# III.4. AQUATIC ECOSYSTEM

This section contains a review of fisheries resources within the Upper Reach Study Area, both current and historical. The regulatory background with respect to fish and aquatic resources is reviewed, and potential effects of the project on these resources are described.

## III.4.A. Regulatory Background

### TRPA GOALS AND POLICIES

The Tahoe Regional Planning Agency (TRPA) is responsible for regulating local development to ensure preservation of fish resources. The following discussion of the regulatory background was excerpted from various TRPA documents.

The TRPA must attain and maintain fishery thresholds and other adopted standards. Fishery thresholds consider the importance of all existing fish species and their contribution to the ecological balance of the total fishery resource. The TRPA fishery thresholds, along with other agency's standards, are summarized in Table 3.15.

The maintenance of essential habitat serves as the fisheries management emphasis. For streams, thresholds call for the maintenance of 75 miles of excellent stream habitat, 105 miles of good habitat, and 38 miles of marginal habitat. Habitat is rated by a technical committee at regular intervals, based on professional judgment regarding substrate quality, bank stability, and other habitat features. Also, stream habitat is classified as resident or migratory, based on suitability for spawning by lake resident fish. The Upper Truckee within the Study Area is classified as migratory habitat and was rated as marginal at the last threshold update, though it has the potential for excellent. Fish thresholds are currently being updated by TRPA.

### OTHER AGENCIES

The mission statement of the California Department of Fish and Game (CDFG) is to manage California's diverse fish, wildlife, and plant resources and the habitats upon which they depend. These resources are to be managed for their ecological values and for their use and enjoyment by the public. The CDFG is the lead agency in California for safeguarding and regulating the uses of fish and wildlife.

The United States Fish and Wildlife Service (USFWS) is charged with the responsibility to protect, preserve and, if possible, enhance the nation's fish, wildlife, and related ecological resources for the benefit and utilization of the people of the United States. In fulfilling this responsibility, one of the USFWS functions is to review proposals for the erection of structures in navigable waters of the United States to insure that: 1) fish and wildlife resources and their habitats receive due consideration in the decision-making process, and 2) the public's interest in fish and wildlife

resources, and in the uses of these resources, are protected. Authority for the USFWS review of such proposals originates from the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.). The USFWS is also responsible for the status of wild populations of flora and fauna and for the identification of those that are in danger of extinction, pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. 1533). Permits from, or consultation with, the USFWS is required for most actions that may affect listed threatened or endangered species.

Table 3.15: Fishery ordinances, policies and regulations

| Plan/Policy | Standard/Criteria |
|---|---|
| TRPA Thresholds | Lahontan Cutthroat Trout: It shall be the policy of the TRPA Governing Board to support, in response to justifiable evidence, state and federal efforts to reintroduce Lahontan cutthroat trout. |
| | Stream Habitat: Maintain 75 miles of excellent, 105 miles of good, and 38 miles of marginal stream habitat. |
| | Instream Flows: a non-degradation standard shall apply. |
| TRPA Goals and Policies Fishery Policies | Goal #1, Policy 1: Development proposals affecting streams, lakes, and adjacent lands shall evaluate impacts to the fishery. |
| | Policy #2: Unnatural blockages and other impediments to fish movement will be prohibited and removed wherever appropriate. |
| TRPA Code of Ordinances | Chapter 79 Fish Resources: Ensures the protection of fish habitat and provides for the enhancement of degraded habitat. |
| California Department of Fish and Game | Manages California's fishery resources and habitat on which they depend. These are to be managed for their ecological values and for their use and enjoyment by the public. Fish and Game issues streambed alteration agreements for construction, modification or reconstruction of shorezone structures. They are currently reviewing their standards and policies for the issuance of these agreements. |
| California Water Quality Control Board | Various policies and regulations for providing water quality sufficient to support cold-water fish and other aquatic organisms. |

## III.4.B Existing Conditions

### Aquatic Communities

Fish found in the Upper Truckee River, and their distribution, are shown in Table 3.16 (Snider et al 1987). Much of the current fish assemblage consists of non-native fish, either introduced by governmental agencies, generally to provide sportfishing, or by the public, either to provide fishing opportunities or inadvertently through the use of live bait.

Table 3.16: Fish in the Upper Truckee River

| Common Name | Scientific Name | Native? | Distribution |
|---|---|---|---|
| Lahontan Redside | *Richardsonius egregius* | native | Resident: downstream from Echo Creek<br>Migratory: downstream from Angora Creek |
| Tui Chub | *Siphateles bicolor* | native | Primarily near mouth |
| Speckled Dace | *Rhinichthys osculus* | native | Near mouth |
| Tahoe Sucker | *Catostomus tahoensis* | native | Resident: downstream from Echo Creek<br>Migratory: downstream from Angora Creek |
| Mountain Whitefish | *Prosopium williamsoni* | native | Rare in river |
| Piute Sculpin | *Cottus beldingi* | native | Throughout |
| Lahontan Cutthroat | *Oncorhynchus clarki henshawi* | native | Stocked in headwaters |
| Brown Bullhead | *Ameirus nebulosus* | introduced | Downstream from Echo Creek |
| Kokanee Salmon | *Oncorynchus nerka* | introduced | Rare in river |
| Brook Trout | *Salvelinus fontinalis* | introduced | Echo Creek upstream to 1 mile south of S. Upper Truckee Road |
| Brown Trout | *Salmon trutta* | introduced | Resident and migratory: 1 mile south of S. Upper Truckee Road |
| Rainbow Trout | *Oncorynchus mykiss* | introduced | Resident: throughout<br>Migratory: mouth to 1 mile south of S. Upper Truckee Road |

Fish migrating from Lake Tahoe, particularly rainbow and brown trout, use the Upper Truckee for spawning from the mouth upstream to the cascades about one mile south of the South Upper Truckee Road crossing. Migratory rainbow trout spawning appears to be concentrated from Echo Creek upstream to the cascades above South Upper Truckee Road, while the majority of migratory brown trout appear to spawn from Angora Creek upstream to Benwood Creek (Snider et al 1987). Because of its size and flow volume, the Upper Truckee is one of the most important producers of fish in the Lake Tahoe Basin (TRPA threshold updates).

Fall population estimates of trout abundance were conducted throughout the Upper Truckee River in the fall of 1985 (Table 3.17) in conjunction with a study on instream flow requirements (Snider et al 1987). Although no estimates of statistical variance were presented, population density was substantially lower in the two segments furthest downstream, below Echo Creek. Population density was lowest in the segment from Angora Creek to Echo Creek, encompassing the lower part of the Study Area (Reaches 1 through 4). Trout density in this reach was around ten times lower than in the two segments upstream (Reaches 5-10). The magnitude of the difference

in population estimates between the Angora to Echo Creek segment and upstream segments suggests substantial impairment of aquatic habitat in the Angora to Echo segment, or Reaches 1 to 4 in the Study Area.

Table 3.17: Results of Fall 1985 electrofishing surveys.

| Segment<br>Species | Number per Mile (by age) | | | | | |
|---|---|---|---|---|---|---|
| | Young of year | 1 | 2 | 3 | 4 | total |
| Mouth to Angora Creek | | | | | | |
| rainbow trout | 267 | 17 | 0 | 0 | 9 | 293 |
| brown trout | 1385 | 6 | 12 | 6 | 15 | 1424 |
| Angora Creek to Echo Creek | | | | | | |
| rainbow trout | 594 | 0 | 0 | 0 | 0 | 594 |
| brown trout | 594 | 40 | 26 | 0 | 0 | 660 |
| Echo Creek to Benwood Creek | | | | | | |
| rainbow trout | 5924 | 173 | 31 | 0 | 0 | 6128 |
| brown trout | 2860 | 487 | 0 | 0 | 31 | 3378 |
| Benwood Creek to Upstream End of Christmas Valley | | | | | | |
| rainbow trout | 7550 | 1126 | 123 | 18 | 0 | 8817 |
| brown trout | 0 | 180 | 0 | 0 | 0 | 180 |
| brook trout | 1109 | 528 | 18 | 0 | 0 | 1665 |

Macroinvertebrate studies also suggest that biotic integrity within the lower reaches of the Upper Truckee River has been impaired. Herbst (2001) found that several measures of biotic integrity declined substantially in study sites downstream of the Study Area boundary (downstream of the Elks Club Highway 50 crossing). However, this study detected little or no impairment of macroinvertebrate populations in study sites located within the State Park Recreation Area, within the segment with low trout density in the 1987 study. Additional macroinvertebrate sampling conducted for this project detected few differences between biotic integrity in samples taken upstream of the State Park and within the State Park.

Available data on trout populations thus appear to suggest that impairment has occurred in Reaches 1 through 4, but biotic impairment cannot be detected in populations of macroinvertebrates sampled from selected riffles. There may be two reasons for this. First, macroinvertebrates were sampled from selected riffles, which was likely the best habitat available within the reach. Although this was relatively high quality habitat based on indices of biological integrity, its distribution throughout Reaches 1 through 4 was not measured and is likely

low, based on field reconnaissance. Put another way, the high-quality riffle habitat in which macroinvertebrates were sampled was scarcer in Reaches 1 through 4 than in upstream reaches, possibly due to infiltration of finer sediment from bank erosion or other sources.

It is also possible that trout populations show impairment in response to habitat impacts that do not substantially impair macroinvertebrate community indices. For example, the abundance of pools and available cover can significantly influence fish populations. These habitat variables would be less likely to influence community composition of macroinvertebrate samples collected in high-quality riffles.

### AQUATIC HABITAT

In the most recent TRPA threshold update (TRPA 2001), the 21 miles of resident and migratory habitat in the Upper Truckee was classified as marginal habitat, the lowest designation. Habitat deficiencies, based on qualitative judgments of fishery managers and experts, included a lack of pools, poor spawning substrate, low canopy cover, low streambank and channel stability, water diversion, and barriers to fish migration. With the improvement of some or all of these factors, habitat has the potential to improve to good or excellent. The TRPA threshold updates do not provide adequate detail to address variability in habitat within the river system.

Downstream of the Meyers Highway 50 crossing, the river is relatively unconfined and has a low gradient. Riffles are generally composed of gravel, and pools tend to be found on outside bends, resulting from lateral scour. Extensive side channel systems are found throughout this portion of the river, though most are not active today. These channels may provide ephemeral aquatic habitat today, though this habitat may have been more extensive historically.

From the Meyers Highway 50 crossing upstream to the cascades about one mile upstream of the South Upper Truckee Road crossing, the channel is steeper and substantially more confined by valley walls. Some relatively unconfined meadows are found interspersed through these reaches, with pool-riffle type habitat similar to lower reaches, but these tend to be relatively small. Intervening reaches tend to have step-pool rather than pool-riffle habitat. Large boulders are numerous and important as instream cover and for pool development.

The cascades that begin upstream of the South Upper Truckee Road continue for several thousand feet. The channel is extremely steep, and several waterfalls are present. Habitat primarily consists of step-pools formed by large boulders. These cascades are not passable to fish migrating upstream from Lake Tahoe.

Above the cascades, stream habitat is highly variable. Much of the channel is relatively low gradient with pool-riffle habitat, as in unconfined meadows like Meiss. Other portions are relatively confined and forested, with a combination of pool-riffle and step-pool habitat types. There are also several lakes in the Upper Watershed, many of which have been stocked with trout.

Some are too small or shallow to support fish, but many still do (Showers Lake, for example, contains brook trout).

Tributaries to the Upper Truckee likewise exhibit alternating unconfined and confined reaches, a legacy of glaciation. The lower portions of both Big Meadow and Grass Lake Creeks, for example, are steep, step-pool type channels with extensive boulder substrate. Both also have extensive meadow systems (Cookhouse and Big Meadow on Big Meadow Creek, and Grass Lake on Grass Lake Creek) that are relatively unconfined, with lower gradients, pool-riffle habitat, and gravel substrate.

### Lahontan Cutthroat Trout Recovery Efforts

The combination of habitat loss, changes in water quality conditions, and introduction of non-native salmonids and warm water predatory fish has resulted in extirpation or significant reduction in the native fish species found in the Upper Truckee River. The focus of recovery efforts in the Upper Truckee River Watershed has been on reintroduction of Lahontan cutthroat trout (LCT) and removal of non-native fish from treated reaches.

The Lahontan cutthroat trout was listed as an endangered species in 1970 under the Federal Endangered Species Act. To facilitate restoration and allow limited catch and release angling, the LCT was reclassified as threatened in 1975. Since then, several efforts have been launched to plan for and implement projects to return LCT to its native range. Those efforts involving the Upper Truckee River Watershed include:

- U.S. Forest Service reintroduction of LCT in Meiss Meadows,
- U.S. Forest Service reintroduction of LCT in Showers Lake,
- U.S. Fish and Wildlife Service LCT Recovery Plan,
- Multi-agency Truckee River Basin Recovery Implementation Team, and
- Short-term Action Plan for LCT in the Truckee River Basin.

Due to the presence of non-native salmonids throughout the Upper Truckee River Watershed, LCT recovery planning has focused on isolated reaches of the mainstem within the headwaters or smaller lakes that have high quality habitat and could be intensively managed. Locations targeted for reintroduction of LCT populations have been classified to be managed solely as an LCT fishery, where non-native species are actively eliminated from the management area, or as a reintroduction area, where it is hoped that successive plantings results in development of self-sustaining populations.

The most significant long-term reintroduction program in the Upper Truckee River Watershed began in 1989 and is being directed by the U.S. Forest Service in the Meiss Meadows area. In 1989 and 1990 rotenone was applied to approximately four to six miles of the Upper Truckee River

to remove brook trout prior to reintroduction of LCT. In 1990, following the rotenone treatment, LCT were introduced. Despite the rotenone application, brook trout were still present in an area adjacent to a well-used trail crossing, resulting in suspicions of reintroduction from anglers rather than a lack of success from the rotenone applications. In an effort to completely remove the remaining brook trout populations and understand population dynamics within the reintroduced LCT populations, the Meiss Meadows area has been electrofished annually since 1990. The electrofishing takes place for three separate weeks between September 10 and October 15. In the most recent electrofishing treatment, conducted in the fall of 2003, no brook trout were captured, raising hope that the remaining brook trout populations have been completely removed.

Beginning in 2000, the U.S. Forest Service has also begun introducing LCT into Showers Lake, despite the presence of brook trout. Showers Lake is a popular destination along the Pacific Crest Trail and is northwest of the Meiss Meadows LCT reintroduction area. Showers Lake is thought to be the source of brook trout reintroduced to the Upper Truckee River following the rotenone application in 1989 and 1990. The success of LCT introduction into Showers Lake will be closely monitored to determine whether LCT can coexist with brook trout and other non-native salmonids in a lake environment.

To determine the future success of the current and future reintroduction and recovery programs, like the one being implemented by the USFS in Meiss Meadows, the Truckee River Basin Recovery Implementation Team developed a set of success criteria that include the following (TRBRIT, 2003):

- A self-sustaining, networked LCT population is established, composed of wild, indigenous strains, in streams, lakes, mainstem and tributaries of the Truckee River Basin.
- Physical connectivity exists between spawning and rearing habitats in lakes, mainstem and tributaries of the Upper Truckee River basin to support natural LCT reproduction and recruitment and restore self-sustaining lacustrine LCT in the Truckee River Basin.
- A self-sustaining lacustrine population shall be considered to be naturally reproducing with a stable age-class structure consisting of at least four year classes and a stable or increasing population size with documented reproduction and recruitment. These conditions must be demonstrated to have been met for a minimum period of 20 years.
- Water is obtained through water right purchases or other means to protect and secure a stable Pyramid Lake ecosystem and meet life history and habitat requirements of LCT.
- A flow regime for the Truckee River is implemented which facilitates LCT migration, life history and habitat requirements.
- A commitment is secured to develop and maintain opportunities for fish passage within the Basin in a manner that facilitates migration and reproductive behavior of LCT.
- Threats to LCT and its habitat have been reduced or modified to a point where they no longer represent a threat of extinction or irreversible population decline.

The USFS, USFWS, CDFG, and other government agencies and non-profits will continue to implement recovery projects based on the direction of the TRBRIT planning document and the USFWS LCT Recovery Plan until these criteria are met.

### Historic Changes in Aquatic Ecosystems

Prior to the arrival of white man, Lahontan cutthroat trout and mountain whitefish were the only salmonids in the Upper Truckee River and were the top predators in the aquatic community. Both fish spent most of their adult lives in the Lake and migrated into the river to spawn. Juveniles likely spent a few months to a couple of years in the river before migrating back to the Lake. Cutthroat may have had resident life-history patterns as well.

Both fish were very important parts of the native Washoe culture (Lindström and Rucks, 2003). Several Washoe fishing camps were located on the Upper Truckee River, probably targeting both cutthroat and Tahoe suckers. The best fishing sites were apparently just downstream of the cascades south of South Upper Truckee Road, which were historically a barrier to additional upstream migration. Trout Creek, a tributary to the Upper Truckee River downsteam of the Study Area, was known for having large runs of whitefish. The importance of these fish in Washoe culture suggests that historic spawning runs were quite large.

An extensive fishery developed around Lahontan cutthroat after white settlement of Lake Tahoe, both in the Lake and on spawning runs in the streams. Evidence from this fishery also suggests that spawning runs were large and composed of large individual fish, often 20-30 pounds (Scott 1957). Along with introduction of exotic salmonids, overfishing led to the extirpation of Lahontan cutthroat from the Upper Truckee Watershed by the 1930s. Mountain whitefish are now rare throughout the watershed.

Most of the changes in the original fish assemblage have occurred in the salmonids due to their importance as sport fish. All of the native minnows still occur in the watershed, as well as the Piute sculpin, though some of their ranges may be more restricted, either due to habitat changes or competition with introduced fish.

There is some evidence that substantial changes in fish habitat have occurred in the Study Area. George Snooks, a Washoe familiar with the historic fishery and fish habitat, sketched a map in 1937 showing the location of spawn beds (Lindström and Rucks, 2003). Several good spawning beds are shown on the map in Reaches 1 though 4. Although migratory brown trout use this area for spawning today, rainbow trout (whose spawning behavior and habitat preference is most like that of Lahontan cutthroat) mostly spawn upstream of these reaches today. This suggests that spawning habitat in Reaches 1 through 4, which consists of gravel riffles, may be less extensive in these areas than historically.

Several potential impacts to aquatic ecosystems have occurred since white settlement of the area. Timbering was extensive, and logs were transported in the river (Lindström and Rucks, 2003), likely resulting in fairly extensive habitat disturbance. Grazing was also common throughout meadows historically. For example, dairy farms operated in the meadows around the Angora Creek confluence for several decades, starting as early as the 1860s. Grazing also occurred extensively in meadows throughout the upper portion of the watershed, such as Meiss Meadow. Overgrazing may have had impacts on streambank stability and riparian vegetation.

Stream channels and adjacent riparian habitat were also directly altered in many situations. Analysis of historic maps suggests that the lower portion of Big Meadow Creek was moved several thousand feet sometime before 1940. Substantial constrictions of the channel occur at both the Elks Club Highway 50 crossing at the lower end of the Study Area and on South Upper Truckee Road; both of which likely affected the channel and habitat both upstream and downstream.

Confined and unconfined channels, however, were probably much different in their response to human disturbance. The confined channel types, which predominantly occur upstream of Meyers, were less likely to show negative effects from human disturbance because of the stability conferred by larger substrate. The unconfined channels, found predominantly in Reaches 1 through 4, were more likely to be significantly impacted by land use practices, and were less likely to recover, due to smaller substrate and less erosional resistance.

In many of the meadows throughout the Study Area, there is evidence that the stream has incised relative to the floodplain, a common response to land use impacts. The evidence of incision includes dry side channels, reduction in extent of riparian vegetation, and channel straightening. This has occurred not only in meadows in Reaches 1 through 4, but also in smaller meadows higher up in the watershed, such as Cookhouse Meadow on Big Meadow Creek.

The distribution of trout in the Upper Truckee River suggests that habitat impacts in meadows are still affecting biologic integrity. Habitat degradation includes bank instability, lack of riparian and instream cover, reduction in instream habitat complexity, and reduction in the occurrence and length of high-quality riffles.

### Effects of Watershed Restoration

Based on this discussion, several potential effects to aquatic habitat should be considered during watershed restoration planning.

- The greatest impacts to aquatic habitat have occurred in the Reaches 1 through 4, and in other low-gradient, unconfined meadows throughout the watershed, and the greatest aquatic habitat benefits will accrue from restoration projects in these areas.
- Rip-rap stabilization of streambanks may increase the amount of cover available for fish and may increase the frequency and depth of pools. However, rip-rap is not likely to

increase riparian vegetation density and overhanging cover (unless designed with a strong bioengineering component). Also, without addressing changes in channel planform and geometry resulting from incision, rip-rap will not restore historic in-channel habitat, including pool-riffle ratios and quality and complex side-channel habitat.

- Stream restoration alternatives in Reaches 1 through 4 that restore historic channel fluvial geomorphology (including relationship between the channel and floodplain) are likely to provide the greatest aquatic habitat benefits.
- Reduction of fine sediment entering the river from anthropomorphic sources (roads, cutslopes, eroding streambanks, etc.) may provide benefits to the aquatic ecosystem, especially in Reaches 1 through 4 or other low-gradient areas. However, macroinvertebrate analysis suggests that improvements would likely primarily accrue to reaches downstream of the Study Area.

## III.4.C Opportunities and Constraints

The following opportunities and constraints have been identified with respect to fisheries and aquatic habitat.

### Opportunities

- Several miles of TRPA stream habitat ratings could be upgraded from marginal to good or excellent through bank stabilization, substrate improvements, or other restoration measures.
- Utilization of Reaches 1 though 4 by migrant spawning fish could substantially increase with substrate improvements.
- Restoration of smaller meadows higher up in the watershed, above fish migration barriers, may provide opportunities for introduction of Lahontan cutthroat trout.

### Constraints

- Any construction must be accomplished to minimize potential impacts to fisheries and aquatic resources. Construction may not be allowed when spawning fish are in the river.
- Restoration projects must be designed to protect water quality, both during and following construction.

## III.4.D References

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# III.5 CULTURAL RESOURCES

## III.5.A Methods

Heritage work for the Upper Reach Study Area was accomplished in two phases aimed at assessing project opportunities and constraints that will influence the selection of a preferred project alternative. Initial Phase IA research was conducted to gather the necessary background data in order to assist project planners. Upon completion of background research, a Phase IB field archaeological reconnaissance was performed to identify existing heritage resources within the Study Area.

### PHASE IA: PREFIELD RESEARCH

Baseline information on the prehistoric/Native American and historic/Euroamerican land use were analyzed in order to better identify the location, nature and intensity of environmental/cultural changes occurring within the Study Area, with a focus on past environmental conditions and prehistoric and historic alterations of the UTR channel and its surrounding floodplain.

Heritage research entailed a literature search of prehistoric and historic themes for the Study Area. This included a review of prior archaeological research and of pertinent published and unpublished sources in order to identify any properties listed on national registers, state registers and other listings, including the files of the State Historic Preservation Office. A cursory historic chain of title search was conducted of El Dorado County deeds, pre-emptions and homesteads (J. Starns, personal communication). Richard Solbrig, General Manager of the South Tahoe Public Utilities District (STPUD), was called to clarify details of recent historic development of the Study Area, such as the establishment of subdivisions, formation of assessment districts and installation of sewer and water lines and other accompanying infrastructure. John Stanowski, Maintenance Manager of the Lake Tahoe Golf Course, provided helpful field orientation and offered information on the history of the course. Descendents of pioneer families in Lake Valley, along with other individuals knowledgeable in local history, were contacted and focused oral history interviews were conducted as appropriate (Lindström and Rucks 2003 for interview notes).

Lindström et al (2000) provide the most recent summary of Washoe Indian history, fishing, and land use at Lake Tahoe, drawn from the core Washoe ethnographic literature (e.g., Barrett 1916; Lowie 1939; d'Azevedo 1986; Downs, 1966; Nevers 1976). Most pertinent to the Study Area and aboriginal fishing are Freed (1966); Lindström's research (1992; 1996); and the unpublished field notes Edward Siskin (90-03). These were summarized and incorporated in Lindström and Rucks (2002). There is continuing value in Washoe traditional knowledge for reconstructing environmental history, and there is much to document about the post-contact period through individual family histories (Lindström and Rucks 2003).

### PHASE IB: FIELD ARCHAEOLOGICAL RECONNAISSANCE

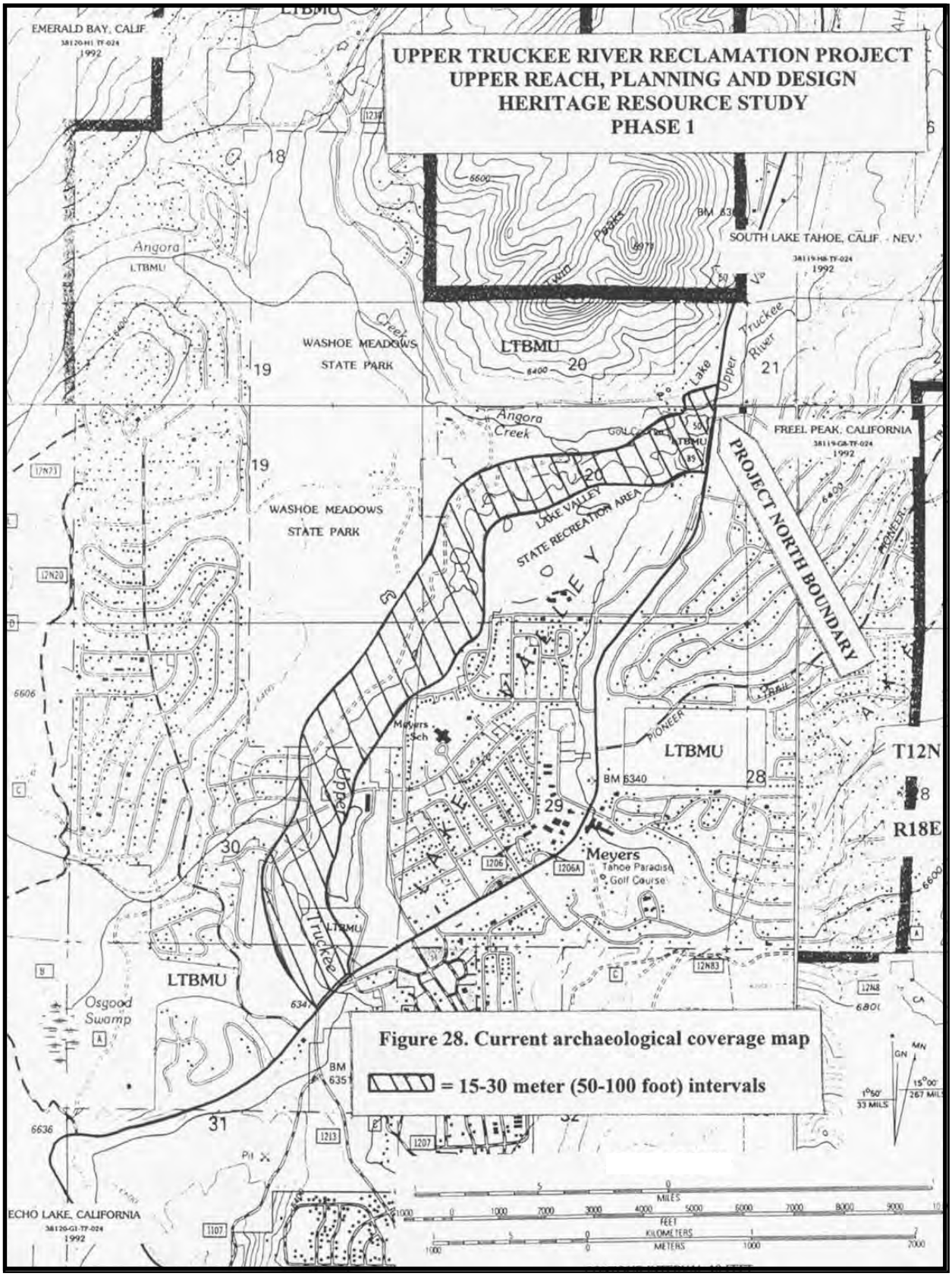
Prefield research provided the rationale with which to develop a strategy for the on-the-ground archaeological field reconnaissance. Lindström and two assisting archaeologists (Lizzie Bennett and Charles Blanchard) walked 480 acres of Study Area (Figure 3.31), employing a pedestrian surface survey that was structured by a mixed archaeological reconnaissance strategy. Potential impact areas within the 1000-foot (305-meter) corridor within the UTR floodplain were targeted for field examination by systematically walking parallel transects. Transect intervals and distances were established by pacing. Cardinal directions were maintained by compass readings.

An attempt was made to employ a surface-intensive coverage type by walking parallel transects at no greater than 15-meter (50-foot) intervals. Such coverage was accomplished in areas along the riverbank, on drier grassy meadows, on terraces above the river, and within gently sloping forested uplands above the wetlands. However, due to extensive riparian thickets, standing water, and canals and ponds excavated by beaver, systematic transects over considerable portions of the Study Area were impossible to maintain and coverage was broadened to surface-30 (100-foot) coverage type, employing transect intervals between 15 and 30 meters. In this case, vegetation and/or water precluded any ground surface visibility and areas within this 30-meter span were left unexamined. These areas of more cursory coverage entail wet grassy meadows and riparian thickets adjacent to the river. Ground surface visibility within the Study Area is variable. Overall, the ground surface is obscured by meadow grass, pine duff and riparian vegetation. Some of the area was inaccessible due to standing/flowing water and impenetrable vegetation.

During this “sweep” survey, all heritage resources were briefly described and plotted on project maps (1”=200’ and 1”=400’ scales). Field recording of the heritage finds is deferred until Phase II work, at which time heritage resources will be recorded in accordance with the guidelines outlined in the "California Archaeological Inventory Handbook for Completing an Archaeological Site Record".

### PREVIOUS ARCHAEOLOGICAL INVESTIGATIONS AND KNOWN HERITAGE RESOURCES

Portions of the Study Area have been subject to an archaeological survey and several heritage resources studies have been done within or immediately adjacent to the project, including CDPR, USFS, Caltrans, MACTEC, and Lindström in the Meyers Area, Hintz, Kraushaar, and Dexter in Christmas Valley, and Marvin and Holson in the Upper Watershed (see Lindström and Rucks 2003 for detailed descriptions of findings). See Figures 3.32A&B for extent of area previously surveyed.




SWANSON HYDROLOGY + GEOMORPHOLOGY
115 Limekiln Street Santa Cruz, CA 95060
PH 831.427.0288 FX 831.427.0472

**FIGURE 3.31:** Map displaying extent of Upper Reach Study Area surveyed in Phase 1B of the field archaeological reconnaissance by S. Lindström, Fall 2003.

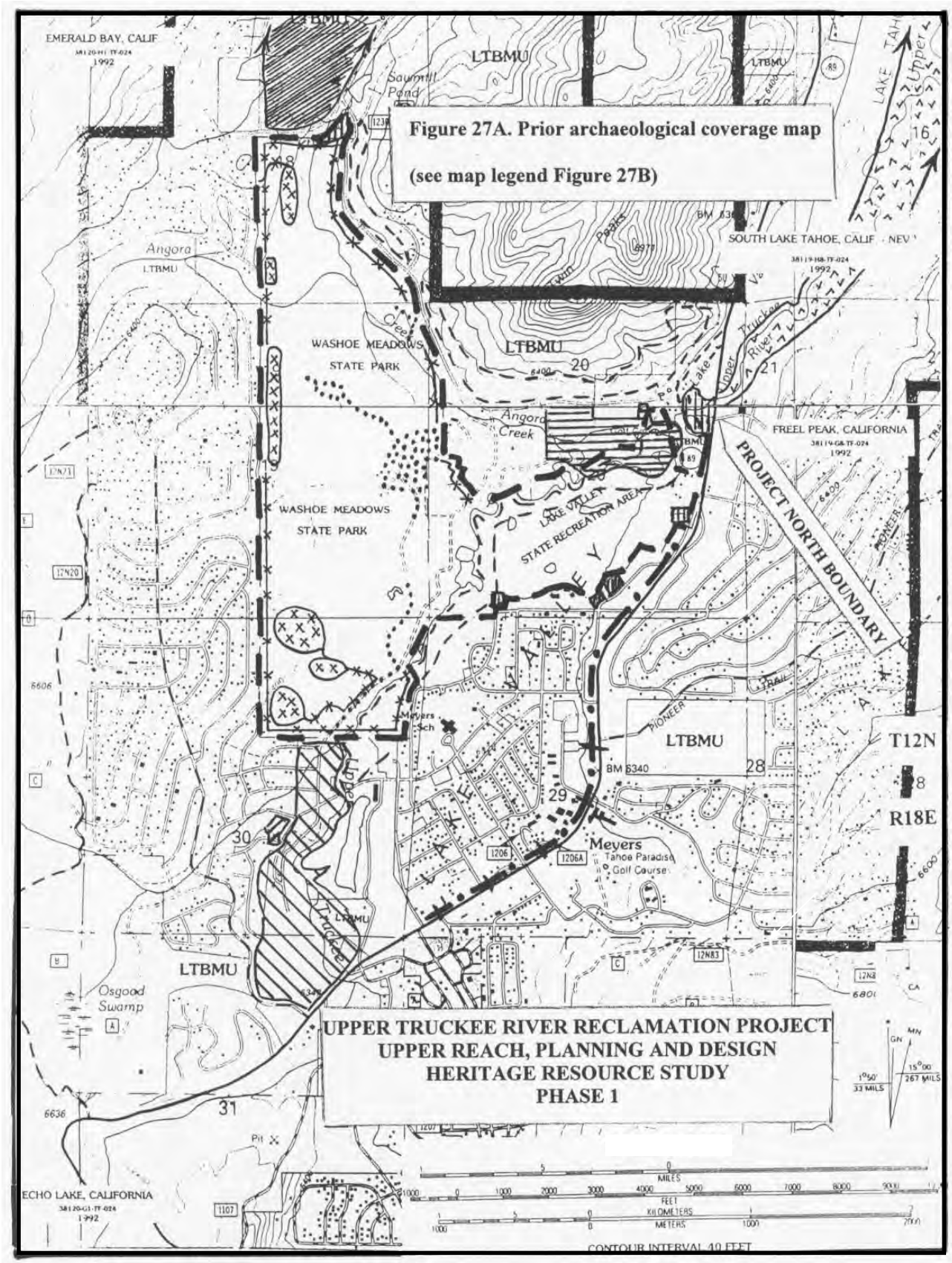



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**FIGURE 3.32A:** Map displaying the location and extent of previously surveyed archaeological studies in the Upper Reach Study Area.

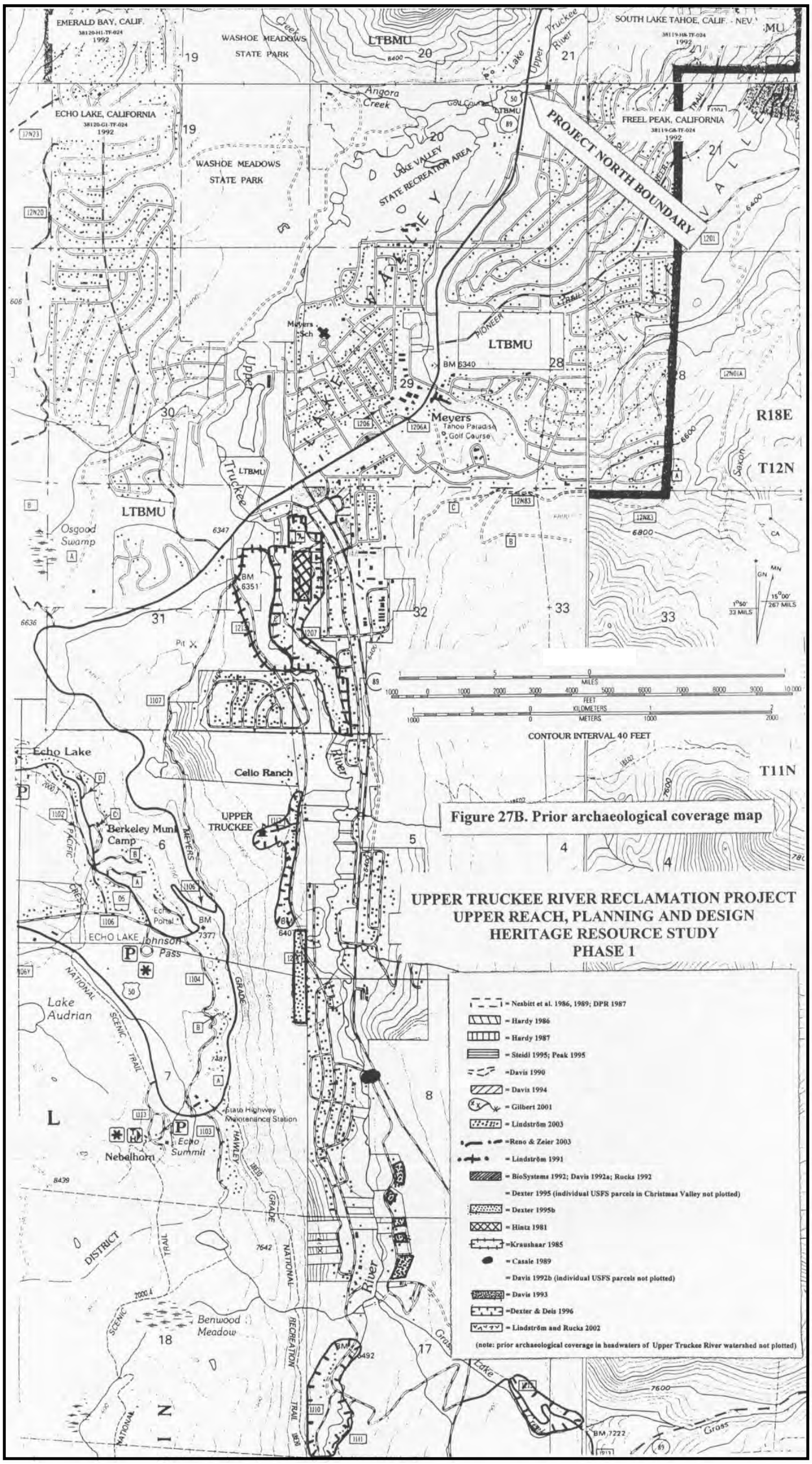


Figure 27B. Prior archaeological coverage map

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**FIGURE 3.32B:** Map displaying the location and extent of previously surveyed archaeological studies in the Upper Reach Study Area.

### III.5.B Summary of Heritage Resources Survey Result

Heritage resources noted during this study are described below and summarized on Table 3.18. Note that these resources have not yet been formally recorded as part of Phase I research. This task should be accomplished as part of Phase II work prior to any project ground disturbance activities and preferably at the earliest stage of project planning. The project sponsor may have additional responsibilities under the following circumstances:

- if the project changes in ways that could impact heritage properties;
- if heritage properties are discovered during the implementation of this project or if a known heritage property will be impacted in an unanticipated manner;
- if a property that was to be avoided has been inadvertently or otherwise impacted;
- if any condition of the project, such as a delay in implementation or implementation in phases over time, may justify reconsideration of the current significance status of heritage properties within the project's area of potential effect.

Table 3.18: Summary of heritage resources recorded within project corridor: Elks Club Highway 50 crossing to Meyers Highway 50 crossing.

| Resource # | Description |
|---|---|
| Native American Sites and Isolates: | |
| UTR-1 | water worn obsidian chunk in exposed stream channel |
| UTR-2 | lithic scatter (1 gneiss biface; flakes: 4 gneiss, 1 basalt) |
| UTR-3 | obsidian flake (mixed into a pile of asphalt at log landing near Amacher Quarry) |
| UTR-4 | lithic scatter (1 basalt biface; 40 flakes, 14 basalt, 21 obsidian, 4 gneiss, 1 igimbrite) |
| UTR-5 | lithic scatter (1 chert uniface/scraper; 36 flakes: 17 obsidian, 16 basalt, 3 gneiss) |
| UTR-6 | 1 red chert flake in dirt road |
| 05-19-613 | 4 bedrock milling features, two hand stones, midden, lithic scatter |
| Euroamerican Sites, Linear Features and Isolates : | |
| UTR-7 | olive glass fragment (pre 1917) |
| UTR-8 | 2 multi-serve cans (early sanitary, 1898-pre-1930s) |
| UTR-9 | "Pearl Oil" can (lead solder with "D" ring handle) |
| UTR-10 | dirt road trace (pre 1940?) |
| UTR-11 | dirt road trace (pre 1940?) |
| UTR-12 | dirt road trace (pre 1940?) |
| UTR-13 | dirt road trace (pre 1940?) |
| UTR-14 | Hwy 50/89 abandoned "dog-leg" segment |
| UTR-15 | Harms Bros. Quarry/Asphalt Plant (pre 1952); now Lake Baron |
| CA-Eld-556/H | Locus A: irrigation ditch (pre 1940) |
| CA-Eld-556/H | Locus B: recent CDFG concrete fish ladder; historic railroad grade |

#### NATIVE AMERICAN SITES AND ISOLATES

UTR-1 Obsidian Chunk. A water worn obsidian chunk is exposed in the UTR stream channel. Its cultural associations and provenience are unknown.

UTR-2 Lithic Scatter. A sparse lithic scatter consists of one gneiss biface and one basalt and four gneiss waste flakes. The site covers an area about 10 meters diameter above the west side of the river and down slope of the termination of Shawnee Street.

UTR-3 Obsidian Flake. An isolated obsidian flake occurs in a pile of asphalt on top of a log landing near the Amacher Quarry.

UTR-4 Lithic Scatter. A widely-broadcast but sparse lithic scatter occurs on a bench above the east bank of the Upper Truckee River and along Bakersfield Street. The site is about 45 meters diameter. One basalt biface and 40 waste flakes were observed (14 basalt, 21 obsidian, four gneiss, and one igimbrite). A quartz crystal fragment is of questionable cultural origins. The site is highly disturbed and flakes tend to cluster along the edge of the road.

UTR-5 Lithic Scatter. Another widely-broadcast but sparse lithic scatter occurs on a bench above the east bank of the Upper Truckee River and along Bakersfield Street, north of UTR-4. It is about 30 meters in diameter. One chert uniface (scraper?) and 36 waste flakes (17 obsidian, 16 basalt and 3 gneiss) were observed.

UTR-6 Chert Flake. One isolated red chert flake occurs in a dirt road that accesses the "back" side of Amacher Ranch.

FS-05-19-613 Camp. A prehistoric camp consists of four bedrock milling features, two hand stones, extensive midden, and lithic scatter. The site is located on a bench above the west bank of the Upper Truckee River and along a tributary stream waterfall. The site was previously recorded by the USFS.

### Euroamerican Sites and Isolates

UTR 7 Glass Fragment. An isolated olive glass fragment neck finish (pre 1917) is located along the east side of a dirt road that traverses the west bank of the Upper Truckee River.

UTR-8 Two Cans. Two multi-serve cans (early sanitary ca. 1898-pre 1930s) occur as isolates on a forested bench above the east bank of the Upper Truckee River.

UTR-9 Can. A "Pearl Oil" can (refined white kerosene) with lead solder and "D" ring handle occurs as an isolate along the west bank of the Upper Truckee River near the southern boundary of the Amacher Ranch.

UTR 10-13. West Bank Road System. Four faint traces of a possible contiguous road occur along the west bank of the Upper Truckee River. Its existence is problematic, however, it is persistent and

very overgrown. No road appears in this location on historic maps that date from 1895 or aerials that date from 1940. It is not until the 1969 photo-revised 1955 USGS quadrangle and the 1971 aerial photograph that the present system of roads appears. However, Cass Amacher has claimed (personal communication 9/20/03): "there has always been a road up the west side of the Upper Truckee River."

UTR 14 Highway 50 Bridge. Remains include an abandoned dirt and asphalt grade and the dismantled and partly washed-out foundations of a highway bridge and rip-rap over the Upper Truckee River. The 1945 highway plans depict the bridge as about 20 feet wide and about 120 feet long. The feature has been formally recorded by Reno and Zeier (2003:16). The road segments and bridge were abandoned ca. 1946-1948 when Highway 50/89 was straightened through Lake Valley. The dogleg may have initially been selected to avoid crossing the wetland traversed by the modern route on a raised causeway. The historic road segment between Sawmill Road and the Upper Truckee River has been obliterated recently and converted to landscaping (Yant, personal communication 2003).

UTR 15 Harms Bros. Quarry/Lake Baron. Lake Baron is formed from a quarry pit and adjoining asphalt plant operated by the Harms Bros. of Sacramento ca. 1952. An asphalt plant was located on the west side and southern third of quarry area. This area is presently razed and mostly devoid of vegetation. Huge granite blasted boulders are stockpiled at various locales within the quarry and down slope towards the river.

The lake was created ca. 1969. Natural springs feed the lake on south end and lake levels are maintained by draining surplus water into the Upper Truckee River or pumping water out of the river during low periods. Obscured at the lower end of the boulder scatter is a discarded concrete, wire and rebar "animal form" (characteristics of an alligator) with cylindrical legs for mounting (perhaps at an old miniature golf course?).

CA-Eld-556-H-Locus A, This long ditch is dug deeply into the ground and extends from the Upper Truckee River, due north of Lake Tahoe Paradise Park and contours imperceptibly down slope on the east side of the river and along the base of the slope break. It is lost in a subdivision in residential landscaping near the corner of San Diego and Bakersfield streets. The ditch is up to four meters wide and 1.5 meters deep. Trees embedded in the berm are mostly lodgepole pine of considerable size. A head gate, constructed near the mouth of the ditch by CDFG, suggests its modern reuse. This irrigation feature may have been reused by the CDFG to divert water in order to avoid erosion of fish spawning beds along the river during flood periods. Attached to the head gates at the river intake point is a brass padlock used to secure the diversion gate with letter embossing "C.F.& G. 95." A large pipe extends outward and downstream from the gates for diversion of water from the gates. A wide platform (10 feet wide by 17 feet long) and secured by four massive split cedar beams and cross planking with wire nails, spans the ditch down slope from the head gate and is believed by DPR personnel (Evans et al. 1987) to be a bridge.

The ditch clearly appears on a 1940s aerial photograph, with a termination point into a series of lateral irrigation ditches that drain into meadowlands within the current LTGC. The ditch was used in the 1920s-1940s to irrigate the pasture surrounding the Lawrence/Scott Dairy and later Broder Dairy (Davis, personal communication with Vera Broder Silberstein 1992).

CA-Eld-556-H-Locus B. The USFS (Davis 1990) recorded a winged concrete weir (42 feet long and five feet high) with narrow spillway and fish ladder along the west bank of the river and across from the ditch and head gate (Locus A). It is surmised that Locus A and Locus B were at one time contiguous. The Locus B weir is no longer in the river channel, but is partly buried in flood deposits at some distance from water. In addition, Davis recorded an earthen mound, located 30 meters (100 feet) downstream from the weir, thought to be part of a railroad grade that allegedly crossed the river in this locale. A standard (?) gauge logging railroad crossed the river at this point and then continued northward along the dirt road following the west bank and through WMSP (Davis, personal communication with Vera Silberstein, 1992). No further evidence of the railroad could be found on the ground or in archival records or on maps during this study.

### Problematic Heritage Resources Noted Not Formally Recorded

Certain heritage resources were detected on historic maps or reported in oral history interviews but there is no archaeological evidence remaining on the ground. These resources are were not formally recorded, but deserve mention here, including submerged stumps, historic cut stumps, fence lines, irrigation ditches, Tahoe Telegraph Line, logging railroad, flotsam, golf course refuse, stream measure gaging facilities, modern ford and check dam, modern dumps, and Ethel's Pie Shop. For a complete discussion of these resources, see Lindström and Rucks 2003.

### Resource Significance

Decisions regarding the management of heritage resources depend upon a determination of their significance based on established criteria for significance, historic context and resource integrity. If project impacts are likely to occur, the significance of the resource must be determined. Significance is commonly based upon the four criteria of eligibility for inclusion in the National Register of Historic Places (NRHP 36 CFR 60.4). Another federal program that acknowledges significance is the National Historic Landmark Program. The California Environmental Quality Act (CEQA Section 15064.5) has established significance criteria that are modeled after National Register guidelines. California also has a State Register, State Historic Landmark Program and Point of Historic Interest Program that recognize buildings, sites, and objects of local or statewide importance. In the Lake Tahoe Basin, the importance of a cultural resource is also assessed according to Subsection 29.5 of the TRPA Code.

Important considerations in federal, state and regional significance criteria focus upon a heritage property's association with important (a) historical associations, (b) personalities, (c) technological and artistic characteristics, and (d) research potential (a heritage property must have the potential to contribute important information towards scholarly research to then be conveyed to the

general public). These significance criteria provide legal and professional guidelines and have been summarized in Lindström and Rucks (2002).

In addition to meeting at least one of the criteria of significance listed above, a property must have integrity of location, design, setting, materials, workmanship, feeling, and/or association (relative to other heritage resources similar in kind). To possess integrity a resource must retain sufficient physical character so that it conveys an association with prehistoric or historic patterns, persons, designs, or technologies.

Prior to determining the significance of a heritage resource, it must be formally recorded (typically on State of California archaeological site record forms). This task is out of the current project scope and is reserved for Phase II research. Based upon results of the DPR surveys, Nesbitt (1986) concluded that all Native American sites recorded within WMSP and LVSRA are significant. Euroamerican sites had compromised integrity and were determined non-significant.

### Heritage Resource Sensitivity

*Native American Theme*

Based upon results of the DPR survey of WMSP/LVSRA, Nesbitt et al. (1966) concluded that Native American archaeological sites tend to occur on glacial moraines and relatively high ground above the Angora Creek/Upper Truckee River floodplain. This trend is confirmed by results of this assessment. However, it is important to add that, while habitation and camp locales may have been situated above the floodplain, task sites for fishing, plant gathering, etc., typically occur along the river channel throughout the watershed, as well as in adjoining meadowlands within the floodplain. Given the extreme amount of disturbance along the river channel and adjoining floodplain, it is likely that an unknown number of Native American sites have been obliterated or obscured by historic and modern development, e.g., a 150-acre golf course development, channel modifications for irrigation, etc., as well as the natural processes of bank erosion and flood deposition by the Upper Truckee River. Given the fact that the Native American record extends back about 9000 years, it is possible that sites and isolated features and artifacts could be deeply buried beneath UTR flood deposits (providing they survived episodes of erosion).

Apart from archaeological issues, the Study Area assumes cultural significance to modern Washoe people. The Washoe Tribe has developed a comprehensive land-use plan (Washoe Tribal Council 1994) that includes goals of reestablishing a presence within the Lake Tahoe Basin, revitalizing Washoe heritage and cultural knowledge, protecting traditional properties within the cultural landscape, and harvesting and caring for traditional plant resources (Rucks 1996:3). Although no "Traditional Cultural Properties" were identified as part of this study (a resource designation that might certainly constrain future project activities), the Study Area holds great interest to the Washoe and the tribe should be consulted as stakeholders throughout the future decision-making process. As part of an on-going process of reinforcement and discovery that encourages recall and experimentation, Washoe traditionalists should be consulted regarding culturally important

plants and traditional use areas. Project revegetation efforts might incorporate native plants of importance to Washoe plant specialists, for example, certain species of desirable basket willow.

*Transportation, Communication and Community Development Theme*
Historic maps, along with a few archaeological traces on the ground, indicate that several roads and bridge crossings traversed the Study Area. Yet, relative to the downstream reach of the UTR, fords and bridge abutments are rare; they are either non-existent or have been removed. This is in contrast to the Airport Reach where several fords and dams remain in place. Official historic maps indicate that only two roads crossed the river in the reach between Elks Club Highway 50 crossing and Meyers Highway 50 crossing. Schematic maps show at least one "Big Dam", a possible logging railroad and maybe three roads through the area. The present network of dirt roads does not appear on maps or aerial photographs until the 1960s. Some of these roads follow sewer lines, which were installed in this part of Lake Valley during the late 1950s and 1960s. Untold numbers of historic sites have been lost to modern development in the Study Area, with the construction of subdivisions and accompanying infrastructure, channel straightening ca. 1955-1959 to accommodate a 150-acre golf course, and excavation and filling of a seven-acre Amacher quarry and the larger Harms Bros. pit and asphalt plant.

*Grazing Theme*
Euroamerican sites occur throughout the Study Area. Unlike Native Americans, Euroamericans may not have necessarily favored upland locales to inhabit. In fact, all but one site (the Forni Cabin) recorded by DPR within WMSP/SVSRA (Nesbitt et al. 1986, 1989) occur on lower ground within the Angora Creek and UTR floodplain. Remaining historic water management features are also likely to be located near the river. The presence of grazing related sites are more likely to occur along the river reach between Angora Creek and Christmas Valley and at the head of the watershed at Meiss Meadows. Stretches with steeper gradients would be of lower archaeological sensitivity. Relative to downstream reaches, the Study Area exhibits fewer irrigation features. This may be due to the greater wetness of the Study Area (springs and tributary streams), whereby at least some ditches were used for draining rather than irrigating. Either way, the hydrology of the Study Area has been altered by grazing activities, the most dramatic changes involving the 1926-1940 diversion of Angora Creek into the Upper Truckee River west of their point of conversion.

The Study Area seems to have been more intensively grazed by dairy and beef cattle than sheep, although sheep are documented in the Upper Watershed at Round Lake.

As a related issue, the successful survival of beaver in the Lake Tahoe Basin (*Castor spp*.), not to be confused with the native Mt. Beaver (*Aplodontia rufa*), and their prolific numbers in certain areas have led to a series of problems initially recognized by ranching and related environmental interests. They claimed that beavers altered the hydrology of streams and adjoining wetlands in a negative way. Throughout this course of events, the question remains whether or not beaver (*Castor spp*.) was ever a native of the Lake Tahoe Basin. The lack of historic fur trade in the Lake

Tahoe Basin/Upper Truckee Watershed, the absence of beaver in Washoe tradition, subsistence and technology, and the unanimous opinion by descendents of pioneer families in Lake Valley tentatively suggest that beavers (*Castor spp.*) were not native to this area. However, it is possible that beaver may have gone without mention in Washoe and Euroamerican literature because they occurred in such low numbers.

*Logging Theme*

Archival research and historic stump fields bear witness to a patchwork of successive and sometimes overlapping logging episodes within the Study Area. First was the CTLFC/EWLC (ca. 1885 to late 1890s), who acquired lands outright or obtained leases to timber and water rights from other landowners; second was C.G. Celio and Sons (ca. 1927-1942), who subsequently acquired land containing virgin stands and also acquired lands previously logged by CTLFC/EWLC, reentering stands to harvest trees that were too young at the time CTLFC initially harvested. Lastly PLC (ca. 1942-1952) cut remaining timber left over from the initial two efforts.

Oddly, this fairly intensive history of logging within the Study Area is not well represented in the archaeological record. With the exception of the Celio sawmills and surrounding site complex, no archaeological sites associated with the logging theme (camps, flumes, chutes, haul roads, skid trails, etc.), were encountered during the field survey or records search of the river corridor or upper watershed. Reports of a logging railroad through the Study Area remain unconfirmed. Camp quarters, usually found in association with logging landscapes, may have been confined to the mill sites and/or boarding facilities offered at nearby Meyers Station. It is possible that future survey of the uplands surrounding the river will disclose more archaeological sites.

Environmental disturbances associated with logging and river driving involve alteration of forest structure and composition, eroding logging roads as conduits of sediment into drainages, soil compaction in near logging camps and staging areas, and fire frequency, as historically fire has been a companion to logging and its associated debris.

*Fisheries*

Dams, diversions, over-fishing, logging, pollution, and competition from non-native species have caused the decline of Tahoe's fisheries and the extinction of the native Lahontan cutthroat trout. At one time, the Study Area of the Upper Truckee River was considered to be an exceptional fishery containing excellent spawning. In terms of numbers of people supported, the UTR may have been the single richest fishery and premier destination for the Washoe at Lake Tahoe. A map of the Upper Truckee fishery, sketched by Washoe George Snooks in 1937, designates at least seven stretches of "good spawning beds" and fish trap locales within the river reach between the Elks Club Highway 50 crossing and the Meyers Highway crossing. Other aquatic resources of interest noted by the Washoe include "oysters" (fresh water mollusks).

In the last few decades, the California Department of Fish and Game has attempted to enhance damaged spawning gravels along the river. A partly buried fish ladder (trap) was observed at a point on the river near the southern boundary of WMSP. Here, floodwaters were diverted into a historic diversion ditch in order to protect downstream spawning gravels from washing away. Further attempts to restore the Upper Truckee River fishery by mechanically reestablishing and maintaining spawning gravels should consider the impacts of beaver activity on fisheries.

## III.5.C Opportunities and Constraints

### Opportunities

- Project revegetation efforts might incorporate native plants of importance to Washoe plant specialists, including, certain species of desirable basket willow.

### Constraints

- All heritage resources should be formally recorded prior to any project ground disturbances. Additional issues may arise if: (a) if the project changes in ways that could impact heritage properties, (b) if heritage properties are discovered during the implementation of this project or if a known heritage property will be impacted in an unanticipated manner, (c) if a property that was to be avoided has been inadvertently or otherwise impacted, and/or (d) if any condition of the project, such as a delay in implementation or implementation in phases over time, may justify reconsideration of the current significance status of heritage properties within the project's area of potential effect.
- If project impacts are likely to occur, the significance of the resource must be determined. Decisions regarding the management of heritage resources depend upon a determination of their significance based on established criteria for significance, historic context and resource integrity.

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# III.6 Land Use, Infrastructure and Regulatory Compliance

This section addresses the infrastructure, land use, and regulatory issues related to implementation of UTR restoration projects and potential impact concerns.

## III.6.A Infrastructure

### Buried Utilities

Figures 3.13A-E show the locations of underground utilities in relation to the Upper Reach Study Area. The river corridor has several types of buried sewer, water and power utility lines.

Most of the trunk lines for STPUD sewer pipelines that service Meyers, Tahoe Paradise and Christmas Valley are located within the UTR river corridor. These are northward flowing gravity lines that are connected to a lift station located on Beecher Avenue, downstream of the South Lake Tahoe Airport. In Reaches 1 through 4 a trunk line parallels the river to the west and north. In most other locations the sewer lines are near streets, however there are several crossings where the line is under the river.

STPUD also has export lines buried under the Highway 50 and 89 corridors. These lines come close to the UTR in several spots.

Figures 3.13A-E also show the location of underground water and power lines.

### Roads

Caltrans maintains Highway 50 and Highway 89, the main thoroughfares in the Study Area. El Dorado County Department of Transportation maintains all paved roads in the subdivisions in Tahoe Paradise development and in Christmas Valley. The LTBMU maintains roads accessing summer cabin tracts in Meyers and Christmas Valley (most of these are unpaved) and the southern end of South Upper Truckee Road between the Highway 89 crossing and the Big Meadow Trailhead. The CDPR maintains roads within the LTGC and Washoe Meadows State Park. All of these agencies are participating in projects to implement retrofit erosion control BMPs. Figure s 2.12A&B show the BMP retrofit projects underway in the Study Area.

## III.6B Land Use

### Land Ownership

The Upper Reach Study Area has a mix of land ownerships, including private, state, and federal. Figure 3.33 shows these various ownerships and local roads. Reaches 1 through 3 are primarily state ownership, whereas ownership along Reaches 6 through 10 is very fragmented with federal and private land alternating along the river corridor.

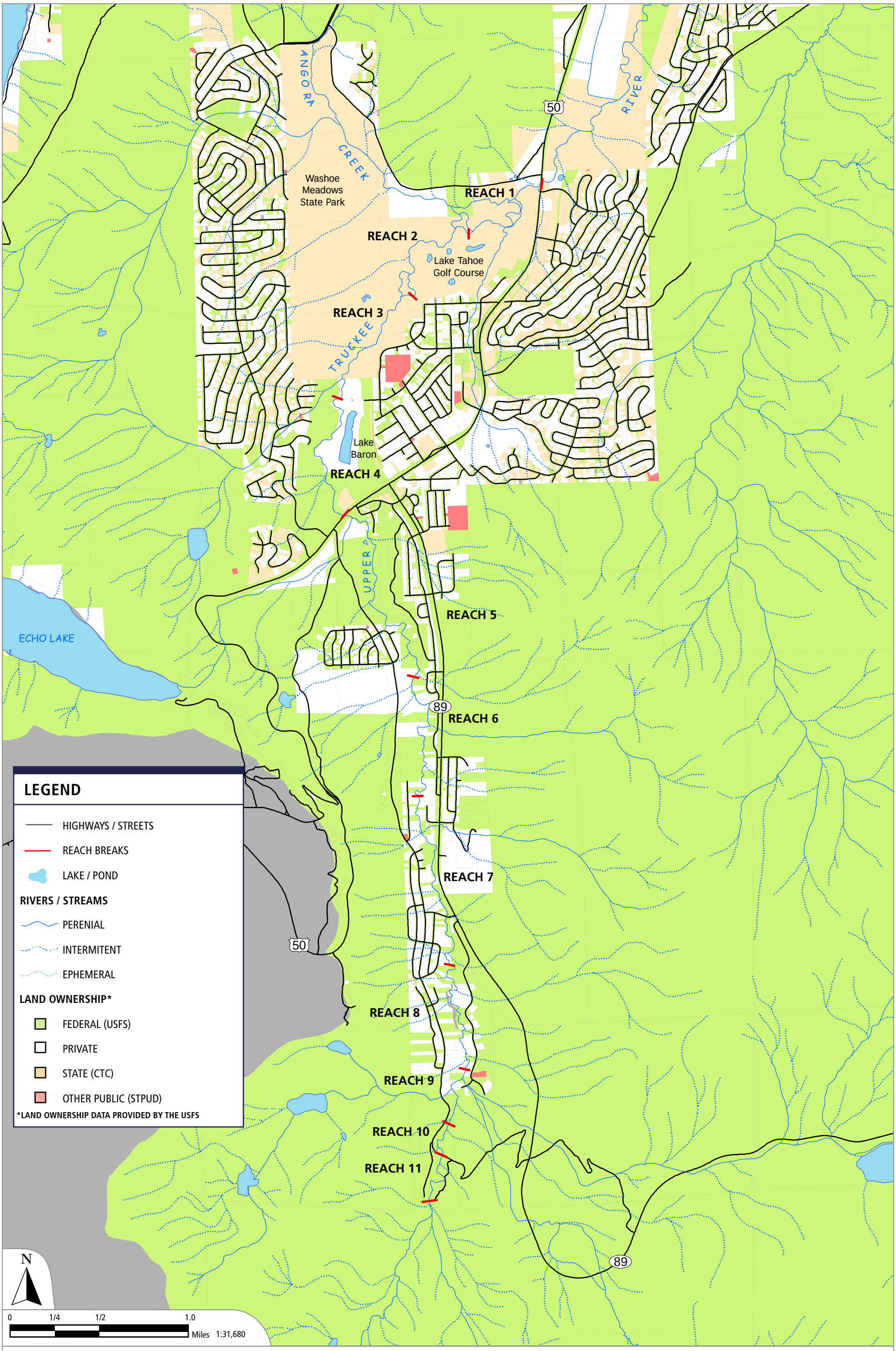


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**FIGURE 3.33:** Map indicating existing land ownership and roads in the Upper Truckee River Watershed.

### RECREATION

There are several major recreation areas within the Study Area (Figure 3.33).

CDPR, under contract with US Golf, operates the LTGC, which occupies approximately 125 acres in the lower Study Area. The LTGC offers 18 holes (some which cross over the UTR) and is operated between May and October. During the winter months there have been snowmobile and cross-country skiing concessions on the golf course, but not every year.

CDPR also operates and maintains the Washoe Meadows State Park as a natural preserve. This area encompasses 620 acres and includes much of the river corridor between LTGC and the Meyers Highway 50 crossing. The natural preserve designation limits recreation use to hiking, and local residents often bring their dogs for walks in this area.

Lake Baron and Tahoe Paradise Park are privately owned but open to the public. Facilities offer boating and fishing on Lake Baron, as well as picnic and soccer fields and tennis courts along the east side of the river and tennis courts.

There are numerous informal hiking trails along the banks of the UTR between the upstream end of the LTGC and the Meyers Highway 50 crossing. These are lightly used in the summer months, mostly by local residents in the surrounding subdivisions. Some trails are used for fishing access.

Upstream of Meyers Highway 50 crossing, trails along the banks of the UTR are discontinuous, owing to the fragmented land ownership. Nonetheless, there are long segments of hiking trails immediately along the banks of the river. One private campground is located on the west bank of the river immediately upstream of the Meyers Highway 50 crossing.

The Upper Watershed has a defined trail network for hiking, mountain biking and horse back riding. These are maintained by the LTBMU.

## III.6.C Regulatory Compliance

The Lahontan Regional Water Quality Control Board (RWQCB), Tahoe Regional Planning Agency (TRPA), US Army Corps of Engineers, El Dorado County, and California Department of Fish and Game (CDFG), all have permitting authority in the Upper Reach Study Area. Most stream enhancement and restoration projects involve activities within the areas of interest of these authorities, including work in streambed, damming or diversion of streamflow, and work within sensitive habitat areas. Each project requires a lead agency to conduct environmental review, disclosing all of the potential impacts of a project and the measures taken to avoid or reduce impact significance. In the Tahoe Basin, there are local processes that usually involve a Technical Advisory Committee to review plans at several steps leading up to a project, so that designs can reflect the measures deemed necessary to manage impacts.

This project has involved most of the regulatory agencies mentioned above in developing the plan and priority project list. Nearly all of these agencies have programs to enhance and restore the resources that they are also authorized to protect through permitting authority, so there is a high level of cooperation. In addition, projects such as Trout Creek Restoration Project involved construction activities of a similar nature as considered in alternatives herein, and thus there is a good knowledge base of how to manage impacts.

## III.6.D Opportunities and Constraints

### Opportunities

- Most of the Study Area in Reaches 1, 2, 3, 4, 10 and 11 is in public ownership, allowing for ease of access for restoration projects.

### Constraints

- Some public utility lines are in close proximity of the river corridor, and, in some cases, even cross the UTR river channel. These will require careful consideration and perhaps additional project costs to manage potential impacts.
- Land ownership in Study Area Reaches 5, 6, 7, 8 and 9 is a mix of public and private, making coordinated access for restoration activities difficult.
- The LTGC and WMSP are popular recreation sites. Any extensive restoration projects affecting these sites will have to consider the effects on public recreation.

# IV. Alternatives Analysis and Environmental Assessment

The forgoing assessment of historical change and current conditions on the UTR found that present conditions are far below the potential environmental quality. The key problem for any proposed restoration project will be to overcome the effects of channel incision and restore channel stability.

The UTR is presently in a state of responding to past land use through erosion of its channel banks to gain a wider meander belt and higher planform sinuosity. There are sections of the UTR in Reaches 3 and 4 where the bank erosion has restored what appears to be a quasi-stable width of 200 to 250 feet +/- (Figure 4.1) and some bank stability. There are also locations with vertical instability and active headcuts, as discussed in Section III.1.C and shown in Figure 3.15. It is probable that the UTR would continue to expand and erode until the stable width and/or planform is achieved. It is likely that such quasi-stability would reduce sediment input and enhance shoreline habitat. However, the condition achieved would likely occur with the existing incised channel longitudinal profile and the resultant groundwater table would remain well below pre-disturbance elevations, retaining the drying trend in terrace riparian and wetland areas.

The process of developing a "preferred plan" requires analysis of a range of alternatives from no action to restoring the original river to the extent feasible, given land ownership and land use. The alternatives must be evaluated for feasibility, cost, the resultant benefits, environmental impacts, constructability, socio-economic effects and the likelihood of receiving approval from regulatory agencies. The effort to prepare this assessment has involved presentations and consultations with a Technical Advisory Committee (TAC) and the public. This section of the report presents a range of feasible alternatives and an analysis of the costs, benefits and impacts of each. The project reach within the river corridor has been divided into 11 distinct reaches and the alternatives and alternatives analysis has been developed so that each reach can be addressed individually. The alternatives chapter is followed by a chapter of general recommendations designed to move the project forward towards design and implementation.

## IV.1 Description of Alternatives by Reach

Five alternatives were identified to present a range of environmental restoration and enhancement options for the mainstem UTR from Elks Club Highway 50 crossing to the upstream end of the USFS Bridge Tract Summer Homes.

### 1- No Action

No Action Alternative 1 takes existing conditions and projects them into the future, as if no projects will be implemented. This mostly extends existing geomorphic processes of the UTR into the future. This alternative was applied to all reaches for analysis.

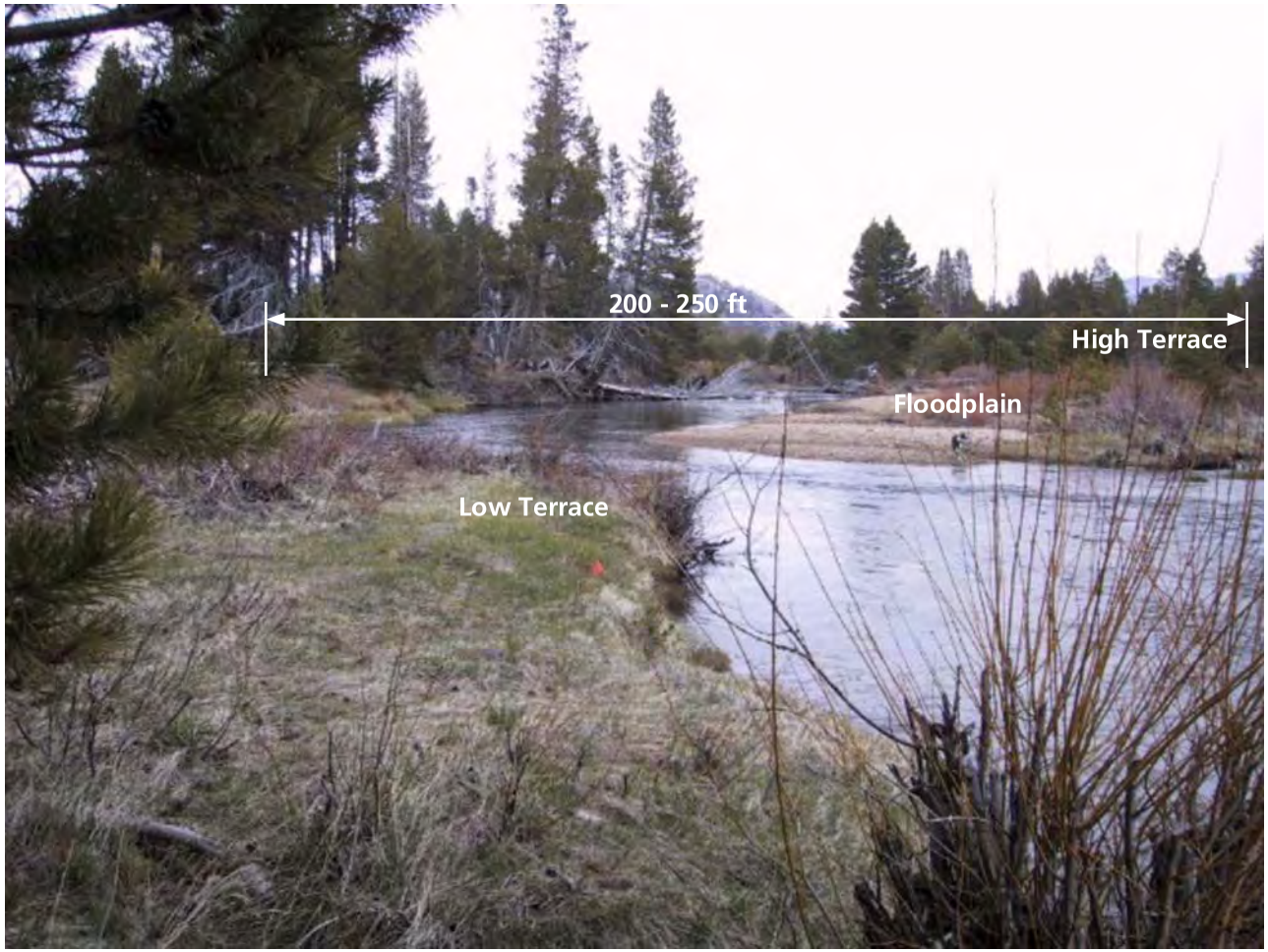


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**FIGURE 4.1:** Photo depicting portion of Upper Truckee River in Reach 3 with wide, quasi-stable channel geometry.

### 2- Stabilization

Alternative 2 involves a systematic installation of bank protection revetment (rip rap) and grade controls (boulder weirs), incorporating bioengineering with native riparian vegetation to the extent possible. Alternative 2 would use the existing stream channel longitudinal profile and planform. Figures 4.2A-B show typical drawings of the proposed treatments. The areas receiving bank treatment and grade control were selected to achieve system-wide stability and to minimize the risks of outflanking erosion, avulsion or other damage.

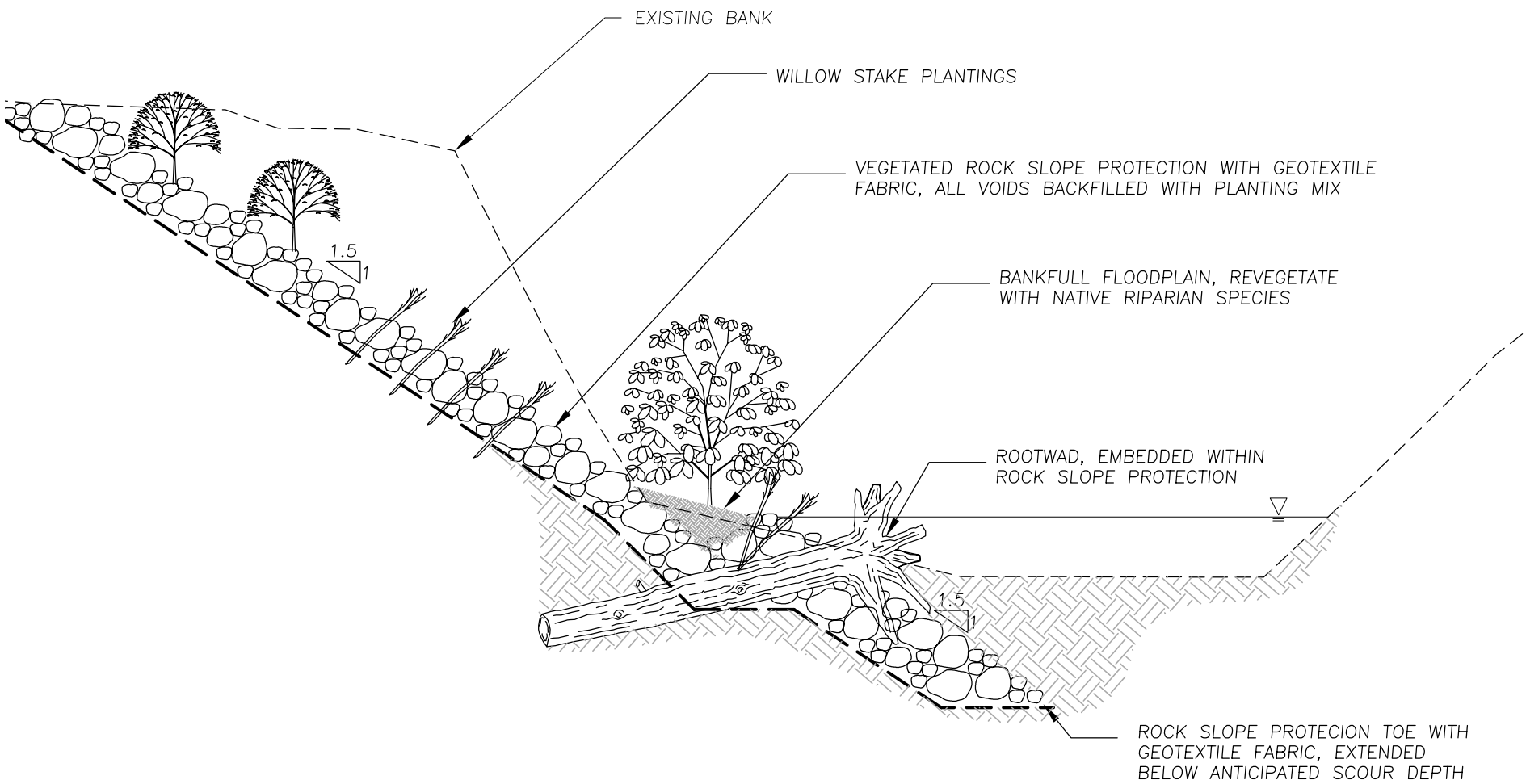
The project would be constructed using heavy equipment (excavators, dump trucks, loaders), which would be brought in through temporary access roads. Several routes on public land are available to gain access to the UTR in Reaches 1 through 4. Access to Reaches 5 through 9 is problematic due to limited physical access and a need for easements and permission across numerous private lands. Alternative 2 would involve an excavation and off-haul of approximately 52,000 $yd^3$ of alluvial soils and the placement of 157,000 tons of rock slope protection and 11 grade control structures.

### 3- Floodplain Excavation

Alternative 3 would accelerate the present geomorphic trends toward widening by excavating the banks adjacent to the existing channel down to the elevation of the modern geomorphic floodplain formation (4 feet below terrace on average). Alternative 3 would create a 200-foot wide floodplain and utilize the existing profile and planform. The excavation would occur in two phases: the first would involve the excavation of an area behind the existing banks followed by one or two growing seasons of revegetation, and the second phase would excavate the banks to connect the Phase 1 floodplain to the existing channel.

The project would be constructed using heavy equipment (excavators, dump trucks, loaders), which would be brought in through temporary access roads. Several routes on public land are available to gain access to the UTR in Reaches 1 through 4. Access to Reaches 5 through 9 is problematic due to limited physical access and a need for easements and permission across numerous private lands. Alternative 3 would involve an excavation and off-haul of approximately 350,000 $yd^3$ of alluvial soils in Reaches 1, 2, 3, and 4.

The need for grade control structures will be specifically determined in more detailed design studies, should this alternative move forward. For the purpose of cost estimation, these structures were assumed to be present in Reaches 1, 2, 3 and 4. In general, extensive grade control structures for Alternative 3 are problematic since the risk of erosion outflanking the structures is quite high, unless they are extended into the terraces. This design would be prohibitively expensive as well as risky, given that the channel is subject to lateral migration.




## ROCK SLOPE PROTECTION

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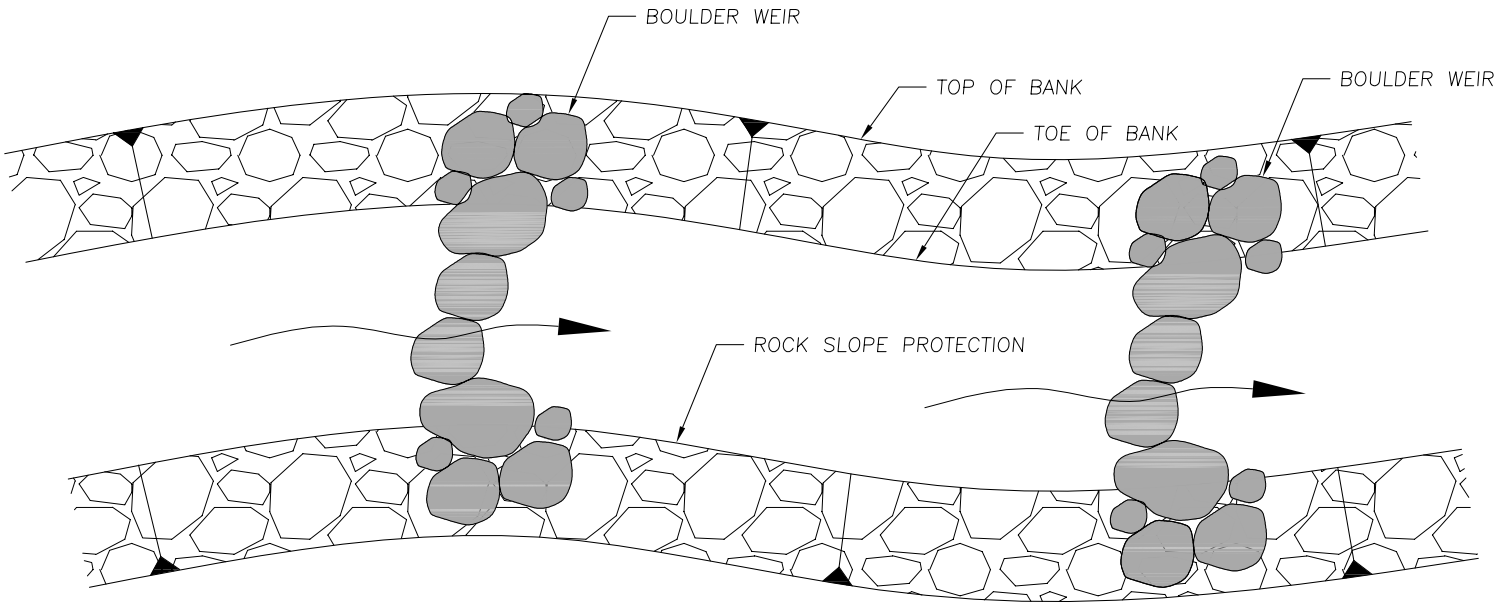
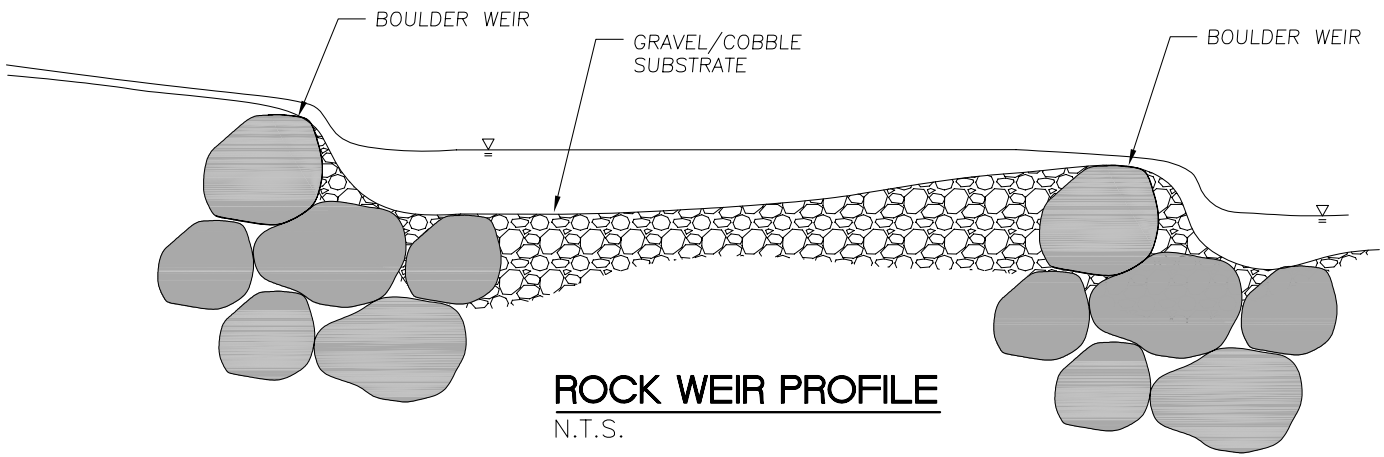
**FIGURE 4.2A:** Typical drawing showing vegetated rip rap cross section for proposed Alternative 2.




## ROCK WEIR PLAN

N.T.S.




## ROCK WEIR PROFILE

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**FIGURE 4.2B:** Typical drawing showing rock weir plan and profile for proposed Alternative 2.

### 4- Restore Original Channel Morphology and Profile

This alternative would reconstruct the original channel and restore the pre-disturbance conditions to the extent possible. Alternative 4 would restore the original profile grade and planform. The new channel would be constructed in segments around the existing channel and revegetated in a first phase of construction. This would be followed in Phase 2 with connecting and watering the new channel, filling the old channel and revegetating exposed areas (similar to the Trout Creek Restoration Project).

The project would be constructed using heavy equipment (excavators, dump trucks, loaders), which would be brought in through temporary access roads. Several routes on public land are available to gain access to the UTR in Reaches 1 through 4. Access to Reaches 5 through 9 is problematic due to limited physical access and a need for easements and permission across numerous private lands. Alternative 4 would involve an excavation of approximately 206,000 $yd^3$ of alluvial soils and a replacement of approximately 161,000 $yd^3$ into filling the existing channel. Total off-haul of alluvial soil is approximately 45,000 $yd^3$.

The concepts of Alternatives 1, 2, 3, and 4 are presented in Figure 4.3

### 5- Selective Bioengineering and Revegetation

Alternative 5 would involve installation of revegetation and bioengineered bank protection at selective sites with the primary aim to revegetated barren banks and expand the native riparian vegetation corridor. The projects would be low tech and many could be carried out by handcrews using minimal heavy equipment. The projects could also be implemented over short reaches as the alternative does not aim for system-wide stabilization. The types of treatments would be developed on a site-specific basis but could involve one or more of seven bioengineered treatments as presented in Figures 4.4 through 4.8.

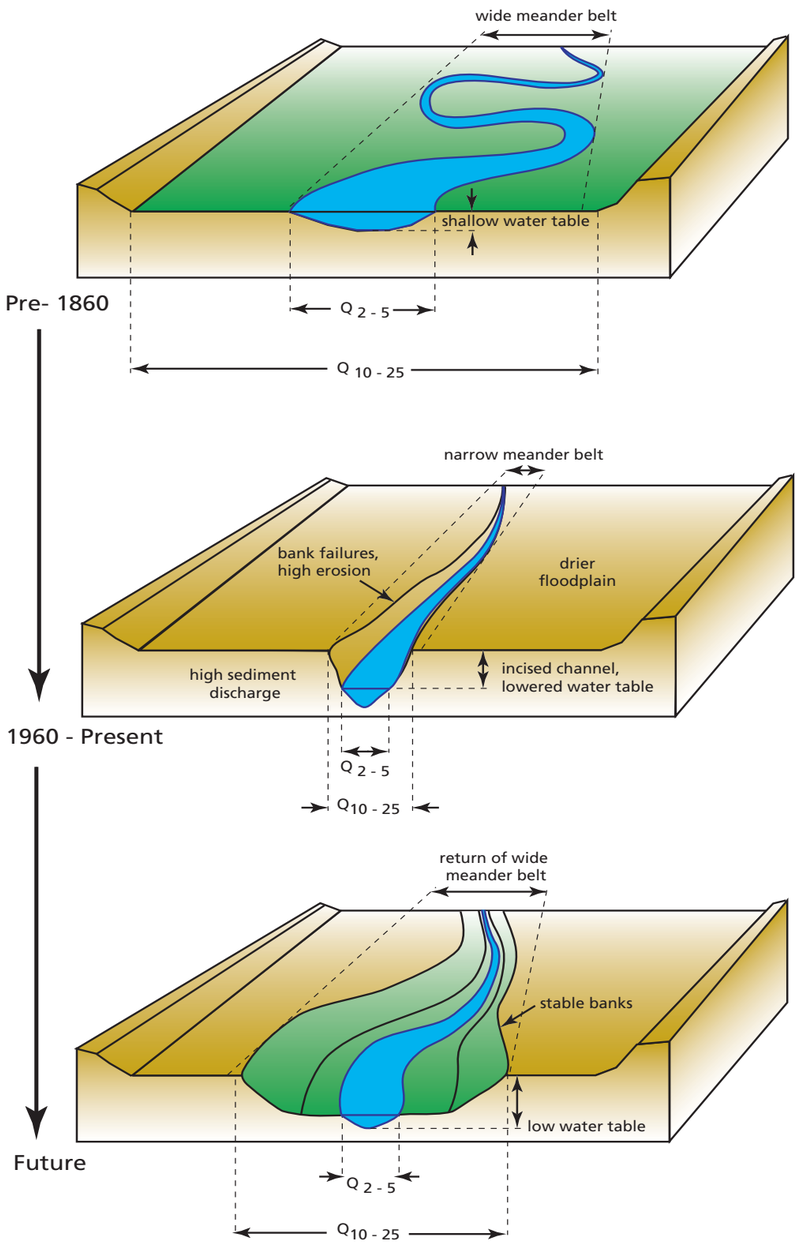
## IV.2 ALTERNATIVE ANALYSIS

### IV.2.A Initial Feasibility Assessment

A first order assessment of alternatives was conducted on a reach-by-reach basis in order to determine preliminary feasibility, costs, impacts and benefits. As a result of this initial appraisal, the following conclusions were drawn.

Reaches 1, 2, 3, and 4 are primarily within public ownership and share similar characteristics as relatively open alluvial stream systems. Historical analysis has revealed that Reaches 1 through 4 share similar channel morphology and loss of planform sinuosity. Given these unified geomorphic characteristics, the majority of publicly owned land, and readily available access, Reaches 1 through 4 lend themselves to system-wide stabilization projects, such as Alternatives 2, 3 and 4.

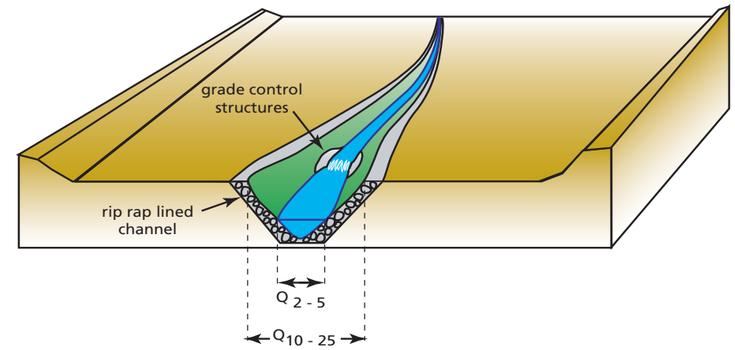
## Geomorphic Process



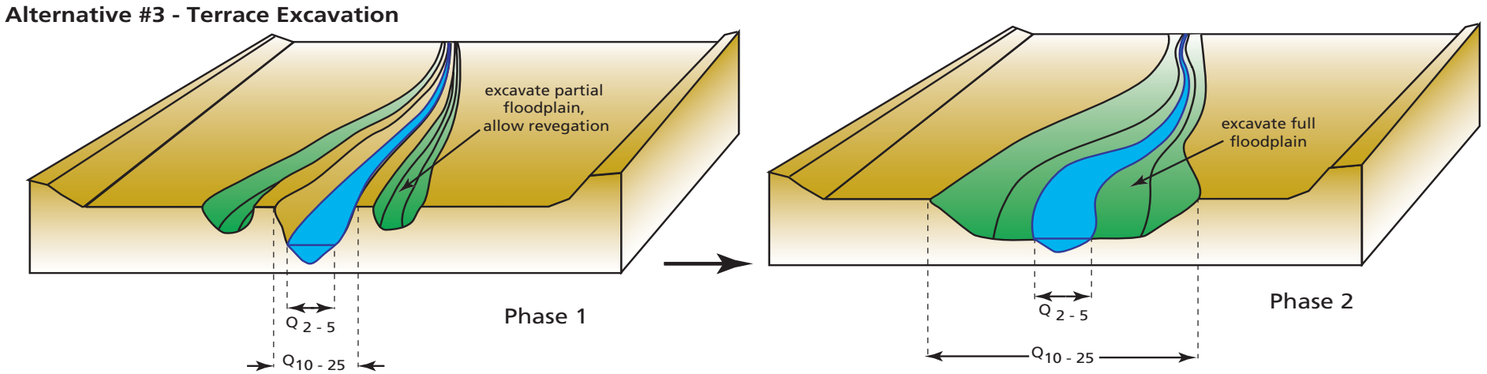

## Design Alternatives

### Alternative #1 - No Action = Future

### Alternative #2 - Stabilization




### Alternative #3 - Terrace Excavation




### Alternative #4 - Restoration

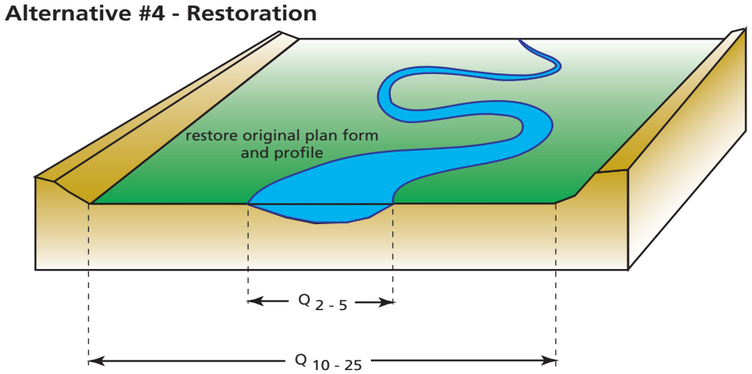



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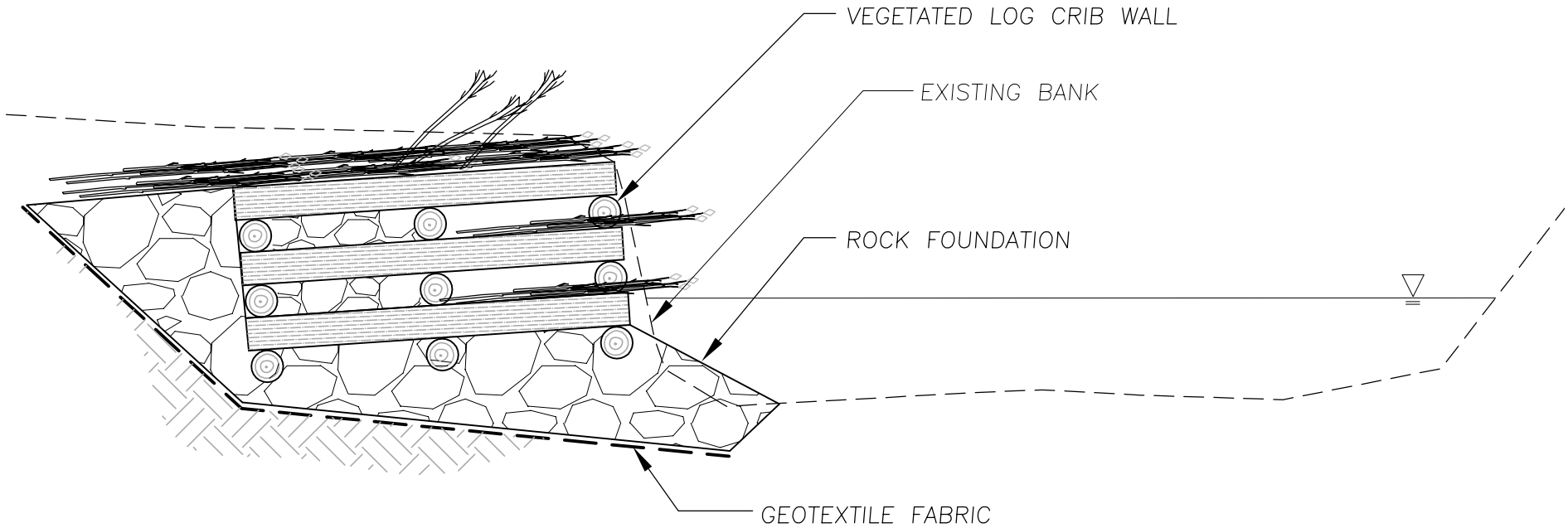
**FIGURE 4.3:** Conceptual diagrams showing the geomorphic process of the Upper Truckee River over time and proposed Alternatives 1, 2, 3, and 4 for Reaches 1 - 4.




## LOG CRIB WALL

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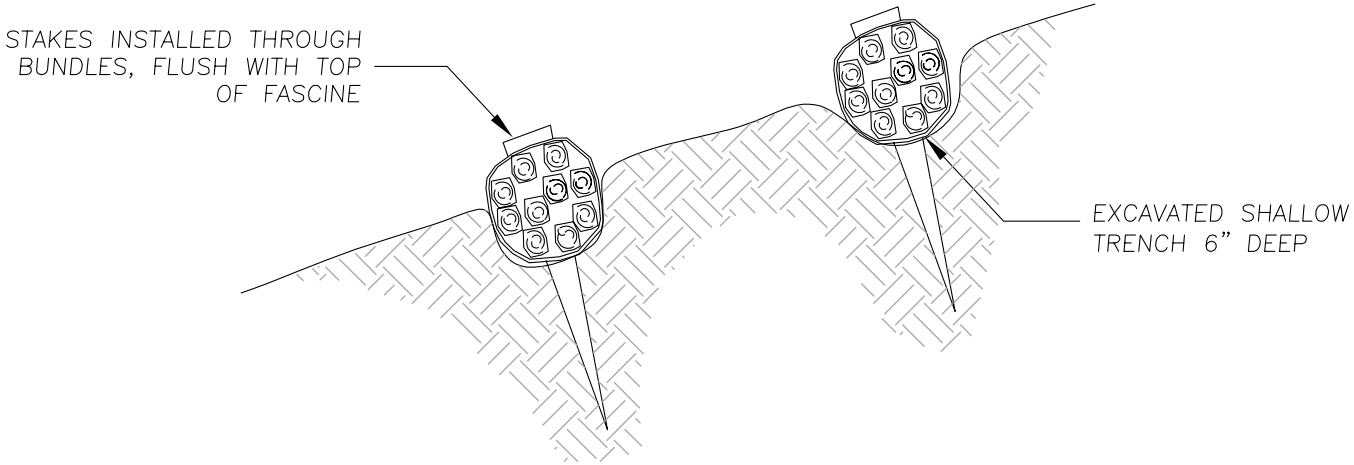
**FIGURE 4.4:** Typical drawing showing log crib wall as bioengineered treatment for bank stabilization.




## FASCINE - SECTION

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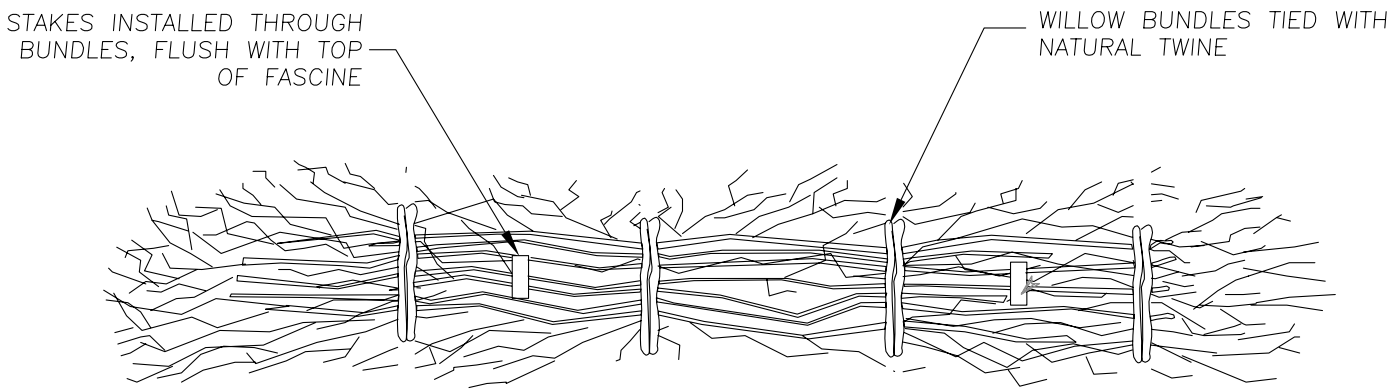


## FASCINE - ELEVATION

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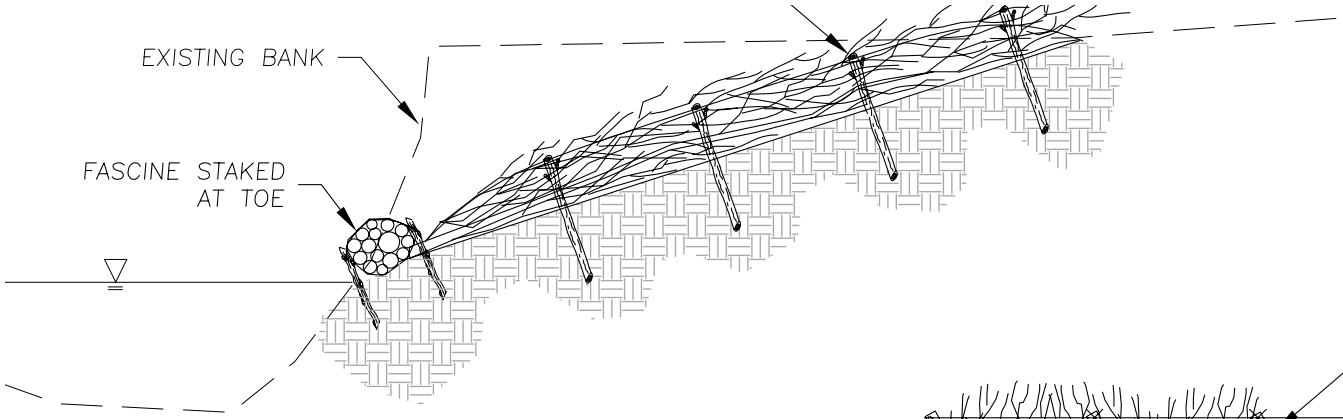
**FIGURE 4.5:** Typical drawing showing fascine as bioengineered treatment for bank stabilization.




## BRUSH MATTRESS - SECTION

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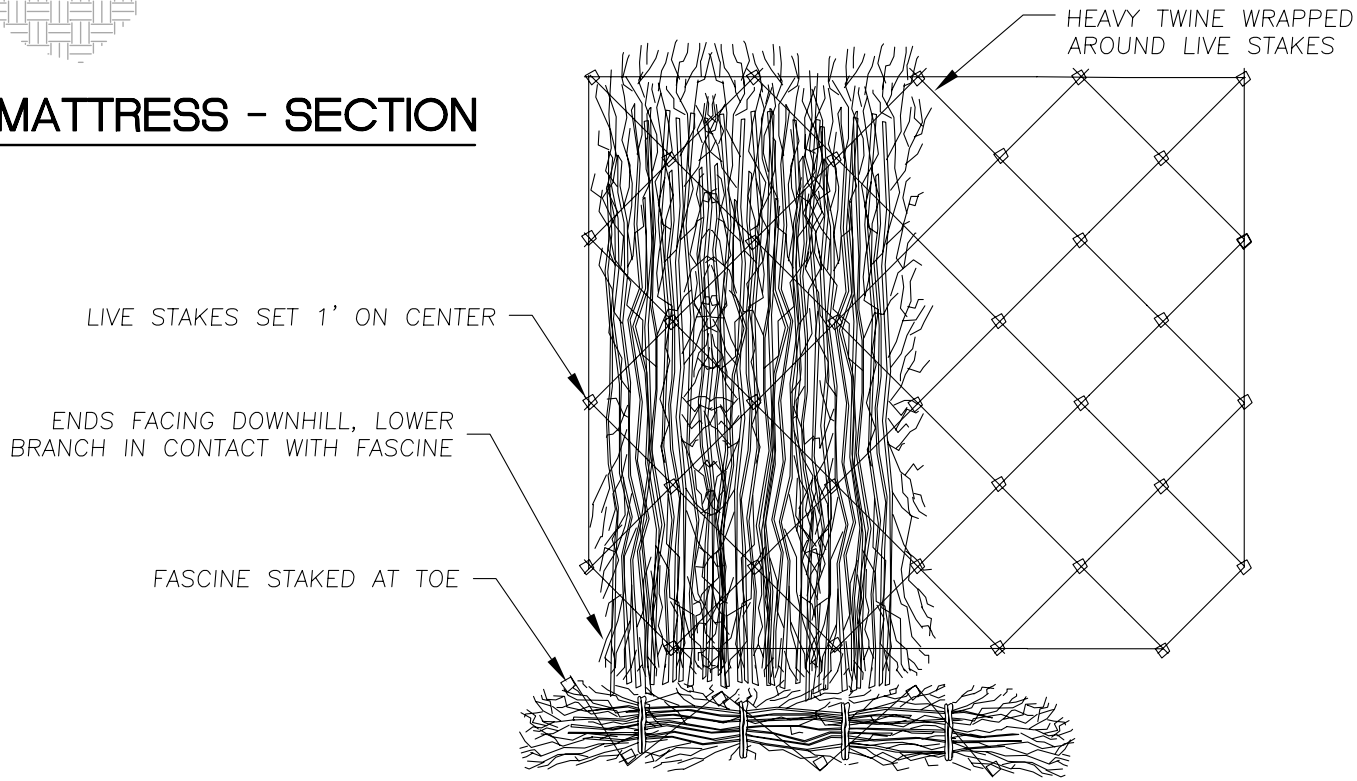


## BRUSH MATTRESS - PLAN

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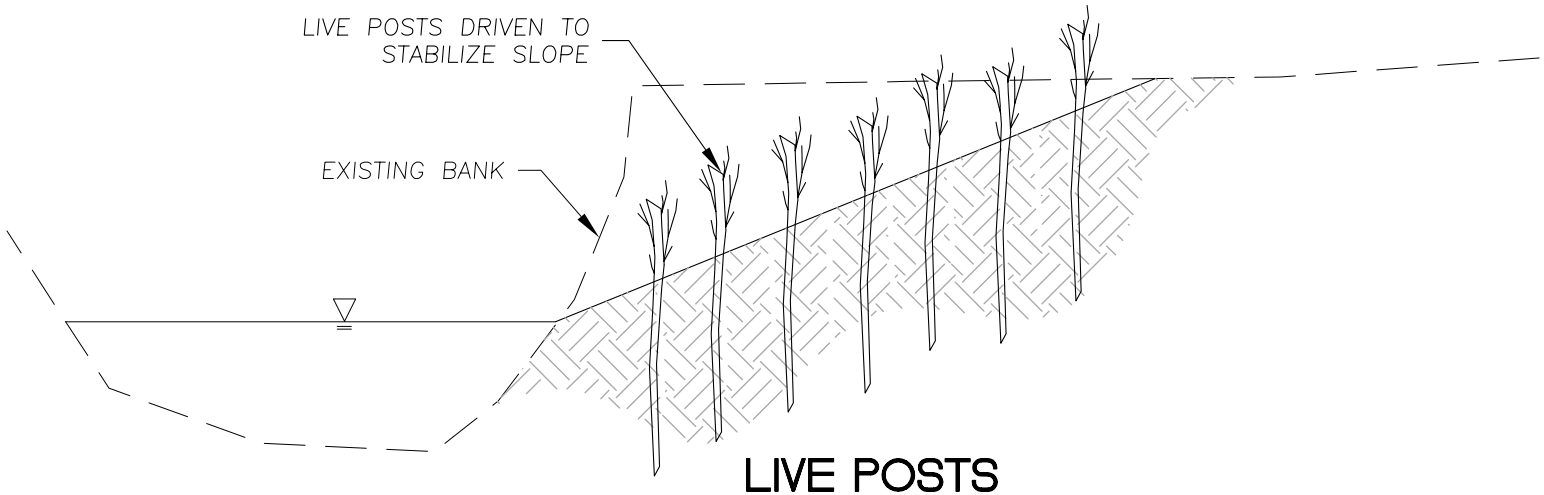
**FIGURE 4.6:** Typical drawing showing brush mattress as bioengineered treatment for bank stabilization.




## LIVE POSTS

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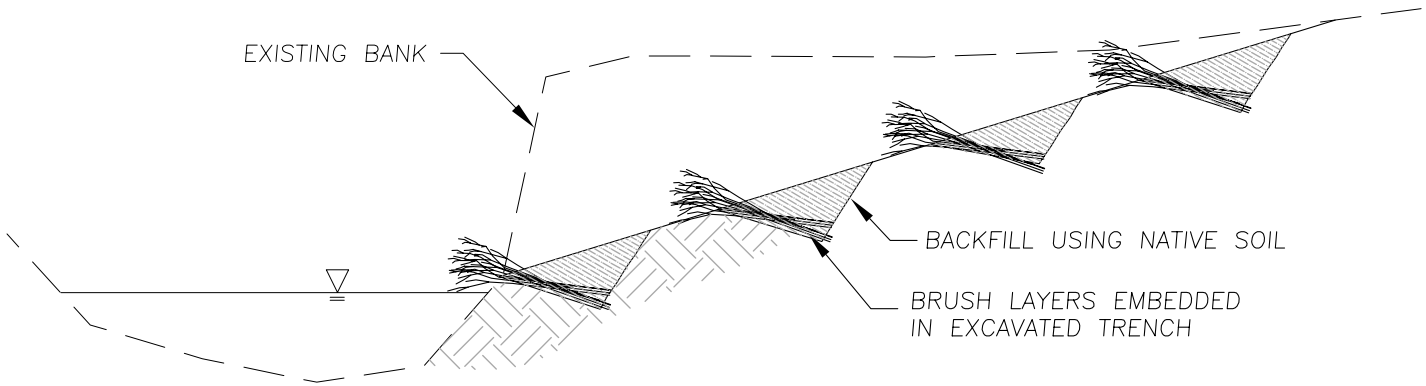


## BRUSH LAYER

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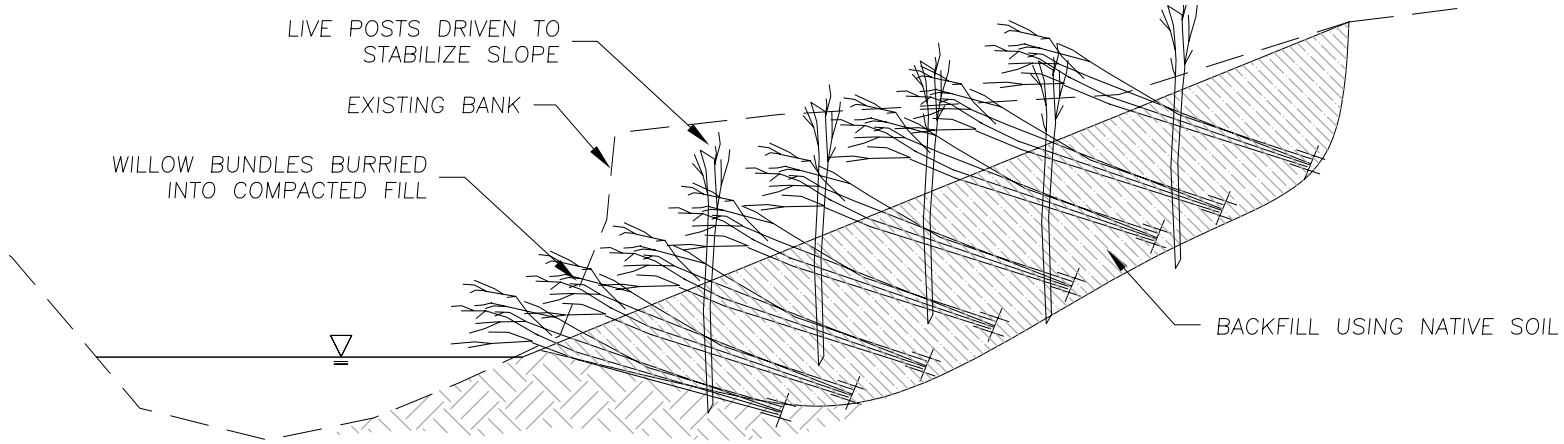
**FIGURE 4.7:** Typical drawing showing live posts and brush layering as bioengineered treatment for bank stabilization.




## BRUSH PACKING WITH LIVE POSTS

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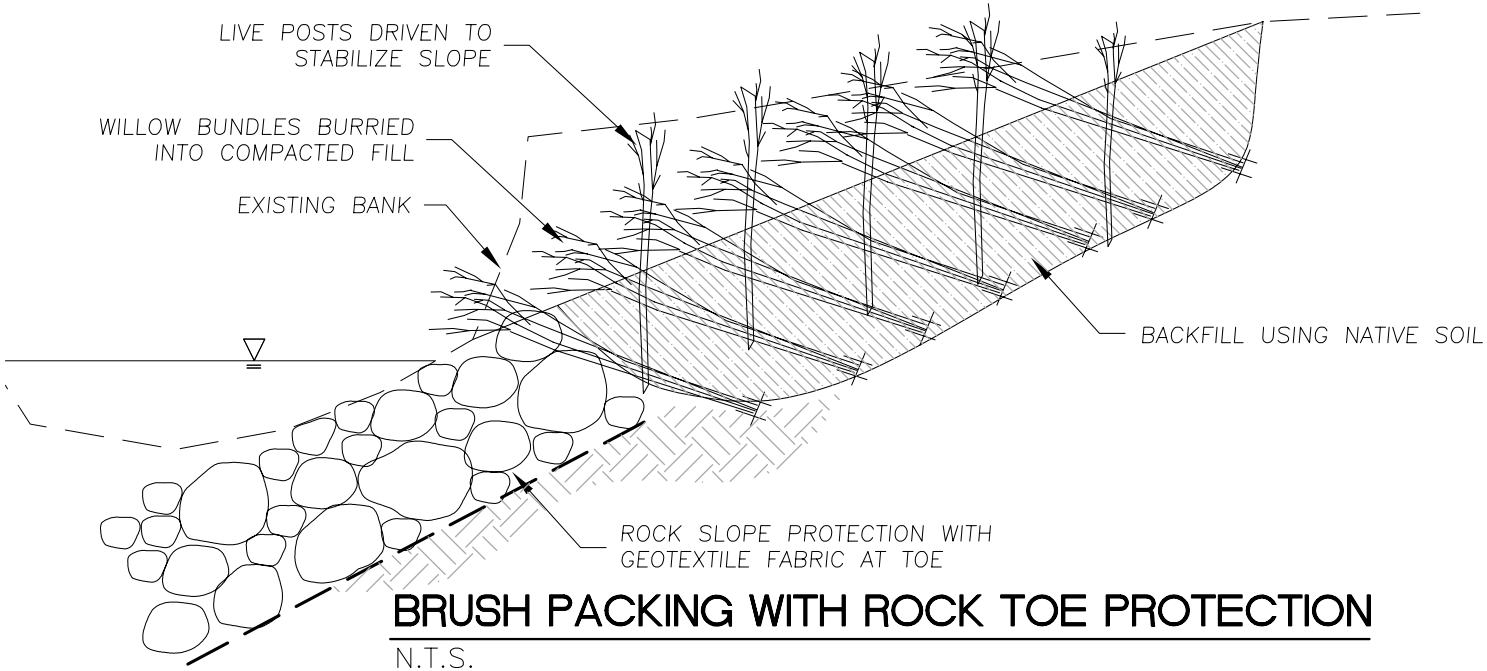


## BRUSH PACKING WITH ROCK TOE PROTECTION

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**FIGURE 4.8:** Typical drawing showing brush packing with and without rock slope protection at the toe as bioengineered treatment for bank stabilization.

Mixing different alternatives in each reach must be approached with caution, since system-wide stability requires hydraulic and longitudinal profile continuity.

In contrast, Reaches 5 through 9 have multiple land ownerships, difficult access and short reaches of highly degraded stream. Reaches 10 and 11 are in public ownership (USFS LTBMU), but are too small of areas for major reconstruction efforts to have any substantial benefits. In the case of the Reach 11 Bridge Tract, large scale projects that restore original function would greatly increase flooding in areas where cabins are now sited. Thus, Reaches 5 through 11 are not well suited for system-wide major construction alternatives, but rather a site-by-site bank stabilization and revegetation approach more in line with Alternative 5. The need for landowner cooperation also makes small-scale projects appealing since cooperation of all is not necessary to implement projects. For these reasons, Alternatives 2, 3 and 4 were not evaluated further for Reaches 5 through 11, rather a programmatic approach of implementing bioengineered erosion control and revegetation projects appears far more feasible and appropriate. The program would include an intensive design and public involvement process on individual and groups of properties; the details of the recommended program are found in Chapter V.

The No Action Alternative can be applied to all 11 reaches of the Study Area and is compared to the other alternatives below. The analysis presented below is strictly focused on conditions in the UTR river corridor, however recommendations are presented for the Upper Watershed in Chapter V.

### IV.2.B Cost Estimates

Estimated project costs for Alternatives 2, 3, 4 and 5 were developed for Reaches 1 through 4. A summary of the results is presented in Table 4.1; a full detailed preliminary engineering cost estimate for Alternatives 2, 3, and 4 is presented in Tables 4.2-4.4

Table 4.1: Summary of cost per reach for Alternatives 2, 3, and 4.

| | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| Reach 1 | $3,410,016 | $2,268,658 | $4,396,722 |
| Reach 2 | $6,717,008 | $3,484,210 | $4,080,116 |
| Reach 3 | $5,532,520 | $2,275,578 | $5,066,964 |
| Reach 4 | $5,159,495 | $5,427,742 | $5,187,890 |
| Total | $22,900,943 | $14,801,807 | $18,731,692 |

In order to develop an implementation cost for each of the 11 reaches, a melded average per linear foot cost was developed for seven potential stabilization/revegetation treatments and applied to all of the banks rated with a high, very high, and extreme erosion hazard. This resultant cost estimate per reach is presented in Table 4.5.

## Table 4.2: Cost of Proposed Alternative 2 by Reach

| REACH | ACTION | QUANTITY | UNITS | UNIT COST | ITEM TOTALS |
|---|---|---|---|---|---|
| REACH 1 | CLEARING AND GRUBBING | 2 | ACRE | $9,500 | $15,790 |
| | TREE REMOVAL | 16 | EA | $500 | $8,000 |
| | SITE PROTECTION FENCING | 3620 | LF | $4 | $14,480 |
| | NATIVE CUT | 8492 | CY | $18 | $152,847 |
| | NATIVE FILL | 0 | CY | $18 | $0 |
| | OFFHAUL OF SOIL | 8492 | CY | $6 | $50,949 |
| | IMPORT OF SOIL | 0 | CY | $6 | $0 |
| | ROCK SLOPE PROTECTION | 25474 | TONS | $85 | $2,165,290 |
| | ROOT WAD STRUCTURES | 72 | EA | $800 | $57,920 |
| | TEMPORARY ACCESS, WATERING, DUST CONTROL | 1685 | LF | $40 | $67,400 |
| | DRAINAGE IMPROVEMENTS | 3620 | LF | $4 | $14,480 |
| | CONSTRUCTION STAKING | 3620 | LF | $8 | $28,960 |
| | UTILITY RELOCATION | 1 | LS | $0 | $0 |
| | REVEGETATION | 1 | LS | $56,400 | $56,400 |
| | EROSION CONTROL | 2 | ACRE | $12,000 | $24,000 |
| | GRADE CONTROL STRUCTURE | 2 | EA | $60,000 | $120,000 |
| | TEMPORARY FLOW DIVERSION | 3620 | LF | $175 | $633,500 |
| | | | | **SUBTOTAL** | **$3,410,016** |
| REACH 2 | CLEARING AND GRUBBING | 3 | ACRE | $9,500 | $29,573 |
| | TREE REMOVAL | 55 | EA | $500 | $27,500 |
| | SITE PROTECTION FENCING | 6780 | LF | $4 | $27,120 |
| | NATIVE CUT | 16368 | CY | $18 | $294,615 |
| | NATIVE FILL | 0 | CY | $18 | $0 |
| | OFFHAUL OF SOIL | 16368 | CY | $6 | $98,205 |
| | IMPORT OF SOIL | 0 | CY | $6 | $0 |
| | ROCK SLOPE PROTECTION | 49103 | TONS | $85 | $4,173,755 |
| | ROOT WAD STRUCTURES | 136 | EA | $800 | $108,480 |
| | TEMPORARY ACCESS, WATERING, DUST CONTROL | 3300 | LF | $40 | $132,000 |
| | DRAINAGE IMPROVEMENTS | 6780 | LF | $4 | $27,120 |
| | CONSTRUCTION STAKING | 6780 | LF | $8 | $54,240 |
| | UTILITY RELOCATION | 1 | LS | $0 | $0 |
| | REVEGETATION | 1 | LS | $101,900 | $101,900 |
| | EROSION CONTROL | 3 | ACRE | $12,000 | $36,000 |
| | GRADE CONTROL STRUCTURE | 7 | EA | $60,000 | $420,000 |
| | TEMPORARY FLOW DIVERSION | 6780 | LF | $175 | $1,186,500 |
| | | | | **SUBTOTAL** | **$6,717,008** |
| REACH 3 | CLEARING AND GRUBBING | 3 | ACRE | $9,500 | $27,043 |
| | TREE REMOVAL | 36 | EA | $500 | $18,000 |
| | SITE PROTECTION FENCING | 6200 | LF | $4 | $24,800 |
| | NATIVE CUT | 14121 | CY | $18 | $254,169 |
| | NATIVE FILL | 0 | CY | $18 | $0 |
| | OFFHAUL OF SOIL | 14121 | CY | $6 | $84,723 |
| | IMPORT OF SOIL | 0 | CY | $6 | $0 |
| | ROCK SLOPE PROTECTION | 42361 | TONS | $85 | $3,600,685 |
| | ROOT WAD STRUCTURES | 124 | EA | $800 | $99,200 |
| | TEMPORARY ACCESS, WATERING, DUST CONTROL | 1640 | LF | $40 | $65,600 |
| | DRAINAGE IMPROVEMENTS | 6200 | LF | $4 | $24,800 |
| | CONSTRUCTION STAKING | 6200 | LF | $8 | $49,600 |
| | UTILITY RELOCATION/PROTECTION | 1 | LS | $10,000 | $10,000 |
| | REVEGETATION | 1 | LS | $92,900 | $92,900 |
| | EROSION CONTROL | 3 | ACRE | $12,000 | $36,000 |
| | GRADE CONTROL STRUCTURE | 1 | EA | $60,000 | $60,000 |
| | TEMPORARY FLOW DIVERSION | 6200 | LF | $175 | $1,085,000 |
| | | | | **SUBTOTAL** | **$5,532,520** |
| REACH 4 | CLEARING AND GRUBBING | 3 | ACRE | $9,500 | $23,946 |
| | TREE REMOVAL | 50 | EA | $500 | $25,000 |
| | SITE PROTECTION FENCING | 5490 | LF | $4 | $21,960 |
| | NATIVE CUT | 13254 | CY | $18 | $238,563 |
| | NATIVE FILL | 0 | CY | $18 | $0 |
| | OFFHAUL OF SOIL | 13254 | CY | $6 | $79,521 |
| | IMPORT OF SOIL | 0 | CY | $6 | $0 |
| | ROCK SLOPE PROTECTION | 39761 | TONS | $85 | $3,379,685 |
| | ROOT WAD STRUCTURES | 110 | EA | $800 | $87,840 |
| | TEMPORARY ACCESS, WATERING, DUST CONTROL | 1950 | LF | $40 | $78,000 |
| | DRAINAGE IMPROVEMENTS | 5490 | LF | $4 | $21,960 |
| | CONSTRUCTION STAKING | 5490 | LF | $8 | $43,920 |
| | UTILITY RELOCATION/PROTECTION | 1 | LS | $20,000 | $20,000 |
| | REVEGETATION | 1 | LS | $82,350 | $82,350 |
| | EROSION CONTROL | 3 | ACRE | $12,000 | $36,000 |
| | GRADE CONTROL STRUCTURE | 1 | EA | $60,000 | $60,000 |
| | TEMPORARY FLOW DIVERSION | 5490 | LF | $175 | $960,750 |
| | | | | **SUBTOTAL** | **$5,159,495** |

| | |
|---|---|
| **TOTAL** | **$20,819,039** |
| **CONTINGENCIES** | **$2,081,904** |
| **GRAND TOTAL** | **$22,900,943** |

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**Table 4.2:** Detailed cost estimate of Alternative 2 for Reaches 1 - 4.

## Table 4.3: Cost of Proposed Alternative 3 by Reach

| REACH | ACTION | QUANTITY | UNITS | UNIT COST | ITEM TOTALS |
|---|---|---|---|---|---|
| REACH 1 | CLEARING AND GRUBBING | 9 | ACRE | $7,000 | $64,400 |
| | SITE PROTECTION FENCING | 3600 | LF | $4 | $14,400 |
| | DEMOLITION | 1 | LS | $55,500 | $55,500 |
| | NATIVE CUT | 42231 | CY | $12 | $506,772 |
| | NATIVE FILL | 0 | CY | $18 | $0 |
| | OFFHAUL OF SOIL | 42231 | CY | $6 | $253,386 |
| | IMPORT OF SOIL | 0 | CY | $6 | $0 |
| | TEMPORARY ACCESS, WATERING, DUST CONTROL | 270 | LF | $40 | $10,800 |
| | DRAINAGE IMPROVEMENTS | 3600 | LF | $4 | $14,400 |
| | CONSTRUCTION STAKING | 3600 | LF | $10 | $36,000 |
| | UTILITY RELOCATION | 1 | LS | $250,000 | $250,000 |
| | REVEGETATION | 9 | ACRE | $52,000 | $468,000 |
| | EROSION CONTROL | 9 | ACRE | $7,000 | $63,000 |
| | TEMPORARY FLOW DIVERSION | 1 | LS | $50,000 | $50,000 |
| | PHASE 1 FLUSHING / IRRIGATION | 1 | LS | $50,000 | $50,000 |
| | WOODY DEBRIS STRUCTURES | 3600 | LF | $120 | $432,000 |
| | | | | **SUBTOTAL** | **$2,268,658** |
| REACH 2 | CLEARING AND GRUBBING | 17 | ACRE | $9,500 | $160,550 |
| | SITE PROTECTION FENCING | 4186 | LF | $4 | $16,744 |
| | DEMOLITION | 1 | LS | $111,250 | $111,250 |
| | NATIVE CUT | 82319 | CY | $12 | $987,828 |
| | NATIVE FILL | 0 | CY | $18 | $0 |
| | OFFHAUL OF SOIL | 82319 | CY | $6 | $493,914 |
| | IMPORT OF SOIL | 0 | CY | $6 | $0 |
| | TEMPORARY ACCESS, WATERING, DUST CONTROL | 1000 | LF | $40 | $40,000 |
| | DRAINAGE IMPROVEMENTS | 4186 | LF | $4 | $16,744 |
| | CONSTRUCTION STAKING | 4186 | LF | $10 | $41,860 |
| | UTILITY RELOCATION | 1 | LS | $10,000 | $10,000 |
| | REVEGETATION | 17 | ACRE | $52,000 | $884,000 |
| | EROSION CONTROL | 17 | ACRE | $7,000 | $119,000 |
| | TEMPORARY FLOW DIVERSION | 1 | LS | $50,000 | $50,000 |
| | PHASE 1 FLUSHING / IRRIGATION | 1 | LS | $50,000 | $50,000 |
| | WOODY DEBRIS STRUCTURES | 4186 | LF | $120 | $502,320 |
| | | | | **SUBTOTAL** | **$3,484,210** |
| REACH 3 | CLEARING AND GRUBBING | 9 | ACRE | $9,500 | $81,510 |
| | SITE PROTECTION FENCING | 4278 | LF | $4 | $17,112 |
| | DEMOLITION | 0 | LS | $20,000 | $0 |
| | NATIVE CUT | 49178 | CY | $12 | $590,136 |
| | NATIVE FILL | 0 | CY | $18 | $0 |
| | OFFHAUL OF SOIL | 49178 | CY | $6 | $295,068 |
| | IMPORT OF SOIL | 0 | CY | $6 | $0 |
| | TEMPORARY ACCESS, WATERING, DUST CONTROL | 1750 | LF | $40 | $70,000 |
| | DRAINAGE IMPROVEMENTS | 4278 | LF | $4 | $17,112 |
| | CONSTRUCTION STAKING | 4278 | LF | $10 | $42,780 |
| | UTILITY RELOCATION / PROTECTION | 1 | LS | $17,500 | $17,500 |
| | REVEGETATION | 9 | ACRE | $52,000 | $468,000 |
| | EROSION CONTROL | 9 | ACRE | $7,000 | $63,000 |
| | TEMPORARY FLOW DIVERSION | 1 | LS | $50,000 | $50,000 |
| | PHASE 1 FLUSHING / IRRIGATION | 1 | LS | $50,000 | $50,000 |
| | WOODY DEBRIS STRUCTURES | 4278 | LF | $120 | $513,360 |
| | | | | **SUBTOTAL** | **$2,275,578** |
| REACH 4 | CLEARING AND GRUBBING | 21 | ACRE | $9,500 | $199,500 |
| | SITE PROTECTION FENCING | 4620 | LF | $4 | $18,480 |
| | DEMOLITION | 0 | LS | $20,000 | $0 |
| | NATIVE CUT | 175649 | CY | $12 | $2,107,788 |
| | NATIVE FILL | 0 | CY | $18 | $0 |
| | OFFHAUL OF SOIL | 175649 | CY | $6 | $1,053,894 |
| | IMPORT OF SOIL | 0 | CY | $6 | $0 |
| | TEMPORARY ACCESS, WATERING, DUST CONTROL | 1000 | LF | $40 | $40,000 |
| | DRAINAGE IMPROVEMENTS | 4620 | LF | $4 | $18,480 |
| | CONSTRUCTION STAKING | 4620 | LF | $10 | $46,200 |
| | UTILITY RELOCATION / PROTECTION | 1 | LS | $50,000 | $50,000 |
| | REVEGETATION | 21 | ACRE | $52,000 | $1,092,000 |
| | EROSION CONTROL | 21 | ACRE | $7,000 | $147,000 |
| | TEMPORARY FLOW DIVERSION | 1 | LS | $50,000 | $50,000 |
| | PHASE 1 FLUSHING / IRRIGATION | 1 | LS | $50,000 | $50,000 |
| | WOODY DEBRIS STRUCTURES | 4620 | LF | $120 | $554,400 |
| | | | | **SUBTOTAL** | **$5,427,742** |

| | |
|---|---|
| **TOTAL** | **$13,456,188** |
| **CONTINGENCIES** | **$1,345,619** |
| **GRAND TOTAL** | **$14,801,807** |

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**Table 4.3:** Detailed cost estimate of Alternative 3 for Reaches 1 - 4. Note: Estimates do not include costs associated with land use alterations.

## Table 4.4: Cost of Proposed Alternative 4 by Reach

| REACH | ACTION | QUANTITY | UNITS | UNIT COST | ITEM TOTALS |
|---|---|---|---|---|---|
| REACH 1 | CLEARING AND GRUBBING | 22 | ACRE | $7,000 | $154,000 |
| | SITE PROTECTION FENCING | 6800 | LF | $4 | $27,200 |
| | DEMOLITION | 1 | LS | $100,000 | $100,000 |
| | NATIVE CUT | 46212 | CY | $18 | $831,816 |
| | NATIVE FILL | 41581 | CY | $20 | $831,620 |
| | OFFHAUL OF SOIL | 4631 | CY | $6 | $27,786 |
| | IMPORT OF SOIL | 0 | CY | $6 | $0 |
| | TEMPORARY ACCESS, WATERING, DUST CONTROL | 7200 | LF | $40 | $288,000 |
| | DRAINAGE IMPROVEMENTS | 6800 | LF | $4 | $27,200 |
| | CONSTRUCTION STAKING | 6800 | LF | $12 | $81,600 |
| | UTILITY RELOCATION / PROTECTION | 1 | LS | $235,000 | $235,000 |
| | REVEGETATION | 25 | ACRE | $13,000 | $325,000 |
| | EROSION CONTROL | 25 | ACRE | $7,000 | $175,000 |
| | TEMPORARY FLOW DIVERSION | 1 | LS | $180,000 | $180,000 |
| | IMPORTED RIFFLE SUBSTRATE | 15450 | CY | $50 | $772,500 |
| | WOODY DEBRIS STRUCTURES | 1 | LS | $136,000 | $136,000 |
| | BANK AND FLOODPLAIN ARMORING | 6800 | LF | $30 | $204,000 |
| | | | SUBTOTAL | | $4,396,722 |
| REACH 2 | CLEARING AND GRUBBING | 19 | ACRE | $9,500 | $180,500 |
| | SITE PROTECTION FENCING | 7175 | LF | $4 | $28,700 |
| | DEMOLITION | 1 | LS | $130,000 | $130,000 |
| | NATIVE CUT | 45913 | CY | $18 | $826,434 |
| | NATIVE FILL | 29041 | CY | $20 | $580,820 |
| | OFFHAUL OF SOIL | 16872 | CY | $6 | $101,232 |
| | IMPORT OF SOIL | 0 | CY | $20 | $0 |
| | TEMPORARY ACCESS, WATERING, DUST CONTROL | 8372 | LF | $40 | $334,880 |
| | DRAINAGE IMPROVEMENTS | 7175 | LF | $4 | $28,700 |
| | CONSTRUCTION STAKING | 7175 | LF | $12 | $86,100 |
| | UTILITY RELOCATION | 1 | LS | $0 | $0 |
| | REVEGETATION | 20 | ACRE | $13,000 | $260,000 |
| | EROSION CONTROL | 20 | ACRE | $7,000 | $140,000 |
| | TEMPORARY FLOW DIVERSION | 1 | LS | $209,000 | $209,000 |
| | IMPORTED RIFFLE SUBSTRATE | 16300 | CY | $50 | $815,000 |
| | WOODY DEBRIS STRUCTURES | 1 | LS | $143,500 | $143,500 |
| | BANK AND FLOODPLAIN ARMORING | 7175 | LF | $30 | $215,250 |
| | | | SUBTOTAL | | $4,080,116 |
| REACH 3 | CLEARING AND GRUBBING | 28 | ACRE | $9,500 | $266,000 |
| | SITE PROTECTION FENCING | 7210 | LF | $4 | $28,840 |
| | DEMOLITION | 1 | LS | $20,000 | $20,000 |
| | NATIVE CUT | 41941 | CY | $18 | $754,938 |
| | NATIVE FILL | 50682 | CY | $20 | $1,013,640 |
| | OFFHAUL OF SOIL | 0 | CY | $6 | $0 |
| | IMPORT OF SOIL | 8741 | CY | $6 | $52,446 |
| | TEMPORARY ACCESS, WATERING, DUST CONTROL | 8556 | LF | $40 | $342,240 |
| | DRAINAGE IMPROVEMENTS | 7210 | LF | $4 | $28,840 |
| | CONSTRUCTION STAKING | 7210 | LF | $12 | $86,520 |
| | UTILITY RELOCATION/PROTECTION | 1 | LS | $460,000 | $460,000 |
| | REVEGETATION | 31 | ACRE | $13,000 | $403,000 |
| | EROSION CONTROL | 31 | ACRE | $7,000 | $217,000 |
| | TEMPORARY FLOW DIVERSION | 1 | LS | $214,000 | $214,000 |
| | IMPORTED RIFFLE SUBSTRATE | 16380 | CY | $50 | $819,000 |
| | WOODY DEBRIS STRUCTURES | 1 | LS | $144,200 | $144,200 |
| | BANK AND FLOODPLAIN ARMORING | 7210 | LF | $30 | $216,300 |
| | | | SUBTOTAL | | $5,066,964 |
| REACH 4 | CLEARING AND GRUBBING | 24 | ACRE | $9,500 | $228,000 |
| | SITE PROTECTION FENCING | 7435 | LF | $4 | $29,740 |
| | DEMOLITION | 1 | LS | $20,000 | $20,000 |
| | NATIVE CUT | 71670 | CY | $18 | $1,290,060 |
| | NATIVE FILL | 39729 | CY | $20 | $794,580 |
| | OFFHAUL OF SOIL | 23200 | CY | $6 | $139,200 |
| | IMPORT OF SOIL | 0 | CY | $6 | $0 |
| | TEMPORARY ACCESS, WATERING, DUST CONTROL | 9240 | LF | $40 | $369,600 |
| | DRAINAGE IMPROVEMENTS | 7435 | LF | $4 | $29,740 |
| | CONSTRUCTION STAKING | 7435 | LF | $12 | $89,220 |
| | UTILITY RELOCATION/PROTECTION | 1 | LS | $210,000 | $210,000 |
| | REVEGETATION | 27 | ACRE | $13,000 | $351,000 |
| | EROSION CONTROL | 27 | ACRE | $7,000 | $189,000 |
| | TEMPORARY FLOW DIVERSION | 1 | LS | $231,000 | $231,000 |
| | IMPORTED RIFFLE SUBSTRATE | 16900 | CY | $50 | $845,000 |
| | WOODY DEBRIS STRUCTURES | 1 | LS | $148,700 | $148,700 |
| | BANK AND FLOODPLAIN ARMORING | 7435 | LF | $30 | $223,050 |
| | | | SUBTOTAL | | $5,187,890 |
| | | | TOTAL | | $18,731,692 |

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**Table 4.4:** Detailed cost estimate of Alternative 4 for Reaches 1 - 4. Note: Estimates do not include costs associated with land use alterations.

Table 4.5: Summary of costs per reach for Alternative 5.

| | Ownership | Total Length of Bank Protection (ft) | Avg. Cost per linear foot | Total Cost |
|---|---|---|---|---|
| Reach 5 | Mixed | 11786 | $220 | $2,592,920 |
| Reach 6 | Mixed | 7827 | $220 | $1,721,940 |
| Reach 7 | Mixed | 8508 | $220 | $1,871,760 |
| Reach 8 | Mixed | 6904 | $220 | $1,518,880 |
| Reach 9 | Mixed | 1506 | $220 | $331,320 |
| Reach 10 | USFS | 2476 | $220 | $544,720 |
| Reach 11 | USFS | 1650 | $220 | $363,000 |
| | | | Combined Total | $8,944,540 |

## IV.2.C Alternatives Assessment Reaches 1 through 4

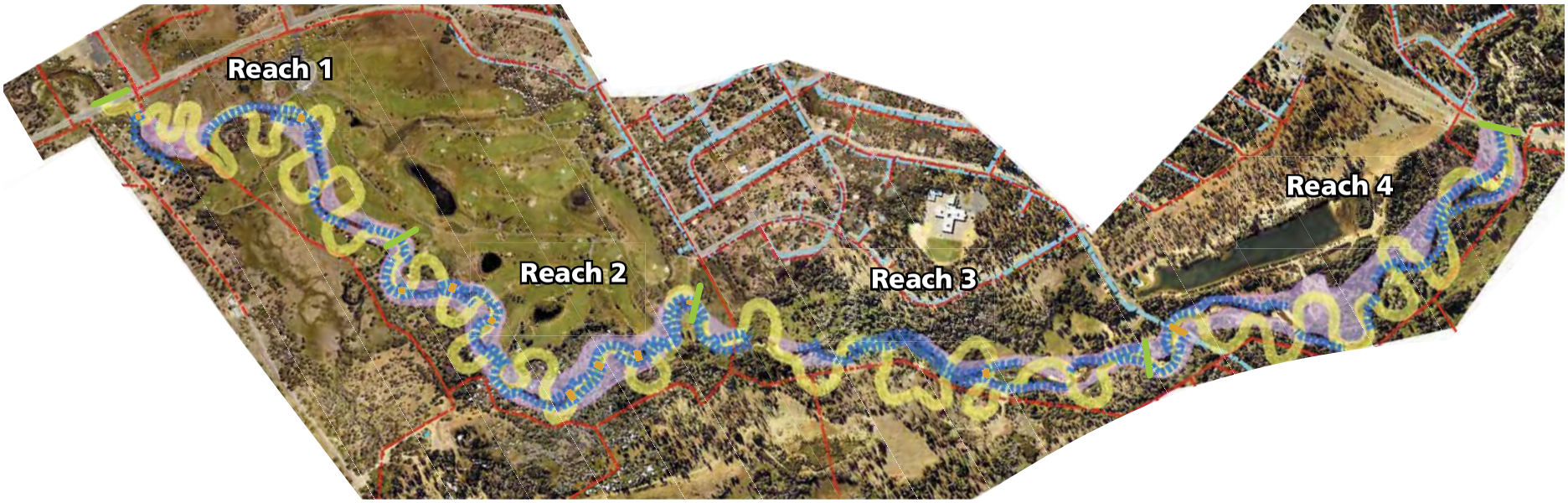
Alternatives 1 through 5 were assessed for Reaches 1 through 4 by discipline area (geomorphology, water quality, hydrology, construction impacts, vegetation and wetlands, terrestrial wildlife, aquatic wildlife and habitat, cultural resources, and infrastructure, land use and regulatory compliance). Table 4.6 is a matrix of the effects of each alternative by discipline areas.

Figures 4.9 through 4.13 present conceptual plans for Alternatives 2, 3, and 4 overlain onto a current aerial photograph for Reaches 1 through 4, respectively. These figures show the proposed areas of rip rap and bank protection placement for Alternative 2, the area of floodplain excavation for Alternative 3, and the original channel planform, which is the assumed reconstructed channel for Alternative 4. The estimated areas for Alternative 5 projects are drawn from site specific, linear foot bank stability ratings presented in Section III.1.C.

Table 4.6: Matrix of effects of alternatives on various resource disciplines.

| Discipline | Alternative | | | | | |
|---|---|---|---|---|---|---|
| | No Action | 2 | 3 | 4 | 5 (Reaches 1-4) | 5 (Reaches 5-11) |
| Geomorphology | - | + | ++ | ++ | + | ++ |
| Water Quality | - | + | ++ | ++ | + | ++ |
| Hydrology | 0 | 0 | + | ++ | 0 | 0 |
| Vegetation and Wetlands | - | + | ++ | ++ | 0 | + |
| Terrestrial Wildlife | - | - | ++ | ++ | - | + |
| Aquatic Wildlife and Habitat | 0 | + | ++ | ++ | 0 | + |
| Cultural Resources | 0 | 0 | 0 | 0 | 0 | 0 |
| Infrastructure | 0 | ++ | - | -- | 0 | 0 |
| Land Use | 0 | 0 | -- | -- | 0 | 0 |
| Ease of Regulatory Compliance | N/a | -- | -- | -- | - | - |
| Short-term Construction Impacts | N/a | -- | -- | -- | 0 | - |

++ : very significant improvement
+ : significant improvement
0 : neutral
- : degradation
-- : significant degradation




= Reach Breaks

= Water Lines

= Sanitary Sewer Lines

N

0 250 500 1000 Feet 1:6000

**Alternative #1** - No Action

**Alternative #2**- Provide Rip Rap Protection along banks and Grade Control in channel.

= proposed Rip Rap

= proposed Grade Control

**Alternative #3**- Excavate incised banks to create Floodplain Terraces.

= proposed Floodplain Terraces

**Alternative #4**- Restore channel to its original planform and profile. Fill existing channel.

= proposed Channel Alignment

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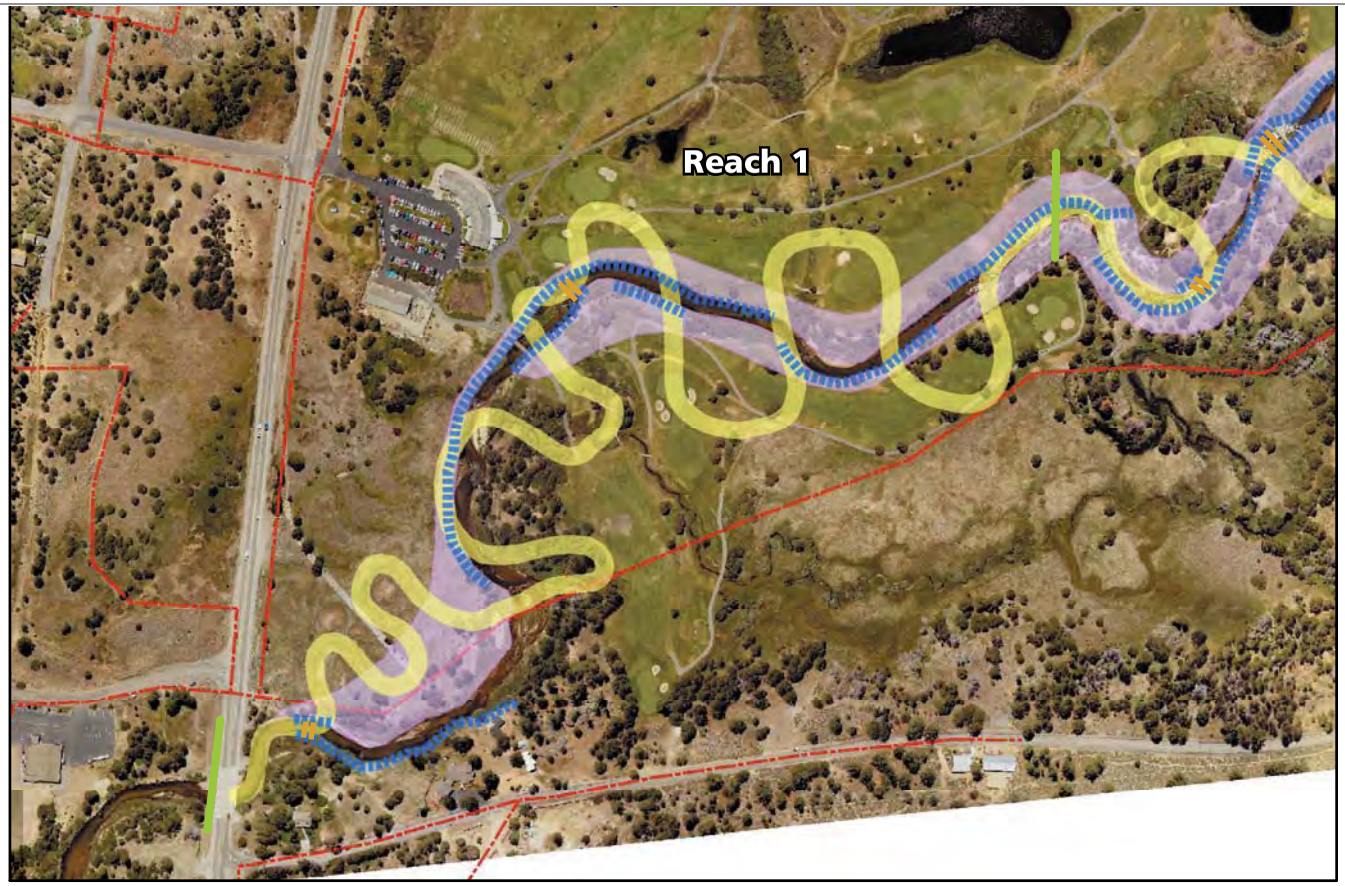
**FIGURE 4.9:** Design alternatives for Reaches 1- 4.




= Reach Breaks

= Water Lines

= Sanitary Sewer Lines

N

0 250 500 1000 Feet 1:6000

**Alternative #1** - No Action

**Alternative #2**- Provide Rip Rap Protection along banks and Grade Control in channel.

= proposed Rip Rap

= proposed Grade Control

**Alternative #3**- Excavate incised banks to create Floodplain Terraces.

= proposed Floodplain Terraces

**Alternative #4**- Restore channel to its original planform and profile. Fill existing channel.

= proposed Channel Alignment

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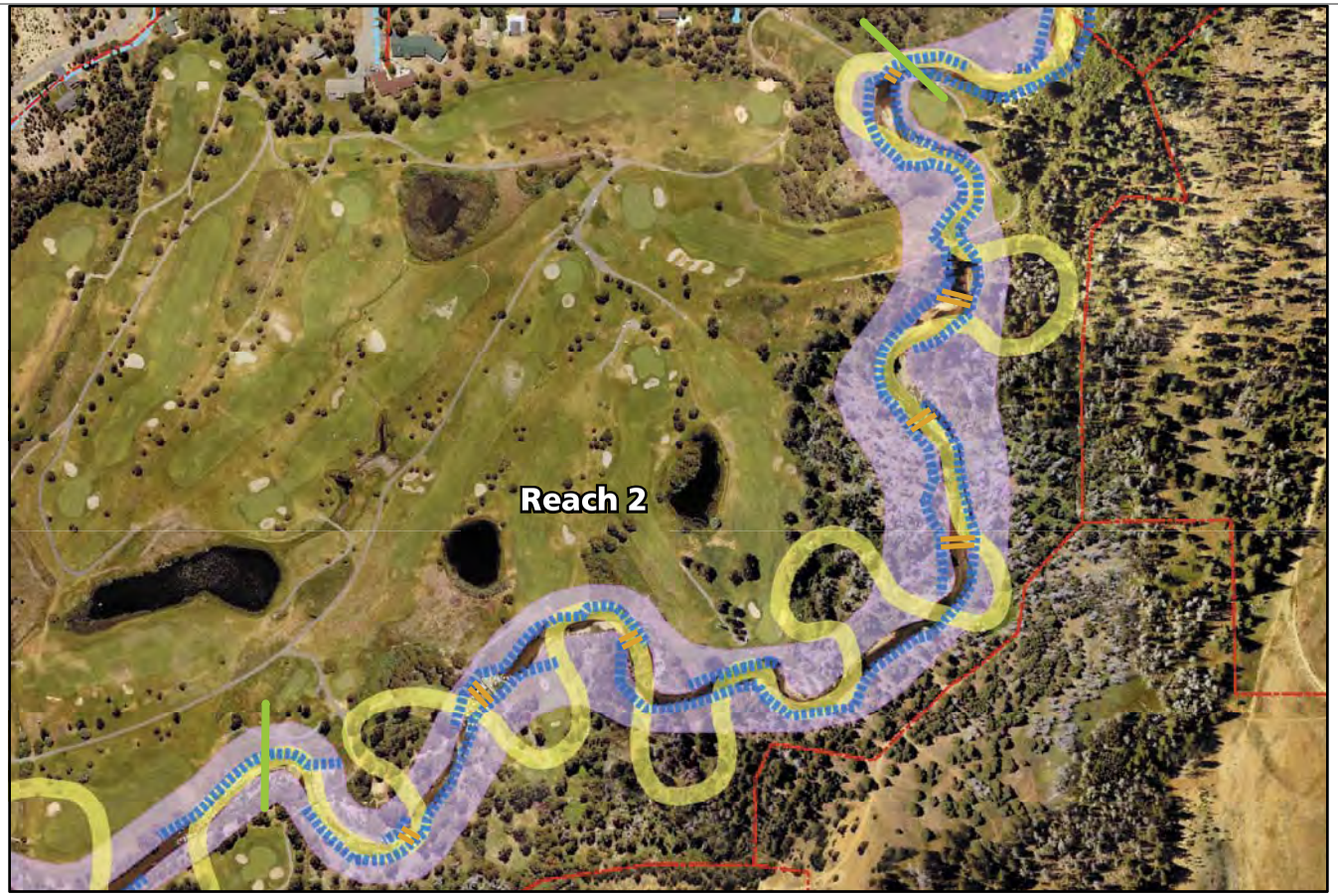
**FIGURE 4.10:** Design alternatives for Reach 1.




= Reach Breaks

= Water Lines

= Sanitary Sewer Lines

0 250 500 1000 Feet 1:6000

N

**Alternative #1** - No Action

**Alternative #2**- Provide Rip Rap Protection along banks and Grade Control in channel.

= proposed Rip Rap

= proposed Grade Control

**Alternative #3**- Excavate incised banks to create Floodplain Terraces.

= proposed Floodplain Terraces

**Alternative #4**- Restore channel to its original planform and profile. Fill existing channel.

= proposed Channel Alignment

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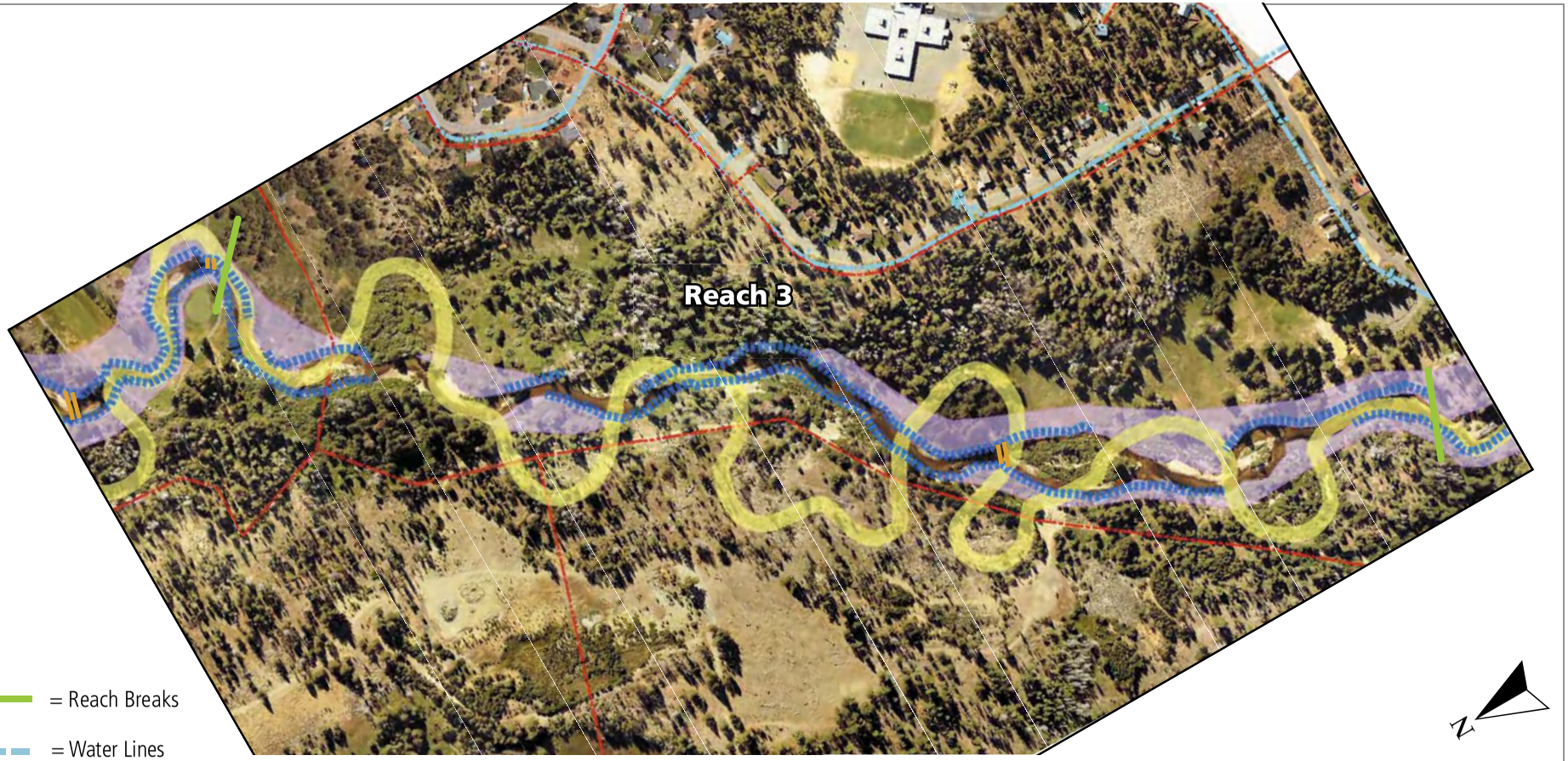
**FIGURE 4.11:** Design alternatives for Reach 2.




= Reach Breaks

= Water Lines

= Sanitary Sewer Lines

0 250 500 1000 Feet 1:6000

**Alternative #1** - No Action

**Alternative #2**- Provide Rip Rap Protection along banks and Grade Control in channel.

= proposed Rip Rap

= proposed Grade Control

**Alternative #3**- Excavate incised banks to create Floodplain Terraces.

= proposed Floodplain Terraces

**Alternative #4**- Restore channel to its original planform and profile. Fill existing channel.

= proposed Channel Alignment

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**FIGURE 4.12:** Design alternatives for Reach 3.

= Reach Breaks

= Water Lines

= Sanitary Sewer Lines

N

0 250 500 1000

Feet 1:6000

**Alternative #1** - No Action

**Alternative #2**- Provide Rip Rap Protection along banks and Grade Control in channel.

= proposed Rip Rap

= proposed Grade Control

**Alternative #3**- Excavate incised banks to create Floodplain Terraces.

= proposed Floodplain Terraces

**Alternative #4**- Restore channel to its original planform and profile. Fill existing channel.

= proposed Channel Alignment

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**FIGURE 4.13:** Design alternatives for Reach 4.

### ALTERNATIVE 1 – NO ACTION

*Geomorphology, Water Quality and Hydrology*

The present degraded channel would remain unstable and a chronic source of fine sediment. There would be continued widening of the river corridor until a stable section is achieved; this appears most problematic in Reaches 1, 2, 3 and 4, since the actively moving headcuts continue to incise the longitudinal profile. In Reaches 5 through 11 the presence of bedrock and boulder control appears to arrest any further downcutting in most reaches. Using the present erosion hazard ratings as a guide, it is possible that up to 350,000 cubic yards (525,000 tons) of sediment (equivalent to the amount being excavated under Alternative 3) will be released from the Reaches 1 through 4 over the next several decades if the channel is allowed to adjust to a new equilibrium width on its own. The volume eroded from streambanks in Reaches 5 through 11 would be less as most of the deepening and widening has already occurred, however in all cases fine sediment production would be greater than background pre-disturbed conditions for decades to come. Channel instability would continue until a stable width and profile is achieved, a period of at least several decades at minimum.

The present water quality conditions would continue into the future with excessive chronic fine sediment supplied from unstable banks and the continued discharge of untreated to partially treated urban runoff from residential roads, commercial areas and golf courses. The lack of overbank flooding in the UTR will allow all entrained sediments, nutrients and other pollutant constituents to flow into the UTR and directly into Lake Tahoe.

With respect to hydrology, the No Action plan will retain the existing degraded conditions in all reaches indefinitely into the future. The shallow groundwater table surrounding the river will be well below it historic level, at least 3-4 feet through the Study Area. This will limit the recovery of native vegetation, wetlands and associated wildlife habitats to the channel. As mentioned above, overbank flow out of the channel will continue to be infrequent since channel flood capacity is so high.

The No Action Alternative would avoid short-term construction impacts that could affect water quality, increase noise, traffic and reduce air quality. With other alternatives, these could be significant impacts during multiple-year construction scenarios associated with each.

*Vegetation and Wetlands*

Under No Action plan, native vegetation in the riparian zone will continue to reflect a drying trend favoring facultative and upland species over wetlands and obligate species. This trend will re-enforce existing conditions by reducing plant diversity and ecosystem function as vegetation is generally less dependent upon riverine hydrology and fluvial processes. Invasion of dense lodge pole forests into former floodplain and wetland areas, now on terraces, will continue and perhaps replace existing decadent willow and cottonwood stands. Important exceptions to this outcome will be the areas of tributary spring flow in Reaches 3, 4 and 10, for example, where independent

sources of surface flow and shallow groundwater occur. These independent hydrologic sources could be enhanced though isolated and specific activity of beavers, such as that occurring on the east bank of the UTR in Reach 10.

There will be an expansion of riparian vegetation as the UTR erodes to a wider channel and meander belt. There are areas in Reach 3 where an overall stable width has been achieved and there has been a development of new riparian and wetland vegetation. However, many of the channel banks and terrace areas will remain too dry to support riparian species for decades to come.

Forest conditions would remain favoring dense, young stands of lodgepole pine and white fir in densities far greater than the original forest structure. Historically logged areas around Meyers and in WMSP will be subject to destruction by catastrophic fire, which also threatens many properties and structures.

*Terrestrial Wildlife*

Terrestrial wildlife conditions would remain unchanged, with the exception of a continuing drying of terrace surfaces and invasion of upland species. This will influence habitat for several key species. The loss of willow scrub habitat due to drying on terraces will reduce the extent of willow flycatcher habitat in the river corridor; this will be partially offset by generation of new willow scrub in some locations where the UTR channel will widen in the future and create new floodplain, although the suitability will be less until the new plants mature. The conditions surrounding beavers would remain unchanged. Encroaching land use will continue to impact potential riparian areas, especially in the LTGC.

Overall, the condition of wildlife habitat would remain far below its potential diversity and abundance. Riparian areas are unusually rich wildlife habitat areas, especially when geomorphic processes are functional and creating erosion and sediment deposition disturbances. The present incised channel confines these processes to the narrow area of the channel, which is often less than 100 feet in width; in the pre-disturbed condition the entire meander belt, up to 1,000 feet or more wide, was subject to erosion and deposition, beneficial disturbance processes.

One potential benefit of the No Action plan is that wildlife habitat will not be disturbed by construction activities. Although, future bank erosion may necessitate bank repairs to stabilize sewer lines or facilities associated with the LTGCand thus affect wildlife habitat.

*Aquatic Wildlife and Habitat*

Under the No Action plan, the conditions supporting aquatic habitat would remain unchanged. This means that fine sediment will still affect substrate quality for macroinvertebrate production and spawning success. CDFG would continue its program of fisheries management.

The condition of the UTR would continue to be far below its potential due to a lack of optimum channel morphology: the straight channel planform creates a flat streambed profile, instead of the more valuable pool and riffle morphology. The lack of riparian vegetation along the bank edges reduces cover and the formation of rooted undercut banks; that may be partially offset by enhanced logjam formation as undercut trees fall into the low flow channel.

*Cultural Resources*
Cultural resources will not be affected by the No Action plan since no projects are proposed.

*Infrastructure, Land Use and Regulatory Compliance*
The No-Action plan would not affect present land use, infrastructure nor require regulatory permits.

### ALTERNATIVE 2: STABILIZATION IN REACHES 1 THROUGH 4.

*Geomorphology, Water Quality and Hydrology*
Channel stabilization would reduce channel erosion and arrest headcut migration. This would improve channel stability and reduce fine sediment supply from the channel. Conversely, reduction of erosion could reduce coarse gravel supply to the channel, which is important for substrate.

Although the project aims to provide stability, there is a measure of risk and uncertainty under future conditions because this alternative simply fixes the position of the channel that has an unstable geometry and planform. There are several examples of failed rip rap structures in teh UTR channel, which have exacerbated bank instability at those locations. Proper design and placement will be essential and the main test for stability will be during a large rain on snow flood event, which occur roughly once every 10 years on average. The initial design identified selected treatment sites based upon present erosional processes; there may be some need to re-enter to maintain existing structures, extend some structures and/or install new structures. As a result, there would be a need to sustain funding for post-project maintenance and monitoring.

Water quality would be improved to the extent that erosion and fine sediment supply is reduced. Otherwise, discharges from existing land uses in the historic floodplain would continue as no new buffer areas or land use conversions would occur.

The hydrology of the UTR would remain unaffected under Alternative 2, because the stream profile would remain unchanged.

*Vegetation and Wetlands*

Riparian vegetation along the channel banks would expand somewhat under Alternative 2 since it is proposes to use bioengineered designs. However, there would be vegetation removal in order to provide construction access the proposed sites. In most cases, it appears that most of the removal would involve taking lodgepole pine along the immediate upper bank area; removing these from the riparian corridor is deemed beneficial due to their dense stands and low habitat value. The removed logs could be incorporated in the bioengineered bank structures to provide aquatic cover and shoreline diversity.

In some cases, high quality riparian vegetation would be removed to allow space for the bank structure. There would be an offset gained by allowing riparian planting in the structures to the greatest extent possible; this would primarily include the multiple willow species available locally. Some of the willow and alder removed for construction could be salvaged and incorporated in new structures and/or new plantings in the floodplain and providing little habitat value.

Alternative 2 would not create conditions for natural plant colonization and would arrest the present trend of channel widening and floodplain formation, thereby reducing the formation of new stands of riparian and wetlands plants.

The need to re-enter the project sites and to repair, extend or construct new structures could lead to more impacts to vegetation beyond the initial construction.

*Terrestrial Wildlife*

Terrestrial wildlife habitat would be affected by the construction activities during the initial period and during any maintenance repair, extension or new installations afterward. This would include wildlife disturbance from noise, excavation and removal of vegetation to allow for construction. There are measures that could be implemented to avoid wildlife impacts such as LOPs to avoid breeding periods and identification and exclusion of sensitive habitat areas from access or construction. The degree of vegetation replacement in the bioengineered structures in the riparian zone should be sufficient to offset short-term losses of construction.

Alternative 2 essentially confines geomorphic processes important for riparian habitat generation to the limited space within the channel and will not change hydrologic conditions in the river corridor or on the terraces. Therefore, the terrace areas of former floodplain and riparian zones will continue to dry and become more upland in composition and wildlife habitat will continue to shift from riparian to upland in the terrace areas with riparian zones confined to the river channel.

*Aquatic Wildlife and Habitat*
Aquatic habitat and wildlife would benefit from the reduction of fine sediment supply which impacts coarse substrate for macro invertebrate production, viability for successful spawning, and fills pools.

The bioengineered bank protection structures would include features beneficial to shoreline habitat for fish, including irregular shoreline, boulders, logs and root wads for cover and hydraulic roughness to scour pools, and opportunities to convert barren banks to vegetated shorelines. These changes would improve fisheries habitat over present conditions.

Alternative 2 would reduce the recruitment of logs from eroding banks and thus reduce habitat complexity and cover. This could be partially offset by incorporating logs into the bioengineered bank protection structures.

Alternative 2 would also reduce the level of geomorphic disturbance in the channel, resulting in more stable but uniform conditions. Some of the channel instability such as headcuts and areas of abrupt geomorphic change can actually create some good fish habitat (pools, bars, side channels etc.). These processes would be reduced.

*Cultural Resources*
Impacts to cultural resources should be very limited under Alternative 2. Most of the sensitive sites are located at the fringes of the floodplain near the upland boundary; it does not appear, based upon the surveys conducted in Reaches 1 through 4, that any sites exist near the river channel, in historic terraces or other areas that were riparian or wetland areas under pre-disturbance conditions. These sites could be avoided during construction by properly locating construction access away from these areas.

*Infrastructure, Land Use and Regulatory Compliance*
Alternative 2 would benefit infrastructure by providing added erosion control protection to sewer and other utility lines. The LTGC would receive erosion control protection within the existing river boundaries, thereby not affecting the present golf course operation or layout.

The Alternative 2 project would require permits from RWQCB, TRPA, US Army Corps of Engineers, El Dorado County and California Department of Fish and Game. The project would have to overcome several unprecedented challenges in order to obtain permits. It would be the largest rip rap revetment project to be undertaken in the Lake Tahoe Basin. It would require excavation below the streambed in order to construct grade control weirs and to extend rip rap slope revetment to a suitable depth below scour; this will require partial damming and/or diversion of surface flow during construction. In addition, stabilization runs counter to the policies of several agencies in the Lake Tahoe Basin to restore natural geomorphic and ecosystem function.

### ALTERNATIVE 3: FLOODPLAIN EXCAVATION

*Geomorphology, Water Quality and Hydrology*

Alternative 3 would significantly improve channel stability through a reduction of hydraulic force associated with a wider cross section and an increase of deeply rooted riparian vegetation in banks. The width of excavation would approximate what appears to be a stable width, based upon observation of some areas in Reach 3. These areas were naturally formed through erosional processes over a decades time scale, and it is assumed that it would require decades into the future for the UTR in Reaches 1, 2, 3, and 4 to reach the same quasi-stable configuration. An estimated 350,000 cubic yards or 525,000 tons of alluvial soils would be removed by implementing Alternative 3, which corresponds to what might be expected to be eventually eroded and discharged to downstream reaches and Lake Tahoe.

Alternative 3 would be implemented in two phases of grading and revegetation: the first would allow for the substantial area of new floodplain away from the channel to become stabilized through revegetation. The second phase involves excavating soil from the remaining bank and installing temporary erosion control. This approach is designed to minimize risk of soil loss in the early stabilization period.

The project could address bank instability, however it would be excavated to use the existing stream bed profile and adopt the existing planform. This leaves a residual risk of instability in profile due to head cuts and in cross section due to impingement of terraces. It is not feasible to use grade control for Alternative 3 since the lower floodplain surface would allow for outflanking of the structure. To reduce outflanking, grade control would have to be tied into the terraces and be over 200 feet wide. For cost estimation purposes we assumed these structures would be constructed in Reaches 1, 2, 3 and 4. Erosion and channel stability should be closely monitored after the project and provisions for possible repair and remediation should be planned.

The change in hydraulics associated with Alternative 3 could reduce the bedload transport capacity and create new areas of bedload deposition. This could create discontinuities in bedload transport and create areas could that might become unstable and initiate channel widening. Reach 4 exhibits evidence of being in a zone of net bedload deposition; the effect of Alternative 3 would likely move this zone upstream closer to the Meyers Highway 50 crossing, which should not have a significant impact because the area is confined by high terraces.

Water quality would be improved under Alternative 3 by reducing the supply of fine sediments from eroding banks and by increasing floodplain area from 24 acres of existing channel to over 80 acres subject to overbank flow. This combination would significantly reduce fine sediment supply (up to 350,000 cubic yards) and increase deposition of fine sediments in the new floodplain area for flows higher than 350 cfs (the design bankfull channel capacity before overbank flow would occur). This should improve water quality within Reaches 1 though 4 and downstream.

Alternative 3 would also set back the land uses from the river corridor allowing for a buffer to reduce direct urban runoff and pollutant discharge. This effect would be most profound along the LTGC where the setback would allow for runoff to flow through riparian vegetation buffers. This would be a significant improvement.

The hydrology of the UTR would only be affected during periods of overbank flow (flows greater than 350 cfs). Enhanced overbank flow would increase flood storage, increase percolation of surface water into shallow groundwater, and attenuate floods downstream. Alternative 3 would create over 200 acre-feet of new flood storage between 350 cfs and about a 10-year flood. This would significantly improve hydrologic function but only partially restore historic floodplain storage and function.

*Vegetation and Wetlands*

Alternative 3 would create significant benefits for riparian vegetation and wetlands by expanding the area with a shallow groundwater table in the created floodplains and by restoring overbank flow and associated geomorphic function, including fine mineral sediment deposition that drives native riparian plant colonization. The project would create 56 acres of new floodplain that will support native riparian and a range of wetland habitats. It is anticipated that natural geomorphic processes and restored hydrologic conditions will create a self-sustaining riparian corridor.

Alternative 3 would require removal of existing vegetation in the terrace areas in order to excavate the project floodplains. This area includes decadent stands of willow scrub and dry meadow grasses. The project would provide for salvaging willow and alder clumps by moving them into restored floodplain areas. The meadow grasses could be enhanced to wet meadow sod by irrigation in the year or two prior to construction. This could provide a ready source of sod for Phase 2 construction when the banks near the edge of the channel would be excavated. The dominant dense stands of lodgepole pine would be removed and the logs used as floodplain roughness features or as streambank enhancements for fisheries habitat. It is assumed that removal of the dense stands of lodgepole and replacement with riparian species would be a significant benefit.

The project will remove significant stands of riparian vegetation and replace them with new riparian wetland plantings and salvaged plantings; considerable amounts of decadent lodgepole pines will also be removed. This will result in a short-term loss of native vegetation until the plantings become established. It is believed that the short-term impacts are acceptable given the long-term gains in benefits for vegetation in the natural riparian corridor.

*Terrestrial Wildlife*

Alternative 3 will have significant short-term impacts to wildlife associated with construction (noise), vegetation removal and habitat disruption. The greatest potential impact would be to willow flycatcher habitat where large decadent willow scrub stands would be removed or

relocated from the terraces. This could be offset by limiting operation periods for construction, avoiding known nesting stands, and replacing drier terraces with functional floodplain areas capable of naturally generating new willow scrub stands.

Once the construction and initial vegetation stabilization period has passed, the potential benefits of Alternative 3 for wildlife are significant. The project will greatly diversify the riparian plant communities and restore significant, naturally functional wetland areas adjacent to the river. This would expand habitat for many species that utilize riparian and wetland areas during their life cycle. Restoration of riparian corridor would greatly increase primary productivity and foraging for higher mammals and for avian wildlife.

*Aquatic Wildlife and Habitat*
Aquatic wildlife and habitat would benefit from Alternative 3 through increased shoreline riparian vegetation and development of densely rooted undercut banks for cover. The increase is shoreline riparian vegetation will also increase insect drop for food production for fish. A reduction in eroding banks should reduce localized fine sediment supply affecting substrate quality.

Construction of Alternative 3 could result in significant short-term impacts to aquatic habitat and fisheries. The project will remove some bank-side vegetation, which might provide habitat, and would not be replaced until new riparian plantings matured. This could be offset by installing boulders, root wads and logs to provide shoreline habitat until riparian plantings mature.

*Cultural Resources*
Cultural resources should not be affected by implementation of Alternative 3 since excavation would occur away from the terrace/upland fringe where most significant sites in the area are typically found. Care must be taken to avoid sites along construction access roads and along the outer edges of the terrace excavation areas. A preconstruction survey should be conducted prior to final design to avoid significant sites.

*Infrastructure, Land Use and Regulatory Compliance*
Alternative 3 could have significant impacts to infrastructure, land use, traffic and noise. The proposed floodplain excavation area comes close to sewer line locations, which might require armoring to protect from lateral erosion or to maintain suitable cover. In some cases, line relocation or siphoning may be required. The precise parameters and mitigation measures would have to be developed in consultation with STPUD.

The proposed excavation corridor includes areas within the LTGC. The proposed project could affect several holes that would have to be reconfigured. Although there appears to be opportunities to do so, neither specific plans nor associated costs have been developed and any effort to do so would have to be considered in consultation with CDPR and the contractor lessee.

The project proposes restoration on some private lands near Lake Baron along the east bank of the river in Reach 4. Landowner permission would have to be acquired.

The Alternative 3 project would require permits from RWQCB, TRPA, US Army Corps of Engineers, El Dorado County and California Department of Fish and Game. The project would have to overcome several unprecedented challenges in order to obtain permits: first the method and design, although based upon observed natural stream behavior, is untried on the scale proposed for UTR and this may present some reluctance on part of agencies. Water quality protection during construction would be a significant challenge since the acreage of soil disturbance along the river corridor would be significant.

### Alternative 4 Restore Original Profile and Planform

*Geomorphology, Water Quality and Hydrology*

Alternative 4 would restore the pre-disturbance channel morphology in planform, geometry and profile grade. The proposed channel alignment was derived from an analysis of historical aerial photographs and topographic maps. The intent of the design is to restore the natural form of geomorphic processes upon which the original UTR ecosystem existed. This infers a high degree of natural stability in channel bed and banks. The reconstructed channel would eliminate existing headcuts. Alternative 4 would minimize stability risk factors associated with the existing planform and profile since it would minimize concentration of erosional force and create significant backwater and overbank flooding areas. The restoration of the original channel morphology means that the channel form most appropriate for the balance of flow and sediment generated by the watershed will be in place. Since the channel forming flows are associated with snowmelt flows generated high above the area of urban development, it is doubtful that channel forming flows have been affected from pre-Comstock era.

Restoring natural geometry and planform will drive the natural processes of meandering, point bar formation and floodplain terrace destruction. Restoration of these processes will greatly benefit wildlife, aquatic habitat, and creation and sustenance of native riparian vegetation and wetlands. This would essentially restore the original natural ecosystem of the UTR in Reaches 1, 2, 3 and 4.

Water quality would greatly benefit due to the reduction of fine sediment supply from unstable, chronically eroding banks and replacement with deeply rooted riparian plants. The project would remove pollutant sources near the channel and provide a large buffer from urban runoff. The restoration of the original profile to a point that has overbank flow above 350 cfs will allow for the natural filtering of flow and deposition of fine sediments. Increases in riparian vegetation will enhance nutrient uptake in overbank flow areas.

The hydrology of UTR in Reaches 1 through 4 will be greatly enhanced under Alternative 4. The restored profile will allow for more overbank flow and percolation into shallow groundwater, this may increase base flows within the Study Area and downstream of the project site in the late

summer and early fall months thereby enhancing aquatic habitat. The streambed would be a least three feet higher than existing bed. This will allow for shallower groundwater storage and availability for gaining surface flow in late summer and fall months.

Short-term construction impacts would include soil disturbance away from the river in the riparian zone associated with excavating new channel segments in Phase 1. These segments would be irrigated to allow for vegetation establishment prior to Phase 2 when the segments would be linked and flow moved from the original channel into the restored channel. These methods and activities have been tested successfully on the smaller scale Trout Creek Restoration Project and are deemed appropriate for UTR in Reaches 1, 2, 3 and 4.

*Vegetation and Wetlands*

Native riparian and wetland plant communities would be greatly enhanced with Alternative 4. The project would create 267 acres of restored floodplain suitable for wetlands and native riparian vegetation communities. By virtue of increased overbank flow and shallower groundwater, native riparian plants will colonize and be sustained naturally. Shoreline areas will be enhanced to support native riparian plants, increasing channel stability and enhancing aquatic habitat. Implementing Alternative 4 would reverse the drying trend presently occurring in terrace areas and would expand, widen and diversify the riparian and wetland habitat.

Short-term construction impacts could occur with Alternative 4. In contrast to Alternative 3, most, if not all, of the existing decadent willows on terraces could be avoided and preserved. Some may occur in or near the proposed channel alignment; these could be avoided through alignment modifications or willow plants could be salvaged and re-planted. A significant reduction in lodgepole pine forests within the river corridor would occur with the project; some stands would be removed and some would suffer mortality due to an increase in the water table. This is deemed to be a benefit for vegetation and wildlife as the replacement stands will be more diverse riparian communities.

*Terrestrial Wildlife*

Terrestrial wildlife habitat would greatly benefit from implementation of Alternative 4. This would result from the diversification and expansion of native riparian and wetland plant communities. Increasing wetlands will enable primary productivity to increase benefiting higher mammals and avian species. The restored wetland and riparian areas will replace drying terrace plant communities that are less diverse and less productive.

As mentioned above, it is possible to retain much if not all of the existing decadent willow scrub stands for willow fly catcher habitat on the terrace areas. These stands can be avoided or salvaged and moved. The restored channel should present many opportunities for natural regeneration of willow stands. Removal of dense lodgepole pine stands is deemed to be a benefit to wildlife habitat, as it will be replaced with diverse riparian and wetland habitats.

Short-term impacts associated with construction disturbance are expected to be offset by LOPs and by avoiding sensitive areas. It is generally believed that the long-term benefits outweigh short-term impacts of construction.

*Aquatic Wildlife and Habitat*
Aquatic habitat should benefit from implementation of Alternative 4 as a more natural pool-riffle meandering planform morphology will diversify habitat. Establishment of deeply rooted riparian plants on shoreline and banks will allow for diversification of aquatic habitat and creation of deeply rooted undercut banks. Natural geomorphic processes of meandering and pointbar formation will create and sustain high quality riparian shoreline and aquatic habitat.

Short-term impacts associated with Alternative 4 construction are expected to be offset through salvage operations and relocation techniques that were successful on Trout Creek Restoration Project.

*Cultural Resources*
No impacts to cultural resources are anticipated with the project. Sensitive areas near the floodplain fringe / upland boundary can be avoided. Based upon surveys and research conducted for this study, it is not anticipated that any cultural resource sites will be encountered in the historic floodplain areas.

*Infrastructure, Land Use and Regulatory Compliance*
Alternative 4 would significantly impact infrastructure, most notably the sanitary sewer line west of the river. In places, sewer lines would need to be armored or relocated in order to accommodate channel construction. A specific plan would be developed during the design phase.

Another significant impact of Alternative 4 will be to the LTGC. The proposed reconstructed channel alignment is within areas now in the golf course; this and the increase flooding associated with restoring the profile could affect up to 10 holes. No specific plans or costs have been developed for golf course reconstruction. CDPR would have to address land designations and accomplish internal environmental review in order to address this issue.

Construction of Alternative 4 would include significant grading and channel relocation on a large scale. This would present challenges to water quality protection, aquatic habitat and wildlife protection, noise and air quality. It is anticipated that 44,000 cubic yards of excess fill would be generated and this would have to be hauled offsite, thus traffic impacts may be significant although less so than Alternative 3.

### ALTERNATIVE 5 SELECTIVE BIOENGINEERING AND REVEGETATION

*Geomorphology, Water Quality and Hydrology*

Alternative 5 involves installation of low tech bioengineered revegetation projects on stream banks at selected sites. It is anticipated that most of the projects could be installed by handcrews without the need for significant heavy equipment use.

The proposed treatments would be placed on existing eroding banks in reaches with significant profile instability. This means that the installed structures will be subject to instability, erosion and destruction. Although the intent is to not invest as much as other alternatives that are designed to stabilize channel profile and planform, there could be a diminished return due to the high risk of destruction and short time of proper function. The risks to Alternative 5 structures on Reaches 1, 2, 3 and 4 are higher than 5 though 11, due to profile instability. Reaches 5-11 have short alluvial reaches separated by boulder and/or bedrock control reaches. It also appears that the historical incision has reached a limit since no active headcuts were observed. In addition, Reaches 5 through 11 exhibit far greater riparian plant regeneration after the 1997 flood than Reaches 1 through 4; this appears to be the result of having achieved a stable width and suitable new floodplain surfaces.

Notwithstanding the risks, implementing Alternative 5 in Reaches 1 through 4 should generate some measurable benefits albeit potentially short-lived. Much will depend upon the unpredictable flood seasons subsequent to the installation and the rate of plant establishment. Unfortunately, the sites in need of stabilization do not appear well suited for riparian revegetation due to excessively coarse substrate and/or banks elevation high above shallow groundwater in the growing season.

Water quality benefits would be significant if areas could be successfully revegetated. However, as mentioned above substrate, channel grade and groundwater do not appear as favorable. It is possible to incorporate irrigation into the projects, but this would require significant maintenance and would not result in a self-sustaining project. Given the risks to the revegetation sites without modification to channel morphology and soil/groundwater conditions, there does not appear to be grounds for claiming significant water quality benefits.

Since the projects are designed to be installed with handcrews and limited, if any, heavy equipment, no significant construction impacts are foreseen.

Alternative 5 would not change nor benefit or impact hydrologic conditions.

*Vegetation and Wetlands*
The benefits to vegetation will depend upon the success of the installed plantings. Unfortunately, the soil and groundwater conditions in Reaches 1 through 4 are not suitable for successful revegetation. Many of the banks are vertical, eroding, and do not have a stable platform for planting. In other areas, recently deposited substrate is too coarse to retain adequate soil moisture through the growing season; the coarse substrate may also indicate excessive scour, which would also be a limiting factor for successful revegetation. Given the risks of the revegetation projects to stream banks, significant benefits can not be claimed in Reaches 1, 2, 3,and 4.

It is feasible to revegetate areas away from the main river channel, such as converting dense lodgepole forest to more Jeffrey pine and, in some places in upper Reach 4, black cottonwood and alder. These projects do not address the quality of riparian habitat in and near the existing channel.

*Terrestrial Wildlife*
There is little effect in terms of benefits and impacts to terrestrial wildlife with implementation of Alternative 5 in Reaches 1 through 4. For the most part, the present trends under the no action plan would occur with gradual degradation into the future, resulting from the fact that Alternative 5 would not affect the underlying hydrology of geomorphic processes.

*Aquatic Wildlife and Habitat*
The effects of Alternative 5 on aquatic wildlife and habitat are insignificant in terms of benefits and impacts. Given the risks to plantings and the probable lack of success, little benefit can be ascribed. Limiting construction activities to handcrews will minimize potential disturbance to wildlife.

*Cultural Resources*
There are no significant effects to cultural resources resulting from implementation of Alternative 5 in Reaches 1 through 4.

*Infrastructure, Land Use and Regulatory Compliance*
Implementation of Alternative 5 will not result in any significant impact to land use, infrastructure. Regulatory permitting will be challenged by the risks and potential short-term life of the projects. The project will not generate self-sustaining revegetation projects.

### ALTERNATIVE ANALYSIS REACHES 5-11
As discussed above, Reaches 5-11 (Christmas Valley) occur within multiple land ownerships in a terrain of difficult construction access and it appears that channel profile instability has run its course. Since bank erosion is the primary problem to be addressed, the alternatives addressing

large-scale instability (i.e. Alternatives 2, 3 and 4) were eliminated from detailed consideration. Only Alternative 5 bioengineered revegetation was assessed in detail.

Alternative 5 was developed assuming that six types of treatment would be applied to streambanks that received high, very high and extreme erosion hazard ratings as a result of the surveys conducted for this study. The proposed treatments and costs are showing Figures 4.4 through 4.8 and Table 4.5. It is assumed that most of the projects can be installed by handcrews and that only limited, if any, heavy equipment is needed. It is also assumed that specific plans would be generated by a Cooperative Authority (CA), an organization that would conduct public outreach, oversee the design, installation, monitoring and maintenance of projects and coordinate with permitting agencies and public ownership agencies.

*Geomorphology, Water Quality and Hydrology*

Installation of bioengineered revegetation projects will significantly improve stream bank stability over about seven miles of stream banks in Christmas Valley. The projects would utilize native species of willow, alder, sedge and other species that provide habitat and deep roots in bank soils. The loss of root strength and vegetation cover is a primary reason for eroding banks. When installed and established, the erosion ratings of the treated banks would be reduced from high, very high, or extreme erosion hazard to low or moderate.

Water quality should improve significantly with the bioengineered projects in place. All of the eroding banks contribute to the sediment load of the UTR and discharge into Lake Tahoe and potentially degrade the aquatic habitats. The project will result in treatment of over 7 miles of stream bank, nearly 1/3rd of the total stream bank length of the UTR (about 24.5 miles).

The project will not change hydrologic conditions in surface water or groundwater in the UTR.

The impacts of construction should be limited as most, if not all, of the installations would be accomplished by use of handcrews. The projects will not involve significant earthmoving at the project sites or for access roads.

*Vegetation and Wetlands*

The project would significantly increase native riparian and wetland vegetation cover along the UTR in Christmas Valley. It would increase the diversity of riparian plant species present and would replace bare eroding banks with dense vegetation cover. This will benefit bank stability, water quality, and wildlife habitats. The project would help offset historic losses of riparian and wetland habitats related to urbanization and channel incision.

*Terrestrial Wildlife*
Terrestrial wildlife would greatly benefit from the project with an expansion of native riparian vegetation and the diversification of shoreline and riparian corridor structure. Since most of the projects involve use of willows for bank stabilization, the habitat for willow flycatcher could increase significantly. Also, the projects could convert areas of urban land encroachment with native riparian vegetation and thus create potential wildlife habitat.

There should not be any significant impacts resulting from construction of the projects, since little, if any, existing habitat would be disturbed. In addition, the projects would be carried out by handcrews, thereby avoiding impacts associated with noise and disturbance by heavy equipment.

*Aquatic Wildlife and Habitat*
Aquatic wildlife and habitat would benefit significantly from the proposed project, as nearly all involves revegetation of shorelines that are presently degraded and barren of vegetation. The projects will increase shoreline cover and diversity and structural complexity. An increase in rooted banks will allow for development of undercut banks along the shoreline in alluvial reaches.

No significant construction impacts are anticipated since installation would be carried out by handcrews and will not involve heavy equipment or any flow diversion or dewatering operations.

*Cultural Resources*
Cultural resources should not be significantly affected since the proposed projects do not involve earth grading or any work with heavy equipment.

*Infrastructure, Land Use and Regulatory Compliance*
The proposed projects will not affect infrastructure since no earth grading, drilling or other activities that could affect utilities, roads or bridges is anticipated.

The projects will not affect land use. All projects on private lands would necessitate an agreement for access to install and maintain the projects and thus the cooperation and permission of the landowners.

The projects will require permits for TRPA, Lahontan, US Army Corps of Engineers and CDFG. The nature of the projects being revegetation by handcrews lends itself to development of a programmatic permit allowing for a one-time permitting process to the proposed Cooperative Authority.

# V. Recommended List of Priority Projects

## V.1 UTR River Corridor

The preceding analysis and discussion of alternatives reveals significant potential impacts to land uses associated with the projects that might have the greatest ecosystem and environmental benefits for the Upper Truckee River Upper Reach. For the Christmas Valley areas (Reaches 5 through 11), the mixed private public ownerships, potential flood impacts and difficult physical access outweighed the potential benefits of implementing large scale restoration projects. However, since it appears that historic incision has stabilized, small scale low tech streambank and floodplain revegetation projects are suitable.

In Reaches 1 through 4, the systematic geomorphic instability induced by historic channelization continues and these reaches do not lend themselves to piecemeal restoration or stabilization projects – the connection of each reach to the next is important in order to minimize project risks. However, implementing the most environmentally beneficial alternatives (Alternatives 3 and 4) requires conversion of land presently in golf course use to floodplain. New aqency and public consultations and decisions by the various agencies involved are needed to move any proposal forward. Moreover, funding sources will have to be identified. All of these issues and planning activities are beyond the scope and time allotted for the present study.

Notwithstanding the inability to provide firm project recommendations for Reaches 1 through 4, there are some projects that can be recommended and move forward while a new interagency planning process addresses the key land use conversion and funding issues.

## V.2 Priority Project List

1. Develop a recommended project for Reaches 1 through 4 given the analysis presented in Chapter 4.

2. Implement the recommended bioengineered revegetation projects in Christmas Valley (Reaches 5-11) by: 1) establishing a project funding account to implement projects, 2) establishing a cooperative project authority (CA) entity within the TRCD to develop cooperative agreements with landowners to gain access and implement revegetation projects on private lands, and 3) organizing and implementing the construction of projects and post-project monitoring and maintenance. The CA would coordinate with the USFS LTBMU in order to extend projects in and across USFS ownerships and link project reaches. The CA would have the lead role planning projects and developing site-specific designs using the bank erosion ratings contained within as an initial guide. The CA would acquire permitting for the projects, which ideally would be issued on a programmatic basis to cover activities related to installing and maintaining the projects.

3. The El Dorado Department and Transportation and California Department of Transportation should utilize the subwatershed erosion assessment completed for this study as a guideline for planning future BMP retrofit projects on State Highways and County Roads. The BMP projects should coordinate with the TRCD in order to integrate tributary enhancement projects with road BMPs wherever possible; this will allow for sharing of permitting and allow for coordination of designs above and below road crossings.

4. The waterway and drainage system for the unnamed tributary in the northeastern Study Area in Meyers should be the focus of rehabilitation and restoration. There are four individual projects identified along this creek that could be accomplished by one or more agencies (see Figure 5.1 and Table 5.1).

Table 5.1: Restoration projects identified for the unnamed tributary in Meyers.

| Project Reach | Land Owner | Recommended Projects | Estimated Cost |
|---|---|---|---|
| Reach 1: Lake Tahoe Paradise GC / Shopping Center to Highway 50 | Private (GC and Lira's shopping center) and Caltrans (along Highway 50) | Reconfigure drainage entering the inlet basin behind 18th green into a constructed buffered water way and wetland; repair riser to outlet culvert and erosion around edge. | $200,000 |
| Reach 2: Highway 50 ditches | Caltrans | Convert road ditches to curb and gutter in order to separate road runoff from streamflow; install separate WQ treatment system | $150,000 |
| Reach 3: Highway 50/ Santa Fe Road to San Diego Street | CTC;USFS-LTBMU; Caltrans (Hwy 50 easement) | Restore creek to meadow from ditch; construct treatment wetland at mouth of Highway 50 culvert. | $300,000 |
| Reach 4: San Diego Street to Country Club Drive | Numerous Private Parcels with some CTC and LTBMU | Stabilize profile and streambanks through site-specific projects; TRCD could lead a Cooperative Authority to implement | $500,000 |
| Reach 5: Country Club Drive to confluence with UTR in LTGC | CDPR | Restore natural morphology and floodplain; setback fairway turf grass and revegetated | $250,000 |

## V.3 Recommended Beaver Management Plan

The TRCD should lead an effort to coordinate the management of beaver populations in the UTR Upper Reach Project Corridor. The present program involves some individual private landowners acquiring permits from CDFG to remove and destroy beavers on their land. The USFS does not actively remove beaver. CDPR recently had a policy to remove and destroy beaver from LTGC

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**FIGURE 5.1:** Reachbreak designations for the unnamed tributary in Meyers. Scale is approximate.

and WMSP reach (Reaches 1 through 4), however it appears that that policy has lapsed with subsequent personnel changes.

The TRCD has taken initiative to help residents protect trees and to investigate use of drainage devices to control flooding of beaver dam impoundments. TRCD helped USFS Bridge Tract residents protect aspen trees by applying wire or a sand/glue paste to the tree trunks.

The conclusion of this report is that beaver can have beneficial effects on wetlands and in development of habitat for certain key species, such as willow fly catcher, however the range where beaver can exist is limited when private landownership is in conflict. Although the beaver activity appears to be stable or declining in some areas of the river, the lack of natural predators in the urban setting of the UTR Upper Reach retains the possibility of future change. In the future, the revegetation projects recommended herein may require protection to prevent destruction from beaver prior to establishment.

The TRCD should continue its role as a liaison between landowners and agencies in monitoring and managing beaver activity. The TRCD should participate in development of a Lake Tahoe beaver management plan (as identified in the TRPA EIP projects).

## V.4 Recommended Actions in the Upper Watershed

The Upper Watershed forests on the UTR exhibit characteristics of past fire suppression efforts as dense stands of white fir and lodgepole have invaded stands of old growth Jeffrey pine and red fir. The dense young stands would have normally burned due to periodic fires that have been suppressed over the past 80+ years. The problem of dense stands is more severe in areas adjacent to the UTR in WMSP where historic clear cut logging occurred. The presence of dense understory can lead to excessively hot fires which can kill both young and old growth trees. This was demonstrated in the 2002 Showers fire in the Upper Watershed. In many cases old growth trees survived the burning of understory stands of white firs, while in other cases stands of old growth were killed near dense white fir stands and where fire intensity was high.

It appears that many of the forest stands would benefit from selective mechanical removal of dense understory conifer stands. These operations would leave large old growth trees, but clear dense conifer stands in favor of more diverse understory shrubs. These projects would benefit plant diversity and wildlife habitat and would help preserve old growth trees.

List of Reviewers, Draft Report - Upper Truckee River Upper Reach Environmental Assessment, December 15, 2003.

| Reviewer | Agency |
|---|---|
| Cyndi Walck | California Department of Parks and Recreation |
| Jerry Dion | Tahoe Regional Planning Agency |
| Brian Wilkinson | California Tahoe Conservancy |
| Myrnie Mayville | Bureau of Reclamation |
| Jim Howard | United States Forest Service |
| Jane Schmidt | Natural Resources Conservation Service |
| Chuck Taylor | Natural Resources Conservation Service |
| Mary Fiore-Wagner | State Regional Water Quality Control Board – Lahontan Region |
| Jim Hoggatt | South Tahoe Public Utility District |
| Tim Oliver | Tahoe Resource Conservation District |
| Kim Melody | Tahoe Resource Conservation District |