the impacts the Tahoe Ice Company Dam had on the river and habitat. The restoration approach may need to consider potential impacts to sensitive historical resources, and could include educational and interpretive opportunities.

This site was selected for a project sheet to provide additional information and a stand along document. The project sheet can be found in Appendix E.

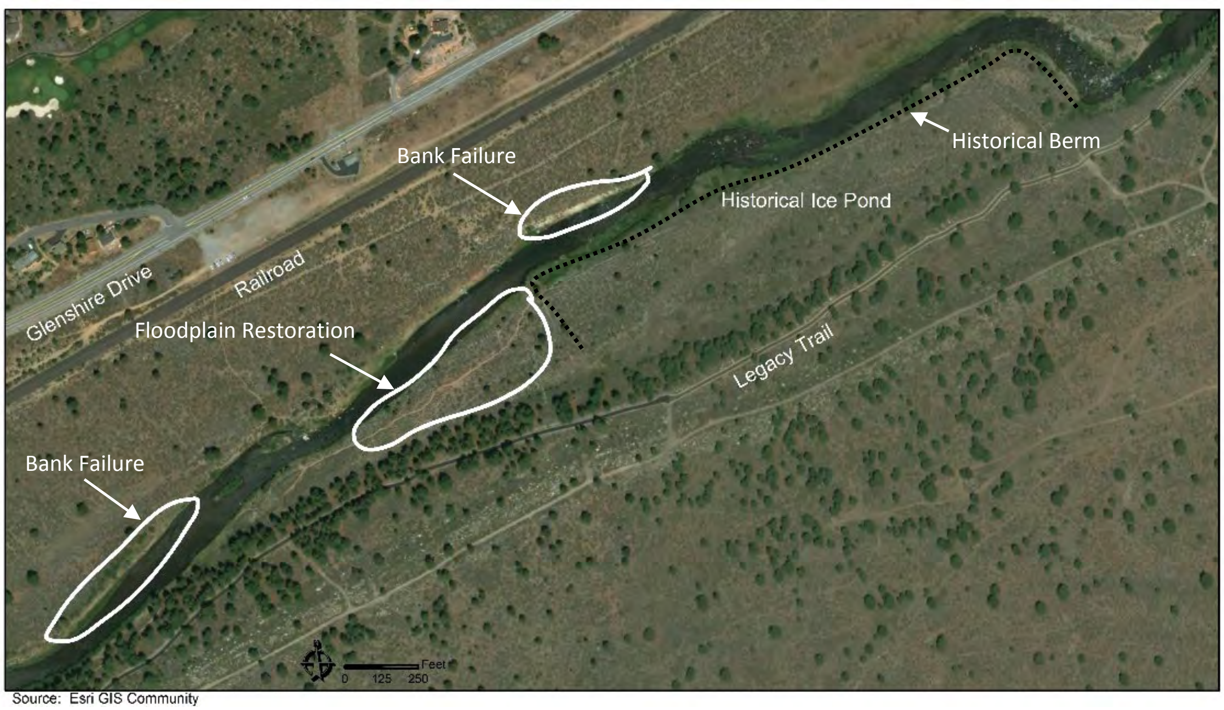

Figure 5-9 Tahoe Ice Company Historical Dam Site Potential Restoration Areas, Bank Stabilization and Habitat Enhancement.

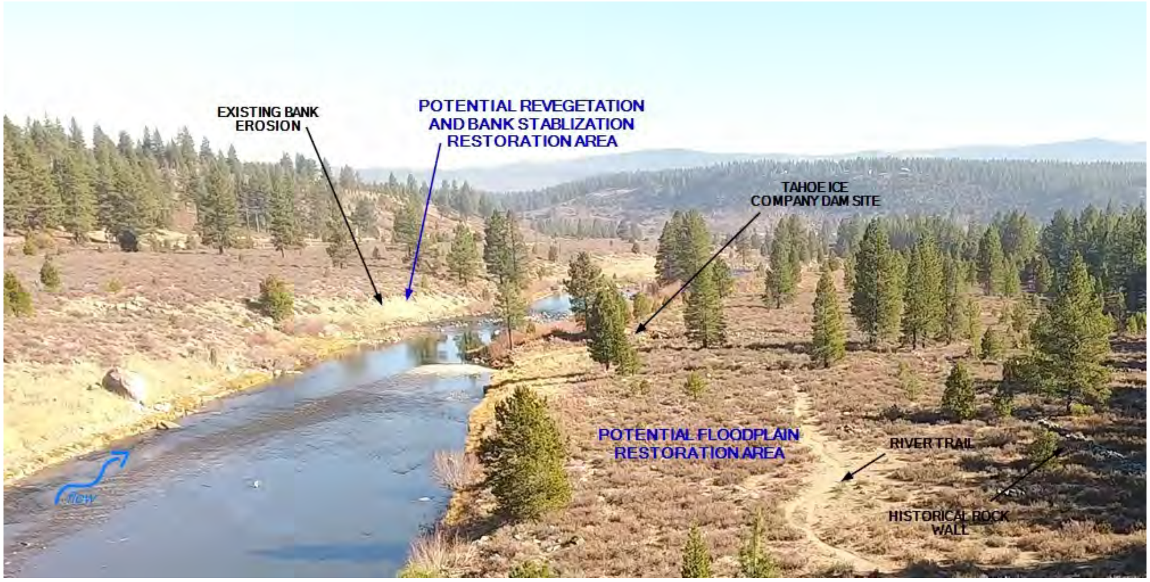

Figure 5-10 Tahoe Ice Company Historical Dam Site Existing Conditions and Potential Restoration Areas.

PR-8: Glenshire Drive Parking Areas

This site includes three sub areas which are located on private property along a one-mile section of Glenshire Drive. The sites are on property owned by Southern Pacific Trans and are popular river access areas. Restoration approaches could limit vehicular access with the use of boulder bollards and revegetation approaches could help re-establish native upland habitat. PR-8a would also include improvements to the stormwater infrastructure from the Olympic Heights neighborhood that currently has limited stormwater treatment.

Source: Esri GIS Community

Figure 5-11 Glenshire Drive Parking Potential Restoration Areas.

PR-9: Polaris Fault Wetland

The Polaris Fault Wetland is a wetland complex near the Polaris fault on private property along sides of Glenshire Drive. The wetland is channelized to convey flows under the railroad in one location, and vehicle access has disturbed the wetland. The historical wetland area could be restored by limiting vehicle access and re-establishing diffuse flow and native wetland vegetation. Stormwater could be dispersed and routed through the wetland as well, allowing for pre-treatment of runoff prior to discharging to the Truckee River.

Source: Esri GIS Community

Figure 5-12 Polaris Fault Wetland Potential Restoration Area.

PR-10: Glenshire Sub-watershed Drainage

The Glenshire restoration site would provide treatment for the one of the larger sub-watersheds with treatment potential adjacent to the Truckee River. The site is located on private property along Glenshire Drive downstream of the Glenshire Bridge.

The potential restoration concepts would require working with private landowners to improve stormwater runoff and provide stormwater treatment. The Glenshire sub-watershed was identified to have poor treatment and the portion of property identified would be an appropriate location for implementation of stormwater BMPs. BMPs could include detention, wet pond or wetland designs that would spread out runoff and encourage infiltration before entering the Truckee River.

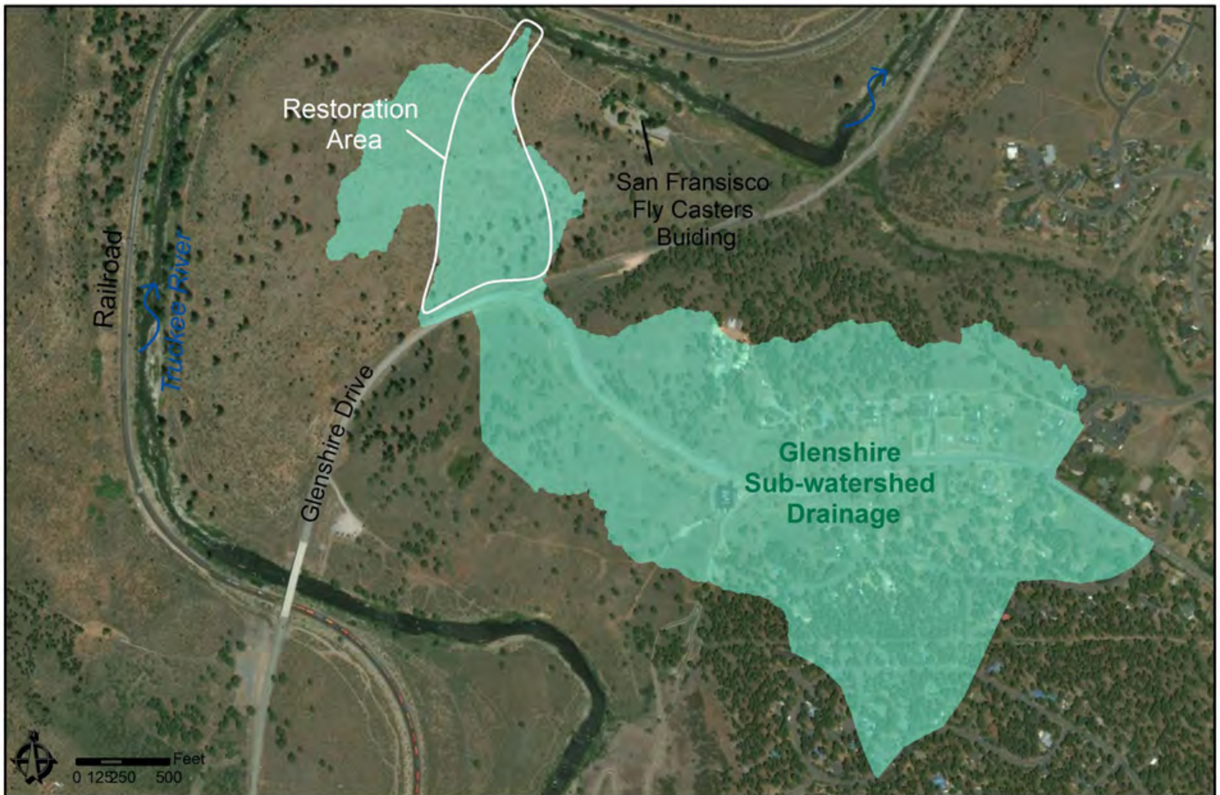

Figure 5-13 Glenshire Sub-Watershed and Potential Restoration Area.

PR-11: I-80 Bridge Stormwater Erosion

The I-80 Bridge site is the second bridge crossing the Truckee River located at roughly I-80 road mile marker 21. The site is located on the south side on I-80 and the river. The potential restoration would improve the stormwater infrastructure from I-80 that is currently generating bank erosion and is a direct source of sediment to the Truckee River. Conceptual improvements could include upgrades to the existing sediment trap or installation of bioswales. Unstable banks could also be addressed through the installation of bioengineered bank stabilization elements.

Figure 5-14 I-80 Bridge Stormwater Erosion Potential Restoration Area.

PR-12: CDFW River Bend (Horner's Corner)

The CDFW River Bend site, locally called Horner's Corner or the Loop, is between the second and third bridge along I-80, near road marker mile 21. The site was the historical location for a spur railroad with the Nevada Ice Company in operation from 1872 to 1875, and the Pacific Shingles Company carta 1874. The site is owned by the CDFW and is a popular highway pullout for fishing.

Historical impacts associated with the spur railroad grade and modern impacts associated with vehicular access could be addressed by removing fill along the left river bank and limiting vehicle access throughout the inside of the river bend. Removing the fill would reintroduce flows to the historical floodplain surface, slowing flows and possibly reducing the potential for erosion along the downstream river bank. A parking and river access area could be established to include sufficient stormwater treatment and boulder bollards could be used to limit disturbance to the floodplain and riparian zone. It should be noted that this is a popular location for fishing access and vehicle access to freedom campsites could be affected.

This site was selected for a project sheet to provide additional information and a stand along document. The project sheet can be found in Appendix E.

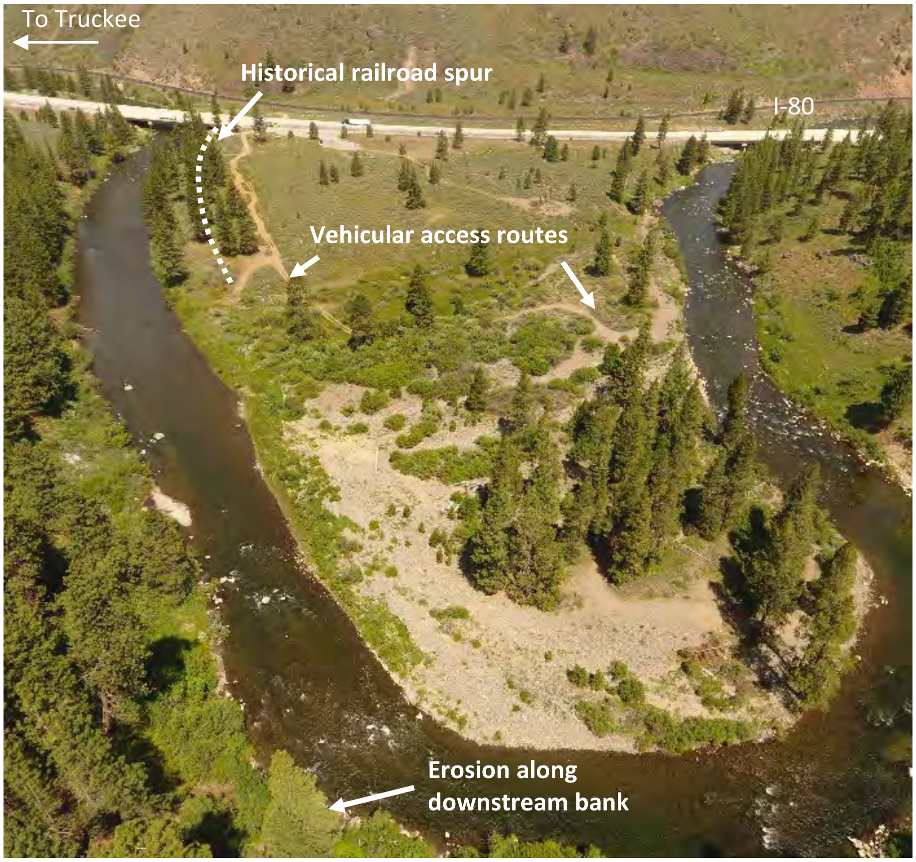

Figure 5-15 CDFW River Bend Potential Restoration Sites and Areas of Impact.

Figure 5-16 CDFW River Bend Site Photos. Top-left: Rail road spur located above the dirt path blocking view of the Truckee River. Top-right: Looking up the railroad spur showing the change in elevations. Bottom-left: Vehicular access road. Bottom-right: Parking area off of I-80.

PR-13: I-80 Runoff and Sub-Watershed Drainage

The I-80 runoff site is located at roughly road mile marker 21.5. The site is on both sides of I-80 between the hillside to the south and the Truckee River to the north. The project would provide stormwater treatment for an unmitigated sub-watershed and from I-80 through the implementation of stormwater BMPs. BMPs could include detention, wet pond or wetland designs that would spread out and infiltrate runoff and deposit road sand before entering the Truckee River.

Source: Esri GIS Community

Figure 5-17 I-80 Runoff and Sub-Watershed Drainage Potential Restoration Area.

6 LIMITATIONS

As stated in the introduction to the report, the objectives of this assessment are to identify sources of sediment to the Town River Corridor, part of the Middle Truckee River Watershed, and describe potential projects that will reduce those sources. This is a reconnaissance report, intended to bracket likely historical and potential future conditions, to identify certain sediment sources which should be investigated more, and to help guide initial planning of restoration projects. This report is not intended to serve as a complete list of sediment sources and is a collection of sediment sources that could be identified under the time and constraints of this work. Use of these results for purposes other than those identified above should be avoided. Balance Hydrologics should be contacted for consultation prior to considering use of this analysis for any purposes other than the reconnaissance, watershed-scale analysis specified above in this paragraph.

As with all historical or archival analysis, the better the record is known and understood, the more relevant and predictive the analysis can be. We do encourage those who have knowledge of other events or processes which may have affected the site or channel system to let us know at the first available opportunity.

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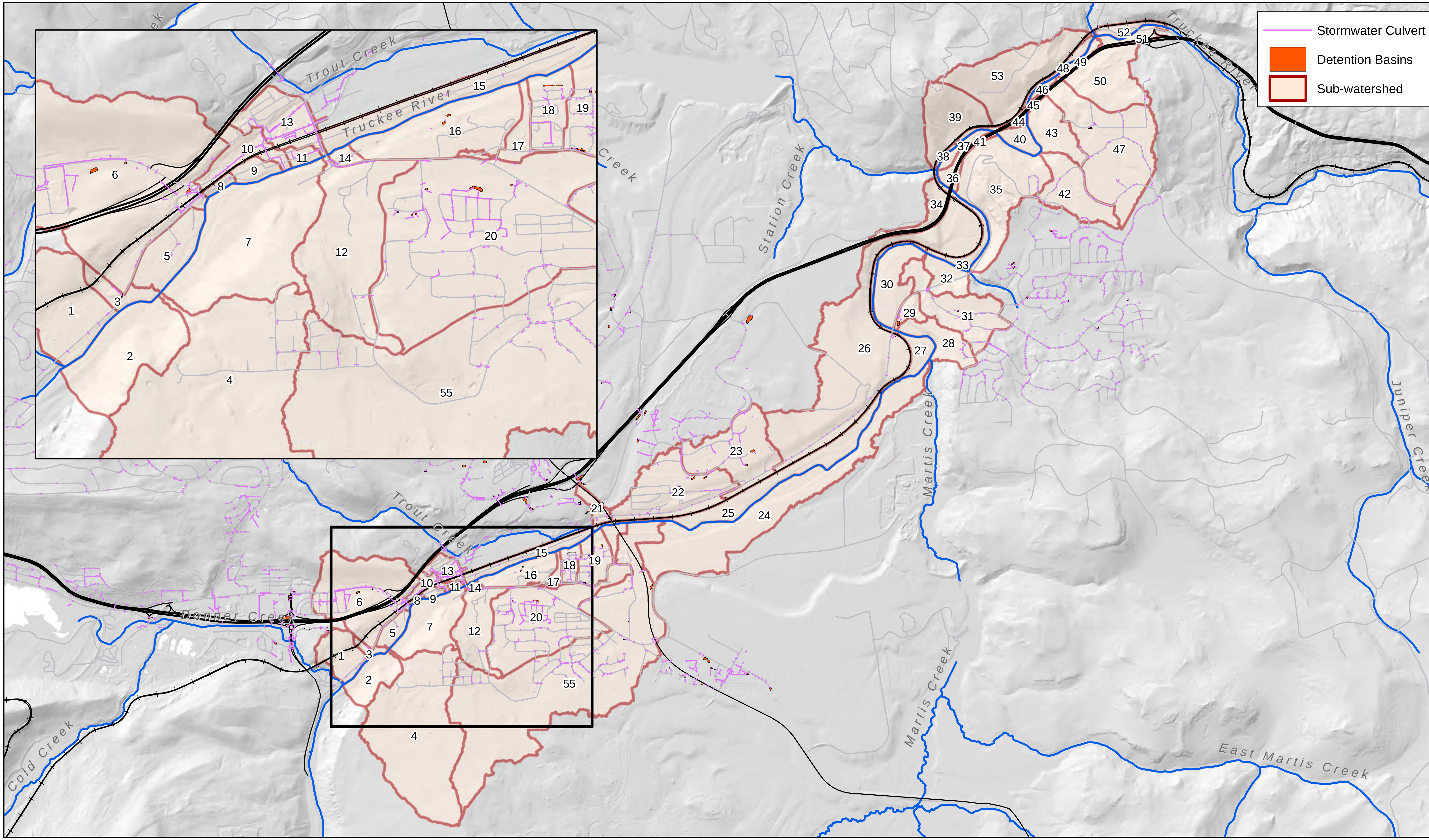
PLATES



Balance Hydrologics, Inc.

Plate 1. Sub-watersheds from Flow Accumulation Analysis Based on 2016 Lidar Data and Adjusted Based on Stormwater Infrastructure, Aerial Imagery, and Field Verification. Town River Corridor, Truckee, California

Basemap Source: 2016 Lidar, Town of Truckee

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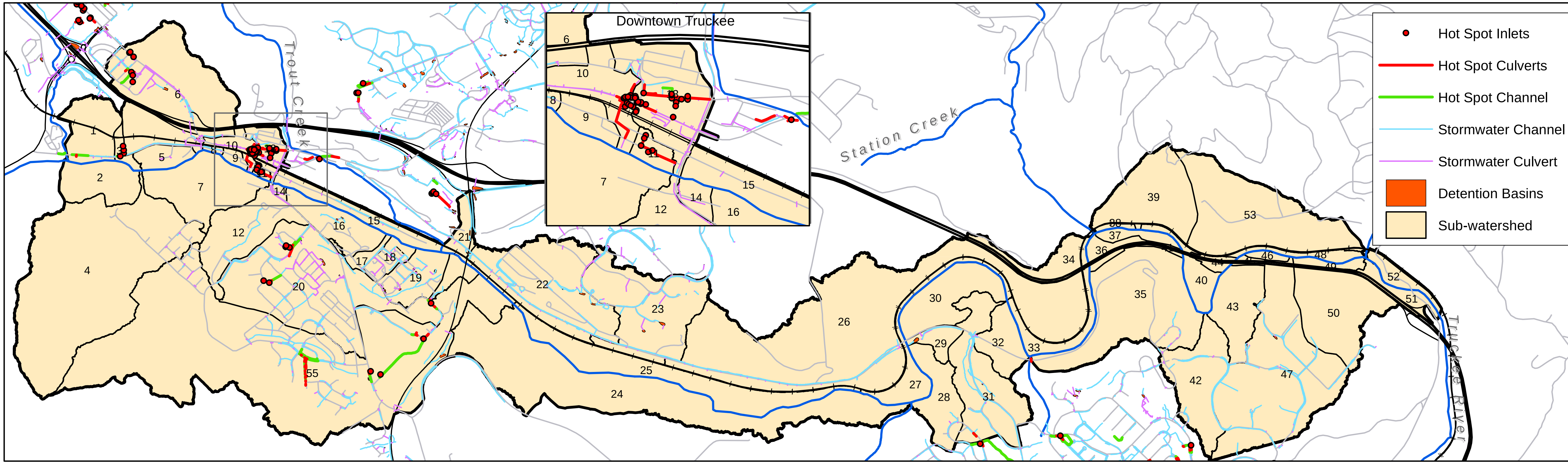

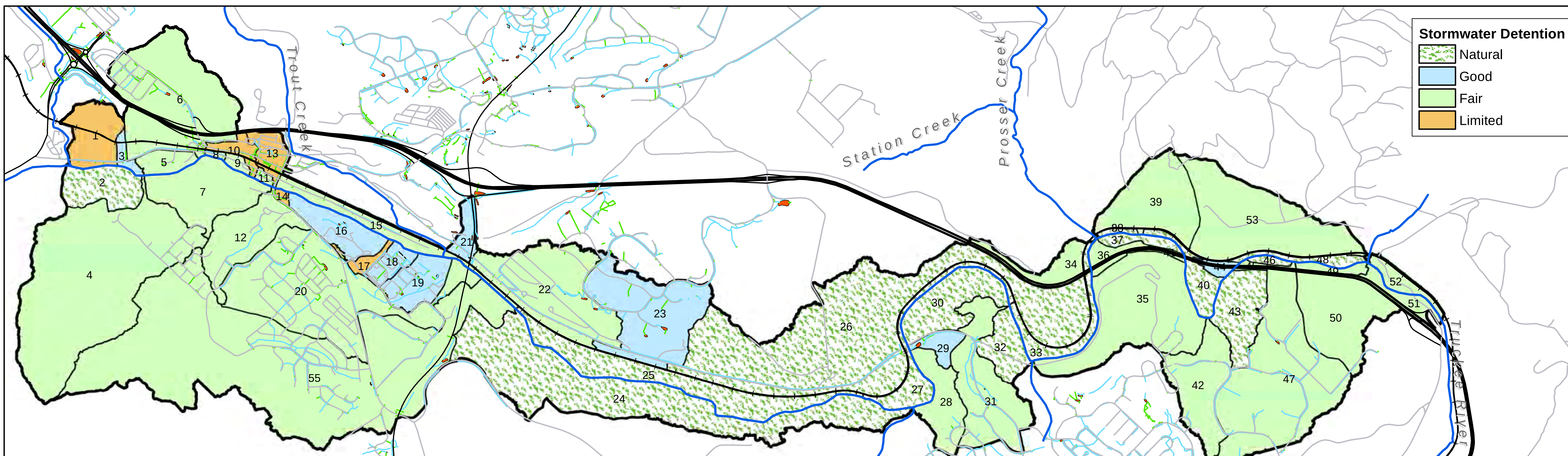

Balance Hydrologics, Inc.

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Plate 2. Sub-watersheds and Stormwater Infrastructure:
Top- Hot Spots Identified by Town of Truckee Staff
Bottom- Treatment Potential and Condition of Stormwater Infrastructure per Sub-watershed.
Town River Corridor, Truckee, California

Source: Esri GIS User Community

0 0.25 0.5 1 Miles

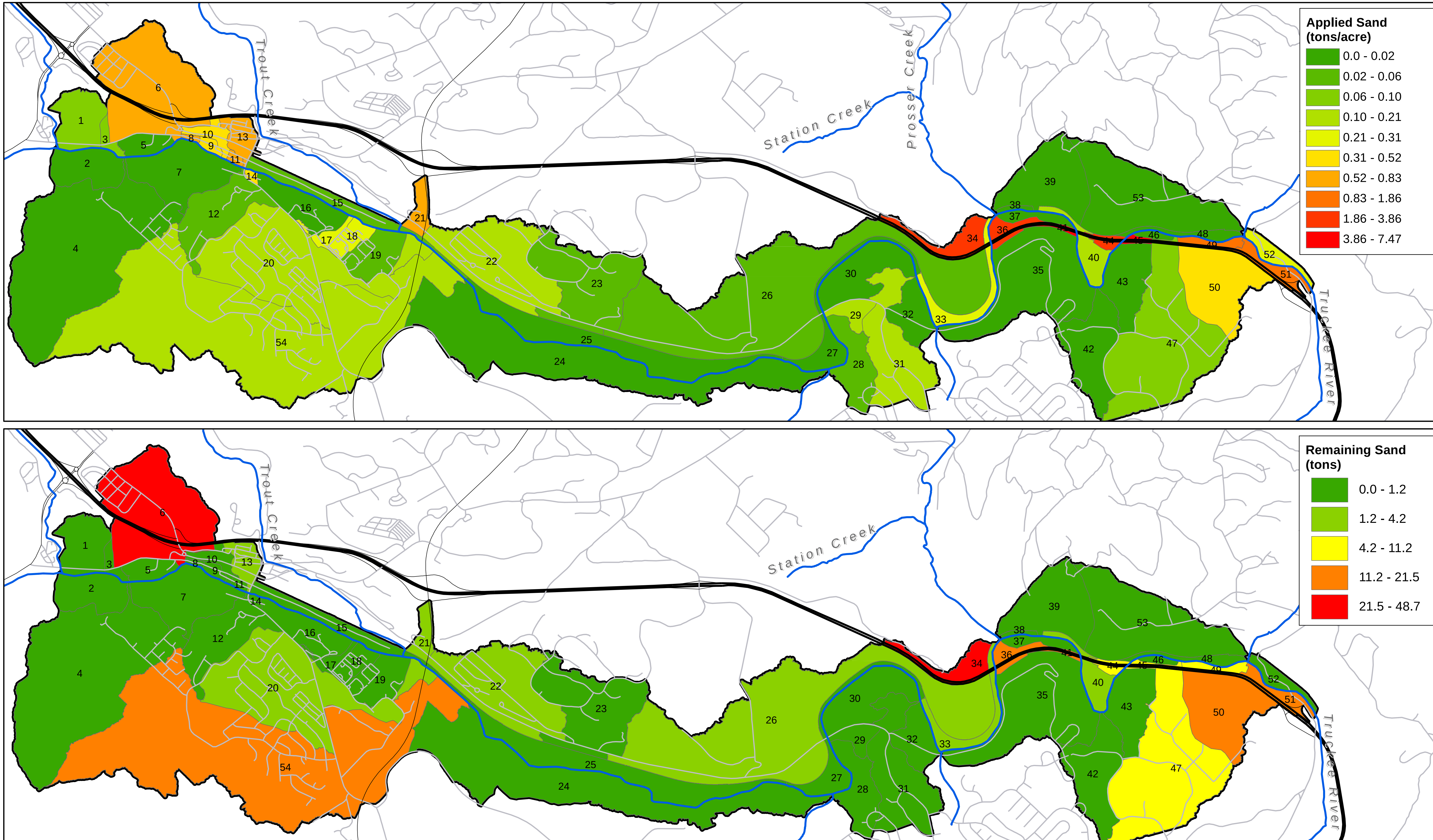

Plate 3. Road Sand Analysis:
Top- Road Sand Applied weighted per Sub-watershed Area (tons/watershed acres),
Bottom- Road Sand Remaining in Sub-watershed (tons),
Town River Corridor, Truckee, California

Balance Hydrologics, Inc.

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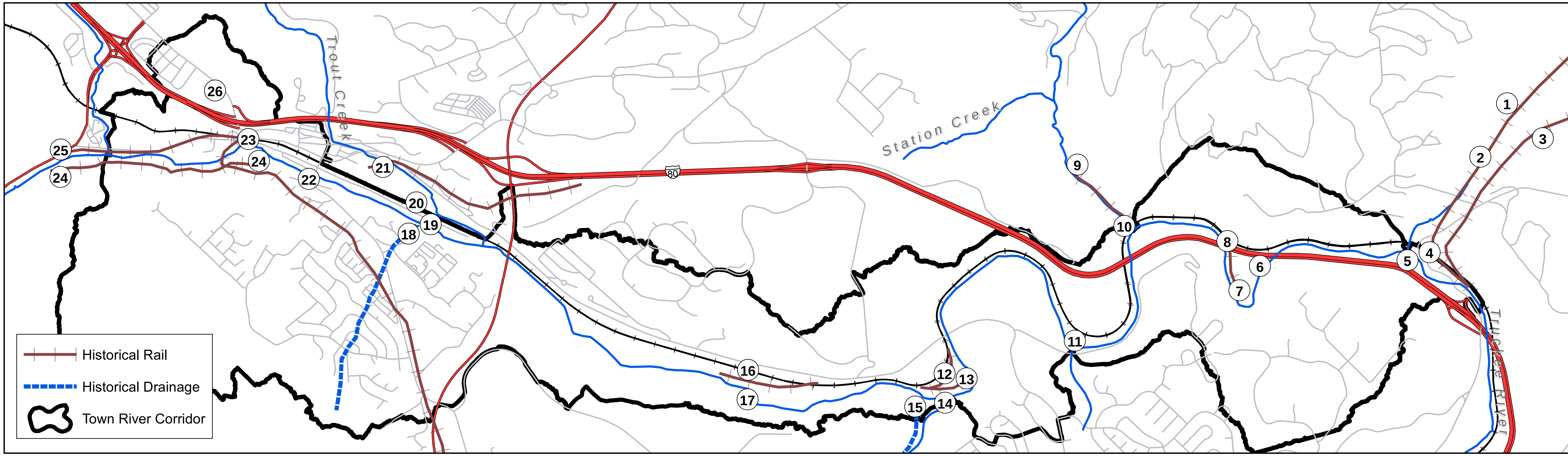
Source: Esri GIS User Community



Map No.	Description	Date
1a	Boca Ice Co (Boca Mill & Ice Co)	1868-1926
1b	Boca Lumber Co (Boca Mill & Ice Co)	1866-1908
2	Boca Mill & Ice Co railroad spur	1868-1926
3	Boca & Loyalton Railroad	1900-1917
4	Camp 17-Boca (station on Central Pacific RR)	Ca. 1868
5	Boca Beer Brewery	Ca. 1875/76-1893
6	Pacific Shingle Co	Ca. 1874
7	Nevada Ice Co and railroad spur	1872-1875
8	Camp 16-Pacific (station on Central Pacific RR)	Ca. 1868-
9	Summit Ice Co and railroad spur	1872-1920
10	Prosser Creek Station and railroad spur	1870-1920
11	Union Mills Station	1868-1939
12a	Martis Creek Station and railroad siding	Ca. 1868-
12b	Brick charcoal kilns (3)	Ca. 1877
13	Richardson V-flume; Box Plant	1876-1886
14a	Placer mining	1863-1864
14b	Truckee Ice Co	1885-1887

Map No.	Description	Date
15	Sisson, Wallace & Crocker Co V-Flume	1872-1887
16a	Stonewall-Proctor Mill	1868
16b	Winstead railroad siding	1901
16c	Polaris railroad siding	1901+
17	Tahoe Ice Co	1886-1919
18	Tecoma Smelter	1872-1875
19	Truckee River Electric Co	1888
20	Schaffer V-Flume	Ca. 1872-1905
21a	Hobart Southern Railroad Standard	1897-1936
21b	Fibreboard Corp. Standard Gauge RR	1946-1952
22a	Schaffer & Gray Lumber Mill	1867
22b	Joe Marzen stockyards (“Slaughter House Hill”)	Ca. late 1800s-early 1900s
23a	Truckee Lumber Co drying yards	Ca. 1867-1909
23b	Von Flue (Fluee) Dairy	Ca. 1901
23c	Von Flue footbridge	Ca. 1901
23d	Prehistoric village/historic Washoe	n/a

Map No.	Description	Date
24a	Base of Truckee Ski Jump/Toboggan Hill	Ca. mid-1890s
24b	Donner & Tahoe Narrow Gauge RR (terminates at Truckee Lumber Co drying yards, shown between the #24s)	1893-1900
25a	Lake Tahoe Railway & Transportation Co (narrow gauge RR)	1900-1925
25b	Southern Pacific Tahoe Branch Line (standard gauge RR)	1925-1943
26a	Varney Dairy	1873-1879
26b	McIver Dairy	1905-ca. 1940s

Balance Hydrologics, Inc.

Plate 4. Historic Sites in the Town River Corridor
Truckee, California

Source: Sites provoded by Susan Lindstrom and basemap by Esri GIS User Community

0 0.25 0.5 1 1.5 2 Miles

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Balance Hydrologics, Inc.

Plate 5. Historical Aerial Imagery Comparison Along the Truckee River, Town River Corridor,Truckee, California

Source: Historical USFS aerials (1939, 1972) and Esri GIS community (2017)

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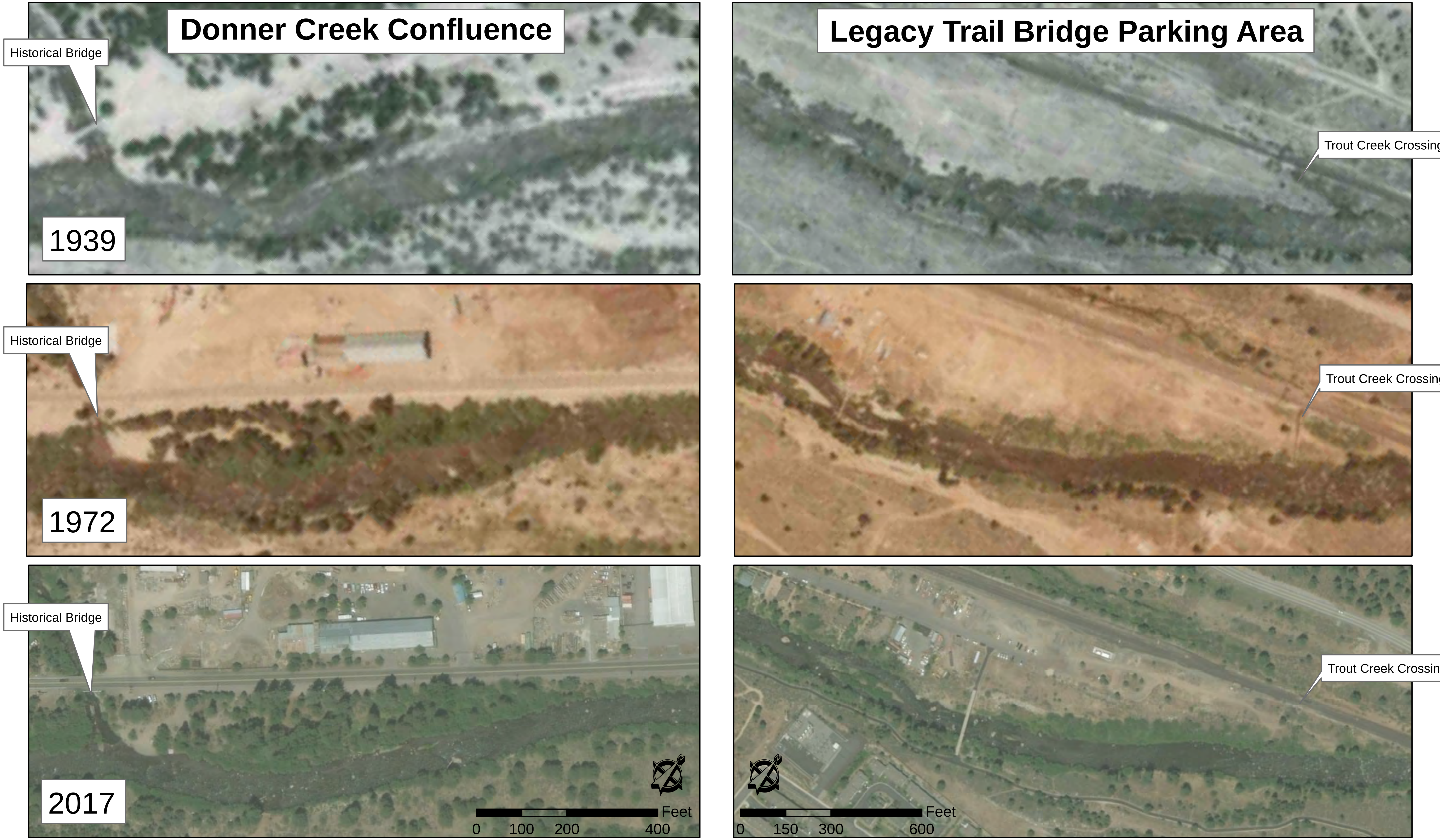

Balance Hydrologics, Inc.

Plate 6. Comparison of the Donner Creek Confluence and Legacy Trail Bridge Parking Area,
Years 1939, 1972 and 2017.
Town River Corridor, Truckee, California

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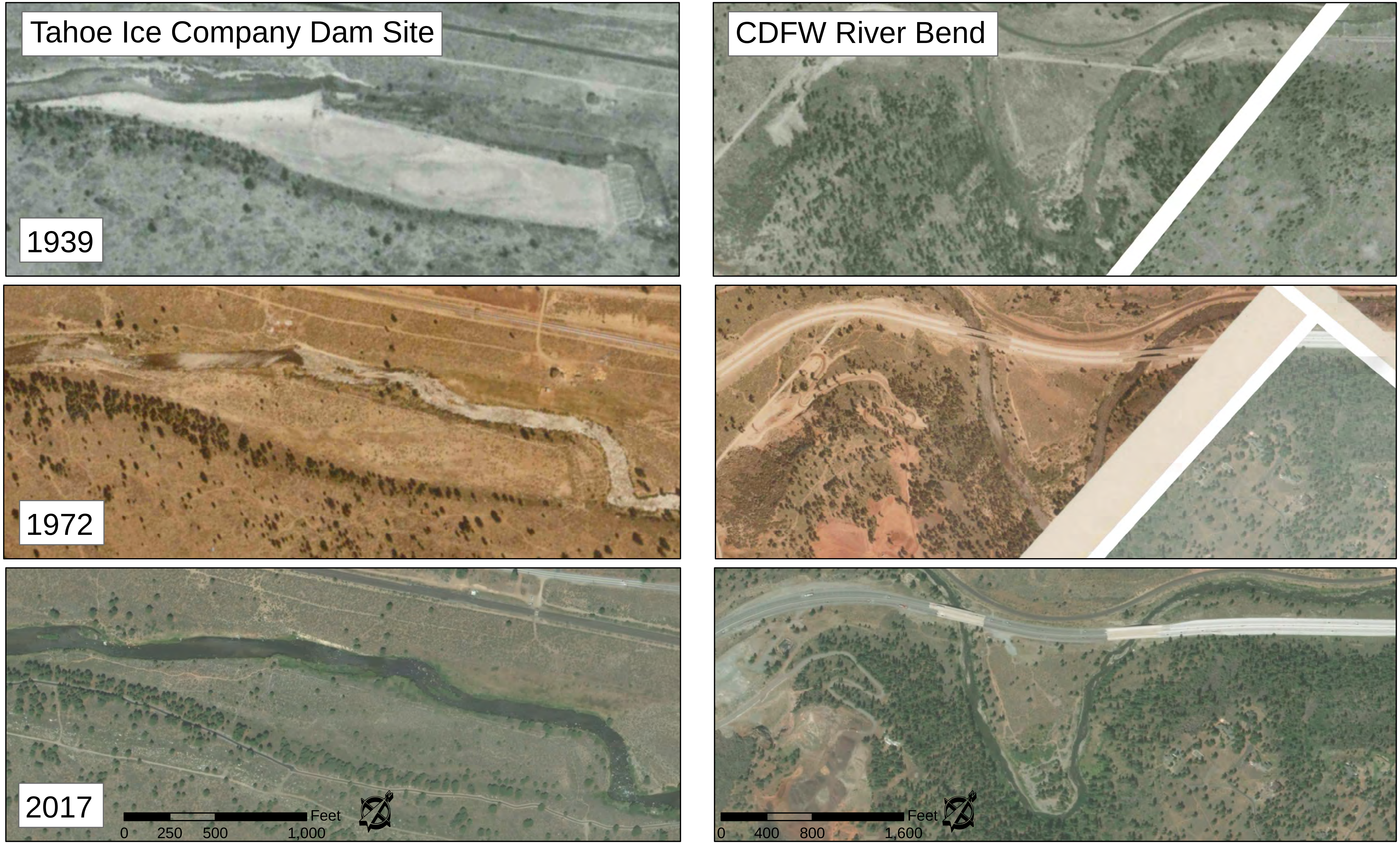
Source: Historical USFS aerials (1939 & 1972) and Esri GIS community (2017)



Balance Hydrologics, Inc.

Plate 7. Comparison of Tahoe Ice Company Dam Site and the California Department of Fish and Wildlife (CDFW) River Bend Site, for the Years 1939, 1972, and 2017. Town River Corridor, Truckee, California

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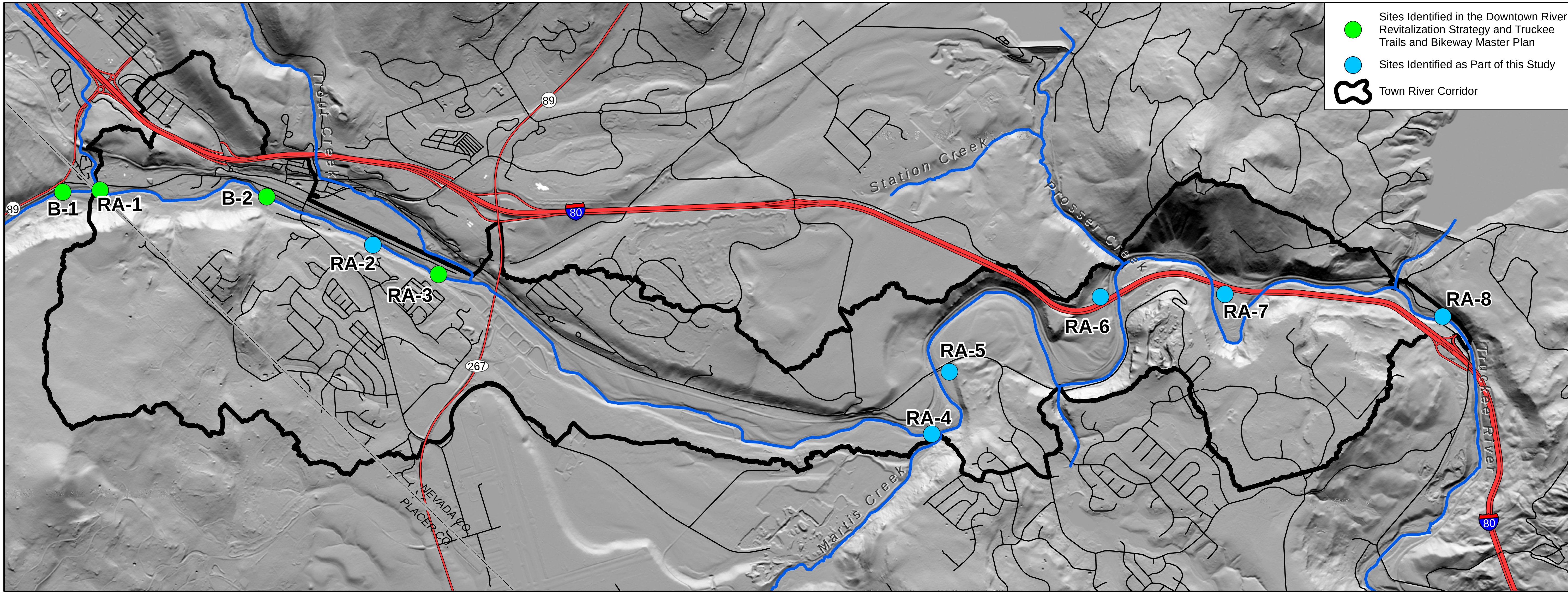
Source: Historical USFS aerials (1939 & 1972) and Esri GIS community (2017)



River Access Sites				
No.	**Description**	**River Side**	**Source**	**Owner**
B-1*	Potential pedestrian bridge crossing location at County line.	Across	Truckee Trails & Bikeways Master Plan, 2015	Tahoe National Forest
RA-1	Existing informal river access location by the mouth of Donner Creek	Left	Downtown River Revitalization Strategy, 2005 (A-2)	ToT/Private/CDFW
B-2	Potential pedestrian bridge crossing at the Central River Village (Old County Corp Yard)	Across	Downtown River Revitalization Strategy, 2005 (E-1) and Truckee Trails & Bikeways Master Plan, 2015	Town of Truckee
RA-2	Truckee River Regional Park, riverside parking lot	Right	Identified as part of this study	Tahoe- Donner Recs and Parks District
RA-3	Legacy trail bridge parking and access area on East River Street	Left	Downtown River Revitalization Strategy, 2005 (F-3)	Truckee Sanitation District
RA-4	Intersection of Legacy Trail and Martis Creek confluence with Truckee River	Right	Identified as part of this study	Tahoe National Forest
RA-5	Glenshire bridge access area	Right	Identified as part of this study	Tahoe National Forest
RA-6	South of I-80 and upstream of the Prosser Creek confluence	Right	Identified as part of this study	Private/Tahoe National Forest
RA-7	Between two I-80 bridges as the river bends back north; "The Loop"	Left	Identified as part of this study	California Department of Fish and Wildlife
RA-8	Historical Boca Bridge	Across	Identified as part of this study	Tahoe National Forest

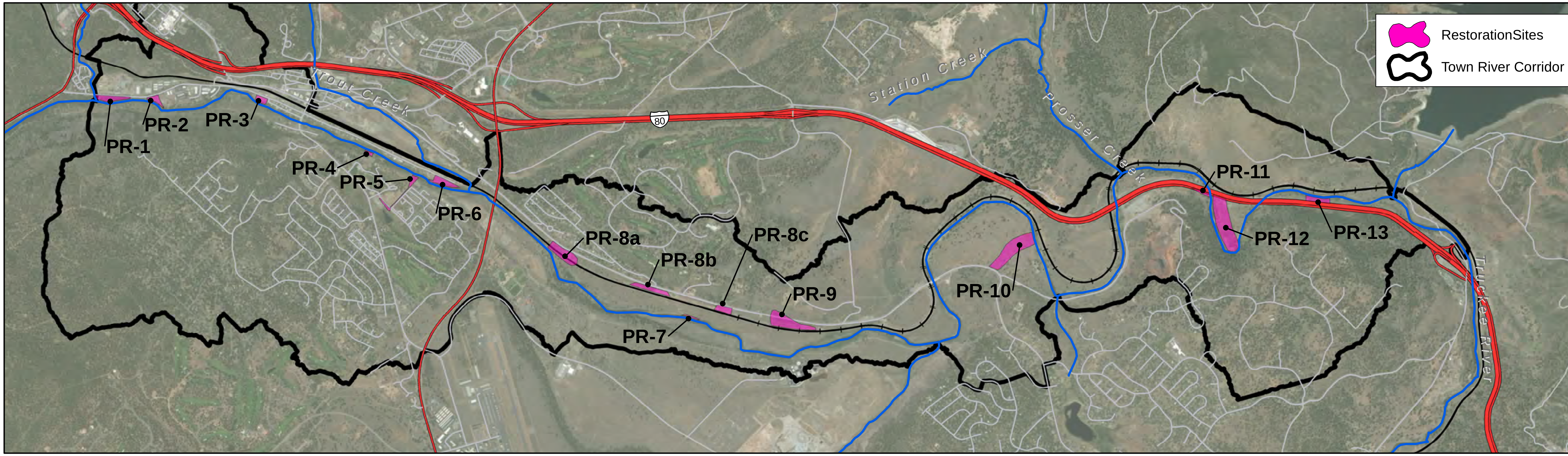
*Outside project boundary, site identified but not assessed

Balance Hydrologics, Inc.

Plate 8. Potential River Access Sites
Town River Corridor, Truckee, California

Source: USFS 2013 Lidar

0 0.25 0.5 1 Miles



No.	Description	Brief Potential Management Actions
PR-1	Existing informal river access location by the mouth of Donner Creek	Improve floodplain function, exclude vehicular access and generate controlled public access. Improve stormwater infrastructure.
PR-2	Triangular corner of private property between West River Street and the Truckee River	Water quality improvements, potential to generate pocket park and potential for native floodplain restoration.
PR-3	Potential pedestrian bridge crossing by the west end of Riverside Drive	Remove fill and pull back floodplain and generate public access.
PR-4	Truckee River Regional Park, riverside parking lot	Generate direct river access locations that minimize bankside erosion, improve parking and drainage.
PR-5	Sub-basin drainage point of discharge along Estates and River View Drive.	Improve stormwater infrastructure to reduce erosion and runoff velocities, spread out flows. Encourage infiltration.
PR-6	Legacy trail bridge parking and access area on East River Street	Improve area for public access to river trail and parking lot stormwater runoff. Remove fill to expose buried floodplain.
PR-7	Bank erosion upstream of Tahoe Ice Company historical dam site	Stabilize banks using bioengineering approaches.
PR-8a	Glenshire Drive informal parking areas on private property adjacent to railroad tracks	Potential to provide water quality benefits for the Olympic Heights neighborhood and water quality improvements from parking area and vehicular access improvements.
PR-8b		Water quality improvements from parking area and vehicular access improvements.
PR-8c		Water quality improvements from parking area and vehicular access improvements.
PR-9	Polaris Fault wetland on private property along Glenshire Drive	Potential to restore historical groundwater discharge wetland and water quality improvements.
PR-10	Runoff from west portion of Glenshire along private property	Provide water quality improvements from sub-watersheds.
PR-11	I-80 bridge stormwater erosion downstream of Prosser Reservoir	Improve stormwater infrastructure from I-80 and address bank erosion by bridge piers.
PR-12	CDFW river bend with access parking between I-80 bridges downstream of Prosser Reservoir	Remove or improve (make official on/off ramp) for parking and remove fill associated with historic railroad spur.
PR-13	I-80 runoff and drainage channel upstream of Boca	Improve stormwater infrastructure by providing treatment for sub-basin watershed, spread out and infiltrate runoff.

Balance Hydrologics, Inc.

Plate 9. Potential Restoration Project Sites and Descriptions, Town River Corridor, Truckee, California

Miles 0 0.25 0.5 1

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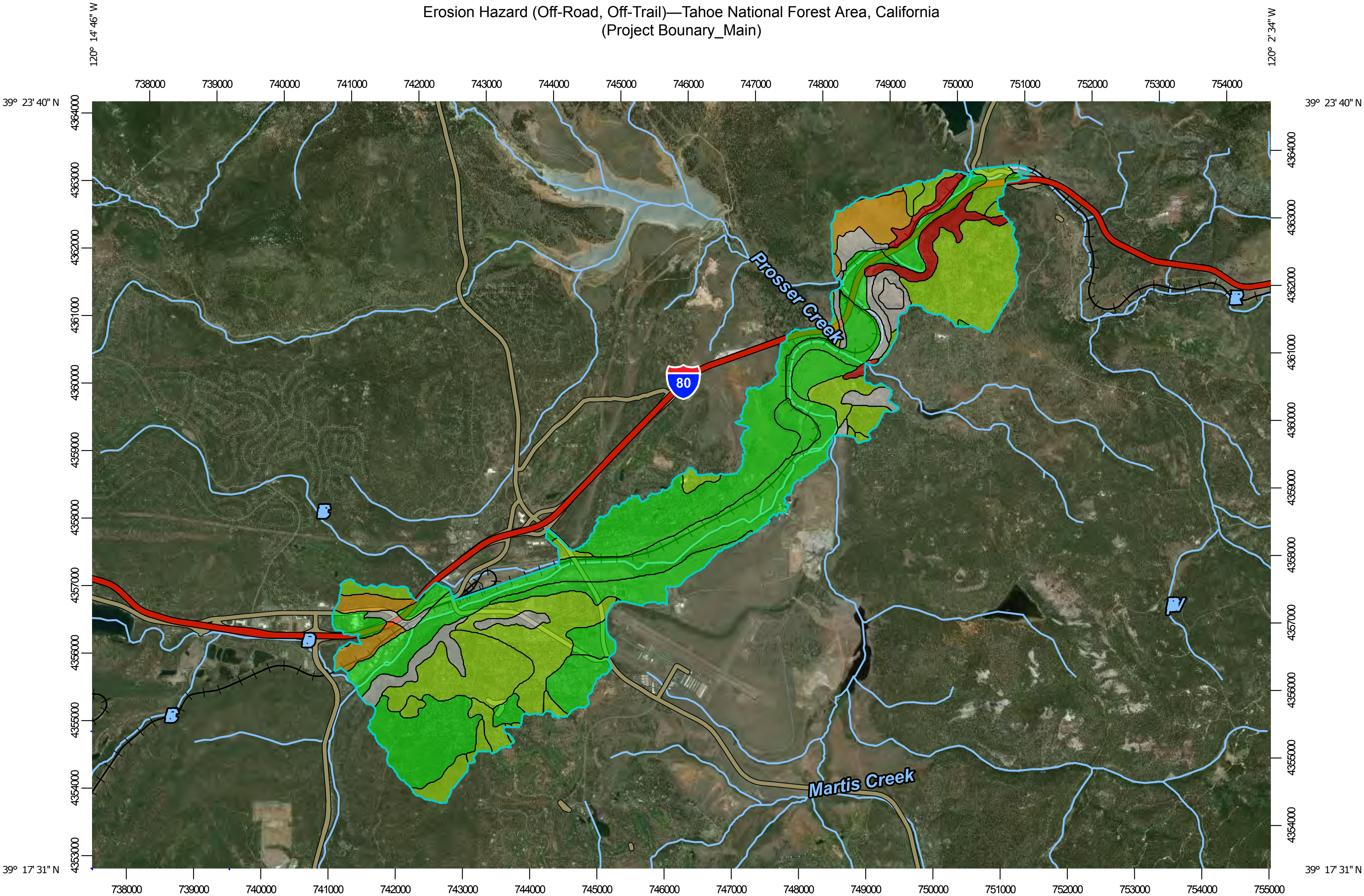
Source: Esri GIS User Community

APPENDICES

APPENDIX A

USDA Erosion soil map and soil type description for the Town River Corridor

Erosion Hazard (Off-Road, Off-Trail)—Tahoe National Forest Area, California
(Project Bounary_Main)



Map Scale: 1:80,100 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 1000, 2000, 4000, 6000

Feet: 0, 3500, 7000, 14000, 21000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

Very severe

Severe

Moderate

Slight

Not rated or not available

Soil Rating Lines

Very severe

Severe

Moderate

Slight

Not rated or not available

Soil Rating Points

Very severe

Severe

Moderate

Slight

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Tahoe National Forest Area, California
Survey Area Data: Version 11, Sep 12, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 28, 2012—Dec 6, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Erosion Hazard (Off-Road, Off-Trail)

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
AQB	Aquolls and Borolls, 0 to 5 percent slopes	Not rated	Aquolls (45%)		110.2	2.0%
			Borolls (45%)			
ARE	Aldi-Kyburz complex, 2 to 30 percent slopes	Moderate	Aldi (55%)	Slope/erodibility (0.50)	626.7	11.5%
			Kyburz (30%)	Slope/erodibility (0.50)		
CIF	Cinder land-Sierraville-Kyburz complex, 30 to 50 percent slopes	Not rated	Cinder land (40%)		48.0	0.9%
EUB	Euer-Martis variant complex, 2 to 5 percent slopes	Slight	Euer (55%)		134.4	2.5%
			Martis variant (35%)			
EUE	Euer-Martis variant complex, 5 to 30 percent slopes	Moderate	Euer (60%)	Slope/erodibility (0.50)	67.2	1.2%
			Martis variant (30%)	Slope/erodibility (0.50)		
EVB	Inville-Martis variant complex, 2 to 5 percent slopes	Slight	Inville (60%)		440.1	8.1%
			Martis variant (25%)			
EWB	Inville-Riverwash-Aquolls complex, 2 to 5 percent slopes	Slight	Inville (55%)		1,038.8	19.0%
FTE	Fugawee-Tahoma complex, 2 to 30 percent slopes	Moderate	Fugawee (50%)	Slope/erodibility (0.50)	43.0	0.8%
			Tahoma (40%)	Slope/erodibility (0.50)		
FTF	Fugawee-Tahoma complex, 30 to 50 percent slopes	Severe	Fugawee (50%)	Slope/erodibility (0.75)	5.2	0.1%
			Tahoma (40%)	Slope/erodibility (0.75)		
FUC	Kyburz-Trojan-Sierraville complex, 2 to	Slight	Kyburz (45%)		399.5	7.3%
			Trojan (25%)			

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
	9 percent slopes		Sierraville (15%)			
FUE	Kyburz-Trojan complex, 9 to 30 percent slopes	Moderate	Kyburz (60%)	Slope/erodibility (0.50)	524.0	9.6%
			Trojan (25%)	Slope/erodibility (0.50)		
FUF	Kyburz-Trojan complex, 30 to 50 percent slopes	Severe	Kyburz (65%)	Slope/erodibility (0.75)	8.0	0.1%
			Trojan (20%)	Slope/erodibility (0.75)		
JUE	Jorge-Rubble land complex, 2 to 30 percent slopes	Moderate	Jorge (55%)	Slope/erodibility (0.50)	3.7	0.1%
JUG	Jorge-Rubble land complex, 30 to 75 percent slopes	Very severe	Jorge (55%)	Slope/erodibility (0.95)	193.6	3.5%
KRE	Kyburz-Rock outcrop-Trojan complex, 2 to 30 percent slopes	Moderate	Kyburz (55%)	Slope/erodibility (0.50)	93.7	1.7%
			Trojan (15%)	Slope/erodibility (0.50)		
MEB	Martis-Euer variant complex, 2 to 5 percent slopes	Slight	Martis (60%)		803.8	14.7%
			Euer variant (25%)			
PX	Pits, borrow	Not rated	Pits, borrow (100%)		49.5	0.9%
SIE	Sierraville-Trojan-Kyburz complex, 2 to 30 percent slopes	Moderate	Sierraville (45%)	Slope/erodibility (0.50)	372.6	6.8%
			Trojan (25%)	Slope/erodibility (0.50)		
			Kyburz (20%)	Slope/erodibility (0.50)		
STG	Rubble land-Jorge complex, 30 to 75 percent slopes	Not rated	Rubble land (60%)		58.9	1.1%
SUG	Rubble land-Rock outcrop complex	Not rated	Rubble land (60%)		156.7	2.9%
			Rock outcrop (30%)			
TTF	Trojan-Sattley-Kyburz complex, 30 to 50 percent slopes	Severe	Trojan (45%)	Slope/erodibility (0.75)	150.9	2.8%
			Sattley (25%)	Slope/erodibility (0.75)		

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
			Kyburz (15%)	Slope/erodibility (0.75)		
ULC	Kyburz loam, 2 to 9 percent slopes	Slight	Kyburz (85%)		2.9	0.1%
WAF	Waca-Windy complex, 30 to 50 percent slopes	Severe	Waca (65%)	Slope/erodibility (0.75)	60.5	1.1%
			Windy (30%)	Slope/erodibility (0.75)		
WDF	Waca-Meiss complex, 30 to 50 percent slopes	Severe	Waca (65%)	Slope/erodibility (0.75)	71.4	1.3%
			Meiss (25%)	Slope/erodibility (0.75)		
XCE	Kyburz-Aldi variant-Jorge variant complex, 2 to 30 percent slope s	Moderate	Kyburz (40%)	Slope/erodibility (0.50)	0.9	0.0%
			Aldi variant (25%)	Slope/erodibility (0.50)		
			Jorge variant (25%)	Slope/erodibility (0.50)		
Totals for Area of Interest					**5,464.1**	**100.0%**

Rating	Acres in AOI	Percent of AOI
Slight	2,819.5	51.6%
Moderate	1,731.7	31.7%
Severe	296.0	5.4%
Very severe	193.6	3.5%
Null or Not Rated	423.3	7.7%
Totals for Area of Interest	**5,464.1**	**100.0%**

Description

The ratings in this interpretation indicate the hazard of soil loss from off-road and off-trail areas after disturbance activities that expose the soil surface. The ratings are based on slope and soil erosion factor K. The soil loss is caused by sheet or rill erosion in off-road or off-trail areas where 50 to 75 percent of the surface has been exposed by logging, grazing, mining, or other kinds of disturbance.

The ratings are both verbal and numerical. The hazard is described as "slight," "moderate," "severe," or "very severe." A rating of "slight" indicates that erosion is unlikely under ordinary climatic conditions; "moderate" indicates that some erosion is likely and that erosion-control measures may be needed; "severe" indicates that erosion is very likely and that erosion-control measures, including revegetation of bare areas, are advised; and "very severe" indicates that significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion-control measures are costly and generally impractical.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the specified aspect of forestland management (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX B

McIver Restoration and Truckee River Revitalization Project, A Contextual Overview of Human Land Use and Environmental Conditions, Susan Lindstrom, December 2017

MCIVER DAIRY RESTORATION AND TRUCKEE RIVER REVITALIZATION PROJECTS

A CONTEXTURAL OVERVIEW OF HUMAN LAND USE

AND ENVIRONMENTAL CONDITIONS

WORKBOOK

Report prepared by:

Susan Lindström, Ph.D. (RPA), Consulting Archaeologist

Truckee, CA

Report prepared for:

Balance Hydrologics, Inc.

Truckee, CA

On behalf of:

Truckee River Watershed Council

Truckee, CA

December 2017

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PROJECT DESCRIPTION AND SCOPE

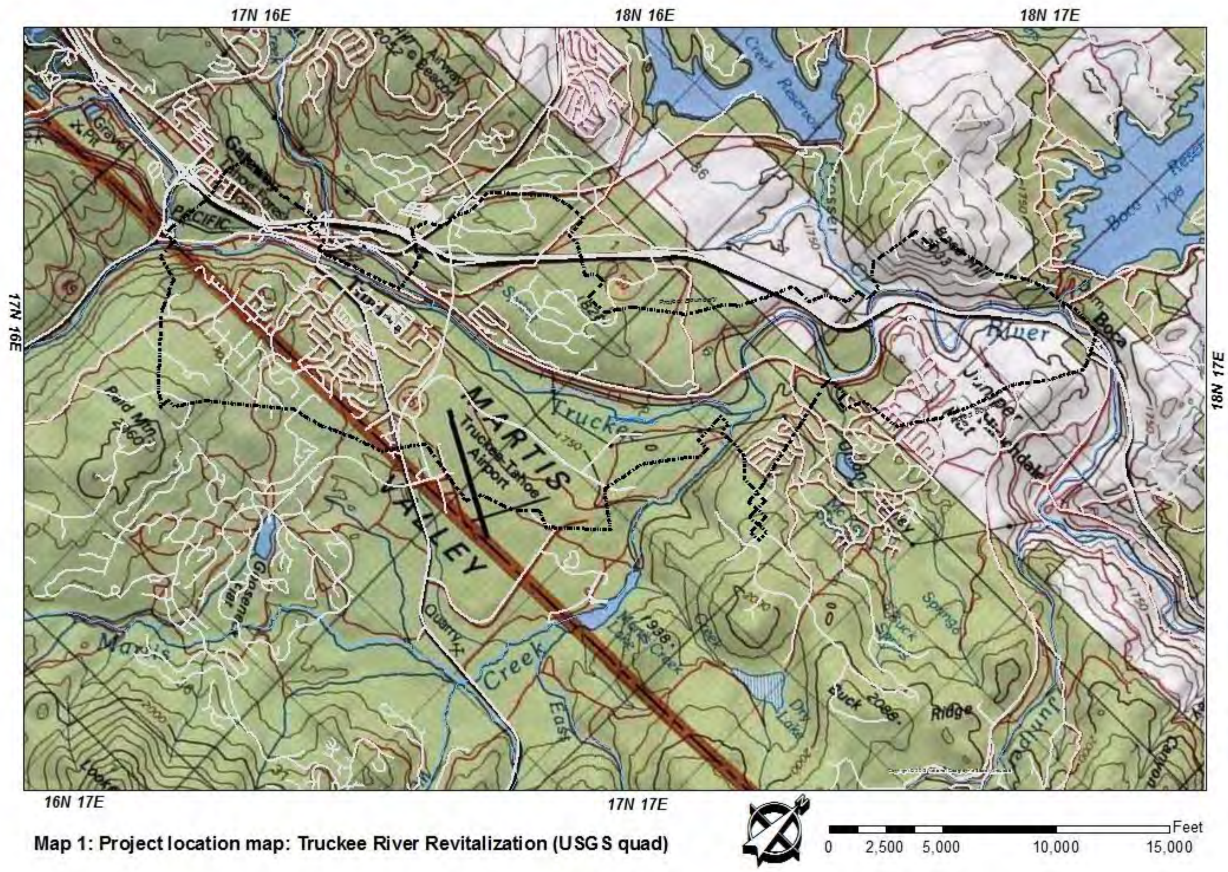
The McIver Dairy-Truckee River Revitalization study area encompasses approximately 11 miles of watershed along the middle reach of the Truckee River between its confluence with Donner Creek on the west and Little Truckee River on the east. The study area is in Nevada County within the Town of Truckee (maps 1-4). The river reach under study falls within Township 17 North, Range 16 East sections 11-12 and 14-16; Township 17 North, Range 17 East sections 5-7; and Township 18 North, Range 17 East sections 28-29 and 31-33 M.D.M. (Truckee, Martis Peak and Boca 7.5' quadrangles).

Over the past century and a half, the river reach has experienced physical and ecological impacts, in part due to anthropogenic disturbances that are largely associated with natural resource exploitation involving the logging, ice, dairying, and recreation industries, and impacts due to modern transportation, land and community development. These impacts have altered the health of the watershed's hydrology, geomorphic processes, water quality, and biological resources. The Truckee River Watershed Council (TRWC) is engaged in a sediment-source assessment as part of its coordinated water management strategy to evaluate the watershed's natural attributes, disturbances, existing conditions, and opportunities for restoration and access. The sub-watershed meadow containing the historic McIver Dairy is specifically targeted for restoration of four acres of wetland. Overall project goals are designed to identify and reduce sediment sources reaching the Truckee River and identify potential areas of improved or new public access to the Truckee River.

To accomplish this work, the TRWC has retained a multidisciplinary team led by Balance Hydrologics, Inc., and joined by Dudek to develop a mix of ecological restoration and storm-water treatments. Susan Lindström, Ph.D., Consulting Archaeologist, has collaborated in this effort to provide a contextual overview of human land use and preservation guidelines regarding cultural resources within the study corridor. Human beings are a noteworthy component of the Truckee River watershed ecosystem. Watershed restoration efforts can benefit from an understanding of the long-term ecological role of aboriginal peoples, as well as historical Euroamerican populations, in the dynamics of wild plant and animal populations and alterations of the physical environment. Interdisciplinary science team collaboration is a productive means to explore the direct link between culture history and contemporary restoration project design and implementation to provide the science and policy information needed to establish a baseline to direct restoration and protection projects within the watershed.

The goal of the cultural component of this multidisciplinary study is to assist project planners in assessing potential restoration opportunities and constraints along the Truckee River study corridor by documenting human land use and thereby the potential link between historic conditions and contemporary environmental restoration and protection efforts. Specific objectives are as follows.

- Review readily available archaeological, ethnographic and historic background data and present a brief contextual history of the Truckee River corridor study area.



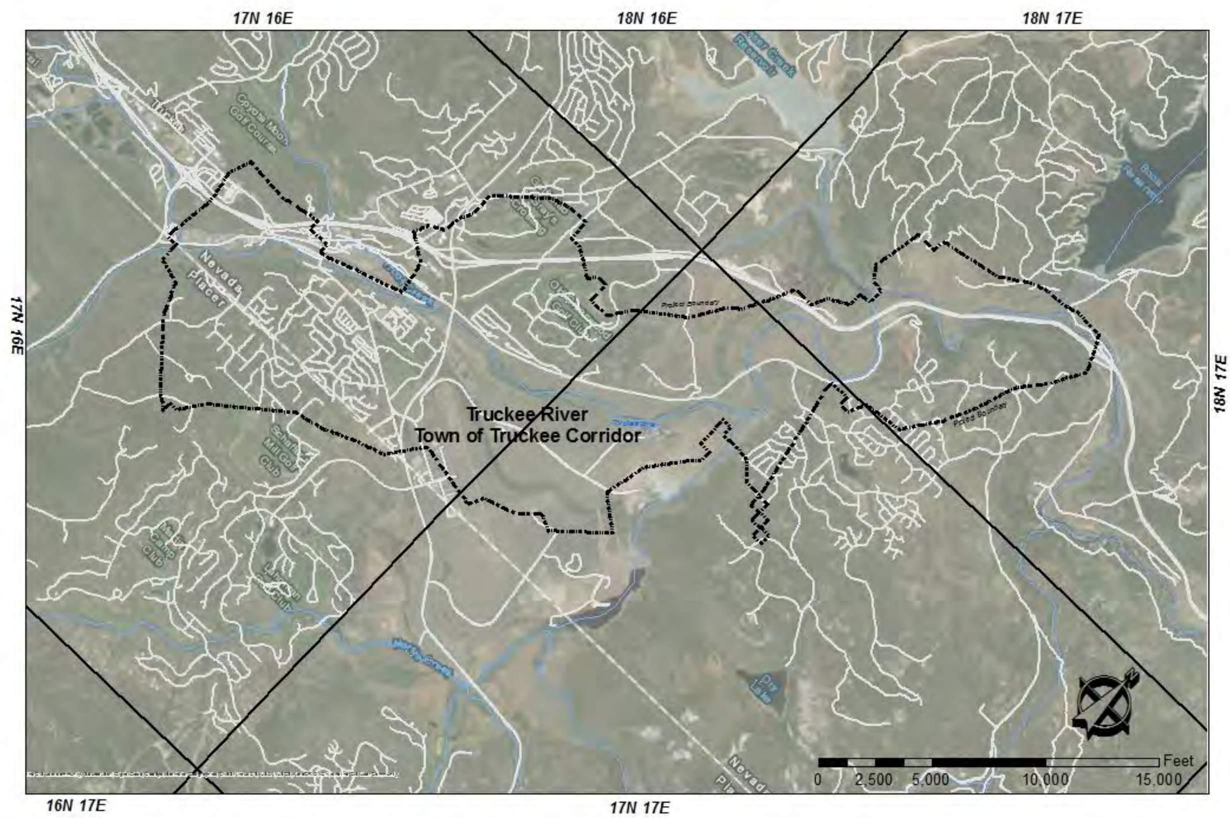
Map 1: Project location map: Truckee River Revitalization (USGS quad)

- Assess the potential for important cultural resources to occur within the study area, and identify the relative sensitivity of lands potentially targeted for watershed restoration improvements with regards to prehistoric and historic archaeological sites and Native American and Euroamerican traditional cultural properties.

- Map and describe the major historic commercial-industrial sites along this stretch of river (e.g., sawmills, ice works, railroad facilities, dams, etc.).

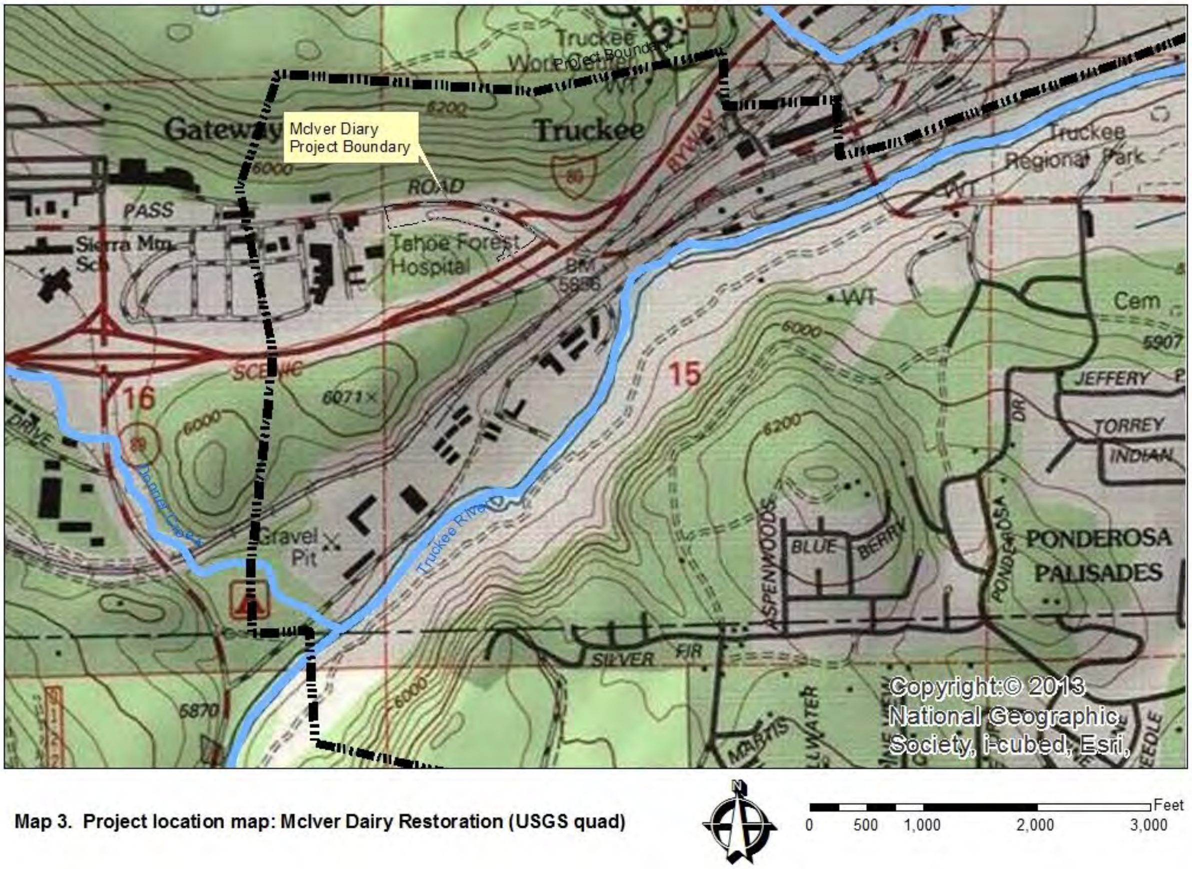
- Provide a specific historical context of the McIver Dairy, highlighting relevant historic activities that may contribute to potential sources of former (and continuing) sediment loading into the sub-watershed – areas that may be targeted as future restoration projects.

- Summarize applicable guidelines developed by State of California, County of Nevada and by the Town of Truckee for the protection, preservation and eventual interpretation of extant archaeological and architectural remains.

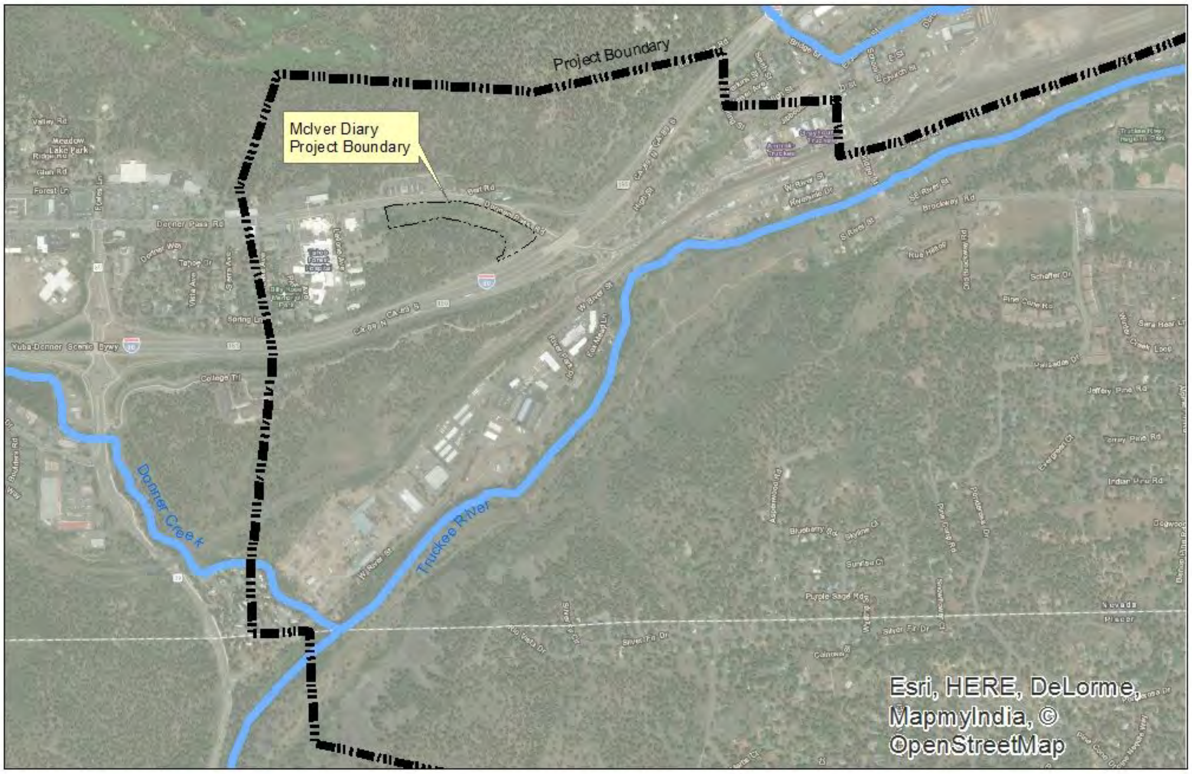


Map 2: Project location map: Truckee River Revitalization (aerial photo)

Historical data are compiled into a "work book" format, in anticipation that additional archival and field research would follow. While this work book appears as an appendix to the main watershed assessment environmental document, it has been prepared as a stand-alone report, which according to standard archaeological protocol is to be filed independently with the North Central Information Center at California State University, Sacramento, an adjunct of the State Office of Historic Preservation's archaeological master data center. The work book begins as a historical narrative, supplemented with contemporary maps (maps 5-6) and corresponding table (Table 1) showing key locales of Native American occupation and historic industries along the river reach. The text is interspersed with miscellaneous historical maps and photographs. Findings presented in this work book are preliminary. Follow-up focused prefield research and intensive field archaeological surveys would be conducted as part of subsequent restoration design and environmental review.



Map 3. Project location map: McIver Dairy Restoration (USGS quad)



Map 4. Project location map: McIver Dairy Restoration (aerial photo)

Feet 0 500 1,000 2,000 3,000

GUIDELINES FOR THE MANAGEMENT AND PRESERVATION OF CULTURAL RESOURCES

To balance restoration/storm water treatment design objectives with historical importance, a summary of historical preservation ordinances is summarized. These requirements assist planners in weighting the merits of the preservation of historical areas against meeting sediment reduction goals in balanced historical/ecological restoration.

Town of Truckee Guidelines

The *Town of Truckee General Plan*, *1995-2014*, *Volume 1 Goals and Policies*, Chapter 4, "Conservation and Open Space Element", provides guidelines for the management, protection and preservation of cultural and historic resources, as follows.

- "Conservation and Open Space Policy 4.1. Develop a Transfer of Development Rights ordinance to provide incentives for permanent protection of the…McIver Dairy site, and other visually and biologically important areas."

- "Conservation and Open Space Goal 9. Protect cultural and historic resources and accommodate public access as appropriate.
    - Conservation and Open Space Policy 9.1. Require evaluation of impacts to cultural resources for projects which involve substantial site disturbance.
    - Conservation and Open Space Policy 9.2. Encourage appropriate reuse of historic structures for housing, public recreation, and commercial uses without compromising their historic character.
    - Conservation and Open Space Policy 9.3. Maintain regulatory standards that protect and preserve the historic quality of the Downtown Historic District and other historic structures in Town.
    - Conservation and Open Space Policy 9.4. Request the inclusion of significant sites or districts in the Federal or State Historical Register based on the recommendation of local historical societies or a qualified professional archaeologist/historian.
    - Conservation and Open Space Policy 9.5. Encourage and cooperate with the private sector in the implementation of innovative techniques intended to preserve archaeological and historic sites by gift, private conservancies and easements.
    - Conservation and Open Space Policy 9.6. Work with State Parks, the Recreation and Parks District, the Historical Society, the Truckee Donner Land Trust, and other appropriate entities to increase opportunities for public recreation and access to historic sites as appropriate.

Truckee Downtown Specific Plan, Volume 3: Historic Design Guidelines

The *Truckee Downtown Specific Plan, Volume 3: Historic Design Guidelines* (2003) presents design review guidelines for the downtown historic overlay in Truckee. These guidelines apply in addition to design standards and development regulations that are found in the Town's Development Code. The publication includes guidelines that are used by the Town in determining the appropriateness of proposals for improvements that involve alterations to historic buildings as well as new construction. Site work and improvements to existing, non-historic structures are also addressed. Guidelines are assessed by the Town's Historic Preservation Advisory Council and implemented on a case-by-case-basis by a review board.

In addition to general guidelines for preservation and new development, special guidelines are included for "Design Districts and Character Areas" that relate to differing design contexts of individual neighborhoods. As a result, the historic area of Downtown Truckee is divided into nine geographic" Character Areas." Portions of the Truckee River Revitalization Project fall within the "Brickelltown", "River", and "Railroad" character areas.

Town of Truckee Architectural Inventory

Historic downtown Truckee is listed in the *Office of Historic Preservation Historic Property Directory*. The route of the Emigrant Trail, First Transcontinental Railroad and the

Truckee Jail appear in the *California Inventory* and the historic Dutch Flat and Donner Lake Wagon/1914 Lincoln Highway/Victory Highway/Old Highway 40 (i.e., Donner Pass Road) traverse through downtown. In addition, several *California Historical Landmarks* and *Points of Historical Interest* are included within in or adjacent to Truckee town. The Town of Truckee's commercial core area is listed on the National Register of Historic Places as a historic district. The Kruger House (i.e., C.B. White House) is individually listed on the National Register of Historic Places. Numerous other buildings and features qualify as contributing elements of the National Register District.

As prelude to the National Register District designation, several historic resource and architectural inventories were conducted (Lord 1980-1981; Christensen et al. 1999, 2001, 2004). In these studies, individual buildings, structures and objects were evaluated, including the McIver Dairy buildings. The Varney/McIver Dairy, although not included within the National Register of Historic Places District boundary, is listed on the Department of Parks and Recreation Historic Resources Inventory (November 1980) and described as follows.

> The two buildings which remain on this historic dairy site at the west end of Brickelltown are both wood framed with metal clad gable roofs. The larger building to the west set on a rock foundation, while the building to the east is on a pier foundation. Wood framed wood sash windows of small proportions are used in both buildings. Eaves have exposed rafter ends in both buildings. The two buildings sit on a large parcel of land which has become an important open space in the community. The meadow like land has a small pond at the west end where skaters can be found enjoying themselves during the winter months.
>
> Estimated construction = 1880; approximate property size, frontage = 300 feet, depth = 100 feet
>
> A.C. Varney was an important dairyman during the town's boomtown years. This dairy site was the source of much of the fresh dairy products used in the region during the latter part of the 19th century. The home located directly across Donner Pass Road was the Varney residence during the years he operated the dairy. The dairy site is now an important piece of open space in the community…

Even though the McIver Dairy area is outside the Truckee National Historic Preservation District, potential project impacts to this historic resource remain subject to the Town of Truckee general and specific plans and review by Truckee's Historic Preservation Advisory Council. How best to design around the historic structures will likely be a more nuanced discussion, where additional data are required to support project restoration alternatives.

County Guidelines

Chapter II of the *Nevada County Land Use and Development Code* requires a site-specific inventory and analysis of significant cultural resources and that this evaluation include recommended mitigation and/or alternatives necessary to avoid or lessen impacts (Section L-II 4.3.3 General Provisions) by:

> (1) avoiding the impact by designing so that the resource or constraint is fully protected and not disturbed;

(2) minimizing the impact through preparation and implementation of a county-approved management plan; and/or

(3) the use of compensatory mitigation.

Section L-II 4.3.6 lays out the purpose, definitions and standards regarding significant cultural resources. As a condition of project approval, a project sponsor is directed to conduct a records search at the North Central Information Center and initiate contact with the appropriate Native American group. Preservation and avoidance are the first priority and projects shall only be approved when they do not remove or disturb cultural resources, unless a county-approved management plan is implemented according to professional standards. Significant cultural resources discovered during project construction are also protected until a qualified professional can develop an appropriate management plan for their treatment. The locations of significant cultural resources are confidential and are not circulated as part of public documents, but are used for planning purposes only.

State Guidelines

State antiquities mandates under the California Environmental Quality Act (CEQA Section 5024, Public Resource Code) also provide guidelines for the management, protection and preservation of cultural and historic resources. For the purposes of CEQA, significant "historical resources" and "unique archaeological resources" are defined as (Section 15064.5[a]):

(1) A resource listed in, or determined to be eligible by the State Historical Resources Commission, for listing in the California Register of Historical Resources (Pub. Res. Code SS5024.1, Title 14 CCR, Section 4850 et seq.).

(2) A resource included in a local register of historical resources, as defined in section 5020.1(k) of the Public Resources Code or identified as significant in an historical resource survey meeting the requirements section 5024.1(g) of the Public Resources Code, shall be presumed to be historically or culturally significant. Public agencies must treat any such resource as significant unless the preponderance of evidence demonstrates that it is not historically or culturally significant.

(3) Any object, building, structure, site, area, place, record, or manuscript which a lead agency determines to be historically significant or significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California may be considered to be an historical resource, provided the lead agency's determination is supported by substantial evidence in light of the whole record.

DATA SOURCES AND CONTACTS

To accomplish the cultural study, Balance Hyrologics, Inc. contracted with Susan Lindström, Ph.D., Consulting Archaeologist. Dr. Lindström meets the Secretary of Interior's Professional Qualifications Standards in archaeology, history and related disciplines (48 FR 44738-44739). She has 43 years of professional experience in regional prehistory and history, holds a doctoral degree in anthropology/archaeology and since 1982 has maintained certification by the Register of Professional Archaeologists (RPA, former Society of Professional Archaeologists/SOPA). (See attached resume.)

Her research involved a cursory and broad-based literature survey of pertinent historic and prehistoric themes to assess the overall archaeological sensitivity of the study area. The contextual discussion presented in the report text and accompanying maps, photos and table is drawn from the existing literature, supplemented by personal notes and experience. This overview is far from exhaustive and data are uneven. Mostly assembled at an earlier time and for a different purpose, information has been adapted to fit into the McIver Dairy restoration and Truckee River revitalization assessment framework. A table description (Table 1) and various maps (maps 5-6) describe the major historic commercial-industrial sites along this stretch of river (e.g., sawmills, ice works, railroad facilities, dams, etc.).

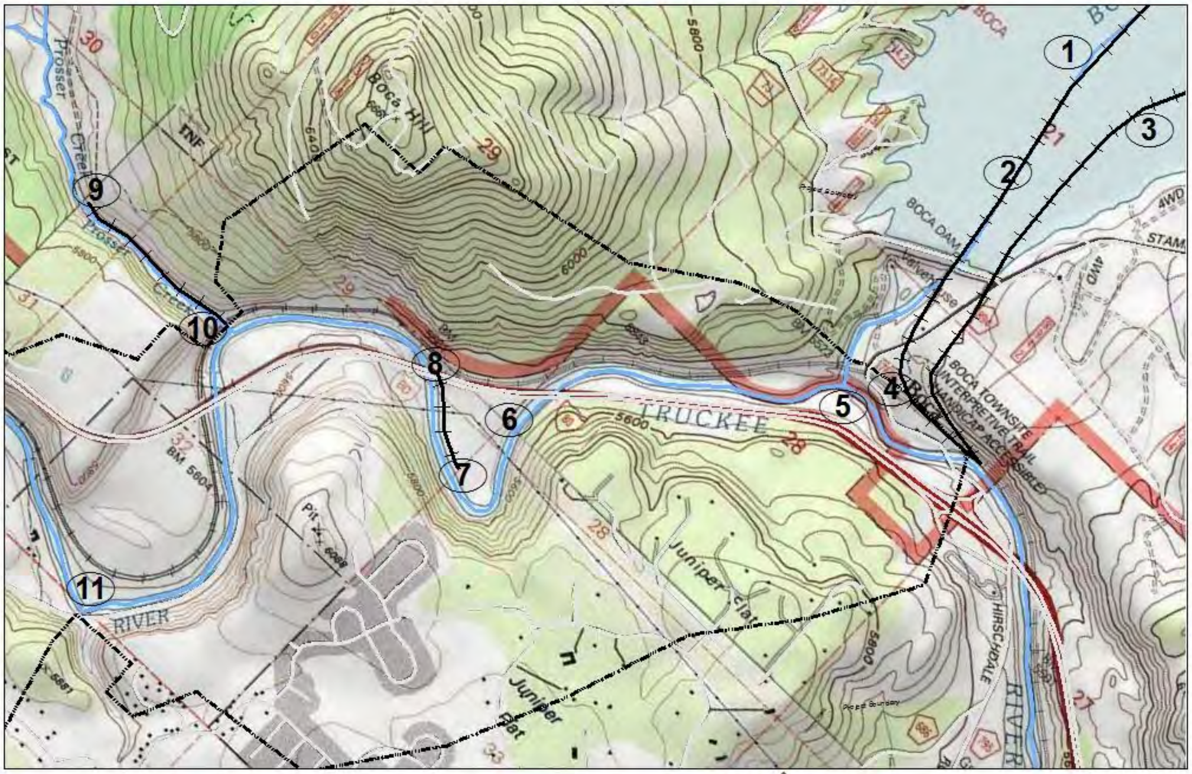
Historical files of the Truckee Donner Historical Society were reviewed to locate pertinent historical photographs, maps, aerial photographs, oral histories, newspaper accounts, and other unpublished resources. Chaun Mortier, Research Historian and President of the Truckee Donner Historical Society, along with several Society board members were particularly helpful in this effort. Most information regarding the McIver Dairy was included in the *Joseph Family Photo Book* and the Society's *McIver File*. In addition, general local and state histories, regional inventories, miscellaneous unpublished manuscripts, and newspaper articles were examined.

Historical photographs are credited to a variety of sources (as listed beneath each image). Aerial photographs, on file with the U.S. Forest Service and dating from 1939, 1952, 1966 and the 1970s through 2000, were also reviewed.

Over four decades of miscellaneous regional research compiled by Dr. Lindström was cursorily reviewed and more focused studies regarding the study area were consulted. Resources comprise historic documents, photographs, Nevada County deeds and assessment records, and maps on file in the consultant's personal library.

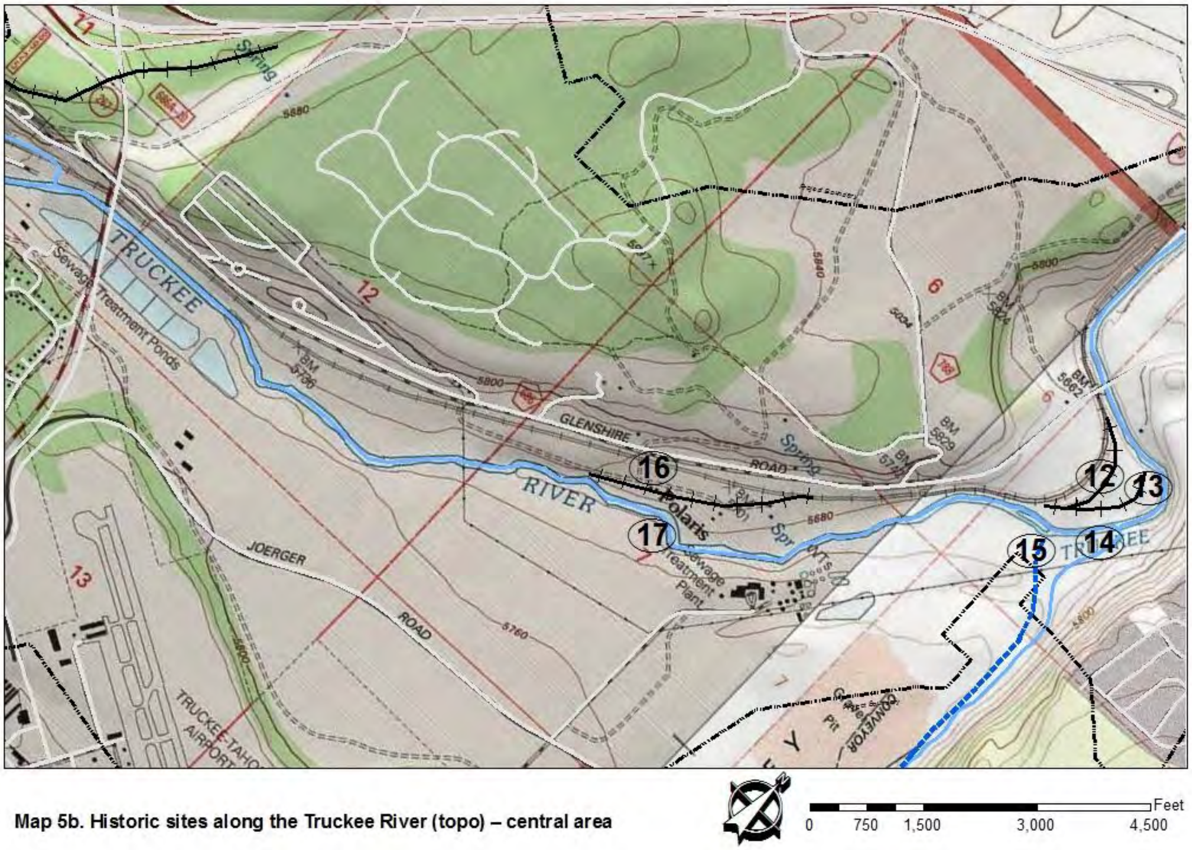
Table 1. Historic Sites in the Truckee River Study Area

Map Reference	Description	Date
1a	Boca Ice Co (Boca Mill & Ice Co)	1868-1926
1b	Boca Lumber Co (Boca Mill & Ice Co)	1866-1908
2	Boca Mill & Ice Co spur	1868-1926
3	Boca & Loyalton Railroad	1900-1917
4	Camp 17-Boca (station on Central Pacific RR)	Ca. 1868
5	Boca Beer Brewery	Ca. 1875/76-1893
6	Pacific Shingle Co	Ca. 1874
7	Nevada Ice Co and railroad spur	1872-1875
8	Camp 16-Pacific (station on Central Pacific RR)	Ca. 1868-
9	Summit Ice Co and railroad spur	1872-1920
10	Prosser Creek Station and railroad spur	1870-1920
11	Union Mills Station	1868-1939
12a	Martis Creek Station and railroad siding	Ca. 1868-
12b	Brick charcoal kilns (3)	Ca. 1877
13	Richardson V-flume; Box Plant	1876-1886
14a	Placer mining	1863-1864
14b	Truckee Ice Co	1885-1887
15	Sisson, Wallace & Crocker Co V-Flume	1872-1887
16a	Stonewall-Proctor Mill	1868
16b	Winstead railroad siding	1901
16c	Polaris railroad siding	1901+
17	Tahoe Ice Co	1886-1919
18	Tecoma Smelter	1872-1875
19	Truckee River Electric Co	1888
20	Schaffer V-Flume	Ca. 1872-1905
21a	Hobart Southern Railroad Standard Gauge RR	1897-1936
21b	Fibreboard Corp. Standard Gauge RR	1946-1952
22a	Schaffer & Gray Lumber Mill	1867
22b	Joe Marzen stockyards ("Slaughter House Hill")	Ca. late 1800s-early 1900s
23a	Truckee Lumber Co drying yards	Ca. 1867-1909
23b	Von Flue (Fluee) Dairy	Ca. 1901
23c	Von Flue footbridge	Ca. 1901
23d	Prehistoric village/historic Washoe camp	n/a
24a	Base of Truckee Ski Jump/Toboggan Hill	Ca. mid-1890s
24b	Donner & Tahoe Narrow Gauge RR (terminates at Truckee Lumber Co drying yards)	1893-1900
25a	Lake Tahoe Railway & Transportation Co (narrow gauge RR)	1900-1925
25b	Southern Pacific Tahoe Branch Line (standard gauge RR)	1925-1943
26a	Varney Dairy	1873-1879
26b	McIver Dairy	1905-ca. 1940s

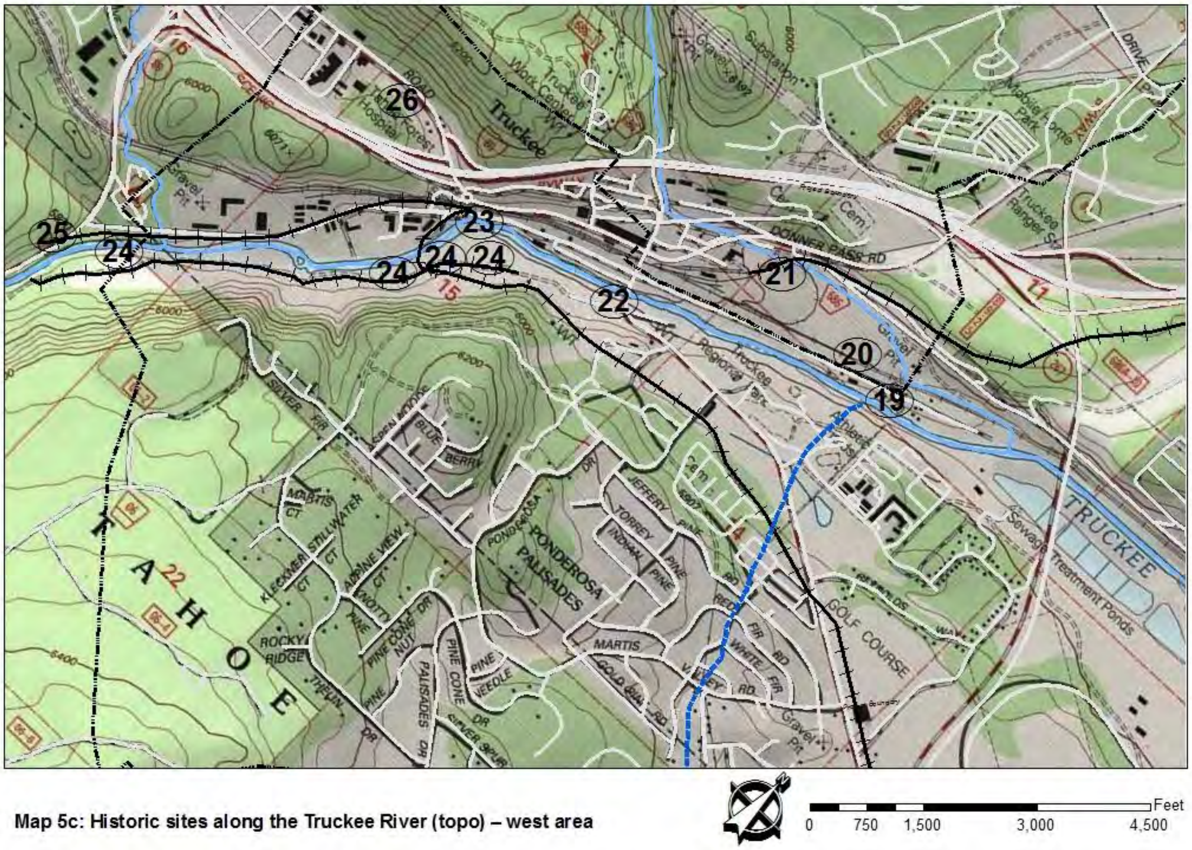


Map 5a: Historic sites along the Truckee River (topo) – east area

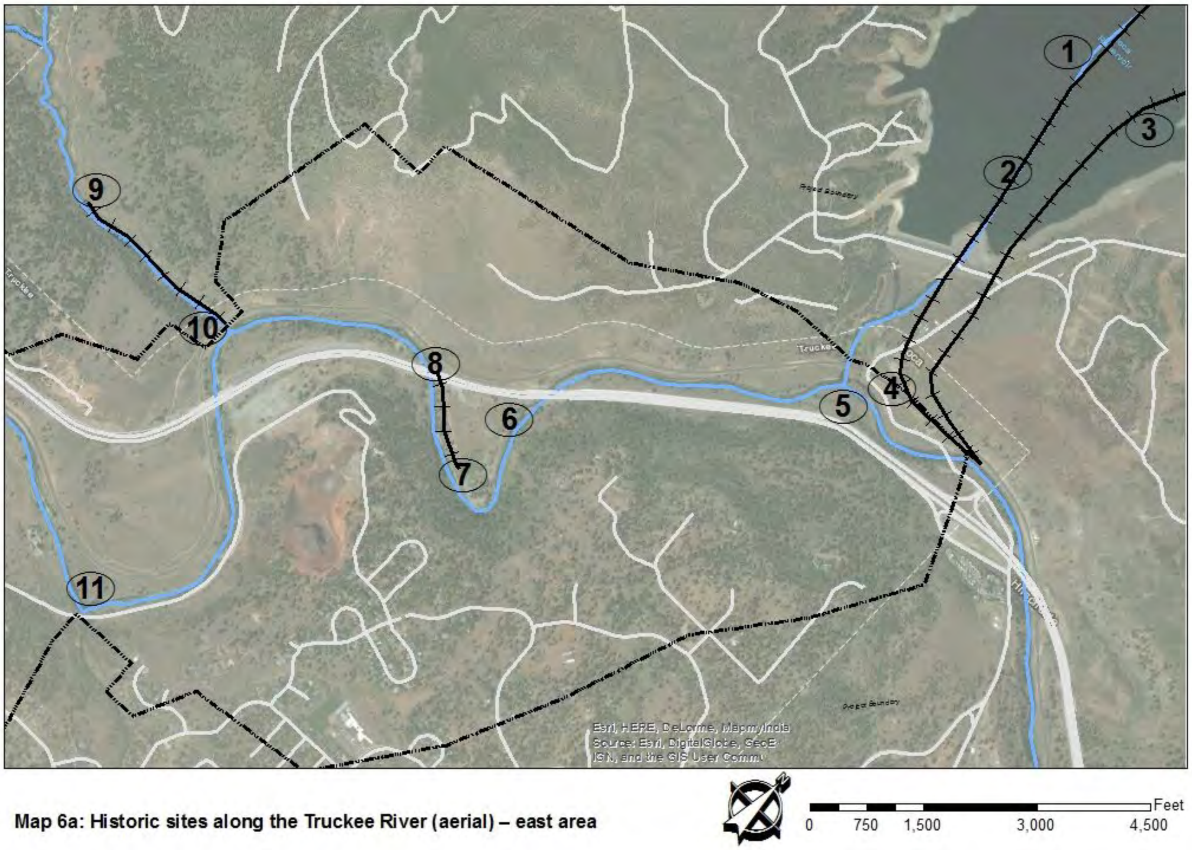
0 750 1,500 3,000 4,500 Feet



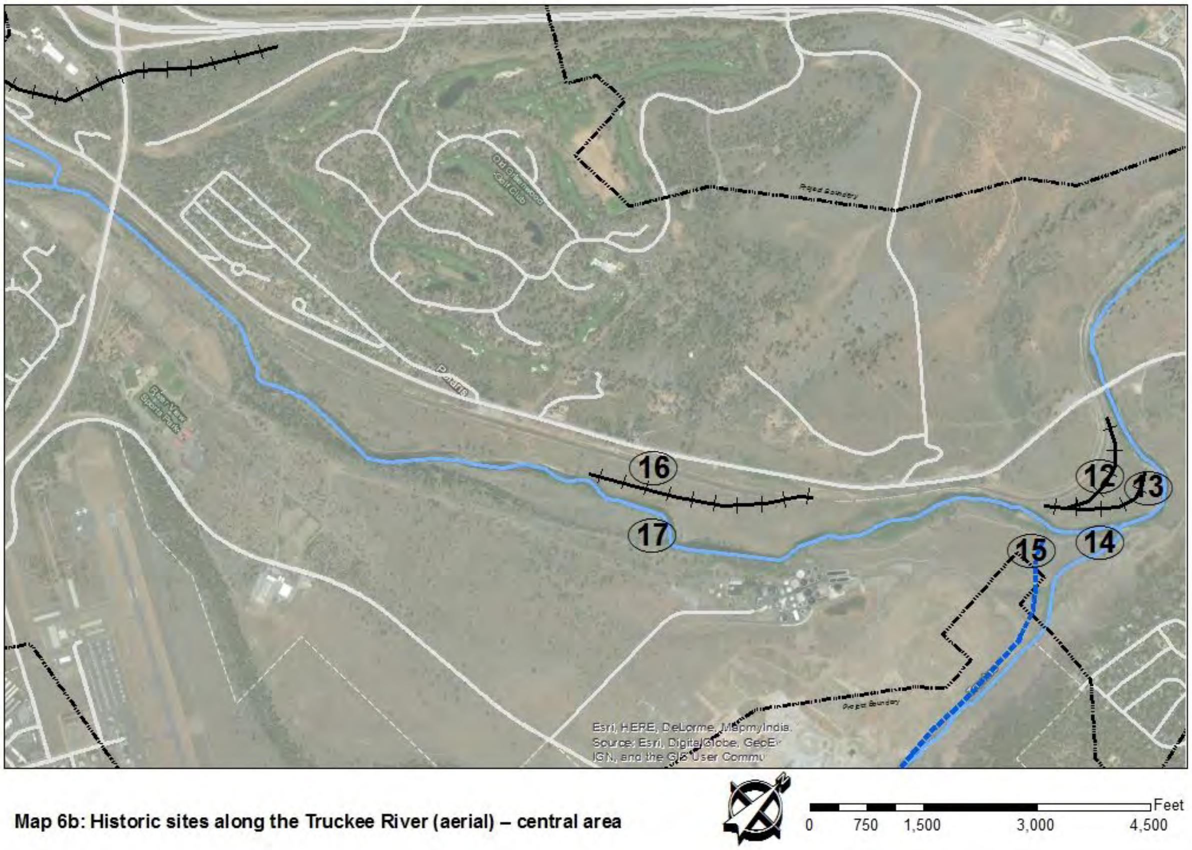
Map 5b. Historic sites along the Truckee River (topo) – central area



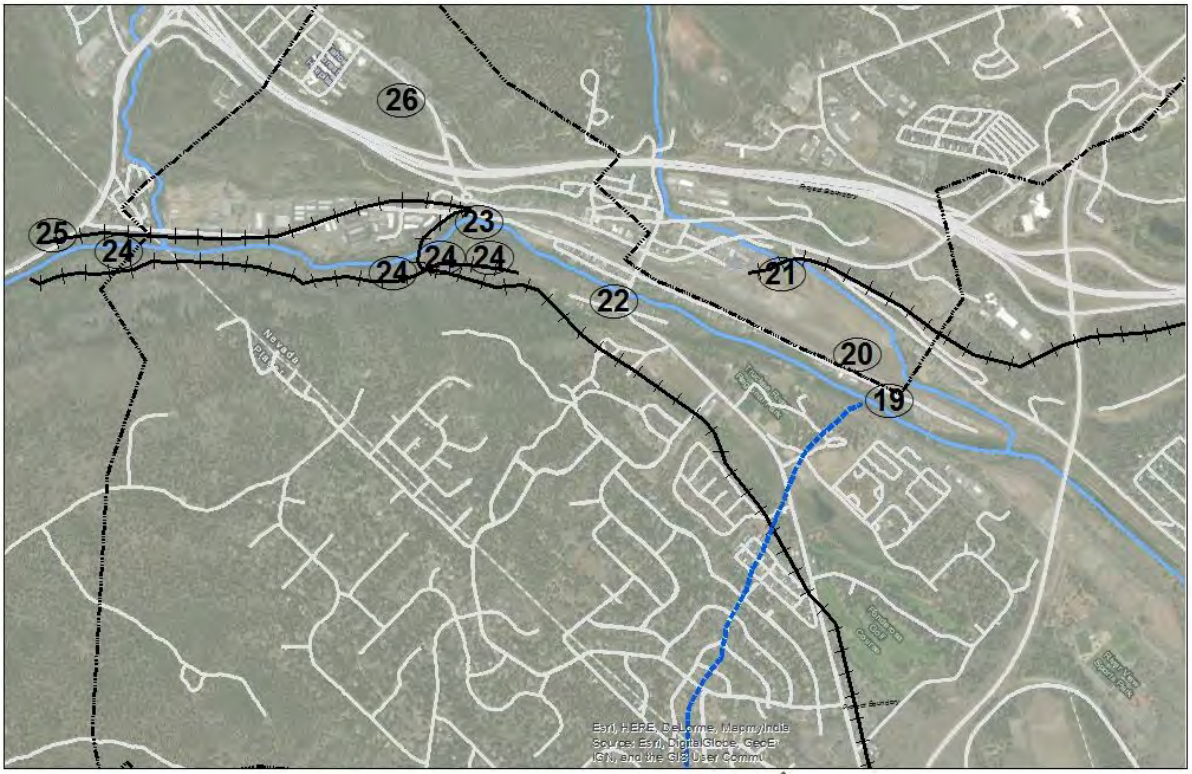
Map 5c: Historic sites along the Truckee River (topo) – west area



Map 6a: Historic sites along the Truckee River (aerial) – east area



Map 6b: Historic sites along the Truckee River (aerial) – central area



Map 6c: Historic sites along the Truckee River (aerial) – west area

SETTING

PHYSICAL ENVIRONMENT

Topography within the study area is gentle to moderately steep, with elevations ranging from about 5,840 feet at the confluence of Donner Creek down to 5,320 feet at the junction with the Little Truckee River. The project is situated in the Truckee Basin, an alluviated structural basin west of the Carson Range and east of the main crest of the Sierra Nevada. Low hills and ridges are Tertiary and Pleistocene volcanic rocks (Birkeland l963) and valley floors are covered with relatively flat-laying alluvial, glacial and glacio-fluviatile deposits (Birkeland l964). Holocene glaciation within the past 10,000 years was limited to the advance of small cirque glaciers. Pleistocene volcanic activity occurred between 2.3 and l.2 million years ago. These flows are correlated with the Lousetown Formation, a series of early Quaternary basaltic rocks extruded from several local vents that underlie much of the Truckee Basin and its flanks. The presence of tool stone-quality basalt in the project's vicinity attracted prehistoric populations into the general area for stone tool manufacture.

The study area lies within Storer and Usinger's (l97l) Yellow Pine/Jeffrey Pine Belt. In the Truckee Basin Jeffrey pine (*Pinus jeffreyi*) dominates forest stands and on the project site it shares dominance with ponderosa pine (*P. ponderosa*) and lodgepole pine (*P. murrayana*). Understory species include sagebrush (*Artemesia tridentata*), bitterbrush (*Pursia tridentata*), current (*Ribes* spp.), *Ceanothus (*spp.), and assorted forbs and grasses.

Typical fauna associated with these plant communities are also described in Storer and Usinger (1971) and include mule deer (*Odocoileus hemionus*), black bear (*Ursus americanus*), and a variety of small mammals and fish. The Truckee River sustained an extraordinarily productive and stable native fishery for thousands of years (Lindström 1992).

Potential human modifications to these habitat types and plant-animal associations began with the aboriginal management of plants and animals, followed by historic mining, transportation, logging, stock grazing and dairying activities, water reclamation, recreation, and residential and commercial development. It is doubtful that modern plant and animal communities closely resemble their pristine composition due to past disturbance. In former times the area is thought to have supported a luxuriant growth of native bunch grasses which allowed an abundant large game population (deer and antelope) and provided a nutritious source of seeds for use by prehistoric peoples. Oral histories from Native American Elders and with descendants of pioneer families document a variety of valued medicinal and edible plants within the Truckee River corridor. Forests within the watershed were intensively harvested from the later 1860s into the 1960s. Since the 1860s excessive commercial fishing, dam construction, disturbance of spawning grounds, obstruction of spawning runs, pollution of the watershed, and competition from introduced species combined to cause the demise of the native fishery by the 1920s. With the demise of native fish populations, programs intended to restore the sport fishery were based on unrecorded stockings of exotic aquatic species; the subsequent hybridization, competition, predation, disease, and taking of spawn completely decimated the native cutthroat trout.

PREHISTORY

In broadest terms, the archaeological signature of the Truckee-Donner area marks a trend from hunting-based societies in earlier times to populations that were increasingly reliant upon diverse resources by the time of historic contact (Elston 1982; Elston *et al*. 1977, 1994, 1995). The shift in lifeways may be attributed partially to factors involving paleoclimate, a shifting subsistence base, and demographic change. Some of the oldest archaeological remains reported for the Truckee Region have been found in the Truckee River Canyon near Squaw Valley. These Pre-Archaic remains suggest occupation by about 9,000 years ago (Tahoe Reach Phase). Other Pre-Archaic to Early Archaic occupation dating from about 7,000 years ago was documented at Spooner Lake (Spooner Phase) near Spooner Summit overlooking Lake Tahoe. The most intensive period of occupation in the region may have occurred at varying intervals between 4,000 and 500 years ago (Martis Phases during the Early and Middle Archaic, and Early Kings Beach Phase during the Late Archaic). The protohistoric ancestors of the Washoe (Late Kings Beach Phase), also of Late Archaic times, may date roughly from 500 years ago to historic contact.

WASHOE HISTORY

Regional Communities

The project area falls within the center of Washoe (*Wa She Shu*) territory, with primary use by the northern Washoe or *Wel mel ti* (Downs 1966; Nevers l976; Steward 1966). Three general settlement areas -- regional communities that include the Washoe descriptor "*detdéyi*" -- have been reported from the confluence with Donner Creek, east to Boca and the confluence of the Little Truckee River (d'Azevedo 1956; Rucks in Lindström et al. 2007). Rucks (2005) reported on this noteworthy concentration of settlements along the Truckee River between Donner Creek and the Little Truckee River at Boca, suggesting that this stretch of river was unusually productive. Washoe respondents also indicate that winter settlements were established up the Truckee River to Donner Lake in all but the most severe winters (d'Azevedo 1984:33).

Donner Creek

Datsáshit mál'im detdéyi? is located on Donner Creek 1/4 mile downstream from where highway crosses the creek; "on sunny side of hill" where the large lumber mill is located "on the spot of the settlement" (d'Azevedo 1956: #129). These were the Washoe people who may have encountered the Donner Party, as recounted in Washoe oral tradition and documented by a February 28, 1847 diary entry by Patrick Breen, who wintered at the Donner Lake camps.

Dewbeyulélbeti? is at the junction of Donner Creek and the Truckee River, "where *welmelti* [Northern Washoe] got much of their fish and game. Donner Creek was better fishing than Truckee; it was smaller and could be diverted (Freed 1966: #14). Families owned fish blinds and the reference to "*yutsim*" (a technique of capturing stranded fish by temporarily damming Donner Creek) refers to one of several communal fishing practices.

Truckee River and Town

The town and the river were named by non-natives for "Captain Truckee", the Northern Paiute Indian who famously guided the Stephens-Townsend-Murphy emigrant party (among others) from eastern Nevada over Donner Pass to California in 1844. The Truckee River which bears his name, was a travel corridor and conduit of resources (fish) and communication between *wélmelti'* and their Northern Paiute neighbors.

K'ubüna[u] detdéyi? refers to the settlement on the south side of the river across from Commercial Row (d'Azevedo 1956: #130). The place where the Town of Truckee is located is also known as *Dawbayóyabuk*, translated as "flowing through a narrow place or passage" (Merriam 1904). This general site area has been inventoried as archaeological site CA-Nev-74/H. In 1902 the camp was described as: "Indian camp across the river. Washoe people. Bedrock mill and ponderous pestles of granite. The arbor shelter on the sun side." Early commentators were impressed by unique patterns on Washoe basketry, and by Washoe fishing technology such as fish hooks, fish spears, and seines (Hudson 1902).

Dat'sa sut ma'lam detde'yi' describes a Washoe encampment near Gateway (d'Azevedo 1956:51, 55).

Péle? má'lam detdéyi? is the name of an old Washoe settlement at the confluence of Trout Creek and the Truckee River (d'Azevedo 1956: #131).

Boca

<u>Wálsi?</u> *wáta* refers to the lower stretch of Little Truckee River, above Boca (d'Azevedo 1956: #133).

<u>Wálsi?</u> *wáta mál'im detdéyi?* is a "camp on the side of a hill" at Boca at the mouth of the Little Truckee River (d'Azevedo 1956: #133).

Land Use and Contact Period

The Washoe once embodied a blend of Great Basin and California in their geographical position and cultural attributes. While they were an informal and flexible political collectivity, Washoe ethnography hints at a level of technological specialization and social complexity for Washoe groups, non-characteristic of their surrounding neighbors in the Great Basin. Semisedentism and higher population densities, concepts of private property, and communal labor and ownership are reported and may have developed in conjunction with their residential and subsistence resource stability (Lindström 1992).

The ethnographic record suggests that during the mild season, small groups traveled through high mountain valleys collecting edible and medicinal roots, seeds and marsh plants. In the higher elevations, men hunted large game (mountain sheep, deer) and trapped smaller mammals. Suitable toolstone (such as basalt) was quarried at various locales north of Truckee town. The Washoe have a tradition of making long treks across the Sierran passes for the purpose of hunting, trading and gathering acorns. These aboriginal trek routes, patterned after game trails, are often the precursors of our historic and modern road systems. Archaeological evidence of these ancient subsistence activities is found along the mountain flanks as temporary small hunting camps containing flakes of stone and broken tools. In the high valleys permanent base camps are represented by stone flakes, tools, grinding implements, and house depressions.

Into the early 20th century, Washoes survived by trading goods and services to the dominant Euroamerican population and establishing patronage relationships on ranches (selling baskets, catching fish and game, and working as domestic laborers, wood cutters, ice harvesters, caretakers, game guides, etc.). In exchange Washoes arranged for camping privileges on traditional lands with access to what resources remained. Even into the 21st century, the Washoe were not completely displaced from their traditional lands. For example, pioneer residents of South (west) River Street, Karl Kuttel (personal communication 2007) and Nick Sassarini (personal communication 2006), recalled a traditional Washoe camp at the west end of the street at the old "Tonini Spring", which was once the domestic water supply for all of South (west) River residents. Washoes were "permitted" to use the water for domestic purposes. Their Washoe neighbor, Betty Kennedy, lived on the street into the 1970s. Contemporary Washoe have developed a Comprehensive Land Use Plan (Washoe Tribal Council 1994) that includes goals of reestablishing a presence within the Tahoe Sierra and re-vitalizing Washoe heritage and cultural knowledge, including the harvest and care of traditional plant resources and the protection of traditional properties within the cultural landscape (Rucks 1996:3).

Photo 1. 19th century Truckee looking from Hilltop northeastward across the Truckee River to the railyards and roundhouse; Bridge Street bridge (lower left); Chinatown represented by peaked roofs (lower center and lower right); photo courtesy of Truckee Donner Historical Society

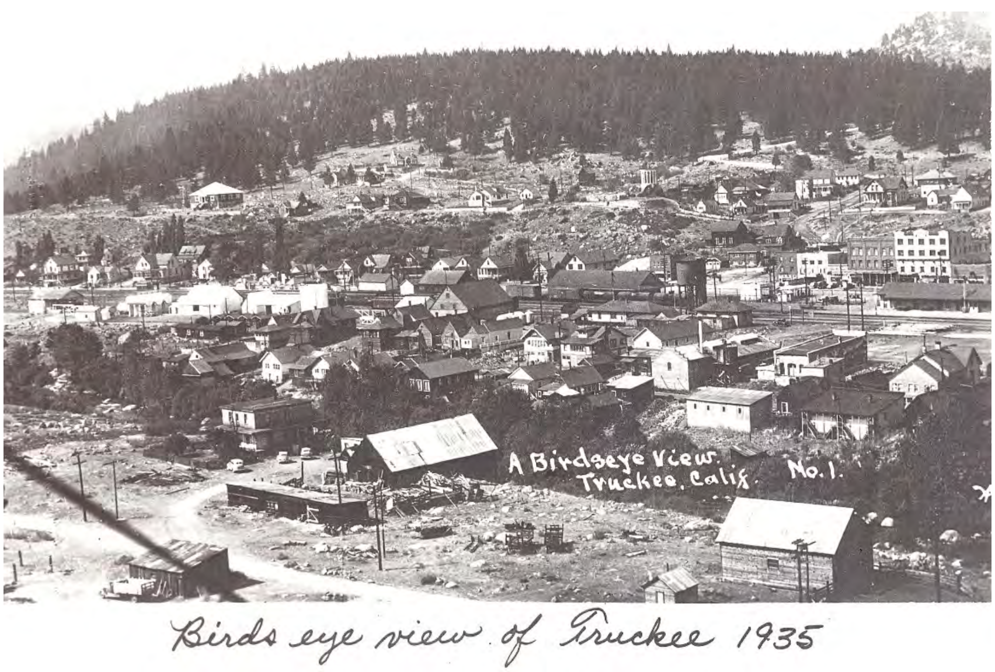


Photo 2. "Birds eye view of Truckee 1935"; looking from Hilltop northwestward across the Truckee River to High Street; photo courtesy of Truckee Donner Historical Society

HISTORIC PERIOD

As one of the major urban areas of Nevada County, Truckee has been what historians call an "urban frontier," or an urban area with many characteristics of the frontier (photos 1-2). A history of the community of Truckee is marked by the arrival of Joseph Gray, who built a stage station near the present-day downtown in l863. Gray was soon joined by a blacksmith named S. S. Coburn, and the fledgling settlement of Gray's Toll Station was renamed Coburn's Station. This tiny way station grew from two structures into a thriving town that accommodated emigrants, stagecoach travelers and freight wagons in route westward to California's gold fields and eastward to the Comstock Lode in Nevada. In 1868 Coburn's Station burned and the name was changed to Truckee. Throughout the rest of the 19th century, Truckee thrived on the related fields of lumber, railroading and ice. By the 1920s, this industrial economy and society had largely disappeared, due in major part to the relocation of the train's switching yard to Roseville, the depletion of local timber supplies and the development of mechanical refrigeration. In its place, the community began to develop into a recreation-based economy, boosted by the completion of a transcontinental highway over Donner Pass (Lincoln Highway/Victory Highway/ U.S. Highway 40/Interstate 80).

Mining

A brief flurry of mining (lasting only a few months) was staged out of Martis Valley during the summer of 1863 when several quartz ledges were discovered. The initial focus of mining at the diggings in Martis Valley, known as the Red, White, and Blue Mining District, was along Middle Martis Creek where miners dug "coyote holes" and bored shafts and tunnels. While efforts were centered on hard rock mining and silver ore, some industrious miners in a search of free gold washed down from these ore deposits also engaged in limited placer mining along main Martis Creek and the Truckee River. Placer mining features survive near the mouth of Martis Creek (maps 5-6), where bench deposits were once worked by ground sluicing and shallow placer mining (e.g., pans, rockers, long toms, and sluice boxes). Workings are marked by an artificial water channel that diverted creek water through a "cut"that drained directly into the Truckee River. Adjacent gravel banks were brought down by picks, forks and shovels. Cobbles removed from the herringbone-patterned-ground sluice trenches were stacked vertically on ground along the trenches to form a series of low cobble walls.

Transportation

Emigrant Travel

Some of the first Euroamerican visitors to the Truckee area were members of the Stephens-Murphy-Townsend emigrant party who ascended the Truckee River in mid-November of l844. This route, which passed through Truckee along present-day Donner Pass Road, has later become known as the Truckee Route of the Emigrant Trail.

Dutch Flat Donner Lake Wagon Road/Lincoln-Victory Highway/Old Highway 40

In 1864 the Dutch Flat and Donner Lake Wagon Road was opened over Donner Pass and followed basically the same route through Truckee that the earliest emigrants had traveled. This historic route (which now follows present-day Donner Pass Road, maps 5-6) bisects the McIver Dairy. The freight and passenger wagon road was situated near the proposed alignment of the Central Pacific

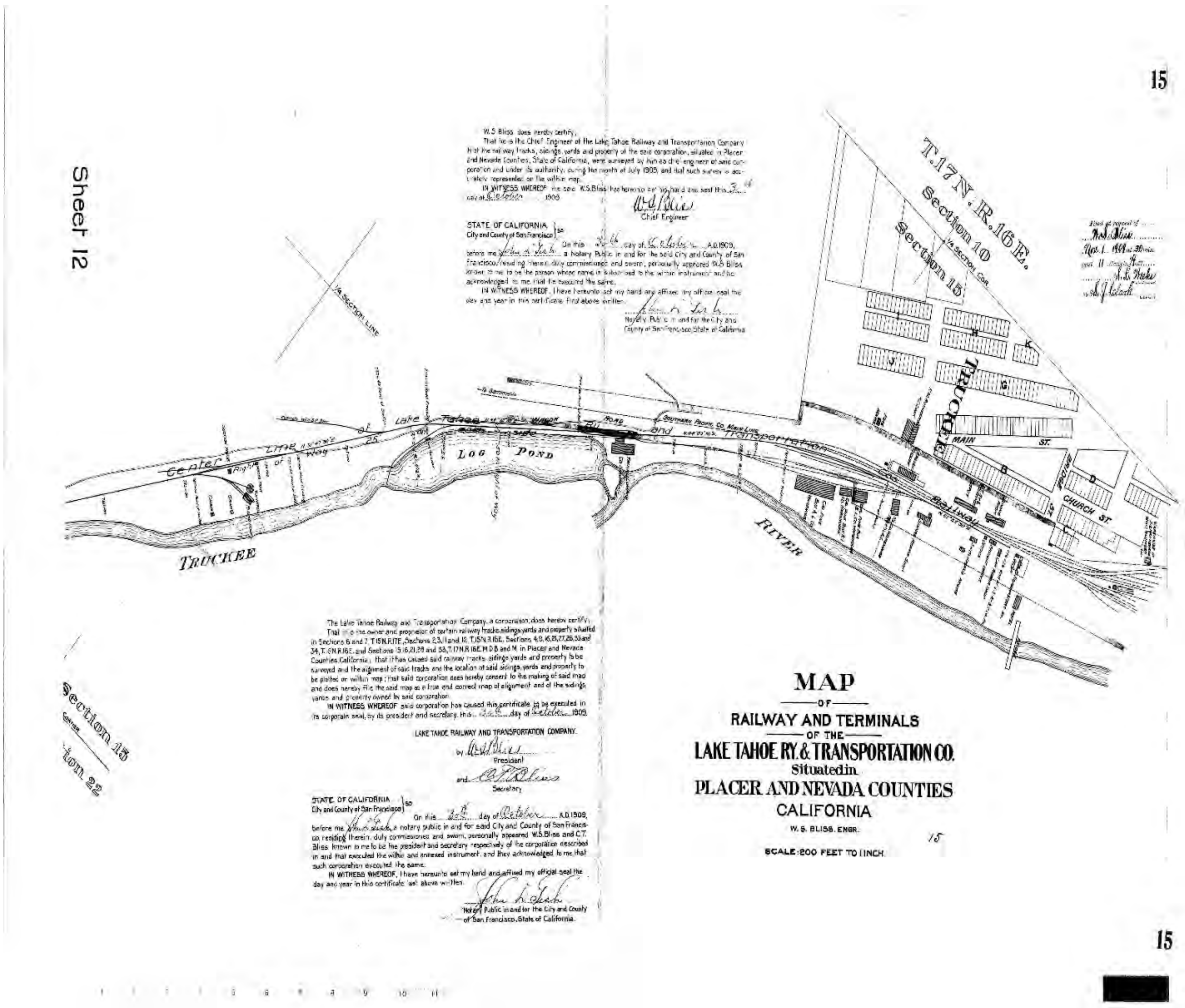
Railroad (CPRR, later Southern Pacific Railroad and currently owned by the Union Pacific Railroad). The wagon road was designed to facilitate the transport of supplies to points along the rail line. The road formed the final link in a continuous freight and passenger road from Dutch Flat to the Comstock mines near Virginia City (Hoover, Rensch and Rensch l966:267). To facilitate travel through the region, a bridge was constructed across the Truckee River in 1863. The Bridge Street bridge was essential to the development of Truckee town and the surrounding region (*Sacramento Daily Union* 8/26/1863), and serves the community to the present day.

The expanding state and national highway system during the early part of the 20th century was pioneered by the Lincoln Highway, the nation's first transcontinental auto road. The Lincoln Highway concept was conceived in the fall of 1913 by the Lincoln Highway Association, in concert with the fledgling auto industry and its support industries. The route of the Lincoln Highway/Victory Highway/Old Highway 40 over Donner Pass closely follows the original route of the Dutch Flat Donner Lake Wagon Road and portions of the Emigrant Trail (maps 5-6). In the 1920s, portions of the Lincoln Highway were re-designated as the "Victory Highway", conceived as a memorial to veterans of World War I. In 1928 the roadway was incorporated into the Federal Highway system and designated as U.S. Route 40. In 1963-1964 portions of the two-lane U.S. 40 were incorporated into the new interstate highway system and became the four-lane Interstate 80. However, a continuous segment of "old" U.S. 40, stretching from the Glenshire Bridge (five miles east of Truckee), westward over Donner Summit and down to Cisco Grove (approximately 20 to 25 miles), escaped impact by the new interstate freeway.

Transcontinental Railroad

The first transcontinental train rolled into Coburn's Station in l868 (Kraus 1966). Truckee was a major maintenance station along the route of the CPRR. The CPRR and sidetrack were located near the confluence of Trout Creek and the Truckee River (Photo 1). The completion of the transcontinental railroad gave rise to other developments in the transportation, lumbering, ice, agriculture, dairying, and the tourism industry, which were to become the essential economic bases of Truckee. Various stations along the route of the railroad (shown on maps 5-6) were established as a base from which to export local lumber products and ice, e.g., Camp 17-Boca Station, Camp 16-Pacific, Prosser Creek Station and railroad spur, Union Mills Station, Martis Station and railroad sidings, and Winstead/Polaris.

<u>Lake Tahoe Railway and Transportation Company</u>. Several branch railroads tied into the main line at Truckee (maps 5-7). Family members of lumber baron D. L. Bliss incorporated the Lake Tahoe Railway and Transportation Company railroad in December 1898. The necessary right-of-way was secured across lands of the Truckee Lumber Company and Bliss purchased the site of the Tahoe Tavern resort at Tahoe City, which served as the major steamer stop for ports of call around Lake Tahoe (Myrick 1962:430). Beginning in 1900 the railroad operated a 15-mile-long narrow-gauge railroad following the Truckee River between the main line at Truckee and the Tavern. Unlike previous railroads in the Tahoe region, the Lake Tahoe Railway and Transportation Company line was intended primarily as a tourist railroad. In 1925 the narrow-gauge railroad was leased to the Southern Pacific Railroad. In exchange, Southern Pacific widened (i.e., standard-gauged) the



Map 7. "Map of Railway and Terminals of the Lake Tahoe Ry. & Transportation Co." 10/30/1909

tracks and operated Pullmans with over-night service between San Francisco and Tahoe City (Scott 1957:45; Myrick 1962:435-436). An extensive publicity campaign was launched, and Tahoe was promoted as an all-year resort. The Southern Pacific Tahoe Branch Line standard gauge railroad line was abandoned in 1943, as more automobile traffic moved over the highways (Myrick 1962:436).

Sierra Nevada Wood and Lumber Company Narrow Gauge/Hobart Southern Railroad Railway/Fibreboard Corporation Standard Gauge. In 1896 the Sierra Nevada Wood and Lumber Company relocated their mill from Lake Tahoe seven miles north of Truckee and established the company town of Overton (later known as Hobart Mills). A new standard gauge railroad was built between Overton and Truckee to connect the new facilities with the main transcontinental line at Truckee (maps 5-6). In 1917 the company disbanded, and holdings were transferred to the Hobart

Estate Company and the railroad line between Hobart Mills and Truckee became the Hobart Southern Railway. From 1930 to 1937 the line not only transported wood products but also served as a common carrier. Two trains operated daily until 1936, when Hobart Mills closed after operating almost 40 years as one of the principal lumber operations in the Truckee Basin. Immediately following World War II, Fiberboard Paper Products Corporation commenced logging in the project vicinity. In l946 Fiberboard built a new standard gauge railroad on the old right-of-way of the former Hobart Southern Railway. The railroad was taken up in 1955.

Lumbering

Logging was first initiated in the Truckee area after the discovery of the Comstock Lode in l859. When production began to fall in the mines in l867, the lumbering business also began to suffer. A new market for lumber was found in the CPRR. As the rails reached the summit in l866-1867, several mills established operations in the Truckee Basin to supply the railroad with cordwood for fuel, lumber for construction and ties for the roadbed. Coburn's Station (Truckee) soon became one of the major lumbering centers. Over 18 sawmills were operating in the Truckee area during the late l9th century. After the completion of the railroad in l868-1869 lumber companies diversified and grew as new markets were opened to them (Knowles 1942). The expansion beyond saw milling targeted such facilities as planing mills, box factories, sash and door establishments, a chair factory and furniture factory, shingle mills, and charcoal earthen and brick kilns. Mill sites were oriented primarily along main streams, such as the Truckee River, which insured easy access to water to power machinery, to supply boilers, to float logs or lumber, as well as for domestic use (Wilson 1992:12).

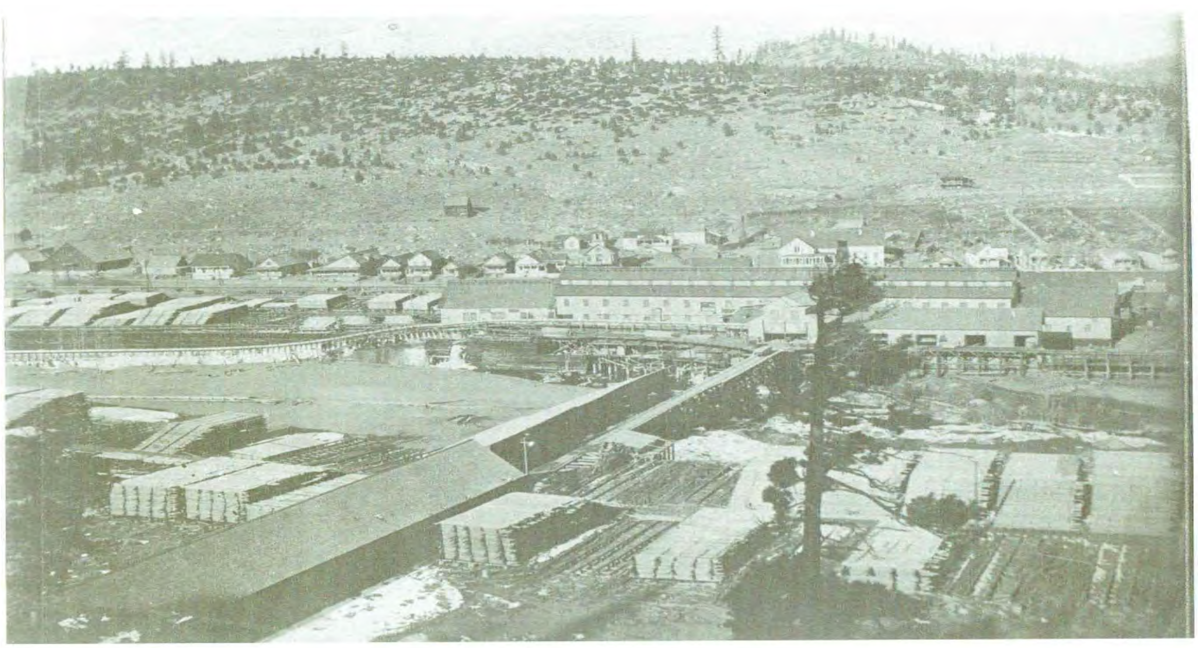


Photo 3. Truckee River Lumber Company lumber drying yards, trestle flumes and tramways; looking from Hilltop north-northwestward across the Truckee River to the sawmill and Brickelltown; the company millpond is located upstream to the left and out of view; company was in operation 1867-1909; photo courtesy of Truckee Donner Historical Society

Joseph Gray and George Schaffer started the earliest sawmill in Truckee town in 1866-1867 (Edwards; 1883:21; Knowles 1942:9, 16). Their mill property, adjacent to the southwest side of the Bridge Street bridge (maps 5-6), was subsequently transferred to the Truckee Lumber Company. By 1871 Schaffer had purchased timber holdings and established a sawmill in Martis Valley. Until operations ceased in 1905, Schaffer transported mill products by V-flume down to the CPRR (maps 5-6).

The Truckee Lumber Company was established in 1867 by E. J. Brickell and George Geisendorfer (Knowles 1942:17, 39). In 1873 W.H. Kruger bought a half interest in the company and together, Kruger and Brickell expanded their timber holdings and mill operations to become the largest and longest-standing lumber firm in the Truckee region. The company was unique in its

Photo 4. Truckee River Lumber Company millpond; looking eastward (downstream) towards sawmill and lumber drying yards at Truckee town; photo courtesy of Truckee Donner Historical Society

diversification of a variety of markets along the CPRR, operating its sash, blind, door, box, and furniture factories at Truckee (maps 5-6). The last years of company's activities were in 1909. The Truckee Lumber Company held considerable land holdings in Martis Valley (Myrick 1962:436), but had no means of accessing their timber tracts. The company negotiated a contract with the Pacific Lumber and Wood Company, a competitor based out of Clinton (present-day Hirschdale), to haul logs on the Donner and Tahoe Railroad down to their log pond, mill site and lumber yard along the river in the center of Truckee town (maps 5-6, photos 3-4). The railroad was in operation between 1893 and 1901.

In 1874 the Richardson Brothers built a V-flume (maps 5-6) to ship lumber down to their lumber yards at Martis Creek Station (maps 5-6) on the line of the CPRR at the mouth of Martis Creek (Knowles 1942:20). In route, the Richardson V-flume connected with the Sisson, Wallace and Company's V-flume (maps 5-6). At Martis Creek Station, the Richardson Brothers constructed a planing mill in 1876 and a box factory in 1882 (Knowles 1942:20, 34; *Truckee Republican* 7/25/1874; 8/2/1874; 9/17/1874).

In 1868 D. D. Whitbeck, L. E. Doan and James Akin founded the Boca Mill and Ice Company to supply wood for railroad construction (maps 5-6; Photo 5). They constructed a dam across the Little Truckee to create a log pond of 30 acres (Photo 6). During the winter, the pond froze over, and in 1869 the company began harvesting ice. The company expanded and by 1873-1874, a post office, school and hotel were built. For the next 15 years, the town was a busy, industrious place, boasting a post office, hotel, general store, dairy, butcher, shop, school, brewery, several bars, and a cemetery. In 1875-1876 Doan constructed a brewery across the Truckee River from the Boca townsite, and near a mountain spring that flowed into the river at this location (Photo 7). The brewery was destroyed by fire in 1893. In 1901 the Boca & Loyalton standard gauge railroad was constructed to connect Sierra Valley sawmills and communities to the Central Pacific line at Boca. Service between Boca and Loyalton continued until 1915 when the company was sold to Western Pacific Railroad (maps 5-6). By the beginning of the 20th century, the town of Boca had passed its prime. With the drought of the 1930s heightening disputes in the eastern Sierra over water, a reservoir was constructed at Boca in 1934.

A number of smaller sawmills were established along the transcontinental main line, e.g., Stonewall-Proctor Mill and Union Mills (maps 5-6).

Cordwood

Cordwood formed a principal adjunct to the lumber business to meet the fuel demands of railroads and ore mills. Efficient procedures were developed to glean cutovers after a timber harvest and convert residues into cordwood (Wilson 1992:7). The V-flume system rendered the cordwood business especially profitable, as wood could be floated, not hauled, to market. As a result, cordwood was cheap and plentiful (Edwards 1883:74).

Sisson and Company, the principal employer of Chinese labor in the Truckee Basin, had substantial land holdings throughout the area and operated wood camps in the forest surrounding the valley and cordwood was floated down their flume to Martis Creek Station (*Truckee Republican* 8/12/1882).

Photo 5. Boca townsite (ca. late 1800s-early 1920s) looking northward to site of Boca Mill and Ice Company operations; ice ponds (back left); ice warehouses and tramways scattered throughout; transcontinental railroad alignment (center); photo courtesy of Truckee Donner Historical Society

Photo 6. Cutting ice at Boca ice pond (ca. late 1800s-early 1920s); looking eastward across pond to the Boca & Loyalton Railroad on approach to Boca townsite (far right and out of view); photo courtesy of Truckee Donner Historical Society

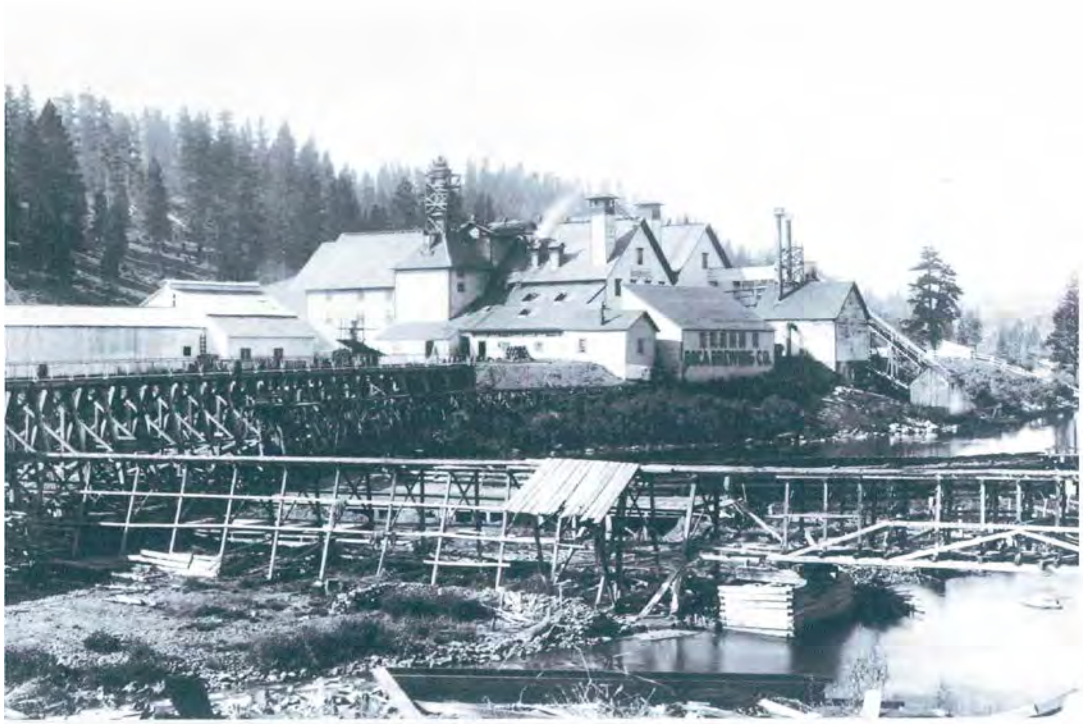


Photo 7. Boca Beer Brewery (ca. 1875/76-1893) looking southwestward across the Truckee River; the brewery covered an acre of ground on the knoll opposite the confluence of the Truckee River and Little Truckee River; the company produced 160 dozen bottles of beer each day; photo courtesy of Truckee Donner Historical Society

Shingles

The shingle business in Truckee was brisk (Edwards 1883:36). In 1869 Hawthorne and Company built a two-mile-long V-flume on Martis Creek to float wood and shingles (*Truckee Republican* 2/20/1868; 5/26/1869) to Martis Creek Station (*Truckee Republican* 10/8/1872:3/1). Sisson, Wallace and Company incorporated the old Hawthorne V-flume into their operations in 1872 (*Truckee Republican* 10/8/1872). Sam McFarland also transported wood and shingles in the Sisson V-flume (maps 5-6) sometime between 1869-1870 and 1878 *(Truckee Republican* 2/24/1886).

The Shaffer Lumber Company transported shingle blocks in their V-flume (maps 5-6) down to Martis Creek Station, where they were then dumped into the Truckee River and floated down to the H. Hale and R. P. Ferguson's Pacific Shingle Company water-powered mill at Prosser Creek (*Truckee Republican* 1/15/1874:3/2).

During the 1870s and 1880s, Richardson Brothers (maps 5-6) also cut shingles in their mill at Martis Creek Station (*Truckee Republican* 2/23/1874:2/2; 12/30/1874:3/4).

Charcoal

Like cordwood, charcoal production also formed an important aspect of the logging industry in the Truckee Basin. On their extensive land holdings, the firm of Sisson, Wallace and

Crocker organized gangs of Chinese colliers in charcoal production. Tons of charcoal were transported on the transcontinental railroad to the mines of Nevada and Utah to fuel smelters there. In addition, ore was also shipped westward to the Tecoma Smelter located along the river in Truckee on present-day East River Street (maps 5-6; Photo 5). During its active years between 1872 and 1875, the smelter could consume from 600 to 900 bushels of charcoal every 24 hours. In addition, Sisson and Wallace also shipped from 1,000 to 2,000 bushels weekly to Virginia City and had orders from Utah for about 8,000 bushels a day. The closure of the Tecoma Smelter in 1875 nearly broke-up Truckee's charcoal industry. However, up until 1883, Truckee was still poised to take advantage of changing markets, especially given Sisson and Wallace's construction of three new brick charcoal kilns at Martis Creek Station in 1877 (maps 5-6).

Photo 8. Tecoma Smelter (1872-1875); looking northward; former smelter site is at present-day 10689 East River Street; former site of the Truckee Power and Light Company (1888) was located immediately upstream on the north side of the river; photo courtesy of the Dana Scanlan Collection, Gold River, California

Ice

From 1868 through the 1920s, ice harvesting rivaled the economic importance of the lumber industry (Macaulay 2002). Eastern ice and Alaskan ice were costly and not dependable, so closer sources were sought. With the completion of the first transcontinental railroad across Donner Pass in 1869, ice could be harvested and transported cost-effectively, and Truckee-Donner ice soon dominated the industry (Macaulay 2002:2). Sawdust supplied by the many local sawmills was packed into the storage houses as insulation; ice blocks could be preserved for up to three years. Sierra ice was noted for its superior quality and crystal purity and it was proudly served in grand hotels throughout the nation. Yet, the Truckee ice industry targeted commercial demands for cooling rather than the market for domestic consumption. Truckee ice allowed the expansion of Comstock mining and was shipped to the mines of Virginia City where miners found temporary relief from the 140-degree temperatures in ice-cooled chambers. Truckee ice enabled the growth of California's agricultural industry, whereby iced box cars shipped produce to meet the demands of eastern markets.

Several ice works were established along the Truckee River and on or near the transcontinental main line, e.g., Trout Creek Ice Company in Truckee, Nevada Ice Company, Summit Ice Company on Prosser Creek, etc. (maps 5-6). In 1873-1874 the Summit and Nevada ice companies combined with Boca ice operations to form the Pacific Ice Company (Taylor 1976). The Sierra Lakes Ice Company took over the Pacific Ice Company holdings in 1890 until the Union Ice Company finally acquired these operations in 1901. The last ice crop harvested and stored was at Boca in 1927, making this facility both the first and the last of the great Truckee River natural ice companies.

Truckee Ice Company

In 1884 Sisson Crocker and Company established The Truckee Ice Company, which was strategically located at the mouth of Martis Creek (maps 5-6). The ice plant itself was confined to the south side of the river and a bridge provided easy rail access to the siding at Martis Creek Station on the north side of the river (Macaulay 2006:2). The ice pond was situated in the center of Martis Creek. Creek overflows were diverted away from the pond through the mining ground sluice channel constructed in previous decades. A dam was constructed of readily-available materials, incorporating both angular rock and river cobbles. The dam had a dirt-fill core and formed a pond about 10 acres in size (*Truckee Republican* 7/15/1885). Two parallel and stepped-down ice houses were built below the dam and the river. Blocks of ice were gravity fed from the pond into the ice house. With only a capacity of 5,000 tons, Truckee Ice Company was one of the smallest plants in the Truckee Basin (Macaulay 2006:1). Construction commenced in 1885, and ice harvests continued until 1895. Competition finally forced the plant out of business in 1898 (*Truckee Republican* 8/8/1898).

*Tahoe Ice Company (Polaris)*The Tahoe Ice Company was incorporated in Truckee in 1886 (maps 5-6, 8). It became one of the largest and most successful independent companies in the region (Lord 1994:38). The Tahoe Ice Company negotiated its sale to the National Ice Company in 1901

Map 8. Map: "Survey of Truckee River (4 miles south of Truckee to 2 miles south of Prosser Creek)" by Stone and Webster Engineering Corp, Reno. April 28, 1911

(*Truckee Republican* 9/7/1901:2/3) and in May of 1913, Tahoe Ice Company deeded all of its real property and the ice plant to the National Ice and Cold Storage Company.

> The site selected for the [two] pond[s] and houses is an admirable one, and one of the best on the Truckee river [sic]. The pond is formed by making an embankment or levee along the bank of the river and encloses a flat six hundred feet wide and nearly a half a mile long. The pond covers about 30 acres and the water averages about 5 feet in depth. A dam seventy-five-feet long across the stream diverts the water into the pond. [Photo 9] The dam is composed wholly of rocks and is so substantial that no flood can possibly wash it away. A roadway crosses the dam. The water in the pond is exceedingly clear and the ice will be transparent, pure and equal to any produced in the mountains. The water, being shallow in the pond, will freeze quickly which is quite an advantage. [*Truckee Republican* 12/1/1886]

In addition to the road across the dam, a second bridge was located across from the ice house. From the ice house (the largest one in the region), blocks were railed on carts across the river to the railroad spur at Proctors/Winsted (maps 5-6, 8). This siding was completed in April of 1887 and it was one of the best on the river to facilitate the loading of ice onto rail cars, surpassed only by the longer siding at Boca (*Truckee Republican* 4/20/1887). A dam located upstream from the main ice works has also been reported (Richards, personal communication 2006).

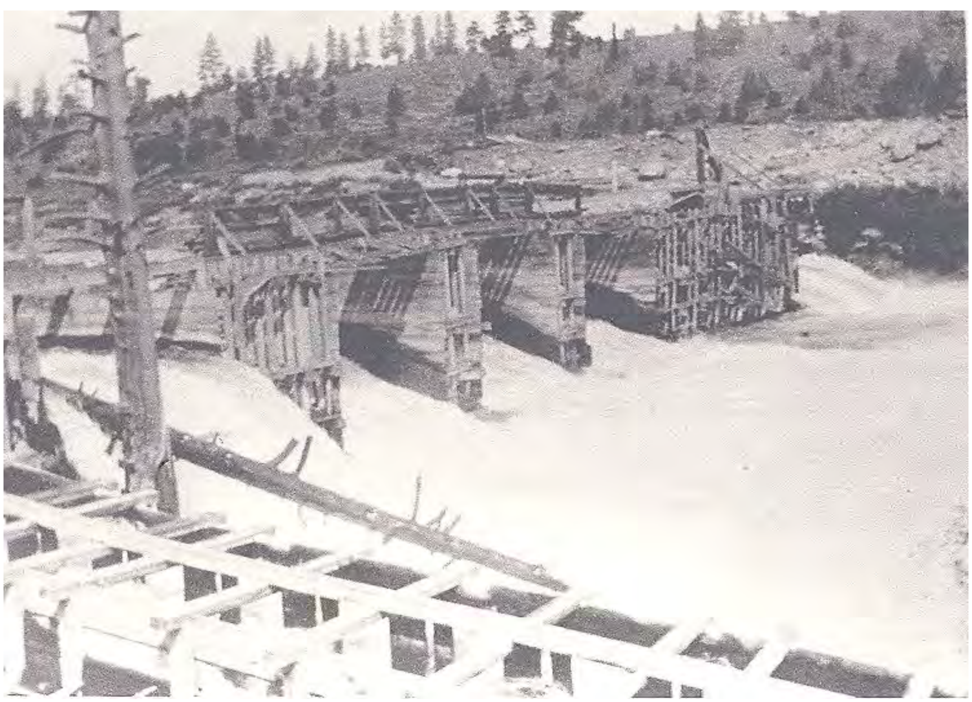


Photo 9. Tahoe Ice Company dam across the Truckee River (1886-1919); looking northwestward upstream from ice ponds and ice warehouse; photo courtesy of the Tom Macaulay Collection, Reno

Dairying

Valleys and meadowlands surrounding Truckee town served as summer pasture for herds of dairy cows brought from the California and Nevada foothills. The dairy business in the Truckee Basin flourished on a large scale from the 1860s until about 1930 (McGlashan 1982:13-17). During the 1880s up to 20 dairy farms had been established around Truckee that produced 60,000 pounds of mountain butter annually (Edwards 1883:69-70; *Truckee Republican* 3/14/1883). Butter was the chief product, since milk would spoil without refrigeration. "Truckee Butter was touted on the menus of big city hotels…to lure sophisticated gourmand palates" (McGlashan 1982:13).

Varney/McIver Dairy

McIver Dairy is located at the site of the former Varney Dairy (maps 5-6, 9). In 1873 A.C. Varney, a native of Maine and notable Truckee townsman, was assessed for three cows, one calf and one hog on his lot on Donner Lake Road, the dairy being located ¼ mile west of Truckee on the south side of the road leading to Donner Lake (Nevada County Assessor's Records 1873 #1792). By 1874 assessments had increased to three cows, three calves and 24 poultry (Nevada County Assessment Records 11/21/1874 #3426). Assessments in 1876 entailed 10 cows, three calves, six stock cattle, one horse, and one wagon (Nevada County Assessment Records 11/20/1876 #2461). Assessments decreased in 1879 to six cows, four calves and two horses (Nevada County Assessment Records 11/18/1879 #3334). The 1880 U.S. Census lists Albert Varney as a "milkman living on Donner Street."

Deeds on file at the Nevada County Recorder's office document land transfers involving A.C. Varney and J. McIver and dating from 1893 to 1906. At the time of Varney's death in 1892 (U.S. Census 1880), he owned property on the north side of the Dutch Flat Donner Lake Wagon Road (being about 250 by 150 feet), along with three acres on the south side of the road (Book 79, page 180, 2/27/1893). Sarah E. Varney (A.C. Varney's wife) granted the property to F. D. Hilton in 1894 (10/22/1894, Book 82, page 374-76) and to James Carson in 1904 (8/27/1904, Book 102, page 361). James Carson in turn conveyed the deed to James McIver, Sr. in 1905 (1/27/1905, Book 102, page 360). The Truckee Lumber Co. also conveyed lands to James McIver, Sr. that same year (10/2/1905, Book 108, page 247) and W. F. Wilkie deeded land to James McIver, Sr. in 1906 (11/9/1906, Book 106, page 351-52). Although Varney and McIver may have grazed their stock throughout Gateway, deeds indicate that the meadow land owned by the Varney's and (at least initially) by McIver's was limited in size, being only 8/10-acre on the north side of Donner Pass Road and three acres on the south.

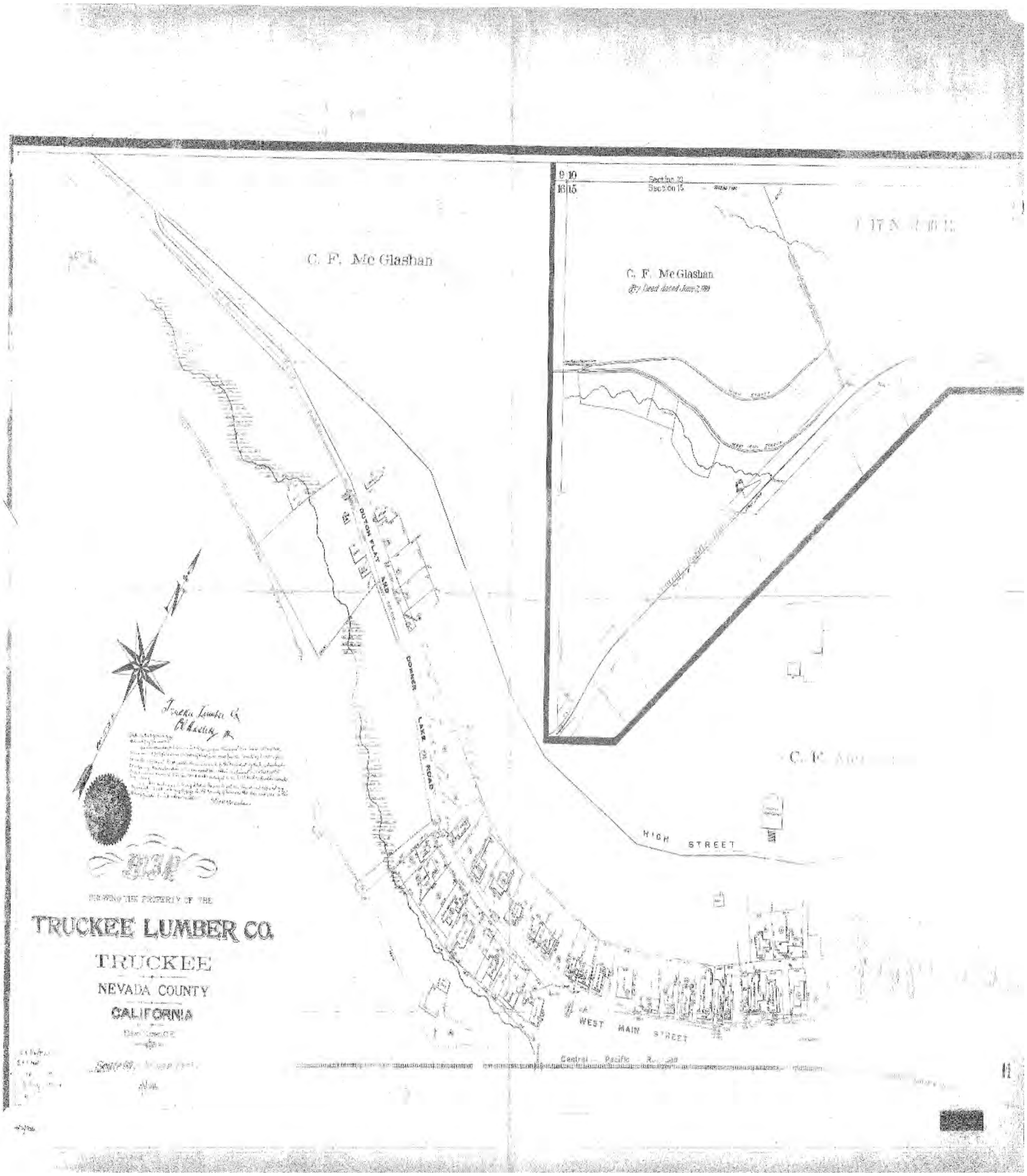
McIver Dairy was one of the largest dairies and one of the main suppliers of milk to Truckee. With their 35 Holsteins, the McIver Dairy supplied resident customers with milk and cream for 45 years (McGlashan 1982:16). Other dairies concentrated on the production of butter for export within and from the region (Roy Baker, personal communication 5/22/1984, Reno). McIver dairy was in full operation almost half century and was the last dairy to close.

A brief biography of the McIver family can be gleaned from various local newspaper published in the *Sierra Sun* (4/3/1952; 7/15/1981; 8/8-9/1987;_8/11/1988; 10/22/1998; 4/2/2003). James McIver, Sr. emigrated to the United States from Ireland in 1882 (U.S. Census 1880). He knew his future wife, Sarah, in Ireland and the two married when she arrived in Reno two years later. The 1910 U.S. Census lists Jim McIver, Sr. as a dairy man. His first dairy was on South River Street. Between 1900 and 1906 the McIver's purchased land in Gateway. Improvements eventually included

Photo 10. McIver Dairy (1905-1940s) looking northward across the meadow towards Donner Pass Road (former Dutch Flat Donner Lake Wagon Road) to the McIver residence; large boulder (center) may have been removed as part of road improvements ca. 1950s; photo courtesy of Truckee Donner Historical Society

a white-painted milk house, a red-painted horse barn, a second large barn for cows and hay, and miscellaneous out buildings (Photo 10). The two-story family home remains today along the north side of Donner Pass Road and the blacksmith/garage and smaller out building stand on the south side of the road. The McIver's started operations with three cows and added more. They could milk 50 cows at a time in the large dairy barn, which also accommodated room for hay storage, pigs, chickens, and horses. Sarah is attributed with running most of the dairy operations, which ceased in the 1940s when she grew ill and moved from the family home. She died in 1951, leaving the property to her son Jim, Jr. and daughter Jane. Part of the property was sold in 1950 to the State for improvements along Donner Pass Road (Deed for State Highway, James McIver, Jr. to State of California, 60-foot-wide right-of-way, 12-23-1950), and later for the construction of a right-of-way for Interstate 80. Some of the dairy buildings were removed.

Jim McIver, Jr. was born in Floriston in 1894; he died in 1965. He was regarded as a prominent townsman, being cleaver, creative, inventive, and industrious, as well as a civic personality and candidate for Nevada County Supervisor. He was a horseman, dairyman, mailman, teamster, and work contractor. He ran a blacksmith shop/garage, did wagon hauling, grew Christmas trees, and leased four-to-six team sleights to early movie makers. Jim, Jr. married Victoria (Azad) McIver in 1944. Victoria was a member of the Joseph family who developed Gateway Motel in 1939, a subdivision in 1940s and a shopping center in 1950s. The Joseph's bought land in Gateway from Union Ice Company.



Map 9. “Map Showing Property of the Truckee Lumber Co.” 10/3/1906 (showing McIver Dairy)

In honor of Jim McIver, Jr., several local landmarks carry his namesake: the McIver undercrossing or "McIver's Crossing", which connects West River Street and Donner Pass Road; McIver Hill, the prominent saddle south of the dairy, once owned by the McIvers and now the site of Sierra Nevada College and an Interstate-80 right-of-way; and the McIver (rodeo) Arena. In 1988 Dr. Lindström and a group of archaeologists and civic enthusiasts catalogued the remaining collection of artifacts contained in McIver's blacksmith shop/garage. The equipment (sleigh, blacksmith bellows, wagon wheels, leather goods, etc.) were auctioned and proceeds went towards improvements at the McIver Arena. The Town of Truckee acquired the McIver Dairy property in 1998, recognizing it as a piece of valuable open space, yet concerned regarding potential liabilities with increased public access (e.g., sledding, social walking trails, parking, etc.). The two remaining dairy structures were given a "facelift" in 1999. Buildings were painted and repaired, and the property was "cleaned-up."

Von Flue (Fluee) Dairy

Swiss native, Joseph Von Flue, ran a dairy ranch on the south bank of the Truckee River and along present-day South (west) River Street (maps 5-6; Photo 11). This dairy also supplied fresh milk and cream to local residents. Von Flue commenced dairy operations in the Truckee area in 1901 (*Truckee Republican* 9/7/1901, 11/27/1901). He eventually purchased the South (west) River Street property from the estate of W.H. Kruger in 1915.

Photo 11. Footbridge across Truckee River to Von Flue (Fluee) home and dairy (ca. 1901); looking southward across the Truckee River towards the ski hill at Hilltop

Recreation and Community Development

Truckee

At least through the 1920s, the exposure Truckee gained outside the immediate area related to its many brothels, its violent discrimination against Chinese, and its general reputation as a rough lumber and railroad town. Truckee had an especially large subpopulation of Chinese, the second-largest concentration of overseas Chinese in the West. The organization of Sisson, Wallace/Crocker and Company, a subsidiary of the CPRR, was one of the main importers and contractors of Chinese labor for the railroad in 1866 (Edwards 1883:14; Lord 1981:15). With the completion of the transcontinental railroad in 1869, Chinese immigrants were channeled into other regional occupations. This forced them into direct competition with Euroamericans, and the subsequent anti-Chinese sentiment resulted in the initial expulsion of Chinese from Truckee town in l878. In 1879 Charles Crocker sold CPRR land southeast of the bridge to the South Truckee Land Association for a new Chinatown (Photo 1). By 1886 Chinatown disbanded as most Chinese were expelled from the community.

By the 1920s Truckee's industrial economy and society had largely disappeared, due in major part to the relocation of the train switching yard to Roseville, the depletion of local timber supplies, and the development of mechanical refrigeration. In its place, the community began to develop into a recreation-based economy. Historic Truckee was unique among turn-of-the-century mountain communities, in that summer recreationists and winter-sports enthusiasts could easily reach the town in summer or winter via the first transcontinental railroad or the first transcontinental highway. By the mid-1890s Truckee was host to ice carnivals, drawing people from both east and west of the Sierra to enjoy the mountain winters. Sleighing, tobogganing, dog races, two large ice palaces, and Hilltop's ski area and ski jump (Photo 11) were some of the attractions offered to tourists, along with "Snow-Ball" special excursion trains. The development of the Hilltop ski hill and ski jump during the 1910s-1930s and the 1960 Winter Olympics at nearby Squaw Valley secured Truckee's position as a center point for year-round recreation.

The growing needs of Truckee prompted the need for more organized municipal infrastructure and the establishment of utility and water companies and sewer systems. Small independent systems were unable to supply enough sanitary water to the growing town and most of these older systems were consolidated under the Truckee Donner Public Utility District (TDPUD), which was incorporated in 1927 (TDPUD 1968:18, 25-26; 1971: II-45). Truckee's first hydro-electric power plant was incorporated as part of Truckee Power and Light Company in 1888. The stone building and accessory dams and flumes were located along the river off of East River Street (maps 5-6; Photo12).

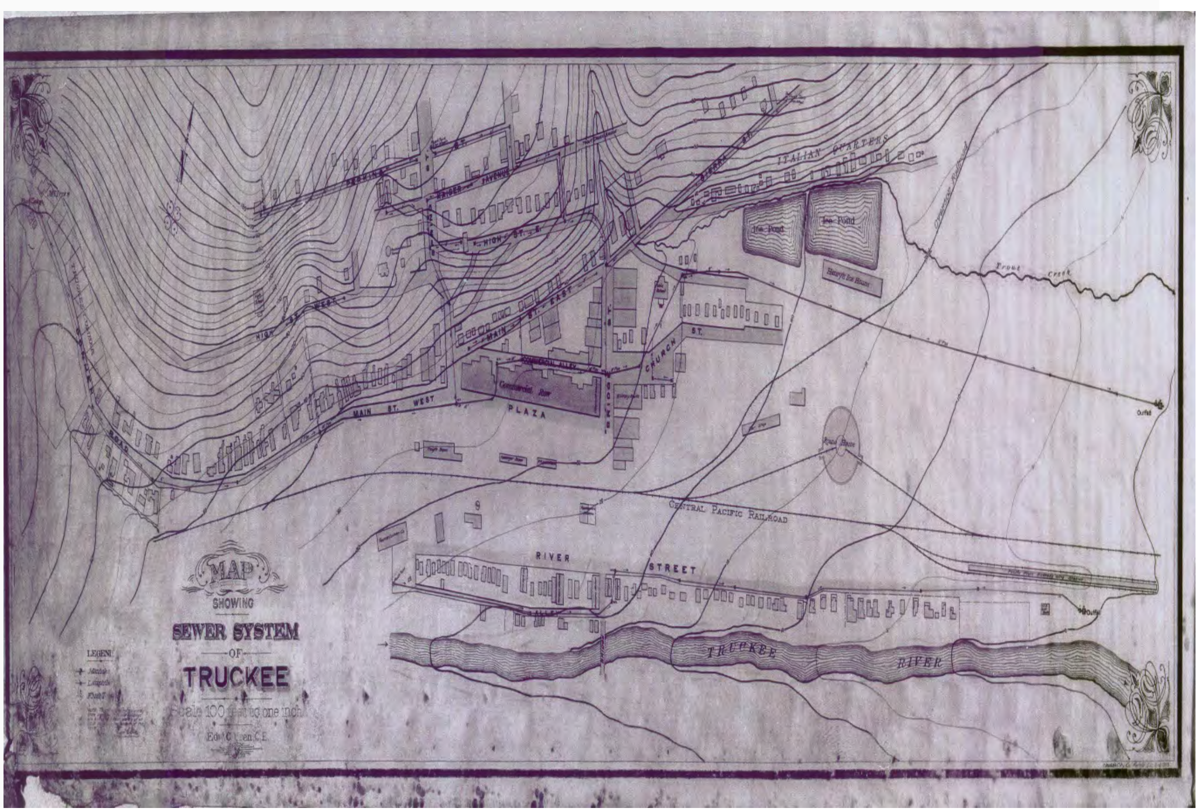
In the early days of Truckee there was no organized refuse collection system nor was there an awareness of the potential hazards of chemical wastes. For matters of convenience, residents and merchants widely broadcast their household and commercial garbage, especially along roadsides (major or minor) leading out from town. Local industries, such as the several lumber mills and railroad facilities, often dumped liquid wastes into the Truckee River and its tributaries and burned all combustibles. Trash was fed to the family chickens or hogs and otherwise left to

Photo 12. Truckee Power and Light Company stone power plant building and flume system (ca. 1888); plant was located on the north side of the river on East River Street immediately upstream from the Tecoma Smelter; photo courtesy of Truckee Donner Historical Society

decompose and litter the alleys and backyards. Commercial stockyards, such as one owned by Joe Marzen south of the river on “Slaughterhouse Hill” (maps 5-6), operated without regulation. "Tons" of manure were piled along the water's edge, breeding flies and causing a menace to the general health.

With the decline of the lumbering, railroad and ice industry and in order for Truckee to realize prosperity as a tourist center, it had to endure "a most revolutionary clean-up" (Gillespie 1918:14). As of 1918, the town had an exceedingly rough-edged appearance (Photo 2). Homes along the river, “where the principal element was foreign”, were described as "distressingly dilapidated." Buildings in the business section of town along Main Street (most being saloons) were "not at all modern." The absence of landscaping and of paved streets offset the initial positive impressions (formed at a distance) of a quaint, steeply-pitched roofed mountain town.

The Truckee Sewer District (TSD) is the oldest sanitary district in the State of California. The sewer collection system of the town was installed in 1908 and until the 1960s, the system remained basically unchanged (TSD 1964:3-1). There were two different sewer systems in town, and both were inadequate (Map 10). The Southern Pacific maintained a sewer serving its depot and hotel, which discharged under the bank of the river near the county bridge. The TSD had two main sewers, on each side of the railroad track, leading to cesspools below town. Both cesspools were crude affairs and ineffective, and discharged a "zone of gray water and slime" into the river that was said to emanate terrific odors in the summer months. Privies scattered along the river-front and directly over Trout Creek were common. The block of residences along the river were too low to be sewered by the TSD system (Gillespie 1918:16). Pollution of Truckee's water supply was inevitable, and contamination of the Trout Creek water supply resulted in an epidemic of typhoid fever during the nineteen teens. A state investigation was conducted in 1918 to report on the pollution and bacterial contamination of the Truckee River (Gillespie 1918). According to this report, the condition of the river was especially "dangerous" between Truckee and Polaris. Gillespie (1918:23) noted that contamination of the Truckee River was especially a threat to natural ice manufacture below Truckee town, and the identification of the Truckee River as “impure water” in 1918 may have caused the State Board of Health to close the ice plant at Polaris. The 1918 report recommended the elimination of privies and manure piles, prohibition of swine, cattle or fowl within prescribed setbacks from water sources, the employment of a paid garbage collector, and connection of the Southern Pacific Company sewage with the TSD. A new site was designated for acceptable sewage treatment and disposal, about one half mile below Truckee town along the south side of the river. Following recommendations of the 1918 study, pipes from both north and south cesspools were brought together under the Trout Creek crossing of the railroad tracks and effluent was transported into filter beds on the new sewage treatment site. Sometime between 1925 and 1930, the cesspools were abandoned, and sewage was sent through a 10-inch steel pipe to a reinforced concrete tank. Settled sewage was then discharged to the effluent ponds, where it underwent oxidation and percolated into the soil. The system consisted of seven effluent ponds and three earth sludge drying beds, covering about 2 ½ acres. The stabilization ponds were abandoned with the opening of the Tahoe Truckee Sanitation agency (TTSA) plant in 1978.



Map 10. “Map Showing Sewer System of Truckee” ca. 1920

CONCLUSIONS

FINDINGS

The brief contextual history and mapped identification of at least 39 major historic commercial-industrial sites along the Truckee River and McIver meadow sub-watershed confirms the high potential for important cultural resources to occur throughout the Truckee River corridor study area. Numbered areas highlighted on maps 5-6 are known Native American and/or historic sites and are especially sensitive.

While the historical context and physical layout of the McIver Dairy are presented, information involving relevant historic activities that may have impacted (and continue to impact) the sub-watershed are less specific. While Map 9 and Photo 10 hint at the physical layout and environmental context of McIver Dairy, its usefulness towards restoration plans to replace the damaged culvert at the base of the meadow and develop storm water drainage infrastructure and snow storage management practices is limited. The map and photo show that structural coverage on the lower end of the meadow was fairly dense; but now, most buildings have been removed. The residence on the north side of the road remains. In the meadow on the south side of the road, the larger building to the west and set on rock foundations was the site of a complete blacksmith shop/converted garage and storage shop for sleighs and wagons (*Sierra Sun* 7/15/1981, 8/11/1988). It is not known whether drainage flow around the north end of this structure is produced by a natural or historic/anthropogenic channel. The historic context of the dirt road with small culvert accessing the building and the well south of the building is also unknown. The smaller building to the east and on a pier foundation was a miscellaneous out building whose function is unknown.

Archival documentation of historic meadow hydrology is largely unavailable. Yet, the 1906 map (Map 9) depicts at pond at the head of the meadow and shows the (schematic) course of the drainage through the meadow. Victoria McIver, wife of Jim McIver, Jr., recalled that "McIver's pond was a great place to play", a statement that (combined with the 1906 map) indicates some antiquity for the pond and that it is not merely a modern creation as a detention basin for storm water runoff from the hospital. Photo 10 shows a large rock outcropping in the meadow between the barn and miscellaneous outbuildings. This may be the same rock that appears on Map 9. The rock is now gone, and may have been removed when the State improved Donner Pass Road through the dairy, as documented on a 1950 deed and accompany map granting right-of-way from McIver to the State highway department. At this time the road may have been widened and modified with a low causeway, hence necessitating removal of the large boulder.

The summary of historical preservation ordinances provided in this report will assist planners in weighting the merits of the preservation of important historical areas against meeting sediment reduction goals in balanced historical/ecological restoration.

RECOMMENDATIONS

Impacts to cultural resources could result with implementation of the various project alternatives under consideration. These impacts may result from: (1) the disturbance or destruction of prehistoric or historic archaeological sites during project ground disturbance activities; (2) general changes in land use that may affect the integrity of the setting of cultural properties by introducing incompatible visual or audible elements into the setting of a potentially significant resource; and/or (3) increased public access and potential for damage and/or vandalism. Important archaeological and architectural remains may warrant protection, preservation and eventual interpretation according to guidelines developed by State of California, County of Nevada and by the Town of Truckee under the downtown specific and general plans as summarized in this report.

Apart from the cultural literature overview presented in this report, the completion of additional archaeological tasks would be required on a project-specific basis. Recommendations outlined below summarize standard archaeological protocols for cultural resource management. The relative level of effort and timing for completion of each of these archaeological tasks would be determined later as specific restoration proposals are developed.

(1) On-going Consultation and Outreach

- contact with tribal representatives regarding Native American presence within the Truckee River study corridor, where the TRWC will defer to and work with Town on tribal consultation as they are the landowner

- oral history interviews with individuals knowledgeable in local history (Truckee Donner Historical Society)

(2) Archival Research

- update records search at the North Central Information Center, California State University, Sacramento, where prior records search is older than two to three years

(3) Archaeological Field Research

- field verification of known archaeological sites to assess their current content and integrity in areas not previously subject to archaeological coverage or where prior coverage is older than five-to-ten years

- a qualified archaeologist to conduct project-specific archaeological field reconnaissance to detect any newly discovered archaeological resources within the project area

- a local Native American representative maybe involved as appropriate

(4) Preparation of Final Report

- a final cultural resource study report to comply with guidelines established by Nevada County under the California Environmental Quality Act (CEQA Section 5024, Public Resource Code) and Chapter II of the *Nevada County Land Use and Development Code*; the *Town of Truckee General Plan, 1995-2014, Volume 1 Goals and Policies*, Chapter 4, “Conservation and Open Space Element”, and the *Truckee Downtown Specific Plan, Volume 3: Historic Design Guidelines*

- review and concurrence of the study report by agency personnel, in consultation with the State Historic Preservation Officer (if appropriate) and other interested parties (including Native American representatives)

(5) Archaeological Monitoring

- due to increased public access into the study area, the potential for increased archaeological site vandalism should be monitored on a periodic basis

- monitoring of archaeological sites during the implementation of restoration projects may be required; a Native American monitor may be required on or near prehistoric sites

(6) Public Interpretation

- selected archaeological sites (that have been studied/stabilized and where vandalism is not likely to occur) to be developed as part of a program to further educate the public regarding the prehistory and history of Truckee; details of any public outreach program would be developed on a project-specific basis.

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RESUME

RESUME

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Education

Ph.D. Archaeology 1992 - University of California Davis
M.A. Anthropology 1978 - University of California Davis
B.A. Anthropology 1972 - University of California Berkeley

Expertise

Cultural Resource Management
Archaeology (prehistoric and historic period)
History and archival records research
Ethnography, ethnohistory, oral history
Native American consultation
Interpretation and public education

Professional Organizations

Register of Professional Archaeologists (member since 1982)
Society for Historical Archaeology
Society for California Archaeology
Various county and regional historical societies

Lindström's qualifications include archaeological field work and analytical and archival research in the prehistory and history of the western United States including California, the northern and western Great Basin in Nevada and Oregon, and the Cascade Range and the Columbia River Plateau in Oregon and Washington. Her area of expertise is centered in the north-central Sierra where she has over 43 years of experience in historic preservation matters on a local, state and federal level. She has resided in the Tahoe Sierra and accrued full-time professional experience here since 1973.

Heritage Resource Management -- As Forest Archaeologist from 1973 until 1978 for the Tahoe National Forest and "zone" Archaeologist for the El Dorado National Forest and Lake Tahoe Basin Management Unit, and as District Archaeologist for the Bureau of Land Management in 1978 (Burns, Oregon), Lindström initiated and implemented heritage resource programs for the inventory, protection, management and interpretation of prehistoric and historic heritage resources. She conducted training sessions on heritage resource identification and on antiquities legislation.

Contracting and Consulting -- Between 1980 and the present time, as a private consultant, Lindström has conducted and/or supervised fieldwork, data analysis, archival research, and report preparation for hundreds of federal, state, county, and private projects within the north-central Sierra and adjoining regions in California and Nevada. During this time, she has served as an expert witness on historic and prehistoric resources involving California State Supreme Court cases within the Tahoe Sierra.

Teaching -- Lindström instructed introductory level courses in cultural and physical anthropology and archaeology at the University of Nevada, Reno and the University of California, Davis and was appointed as an adjunct professor to the University of Nevada, Reno in 2010.

****Research, Publications and Papers*** -- Academic and heritage management reports pertain to regional prehistory and history, as well as print and video publications for the popular audience (including research findings on the Donner Party, California gold mining, Washoe Indians, and California ethnobotany).

Secretary of Interior Standards: Archaeology and History (Prehistory, Ethnography, Ethnohistory, Ethnobotany, History, Paleoenvironmental Studies)

Lindström's 43 years of full-time professional experience in archaeological research, administration and management at the supervisory level involves the study of resources of the prehistoric, ethnographic, ethnohistoric, and historic period. In the Lake Tahoe Basin and Truckee Basin alone, Lindström has supervised and/or participated in the cumulative survey of nearly 50,000 acres. Her work in the adjoining sierran foothills and valleys approaches an additional 25,000 acres.

Prehistory. Experience in prehistoric archaeology largely pertains to the study of hunter-gatherer groups in the far west. Her surveys and excavations center upon the prehistoric ancestors of the Washoe and Maidu Indians of the north-central Sierra.

Lindström's Ph.D. dissertation focused on Washoe fishing in the Truckee River Drainage Basin. Her M.A. thesis explored high-elevation prehistoric land use in the Truckee-Tahoe Sierra.

During the 1990s she participated in the development of a research design for the Framework for Archaeological Resource Management (FARM), a heritage resource management document used by all north-central sierran forests.

She is presently a reviewer for the *Journal of California Archaeology*.

Ethnography, Ethnohistory, Ethnobotany. Lindström has developed an extensive knowledge of Washoe and Maidu territory and has maintained a good working relationship with these groups beginning in 1973. Since 2000 she has collaborated with prominent Washoe ethnographers such as Warren D'Azevedo and Merideth (Penny) Rucks. Lindström conducted and coordinated ethnographic research to develop a management plan for Cave Rock, a high-profile Washoe Traditional Cultural Property within the Lake Tahoe Basin. She authored a chapter on Native Californian ethnobotany that appears in a standard source book on California vegetation.

History. Experience in historic sites archaeology has focused on resources associated with the study of mining, logging, ranching, transportation, and water management resources. Since 1991 Lindström has conducted excavations at several rural work camps and industrial sites, many involving Chinese wood cutters and colliers. In 1987 and 1990 she field-directed excavations at two Donner Party camps (Murphy's Cabin and Alder Creek) and co-authored a book detailing the archival research, archaeology, architecture, dendrochronology, and zooarchaeology surrounding the tragedy.

Paleoenvironmental Studies. Lindström is a contributor to the 1997 congressionally funded, multi-disciplinary study assessing the environmental health and ecosystem management of the Sierra Nevada (*Sierra Nevada Ecosystem Project* [SNEP]) and the pilot case study focusing on the Lake Tahoe Basin.

She is also a contributor to the *Lake Tahoe Watershed Assessment* study, published in 2000 by the Pacific Southwest Research Station, USDA Forest Service, in collaboration with the Pacific Southwest Region of the USDA Forest Service, the Tahoe Regional Planning Agency, the University of California at Davis, the University of Nevada at Reno, and the Desert Research Institute, Reno, Nevada. The study was mandated as part of former President Clinton's actions to protect Lake Tahoe.

Through a series of snorkel and SCUBA surveys during the 1980s and 1990s in Lake Tahoe and its tributary lakes, Lindström investigated lake level changes and explored submerged remnant forests and prehistoric milling features as paleoenvironmental indicators over the past 6000 years. She presented her findings in scientific journals as a co-author with geologists, hydrologists and limnologists. Her work was also featured in *National Geographic* magazine (March 1992).

Secretary of Interior Standards: Closely Related Fields

Lindström's 43 years of full-time experience also entails research, writing, inventory, evaluation, data recovery, and management in closely related fields pertaining to the "built environment." Her work falls within the historical context of mining, logging, water supply engineering, and ranching landscapes, as well as transportation and communications networks, and town sites. Evaluation and data recovery have been directed to 19th and 20th century structural remains for the following resource types: Chinese/Basque/miner cabins; bake ovens/hearths; sawmills; railroad grades and camps; flumes; ditches; pipelines; dams; reservoirs; water tanks; ice works; ranch complexes; charcoal kilns; mine features; trails/roads/highways; utility lines; and fences.

For her projects involving more complex structural properties such as intact standing buildings, bridges and other architectural features, Lindström has had the opportunity to collaborate and learn from prominent architectural historians, beginning in the early 1980s with the Town of Truckee National Register District nomination process up until the present time.

Lindström also has experience with several historic preservation projects. She authored the heritage resource components for local community plans (from 1989 through 2005) and for county general plans (beginning in 1991). During the 1980s she served as a charter member of the Truckee Historical Preservation Advisory Council. She assisted in the preparation of the Truckee Historic Preservation Plan in 2009, followed by the formal National Register District nomination and subsequent Truckee Streetscape project. She served as a member of the "Placer County Department of Museums Collections Management Task Force" in 2000 and is currently an advisor to the California Department of Parks and Recreation (Sierra District) for their upcoming museum at Donner Memorial State Historic Park.

*available upon request

APPENDIX C

Road Sand Analysis Data

1) Town of Truckee Sand Routes
2) Caltrans I-80 Application Rates
3) Caltrans SR 267 Application Rates
4) Recovery Rates from Lake Tahoe Hydrologic Unit

Permit Year	Tons or road abrasives applied	Tons of road abrasives removed
2012/2013	1,032	1,611
2013/2014	1,688	2056
2014/2015	455	234
2015/2016	1,500	935.99
2016/2017	1,330	812

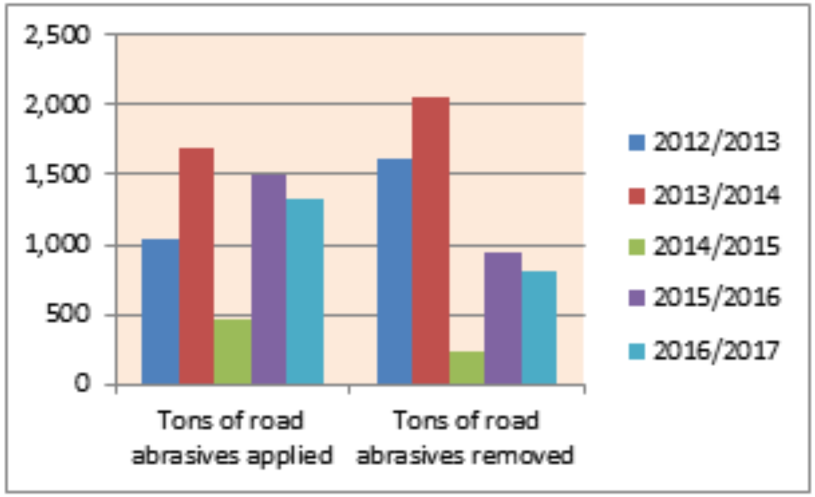
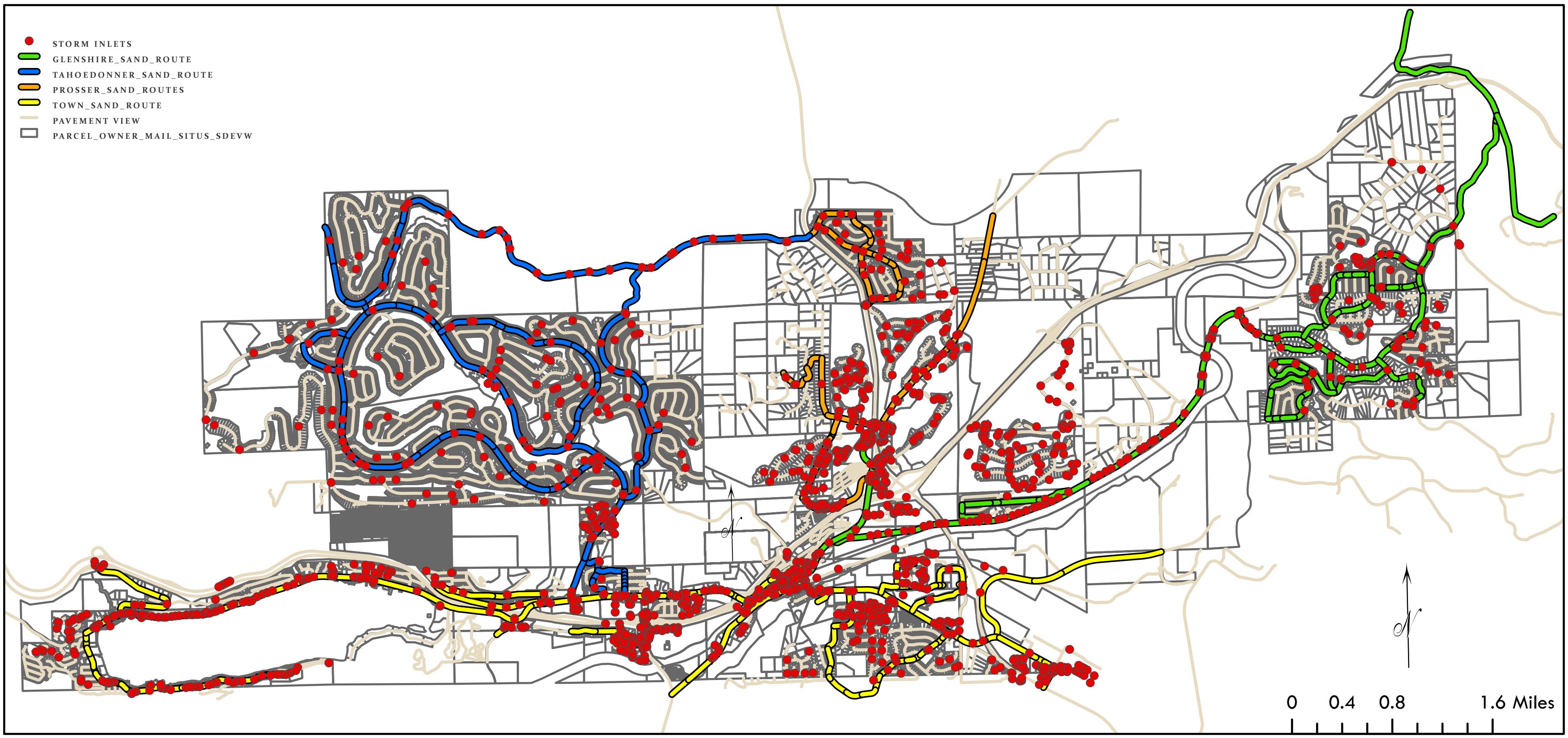


Figure 4. Road Abrasives - Applied and Removed

TOWN OF TRUCKEE SAND ROUTES



CALTRANS DISTRICT 3

OFFICE OF MAINTENANCE AND EQUIPMENT

SAND USAGE - TONS

NEV 080 PM 9.1 to 31.7						
	2016-2017	2015-2016	2014-2015	2013-2014	2012-2013	**5 YEAR TOTAL**
OCTOBER	0.00	0.00	0.00	0.00	199.50	**199.50**
FYTD	0.00	0.00	0.00	0.00	199.50	**199.50**
NOVEMBER	674.40	871.80	243.00	158.60	465.70	**2413.50**
FYTD	674.40	871.80	243.00	158.60	665.20	**2613.00**
DECEMBER	1035.40	1918.50	497.30	354.50	1834.50	**5640.20**
FYTD	1709.80	2790.30	740.30	513.10	2499.70	**8253.20**
JANUARY	2307.50	1974.00	9.00	243.50	553.14	**5087.14**
FYTD	4017.30	4764.30	749.30	756.60	3052.84	**13340.34**
FEBRUARY	1923.00	662.00	491.50	773.50	298.25	**4148.25**
FYTD	5940.30	5426.30	1240.80	1530.10	3351.09	**17488.59**
MARCH	838.50	498.00	148.00	595.00	272.00	**2351.50**
FYTD	6778.80	5924.30	1388.80	2125.10	3623.09	**19840.09**
APRIL	384.30	78.80	255.50	149.00	1.00	**868.60**
FYTD	7163.10	6003.10	1644.30	2274.10	3624.09	**20708.69**
MAY	20.00	3.00	0.00	0.00	0.00	**23.00**
FYTD	7183.10	6006.10	1644.30	2274.10	3624.09	**20731.69**
JUNE	0.00	0.00	0.00	0.00	0.00	**0.00**
FYTD	7183.10	6006.10	1644.30	2274.10	3624.09	**20731.69**

Annual Average	4,146.3	tons
Distance	110.6	lane miles
Application Rate	**37.5**	**tons/lane mile**

Assumptions

- Agricultural Check Station not included

- on/off ramps all one lane

Source

- Department of Transportation, 2018, Email correspondence with Alison Plant dated March 28, 2018.

CALTRANS DISTRICT 3

OFFICE OF MAINTENANCE AND EQUIPMENT

SAND USAGE - TONS

NEV 267 PM 0.0 to 2.8 (I-80 to Nevada/Placer County Line)						
	2016-2017	2015-2016	2014-2015	2013-2014	2012-2013	**5 YEAR TOTAL**
OCTOBER	2.00	0.00	*0.00*	*6.00*	*16.00*	**24.00**
FYTD	2.00	0.00	*0.00*	*6.00*	*16.00*	**24.00**
NOVEMBER	12.00	26.50	*10.50*	*6.00*	*37.00*	**92.00**
FYTD	14.00	26.50	*10.50*	*12.00*	*53.00*	**116.00**
DECEMBER	18.50	54.50	*36.50*	*225.00*	*202.50*	**537.00**
FYTD	32.50	81.00	*47.00*	*237.00*	*255.50*	**653.00**
JANUARY	52.25	27.10	*0.00*	*37.00*	*16.00*	**132.35**
FYTD	84.75	108.10	*47.00*	*274.00*	*271.50*	**785.35**
FEBRUARY	34.00	5.50	*23.00*	*68.00*	*26.00*	**156.50**
FYTD	118.75	113.60	*70.00*	*342.00*	*297.50*	**941.85**
MARCH	0.75	38.00	*5.00*	*28.00*	*27.50*	**99.25**
FYTD	119.50	151.60	*75.00*	*370.00*	*325.00*	**1041.10**
APRIL	0.00	0.00	*4.50*	*10.00*	*0.00*	**14.50**
FYTD	119.50	151.60	*79.50*	*380.00*	*325.00*	**1055.60**
MAY	0.00	0.00	*0.00*	*0.00*	*0.00*	**0.00**
FYTD	119.50	151.60	*79.50*	*380.00*	*325.00*	**1055.60**
JUNE	0.00	0.00	*0.00*	*0.00*	*0.00*	**0.00**
FYTD	119.50	151.60	*79.50*	*380.00*	*325.00*	**1055.60**

Annual Average	211.12	tons
Distance	5.6	lane miles
Application Rate	**37.7**	**tons/lane mile**

Assumptions

- assume two lane average

- no on or off ramps to add lanes to route

Source

- Department of Transportation, 2018, Email corospondance with Alison Plant dated April 26, 2018.

Tahoe Hydrologic Unit Deicing Report 2012

Snow Season	Sand Applied (tons)	Sand/Sediment Recovered (tons)	Percent Recovered
2012	2,343	4,511	193%
2011	3,865	4,761	123%
2010	4,986	6,197	124%
2009	3,423	4,788	140%
2008	5,261	5,124	97%
2007	4,256	6,214	146%
2006	9,502	5,053	53%
2005	4,896	3,983	81%
2004	7,232	6,623	92%
2003	6,407	7,564	118%
2002	7,954	6,821	86%
2001	7,991	6,708	84%
2000	12,666	7,741	61%
1999	15,465	8,568	55%
1998	19,815	8,604	43%
1997	12,796	5,542	43%
1996	16,759	4,535	27%

Total Applied	Total Recovered	Annual Percent Recovery
145,617	**103,337**	**71.0%**

Source:
California Department of Transportation (CDOT), 2012, District 3 deicer report, Fiscal year 2011/2012. Office of Environmental Engineering, South, Caltrans, p. 16.

Removal Rates Stats	
Min	27%
Max	193%
Ave	71%
Count	17

APPENDIX D

Memo: Public Access Observations for the Truckee River Revitalization Project, 4-5-2018

DUDEK

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SACRAMENTO, CALIFORNIA 95811
T 916.443.8335 F 916.443.5113

MEMORANDUM

To:	Teresa Garrison, P.E., Balance Hydrologics
From:	John Zanzi, CRLA #2933, Restoration & Open Space Design Specialist
Subject:	Public Access Observations for the Truckee River Revitalization Project
Date:	April 5, 2018
cc:	Brian Hastings and David Shaw, Balance Hydrologics
Attachment(s):	Table 1. Truckee River Revitalization: Site Assessments for Public Access and Recreation, Conducted on November 8, 2017

To support Balance Hydrologics (Balance) and their assessment efforts for potential restoration areas along the Truckee River, Dudek was tasked to provide input for improved and safe public access to the River by way of reviewing background information, previous plans and studies, and conducting a field reconnaissance of the prioritized restoration areas identified by Balance. Our input has considered opportunities and constraints to access, potential benefits to access in a given location, and linkages to other recreational trails or facilities. In addition, the input reflects our review of the Town of Truckee's Downtown River Revitalization Strategy prepared in 2005. Overall, 14 restoration areas were considered by Balance. Of those areas, the prioritized restoration areas were identified as "RA" and numbered in order from downstream to upstream along the River; an additional restoration area was identified as "Bridge 2" as is located on the north side of the River, at the old County Corp Yard.

This memorandum summarizes our observations and input from the reconnaissance of the prioritized restoration areas conducted on November 8, 2017 by John Zanzi, a Dudek Senior Landscape Architect, who provided qualitative input to Teresa Garrison and Brian Hastings of Balance during the reconnaissance. The prioritized restoration areas observed were RA-1 through RA-8 and Bridge 2.

OBSERVATIONS

Observations from the reconnaissance are summarized as general observations applying to all or most of the priority Restoration Areas, and site specific observations and input for each priority Restoration Area.

General

- All of the sites provide opportunities for interpretative and educational signage. Interpretative themes can include the following:
  - *natural resources:* ecology, physical and biological sciences, water quality, erosion control, habitat restoration;
  - *cultural resources:* pre-historical, Native American, historical (e.g., narrow gauge railroad); and
  - *land use:* impacts from development, current railroad use, fishing, fitness opportunities along the trails.
- All of the sites can benefit from the addition of the following components:
  - directional and safety signage;
  - dog stations, except RA-2 where dog stations exist; and
  - trash cans, except RA-2 and RA-4 where trash cans exist.
- All sites, except RA-5, have utilities along the River that are considered a constraint to public access improvements.
- Sites RA-4 through RA-8 are considered good areas for fishing.

Site Specific Observations

Site specific observations and input from the reconnaissance of the River Restoration Areas are documented in Table 1 (attached). The table lists the restoration areas in the rows, while the columns represent key public access and recreation considerations in context of the river restoration actions for the sites; the key considerations are defined as follows:

- **Priority Site:** site designated as a priority restoration area by Balance's assessment efforts.
- **A part of the Downtown Revitalization Strategy**: identifies whether the site has been considered previously as part of the Town of Truckee's Downtown Revitalization Strategy efforts in 2005.

- **Benefit of Improvements:** summary category for an overall assessment of a given site in terms of high, medium, or low enhancement for river users by implementing public access and recreation improvements.

- **Feasibility of Improvements:** summary category for an overall assessment of a given site in terms of good, fair, or poor practicality of physically implementing public access and recreation improvements.

- **Railroad Constraints:** proximity to existing railroad tracks and related railroad right-of-way issues may result in limited ability for public access and recreation improvements.

- **Opportunity for Formal Parking:** existing open space within the site in terms of good, fair, or poor practicality of implementing formal (e.g., paved) or designated parking improvements.

- **ADA Access Constraints (for access to the River):** topographic issues in terms of high, medium, or low limitations to providing barrier-free access within the site as defined by the American with Disabilities Act (ADA).

- **Distance to River:** relative length in terms of short, medium, or long distance one would walk from entering the site and down to the River

- **Existing Onsite Trails:** any existing trails on site were noted.

- **Opportunity to Link to Adjacent Trails:** ability to connect site access to existing or planned offsite trails; noted in terms of good, fair, or poor connection potential.

- **Trailhead Opportunity:** location, proximity and site character may support a formal gathering point and related facilities (e.g., parking areas, rest rooms, maps, sign posts and informational brochures about the trail and its features) for access to the existing Legacy Trail or other proposed trail improvements along the River.

- **Views-in:** from offsite, whether sight lines into the site are clear for observation of the site's character and potential recreation amenities, rated in terms of good, fair, or poor sight lines.

- **Views-out:** from onsite, whether sight lines to offsite vistas are clear and/or aesthetically pleasing for a sense of the regional character, rated in terms of good, fair, or poor site lines.

- **Fishing Access:** when onsite, the ability to walk to the River edge for the purpose of recreational angling, rated in terms of good, fair, or poor accessibility.

- **Non-motorized Boat / Water Access:** when onsite, ability to approach the River edge for the purpose of recreational boating or other non-motorized watercraft put-in/take-out, rated in terms of good, fair, or poor accessibility; considerations included topography, existing vegetation, and staging.

- **Erosion Potential:** onsite evidence to suggest that erosion or sedimentation may occur in a storm event or during snowmelt run-off that may compromise the water quality of the River, assessed in terms of low, moderate, or high possibility of occurrence.

- **Need to Direct Circulation:** low, moderate, or high necessity to control and direct public access areas onsite in order to preserve natural areas; can be achieved by implementing natural barriers such as boulders and logs, or by installing split rail fencing in select locations.

- **Overlook Opportunity:** onsite space, vertical and horizontal proximity and sight lines to the River for a view deck with interpretive and educational benefit for users; assessed in terms of low, moderate, or high opportunity relative to site characteristics.

- **Need for Bike Parking:** site proximity to existing or proposed bike trails or bike lanes; assessed in terms of low, medium, or high potential benefit for cyclists who may access the site.

- **Picnic Area Opportunity:** onsite space, sight lines and site characteristics to support picnic facilities (e.g., tables); assessed in terms of low, medium, or high potential for picnic use.

- **Need for Restroom Facilities:** onsite space and proximity to other potential or existing public access components (e.g., trailhead); assessed in terms of low, medium, or high potential for fixed restroom facilities.

CONCLUSIONS

In assessing public access and recreation opportunities and constraints for the priority restoration areas at a reconnaissance level, sites RA-1 and RA-3 appear to offer high potential benefits from implementing public access improvements, coupled with a good feasibility to physically implement the improvements; these site may provide the best overall value for public access and recreation, with minimal constraints. Several sites may provide a medium benefit with fair feasibility for public access and recreation improvements; these are sites Bridge 2, RA-2, RA-5, and RA-18. While a few other sites offer medium benefits, they may have poor feasibility for public access and recreation improvements; these sites are RA-4 and RA-7.

Table 1. Truckee River Revitalization: Site Assessments for Public Access and Recreation, Conducted on November 8, 2017

River Restoration Area	Priority Site	A part of the Downtown Revitalization Strategy	Benefit of Improvements	Feasibility of Improvements	Railroad Constraints	Opportunity for Formal Parking	ADA Access Constraints (for access to the River)	Distance to River	Existing Onsite Trails	Opportunity to Link to Adjacent Trails
RA-1	yes	yes	high	good	none	good; an open dirt area is an opportunity for a formal parking area on site; an opportunity also exists for parking adjacent to West River Street	high; significant gradient to river; ramps/ switchbacks would be needed	short	no formal trails; "social" foot trails only	good; a bike lane is proposed along West River Street
Bridge 2	yes	yes	medium	fair	none	good; opportunity for parking in the large upland undeveloped lot	high; the site is very steep to River; low with respect to the potential bridge	short	none	good; a bike lane is proposed along West River Street; at the potential bridge, there can be access to potential trail enhancement south of River
RA-2	yes	no	medium	fair	none	good; there is existing parking near the River within Truckee Regional Park; the parking area could benefit from improvements	high; the site is steep from the parking area to the River	short	the site is adjacent to existing picnic facilities and the Legacy Trail within Truckee Regional Park and	good; the existing Legacy Trail is adjacent to the site
RA-3	yes	yes	high	good	none	good; a small parking area exists, and there appears to be room for additional parking	high; significant gradient to river; ramps/ switchbacks would be needed	moderate	no formal trails; "social" foot trails only	good; a bridge to the existing Legacy Trail exists and bisects the site
RA-4	yes	no	medium	poor	none	poor	low	short	no formal trails; "social" foot trails only	good; the existing Legacy Trail is adjacent to the site
RA-5	yes	no	medium	good	none	good; a large open area is an opportunity for a formal parking area on site	low	moderate	one designated trail for boat access exists on site; other "social" foot trails exist - these are rocky and would benefit from being graded smooth	fair; the addition of a spur trail could connect to the existing Legacy Trail
RA-6	yes	no	n/a; see comments	n/a; see comments	yes	n/a; see comments	n/a; see comments	n/a; see comments	n/a; see comments	n/a; see comments
RA-7	yes	no	medium	poor	none	good; an open dirt area is an opportunity for a formal parking area on site	medium	moderate to long	no formal trails; "social" foot trails only	none
RA-8	yes	no	medium	fair	yes	fair; a small open dirt area is an opportunity for a formal parking area on site	high	short	none	poor; the existing historic bridge over the River would benefit from resurfacing

Table 1. Truckee River Revitalization: Site Assessments for Public Access and Recreation, Conducted on November 8, 2017

River Restoration Area	Trailhead Opportunity	Views-in	Views-out	Fishing Access	Non-motorized Boat / Water Access	Erosion Potential	Need to Direct Circulation	Overlook Opportunity	Need for Bike Parking	Picnic Area Opportunity	Need for Restroom Facilities
RA-1	no	fair	good	good	good	high; several rills exist from the road and extend onto the site	low	low	medium	high	low
Bridge 2	yes; a trailhead can serve as a gateway to the proposed trail enhancements south of the River	fair	good	poor	poor	moderate	high	high	high	high	high
RA-2	no	fair	good	fair	poor	moderate	yes	moderate	none	none; picnic facilities exist on site	yes; the site is part of the Truckee Regional Park and existing picnic facilities
RA-3	yes; a trailhead can connect the Legacy Trail bridge to the proposed railyard improvements	good	good	fair	poor	low	high	high	high	high	high
RA-4	no	good	good	good	poor	low	high	low	high	high	low
RA-5	yes; if a spur trail connection is provided to the Legacy Trail	fair	good; especially too railroad to the west and rock outcroppings to the east	good	good	low	yes; in particular, need to control vehicle "donut spinning" within the existing dirt parking area	low	medium	medium	high
RA-6	n/a; see comments	n/a; see comments	n/a; see comments	n/a; see comments	n/a; see comments	n/a; see comments	n/a; see comments	n/a; see comments	n/a; see comments	n/a; see comments	n/a; see comments
RA-7	no	fair	good	good	fair; pending site access issue (see comments)	moderate	high	low	low	medium	medium
RA-8	no	good	good	good	poor to fair	high	high	low	medium	medium	low

Table 1. Truckee River Revitalization: Site Assessments for Public Access and Recreation, Conducted on November 8, 2017

River Restoration Area	Comments
RA-1	The site is large and linear long along the River. A lot of debris has been dumped within the site.
Bridge 2	Access to the River is limited due to steep slopes; however, the upland area of site can serve as an excellent gateway to the potential bridge to the proposed trail enhancements south of the River.
RA-2	The site is adjacent to an existing picnic area within Truckee Regional Park, and appears to be well used.
RA-3	The site includes a newer bridge to the Legacy Trail and could serve as an excellent link between he River, the existing Legacy Trail and the proposed Railyard site improvements.
RA-4	The site provides good River access opportunities off of the existing Legacy Trail.
RA-5	If a spur trail is implemented, the site can link Glenshire Road to the existing Legacy Trail; and if so, the site could serve as a trailhead with enhanced amenities for recreation users.
RA-6	This site was not considered a priority site and was not visited; a public access and recreation assessment was not conducted.
RA-7	Site access from I-80 is a challenge due to the quick need to exit the freeway; there may also be Caltrans R-O-W constraints; site parking may be illegal.
RA-8	Site access is poor from the south side of the River.

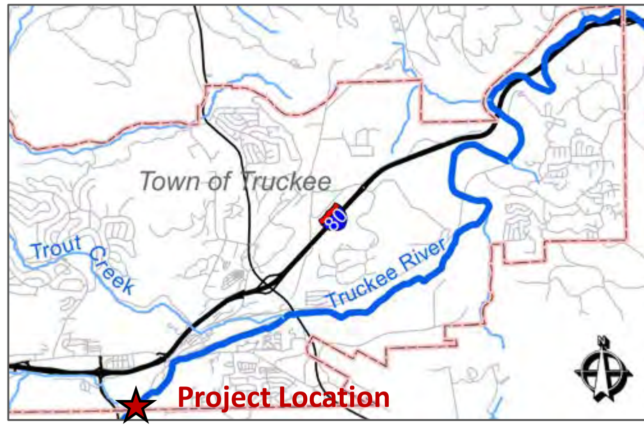
APPENDIX E

Potential Restoration Project Sheets

TRUCKEE RIVER REVITALIZATION: Truckee River at Donner Creek Mouth

Problem: Inadequate stormwater infrastructure, erosion, and loss of floodplain
Project: Sediment reduction and public access improvements
Location: West River Street and the east bank at the mouth of Donner Creek

Truckee River at the Donner Creek Mouth



General Description of problem:

Riparian habitat is degraded due to anthropogenic impacts near the mouth of Donner Creek. West River Street was constructed immediately adjacent to the Truckee River and appears to have constricted the floodplain. The site is currently affected by vehicular access, generating bare spots and compacted soils. Runoff from West River Street conveys untreated stormwater directly to the Truckee River.

Goal(s)	Sources of degradation	Objectives to achieve goal(s)
Reduce excess sediment delivery to Truckee River and improve public access	Stormwater direct connection, vehicular access, and trash	Re-establish floodplain, improve stormwater infrastructure, and control vehicular access

Restoration or Management Approach:

Potential restoration concepts would include re-establishment of floodplain vegetation, installation of stormwater BMPs, and improved river access elements. The floodplain would be enhanced to promote sediment deposition. Stormwater BMPs may include sediment basins and bioswales at culvert outfalls. Drainage from private parcels on the north side of West River Street could be addressed as part of this project. Public access elements could include parking zones at the site, with a dedicated boat launching location, consistent with the Downtown River Revitalization Strategy (2005). Limiting parking and controlling vehicular flow would reduce sediment generation at the site. Making this area a formal public access area could also help to keep the site free of dumped trash.

Source: Esri GIS Community

Potential Restoration Site Boundary

Cost Estimate:

Cost Estimate
Less than $10K
$10K-$100K
$100K-$500K
$500K-$2M
$2M +

Balance Hydrologics, Inc.

foriver TRUCKEE RIVER WATERSHED COUNCIL

TRUCKEE RIVER REVITALIZATION: Truckee River at Donner Creek Mouth

Target Conditions/Success Criteria:
- Reduced sediment delivery.
- Increased floodplain area and improved habitat.

Implementation Timeframe
- Conceptual design (4-6 weeks)
- 60% design (8-10 weeks)
- 90% design (8-10 weeks)
- Permitting (3-6 months)
- Implementation (4-6 weeks)
- Project monitoring (3-5 years)

Monitoring recommendations:
- Repeat cross-sectional channel surveys.
- Observations of high-water marks and peak floodplain conditions.
- Quantify sediment removed from stormwater BMPs.

Phasing or Order of Implementation:
Stormwater management should be implemented prior to or in concert with floodplain restoration or access improvements.

Stormwater Improvements
- Runoff and sediment retention basins to capture road runoff prior to discharge into Truckee River.
- Installation of vegetated swale on south side of West River street to treat flows prior to discharge into Truckee River.
- Repairs to existing riser pipe on north side of West River street to help capture sediment in runoff.

Restoration Options
- Inset floodplain for lower frequency flooding events.
- Limit vehicular access along floodplain and provide formalized parking and boat access.
- Restore and stabilize over compacted river bank though bioengineering and revegetation techniques.

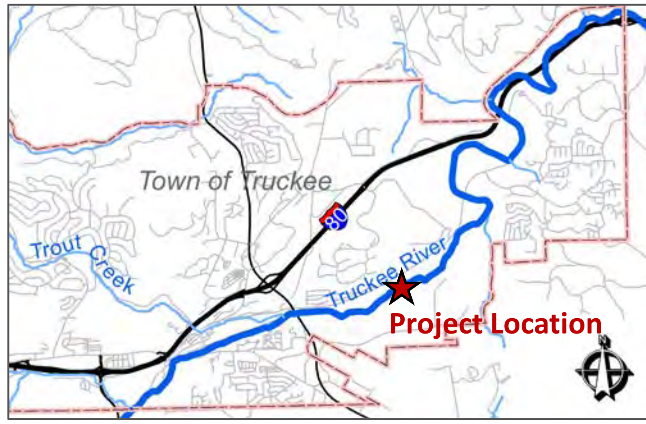
Expand and enhance existing floodplain and modify vehicular access

Clean up trash and other urban pollutants

Stabilize bars with revegetation techniques

TRUCKEE RIVER REVITALIZATION: Tahoe Ice Company Historical Dam Site

Problem: Bank failure and historical dam impacts
Project: Bank stabilization and floodplain habitat enhancement
Location: North and south banks of Truckee River at the location of the historical Tahoe Ice Company Dam



General Description of problem:
The Tahoe Ice Company was in operation at this location from 1886 to 1919 with a dam and diversion works to direct flows into a shallow ponding area for ice harvesting. The dam disrupted riparian vegetation, altered flow paths and limited floodplain area. Several sections along the left river bank are unstable, due to historical land uses, and appears to be a chronic source of sediment to the Truckee River.

Goal(s)	Sources of degradation	Objectives to achieve goal(s)
Reduce excess sediment delivery to Truckee River and enhance habitat	Bank failure and habitat reduction due to historical impacts	Bio-engineered bank stabilization and enhance or expand floodplain habitat.

Restoration or Management Approach:
The bank failure can be stabilized through bioengineering techniques, such as a willow mattress, log crib walls, or rock and rootwad toe protection. Bioengineering techniques can reduce erosion and enhance fish habitat within the River. Additional research and investigations should be conducted to further evaluate the impacts the Tahoe Ice Company Dam had on the river and habitat. The restoration approach may need to consider potential impacts to sensitive historical resources, and could include educational and interpretive opportunities.

Source: Esri GIS Community

Potential Restoration Site Boundaries

Cost Estimate:*

Less than $10K
$10K-$100K
$100K-$500K
$500K-$2M
$2M +

**Cost estimate will depend on area of habitat restored*

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TRUCKEE RIVER REVITALIZATION: Tahoe Ice Company Historical Dam Site

Target Conditions/Success Criteria:
- Reduced sediment delivery to Truckee River.
- Increase floodplain area and improve habitat.

Implementation Timeframe
- Background research on historical site and site preservation requirements (2-3 months) when accessible
- 60% design (8-10 weeks)
- 90% design (6-8 weeks)
- Permitting (3-6 months)
- Implementation (10-14 weeks)
- Project monitoring (3-5 years)

Monitoring recommendations:
- Repeat cross-sectional channel surveys.
- Observations of high-water marks and peak floodplain conditions.
- Measure sediment deposition on floodplain.

Phasing or Order of Implementation:
Projects could be separated into three phases with bank repairs occurring separately from the floodplain restoration site.

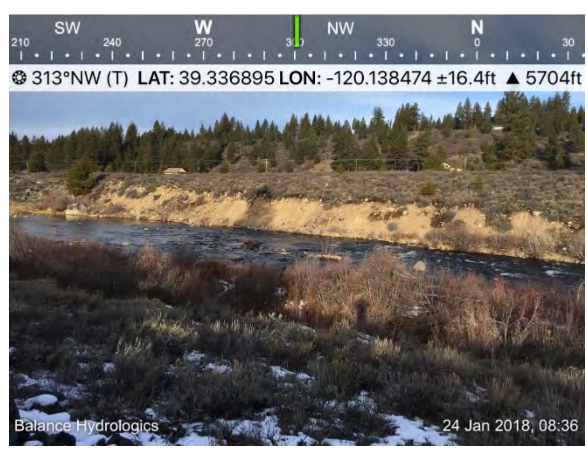
Habitat/Floodplain Restoration Options
- Enhance floodplain for increased frequency of inundation.
- Native plant revegetation and weed removal.
- Removal or breaching of historical dam berms and other flow impeding structures.

Constraints
- Historical site preservation.
- Existing informal trail preservation or relocation.

Historical aerial image of the ice pond site showing the extent of disturbance (photo credit: USFS)

Bank Stabilization Bioengineering Options
- **Willow mattress:** Installation on layers of live cutting placed flat against the bank, using stakes and string to anchor in place. The cuttings are expected to root into the entire bank face and provide surface reinforcement to the soil (NRCS, 2007).
- **Large Debris:** Large debris structures are rocks and rootwads intended to provide habitat and stabilization, until woody riparian vegetation and stable bank slopes can be established.
- **Cribwall:** A hollow, boxlike structure of interlocking logs or timbers filled with rock, soil, and live cuttings, or rooted plants. The live cuttings or rooted plants are intended to develop roots and top growth and take over some or all of the structural functions of the logs .

Tahoe Ice Company dam across the Truckee River (1886-1919); looking northwestward upstream; (photo credit: Tom Macaulay Collection)



Bank failures could be stabilized to minimize chronic sources of sediment.

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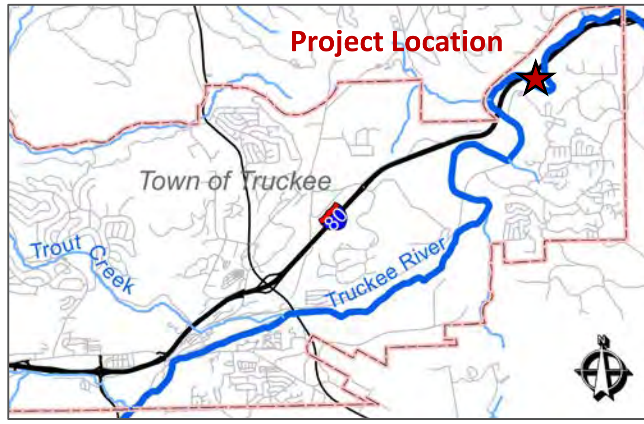
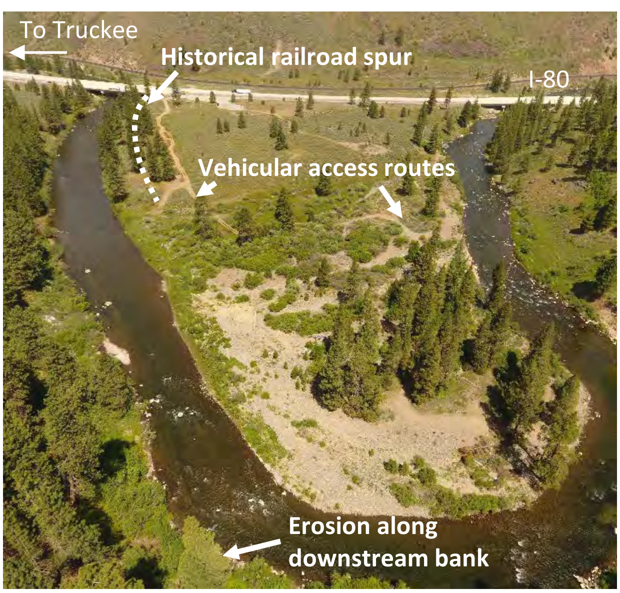
TRUCKEE RIVER REVITALIZATION: CDFW River Bend (Horner's Corner)

Problem: Erosion along banks, sediment from vehicular access and loss of floodplain function
Project: Aquatic habitat, floodplain and public access improvements
Location: CDFW River bend along east bound I-80 between second and third bridge (Horner's Corner)



General Description of problem:
The CDFW River Bend site contains an historical railroad spur from the Nevada Ice Company and is currently a popular fishing location along the Truckee River. The railroad spur appears to have disconnected the floodplain from the river and confined the river to a straight channel that has exacerbated erosion on the downstream bend. Additionally, vehicular access has compacted soils on river bars and limiting vegetation growth. Runoff from access routes conveys sediment directly to the Truckee River.

Goal(s)	Sources of degradation	Objectives to achieve goal(s)
Reduce excess sediment delivery to the Truckee River and re-establish floodplain function	I-80; Historical railroad spur and vehicular access	Re-establish floodplain, remove fill, and control vehicular access



CDFW River Bend Project Site

Restoration or Management Approach:
Historical impacts associated with the spur railroad grade and modern impacts associated with vehicular access could be addressed by removing fill along the left river bank and limiting vehicle access throughout the inside of the river bend. Removing the fill would reintroduce flows to the historical floodplain surface, slowing flows and possibly reducing the potential for erosion along the downstream river bank. A parking and river access area could be established to include sufficient stormwater treatment and boulder bollards could be used to limit disturbance to the floodplain and riparian zone. It should be noted that this is a popular location for fishing access and vehicle access to freedom campsites could be affected.

Cost Estimate:

Less than $10K
$10K-$100K
$100K-$500K
$500K-$2M
$2M +

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TRUCKEE RIVER REVITALIZATION: CDFW River Bend (Horner's Corner)

Target Conditions/Success Criteria:
- Reduced sediment to Truckee River.
- Increased floodplain area.
- Increased floodplain inundation frequency.

Implementation Timeframe
- Conceptual design (3-5 weeks)
- 60% design (8-10 weeks)
- 90% design (8-10 weeks)
- Permitting (3-6 months)
- Implementation (4-6 weeks)
- Project monitoring (3-5 years)

Monitoring recommendations:
- Repeat cross-sectional channel surveys.
- Stage recorders.
- Vegetation monitoring.

Restoration Options
- Remove fill or create breach in railroad spur and if needed generate inset floodplain
- Limit vehicular access along floodplain and provide designated parking area.
- Revegetate and stabilize compacted areas.

Constraints
- Historical site preservation.
- Potential channel cut-off across floodplain and meander abandonment.

Railroad spur grade channelizes river and limits floodplain inundation

Parking area off I-80

Vehicular access routes compacted soils and divert runoff to the Truckee River

Possible historical railroad spur artifacts

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