Taylor-Tallac Ecosystem Restoration Plan

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INTRODUCTION

Taylor and Tallac Creeks are located on the south shore of Lake Tahoe in El Dorado County, 4.5 miles west of the City of South Lake Tahoe. The Taylor and Tallac Creek analysis area include complex shoreline wetlands and riparian ecosystems established within a unique hydrologic and geologic setting (Figure 1). The majority of the analysis area is on Forest Service land with the exception of a 20-acre private in-holding along Tallac Creek. Historically, these two wetland complexes provided approximately 400 acres of wetland and meadow habitat. The wetland conditions are influenced by processes occurring on variable time scales. Changes in streamflow and lake levels over the past several thousand years has formed the geologic framework of moraine ridges, outwash fans, beach ridges and the underlying soil complex.

Lake level, stream flow, and shoreline processes interact in conjunction with wave action to dictate the opening and closing of the sandbar across the mouth of Taylor and Tallac Creeks. Both responses determine water availability and soil moisture in the lagoons and shoreline wetland systems. The wetlands are drained in the lower sections by historic lateral lagoon systems through a series of barrier beach bars formed by retreating lake levels over the past thousand years. The beach bars are underlain by peat soils created by former shoreline marsh complexes.

Current and past land use impacts affect the complex interaction in the analysis area and have altered the way the lagoon systems function both physically and biologically. Alterations and impacts to the system include livestock grazing, dredging of creek mouths, regulation of lake levels by Tahoe City Dam, construction of beach access roads and parking lots, un-maintained culverts along beach swales, extensive recreational use, aquatic invasive species and kokanee salmon management that includes seasonal breaching of Taylor Creek mouth and unnatural flow releases from Fallen Leaf Lake Dam.

Prior to large-scale land use impacts the Taylor-Tallac area supported refugia for native non-game fishes (i.e. Lahontan redside shiner [*Richardsonius egregius*] and Tahoe sucker [*Catostomus tahoenis*]) as well Sierra Nevada yellow-legged frog (*Rana sierrae*). Currently the largest population of Tahoe yellow cress (*Rorippa subumbellata* Roll.) in the Lake Tahoe basin occurs along shoreline and lagoon margins within the analysis area. The loss of functional lagoon habitat has resulted in drier site conditions promoting a decrease in the overall wet meadow landscape as well as back-water aquatic habitats for native fishes and other plant and animal species.

An Ecosystem Assessment Report (EAR) was completed in 2005 for the Taylor and Tallac Watershed (USDA 2005). The purpose of the EAR was to determine historic conditions, currents conditions which could be used to develop desired conditions. Using information from the EAR as well as additional information gathered from Lake Tahoe Basin Management Unit (LTBMU) staff, restoration options have been developed for the analysis area. The restoration options were designed to meet overall goals and objectives for the project area as well as desired conditions for the meadow and wetland complex.

EXISTING CONDITION

Tallac Creek

The upper watershed of Tallac Creek is steep and dominated by debris flow erosion and deposition. The main channel of Tallac Creek is 12 to 15 feet wide and 1.5 to 3.0 feet deep, with a steep gradient and step pool morphology. The bed material tends to be coarse, dominated by cobbles. Tallac Creek is more variable than Taylor Creek, with a range of conditions from very high quality relatively undisturbed step-pool channel to highly eroding and incised sections and areas where debris flow deposits have obliterated the channel.

Tallac Creek below highway 89 emerges into an alluvial fan area. The upper portion of the alluvial fan is dominated by a series of beaver dams and ponds that disperse through numerous small distributary channels. These channels eventually coalesce into two main channels marking the east and west extents of the wetland area. Both channels show signs of past grazing impacts, with evidence of wide width-to-depth ratios (resulting from trampling) and bank instability. The two channels rejoin close to the outlet to the lake and form a more distinct low gradient sand bed channel that is approximately 15 feet wide and one foot deep.

Prior to entering Lake Tahoe, Tallac Creek passes over the concrete-encased sewer line, which could be acting as a grade control. This structure appears to have been constructed below grade and is now exposed 6 inches above grade, which indicates that the channel has incised at least 6 inches. Downstream of the sewer line the channel continues to incise with various scour pools that are 3 to 4 feet deep.

The area was heavily logged during the Comstock Era from the mid 1870s through the mid 1880s at which time the Gardner Railroad was constructed (Figure 2). The impacts from these activities can still be seen on the landscape. It is predicted that the channel below the sewer line was channelized during the Comstock Era to allow boats further inland, most likely to the railroad, to conduct product loading operations.

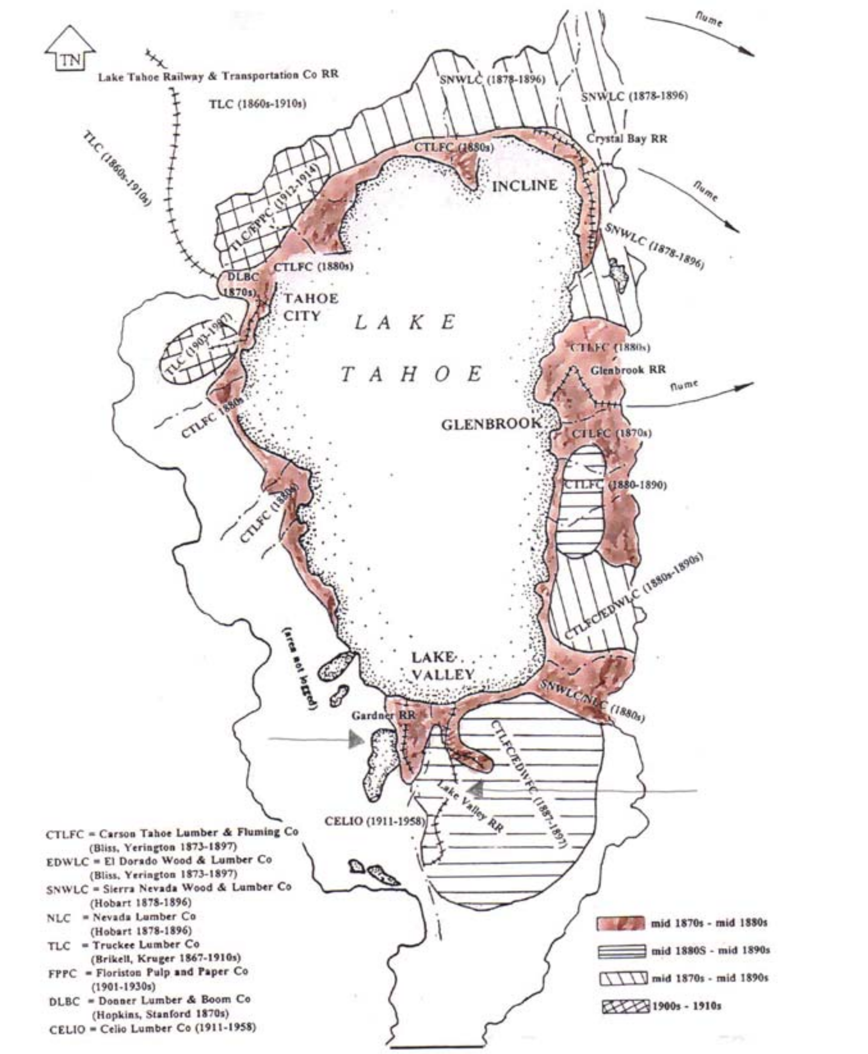


Figure 2-17—Schematic map of large-scale cutting (based on archival/archaeological/dendrochronological data).

Lake Tahoe Watershed Assessment

Near the mouth of Tallac Creek (lake-tributary interface) a large sand bar deflects flow in an eastward path, which currently has resulted in the creation of a barrier beach. Analysis of air photos from 1940 – 2005 demonstrate the central tendency of Tallac Creek to move in an easterly direction not only indicated by the persistence of the barrier beach, but also by the presence of remnant channels that lead into historic lagoonal "swales" that perpendicularly dissect the valley between Tallac and Taylor creeks (Figure 3).

Taylor Creek

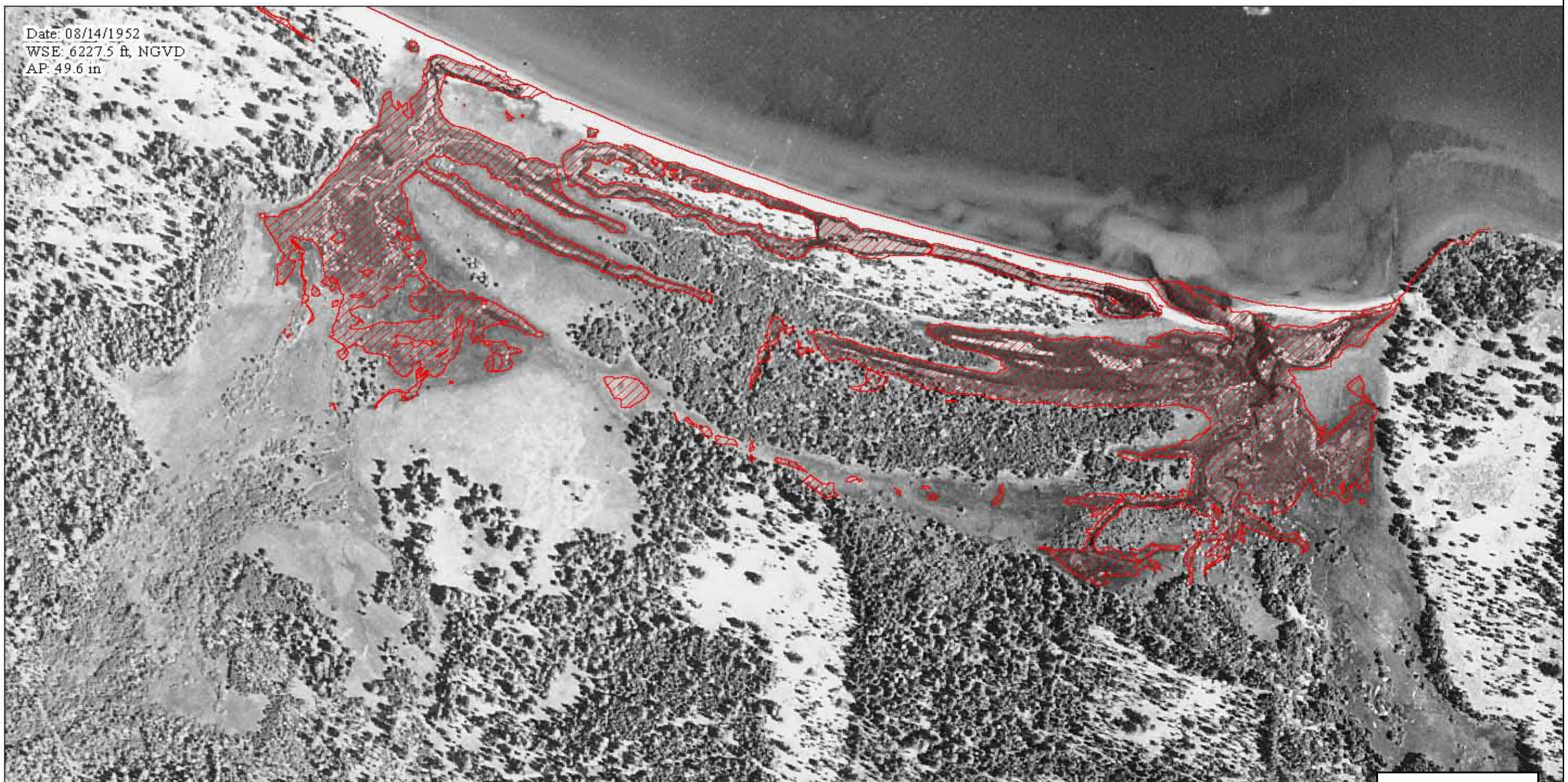
Taylor Creek drains Fallen Leaf Lake and runs approximately 2 miles prior to entering Lake Tahoe. A regulated dam at Fallen Leaf Lake controls the flows of Taylor Creek. Fallen Leaf Lake, in addition, acts as a sediment trap to Taylor Creek. The stream bed material is typically gravel or sand in pools and coarse gravel, cobbles and boulders in riffle runs. The upstream portion of Taylor Creek (above SR 89) is naturally incised but becomes unconfined with a well-developed floodplain below SR 89. Approximately 1,000 feet downstream of SR 89 the channel splits into multiple threads as a result of several large beaver dams. Downstream of the beaver activity the flow splits into two main channels that combine approximately 500 feet upstream of the outlet to Lake Tahoe.

The outlet of Taylor Creek is controlled by a sand bar that currently deflects the mouth westward toward Tallac Creek. The presence and position of this sand bar is a strong indication that the central tendency of Taylor Creek is to form a barrier beach. However, the barrier is breached annually in order to pass kokanee salmon making barrier length usually limited to no greater than 100 feet.

Like Tallac Creek, Taylor Creek was most likely channelized during the Comstock Era. The Lake Valley Railroad was constructed through the wetland to Lake Tahoe (Figure 2). Dredging of the creek mouth for logging access and the removal of an erosionally clay sill, which maintained elevated lagoon levels and wetland habitat during low lake sands, has induced channel bed incision, caused existing bank erosion, and increased the drying of marsh surfaces.

Wetland Lagoons (Swales)

As previously stated the valley between Taylor and Tallac Creeks is dissected by a series of historic lagoons that created wetland for variety of native animal and plant species. From historic aerial photos, it appears that these swales hydrologically connected between Taylor and Tallac and follow topographic features such as historic beaches/lake levels (Figure 4). These swales were formed by 2 processes: 1) the connection of barrier beaches by Taylor and Tallac creeks, thus creating hydrologic connectivity between the 2 streams and 2) lake level interaction controlling the available ground water. At maximum lake level (6229.0 feet NGVD 29), the majority of wetland area and swales are inundated with water (Figure 5). As lake levels recede the available surface water in each swale is reduced as well resulting in drier site conditions.



Notes: Fallen Leaf Lake annual precipitation (AP) prior to 1980 was estimated based on correlation with Tahoe City annual precipitation for water years 1980 through 2003 (this study); annual precipitation is reported for each year for the period of October 1 through September 30; Lake levels were interpolated from end-of-month observations; theoretical inundation overlay was derived from the 2003 topographic model (this study) and then spatially adjusted to fit the orthophoto

Source: Fallen Leaf Lake annual precipitation was obtained from the Natural Resource Conservation Service (NRCS) website; Tahoe City annual precipitation was obtained from the Western Regional Climate Center (WRCC) website; Lake Tahoe water levels were obtained from Federal Water Master; orthophotos from the Lake Tahoe Basin Management Unit, except for the 2003 orthophoto (this study)

Figure 4

Taylor, Tallac, and Spring Creeks Water

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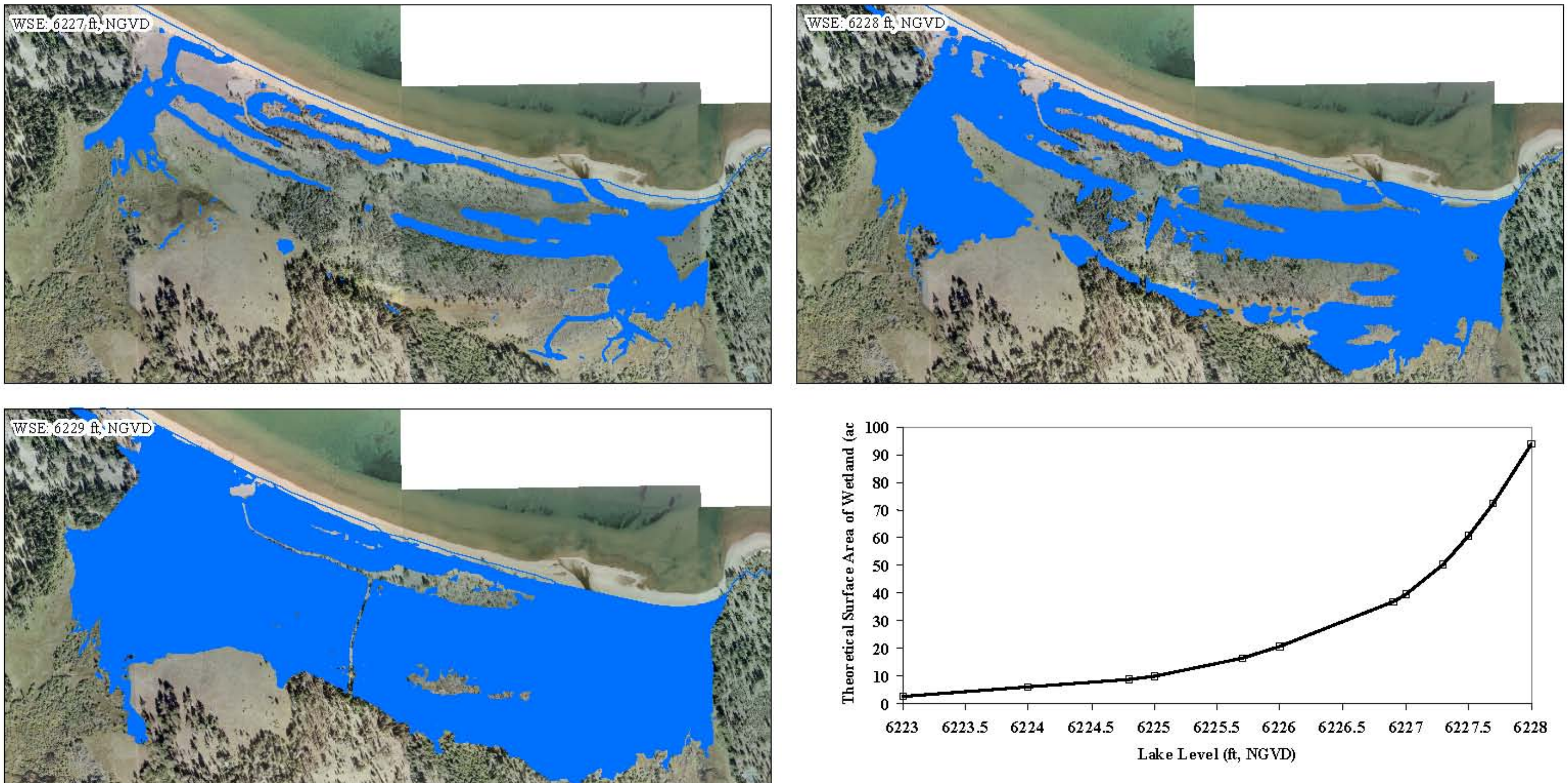

Notes: theoretical inundation overlay was derived from the 2003 topographic model (this study)
Source: the topographic model in NGVD was generated by PWA from points and breaklines supplied by NAM in Lake datum (this study)

Figure 5

Taylor, Tallac, and Spring Creeks Watershed Assessment

Theoretical inundation due to Lake level

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Swale 1 runs immediately behind the beach and is currently the most continuous channel. It originates in Tallac Creek and runs parallel to Baldwin Beach where it comes approximately 30 feet from connecting to Taylor Creek. Swale 1 ends at a narrow but high sand bar that has formed by the movement of Taylor Creek and wind movement causing shifting of sand particles. Historically this bar may have opened forming an alternate mouth for Tallac Creek. Swale 1 is dissected by five various sized culverts that were installed for beach access and/or manhole access that service South Tahoe Utility District (STUPD) water lines (Figure 6). All of these culverts are dilapidated and restrict water movement through the swale.

Swale 2 is not continuous and forms two separate features in Tallac and Taylor Creeks that appear from aerial photos to occupy the same raised beach level. Swale 2 shares the same connection of Tallac Creek as Swale 1 but has a different outlet into Taylor Creek. Swale 2 is less eroded than swale 1, perhaps because it is less influenced by anthropogenic impacts, and appears to be a back channel rather than an active channel. Both channels of this swale die out before the Baldwin Beach Access Road. There is about 700 feet between the ends of the swale channels on each side of the access road.

Swale 3 lies 100 feet inland from Swale 2. Although the channels of this swale do not connect, they come closer than Swale 2 to the access road. The Tallac channel dies out approximately 300 feet from the access road while the Taylor channel dies out 150 feet from the road. Pending the water year, Swale 3 has standing water in the spring and early summer.

Swale 4 lies 500 feet inland from Swale 3, at the point where the Baldwin Beach access road drops off a higher land surface onto a lower surface, transitioning from upland to riparian habitat. The use of approximately 10 feet of fill to maintain an even road surface has blocked the swale. Typically each spring there is standing water on each side of the road indicating that this feature could transmit water if breached or made more hydraulically permeable.

The sewer line crosses Tallac Creek downstream from Swale 1 (Figure 6). It runs parallel to Swale 1 until it reaches the east parking lot where it turns and runs down the Baldwin beach access road until it meets Highway 89. South Tahoe Public Utility District (STPUD) has a 20 foot easement along the sewer line, which includes access for maintenance and inspection.

Recreation

Baldwin Beach is located on the south shore of Lake Tahoe. Land management priorities shifted to support growing recreational and public access needs in the mid 1950's. The paved access road and two parking lots were installed in 1956. The majority of use occurs on the beaches and in close proximity to the parking lots. California Land Management operates the site under a Forest Service special use permit.

Taylor Visitor Center and interpretive trails were constructed in 1965 with the Stream Profile Chamber constructed in 1967. The Kokanee Salmon Festival is an annual event that takes place on Taylor Creek in October. Flows are manipulated to insure adequate water levels exist for Kokanee spawning. Additionally, the mouth of Taylor Creek is manually opened to allow for fish passage.

Aquatic Invasive Species

At least six known non-native aquatic species, including plants, fish, and an amphibian are established in the project area. These non-native species were introduced illegally, for example, through recreational activities, the aquarium trade, or resource management activities such as habitat enhancement projects.

Aquatic Plants

Eurasian watermilfoil (*Myriophyllum spicatum*) is a submersed, perennial herb. Heavy infestations form impenetrable mats of stems and leaves below the water's surface. Eurasian watermilfoil reproduces by seed from buds, stem fragments, rhizomes and root crown as the stem dies back each season. It is very competitive with native species and can completely dominate a plant community within a few years of introduction. Because of the plant's ability to form dense growths, water use activities become severely impaired.

Eurasion watermilfoil is established throughout the project area. It is found in both Taylor Creek and Tallac Creek. Additionally it is found throughout the swales. No restoration action discussed in this plan will increase the abundance or distribution of this species. Part of the restoration effort of the wetland ecosystem will involve experimental removal methods for this species, including but not limited to pulling, section dredging, and bottom barriers.

Warm Water Fishes

Until recently, the distribution of warm water fishes beyond the Tahoe Keys was largely unknown, but a survey by Kamerath et al. (2008) found non-native fish species, including bluegill, largemouth bass, brown bullhead (*Ameiurus nebulosus*), black crappie (*Pomoxis nigromaculatus*), and gold fish (*Carassius auratus auratus)* at 12 of 21 sites around Lake Tahoe, including the project area (Figure 7). It is believed that increased water temperatures have extended the amount of habitat available for warm water fishes to spawn (Chandra et al. 2009).

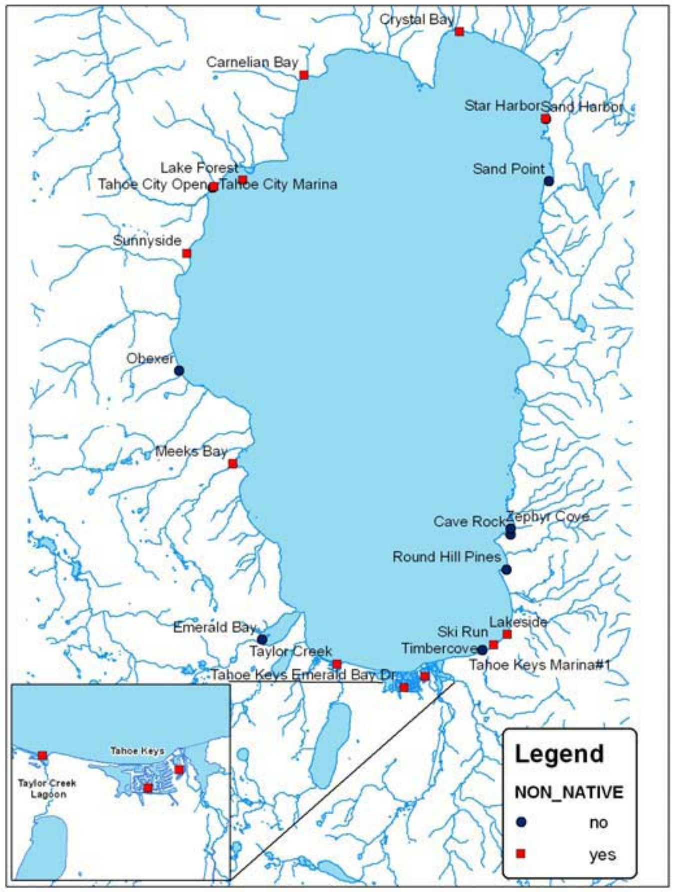
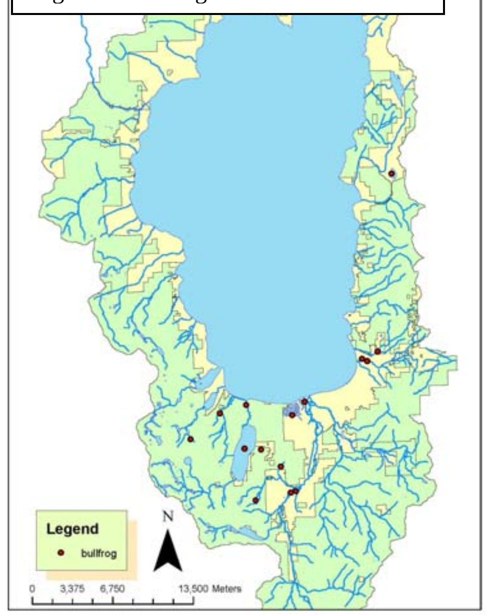


Figure 7: Warm water invasive species distribution studv results.

Amphibians

Adult bullfrogs are voracious, opportunistic predators that employ a sit-and-wait approach and will readily attack any live animal smaller than themselves, including conspecifics and other frogs (Bury and Whelan, 1984). Bullfrogs are among the most successful vertebrate invaders and are considered Invasive Species Specialist Group to be among the 100 worst invaders in the world.

Figure 8: Bullfrog locations in the LTB.



Unlike many other frogs, bullfrogs can coexist with predatory fishes. Bullfrog tadpoles are relatively immune to fish predation because of unpalatability and are one of only a few species likely to persist after fish invasion. Additionally, bullfrogs are extremely prolific, producing up to 20,000 eggs per clutch. Some females can have two clutches per season. Breeding takes place in vegetative choked shallows of permanent bodies of water. All these factors contribute to the difficulty in extirpating bullfrogs once they have established in an area as well as illuminate the importance for native aquatic species the importance of bullfrog management.

The Taylor/Tallac Wetland Complex is currently supporting the largest population of bullfrogs in the Tahoe basin (Figure 8).

Other Species

Other aquatic invasive species that could be in the project area include Asian clam *(Corbicula fluminea),* signal crayfish (*Pacifastacus leniusculus),* and curly-leaved pondweed *(Potamogeton crispus).* No surveys have been conducted for these species but the habitat for these species exists within the project area.

Terrestrial Invasive Species

In addition to aquatic invasive species, there are two non-native invasive plant species within *Rorippa subumbellata* populations. Currently, bull thistle (*Cirsium vulgare*) has been manually treated and populations are declining. Wooly mullien (*Verbascum thapsus*) is another non-native invasive species in the area that has not been treated. This species occurs with *Rorippa subumbellata* and has the potential to out compete the species. Methods maybe used to address these species within the project area to improve *Rorippa subumbellata* habitat.

Tahoe Yellow Cress

Tahoe yellow cress (*Rorippa subumbellata* Roll.) is a rare plant species endemic to the shores of Lake Tahoe in California and Nevada. It is listed as endangered by the State of California and is state-listed as critically endangered in Nevada. It is classified as a candidate species for listing under the Endangered Species Act of 1973. Evidence suggests the current decline in the number of sites occupied by Tahoe yellow cress is due to a variety of causes, including the combined effects of sustained high lake elevations and increased human use of lakeshore habitats.

Rorippa subumbellata is found throughout the project area. There are three sites within the project area, as delineated by the Tahoe Yellow Cress working group (Figure 9). These sites include Taylor, Tallac, and Baldwin. Within each of these sites there are multiple subpopulations.

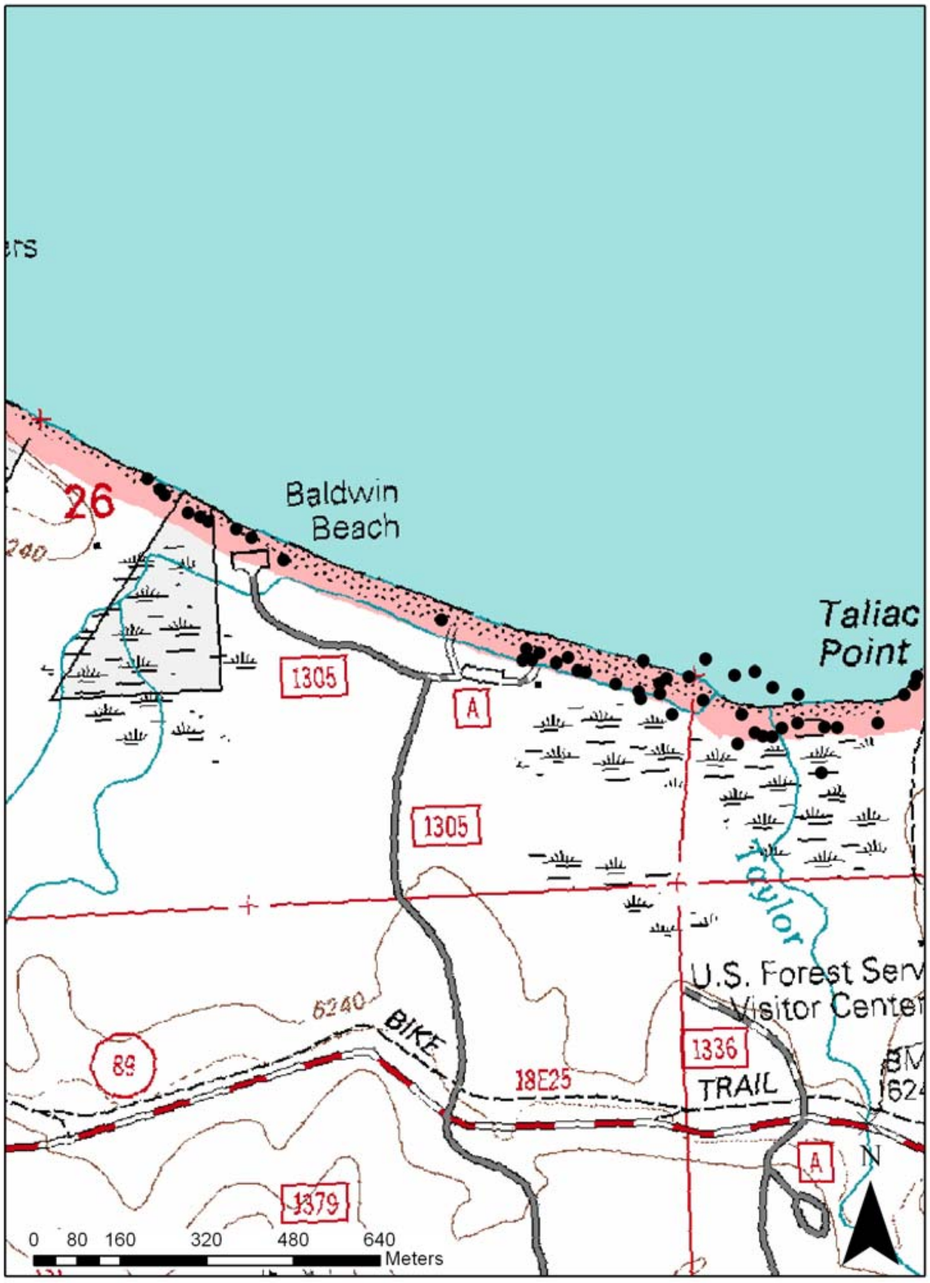


Figure 9: Rorippa subumbellata (Tahoe yellow cress) locations within the project area.

The Taylor site begins at the mouth of Taylor creek and extends west towards the eastern edge of the Baldwin Beach parking lot. Plants within this site are found along the beach, within a fence in the back beach area, in swale 1, and along the edges of Taylor creek extending to just before swale 2. This site is considered a core population, a site that supports relatively large, invariant and persistent populations and therefore is of highest conservation value because they consistently provide favorable conditions for the species. Of the three sites in the project area this is the most consistent through all lake elevations (Figure 10).

The Baldwin Beach site extends from the east end of the Baldwin Beach parking lot (edge of the Taylor Site) and to Tallac Creek. This site has two enclosures on it, both by the west parking lot. Plants are found in both enclosures, in swale 1, and sometimes along the beach depending on recreational impacts and lake levels. This is considered a medium priority site, because it is a site with a highly variable population with significant gaps that still provides habitat under some conditions. While this site has large populations during low lake levels, when the lake is 6225 and above mean stem counts are low due to increased pressure from recreation from decreased beach area.

The Tallac site extends from Tallac Creek west to the private property line. This site has one enclosure present on the west side of the creek. Plants are found in the enclosure and along the beach. This site is considered a core population, it is a site that supports invariant and persistent populations and therefore is of highest conservation value because they consistently provide favorable conditions for the species. While the site has persistent plants, populations are generally small. During high lake levels, the majority of the plants are found in the enclosures as recreational impacts increase due to decreased beach area.

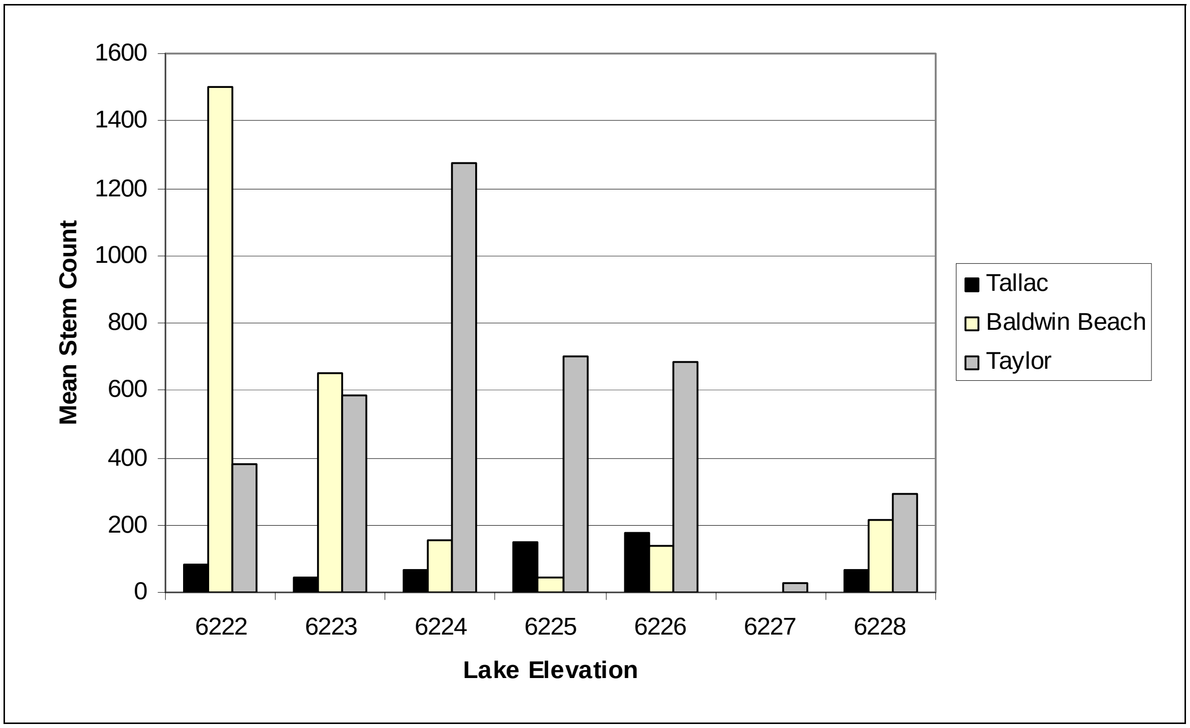


Figure 10: Mean *Rorippa subumbellata* stems at each of the three sites within the project area at different lake elevations (feet). Mean data was collected from 1978 through 2009.

This project will not negatively impact any *Rorippa subumbellata* plants. The project has the potential to positively influence the metapopulation dynamic of this species through microhydrology changes. Additional management to protect *Rorippa subumbellata* populations will be explored during project design development.

Goals and Objectives for the Taylor-Tallac Analysis Area

Project Goals:

1. Restore ecological processes and functions.
2. Facilitate and appropriate balance between the human use and the natural values of the site.

Project Objectives:

- Restore hydrologic and geomorphic processes and functions.
- Enhance and restore vegetative processes and wetland functions.
- Enhance the value of the site for native aquatic and terrestrial wildlife.

- Tahoe Yellow Cress: Improve Tahoe yellow cress populations by promoting conditions that favor a positive metapopulation dynamic..
- Enhance the value of the site to benefit species of value to the Washoe Tribe, such as yampah (*Perideridia sp*.), bracken fern (*Pteridium aquilinum,and tule (Scirpus lucstris).*
- Improve water quality by reducing fine sediments and nutrients delivered to Lake Tahoe.
- Reduce adverse effects of recreation, and infrastructure development.
- Enhance environmental educational and interpretive opportunities.
- Enhance human use and enjoyment of the site in ways consistent with its natural ecology.
- Conduct experimental removal methods for aquatic invasive species that could provide information for removal methods in other areas in the Tahoe basin.

Desired Conditions

The following are specific ecological desired conditions for the Taylor and Tallac Creek analysis area:

- The habitat supports viable populations of native and desired non-native plant, invertebrate, and vertebrate riparian and aquatic-dependent species.

- New introductions of invasive species are prevented. Where invasive species are adversely affecting the viability of native species, impacts to native populations are reduced or eliminated.

- The species composition and structural diversity of plant and animal communities in riparian areas, wetlands, and meadow provide desired habitat conditions and ecological functions.

- The distribution and health of biotic communities in special aquatic habitats, marshes and seeps, perpetuates their unique functions and biological diversity.

- The connections of floodplain, channels, and water tables in Taylor and Tallac distribute flood flows and sustain diverse habitats.

- Soils in Taylor and Tallac wetland and meadows have favorable infiltration characteristics and diverse vegetation cover that absorb and filter precipitation and sustain favorable conditions of stream flows.

- The in-stream flows in Taylor and Tallac Creek are sufficient to sustain desired conditions of riparian, aquatic, and wetland, and meadow habitat, and keep sediment regimes as close as possible to those with which aquatic and riparian biota evolved.

- The physical structure and condition of stream banks along Tallac and Taylor Creek minimize erosion and sustain desired habitat.

- The ecological status of meadow vegetation in Tallac and Taylor wetland and meadow complex is late seral (50 percent or more of the relative cover of the herbaceous layer is late seral with high similarity to the potential natural community). A diversity of age classes of hardwood shrubs and trees is present and regeneration is occurring.

- Meadows, wetlands and lagoons in the Taylor and Tallac complex are hydrologically connected. The meadows and streams within the potential project area have the following characteristics:

1. Stream energy from high flows is dissipated, promoting backwater aquatic habitat, reducing erosion and improving water quality.
2. Meadow conditions enhance floodwater retention and groundwater recharge.
3. Riparian and wetland vegetation stabilize stream banks against scour processes resulting from high flows.

DESCRIPTION OF RESTORATION ALTERNATIVES

The focus of restoration in Tallac and Taylor Wetland and Meadow complex is to restore ecological conditions to as close to pre-1850 conditions as possible considering current constraints (e.g. recreational infrastructure and climate). With climate change dramatically affecting riparian and aquatic habitats and species, restoration efforts that increase water yield longer throughout the year are becoming crucial efforts throughout Sierra Nevada wetland and meadow ecosystems. Restoration efforts will include increasing wetland and meadow area by reconnecting historic swales, re-introducing vegetative management techniques (e.g. prescribed fire), managing aquatic invasive species, and incorporating alternative recreational access that is consistent with the

Sierra Nevada Forest Plan Amendment, Forest Plan and the desired conditions for this area. All restoration actions are intended to restore natural ecosystem processes.

Alternative 1: No Action

Alternative 2: Move the position of Tallac Creek into Swale 3 and reconnect to Taylor Creek

This alternative would reactivate flow into Swale 3 at Tallac Creek (Figure 3). The position of Tallac Creek would be moved into Swale 3 and a plug would be constructed in the area where the channel was formally positioned. The plug would allow flows to be directed into Swale 3. Some excavation might be required to ensure the swale height is level or slightly below the current stream height. Currently the center point of Swale 3 is hydrologically disconnected by the Baldwin Beach access road and is positioned at a higher elevation verses the swale's inlet and outlet of this area. In order to maintain a flow path from Tallac to Taylor, this portion of higher ground would be excavated to achieve the design swale cross section dimension and slope. A road crossing structure would be installed where Swale 3 crosses the access road to allow the pertinent range of flows to pass and provide aquatic species passage.

To prevent reoccupation of the existing channel below swale 3, channel plugs would need to be installed. The plugs would extend at or slightly above the existing meadow surface to avoid incision around the downstream plug, thereby lowering the base level setting the stage for successive head-cutting around the plugs and complete recapture of the stream. The plugs would be constructed of rock and wood material mixed with native meadow top soil and sod. Additional willow planning would aid in site stability.

The reactivation of flow into Swale 3 will increase meadow wetness by directing Tallac Creek into a larger portion of the meadow. A portion of the available water from Swale 3 is expected to move into the surrounding meadow and follow the elevation gradient towards the lake as ground water. In addition, to increasing meadow wetness this alternative could increase *Rorippa* habitat. Currently there are no known plants in Swale 3 so no plants would be impacted through excavation activities. The action of increased water in this swale could decrease herbaceous plant competition and increase bedload deposition (sand) into this swale rather than directly into the lake. If sand deposits occur within the swale (as a result of high flow recession) and vegetation decreases, *Rorippa* could colonize the area, potentially along the Taylor Creek edge.

Of the series of five culverts beginning at the west parking lot access road and continuing to the east park lot, all five would be removed as well as all associated fill (Figure 11). The west parking lot culvert would be replaced with a crossing structure that would allow more contiguous flow transfer as well as aquatic species passage. The two culverts within the Swale 1 would be removed and the swale would be re-contoured to mimic its historic condition. The two culverts located at the east lot and currently used as access points to the beach would be replaced with raised boardwalks. Access to the STPUD easement would need to be provided via one of the culvert replacement locations. Additionally a swale crossing would be installed along the access road that currently dissects Swale 4; currently no culvert exists. Road material and fill would be removed and replaced with a crossing that would allow water conveyance and aquatic species passage.

In conjunction with the habitat restoration efforts, Best Management Practices (BMPs) will be implemented on the access road and east parking lot. This includes but is not limited to permeable fill segments along the access road, installation of catchment basins to collect parking lot runoff, and repaving road and parking surface.

The removal of culverts would improve the water flow through the associated swales and could open up *Rorippa* habitat. *Rorippa* is currently known in Swale 1, associated culvert actions will not cause any take of this species. The establishment of foot bridges will aid in protection of *Rorippa*. By establishing foot bridges the public may be less likely to trample known populations within the swales and follow designated access to the beach.

The removal of culverts will also improve aquatic passage and aquatic habitat for native minnow species. Additionally, the removal of culverts along swale 1 and the additions of culverts/aquatic passages along the access road will increase the hydrologic functionality of the wetland by allowing unobstructed water passage between Tallac and Taylor Creeks.

Taylor and Tallac creeks currently have known populations of various aquatic invasive species. Part of the restoration effort of the wetland ecosystem will be conducting experimental removal methods in a controlled setting. This effort will be in coordination with the Lake Tahoe Aquatic Invasive Species Working Group. Targeted species will include but not limited to: American bullfrog, blue gill, large mouth bass, brown bullhead, and Eurasian milfoil. Surveys for additional Aquatic Invasive Species will also occur. Removal methods are intended to reduce invasive species numbers so that native species can once again thrive in this rare habitat. The current dissection of the swales (by roads, culverts, or natural landforms) is conducive for experimental removal using various techniques to determine the most successful method.

The timing of removal actions can either occur prior to or after the wetland restoration actions. The timing will be determined through mapping efforts to analyze the population size and location of invasive species. Methods of removal will vary depending on targeted species, but most likely will involve: bottom barriers, hand pulling and/or diver-operated suction for mechanical harvesting (milfoil and pondweed); spot capture and/or trapping (bull frogs); electrofishing or gill nets (warm-water fishes). Bottom barriers will only be utilized outside of *Rorippa* populations. Removal actions will need to be maintained to ensure either numbers remain low or full eradication is achieved. Additionally, removal methods could be tied to service learning opportunities with local schools.

Prescribed fire as a tool to maintain meadow size, function and distribution would be used. Fire is a desired treatment for returning habitat invaded by lodgepole back to meadow vegetation. Tree ring chronology indicates lodgepole stands surrounding meadows in the Sierra Nevada burned on a 30-75 year interval (Caprio 2008). Due to fire suppression activities lodgepole has become established within meadow systems. Through management tools including thinning and burning, invasion of lodgepole will be reduced. Results from the Meadow Restoration Pilot Project will be used to determine where fire is best suited in the meadow as a means of management. In addition to reducing lodgepole encroachment, fire stimulates aspen (*Populus tremuloides*) regeneration. Aspen were identified in the Watershed Assessment (2000) as Ecologically Significant Areas (ESAs) yet aspen occupy less than two percent of the landscape on the LTBMU. This action could improve Aspen stands in the basin.

By restoring the function and process of Taylor and Tallac Wetland complex, opportunity exists to work in collaboration with the Washoe tribe to reestablish native vegetation important to historic cultural practices. Additionally opportunity exist to incorporate interpretive signs regarding historic use of the land by the Washoe Tribe as well as signs interpreting native terrestrial and aquatic dependant species.

Because of the proximity of the project area, these restoration efforts could easily be incorporated into service learning opportunities with local schools. Various age groups could implement AIS removal methods and study results in a classroom setting. Native vegetation could be grown in the classroom and planted in the restored area. Classroom could measure ground water levels to measure restoration affects. As invasive species numbers are reduced, studies could be conducted to determine the native assemblage of terrestrial and aquatic species that re-inhabit the area. The options to include the local schools as well as the community as a whole are bounteous.

Additional management actions will be explored for *Rorippa subumbellata* within the project area. These actions could include restoration signage for an area around Taylor Creek requesting the public to stay out restoration actions occurring. (This could also be linked to environmental education). By closing a portion of the beach surrounding Taylor Creek, this core *Rorippa subumbellata* site would have protection from one of the largest threats – trampling.

A cost analysis for this alternative can be found in Appendix A.

Alternative 3: Divert Tallac Creek into Swale 1 and reconnect to Taylor Creek

This alternative would reactivate flow into Swale 1 at Tallac Creek. The position of Tallac Creek would be moved into Swale 1 and a plug would be constructed in the area where the channel was formally positioned. Some excavation might be required to ensure the swale height is either level or slightly below the stream height. In order to maintain a flow path from Tallac to Taylor, some excavation would be required to achieve the design swale cross section dimensions and slope. Repositioning Tallac Creek into Swale 1 would allow more contiguous source of flow into this lagoon.

To prevent reoccupation of the existing channel below Swale 1, channel plugs would need to be installed. The plugs would extend above the existing meadow surface to prevent continuous flow through the old channel. To ensure that the flow from Tallac moved toward Taylor Creek through Swale 1, additional plugs would be required. In order to avoid incision around the downstream plug, thereby lowering the base level setting the stage for successive head-cutting around the plugs and complete recapture of the stream, the furthest downstream plug would be faced with cobble. Additional willow planting would aid in bank stability. The interstices would be filed with topsoil and meadow sod.

This alternative would not increase meadow wetness since Tallac creek would not be diverted into any of the earlier swales.

While the long term benefit may exceed the short term loss, this alternative could cause take to *Rorippa subumbellata* plants. This species occurs along the sandy margins of Swale 1. Direct effects could occur during excavation and implementation. In addition, if the water level in swale 1 rises for a longer period of time there could be indirect effects to *Rorippa subumbellata* by decreasing potential habitat. When the lake elevation is high, populations of this species are found only in enclosures and along swale 1. There could however, be positive indirect effects if the increased water level actual decreased competition from other species due to longer saturation and a sandy margin still remained along the swale.

Excavation of the sand bar formed by movement of Taylor Creek would be required to allow Swale 1 to reconnect with Taylor creek. Excavation practices will avoid any intentional take of *Rorippa* plants. By restoring the characteristics of water flow through Swale 1, more *Rorippa* habitat will be created through implementation. The dynamic nature of Taylor creek forming a barrier beach is ecologically consistent with *Rorippa subumbellata*'s metapopulation dynamics. Seedlings of Tahoe yellow cress are often observed in the "bathtub" ring of organic matter deposited on berms, in beach depressions, and on dune areas by rising lake levels, tides, wind, and storm waves (Pavlick et al 2002). The dynamic nature of Taylor creek forming barrier beaches provides the extirpation and colonization pattern the metapopulation dynamics of this species depends on.

Some planting of riparian vegetation along the parking lot side of Swale 1 will occur to improve wildlife habitat and discourage trampling of the swale by recreational users.

All other aspects of Alternative 3 are the same as Alternative 2 (aquatic invasive species, meadow vegetation, Washoe Tribe collaboration and environmental education).

COMPARISON OF ALTERNATIVES

	Alternative 1: No Action	Alternative 2: Divert Tallac Creek into Swale 3 and reconnect to Taylor Creek	Alternative 3: Divert Tallac Creek into Swale 1 and reconnect to Taylor Creek
Aquatic Resources	Invasive species will continue to thrive further displacing native aquatic species.	Invasive species would be drastically reduced and/or eliminated. Approximately 2.4 stream miles would be enhanced for native aquatic species. Six aquatic passage obstructions would be eliminated. One additional aquatic passage would be created.	Invasive species would be drastically reduced and/or eliminated. Approximately 2 stream miles would be enhanced for native aquatic species. Six aquatic passage obstructions would be eliminated.
Hydrology and Soils	Meadow and wetland will continue to dry out until maximum lake levels are reached. Areas of incision will continue to down grade.	Swale 1 will have unobstructed flow to Taylor Creek and carry flow for longer throughout the season. Swale 3 will have unobstructed flow to Taylor Creek and carry flow for longer throughout the season. Approximately 300 acres of wetland will be enhanced and remain wetter for longer throughout the season.	Swale 1 will have unobstructed flow to Taylor Creek and carry flow for longer throughout the season. Swale 3 will have unobstructed flow to Taylor Creek and carry flow for longer throughout the season. Approximately 250 acres of wetland will be enhanced and remain wetter for longer throughout the season.
Wildlife	Habitat for riparian dependant species will continue to decline as wetland and meadow dry out. Recreational impacts to wildlife habitat will continue to exist.	Approximately 300 acres of riparian dependant species habitat will be enhanced. Recreation impacts to wildlife habitat will be reduced due to increased vegetative cover and creation of wetland habitat away from high recreational activity.	Approximately 250 acres of riparian dependant species habitat will be enhanced.
Botanical Resources	Wetland and meadow vegetation would continue to dry out. *Rorippa subumbellata* populations would remain stable with potential threats	Because the wetland/meadow would remain wet longer, facultative and obligate meadow species could thrive. *Rorippa subumbellata* habitat would improve from	Wetland and meadow vegetation will continue to dry out – there may be a trend towards faculatative and facultative-upalnd species rather than

	unmitigated, due to recreational impacts, and drying of swales.	improved metapopulation dynamics, not plants will be impacted, and increased protection through education would occur. Competition with invasive species would be reduced.	obligate species. *Rorippa subumbellata* habitat may improve, some direct take could occur. Increased protection through education would occur. Competition with invasive species would be reduced.
Recreation and Scenery	Recreation use will continue at status quo. With potential increased regional temperatures, more users are expected.	Recreation use would be compatible with ecological setting. Interpretation would be incorporated into the recreation experience. TRPA scenic and visual thresholds would be met by creating vegetative screens to parking lots.	Recreation use would be compatible with ecological setting. Interpretation would be incorporated into the recreation experience. TRPA scenic and visual thresholds would be met by creating vegetative screens to parking lots.
Heritage Resources	No impacts to heritage resources.	Interpretive signs would include input from Washoe Tribe. Washoe input would be incorporated into vegetative restoration efforts.	Interpretive signs would include input from Washoe Tribe. Washoe input would be incorporated into vegetative restoration efforts.

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Appendix A:
Taylor-Tallac Restoration Project Funding Needs

Cost and Implementation Summary

SUB-PROJECT	DESCRIPTION	COST	IMPLEMENTATION SEQUENCE
NEPA	Covers wetland restoration and road/recreation site improvements	$300K (Rnd 11)	2011 (Est. decision = 2nd Quarter 2012)
Baldwin Beach Access Road Culvert Replacement/Installation	Replace/install 3 culverts along access road at swales 1, 3 and 4 intersections	$400K (Rnd 12)	Year 1: post-NEPA decision (Aug./Sept./Oct.)
Legacy Road Upgrades	Remove 2 historic road crossings and replace 1 culvert along Swale 1 (STPUD man-hole access)	$300K (Rnd 12)	Year 1 (Aug./Sept./Oct.)
Recreation Site Upgrades	Upgrade Baldwin Beach parking lots (re-pave, drainage, sediment filter system)	$300 (Rnd 12)	Year 1 (Aug./Sept./Oct.)
Lagoon/Wetland Restoration	Re-position Tallac Creek channel/flow into Swale 3 and tie into Taylor Creek	$1M (Rnd 12)	Year 2 (Aug./Sept./Oct.)
<u>SUB-TOTAL</u> SNPLMA RND 11 COSTS		$300K	
<u>SUB-TOTAL</u> SNPLMA RND 12 COSTS		$2M	
Aquatic Invasive Species	Conduct AIS control measures for warm-water fishes, milfoil and bull frogs	Est. $70 - $100K/yr (SNPLMA AIS, et al.)	Ongoing (Coordination w/ LTAISWG)
Meadow Restoration	Thin and burn encroaching conifers (includes NEPA and implementation); NOTE – sub-project is part of “Restoration of Fire Adapted Meadows”	$60K (Rnd 9) $130K (Rnd 11)	2012
Terrestrial Invasive Species	Conduct control measures for invasive weeds	TBD	2012