TRUCKEE MEADOWS FLOOD CONTROL PROJECT, NEVADA

FINAL GENERAL REEVALUATION REPORT

December 2013

US Army Corps
of Engineers ®
Sacramento District

Truckee Meadows Flood Control Project, Nevada

Final General Reevaluation Report

December 2013

Prepared by
U.S. Army Corps of Engineers
Sacramento District

(This page is intentionally blank)

EXECUTIVE SUMMARY

This General Reevaluation Report (GRR) addresses potential modifications to the Congressionally-authorized Truckee Meadows Flood Control Project in the cities of Reno and Sparks in Washoe County, Nevada. The study area for this report extends along the Truckee River from upstream of the City of Reno to Pyramid Lake. This report: (1) assesses the risks of flooding; (2) analyzes ecosystem problems within the study area; (3) evaluates a range of alternatives to reduce flood risks in the cities of Reno and Sparks; (4) evaluates opportunities for fish passage improvements; and (5) identifies the Recommended Plan. The Recommended Plan includes flood risk management and associated recreation measures along the Truckee River within the Truckee Meadows area.

This final GRR will be submitted to United States Army Corps of Engineers (USACE) Headquarters. A Chief's Report based on the GRR will be developed and provided to the Assistant Secretary of the Army for Civil Works (ASA(CW)) and the Office of Management and Budget for review and approval. It will then be transmitted to Congress for potential project authorization and funding of the Federal share of the Recommended Plan.

BACKGROUND

The Truckee Meadows Flood Control Project[1] was authorized by the Water Resources Development Act of 1988, Pub. L. No. 100-676, § 3(a)(10), 102 Stat. 4012 (1988), (WRDA 1988, §3(a)(10)), which reads:

> The project for flood control, Truckee Meadows, Nevada: Report of the Chief of Engineers, dated July 25, 1986, at a total cost of $78,400,000, with an estimated first Federal cost of $39,200,000 and an estimated first non-Federal cost of $39,200,000; except that the Secretary is authorized to carry out fish and wildlife enhancement as a purpose of such project, including fish and wildlife enhancement measures described in the District Engineer's Report, dated July 1985, at an additional total cost of $4,140,000.

Construction of the authorized project was deferred during the Pre-construction Engineering and Design (PED) phase, in or around 1992, when changes in real estate costs made the project economically infeasible. The Fallon Paiute Shoshone Indian Tribes Water Rights Settlement Act, Pub. L. 101-618, § 207, 104 Stat. 3289 (1990) (Tribes Water Rights Settlement Act, § 207), provided direction regarding the conduct of a general reevaluation as follows:

[1] A previous USACE project was authorized and constructed pursuant to the Flood Control Act of 1954, Pub. L. 83-780, § 203, 68 Stat. 1256, 1264 (1954) (FCA 1954, § 203) and the Flood Control Act of 1962, Pub. L. 87-874, § 203, 76 Stat. 1180, 1191 (1962) (FCA 1962, § 203).

> The Secretary of the Army, in consultation with and with the assistance of the Pyramid Lake Tribe, State of Nevada, Environmental Protection Agency, the Secretary [of Interior], and other interested parties, is authorized and directed to incorporate into its ongoing reconnaissance level study of the Truckee River, a study of the rehabilitation of the lower Truckee River to and including the river terminus delta at Pyramid Lake, for the benefit of the Pyramid Lake fishery. Such study shall analyze, among other relevant factors, the feasibility of:
>
> - Restoring riparian habitat and vegetative cover
> - Stabilizing the course of the Truckee River to minimize erosion
> - Improving spawning and migratory habitat for the cui-ui
> - Improving spawning and migratory habitat for the Lahontan cutthroat trout
> - Improving or replacing existing facilities, or creating new facilities, to enable the efficient passage of cui-ui and Lahontan cutthroat trout through or around the delta at the mouth of the Truckee River, and to upstream reaches above Derby Dam, to obtain access to upstream spawning habitat.

In 1996, local communities requested that flooding problems in Truckee Meadows be reevaluated. The Secretary of the Army also received guidance regarding USACE's conduct of the GRR pursuant to the House Report, H.R. Rep. No. 104-293, at 14 (1995), associated with the Energy and Water Development Appropriations Act of 1996, Pub. L. 104-46, 109 Stat. 402 (1996) (EWDAA 1996). A major flood event in January 1997 exceeded all previous records and caused $450 million (unadjusted) in reported damages.

During the current general reevaluation, the Energy and Water Development Appropriations Act of 2006, Pub. L. 109-103, § 113, 119 Stat. 2247, 2254 (2005) (EWDAA 2006, § 113) was passed. Section 113 of EWDAA 2006 states:

> Truckee Meadows Flood Control Project, Nevada: The non-Federal funds expended for purchase of lands, easements and rights-of-way, implementation of project monitoring and assessment, and construction and implementation of recreation, ecosystem restoration, and water quality improvement features, including the provision of 6,700 acre-feet of water rights no later than the effective date of the Truckee River Operating Agreement for revegetation, reestablishment and maintenance of riverine and riparian habitat of the lower Truckee River and Pyramid Lake, whether expended prior to or after the signing of the Project Cooperation Agreement (PCA), shall be fully credited to the non-Federal sponsor's share of costs for the project: Provided, that for the purposes of benefit-cost ratio calculations in the General Reevaluation Report (GRR), the Truckee Meadows Nevada Flood Control Project shall be defined as a single unit and non-separable.

USACE initially sought to identify a comprehensive solution for flood, ecosystem, and recreation problems, including detailed evaluation of a locally-developed plan resulting from a community coalition process. Despite several attempts, those efforts did not result in a plan that USACE could recommend. The primary purpose of the reevaluation study is to assess the feasibility of modifying the Congressionally-authorized project to reduce flood damages in the Truckee Meadows project area while avoiding or minimizing adverse effects.

AUTHORIZED PLAN

The flood control features authorized in WRDA 1988, § 3(a)(10),begin near Booth Street in downtown Reno, extend downstream along the Truckee River to the Truckee Meadows Wastewater Reclamation Facility (TMWRF), and continue up Steamboat Creek for approximately two miles. Features include floodwalls, setback levees, reconstruction/ replacement of six bridges in downtown Reno, channel excavation, reconstruction of the TMWRF diversion dam, backwater levees on the North Truckee Drain, a large detention basin at Nevada Agricultural Experiment Station (also known as UNR Farms), and levees along Steamboat Creek and Boynton Slough with an additional bridge modification. These project features were designed to provide "100-year flood protection" based on then-current (1988) hydrology and design standards. Authorized recreation features include a new pedestrian/bike bridge, bike lanes on bridges, pedestrian/bike paths, and new access sites and improvements in downtown Reno. The authorized project includes riparian habitat plantings as compensatory fish and wildlife mitigation. Fish and wildlife "enhancement" features, consisting of riparian plantings, marsh habitat preservation, and fish habitat improvements, were also specifically authorized.

CONSIDERATION OF ALTERNATIVE PLANS

During the general reevaluation, the Federal water resources planning process established by the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (1983) was used to identify a recommended plan. Following definition of problems and opportunities related to flooding, ecosystems, and recreation (Chapter 3), specific planning objectives and constraints were identified (Chapter 4). Next, various structural and non-structural management measures were identified to achieve the planning objectives and avoid the planning constraints. Management measures were screened based on how well they met the study objectives and formulation criteria, and some measures were dropped from further consideration at that point. The retained management measures were combined to form preliminary alternative plans.

Flood Risk Management

The study area includes approximately 60 miles of the Truckee River. Because of the size of the land area and number of river miles the study area was divided into general reaches for analysis.

For Downtown Reno reach (Figure 2-2), which includes the Truckee River area from about Booth Street to U.S Highway 395, seven preliminary flood risk management alternatives, including a non-structural alternative, were evaluated. The structural alternatives focused on the modification of multiple bridges, along with increases in channel capacity, levees, and floodwalls. None of the preliminary alternatives were found to be economically justified, so no plan was carried forward for detailed evaluation.

For the Truckee Meadows reach (Figure 2-6), which includes the Truckee River area from U.S. Highway 395 to the Vista, three preliminary alternatives representing different strategies were initially evaluated. All three alternatives included levees and floodwalls along portions of the Truckee River between Highway 395 and Vista. Alternative 1 was limited to levees and floodwalls as the primary features. Alternative 2 also included detention facilities at Huffaker Hills, UNR Farms, and Mustang Ranch. Alternative 3 included floodplain terracing in addition to levees and floodwalls. In response to stakeholder input, eight additional preliminary alternatives focused on increasing storage opportunities at Huffaker Hills, UNR Farms, and Upper Lockwood were also evaluated. The preliminary alternatives were developed to a level of detail to allow a basic comparison of costs and benefits. None of the eight additional storage alternatives were found to be economically justified. Of the three initial alternatives, Alternative 3 was ranked the highest, but had not yet been demonstrated to be the National Economic Development (NED) plan for flood risk management. Alternative 3 was the focus of a reformulation workshop with the non-Federal sponsor, Truckee River Flood Management Authority (TRFMA), and USACE vertical team members held in November 2011 to identify a Federally-supportable flood risk management plan. The reformulation workshop assessed the incremental costs and benefits of the various elements of Alternative 3 to ensure that each added element was incrementally justified. The workshop resulted in more focused evaluation of the 2% Annual Chance Exceedance (ACE) scale of Alternative 3 with high assurance (2% event is also commonly called the 1:50, 1/50, or "50-year" event). Previous analysis had identified maximum net benefits at this relative scale. Terracing downstream of Steamboat Creek was eliminated from Alternative 3, and capping of People's Drain outlets was added, as a result of the workshop.

Federal policy requires USACE to recommend the plan that reasonably maximizes net economic benefits consistent with protecting the Nation's environment (the National Economic Development or NED Plan), unless an exception is granted by the ASA(CW). The 2% ACE scale of the reformulated Alternative 3 was identified as the plan that reasonably maximized net economic benefits consistent with protecting the environment.

Recreation

Three alternative recreation plans composed of policy-compliant basic recreation features were formulated based on the opportunities provided by the flood risk management NED Plan. All three recreation plans included picnic areas, fishing access, non-motorized watercraft launches, and trails. The two larger-scale plans also included a playground and group picnic shelters. The largest-scale plan (Recreation Alternative C) is economically justified and would provide the maximum net recreation benefits and was therefore included in the NED Plan.

Ecosystem Restoration

The Truckee Meadows project was authorized by Congress in WRDA 1988, §3(a)(10), for flood control and fish and wildlife enhancement purposes. Since the 1990's, there has been a strong local interest in reestablishing a "living river" corridor to convey flood flows, reestablish native habitat and restore fish passage along the Truckee River. Fish and wildlife enhancement was considered during USACE's general reevaluation of the project. In 2012, USACE and the Administration, in coordination with the sponsor, decided to give priority to flood risk reduction to expedite completion of the study. As a result, habitat restoration was deferred. Measures to avoid or minimize adverse effects on existing habitats and sensitive species, including revegetation, landscaping, and erosion protection on project lands, have been included in the Recommended Plan. The District Engineer's recommendation in Chapter 9 includes retaining the existing authorized fish and wildlife enhancement (i.e., ecosystem restoration) purpose of the Truckee Meadows Flood Control Project for potential future implementation.

Restoration of fish passage on the Truckee River was evaluated in detail pursuant to the 1990 Tribes Water Rights Settlement Act, § 207. USACE's Engineer Research and Development Center (ERDC) developed measures to address upstream and downstream fish passage problems at 18 barriers between Pyramid Lake and Fleisch diversion dam in California. The measures considered included diversion structure removal or modification, installing or modifying fish ladders, installing a bypass channel, replacing a diversion structure with a pump diversion, and installing fish screens. A total of 54 system-wide plans providing a wide range of output were evaluated using a fishery quality/quantity scoring system and Cost Effectiveness and Incremental Cost Analyses. Three best buy plans were identified, including the most cost effective plan, which would restore fish access to approximately 90 miles of the Truckee River at a preliminary estimated cost of $47 million. In 2012, USACE and the Administration, in coordination with the sponsor, decided to refocus plan selection on the primary project purpose of flood risk management to expedite completion of the study consistent with Administration and sponsor priorities. Federal interest in a plan for the restoration of fish passage has been established, but that plan is not being recommended for implementation by USACE at this time.

National Economic Development Plan (Floodplain Terrace Plan)

The National Economic Development (NED) plan is the Floodplain Terrace Plan (also identified as Alternative 3 in this GRR). The Floodplain Terrace Plan efficiently reduces flood damages in high-value commercial and industrial areas near the Truckee River, including the Reno-Tahoe International Airport, by containing flood flows with levees and floodwalls, enlarging the existing channel with floodplain terracing, and by detaining peak flows in a designated overflow area. The designated overflow area is on the south side of the river near the mouth of Steamboat Creek and is largely occupied by the Nevada Agricultural Experiment Station (also known as UNR Farms). The NED Plan provides 90% assurance of safely passing the 2% ACE in major damage areas and includes basic recreation features that are compliant with USACE policy.

Increased Depth of Flooding from NED Plan in Two Areas

Feasibility-level hydraulic modeling of the NED Plan found that the 1% ACE flood elevations (also commonly referred to as 1/100, 1:100, or 100-year flood) increase between 0.0 and 0.6 foot in several areas near the downstream end of the project compared to the without-project condition. (There is some level of uncertainty in any hydraulic model. In this case, the actual without- and with-project water surface elevations could be 0.5 foot lower or higher than estimated.)

- UNR Farms and southern periphery: The flood elevation increase in the UNR Farms area is up to 0.6 foot. The USACE estimated with-project 1% ACE flood elevations would exceed the first floor elevations of an estimated 900 existing structures (mostly single-family residences and multiplex apartment buildings) on the southern periphery of the UNR Farms area that are also within the USACE without-project 1% ACE floodplain. An estimated additional 175 residences that are outside of the USACE without-project 1% ACE floodplain would be within the limits of the with-project floodplain, but it is estimated that their first floors would still be above the with-project flood elevation. However, the estimated increase in the 2% ACE flood elevations would affect about 22 existing structures south of UNR Farms, most of which would have an estimated increase of 0.2 to 0.4 foot.

- North Truckee Drain (NTD): The 1% ACE flood elevation on both sides of the North Truckee Drain (NTD) immediately north of I-80 would be increased by approximately 0.5 to 1 foot due to backwater effects in the NTD.

Figure 5-4 shows the areas in the estimated without- and with-project 1% ACE floodplains.

USACE policy allows mitigation for induced flooding to be recommended as a project feature when it is economically justified or there are overriding reasons of safety, economic, or social concerns, or a determination of a real estate taking has been made (ER 1105-2-100, para.3-3.b.(5)). Potential mitigation measures for induced flooding were considered by the District, but none were found to be economically justified. The structural and non-structural measures considered for the south side of the Truckee River were: raising or wet flood-proofing existing residential and commercial structures; levees and floodwalls to protect existing structures; a detention basin with perimeter levees in the UNR Farms area; excavation of the hydraulic constriction downstream of Truckee Meadows including downstream hydraulic and environmental mitigation; or purchase/removal of the affected structures. The structural and non-structural measures considered for the north side of the Truckee River were: a pump station; ring levees; or raising/wet flood-proofing existing residential and commercial structures. Raising/flood-proofing structures on the south side and a pump station on the north side were found to be the least costly options that could be added to the NED Plan, based on rough cost estimates for each measure by District civil design and cost engineering staff using their professional experience. The average annual flood risk management benefits for those measures were found to be far less than required to justify their costs. Any increase in flooding will be an important concern for adversely affected property owners. However, because of the small

increase in flood elevations and the low recurrence frequency of induced flooding, those concerns are not considered to be overriding safety, economic, or social concerns under USACE policy, and no real estate taking would occur specifically due to the increase in water surface elevation in the vicinity of the North Truckee Drain or University of Nevada Reno Farms. Therefore, mitigation for induced flooding is not proposed as a project feature of the Federally-funded NED Plan.

The costs for the NED Plan include the estimated minimum cost for non-Federal interests to comply with the NFIP. The NFIP compliance costs are not based on specific features proposed by the sponsor. The estimated NFIP compliance costs are based on the least-cost features that could be added to the NED Plan by local interests, without modifying the NED Plan, to achieve NFIP compliance.

USACE has considered several options for NFIP compliance and determined that non-structural methods including house raising would likely be the least-cost option on the south side of the Truckee River. Based on feasibility-level hydraulic modeling, approximately 764 homes and 128 multiplex apartment buildings would need to be raised in the area south of the river. An additional four commercial structures and three public buildings would also need to be raised or "wet flood-proofed" with closures and sealing. The preliminary cost estimate to raise and flood-proof structures for NFIP compliance on the south side of the Truckee River is $172 million. For the north side of the Truckee River, a 400-cfs capacity pump station on the North Truckee Drain with an outfall to the Truckee River would be the least-cost option. The estimated first cost for the pump station is $23 million including contingencies. Because compliance with the NFIP is a non-Federal responsibility, the affected NFIP communities could develop their own plan for compliance with the NFIP and would not be required to implement the specific assumed least-cost features. The estimated NFIP compliance costs are subject to change based on more detailed hydraulic analysis during final design of the project, including the results of NFIP hydraulic modeling assumptions and methods, and more detailed surveys of the elevations of existing structures.

Federal cost sharing will be based on the NED Plan and all additional costs for NFIP compliance will be non-Federal costs.

RECOMMENDED PLAN

The Recommended Plan is the NED plan for flood risk management (Alternative 3 – Floodplain Terrace Plan) and recreation (Alternative C). The principal features of the Recommended Plan are (1) construction of floodwalls, levees, and floodplain terracing in the Truckee Meadows reach, and (2) basic recreation features in the Truckee Meadows. Features are summarized below and shown in Figures 6.2 and 6.3.

- Levees: 31,000 lineal feet (lf) on north/south banks of Truckee River.
- Floodwalls (on-bank): 6,500 lf on north and south banks of Truckee River.
- Floodwalls (in-channel): 3,150 lf on north and south banks of Truckee River.

- Floodplain terrace: 150-200 ft to the landside of the south bank of the Truckee River. A higher bench would be extended approximately 50-70 feet to the landside of the low bench.
- Box culverts: 2 box culverts on North Truckee Drain (NTD for approximately 3,100 lf. Includes a 200 lf extension to the existing People's Drain. Cap 2 junction structures of People's Drain.
- Interior drainage: 14 cfs pumping station and new flap gates and vertical sluice gates.
- Seepage prevention: Berms, drainage blankets, and relief wells.
- Bridge pier and scour protection: 11,600 lf rock scour protection. Pier protection at 3 bridges between US Hwy 395 and Vista.
- Picnic areas: 50 individual picnic areas, 1 small and 1 medium group picnic shelter, with parking, playground and restrooms.
- Water recreation access: 4 kayak/canoe input areas and 13 fishing areas.
- Trails: 18,800 lf of paved and unpaved trails.

The Recommended Plan will require new congressional authorization because the Section 902 cost limit would be exceeded. Additional information about the Recommended Plan can be found in Chapter 6.

ENVIRONMENTAL EFFECTS

An evaluation of environmental effects determined that the proposed action has the potential for adverse effects on a number of environmental resources.

Construction of the flood risk management features for the Recommended Plan would detrimentally affect fish and wildlife habitat. The Recommended Plan would cause temporary and permanent losses of riparian habitat from construction activities required for excavations, floodwalls, and levees, affecting 28.3 acres of native riparian habitat.

Removal of riparian habitat that shades the river would also potentially increase water temperatures, which would be detrimental to fish spawning activities and egg and young survival. The Recommended Plan would remove about 7,200 linear feet of riparian river shading. However, the plan would avoid long-term effects to water temperature through revegetation of floodplain terraces and implementation of bioengineering techniques in scour protection features. Formal consultation with the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act is complete and USACE received a Biological Opinion (BO) on December 5th, 2013. In addition, a Coordination Act Report from the Service was finalized on December 12th, 2013. Coordination with USFWS to implement the terms and conditions of the BO and recommendations from the Coordination Act Report will continue through PED and Construction.

The Recommended Plan would remove approximately 1.1 acres of existing wetland habitat primarily associated with Pioneer Ditch and the North Truckee Drain. However, the

Recommended Plan would reestablish connection of the river to its historic floodplain through excavation and revegetation of floodplain terraces that are exposed to seasonal inundation.

In-channel construction activities would represent a temporary disturbance to fisheries habitat. Construction of in-channel floodwalls and scour protection features for the Recommended Plan would involve temporary disturbance of 3.7 acres of river bottom and the permanent loss of approximately 2.5 acres of open water habitat along the river margin and the North Truckee Drain. However, following completion of construction activities, river bottom habitat conditions are expected to be similar to existing conditions. Bottom dwelling organisms should repopulate to pre-project levels within 6 months.

In-channel construction would also temporarily increase turbidity levels causing spawning gravel spaces to fill in, which contributes to low dissolved oxygen levels, and can cause gill damage. Increases in turbidity levels during construction would be avoided or minimized by use of cofferdams to divert flows around the construction area, timing construction during low flows, installing silt screens, and monitoring turbidity levels to avoid exceeding significance thresholds.

Increased turbidity levels and water temperatures also represent a potential effect to the threatened Lahontan cutthroat trout and endangered cui-ui. While the Lahontan cutthroat trout, extirpated from the Truckee River in the 20th century, was recently reintroduced to the river, existing water temperature conditions prohibit the presence of a self-sustaining population of the species in and downstream of the project area. Cui-ui populations are present only downstream of the project area, below Derby Dam. While changes in water temperature and turbidity could represent an indirect adverse effect to cui-ui, measures to control turbidity levels during construction and reestablishment of riparian vegetation on floodplain terraces and scour protection features would avoid or minimize adverse long-term effects to this species. The limited increase in downstream flows induced by the Recommended Plan are not expected to generate a measurable change in sediment aggradation or degradation within the Lower Truckee river.

The Recommended Plan would convert about 30 acres of prime and unique farmland and 19 acres of farmland with statewide and local importance for levee construction. While the overall acreage of land available for agriculture would be reduced in portions of the Truckee Meadows reach, the conversion of land for flood risk management would reduce the danger of catastrophic floods and benefit the remaining agricultural land by improving groundwater recharge and nutrient exchange through construction of the floodplain terraces.

In all cases the potential adverse environmental effects would be reduced to a less than significant level through project design, construction practices, preconstruction surveys and analysis, regulatory requirements, and best management practices. No compensatory mitigation would be required. A National Pollutant Discharge Elimination System (NPDES) general construction permit would be required. A Storm Water Pollution Prevention Plan (SWPPP) and Spill Prevention Control and Countermeasures Plan (SPCCP) would be developed by the contractor prior to construction.

ECONOMIC EVALUATION

Investment costs, annual costs, and annual benefits are displayed in Table S-1 below, both with- and without the associated economic costs and benefits for NFIP compliance.

Table S-1. Comparison of Total Annual Benefits and Costs for the NED Plan (with and without associated economic costs and benefits for NFIP compliance) [1,2]

Item	NED Plan without NFIP ($1,000)	NED Plan with NFIP ($1,000)	Difference ($1,000)
Investment Costs			
Flood Risk Management First Costs[2]	$224,778	$224,778	$0
Associated Cost NFIP Compliance[3]	0	195,000	$195,000
Recreation First Costs	10,113	10,113	$0
Interest During Construction	22,205	25,828	$3,623
Total	257,096	455,719	$198,623
Annual Cost			
Interest and Amortization	$10,961	$19,428	
OMRR&R[4]	862	862	
Total	11,823	20,290	$ 8,467
Annual Benefits	25,505	26,524	$1,019
Net Annual Benefits	13,682	6,234	($7,448)
Benefit to Cost Ratio	2.2	1.3	

[1] October 2013 price levels, 3.5 percent rate of interest, and a 50-year period of analysis.
[2] Excludes PED sunk costs ($42,200,000), cultural resources data recovery costs ($1,817,000), and Section 113 financial costs ($1,912,000).
[3] Minimum additional cost for non-Federal compliance with National Flood Insurance Program regulations.
[4] Operation, Maintenance, Repair, Replacement, and Rehabilitation.

COST-SHARING REQUIREMENTS

A summary of cost sharing responsibilities is presented in Table S-2. The estimated total first cost for the Recommended Plan is $280,820,000. Federal costs for the Recommended Plan would be limited to the Federal share of the NED plan, which is estimated to be $181,652,000. The estimated costs in Table S-2 include additional financial costs for LER due to Section 113 of the Energy and Water Development Appropriations Act of 2006 (see Section 1.3), as is explained in Sections 6.2 and 6.5.

Table S-2. Summary of Cost Sharing Responsibilities for Recommended Plan[1]

Item	Federal ($1,000)	Non-Federal ($1,000)	Total ($1,000)
Flood Risk Management			
Construction[2,5]	$187,912	$2,406	$190,318
LERRD[3]	1,496	77,076	78,572
Minimum Cash Contribution (5%)	-13,445	13,445	
Additional Cash Contribution	-1,185	1,185	
Sub-total Flood Risk Management	174,779	94,112	268,890
Recreation			
Construction[2]	9,923		9,923
LERRD[3,4]	32	158	190
Cash Contribution	-4,899	4,899	
Sub-total Recreation	5,057	5,057	10,113
Cultural Resources Data Recovery	1,817		1,817
Total	**$181,652**	**$99,168**	**$280,820**

[1] October 2013 price levels; Includes estimated Section 104 credit for RSIC levee.
[2] Construction costs include PED and Construction Management costs.
[3] Federal costs on this line are administrative costs. Non-Federal costs include Section 113 credit for expenditures to date.
[4] Recreation LERRD limited to upgrade of FRM easements to fee title.
[5] Non-Federal Construction includes estimated creditable cost for completed Sec 104 work ($2,406,000).

UNCERTAINTY

Each aspect of flood risk assessment must account for uncertainty. This includes hydrologic and hydraulic analysis, geotechnical analysis, economics, and the impacts of future local projects in the study area. USACE risk assessment procedures were followed in this study that account for uncertainty in the information to the extent practicable. However, the public should recognize that in all studies, even with the risk assessment procedures, there is some project performance uncertainty. Additional information about uncertainty is included in Chapters 3 and 5.

MAJOR CONCLUSIONS

The recommendation of the District Engineer of the Sacramento District, USACE is that the Recommended Plan (NED Plan) be authorized for implementation as a Federal project. The estimated first cost of the Recommended Plan is $280,820,000 and the estimated average annual Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRR&R) cost is $862,000 (October 2013 price levels). The Federal portion of the estimated first cost is $181,652,000. The estimated fully funded total project cost is $307,100,000.

The non-Federal sponsor portion of the estimated first cost is $99,168,000. An additional $195,000,000 is estimated as the minimum cost for non-Federal interests to comply with National Flood Insurance Program requirements by avoiding induced flooding of existing structures. The non-Federal sponsor will agree to provide all lands, easements, rights-of-way,

relocations, and suitable borrow and disposal areas. The non-Federal sponsor will also assume responsibility for OMRR&R. To ensure that the sponsor has full and clear responsibility for all Federal flood risk management features in the Truckee Meadows reach, deauthorization of the features of the Truckee River and Tributaries Project (authorized by FCA 1954, § 203 and FCA 1962, § 203) in the Truckee Meadows reach, which are currently maintained by the State of Nevada, is recommended. The non-Federal sponsor will publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with protection levels provided by the project. The non-Federal sponsor will continue to participate in and comply with applicable Federal floodplain management and flood insurance programs.

SUMMARY OF POST AUTHORIZATION CHANGES

The following provides a summary comparison of the Recommended Plan to the Authorized Project in the 16-item format of a Post-Authorization Change Report (ER 1105-2-100, Appendix G, Amendment #1, June 2004). The GRR is a post-authorization change report that addresses these items in more detail.

1. Description of Authorized Project

The authorized flood control features begin near Booth Street in downtown Reno, extend downstream along the Truckee River to the Truckee Meadows Wastewater Reclamation Facility (TMWRF), and continue up Steamboat Creek for approximately two miles. Features include floodwalls, setback levees, reconstruction/replacement of six bridges in downtown Reno, channel excavation, reconstruction of the TMWRF diversion dam, backwater levees on the North Truckee Drain, a large detention basin at UNR Farms, and levees along Steamboat Creek and Boynton Slough with an additional bridge modification. These project features were designed to provide "100-year flood protection" as defined in 1988. Authorized recreation features include a new pedestrian/bike bridge, bike lanes on bridges, pedestrian/bike paths, and new access sites and improvements in downtown Reno. The authorized project includes 31.4 acres of riparian habitat plantings as compensatory fish and wildlife mitigation. Fish and wildlife "enhancement" features, consisting of 9.5 acres of riparian plantings, 300 acres of marsh habitat preservation and improvement, and fish habitat improvement, were also specifically authorized. The authorized project would require 2,094 acres of lands and permanent easements. The non-Federal cost-share for the authorized project was estimated to be 50%, including credit for Lands, Easements, Rights-of-Way, Relocations and Disposal sites (LERRD).

2. Authorization

The Truckee Meadows Flood Control Project[2] was authorized by WRDA 1988, § 3(a)(10). Construction of the authorized project was deferred during the Pre-construction Engineering and Design (PED) phase when changes in real estate costs made the project economically infeasible. The Tribes Water Rights Settlement Act, § 207, provided direction regarding the conduct of a general reevaluation that had been undertaken by USACE. The Secretary of the Army also received guidance regarding USACE's conduct of the GRR pursuant to the House Report associated with the EWDAA 1996.

3. Funding Since Authorization

Federal funds:	$40,799,653	FY1988-2013
Non-federal funds:	1,400,000	FY2012 only
Total	$42,199,653	

[2] A previous USACE project was authorized and constructed pursuant to the FCA 1954, § 203 and the FCA 1962, § 203.

Federal funding is summarized below.

Years Funded	Amount
1988-1994	$3,787,530
1994-1998	$0
1998-2002	$5,071,800
2003-2007	$11,394,000
2008-2012	$20,546,323

Non-Federal funds were provided for completion of the GRR pursuant to a Memorandum of Agreement dated 22 August 2012 (August 2012 MOA) between USACE and TRFMA, which is the potential non-Federal sponsor of the Recommended Plan. Prior to the August 2012 MOA, no cost-sharing agreements had been executed with any non-Federal entity for sponsorship of the reevaluation, which had been fully federally funded.

4. Changes in Scope of Authorized Project

USACE guidance (ER 1105-2-100, Appendix G, paragraph G-12.c.) defines changes in scope as "increases or decreases in the outputs for the authorized purposes of a project. Outputs are the physical effects which (usually) have associated benefits."

The scope of the Recommended Plan has been reduced from the Authorized Project based on current economic analysis, planning policies, and budget considerations (See Table S-3).

Table S-3. Percentage of Change of Authorized Project and Recommended Plan

PROJECT PURPOSE and SCOPE PARAMETERS	1988 AUTHORIZED PROJECT	RECOMMENDED PLAN	PERCENTAGE OF CHANGE
Flood Risk Management			
Design Discharge	18,500 cfs	13,700 cfs	- 26%
Floodplain Affected	Downtown/Meadows	Meadows only	n/a
Recreation			
Annual Use Days	750,000	115,640	- 85%
Fish & Wildlife Enhancement Acres of Habitat	310 acres	None	- 100%

a. FRM project performance has been reduced from 1% ACE with freeboard to greater than 90% assurance of safely conveying a 2% ACE flood event for the primary damage areas. The reduction in FRM project performance was driven by the need to identify an economically justified plan that reasonably maximized net economic benefits.

b. Anticipated recreation output has been significantly reduced from 750,000 annual recreation days for the Authorized Project to 115,640 days for the Recommended Plan. Reduced recreation scope is consistent with the reduced scope of the FRM features.

c. No fish and wildlife enhancement is included in the Recommended Plan. Ecosystem restoration is not included in the Recommended Plan.

The Recommended Plan will require new congressional authorization because the Section 902 cost limit would be exceeded, as shown in item 9 below.

5. Changes in Project Purpose

The Authorized Project included fish and wildlife enhancement as a project purpose. No fish and wildlife enhancement or ecosystem restoration is included in the Recommended Plan.

6. Changes in Local Cooperation Requirements

In the 1986 Chief of Engineers Report for the Authorized Project, the recommended cost-sharing requirements required a non-Federal sponsor contribution between 25% and 50% in accordance with the Water Resources Development Act of 1986, Pub. L. No. 99-662, § 101, 100 Stat. 4082 (1986) (WRDA 1986, § 101). The project was authorized in WRDA 1988, § 3(a)(10), with those cost-sharing requirements. Cost-sharing for new flood damage reduction projects was modified in WRDA 1996 Pub. L. No. 104-303, § 201, 110 Stat. 3658, 3671 (1996) (WRDA 1996, § 201) to require a minimum non-Federal share of 35%. The Recommended Plan will require reauthorization, which will make the cost-sharing provisions of WRDA 1996 applicable, including a 35 to 50% non-Federal cost-share for structural flood risk management. Cost apportionment for the Recommended Plan has been calculated based on the requirements of WRDA 1996, § 201.

7. Change in Location of Project

The features of the Recommended Plan are located along the Truckee River within the extent of the Authorized Project. The Recommended Plan is more limited in its extent than the Authorized Project because some of the features of the Authorized Project were found to no longer be economically efficient. The Recommended Plan does not include features in Downtown Reno (upstream of Highway 395) and in the Steamboat Creek, Boynton Slough and UNR Farms area that were included in the Authorized Project. The Recommended Plan does not include separable lands for recreation, or for fish and wildlife mitigation or enhancement that were included in the Authorized Project.

8. Design Changes

See Table S-4 for a summary of major design differences between the Authorized Project and the Recommended Plan. These design changes are the result of the changes in scope and project purposes described in items 4 and 5, above.

Table S-4. Comparison of Authorized Plan and Recommended Plan

PARAMETER	1988 AUTHORIZED PROJECT		PARAMETER
COSTS	**1984 Price Level**	**2013 Price Level †**	**2013 Price Level**
Total Project First Costs	$74,720,000	$169,305,000	$280,820,000 (Note 1)
Authorized Cost	$78,400,000 (Note 2)	$177,643,000	n/a
BENEFITS (Annual)	**1984 Price Level**	**2013 Price Level***	**2013 Price Level**
Flood Risk Management	$9,717,000	$21,572,000	$25,899,000
Recreation	$2,395,000	$5,317,000	$625,000
Fish and Wildlife Enhancement	$1,153,000	$2,560,000	n/a
Total Annual Benefits	$13,265,000	$29,449,000	$26,524,000
BENEFIT TO COST RATIO	**1988 AUTHORIZED PROJECT**		**RECOMMENDED PLAN**
Flood Risk Management	1.6 to 1 (50 yrs; 8.375%)		2.2 to 1 (50 yrs; 3.5%)
Recreation	4.7 to 1		1.0 to 1
OVERALL DESIGN	**1988 AUTHORIZED PROJECT**		**RECOMMENDED PLAN**
Location	Booth St (Downtown Reno) to Vista; also includes Steamboat Creek, Boynton Slough and UNR Farms area		Highway 395 to Vista
Length (mainstem only)	8.3 miles		6 miles
Design Level of Performance	100-year with freeboard		1:50 Annual Chance Exceedance (>90% assurance) for primary damage areas
Design Discharge	18,500 cfs		13,700 cfs (between Rock Blvd. & McCarran Blvd.)
BRIDGES	Reconstruct/replace 6 bridges in Downtown Reno; elevate footbridge at Wingfield Park; modify Pembroke Dr. bridge on Steamboat Ck.		Pier/scour protection at 4 existing bridges in Truckee Meadows Reach

Note 1. Total first cost of Recommended Plan does not include the cost of $195,000,000 for compliance with National Flood Insurance Program.
Note 2. Authorized cost includes additional $4,140,000 for fish and wildlife enhancement.
* Benefits escalated based on Consumer Price Index
† Costs escalated based on construction cost index

PARAMETER	1988 AUTHORIZED PROJECT	RECOMMENDED PLAN
CONVEYANCE FEATURES		
Downtown Reno	1.0 mile of floodwalls and channel excavation between Booth St. and Lake St.	None
Truckee Meadows Reach		
Levees (Truckee River)	7 miles	31,000 feet (5.9 mi)
Floodwalls (Truckee River)	3.3 miles	9,650 feet (1.8 mi)
Floodplain Terrace	5.6 ac at Glendale Park	60 ac south bank Greg St. to McCarran Blvd.
North Truckee Drain	Backwater levees from river to north of I-80	3,200 lf box culverts; extend Peoples Drain 200 lf; cap Peoples Drain junction structures
UNR Farms	900-acre detention basin with perimeter levees; 1000-ft wide overflow weir; and outlet structure	Flowage easements
Steamboat Creek and Boynton Slough	Backwater levees	None
INTERIOR DRAINAGE	Ditches and culverts with flapgates	14 cfs pump station near Glendale Ave.; gravity drain at UNR; flap/sluice gates on storm drains
SEEPAGE PREVENTION	None specified	Seepage berms, drainage blankets, impervious berms and relief wells
RECREATION		
Trails	14.4 miles of new pedestrian/bike paths; pedestrian/bike bridge at Mill St. Park;	9,700 lf paved trails; 8,900 lf unpaved trails (3.5 mi total)
River access	80 picnic sites, 3 group picnic shelters, restrooms and parking (9 sites)	50 picnic sites, 2 group picnic shelters, playground, 13 fishing areas, restrooms and parking (1 main site)
Boat access	6 raft/tube access sites	4 kayak/canoe access sites
FISH AND WILDLIFE MITIGATION	31.4 acres riparian plantings	None
FISH AND WILDLIFE ENHANCEMENT	10 acres of riparian plantings; 300 acres of marsh habitat preservation; fish habitat improvements	None

9. Changes in Total Project First Costs

As shown in Table S-5, the estimated Authorized Project costs were $74,720,000 at October 1984 price levels. The authorized project cost in WRDA 1988, § 3(a)(10), was $78,400,000, including an additional $4,140,000 authorized for fish and wildlife enhancement. The current preliminary estimated cost limit for the Authorized Project is $184,249,000 (not including fish and wildlife enhancement) in accordance with 33 U.S.C. § 2280 (Section 902). The project first costs for the Recommended Plan are currently estimated at $280,820,000 (Oct 2013 price level).

Because the estimated total project first costs of the Recommended Plan would exceed the Section 902 limit for the Authorized Project, additional Congressional authorization will be required.

Table S-5. Comparison of Total Project First Costs ($1000)

Item	1988 Authorized Project		Last Reported to Congress	Recommended Plan
	Oct. 1984 Prices	Oct. 2013 Prices	FY 2006 Budget Submittal	Oct. 2013 Prices
Construction/PED/CM	$30,550	$69,222	$18,500[1]	$202,058
LERRD	$44,170	$100,083	n/a	$78,762
Total Project First Costs	$74,720	$169,305	n/a	$280,820

[1] For PED to Chiefs Report only; price level not adjusted; no report to Congress since FY2006

Reasons for cost changes and attributed percentage of the total increase since authorization (Recommended Plan compared to Authorized Project 1984 price):

a. Downtown Reno Reach removed: -10%

   Includes Construction, LERRD, PED, Construction Management (CM), fish and wildlife mitigation, and cultural resources mitigation.

b. Levees in UNR Farm area removed: -10%

   Includes Construction, LERRD, PED, CM, fish and wildlife mitigation, and cultural resources mitigation for levees at UNR Farms, Steamboat Creek and Boynton Slough.

c. Recreation in Downtown Reno and UNR Farms area removed: -1%

   Includes Construction, LERRD, PED, and CM.

d. Price escalation: +24%

   For items f. through j., below, Oct 1984 to Oct 2013

e. Sunk PED costs: +23%

   For general reevaluation study, since authorization.

f. Increase in LERRD costs: +19%

Net increase includes increase in real costs and reduction in project scale for Truckee Meadows Reach.

g. Increase in FRM Construction costs: +42%

Net increase includes increase in real construction costs and reduction in project scale for Truckee Meadows Reach.

h. Increase in Recreation Construction costs: +2%

Net increase includes increase in real construction costs and reduction in project scale for Truckee Meadows Reach.

i. Increase in remaining PED costs: +7%

Net increase includes increase in real costs and reduction in project scale for Truckee Meadows Reach.

j. Increase in Construction Management costs: +4%

Net increase includes increase in real costs and reduction in project scale for Truckee Meadows Reach.

10. Changes in Project Benefits

Table S-6 shows a summary comparison of benefits for the Authorized Project and the Recommended Plan. Benefits are discussed in detail in the GRR and Economic Appendix. Annual benefits for the authorized project have increased by $16,184,000 (122%) as a result of price level increases. Compared to the Authorized Project, the Recommended Plan has lower flood risk management benefits, significantly reduced recreation benefits, and no fish and wildlife enhancement benefits.

11. Benefit-to-Cost Ratio

For the benefit-cost analysis in this GRR, the project costs were amortized over the 50-year period of analysis using the current Federal discount rate of 3.5 percent. See Table S-6 for a comparison of the Authorized Project and the Recommended Plan.

Table S-6. Comparison of Economic Results

Category	1985 Feasibility Report Authorized Project		Last Reported to Congress	Recommended Plan
	Oct. 1984 Prices	Oct. 2013 Prices	FY2006 Budget Submittal[1]	Oct. 2013 Prices
Interest Rate	8.375%	3.5%	n/a	3.5%
Period of Analysis	50 Year	50 Year	n/a	50 Year
Annual Benefits	$13,265,000	$29,449,000	n/a	$26,524,000
Annual Costs	$7,041,000	$8,367,000	n/a	$20,290,000
Net Benefits	$6,224,000	$21,082,000	n/a	$6,234,000
Benefit-to-Cost Ratio	1.9	3.5	n/a	2.2

Note 1: No estimate of benefits or annual costs included; no report to Congress since FY2006

12. Changes in Cost Allocation

Table S-7 compares the allocation of cost among the project purposes for the Authorized Project and the Recommended Plan.

13. Changes in Cost Apportionment

Table S-7 shows changes in the apportionment of costs between the Federal Government and the non-Federal sponsor.

Table S-7. Cost Allocation and Cost Apportionment Comparison of Authorized Project and Recommended Plan ($1000)

Item	Authorized Project (1984 Prices)			Authorized Project (2013 Prices)			Recommended Plan (2013 Prices) (with Sec 104 credit)		
	Federal	Non-Federal	Total	Federal	Non-Federal	Total	Federal	Non-Federal	Total
Flood Risk Management Construction (includes PED/Const Mgt)	$26,600		$26,600	$60,271		$60,271	$187,912	$2,406	$190,318
LERRD		$43,200	$43,200		$97,885	$97,885	$1,496	$77,076	$78,572
Total First Cost (FRM)	$26,600	$43,200	$69,800	$60,271	$97,885	$158,156	$189,408	$79,482	$268,890
Minimum 5% Cash	n/a	n/a		n/a	n/a		($13,445)	$13,445	
Additional Cash Contribution	$8,300	($8,300)		$18,806	($18,806)		($1,185)	$1,185	
Cost-Shared Total (FRM)	**$34,900**	**$34,900**	***93.4%*** **$69,800**	**$79,078**	**$79,078**	***93.4%*** **$158,156**	**$174,779**	**$94,112**	***95.8%*** **$268,890**
Cost-share Percentages	*50%*	*50%*		*50%*	*50%*		*65%*	*35%*	
Recreation Const, LERRD,PED,CM	**$2,260**	**$2,260**	***6.0%*** **$4,520**	**$5,121**	**$5,121**	***6.0%*** **$10,242**	**$5,057**	**$5,057**	***3.6%*** **$10,113**
Cost-Share Percentages	*50%*	*50%*		*50%*	*50%*		*50%*	*50%*	
Cultural Resource Data Recovery	**$400**		***0.5%*** **$400**	**$906**		***0.5%*** **$906**	**$1,817**		***0.6%*** **$1,817**
TOTAL PROJECT FIRST COST	**$37,560**	**$37,160**	**$74,720**	**$85,105**	**$84,200**	**$169,305**	**$181,652**	**$99,168**	**$280,820**

Note: Percentages of Total Project First Cost allocated to each project purpose are shown in ***bold italics***

14. Environmental Considerations in Recommended Changes

An EIS has been prepared to address the proposed modifications to the Authorized Project and new circumstances and information relevant to the environmental concerns previously identified in the EIS prepared with the 1985 Feasibility Report. The new EIS will supersede the 1985 EIS.

15. Public Involvement

The public and concerned resource agencies have been invited to participate in all phases of the Truckee Meadows Flood Control Project since the initiation of the General Reevaluation Study in 1996. This has included opportunities to comment on the 1997 Reconnaissance Report, the Notice of Initiation, the Public Scoping Meeting conducted in 1999, and public workshops in 2000, 2003, 2005, and 2013. Additional efforts included disseminating information through a project web site and publishing a monthly newsletter. Public involvement encouraged the consideration of setback levees and floodplain terracing as flood risk management measures that would minimize the physical isolation of the river from the surrounding community. Public involvement also influenced the types of recreation features included in the Recommended Plan.

16. Project History

The Truckee Meadows Flood Control Project was authorized by the WRDA 1988, § 3(a)(10), which authorized construction of the project as described in the Chief of Engineer's report dated July 25, 1986. In fiscal year 1988, the Preconstruction Engineering and Design (PED) phase for the authorized project was initiated. In addition to further technical studies, the PED phase included evaluating the project based on changes in existing conditions, laws, and requirements since the project was initially studied and authorized. In particular, WRDA 1986 was enacted after completion of the feasibility report and before Congressional authorization. Several changes in USACE guidance that resulted from WRDA 1986 affected the Truckee Meadows project including changes to cost-sharing requirements, real estate valuation rules, and revised project benefits. Application of these changes to the authorized plan resulted in a benefit-cost ratio below unity. Because the project appeared to lack economic justification, it was placed in a deferred status.

In 1996, local communities requested a reevaluation of flood problems in Truckee Meadows. A general reevaluation study of the Truckee River was initially funded by appropriations received through EWDAA 1996. A reconnaissance report was completed in 1997 and the GRR was initiated in 1998. See the GRR main text for additional detailed information regarding the project history.

TABLE OF CONTENTS

Chapter 1 - Introduction 1-1
Purpose and Scope 1-1
Location of Study Area 1-2
Project Authorization 1-2
History of the Truckee River Investigations 1-7
Current Study Effort 1-8
Description of 1988 Authorized Plan 1-9
Flood Control Features 1-9
Recreation Features 1-11
Fish and Wildlife Features 1-11
Costs and Benefits 1-12
Reevaluation of Authorized Project 1-12
Study Coordination 1-12
Related Studies and Reports 1-12
Federal 1-12
Local 1-13
Report Organization 1-14
Technical Appendices 1-15

Chapter 2 - Existing and Future Without-Project Conditions 2-1
Existing Conditions 2-1
Physical Setting 2-1
Related Water Resources Projects 2-12
Population 2-17
Public Health and Safety 2-18
Environmental Resources 2-19
Related Ecosystem Restoration Projects 2-21
Recreational Projects and Facilities 2-22
Cultural Resources 2-24
Tribal Lands and Issues 2-25
Allocation of Water from the Truckee River 2-22
Completed Local Projects 2-25
Future Without-Project Conditions 2-26
Physical Setting 2-26
Socioeconomic Conditions 2-27
Environmental Resources 2-28
Recreational Projects and Facilities 2-29
Regional Transportation Commission Project 2-29
Cultural Resources 2-30
Tribal Lands and Issues 2-31
Completed Local Work Eligible for Credit 2-31

Chapter 3 - Problems and Opportunities 3-1
Flood Problems 3-1

Context of Flooding in the Study Area 3-3
Floodplains 3-4
Flood Damages 3-5
Inventory 3-14
Value of Damageable Property - Structure Value 3-14
Value of Damageable Property - Content Value 3-15
Expected Annual Damages - Without Project Conditions 3-15
Project Performance 3-17
Ecosystem Problems and Opportunities 3-19
Recreation Problem and Opportunity 3-22
Summary of Problems and Opportunities 3-23

Chapter 4 - Development of Alternative Plans 4-1
Plan Formulation Process 4-1
National Planning Goals 4-1
Planning Objectives 4-1
Flood Risk Management 4-2
Ecosystem Restoration 4-2
Recreation 4-2
Planning Constraints 4-2
Flood Risk Management 4-2
Ecosystem Restoration 4-3
Recreation 4-3
Description and Screening of Management Measures 4-3
Flood Risk Management: Nonstructural Measures 4-3
Flood Risk Management: Structural Measures 4-5
Ecosystem Restoration (Fish Passage) 4-14
Recreation 4-16
Formulation of Preliminary Alternative Plans 4-20
Formulation and Screening of Flood Risk Management 4-20
Alternatives Descriptions, Downtown Reno Reach 4-23
Alternatives Screening, Downtown Reno Reach 4-27
Truckee Meadows Reach 4-29
Restoration of Fish Passage in the Truckee River 4-40
Recreation Plan Formulation 4-43
Truckee Meadows Reach 4-43
Recreation Demand and Benefit Methodology 4-44
Preliminary Recreation Alternatives 4-45

Chapter 5 - Evaluation and Comparison of Alternative Plans 5-1
Evaluation Methodology 5-1
Downtown Reno Reach 5-1
Truckee Meadows Reach 5-1
Preliminary Economic Analysis for the Truckee Meadows Reach 5-1
System of Accounts 5-2
Adjustments to Hydraulic and Economic Models 5-5

Reformulation Strategy for Truckee Meadows Reach 5-5
Identification of NED Plan for Flood Risk Management, Truckee Meadows Reach 5-9
Residual Risk for NED Plan and Identification of TSP 5-9
Residual Risk 5-9
Induced Flooding Resulting from NED Plan in Two Areas 5-14
Consideration of Mitigation for Induced Flooding from NED Plan 5-15
National Flood Insurance Program Compliance 5-15
Sensitivity Analysis of Potential Additional Effects of SouthEast Connector 5-16
Restoration of Fish Passage in the Truckee River 5-17
Fish Passage Benefits 5-21
Cost Effectiveness Analysis 5-21
Incremental Cost Analysis 5-21
Identification of Most Cost Effective Plan for Fish Passage 5-24
Recreation Component 5-26
Recreation Plan Evaluation 5-26
Recreation Plan Description 5-31
Identification of the Recommended Plan 5-32

Chapter 6 - Details of the Recommended Plan 6-1
Features and Accomplishments 6-1
Levees and Floodwalls 6-1
Floodplain Terracing 6-1
North Truckee Drain, People's Drain, and Pioneer Ditch 6-4
Bank and Bridge Pier/Abutment Scour Protection 6-4
Interior Drainage Facilities 6-4
Seepage Remediation 6-4
Relocations 6-5
Recreation Features 6-5
Habitat Mitigation 6-5
Operation, Maintenance, Repair, Replacement, and Rehabilitation 6-9
Real Estate Requirements 6-11
Cost Estimate 6-13
Section 104 Credit for Reno-Sparks Indian Colony Levee 6-13
Preliminary Cost Allocation and Apportionment 6-14
Economic Costs and Benefits 6-17
Risk and Uncertainty 6-20

Chapter 7 - Public Involvement 7-1
Overview 7-1
Scoping 7-1
Public Meetings 7-1
Local and Regional Interests 7-2
Community Coalition Process 7-3
Flood Project Coordination Committee 7-3

Truckee River Flood Management Authority 7-4
Views of Local Project Proponent 7-4
Views of Resource Agencies 7-5
Views of Tribes 7-5

Chapter 8 - Plan Implementation and Schedule 8-1
Public Review of Final Document 8-1
Report Review and Approval 8-1
Federal and Non-Federal Responsibilities 8-2
Federal Responsibilities 8-2
Non-Federal Responsibilities 8-2
Project Partnership Agreement 8-5
Project Schedule 8-6
Further Studies 8-6

Chapter 9 - Conclusions and Recommendation 9-1
Conclusions 9-1
Environmental Operating Principles 9-2
USACE Campaign Plan 9-3
Recommendations 9-4

LIST OF TABLES

Table 2-1- Principal Lakes and Reservoirs Providing Flood Protection in the Truckee River System 2-15
Table 2-2 - Major Canals and Capacities of the Truckee Storage Project 2-17
Table 2-3 - Hydroelectric Plants between Truckee and Reno 2-17
Table 2-4 - Potentially Eligible Section 113 Restoration Work and Funding Sources 2-32
Table 3-1 - Peak Flows of Selected Historic Floods since 1900 3-3
Table 3-2 - Total Number of Structures within the Study Area 3-15
Table 3-3 - Value of Structures and Contents at Risk within Study Area by Event 3-16
Table 3-4 - Expected Annual Damages Without Project by Category 3-17
Table 3-5 - Project Performance - Without-Project Condition 3-18
Table 3-6 - Primary Fish Passage Barriers on the Truckee River 3-22
Table 4-1 - Summary of Flood Risk Reduction Measures Considered 4-18
Table 4-2 - Summary of Ecosystem Restoration (Fish Passage) Measures Considered 4-19
Table 4-3 - Summary of Recreation Measures Considered 4-20
Table 4-4 - Management Measures Matrix - Preliminary Alternatives - Downtown Reno 4-22
Table 4-5 - Management Measures Matrix - Preliminary Alternatives – Truckee Meadows 4-23
Table 4-6 - Economic Justification of Preliminary Flood Damage Reduction Alternatives in Downtown Reno at the 1% AEP 4-28
Table 4-7 - Advanced Bridge Replacement Benefits, Downtown Reno 4-29

Table 4-8 - Comparison of Alternative Plans in Downtown Reno 4-29
Table 4-9 - Summary of Flood Risk Management Structures for Alternative 1 4-32
Table 4-10 - Summary of Levee Structures for UNR Farms Detention Facility..... 4-34
Table 4-11 - Summary of Flood Risk Management Structures for Alternative 2 4-35
Table 4-12 - Summary of Flood Risk Management Structures for Alternative 3 4-38
Table 4-13 - Measures Considered at Diversions on the Truckee River 4-40
Table 4-14 - Summary of Upstream Alternatives Considered..... 4-41
Table 4-15 - Summary of Downstream Alternatives Considered..... 4-43
Table 4-16 - Comparison of Preliminary Recreation Plans 4-46
Table 5-1 - Comparison of Flood Risk Management Plans..... 5-2
Table 5-2 - Comparison of System of Accounts..... 5-3
Table 5-3 - Incremental Analysis for Flood Risk Management, Truckee Meadows Reach 5-7
Table 5-4 - Preliminary FRM Benefit-Cost Analysis for Truckee Meadows Reach..... 5-9
Table 5-5 - Project Performance - With Project - Entire Study Area 5-10
Table 5-6 - Incremental Cost Analysis: Best Buy Plans - Average Output..... 5-23
Table 5-7 - Summary of Best Buy Plans for Fish Passage 5-25
Table 5-8 - Unit Day Values Worksheet for Alternative A 5-27
Table 5-9 - Unit Day Value Worksheet for Alternative B..... 5-28
Table 5-10 - Unit Day Value Worksheet for Alternative C..... 5-28
Table 5-11 - Unit Day Values and Recreation Value 5-28
Table 5-12 - Recreation Demand by Feature..... 5-30
Table 5-13 - Total Annual Recreation Value..... 5-30
Table 5-14 - Summary of Recreation Costs..... 5-31
Table 5-15 - Comparison of Alternative Recreation Plans..... 5-31
Table 5-16 – Revised BCR and Net Benefits for Alternative C 5-32
Table 6-1 - Project Features – Truckee Meadows Reach 6-2
Table 6-2 - Lands and Damages 6-12
Table 6-3 - Estimated First Costs of TSP 6-13
Table 6-4 - Preliminary Cost Allocation and Cost Apportionment for Recommended Plan Without Section 104 Credit 6-15
Table 6-5 - Preliminary Cost Allocation and Cost Apportionment for Recommended Plan With Section 104 Credit 6-16
Table 6-6 - Summary of Cost Sharing for Recommended Plan (Fully Funded) 6-17
Table 6-7 - Economic Costs and Benefits of Recommended Plan 6-19
Table 6-8 - Probability Distribution of Equivalent Annual Damages Reduced 6-20

LIST OF FIGURES

Figure 1-1 - Truckee River Basin 1-5
Figure 1-2 - Study Reaches..... 1-6
Figure 1-3 - Authorized Plan 1988 1-10
Figure 2-1 - Verdi Reach 2-2
Figure 2-2 - Downtown Reno Reach 2-4
Figure 2-3 - Truckee River Looking South from Booth Street..... 2-5
Figure 2-4 - Downtown Reno looking Downstream at Center Street Bridge..... 2-5

Figure 2-5 - Truckee Meadows 2-6
Figure 2-6 - Truckee Meadows Reach 2-7
Figure 2-7 - Vista Reefs looking downstream from Truckee Meadows 2-8
Figure 2-8 - Lower Truckee Meadows River Reach 2-9
Figure 2-9 - Lower Truckee Reach near McCarran Ranch 2-10
Figure 2-10 - Derby Dam 2-10
Figure 2-11 - Downstream of Numana Dam near Nixon 2-11
Figure 2-12 - Marble Bluff Dam 2-11
Figure 2-13 - Pyramid Lake 2-12
Figure 2-14 - Proposed SouthEast Connector Project 2-30
Figure 3-1 - Existing Floodplains - Downtown Reno Reach 3-6
Figure 3-2 - Existing Floodplains - Truckee Meadows Reach 3-7
Figure 3-3 - Existing Floodplain – Truckee Meadows Reach (5% ACE) 3-8
Figure 3-4 - Existing Floodplain – Truckee Meadows Reach (2% ACE) 3-9
Figure 3-5 - Existing Floodplain – Truckee Meadows Reach (1% ACE) 3-10
Figure 3-6 - Existing Floodplains - Vista to Wadsworth 3-11
Figure 3-7 - Existing Floodplains - Wadsworth to Pyramid Lake 3-12
Figure 3-8 - Economic Impact Areas - Truckee Meadows Reach 3-13
Figure 4-1 - Alternative 1 - Levees and Floodwalls 4-33
Figure 4-2 - Alternative 2 - Levees, Floodwalls, and Detention Facilities. 4-36
Figure 4-3 - Alternative 3 - Levee, Floodwalls, and Floodplain Terracing 4-39
Figure 4-4 - Fish Passage Improvement Locations 4-42
Figure 5-1 - Alternative 3, Floodplain Terrace Plan Flood Risk Management Increments 5-8
Figure 5-2 - Expected Annual Damages by Impact Area 5-11
Figure 5-3 - Without-project and residual floodplain for NED Plan for a 2% ACE 5-12
Figure 5-4 - Without-project and residual floodplains for NED Plan for a 1% ACE.... 5-13
Figure 5-5 - Proposed Location of SouthEast Connector 5-18
Figure 5-6 - Areas added to1/100 Floodplain and Parcels Potentially Requiring Raising/Flood-proofing for NFIP Compliance 5-19
Figures 5-7 - Parcels with Structures Potentially Requiring Raising/Flood-proofing for NFIP Compliance 5-22
Figure 5-8 - Cost Effective Plans - Average Output 5-23
Figure 5-8 - Best Buy Plans - Average Output 5-20
Figure 6-1 - Typical cross-section of floodplain terrace 6-2
Figure 6-2 - Alternative 3 - Floodplain Terrace (1:50) Truckee Meadows Reach 6-3
Figure 6-3 - Conceptual Plan of Primary Recreation Access/Facilities in Truckee Meadows Reach 6-8

APPENDIXES

Appendix A - Historic Photographs of Flooding
Appendix B - Real Estate
Appendix C - Economics
Appendix D - Engineering
Appendix E - Executive Order 11988 Analysis

CHAPTER 1
INTRODUCTION

This General Reevaluation Report (GRR) addresses potential modifications to the Congressionally authorized Truckee Meadows Flood Control Project in the cities of Reno and Sparks in Washoe County, Nevada. These potential modifications include flood risk management and recreation measures along the Truckee River within the Truckee Meadows.

1.1 Purpose and Scope

The Truckee Meadows Flood Control Project was authorized under the WRDA 1988, § 3(a)(1), , but was deferred in or around 1992 during the Pre-construction Engineering and Design (PED) phase when changes in real estate costs made the project economically infeasible. In 1996, local communities requested that flooding problems in Truckee Meadows be reevaluated. As a result of consultations with local communities at that time, a decision was made to expand the study area beyond Truckee Meadows downstream to Pyramid Lake and to consider ecosystem restoration as a project purpose.

This GRR analyzes the flood and ecosystem problems in the study area, and develops alternatives to reduce flood risks, restore environmental resources, and increase recreational opportunities. The alternatives include the no-action plan and various combinations of structural and nonstructural measures. The Recommended Plan is identified after the engineering, economic, and environmental feasibility of the alternatives is evaluated. Since the recommended plan is not consistent with the authorized plan it will need to be reauthorized by Congress.

This GRR summarizes the plan formulation process for a comprehensive solution to water resources problems in the Truckee River watershed. The USACE planning process initially sought to identify a comprehensive solution for flood, ecosystem, and recreation problems including detailed evaluation of a locally developed plan resulting from a community coalition process. Despite several iterative attempts, those efforts did not result in a project that USACE could recommend. Therefore, in 2012, in coordination with the sponsor, the study was re-scoped to focus plan formulation on flood risk management with basic recreation features. The primary purpose of the reevaluation study is to assess the feasibility of modifying the Federally-authorized project to reduce flood damages in the Truckee Meadows project area while avoiding or minimizing adverse effects.

Within the primary purpose, the specific goal of this study is to identify a complete plan that will yield an economically justified and environmentally sustainable project that accomplishes the following:

- Reduces flood damages to populated areas
- Provides access and recreation to the public, as feasible
- Avoids and minimizes effects to riparian and aquatic habitats

- Complies with pertinent planning and environmental laws, regulations, and policy
- Complements other Federal, state, and local plans and projects for the Truckee River and vicinity

1.2 Location of Study Area

The study area includes approximately 60 miles of the Truckee River beginning just upstream of Reno, passing through Sparks and the Truckee Meadows, and ending at the river's terminus, Pyramid Lake, on Pyramid Lake Paiute tribal lands (see Figure 1-1). The results of the reconnaissance study focused the general reevaluation study from the entire length of the Truckee River to the current study area. Because of the size of the land area and the number of river miles, the study area was divided into four general reaches: Verdi Reach, Downtown Reno Reach, Truckee Meadows Reach, and Lower Truckee River Reach (see Figure 1-2).

The Verdi Reach extends from the Fleish diversion dam to Booth Street in Reno's central business district. The Downtown Reno Reach extends from Booth Street downstream to Highway 395. The Truckee Meadows Reach encompasses an area bordered by Highway 395 on the west, Vista and the Virginia and Pah Rah Mountain Ranges to the east, south along Steamboat Creek to Huffaker Hills, and north to Sparks. The Lower Truckee River Reach extends from Vista downstream to the river's terminus at Pyramid Lake.

1.3 Project Authorization

The Truckee Meadows Flood Control Project[1] was authorized by WRDA 1988, § 3(a)(10), which reads:

> Truckee Meadows, Nevada.--The project for flood control, Truckee Meadows, Nevada: Report of the Chief of Engineers, dated July 25, 1986, at a total cost of $78,400,000, with an estimated first Federal cost of $39,200,000 and an estimated first non-Federal cost of $39,200,000; except that the Secretary is authorized to carry out fish and wildlife enhancement as a purpose of such project, including fish and wildlife enhancement measures described in the District Engineer's Report, dated July 1985, at an additional total cost of $4,140,000.

After a general reevaluation of the authorized project was initiated, the 1990 Tribes Water Rights Settlement Act, § 207, provided direction regarding the conduct of the study as follows:

[1] A previous USACE project was authorized and constructed pursuant to the FCA 1954, § 203, and the FCA 1962, § 203.

> The Secretary of the Army, in consultation with and with the assistance of the Pyramid Lake Tribe, State of Nevada, Environmental Protection Agency, the Secretary [of Interior], and other interested parties, is authorized and directed to incorporate into its ongoing reconnaissance level study of the Truckee River, a study of the rehabilitation of the lower Truckee River to and including the river terminus delta at Pyramid Lake, for the benefit of the Pyramid Lake fishery. Such study shall analyze, among other relevant factors, the feasibility of:
>
> - Restoring riparian habitat and vegetative cover
> - Stabilizing the course of the Truckee River to minimize erosion
> - Improving spawning and migratory habitat for the cui-ui
> - Improving spawning and migratory habitat for the Lahontan cutthroat trout
> - Improving or replacing existing facilities, or creating new facilities, to enable the efficient passage of cui-ui and Lahontan cutthroat trout through or around the delta at the mouth of the Truckee River, and to upstream reaches above Derby Dam, to obtain access to upstream spawning habitat.

The Secretary of the Army received additional guidance regarding USACE's conduct of the GRR pursuant to the House Report associated with EWDAA 1996, providing:

> The Secretary of the Army is directed to initiate a general reevaluation report for the Truckee Meadows Flood Control project, Nevada, authorized in the Water Resources Development Act of 1988. Of the $400,000 provided in the conference agreement for the lower Truckee River, Nevada, project, $50,000 is appropriated for this investigation. The report will consider additional flood protection at and below Reno, Nevada, through levee/channel improvements, local impoundments, and potential reoperation of existing reservoirs in the watershed. The report will also consider the potential for environmental restoration along the Truckee River and tributaries in the Reno-Sparks area.

During the current general reevaluation, EWDAA 2006, § 113, was passed, which states:

> Truckee Meadows Flood Control Project, Nevada: The non-Federal funds expended for purchase of lands, easements and

rights-of-way, implementation of project monitoring and assessment, and construction and implementation of recreation, ecosystem restoration, and water quality improvement features, including the provision of 6,700 acre-feet of water rights no later than the effective date of the Truckee River Operating Agreement for revegetation, reestablishment and maintenance of riverine and riparian habitat of the lower Truckee River and Pyramid Lake, whether expended prior to or after the signing of the Project Cooperation Agreement (PCA), shall be fully credited to the non-Federal sponsor's share of costs for the project: Provided, that for the purposes of benefit-cost ratio calculations in the General Reevaluation Report (GRR), the Truckee Meadows Nevada Flood Control Project shall be defined as a single unit and non-separable.

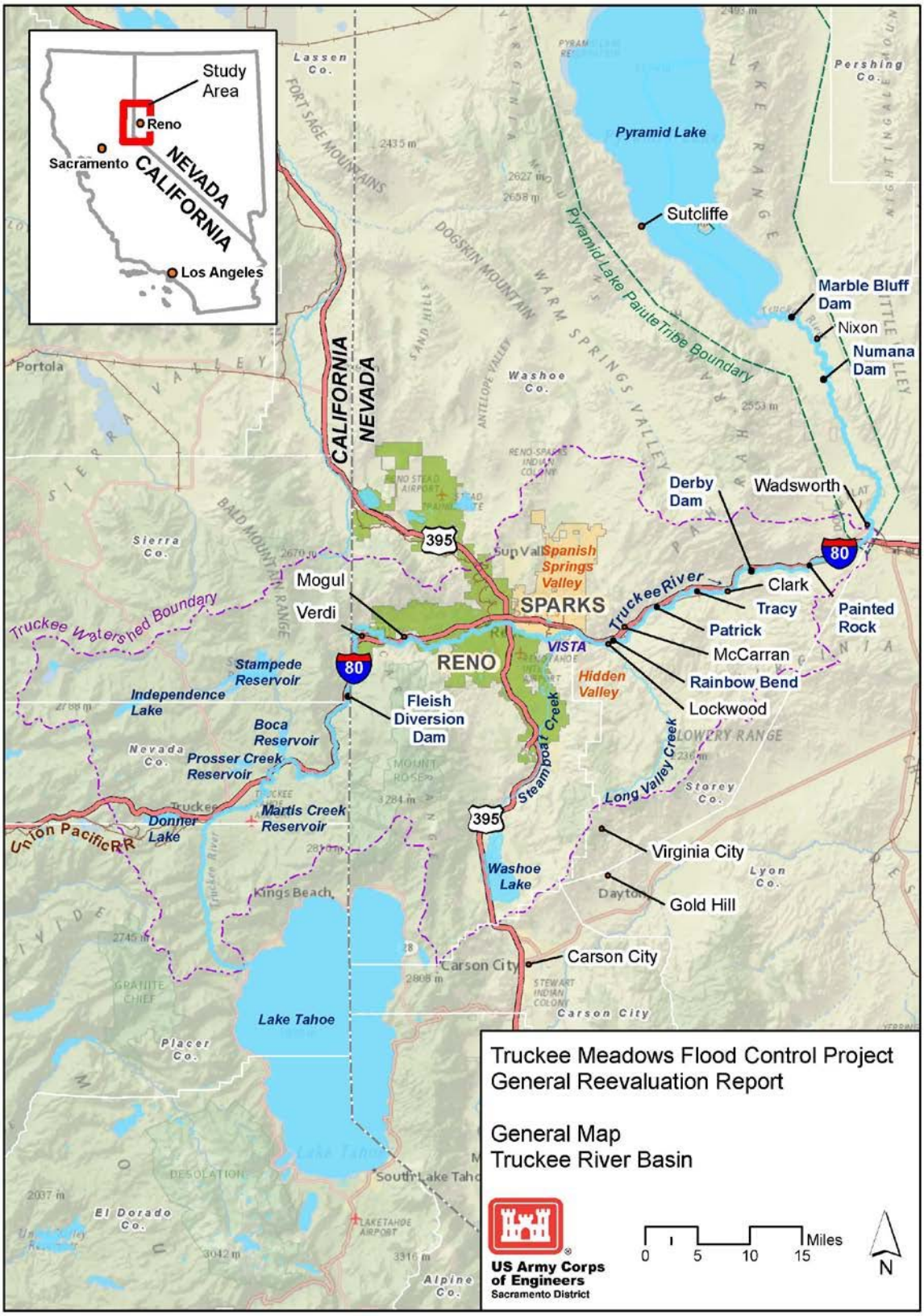

Figure 1-1. Truckee River Basin

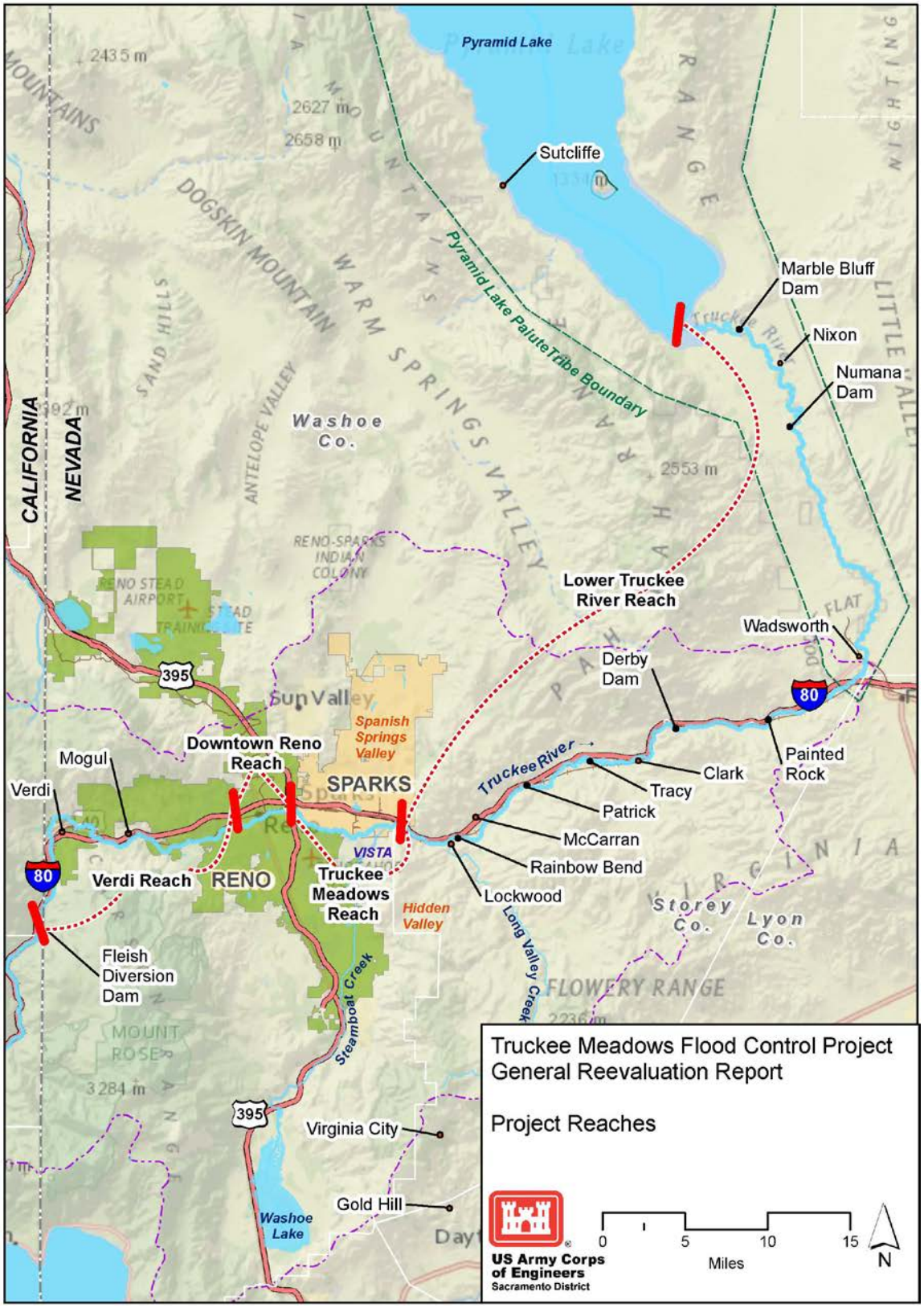

Figure 1-2. Study Reaches

1.4 History of the Truckee River Investigations

Congress authorized the Truckee River and Tributaries, California and Nevada, Project in the FCA of 1954, § 203, and the FCA of 1962, § 203. The project included work at several locations along the Truckee River from Lake Tahoe to Pyramid Lake. Work included channel enlargement near Lake Tahoe; channel improvements along 7.5 miles of the Truckee River below Reno; and clearing and snagging, channel enlargement, and straightening from Vista to Wadsworth to accommodate additional flows created by the construction work upstream. Construction began in 1959 and was completed in 1968.

USACE involvement with the Truckee River continued in 1965 as a result of local requests for additional flood control, which prompted a USACE study. The Truckee Meadows (Reno-Sparks metropolitan area), Nevada, investigation proposed a flood control plan consisting of storage facilities on the Truckee River at Verdi, interceptor facilities on Steamboat Creek, and channel improvements in Truckee Meadows. Due to opposition to the dam proposal at Verdi, that portion of the plan was dropped. Since there was no local support for the proposed plan, the study was suspended in 1970.

In 1974, Washoe County requested that the USACE investigate the feasibility of lowering the Vista Reefs and channelizing the Truckee River. A year later, USACE determined that the channel enlargement was feasible. In late 1976, Washoe County and the cities of Sparks and Reno requested that USACE determine the feasibility of flood control within the Truckee Meadows. In response, the USACE prepared and approved a reconnaissance report in 1977, which determined that channel modification between U.S. Highway 395 and Vista might be feasible. In June 1978, the Washoe Council of Governments gave their vote of approval for USACE to proceed with a feasibility study.

USACE completed the Truckee Meadows (Reno-Sparks Metropolitan Area), Nevada Feasibility Report and Environmental Impact Statement in 1985. The feasibility report identified a project designed to pass a flow of 18,500 cubic feet per second (cfs) (identified in the report as the estimated "100-year" event) through Reno. The flood control features of the project included construction of approximately 5 miles of floodwalls and 7 miles of levees, and replacement of six bridges along the Truckee River. The project also included channel excavation and a 900-acre detention basin and levees to mitigate potential increases in downstream flooding due to upstream flood control features. Adverse effects on fish and wildlife would be mitigated by planting riparian vegetation on 31 acres along the Truckee River and Steamboat Slough.

The total estimated first cost of the project was $78.4 million, and the estimated first Federal cost was $39.2 million (unadjusted 1986 dollars). Annual benefits included $9.7 million for flood control and $2.4 million for recreation. Authorized by Congress in WRDA 1988, § 3(a)(10), the project was to be carried out in accordance with the Truckee Meadows, Nevada: Report of the Chief of Engineers, dated July 25, 1986. The authorization included flood control, recreation, and fish and wildlife enhancement purposes.

In fiscal year 1988, the Preconstruction Engineering and Design (PED) phase for the authorized project was initiated. In addition to further technical studies, the PED phase included evaluating the project based on changes in existing conditions, laws, and requirements since the project was initially studied and authorized. In particular, WRDA 1986, a significant piece of legislation, was enacted between completion of the feasibility report and congressional authorization:

- WRDA 1986 changed the cost-sharing requirements for USACE projects.

- Guidance implementing WRDA 1986 required that all lands, including publicly owned lands, must be included in the project cost estimate at fair market value, regardless of ownership. As a result, the estimation of real estate values changed, and real estate cost estimates significantly increased from the 1985 feasibility report.

Several additional factors affected the Truckee Meadows project:

- The assumptions for determination of project benefits were revised. Assumptions changed about area growth, future flood proofing of structures, and the level of flooding for which project benefits were captured. As a result, project benefits decreased.

- Washoe County, one of the local sponsors, requested that the proposed detention basin at the University of Nevada Agricultural Experiment Station (UNR Farms) be replaced with a detention basin at the Huffaker Hills site.

Application of these changes to the authorized plan resulted in a revised benefit-cost ratio less than 1.0 to 1, based on the information available at that time. Because the project appeared to lack economic feasibility, in or around 1992 it was placed in a deferred status.

1.4.1 Current Study Effort

In 1996, local communities requested a reevaluation of flood problems in Truckee Meadows. In response, USACE received funding with guidance to conduct a reevaluation of the authorized project (see House Report associated with EWDAA 1996) and potential flood and related problems and needs in mid-1996. The Truckee Meadows, Nevada; Reconnaissance Reevaluation Report was completed in August 1997. The conclusions of the study were that: (1) there continues to be a substantial demonstrated flood problem in the study area; (2) in addition to flood control, there is a need for environmental restoration and recreation features along the river consistent with any plan to reduce the risk of flooding; (3) plans to help reduce flood problems and enhance recreation and environmental opportunities in the area appear economically feasible and locally desirable; and (4) Washoe County and the cities of Reno and Sparks support

increased flood protection in the area and support continuing PED studies, with the first step being to conduct a GRR.

During the completion of the reconnaissance report, USACE conducted a post-flood assessment of damages along the entire Truckee River from a major flood event in January 1997. The evaluation identified 40 sites with damage. USACE proposed debris removal, channel clearing, and erosion fill at all 40 sites. This work is completed for the without-project condition for the current study.

1.5 Description of 1988 Authorized Plan

This section describes the plan authorized in 1988. The authorized plan is discussed in more detail in the Truckee Meadows (Reno-Sparks Metropolitan Area), Nevada, Feasibility Report and Environmental Impact Statement, February 1985.

1.5.1 Flood Control Features

Authorized flood control features begin near Booth Street Bridge and extend downstream to the Truckee Meadows Wastewater Reclamation Facility (TMWRF), and then continue up Steamboat Creek through the UNR Farms south of Truckee River for approximately two miles (Figure 1-3). Features include:

- Floodwalls and setback floodwalls constructed or reconstructed along the north bank of the Truckee River between Lake Street and Booth Street, and on the south bank between Lake Street and 1,400 feet upstream of Arlington Avenue. Floodwalls and setback floodwalls would average 2 to 4 feet in height.

- Bridges reconstructed and/or replaced at or above grade at Arlington Avenue, and Booth, Virginia, Lake, Sierra, and Center streets. The foot bridges at Wingfield Park were also identified to be elevated. However, the foot bridges have since been upgraded.

- Channel excavation along the north bank of the Truckee River in the vicinity of Booth Street Bridge, and excavation through the stream channel to a maximum depth of 1.5 feet from just above Arlington Avenue Bridge to just above Sierra Street Bridge. The total river distance involved is approximately 1,600 feet.

- Setback floodwalls (south bank only, 4 to 7 feet in height) from U.S. Highway 395 to Glendale Avenue.

- A reconstructed and realigned TMWRF diversion dam just above Glendale Avenue.

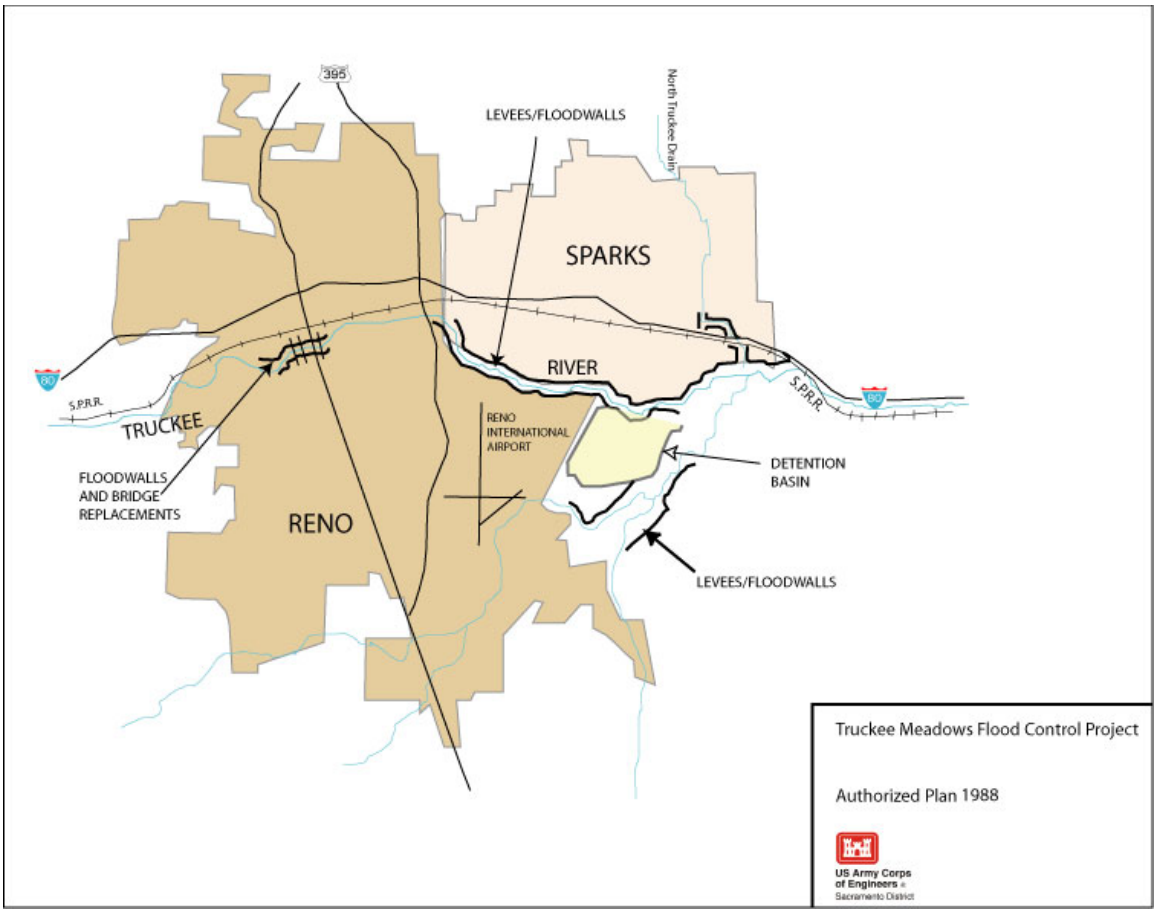

Figure 1-3. Authorized Plan 1988

- Setback floodwalls and setback levees (5 to 8 feet high) between Glendale Avenue and South Rock Boulevard

- Setback floodwalls, floodwalls at the river's edge, and setback levees (5 to 8 feet high) between South Rock Boulevard and South McCarran Boulevard.

- 5.6 acres along the north bank in the area of Glendale Park excavated above the water surface elevation of the Truckee River associated with 1,000 cfs discharge (estimated average annual flow).

- Setback levees constructed on both sides of the river between South McCarran Boulevard and the east end of the project at Vista. These levees would be about 11 feet high and 82 to 90 feet wide at the base.

- Backwater levees with an average height of 5 feet constructed on North Truckee Drain from the confluence with the Truckee River to approximately 900 feet north of Interstate 80 (I-80). This levee also extends along the Southern Pacific Railroad alignment to Peoples Drain.

- A 1,000-foot overflow weir built immediately east of the UNR Farms on South McCarran Boulevard and approximately 7 acres excavated from the south bank of the Truckee River and adjacent agricultural land.

- 10-foot levees surrounding the UNR Farms serving as an overflow area to temporarily store peak flows of floods greater than a 35-year event. This is intended to preclude increased flood peaks for areas downstream of the project. An overflow weir and low-level outlet structure would be located along the east side levee to release flows back into the Truckee River.

- Levees with an average height of 10.5 feet constructed along Steamboat Creek and Boynton Slough. Pembroke Drive Bridge over Steamboat Creek would be raised and lengthened to provide for more flow under the bridge.

1.5.2 Recreation Features

Authorized recreation features included a new pedestrian/bike bridge, bike lanes on bridges, pedestrian/bike paths, and new access sites and improvements to Riverside Park and the Riverwalk area in downtown Reno. Of the approximately 22.7 miles of existing and proposed pedestrian/bike paths, 14.4 miles would be new paths. Access and improvements would include ten sets of steps leading to the river, four observation decks, ten locator or interpretive signs, and six rafting/tubing launch/exits along the Truckee River.

1.5.3 Fish and Wildlife Features

The authorized plan includes about 31.4 acres of riparian habitat plantings as compensatory fish and wildlife mitigation for habitat losses due to construction of the flood risk management features.

Fish and wildlife enhancement features, consisting of 10 acres of riparian plantings, 300 acres of marsh habitat preservation, and fish habitat improvements, were also presented in the 1985 feasibility report. Fish and wildlife features were not included in the recommended plan because of a lack of local sponsorship, but were specifically authorized by Congress.

1.5.4 Costs and Benefits

The estimated first costs of the authorized plan (excluding fish and wildlife enhancement) were $74,720,000 with an annual cost of $6,628,000 (unadjusted 1984 dollars; 8 3/8%). With average annual benefits of $12,112,000, the plan's benefit-cost ratio was 1.8 to 1. The updated cost for the authorized project using October 2012 prices is $167,810,000 (not including fish and wildlife enhancement). Congress also authorized fish and wildlife enhancement at an additional cost of $4,140,000 (unadjusted 1984 dollars).

1.5.5 Reevaluation of Authorized Project

The authorized project is included in the array of alternatives analyzed for a GRR. In the case of Truckee Meadows, the authorized project was based on hydrology developed prior to the 1997 flood event, which exceeded all previous records. USACE estimated 1% ACE peak flow for the Truckee River at Reno was increased by almost 12% after the 1997 event. Therefore, the authorized project would not perform as Report of the Chief of Engineers, July 25, 1986, based on the 1985 feasibility report. To accommodate this change in conditions, USACE formulated a plan for the Truckee Meadows reach that consists of most of the authorized plan features. That plan is identified in this document as Alternative 2 - Detention Plan.

1.6 Study Coordination

The reevaluation study is being accomplished with close coordination with the potential non-federal sponsor, the TRFMA. The planning process is being coordinated with the U.S. Fish and Wildlife Service (USFWS), Nevada State Historic Preservation Office, Nevada Department of Transportation (NDOT), Pyramid Lake Paiute Tribe, and other stakeholders in the affected community.

1.7 Related Studies and Reports

The following is a list of related studies and reports that were consulted as part of the reevaluation of the flood problems and environmental problems of the Truckee River in the study area. This is not intended to be an exhaustive list, but instead to provide a sense of the scope of studies that were consulted.

1.7.1 Federal

- U.S. Army Corps of Engineers, Truckee Meadows, Nevada, Reconnaissance Reevaluation Report, August 1997.

- U.S. Army Corps of Engineers, Truckee Meadows, Reno-Sparks Metropolitan Area, Nevada, Office Report, May 1991.

- U.S. Army Corps of Engineers, Truckee Meadows, Nevada: Report of the Chief of Engineers, dated July 25, 1986.

- U.S. Army Corps of Engineers, Truckee Meadows, Reno-Sparks Metropolitan Area, Nevada, Feasibility Report, February 1985.

- U.S. Army Corps of Engineers, Water Control Manual, Truckee River Basin Reservoirs, Truckee River, Nevada and California, July 1985.

- U.S. Army Corps of Engineers, Truckee Meadows, Reno-Sparks Metropolitan Area, Nevada, Documentation Report, October 1983.

- Federal Emergency Management Agency, Flood Insurance Study, Washoe County, Nevada, 1994.

- U.S. Geological Survey, Environmental and Hydrologic Settings of the Las Vegas Valley Area and the Carson and Truckee River Basins, Nevada and California, Water Resources Investigations Report 96-4087, 1996.

- U.S. Bureau of Reclamation, Truckee-Carson River Basin Study, Western Water Policy Review Advisory Commission, March 1997.

- U.S. Bureau of Reclamation, Phase III Project Information Report, Truckee River, Nevada Emergency Flood Restoration, October 1997.

- U.S. Bureau of Reclamation, P.L. 84-99 Flood Restoration Work for Portions of the Truckee River from the Nevada State Line East to Wadsworth, Nevada, October 1997.

- U.S. Department of the Interior, Bureau of Reclamation, Fish and Wildlife Service, Bureau of Indian Affairs, and State of California, Department of Water Resources, Revised Draft Environmental Impact Statement/ Environmental Impact Report, Truckee River Operating Agreement, California and Nevada, August 2004.

1.7.2 Local

- Washoe County Department of Comprehensive Planning, Washoe County Comprehensive Plan, Volumes 1 and 2, Reno, Nevada, 1996.

- Nevada Department of Water Resources, 1995-2015 Washoe County Comprehensive Regional Water Management Plan, Washoe County, Nevada, November 1996.

- City of Reno Redevelopment Agency, Downtown Riverfront District Plan, August 1997.

1.8 Report Organization

This report documents the study process and its results. The report chapters are as follows:

Chapter 1, Introduction, provides background information concerning the purpose of and need for the project modification, project authorization, and project status, as well as the scope of the reevaluation study. This chapter also notes linkages with other related studies and reports.

Chapter 2, Existing Conditions, describes the current conditions and future without-project conditions for important resources within the study area. This provides the baseline for the evaluation of effects each alternative may have on those resources.

Chapter 3, Problems and Needs, describes the first step in the USACE planning process. This chapter identifies the problems and needs for the project purposes of flood risk management, ecosystem restoration, and recreation.

Chapter 4, Development of Alternative Plans, describes the second and third steps in the USACE planning process. In this chapter, planning goals are set, objectives are established, and constraints are identified. This chapter also identifies a range of potential management measures that address specific problems identified in Chapter 3 and identifies various combinations of preliminary alternative plans that have the potential to address the goals and objectives. A discussion is also provided for why some preliminary alternatives were eliminated from further consideration.

Chapter 5, Evaluation and Comparison of Alternative Plans, describes the fourth, fifth, and sixth steps in the USACE planning process. This chapter qualitatively and quantitatively describes potential costs and benefits as a result of implementation of the alternative plans relative to existing conditions.

Chapter 6, Details of Tentatively Recommended Plan, summarizes the environmental, economic, and social benefits and costs of the recommended plan.

Chapter 7, Public Involvement, describes the numerous coordination and public involvement activities conducted throughout the course of the reevaluation study. These activities include information workshops, status reports, informal briefings, presentations, and correspondence with various resource agencies.

Chapter 8, Remaining Reviews, Approvals, Plan Implementation, and Schedule, identifies the estimated project timeline for future actions, defines commitments and responsibilities, and verifies the fulfillment of procedural notice and review requirements.

Chapter 9, Conclusions and Recommendation, presents the study conclusions and recommendations by the District Engineer.

1.9 Technical Appendices

Appendix A, Historical Photographs, includes photographs of flood events from the past 100 years.

Appendix B, Real Estate, provides the Preliminary Real Estate Plan, which presents the baseline real estate cost estimates based on the analysis and assumptions made during the process of formulating and developing the alternatives.

Appendix C, Economics, presents information regarding the social and economic resources that exist in the vicinity of the project area. This appendix also analyzes the with-project benefits as well as flood damages for both the with- and without-project conditions.

Appendix D, Engineering Appendix, presents a summary of hydraulic analysis, floodplain development, an assessment of geomorphology and sediment transport, design, and cost of alternatives completed for this document.

(This page is intentionally blank)

CHAPTER 2
EXISTING AND FUTURE WITHOUT-PROJECT CONDITIONS

This chapter identifies the existing conditions in the study area and the forecast for those conditions into the future without implementation of a Federal project. To define the potential impacts or benefits with various alternative plans, an understanding of the existing condition of the study area is required. Definition of this existing condition allows the comparison of the value of various alternatives to one another.

2.1 Existing Conditions

This section describes the existing conditions, projects, and important resources in the project area at the time of this study. Conditions, projects, and resources that are relevant to the plan formulation strategy and process are described here. A more detailed description of the important resources can be found in the accompanying Environmental Impact Statement (EIS).

2.1.1 Physical Setting

The Truckee River originates in the Sierra Nevada and flows east from the Lake Tahoe area into Nevada. Nearly all of the Lake Tahoe basin's storage and precipitation is in California. The river continues east down the Truckee Canyon, through Reno and Sparks, east to Wadsworth, where it turns north, and eventually terminates in Pyramid Lake. The Truckee River flows freely through the canyon; however, areas of dense urban development in Reno and Sparks limit channel capacity and impede flow through these areas. There are several reaches of Truckee River within the project area. These are described below and shown in Figure1-2.

Verdi Reach

The Verdi Reach, shown in Figure 2-1, is located within unincorporated areas of Washoe County, which includes the Verdi community, as well as the limits of the city of Reno. Land uses in the Verdi Reach generally consist of rural residential, open space, and undeveloped areas. The Truckee River emerges from steep canyons into the eastern foothills of the Sierra Nevada in this reach.

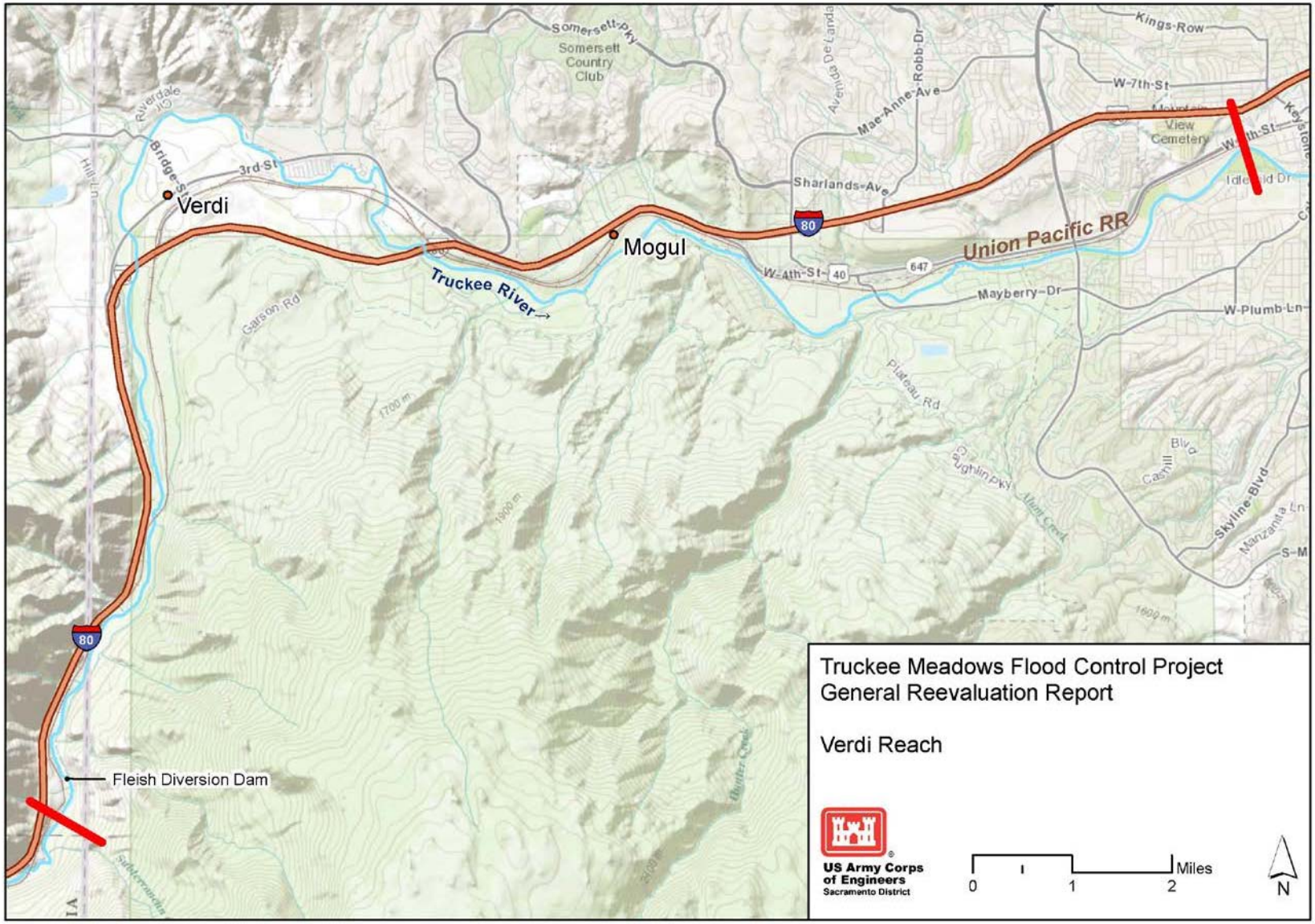

Figure 2-1. Verdi Reach

Downtown Reno Reach

Downtown Reno, shown in Figure 2-2, considered the central business district, consists of dense urban development with residential, commercial, and public structures, including casinos and hotels. The general topography of this portion of Reno is a moderately incised channel that slopes upward away from the river after several hundred feet. This generally confines flood flows to the first two blocks on either side of the river. Part of the reach on the south bank near Booth Street is steeply banked and susceptible to erosion (Figure 2-3). A low berm is located along the north bank downstream of Booth Street. Considerable development exists along the river with little setback. Existing floodwalls can be found along the river through much of the Downtown Reno Reach until roughly Lake Street (Figure 2-4). A river walk has been constructed along portions of the north and south banks of the Truckee River through downtown Reno, portions of which are below grade. Four bridges across the Truckee River within downtown Reno at Virginia, Sierra, Center, and Lake Streets are impediments to high flows, causing flooding of adjacent streets and businesses. The Center, Booth, and Arlington Street bridges have been replaced since the Truckee Meadows project was authorized, but the Center Street Bridge is still an impediment to high flows.

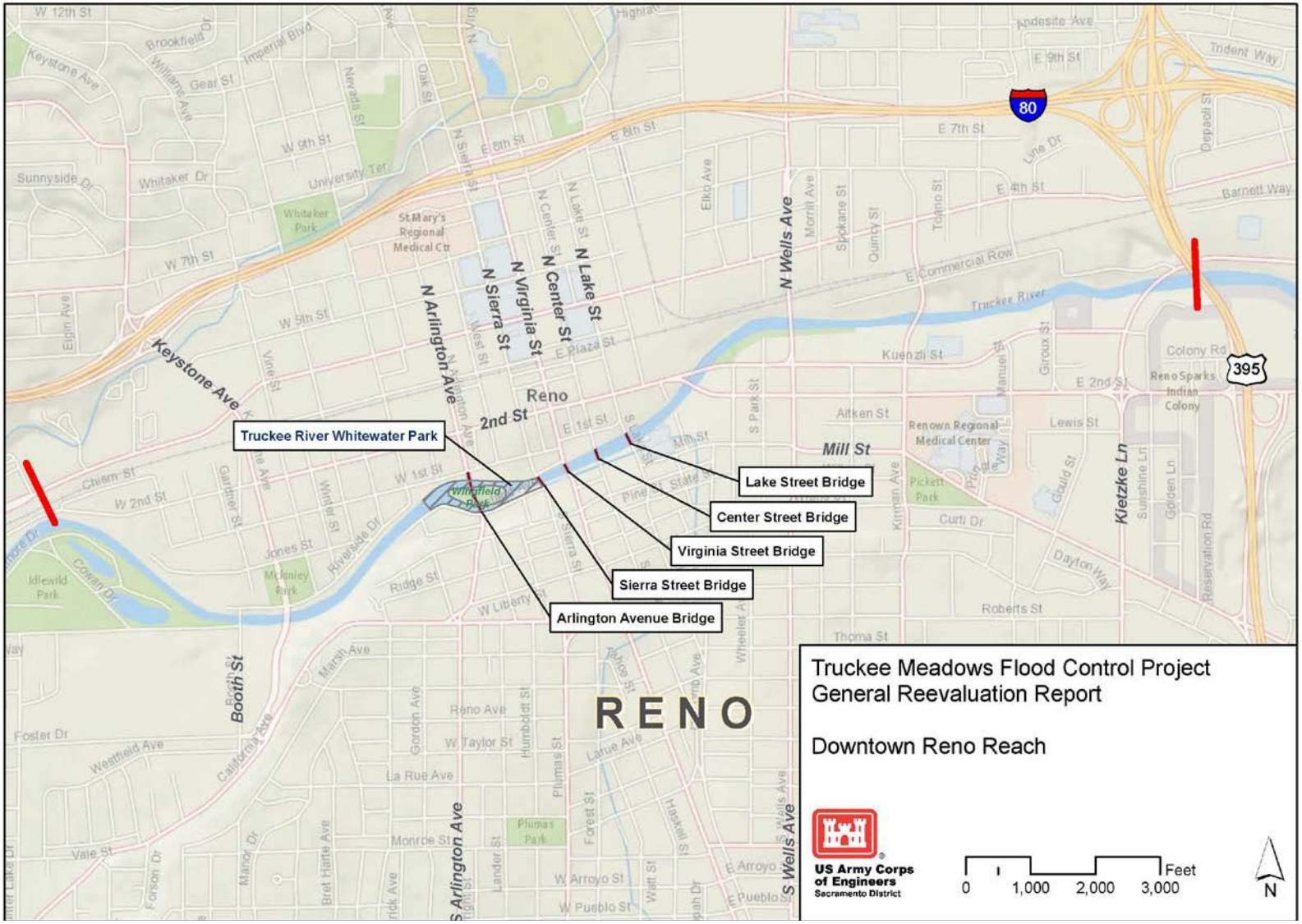

Figure 2-2. Downtown Reno Reach

Figure 2-3. Truckee River Looking South from Booth Street

Figure 2-4. Downtown Reno Looking Downstream at Center Street Bridge

Truckee Meadows Reach

The Truckee Meadows Reach is shown in Figure 2-6. Just east of U.S. Highway 395, the river emerges from the more channelized Downtown Reno Reach onto a broader expanse of the plain historically known as the Truckee Meadows. Land uses in the area include commercial and industrial purposes (e.g., in the City of Sparks) as well as the Reno-Tahoe International Airport. Three major tributaries, Steamboat Creek, Boynton Slough, and the North Truckee Drain, flow into the river along this reach.

The Truckee Meadows encompasses the urban Reno-Sparks metropolitan area, UNR Farms and areas south of the Truckee River (Figure 2-5). It is located in a bowl-shaped area bounded by the Sierra Nevada Mountains on the west and the Virginia and Pah Rah ranges to the east. The project reach begins at U.S. Hwy 395 and follows the Truckee River downstream to the Vista Reefs. The Vista Reefs constrict outflows from the Truckee River, backing up flood flows throughout the Meadows (Figure 2-7). Although a previous USACE project lowered the Vista Reefs, a hydraulic constriction remains.

Figure 2-5. Truckee Meadows

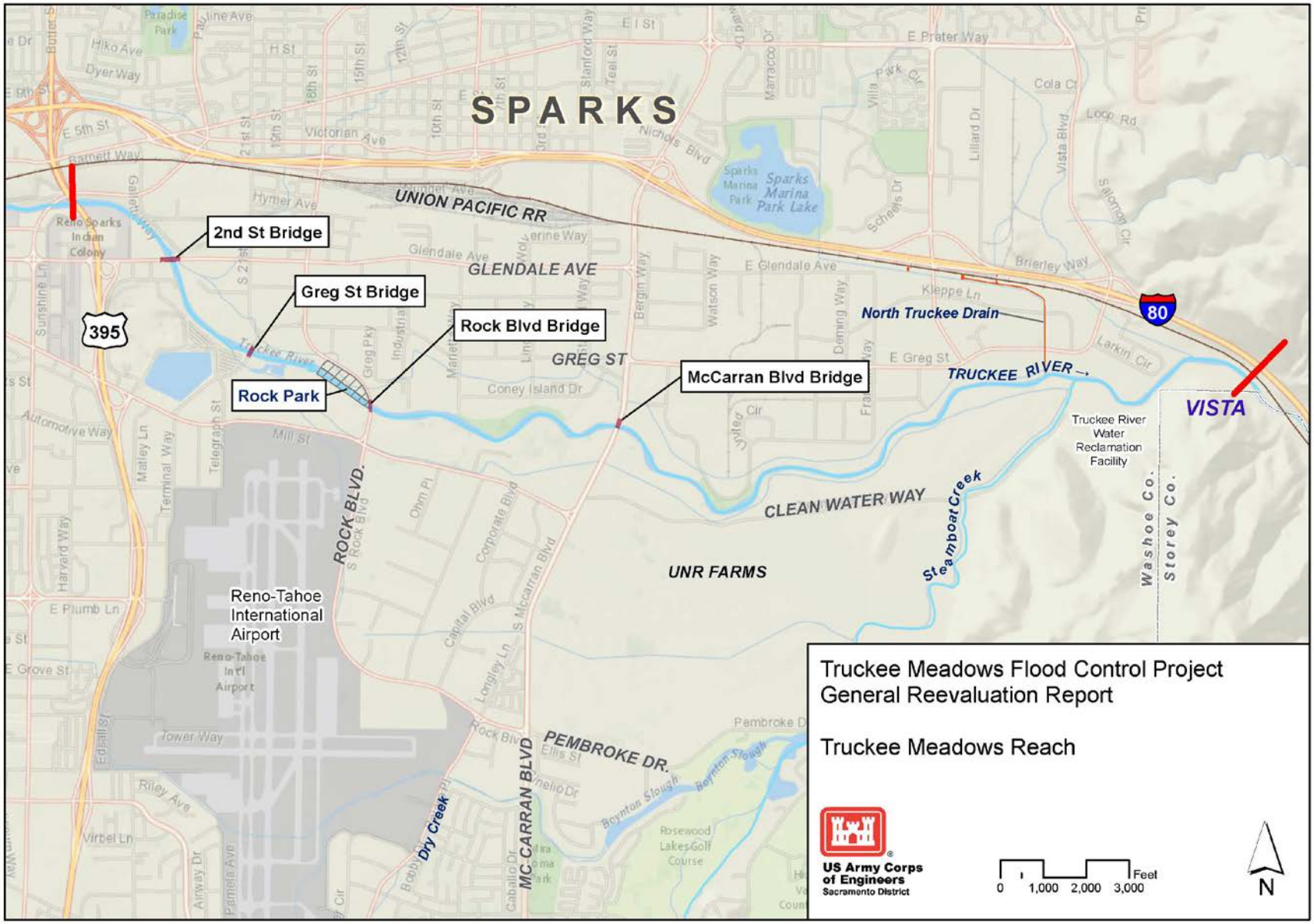

Figure 2-6. Truckee Meadows Reach

Lower Truckee River Reach

The Lower Truckee River Reach is shown in Figure 2-8. Near Vista, the Truckee River enters a narrow canyon on its way to its terminus in Pyramid Lake (Figure 2-7). The Truckee River downstream of Vista passes the small communities of Rainbow Bend, Painted Rock, Patrick, and Wadsworth and is generally confined to fairly narrow canyons and small overflow areas that are now used for ranching or agriculture (Figure 2-9). Derby Dam, which is located above Painted Rock, diverts portions of the Truckee River into the Newlands Reclamation Project in the adjacent Carson River watershed (Figure 2-10). At Wadsworth, the Truckee River turns north and enters the Pyramid Paiute Reservation. This reach of the river is in very narrow canyons and is sparsely populated. Numana Dam (Figure 2-11) and Marble Bluff Dam (Figure 2-12) are both located on the river in this reach. The Truckee River then terminates at Pyramid Lake (Figure 2-13). This reach presents excellent opportunities for ecosystem restoration in certain reaches where access to the historical floodplain exists. There are also numerous diversion structures that are obstructions to fish passage.

Figure 2-7. Vista Reefs looking downstream from Truckee Meadows

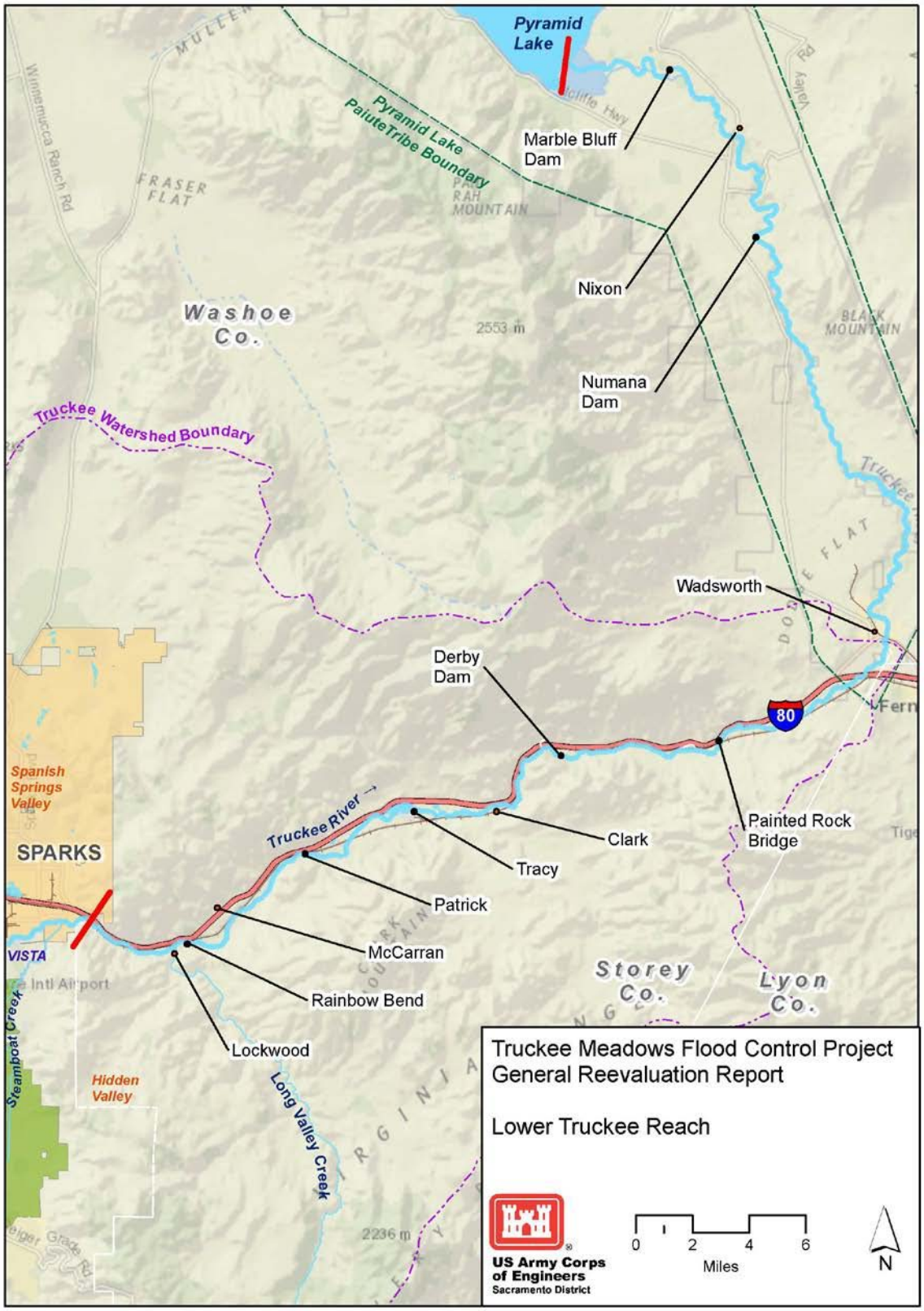

Figure 2-8. Lower Truckee Meadows River Reach

Figure 2-9. Lower Truckee Reach near McCarran Ranch

Figure 2-10. Derby Dam

Figure 2-11. Downstream of Numana Dam near Nixon

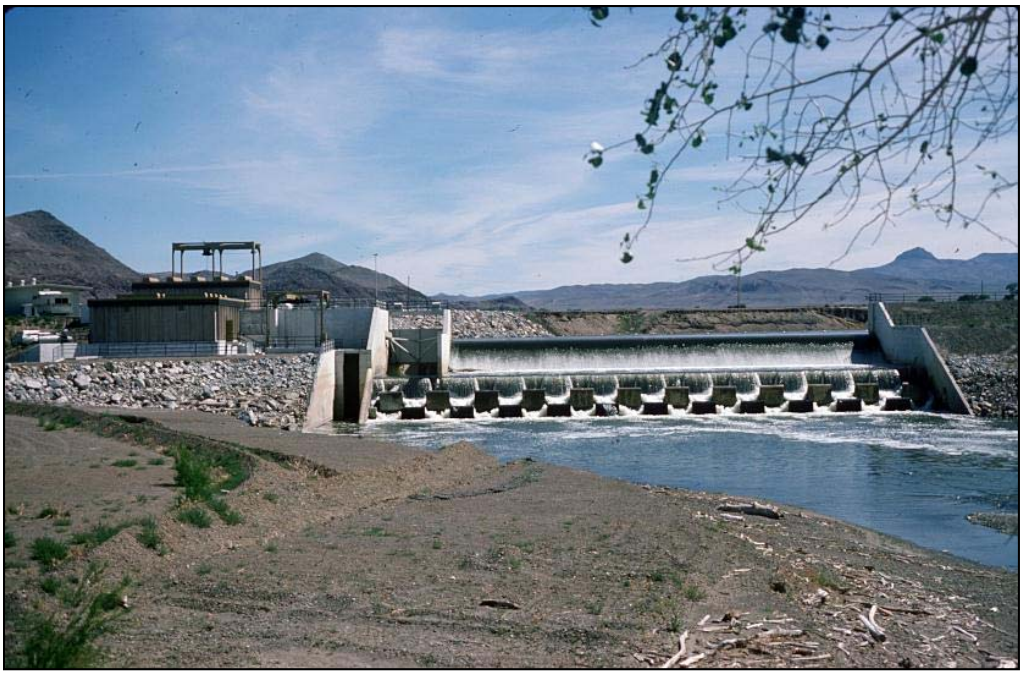

Figure 2-12. Marble Bluff Dam

Figure 2-13. Pyramid Lake

2.1.2 Related Water Resources Projects

Several water resources projects have been constructed on the Truckee River over the last century. These projects addressed different issues within the watershed, but had a common desired outcome of minimizing damages caused by flooding.

Truckee River and Tributaries Project

Flood control work by USACE on the Truckee River began with the Truckee River and Tributaries project, which was authorized under the FCA 1954, § 203, and the FCA 1962, § 203,. Construction of channel improvements through the Truckee Meadows as part of the Truckee River and Tributaries project was completed in 1960. The Truckee River channel through Truckee Meadows was widened and straightened to increase the minimum channel capacity from about 3,000 cfs to 6,000 cfs. Additional channel improvements between Truckee Meadows and Pyramid Lake and in the vicinity of Sparks were completed in 1964 and 1968, respectively. Other project features included enlarging the Truckee River channel for approximately 3,200 feet downstream from the existing structure at Lake Tahoe; increasing the capacity of the outlet at Lake Tahoe to 2,500 cfs at lake level 6,228 feet, and to 3,300 cfs at lake level 6,229 feet; providing downstream channel improvements from Lake Tahoe to Truckee; and snagging and clearing at intermittent locations from Vista to Pyramid Lake to compensate for increased flows through Truckee Meadows. The states of California and Nevada and the Pyramid Lake Paiute Tribal Council are responsible for operation and maintenance of portions of the project. The portion of the project in Downtown Reno is discussed under Martis Creek Lake.

The segment of the project between Glendale Avenue in Sparks and Wadsworth maintained by the State of Nevada was last inspected by USACE in 2010. At that time, the overall rating of the segment was Minimally Acceptable due to sedimentation and vegetation in the channel, encroachments, and erosion of both banks. An engineering determination concluded that the unacceptable items would not prevent the project from performing as intended during the next flood event.

Reno Flood Warning Project

USACE conducted a Section 205 small flood control study for the Reno Flood Warning System, Nevada, with Washoe County and the cities of Reno and Sparks in 1998. The study resulted in a selected plan that includes expanding the network of gages used for forecasting stages in the mainstem of the Truckee River, adding gages in the tributary catchments and providing flood watch for forecasting tributary stages, providing the storm watch data filing and display tool for local jurisdictions, and developing the preparedness plan for the Reno-Sparks area. This plan increased the flood warning time from 8 to 14 hours on the Truckee River and from zero to 2 hours for the North Truckee Drain and Steamboat Creek basins. The plan allowed the River Forecast Center to improve the accuracy of its flood forecasts for the mainstem Truckee River, provide local jurisdictions with storm watch data for monitoring tributary stream levels, and improve flood response planning and implementation. The project was constructed in 2000 and is considered in-place and part of the without-project condition.

Clearing and Snagging on Truckee River

During the 1950s, in cooperation with Washoe County and the City of Reno, USACE completed four clearing and snagging projects on the Truckee River as authorized in the FCA 1954, § 208 (amending the Flood Control Act of 1937, Pub. L. 75-406, § 8, 50 Stat. 876 (1937).. These projects included removing sediment, vegetation, and debris from the river and channel straightening for flood control. Together, the four clearing and snagging projects extended from the California/Nevada border to Vista. The City and County provided the required assurances that the completed work would be maintained. Similar work in the City and County was performed by USACE in the mid-1950s and 1963 under a disaster relief authority.

Other Projects

There are numerous lakes and reservoirs in the upper Truckee River watershed. Several that significantly influence flood flows along the river in Reno are Lake Tahoe and Stampede, Boca, Prosser Creek, and Martis Creek Reservoirs. Martis Creek Dam and Lake is owned by USACE. The U.S. Bureau of Reclamation (USBR) owns Prosser Creek Dam and Reservoir, and Stampede and Boca Dams and Reservoirs. USACE and the USBR mutually agree to the flood control operating principles for the Truckee River Basin reservoirs. However, USACE is responsible for providing the flood control regulations. The physical features for each are shown in Table 2-1, and descriptions of each are summarized below.

Lake Tahoe. Lake Tahoe is the first point at which flow of the Truckee River can be controlled. Lake Tahoe covers 192 square miles, averages 990 feet in depth, and is the tenth deepest lake in the world. The lake drains an area of 506 square miles and occupies an unusually large portion of its drainage area. This means that much of the precipitation falling in the drainage basin falls directly on the lake's surface, with tributary inflow contributing a small portion of inflow. Lake Tahoe is both a natural lake of great beauty and a storage reservoir for the Truckee River. The lake could provide all the carryover storage that the area would need for the long term, but most of the water has been dedicated to in-place, non-consumptive use. Although Tahoe is a natural lake, it is controlled by a small dam constructed 400 feet downstream from the natural outlet rim at the northwestern edge of the lake, which lies at an elevation of 6,223 feet. Lake Tahoe has a capacity of about 122,160,000 acre-feet, but the dam, constructed in 1913 by the Truckee River General Electric Company, regulates the lake level to fluctuate a maximum of 6.1 feet, yielding a usable storage capacity of 744,600 acre-feet.

Stampede Project. Stampede, which was constructed by the USBR starting in 1966 and completed in 1970, is operated for water supply and flood control. At gross pool (elevation 5,948.7 feet), Stampede Reservoir is about 5 miles long, has a surface area of 3,440 acres, and a total capacity of 226,500 acre-feet. Stampede Dam is rolled earth and rockfill construction and has a height of 232 feet above streambed. It has a crest length of 1,511 feet, crest width of 40 feet, and crest elevation of 5,970 feet. The outlet works are located in the right abutment and consist of a trashracked vertical shaft intake structure with sill elevation at 5,765 feet. The tower directs flow into a 12-foot diameter circular tunnel upstream from the gate chamber. The capacity of the outlet works is 2,740 cfs when the water surface is at elevation 5,963.3 feet. The ungated spillway is located in the right abutment of the dam. The spillway crest is at elevation 5,948.7 feet and has a length of 15 feet. The spillway discharge capacity is 3,060 cfs when the water surface in the reservoir is at elevation 5,963 feet.

The USBR is currently evaluating Stampede Dam for dam safety and is considering raising the dam and constructing dikes on the south rim of the reservoir. The latest information from USBR indicates that the potential changes at Stampede Dam would have no effect on this project's hydrologic assumptions.

Boca Project. The Washoe County Water Conservation District operates Boca Dam and Reservoir. USBR also constructed Boca Dam starting in 1937 and completed it two years later. It was constructed for water supply, hydropower, and flood control. Boca Reservoir has a total capacity of 41,140 acre-feet and a surface area of 980 acres at gross pool elevation 5,605 feet. Boca Dam has a zoned, rolled earthfill embankment, and a rockfilled face. The structure rises about 100 feet above streambed.

The crest of the dam is at elevation 5,612 feet, has a total length of 1,629 feet, and a top width of 35 feet. The outlet works are located in the right abutment of the dam and commence with a trashracked structure having a sill elevation 5,521 feet. The capacity of the outlet works is 900 cfs when the water surface is at elevation 5,605 feet. The gated spillway structure is located in the left abutment of the dam. The spillway has a crest length of 38 feet and a crest elevation of 5,589 feet. Two radial gates, each 19 feet by 16 feet, control discharges into the 320-foot-long concrete-lined channel. The spillway design capacity is 8,000 cfs at elevation 5,605 feet.

Table 2-1. Principal Lakes and Reservoirs Providing Flood Protection in the Truckee River System

Lake/ Reservoir	Drainage Area (sq mi)	Surface Area[1] (sq mi)	Total Storage (ac-ft)	Storage capacity per foot[2] (ac-ft/ft)	Flood Control Volume[3] (acre-ft)	January 1997 Flood Control Release[4]
Lake Tahoe	506	190.7	122,160,000	122,000	744,600	2,500
Stampede	136	5.4	226,500	3,349	22,100	2,075[5]
Boca	172	1.5	41,140	930	8,000	0
Prosser	50	1.2	29,800	533	20,000	5
Martis	39	1.2	20,400	505	15,000	374

[1] Surface area at gross pool. Lake Tahoe surface area at maximum permissible elevation.
[2] Storage capacity per foot of depth. For flood control reservoirs, average value for flood control/joint use pool.
[3] Volume in flood control/joint use pool. Lake Tahoe value is volume between natural rim and maximum permissible elevation. Lake Tahoe is not drawn down to natural rim to provide flood control space.
[4] Outflow at time of peak flow at Farad.
[5] Inflow to Boca Reservoir.

Prosser Creek Project. The Prosser Creek project was also constructed by the USBR as part of the Washoe Project. The Prosser Creek project began in May 1960 and was completed in November 1962. Prosser Creek Reservoir has a surface area of 745 acres, and a capacity of 29,800 acre-feet at gross pool elevation 5,741.2 feet. The Prosser Creek Dam is a zoned earthfill structure rising 139 feet above streambed. The crest of the dam at elevation 5,761 feet has a length of 1,830 feet and a crest width of 30 feet. The outlet works, located in the left abutment of the dam, consist of an 8-foot-diameter circular conduit upstream from the gate and a 9-foot flat-bottom (arch roof) conduit downstream. Capacity of the outlet is 1,850 cfs when the water surface is at gross pool (elevation 5,741.2 feet) and about 750 cfs at elevation 5,650 feet. The spillway is an ungated concrete channel extending through the left abutment of the dam. It has a crest width of 15 feet (crest elevation 5,741.2 feet) and a discharge capacity of 2,750 cfs at elevation 5,754.5 feet.

Martis Creek Lake. Martis Creek Lake was authorized as part of the Truckee River and Tributaries Project by the Flood Control Act of 1962 (Pub. L. 89-874). Martis Creek Lake Project is located about 32 miles upstream from Reno. The project consists of a dam and lake for flood control, recreation, and future water supply, and about one mile of channel improvement work by local interests along the Truckee River in Reno. The intermittent channel improvement work in Reno from Booth Street to Center Street consisted mainly of modifying and extending existing floodwalls to provide a capacity of 14,000 cfs though the city. The segment of the project in Downtown Reno upstream of Glendale Avenue, maintained by the Carson-Truckee Water Conservancy District, was last inspected by USACE in 2010. At that time, the overall rating of the segment was Minimally Acceptable due to vegetation growing in and around the floodwalls, vegetation growing in the floodway, minor sedimentation within the channel, and an encroachment causing erosion. An engineering determination concluded that the

unacceptable items would not prevent the project from performing as intended during the next flood event.

The Martis Creek Dam has been identified as having a very high urgency of action to reduce the risk associated with dam failure. Interim risk reduction measures have been implemented which include leaving the gates open limiting the reservoir pool to approximately elevation 5,810 feet. Hydrologic modeling accounts for Martis Creek Dam operating with this interim risk reduction measure in place. A detailed Risk Analysis is being completed to justify whether this classification rating is still warranted. It is anticipated that the classification may be reduced to a lower risk rating. A selected course of action is expected to be identified in 2013. The future without-project assumption is that interim risk reduction measures would remain in place until a solution is identified, approved, and implemented.

Derby Dam and Truckee Canal. Located on the Truckee River about 20 miles below Reno, Derby Dam was constructed between 1903 and 1905 by the Bureau of Reclamation to divert water to the Newlands Project for agricultural purposes. The dam, a concrete gate structure with an embankment wing, is 31 feet high with a crest length of 1,331 feet. The dam diverts up to 1,500 cfs into the Truckee Canal. Constructed between 1903 and 1906, the canal has a bottom width of 20 feet, side slopes of 0.5:1, water depth of 13 feet, and length of 32.5 miles. The canal is believed to be capable of carrying somewhere between 800 to 1,000 cfs at full capacity. During a large flood event, the operating criteria for Derby Dam are to limit diversions into the Truckee Canal to prevent flooding in the vicinity of the Lahontan Reservoir; however, some diversions have occurred during past floods. Diversions tend to have little or no impact to flooding problems, especially in the Reno area.

Truckee River Storage Project. The USBR constructed the Truckee Storage Project to provide a supplemental supply of irrigation water to approximately 29,000 acres of land in the Truckee Meadows area. The actual irrigated area is being reduced by urban development. Supplemental irrigation water for the Project is stored in Boca Reservoir on the Little Truckee River, while release of water from Lake Tahoe (operated by the Truckee-Carson Irrigation District) and Donner Lake is made to provide better regulation of the Truckee River according to the Truckee River Agreement. Diversion and delivery of irrigation water is made by the 33 ditch companies which form the Washoe County Water Conservation District. Table 2-2 lists the major canals and capacities.

Washoe Project. The USBR constructed the Washoe Project to improve the regulation of runoff of the Truckee and Carson River systems and to provide supplemental irrigation water and drainage for presently irrigated lands, as well as water for municipal and industrial and fishery uses, flood protection, fish and wildlife benefits and recreation development. Major features of the project in addition to Prosser Creek and Stampede Dams include Marble Bluff Dam and Pyramid Lake Fishery, both in operation and within the study area.

NV Energy. NV Energy (formerly Sierra Pacific Power Company) owned and operated five hydroelectric power plants with a total installed capacity of 9,400 kW. Descriptive data for plants located along the Truckee River in the reach between Truckee and Reno are provided in Table 2-3.

Table 2-2. Major Canals and Capacities of the Truckee Storage Project

Canal	Capacity (cfs)
Coldron	20
Steamboat Ditch	110
Highland Ditch	104
Orr Ditch	60
Land Chance Ditch	47
Lake Ditch	50
Cochran Ditch	48
Glendale Ditch	40
Pioneer Ditch	35
North Truckee Ditch	43

Table 2-3. Hydroelectric Plants between Truckee and Reno

Plant	Total Head (feet)	Installed Capacity (kw)
Farad	83	2,800
Fleish	125	2,000
Verdi	96	2,400
Washoe	88	1,500
Reno	43	700

The power plants are all run-of-the-river type. Lake Tahoe and Boca River regulate stream flow for irrigation and power purposes, and further regulation is obtained from the Sierra Pacific Power Company's storage reservoir at Independence Lake on Independence Creek, a tributary of Little Truckee River. This reservoir completely regulates the runoff from an 8 square mile tributary area. The NV Energy has also acquired storage rights on Donner Lake, with a capacity of about 9,500 acre-feet on Donner Creek for joint use and Truckee River regulation. The Truckee River Water Authority has recently purchased these power plants.

2.1.3 Population

Washoe County's population was 421,407 in 2010; (US Census, 2010) the 2010 population for Reno was 225,986 and the population for Sparks was 90,264. Most of Storey County is rural or suburban, with only about 1,200 people living in Virginia City and Gold Hill. The U.S. Census recorded a population of 4,010 in 2010 for Storey County. In 2010, the population of the Pyramid Lake Paiute Reservation was 1,660 individuals. Fifty percent of the population resided in Wadsworth, and 15 percent resided in Sutcliffe.

2.1.4 Public Health and Safety

Washoe and Storey Counties, the Cities of Reno and Sparks, and the Pyramid Lake Paiute Tribe (PLPT) provide necessary public services to ensure the health and safety of their residents. These public services include police and fire protection, emergency medical services, and natural disaster plans and response. Public health and safety concerns for the study area include natural disasters, vector control, potential for bird-aircraft strike hazard, and risk of wildland fires.

Natural Disaster Plans and Response

The Washoe County Emergency Management and Homeland Security operates on a regional level and partners with several other local emergency response agencies to provide preparedness, response, mitigation, and recovery services for the County. The Regional Emergency Operations Center serves Washoe County, Reno, and Sparks as a single, permanently established, ready-to-operate location to perform individual and/or integrated emergency response services in support of jurisdictional emergencies or larger regional emergencies and disasters involving two or more jurisdictions. The Washoe County Emergency Management Program functions as a coordination agency during a disaster, providing such assistance as may be needed by the affected communities to safeguard life and property. The intent is to assess and address the effects of the event and use the Incident Command System as part of the National Incident Management System during the response phase.

Storey County Emergency Management provides planning and coordination for the response, recovery and mitigation of natural and man-made disasters occurring within Storey County. The Storey County Emergency Management Plan provides guidance and outlines a cooperative effort among several departments and divisions of county government, including the Fire Department, Sheriff, Public Works, Budget and Finance, Commissioners, District Attorney, Assessor, Recorder, and Clerk that work together to mitigate any actual or potential disaster or event.

The National Weather Service forecast office in Reno provides the watches, warnings, and advisories for the entire study area. Information during the response phase of an emergency is provided by the Emergency Alert System. The Emergency Alert System is the new system adopted by the Federal Communications Commission to replace the old Emergency Broadcast System and is a universal tool to route emergency messages to the public swiftly and efficiently. The Washoe County Emergency Alert System also includes a Flood Warning System, which is a web-based application enabling flood hazard information to be readily available during flood events as well as for general monitoring purposes. For the purposes of this GRR, the existing flood warning system is considered to be sufficient.

Aviation Safety

Reno International Airport is located within the Truckee Meadows Reach south of the Truckee River. Across the U.S., aircraft collisions with birds and other wildlife annually cause millions of dollars in damage and can jeopardize current and aircrews. Most public-use airports

incorporate large tracts of open, undeveloped land that provide added margins of safety for aircraft operations.

2.1.5 Environmental Resources

Water Resources

The Truckee Meadows area depends primarily on the Truckee River for its water needs. Groundwater provides approximately 15 percent of the water needs. Water rights in Nevada are based on the doctrine of prior appropriations; that is, the entity that first diverts water from a stream preempts a right to the quantity withdrawn, provided that the water is used beneficially. NV Energy sold its water power division, as a joint venture, to Washoe County and the Cities of Reno and Sparks, which provide service to a major portion of the Reno-Sparks metropolitan area as the Truckee Meadows Water Authority (TMWA).

According to the Washoe County Master Plan (2010), although the Truckee River is the major source of water for the region, the flow of the river is highly variable and requires reservoir storage for both municipal and industrial use. Seven reservoirs on the Truckee River and its tributaries provide storage to regulate the flow of the river. Lake Tahoe provides about 70 percent of the available storage on the river system. Most of the river's flow originates downstream from Lake Tahoe, where it can be regulated by only 30 percent of the available storage on the river system. Even with seven reservoirs, the storage is not sufficient to fully regulate the flow of the river.

Surface water ownership in the Truckee River Basin was established through the U.S. District Court's Orr Ditch Decree entered by the U.S. District Court for the District of Nevada. *United States v. Orr Water Ditch Co., et al,*, Equity Docket No. A3 (D. Nev. Sept. 8, 1944)). There are in excess of 300,000 acre-feet of water rights either adjudicated through the Orr Ditch Decree (Truckee River water) or permitted by the State Engineer (ground and surface water) in Washoe County (excluding the Lake Tahoe area). However, the actual extent of the water resource in a dry year is significantly less than indicated by the water rights. Most surface water use is for agriculture; however, the Truckee River also represents a potential source of domestic water supply.

Hazardous, Toxic, and Radiological Waste

USACE performed an Environmental Site Assessment during July 2003 and in 2011. The site assessment identified numerous sources of possible contamination due to hazardous, toxic, or radiological waste (HTRW) during a records search and field survey. The data search showed 686 sources of potential contamination within one mile of the study boundaries – but not within the boundaries. In addition to the data search, USACE performed a site visit to look for the following common environmental concerns: drums; landfill or solid waste disposal sites; pits, ponds, or lagoons; wastewater; PCB-containing transformers; and the presence or likely presence of any hazardous substance or petroleum products on the property under conditions that indicate an existing release, a past release, or a material threat of a release on the property or into the ground, groundwater, or surface water of the property. USACE neither saw any hazardous

materials nor encountered any storage containers during the site visit. There are several storage tanks (both AST's and UST's) that exist in the study area, but do not appear to interfere with any of the alternatives. USACE also observed transformers during the site visit that appeared to be recently replaced. HTRW is not expected to be an issue for formulation of alternative plans.

Vegetation

Vegetation in the urban areas of Reno, Sparks, and Truckee Meadows has been heavily modified by residential, commercial, and agricultural developments. Discontinuous, narrow strips of riparian vegetation are currently found along the river, confined to available substrates above and below existing riprap and to urban parks west of downtown Reno. The riparian vegetation is dominated by small stands of native black cottonwood, Fremont's cottonwood, white alder, buffaloberry, willow shrubs and trees, and nonnative ornamental elm trees. Herbaceous understory species include mugwort, horsetail, baltic rush, umbrella sedge, poison hemlock, weedy mustards, and lambsquarter.

Four habitat types are associated with the lower reach of the Truckee River: Great Basin cottonwood-willow riparian forest, Great Basin riparian scrub, upland sagebrush scrub steppe, and shadscale scrub communities. In addition to these native plant communities and species, there are several introduced species that are typically classified as noxious weeds that commonly occur along the lower reach of the Truckee River. These species include tamarisk, Russian olive, whitetop, wide-leaved peppergrass, cheatgrass, and foxtail chess. Tamarisk, whitetop, and wide-leaved peppergrass are of particular concern due to their high densities, extreme competitive behavior, high water use, and lack of usefulness for wildlife habitat and range forage.

Threatened and Endangered Species

Several Federally listed or proposed species have the potential to occur in the study area. These include the Lahontan cutthroat trout, cui-ui lake sucker, and Steamboat buckwheat. The Steamboat buckwheat is not known to occur in the project area.

The Lahontan cutthroat trout (LCT) and cui-ui lake sucker are known to inhabit the Truckee River. The LCT, listed as endangered in 1970, was reclassified as a threatened species in 1975. The U.S. Fish and Wildlife Service (FWS) is currently in the process of revising their 1995 Recovery Plan for the LCT.. In 2003, the Truckee River Recovery Implementation Team[1] developed a short-term action plan for LCT in the Truckee River basin which focuses on gathering information about habitat requirements and implementing demonstration projects and research (Interior & State, 2008). The action plan identifies tasks intended to eliminate or minimize threats that affect LCT in the Truckee River and through continued implementation of this process, ensure the long-term persistence of the species. Major issues include: (1) reduction and alteration of stream flow and discharge; (2) alteration of stream channels and morphology; (3) degradation of water quality; (4) reduction of Pyramid Lake elevation and concentration of chemical components; and (5) introductions of non-native fish species.

[1] Composed of representatives from USFWS, USGS Biological Resources Division, U.S. Forest Service, BIA, USBOR, CDFG, PLPT, Trout Unlimited, Otis Bay Consultants, and UNR.

The cui-ui is classified as endangered by the Federal government and the State of Nevada. The Federal listing occurred on 11 March 1967. Steps needed for the recovery and maintenance of the cui-ui are outlined in the FWS's Cui-ui Second Revision Recovery Plan, 1992. The cui-ui is publically recognized as significant as a sacred resource by the Pyramid Lake Paiute Tribe.

The LCT can be found throughout the entire Truckee River, including the four reaches under this study. The cui-ui are not able to access the river beyond Derby Dam, located downstream of Tracy. According to the Truckee River Operating Agreement (TROA) final EIS, Numana Dam is a complete impediment to cui-ui and impedes spawning success.

2.1.6 Related Ecosystem Restoration Projects

There have been many opportunities for ecosystem restoration along the Truckee River. Local interest in ecosystem restoration has resulted in multiple levels of local, regional, and federal agencies participation in designing projects that have provided an increase in ecosystem habitat within the watershed.

Lower McCarran Ranch

In June 2002, The Nature Conservancy (TNC) acquired the McCarran Ranch property in 2003 and developed a preliminary restoration plan to restore habitats for a diverse array of native species. The plan included reconstructing the river channel to elevate the existing incised riverbed and to reestablish the meandering pattern of the channel. The plan also included an eradication program to eliminate nonnative invasive plant species and revegetation specifications. This restoration plan combined with other measures and alternatives was studied as a USACE Section 1135 Continuing Authorities Program project. In 1986 Congress authorized USACE to modify existing projects to restore the environment (WRDA 1986, § 1135). However, funding constraints in that program caused TNC to proceed on its own.

TNC completed a 1-mile pilot project at the upstream portion of McCarran Ranch in late 2003. It included raising the river channel, and creating a series of pool and riffles in the existing channel and floodplain ponds for the western pond turtle. Restoration of the remaining 4 miles of the river at McCarran Ranch was completed in 2008 by TNC.

Lockwood

Washoe County acquired the Lockwood property on the downstream Truckee River floodplain for permanent open space and potential ecosystem restoration purposes. The County hired Otis Bay Riverine Consultants to prepare a Phase I conceptual level restoration and improvement alternatives study. This property is located about 2.5 miles downstream of Vista, extends 4,000 feet along the channel within Washoe County, and has a history of flooding and flood-related damage. The County purchased the property and removed all but one of the homes (one home is still in private ownership) to prevent future flood-related problems. The report, entitled *Truckee River – Lockwood Conceptual Restoration Project*, prepared by Otis Bay Riverine Consultants (January 2001), states that it is the County's intent to either use the

Lockwood property as land area where required mitigation could be implemented for adverse effects on water quality caused from operation of the Truckee River Municipal Wastewater Treatment Plant, or where increased flood storage or ecosystem restoration could occur as a part of this project. In 2009, the project proponents completed a restoration project on this property that included a trail system, boat launch facility, bank sloping, and plantings.

Steamboat Creek

In October 2001, USACE completed a Preliminary Restoration Plan for restoration of aquatic ecosystems in Steamboat Creek pursuant to WRDA 1996, § 206 (Section 206). The proposed project consists of excavation of a new channel through the alfalfa fields to the west of the current creek location, with an objective of creating a restored stream channel length from 1.1 miles to 2.2 miles upstream from the confluence with the Truckee River. The conceptual design for the new channel is a single threaded, low-gradient meandering channel. Placement of grade control structures and planting of appropriate native obligate wetland species in the channel and on floodplains are also features of the restoration plan. Funding constraints in Continuing Authorities Program forced the USACE to defer the Section 206 study indefinitely. The City of Reno has continued their planning effort for Steamboat Creek. For the purposes of this GRR, no specific restoration project is assumed under future without-project conditions because no specific restoration plan has been adopted or funded.

2.1.7 Recreational Projects and Facilities

Related Recreation Projects

Open Space Plan of 1972. The City of Reno has made efforts to recapture open space and create recreation features favored by residents. In the early 1970's, the city began to take steps to reverse the damage done to the river environment. An open space plan in 1972 identified objectives such as a system of lanes, paths, and trails developed for bicycles, linkages that could be used for equestrian trails, hiking and bicycling between the various existing open spaces, and various commitments to encourage cooperative development along the river to maintain open areas, provide public access to the river, preserve esthetic quality and the natural environment of the river. The city has undertaken several projects implementing aspects of the 1972 plan.

Whitewater Parks. Truckee River Park and Kayak Course at Wingfield Park was constructed in 2003 on the Truckee River above the Center Street Bridge. This whitewater park provides a hardened river-rafting course through the center of downtown Reno. The park is 1,400 feet long and contains five drop structures, current deflectors, benched banks, and boulders. The park also includes a pedestrian and bike path on Wingfield Island. A similar whitewater park has recently been completed for the reach of the Truckee River near Sparks. This park consists of many of the same features as the whitewater park at Wingfield Park.

Tahoe-Pyramid Bikeway. Plans are underway for the Tahoe-Pyramid Bikeway. This is a volunteer effort to create a 116-mile trail along the Truckee River from Lake Tahoe to Pyramid Lake. Several stretches of the bikeway have been completed. The Tahoe-Truckee Link connects Lake Tahoe with the town of Truckee. The Mogul-Verdi Link was opened in May 2005. It joins

the Verdi-Reno-Sparks section that is a continuous trail from Mogul to Vista. A 25-mile section on the Pyramid Paiute Reservation was completed in 2006. A day-use permit is required to use this portion of the bikeway on tribal lands.

Reservoirs. Upstream of the Reno-Sparks metropolitan area within the watershed of the Truckee River are Boca, Stampede, Prosser, and Martis Creek reservoirs. Along with providing flood control and water storage, the reservoirs provide recreational opportunities to residents in the region. Boca, Stampede, and Prosser reservoirs offer motorized and non-motorized boating, angling, swimming, sunbathing, picnicking, camping, hiking, hunting, off-road vehicle recreation, and sailing. Martis Creek Reservoir offers non-motorized boating, angling, hiking, river rafting, and hunting. Although not within the study area, these reservoirs provide recreation opportunities that were considered as part of the without-project condition for the regional recreation needs.

Recreation Facilities

Verdi Reach. The Verdi Reach provides limited opportunities for fishing and rafting. However, there are no developed facilities or public access points along this stretch of the Truckee River.

Downtown Reno Reach. The city of Reno has 17 parks and access sites to the Truckee River. Recreational opportunities exist along the Truckee River throughout the entire study area. The Truckee River Whitewater Park is a $1.5 million project in the downtown Reno district.

Truckee Meadows Reach. A recreation trail exists along portions of the Truckee River from Booth Street to Highway 395 and from Highway 395 through the city of Sparks. The city of Sparks has four parks and access sites and also maintains the Truckee River Greenway, which includes Fisherman's Park and a trail along the north bank of the river. This existing greenway follows the northern bank of the Truckee River and contains both developed park areas as well as natural open space. While facilities vary along the greenway depending on the location, the entire greenway has a paved pathway, which extends further west into downtown Reno. In total, this pathway is 6.8 miles long. A second whitewater park at Rock Park was constructed in 2009 as part of a total renovation of Rock Park. The whitewater park consists of 1,000 feet of constructed pools and riffles.

Along the Truckee River Greenway are picnic shelters, restrooms, sand volleyball courts, playgrounds, horseshoe pits, picnic areas, open play areas and turf, and parking areas. The City of Sparks has made a significant investment in the development and maintenance of the facilities and property along the greenway. Some of the parklands along the Sparks Truckee River Greenway were purchased with Land and Water Conservation Fund Act money. In total, the Sparks Truckee River Greenway occupies 75 acres.

Lower Truckee River Reach. This reach of the Truckee River has limited public access and few developed recreational areas. Most access is via private property. A portion of the Truckee River Greenbelt (a distant extension of the greenbelt in the Meadows reach) is located just downstream of Rainbow Bend. The greenbelt in the lower reach extends approximately 700

feet along the north bank of the channel. Recent restoration efforts at Lockwood and McCarran Ranch provide some passive recreation opportunities and other similar efforts are anticipated. A recent regional effort is the establishment of the Tahoe-Pyramid Bikeway. The objective of the bikeway is to establish a trail that would allow recreationists to follow the Truckee River by foot or by bicycle from its source at Lake Tahoe to its desert terminus, Pyramid Lake. Current open sections of the bikeway include a trail running through the Pyramid Lake Paiute Reservation from Wadsworth to Pyramid Lake.

Pyramid Lake, famous for its LCT fishery, is located about 35 miles north of Reno on the Pyramid Lake Paiute Indian Reservation. Pyramid Lake is the largest lake that is entirely located within the State of Nevada. Along with LCT, other species of fish within the lake are the Lahontan tui chub, the cui-ui, the Tahoe sucker, and the Sacramento perch.

2.1.8 Cultural Resources

A records and literature search of the study area was conducted at various sources in 2004 and 2010. A search of the National Register of Historic Places (NRHP) and the Nevada Historical Society for listed properties was conducted. According to the NRHP records, there are 37 listed historic properties, all of which are buildings, structures, and objects in the downtown Reno area. The term "historic property" refers exclusively to NRHP listed or eligible properties. The NRHP only includes sites that have been determined to meet specific criteria for historical significance; it does not include all known or potentially significant sites. A records search from the Nevada State Museum found that a total of 82 cultural resource surveys have been conducted in the study area. The search showed that 41 historic and historical period properties and 210 archeological sites had been recorded within the project's study area. Previous researchers with a long history of conducting archeology in the area were contacted to verify site locations and determined if they had any recommendations of any kind. Those dialogs were very useful in clarifying contradictory site location information, and testing results. The cultural resources inventory is a compilation of data gleaned from existing records, The National Parks Service, in-house pedestrian surveys, historic building survey contracts, and discussions with local property owners.

USACE met on separate occasions with Washoe Tribe of Nevada and California (Washoe Tribe) and the Pyramid Lake Paiute Tribe. On January 23, 2007 USACE personnel with two consulting ethnographers met with representatives from the Pyramid Lake Paiute Tribe, the Washoe Tribe of Nevada and California, and the Reno Sparks Indian Colony to discuss the upcoming Ethnohistory history report. The Tribal members were asked about known sites or areas of traditional Cultural interest, but offered no details regarding specific locations of interest. When asked specifically about the Truckee River they indicated the river held no spiritual importance to them.

The Painted Rock Bridge in the Lower Truckee River Reach and four other historical period properties have been recommended eligible for the NRHP by Nevada Department of Transportation and JRP Historical Consultants. Painted Rock Bridge and Virginia Street Bridge were dropped from consideration. The Virginia Street Bridge is being dealt with by local interests. The programmatic agreement has been amended as needed.

Cultural resources were given appropriate consideration during the formulation and evaluation of alternative plans.

2.1.9 Tribal Lands and Issues

The Washoe Tribe and Reno-Sparks Indian Colony have trust resources in the Truckee Meadows Reach that are subject to flooding. The Pyramid Lake Paiute Tribe is subject to flooding in the Lower Truckee Reach. Protection and restoration of fisheries, water supply, and water quality are important concerns of the Tribe.

2.1.10 Allocation of Water from the Truckee River

Truckee River water allocations for various uses are complex and are the result of a long history of Federal and interstate decrees, lawsuits, and laws. There are a total of 19 diversions from the Truckee River between the California-Nevada border and Pyramid Lake; 11 of the diversions are downstream of Vista. The Truckee River is the principle source of water for irrigation, municipal, industrial, and domestic uses in the cities of Reno and Sparks, and in the neighboring rural communities of Washoe and Storey counties.

The most significant water development project to affect the Truckee River resulted from the Reclamation Act of 1902 Pub. L. No. 57-161, 32 Stat. 388-390 (1902), which that authorized the Newlands Project and construction of Derby Dam and Truckee Canal, a trans-basin diversion for agricultural development in the Fernley and Fallon areas. This development has changed the hydrology of the Truckee River downstream of Vista to a highly variable regime of minimal low flows and periodic high flood flows when upstream storage is exceeded.

The diversion of over one-half of the annual flow of the Truckee River since 1905 is the major contributing cause of the lowering of the water surface elevation of Pyramid Lake. Pyramid Lake inflows have been significantly reduced during the last century as a result of these trans-basin diversions that caused the level of Pyramid Lake to drop about 80 feet between 1905 and 1967. Lake level fluctuations at the exposed delta at the river mouth have historically created channel instability and aquatic habitat degradation, including the blockage of endangered fish passage at the river's delta/lake interface to spawning grounds upstream.

2.1.11 Completed Local Projects

The following early implementation ("TRAction") projects have been completed by the sponsor:

<u>Reno-Sparks Indian Colony Levee</u>. The project consists of 2,241 linear feet of levee and floodwall construction on the border of the Reno-Sparks Indian Colony along the Truckee River. The project was designed to contain the flood event with an estimated 0.85 recurrence interval with risk and uncertainty included.

Lockwood Restoration. This project is located directly upstream of the Rainbow Bend planned community. It consists of 1,510 linear feet (4.5 acres) of in-stream riffle habitat, 750 linear feet (2.1 acres) of channel habitat; 1.8 acres of wetland habitat; 1.5 acres of grassland/ herbaceous habitat; 4.7 acres of native shrub habitat; and 22 acres of native woodland habitat.

Mustang Ranch Restoration. This project is located at Mustang Ranch along the Truckee River downstream of the Rainbow Bend community. It consists of 1,366 linear feet (3.7 acres) of in-stream riffle habitat; 2,563 linear feet (7.0 acres) of channel habitat; 10.7 acres of wetland habitat; 14.8 acres of grassland/herbaceous habitat; 90.7 acres of native shrub habitat; and 60.0 acres of native woodland habitat.

102 Ranch Restoration. This project is located at 102 Ranch along the Truckee River. The project consists of 875 linear feet (2.5 acres) of in-stream riffle habitat; 1615 linear feet (4.4 acres) of channel habitat; 4.9 acres of wetland habitat; 18.7 acres of grassland/herbaceous habitat; 23.4 acres of native shrub habitat; and 60 acres of native woodland habitat.

2.2 Future Without-Project Conditions

The assumed without-project condition is the benchmark against which alternative plans are evaluated. Under future without-project conditions, it is assumed for planning purposes that no Federal action will be taken to alleviate flood or ecosystem problems in the study area, other than the implementation of the Truckee River Operating Agreement approved in 2008 by the Bureau of Reclamation (BOR). Changes in future without-project conditions that are anticipated due to continuing trends or likely non-Federal actions are addressed in the following paragraphs. These forecasts are from the base year (year when a project is assumed to be operational) to the end of the period of analysis (50 years).

2.2.1 Physical Setting

Verdi Reach

No specific physical changes relevant to the evaluation of alternative plans are anticipated in the Verdi Reach.

Downtown Reno Reach

The existing floodwalls and levees will continue to serve as flood control features for the Downtown Reno Reach, if properly maintained. The Sierra, Virginia, Center and Lake Street bridges will continue to be a constraint on water passage on the Truckee River through downtown Reno.

Truckee Meadows Reach

Though the Reno Flood Warning System will continue to function and provide Reno and Sparks with advanced warning of flood events, the Reno-Sparks area will remain at risk from

flooding without a Federal project. Floodplain management, flood warning systems, and emergency preparedness are expected to continue in the region.

A regional water management plan will remain in place that addresses groundwater and surface water quality, water supply, flood and water drainage management, and other plan requirements.

Lower Truckee River Reach

The community of Rainbow Bend at Lockwood would likely remain the same size since developable land adjacent to the community is scarce. Rainbow Bend would remain at risk from flooding from Long Valley Creek, a tributary to the Truckee River.

2.2.2 Socioeconomic Conditions

Verdi Reach

There likely would be additional development in this reach in the future; however there are no specific plans. Developable areas lie outside the floodplain high on hills and terraces.

Downtown Reno Reach

Forecasts for future without-project conditions indicate that Reno and Sparks will continue to grow at a rate of about 1.4 percent per year. It is assumed that additional redevelopment of the downtown Reno area will continue and that development will include flood proofing from the 1% Annual Change of Exceedance (ACE) event (also referred to as 1:100, 1/100, or "100-year event"). By the year 2030, the city of Reno population is expected to increase to approximately 339,500.

Truckee Meadows Reach

Based on a projected population of 590,490 for Washoe County in the year 2030, the average annual growth rate is 1.32 percent. Pressure to develop the area closer to the Truckee River will continue to be managed by local ordinances that require that there be no net loss of flood storage in the Truckee Meadows area. Truckee Meadows is expected to develop in areas outside the floodplain.

Lower Truckee River Reach

The Nevada Small Business Development Center has estimated that the population of Storey County will increase to 6,023 by 2025. While some reduction in farming and ranching is expected due to economic conditions, it is not expected that development will increase substantially since opportunities closer to Reno and Sparks exist and would lure development before this highly rural area.

2.2.3 Environmental Resources

Previous studies along the Lower Reach of the Truckee River show a decrease in the number of bird species in the area and a decrease in the number of individuals of each species. The researchers concluded that the declining trend is probably due to the loss of suitable marsh and riparian habitats. Bird habitat has continually degraded since the last study in 1976. For example, cottonwoods that depend on a wet substrate for seed germination and development are now isolated from all but the more extreme flood flows. Eventually these isolated forests will die without regenerating new growth. As a result, bird diversity and abundance will continue to decline.

Reservoir storage requirements and in-stream flow requirements are assumed to remain the same under future without-project conditions. Current negotiations are addressing the need for additional water, but many complex issues and conflicting values among the participants result in uncertainty in predicting the future without-project conditions. River system operations are assumed to remain basically the same, since conflicting environmental, social, and economic factors will continue to make storage and in-stream flow changes to the system increasingly difficult with time. Because of the scarcity of water in Nevada and the institutional pressures created by that scarcity, it is assumed for planning purposes that no specific increases in flow for recovery of Federally listed fish species (LCT and cui-ui) will be implemented under the future without project conditions. However, it is assumed that Numana Dam on the lower Truckee River will be removed or modified for fish passage purposes by the PLPT in coordination with the Bureau of Indian Affairs per the Consolidated Appropriations Act of 2008 (Pub. L. No. 110-161, Truckee River Operating Agreement approved in 2008 which appropriated funding through tBOR's Terminal Lakes Project for that purpose. In addition, it is assumed that USBOR will install a fish screen on the Truckee Canal at Derby Dam under the future without-project condition, allowing the existing fishway at Derby Dam to be operated, as required by a USFWS Biological Opinion (File No. 1-5-01 -F-228) issued to BOR in 2001.

Future conditions of the ecosystem on the Truckee River will be heavily influenced by the availability of water for in-stream uses under any new water allocation arrangements. The latest effort to resolve long-standing disputes over water use and water rights on the Truckee River has been the enactment of the Tribes Water Rights Settlement Act, § 207). The Act requires to be effective, an operating agreement, known as the Truckee River Operating Agreement (TROA), must be implemented. The TROA would implement provisions of the Act, including interstate allocations between California and Nevada, greater flexibility in the operation of Truckee River reservoirs for efficient water use, changes to the exercise of water rights that will benefit listed species and storage of water in Federal reservoirs for the cities of Reno and Sparks during drought. TROA was signed in 2008, but is not yet fully implemented. Instead, flows in the river continue to fall under the Orr Ditch Decree of 1944 previously discussed in Section 2.1.5. However, it is assumed for planning purposes that TROA will be fully implemented in the future without-project condition.

It is assumed that no additional water will be available for restoration unless water rights are purchased. Under the TROA agreement, Washoe County is obligated to ensure that 6,700 acre-feet of yearly water flow will be dedicated to continued in-stream use, rather than

diverted for other uses. This study assumes that 6,700 acre-feet of existing annual flow will continue under future without-project conditions.

The McCarran Ranch ecosystem restoration project has been constructed and will provide restored habitat along a 4-mile stretch of the Truckee River below Vista. (Restoration projects have also been implemented at Lockwood, 102 Ranch, and a portion of Mustang Ranch. See Section 2.1.11 below for more information about these projects.) The Nature Conservancy will likely continue to implement restoration projects along the Truckee River. However, their efforts will be limited by the availability of funding. Because no specific restoration projects have been approved and identified as likely to be funded, no specific additional restoration projects are assumed to be constructed on the Lower Truckee River under future without-project conditions.

2.2.4 Recreational Projects and Facilities

The future without-project condition, from a recreation perspective, is a continued but growing deficit in all types of park amenities, but particularly for group picnic areas, open space for concerts, festivals, and sports and practice fields.

Recreation use without the project was estimated to be 1,800,000 recreation days, based on the surveys conducted earlier in the study process (2008). It is anticipated that the total recreation demand will increase over the period of analysis. From FWS estimates, fishing use without the project is estimated to be from 61,000 to 65,000 angler days in that part of the study area influencing angler use. As quality available land and water are limited, recreation opportunities will remain limited.

2.2.5. Regional Transportation Commission Project

Washoe County Regional Transportation Commission (RTC) plans to construct a 5.5 mile north to south roadway in the USACE study area. This roadway is referred to as the SouthEast Connector and spans the Truckee River and smaller creeks in the study area. Construction is planned in two phases:

- Phase 1 begins at the intersection of Greg Street and Sparks Boulevard in the city of Sparks and continues to just south of Clean Water Way, as shown in Figure 2-14. It includes bridges over the Truckee River and over Clean Water Way. Construction of Phase 1 has begun and is scheduled for completion in April 2014. Due to the design of the bridges, there would be no placement of dredged or fill material in waters of the United States and thus no Department of the Army (DA) permit from USACE under Section 404 of the Clean Water Act was required for Phase 1.

- Phase 2 includes a roadway from Clean Water Way to the intersection of South Meadows Parkway and Veterans Parkway. Phase 2 has opposition from citizen groups, including a notice of intent to sue. This roadway does impact jurisdictional waters of the United States, so the RTC must obtain a Section 404 permit. A permit application was recently submitted to USACE. Construction is tentatively scheduled by RTC for 2014 to 2016.

Although it is considered likely that a roadway project will be built, there is significant uncertainty about the final design and effects of the roadway. This uncertainty is due to changes that may be required in order to obtain a DA permit or to resolve the current public opposition. The SouthEast Connector is being designed to avoid any increase in water surface elevations for the 0.85% ACE flood event, but is not being designed to accommodate any future flood risk management project. Due to the high level of uncertainty, the hydraulic effects of the SouthEast Connector were not included in USACE's detailed hydraulic analysis for existing or future without project conditions. Instead, a sensitivity analysis was conducted for the NED Plan. The results of the sensitivity analysis are described in Chapter 6, Section 6.7.

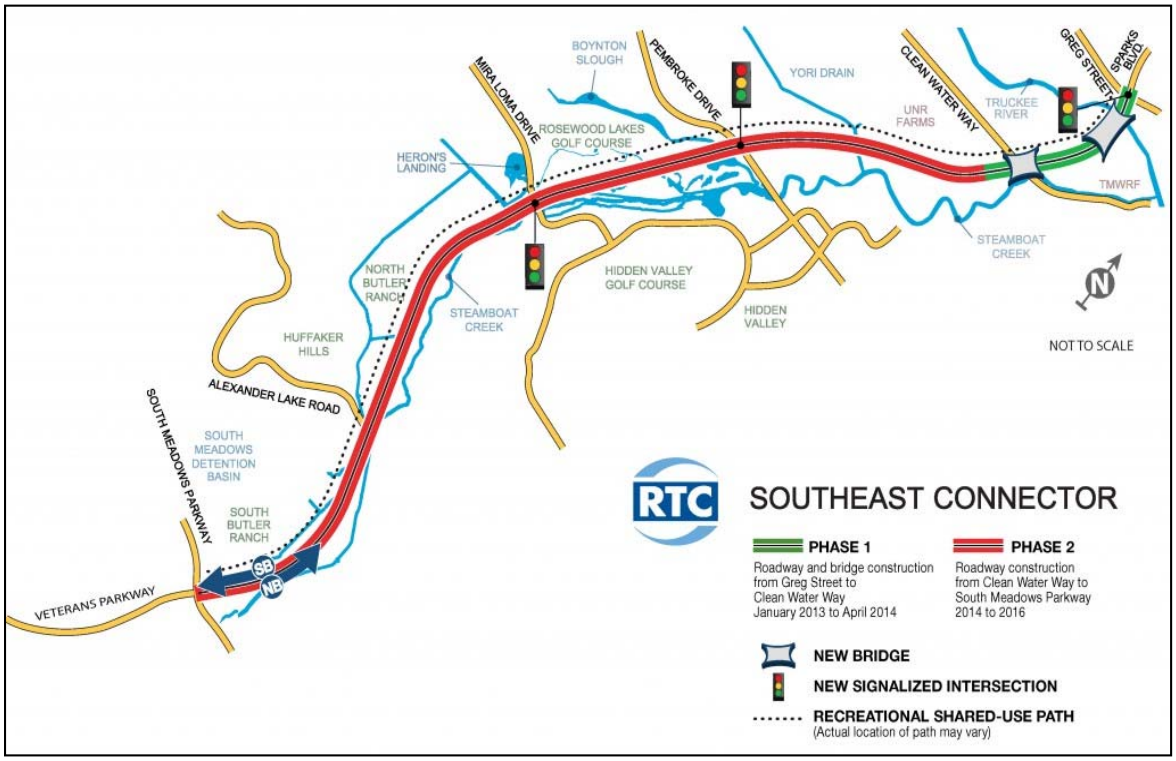

Figure 2-14. Proposed SouthEast Connector Project (Source: Washoe County RTC)

2.2.6 Cultural Resources

Under the future without-project condition, adverse effects to known cultural resources are more likely to occur from abandonment or disrepair rather than future flooding in the Truckee Meadows Reach. Hydraulic modeling indicates the parcels that include the Ferrari Farm historic buildings and structures and the creamery building and barn at Jones Ranch begin to experience flooding between the 1/20 ACE and 1/50 ACE. However, depths remain below 2 feet at the 1/100 ACE on the Ferrari Farms parcel, while flooding at the Jones Ranch creamery building and barn would experience flood depths of up to 6 feet for the 1/100 ACE. Prehistoric archeology sites have been inundated before and do not appear to have suffered any noticeable loss of integrity.

There is insufficient survey information available for the Lower Truckee River reaches to make a clear statement about effects under future without-project conditions. Past flood events generated debris loading on bridge piers, including the Painted Rock Bridge and this debris loading is expected to continue under future without-project conditions. The bridge deck for the Painted Rock Bridge currently overtops at approximately the 2% ACE (also referred to as 1:50, 1/50, or "50-year event"). Maintenance, repair, and potential replacement of the bridge would be expected to be continued by NDOT.

2.2.7 Tribal Lands and Issues

Within the Truckee Meadows Reach, the Reno-Sparks Indian Colony would continue to be affected by potential flooding and flood damages under future without-project conditions. Reno-Sparks Indian Colony trust resources in the Truckee Meadows Reach would continue to be at risk of flooding and flood damages.

Restoration on the Pyramid Lake Paiute Reservation, such as increased water quality and water level in Pyramid Lake, would be limited under without-project conditions. It is expected that the tribe will continue to work with Federal agencies to secure funds for restoration of water quality and the native fishery. Because there is no specific approved plan for restoration on tribal lands that is likely to be funded, it is assumed for planning purposes that no additional restoration will be implemented on tribal lands under without-project conditions.

2.2.8 Completed Local Work Eligible for Credit

The sponsor has constructed several potential project features that had previously received approval from the Assistant Secretary of the Army (Civil Works) for crediting eligibility. It is important to establish the without-project condition with regard to this completed work. The eligible flood risk management work consists of the Reno-Sparks Indian Colony (RSIC) levee/floodwall and the North Truckee Drain (NTD) modifications. Table 2-4 lists the completed ecosystem restoration work and funding sources (Federally-funded work is not eligible for credit). The RSIC levee/floodwall has been constructed, but the NTD modifications have not.

Because this local work was undertaken after approval of consideration for crediting, this work is assumed to not be in place under the without-project condition when formulating or evaluating plans for the same purpose. (For example, the Reno-Sparks Indian Colony Levee is assumed to not be in place when formulating or evaluating flood risk management measures, but would be assumed to be in place when formulating or evaluating ecosystem restoration measures, if it affected any potential restoration measures.) This assumption is necessary to determine whether the locally-constructed work should be included as cost-shared features in the USACE recommended plan. The hydraulic, economic, and environmental analyses for flood risk management include the completed local restoration work in the without-project condition, but exclude the Reno-Sparks Indian Colony Levee from the assumed without-project condition. The North Truckee Drain modifications have not been constructed and are not included in the without-project condition.

Table 2-4. Potentially Eligible Section 113 Restoration Work and Funding Sources

	LOCAL FUNDING SOURCES					FEDERAL FUNDING SOURCES						TOTAL
	TRFMA		WC	Reno/Sparks	SUBTOTAL	USBOR	USBLM	USFWS	FEMA	USACE	SUBTOTAL	
	1/8-cent Sales Tax	AB-5 Grant (State of NV)	SQ-1 Program	TMWRF Sewer Fees	Local Funding	DTL Program	SNPLMA Program				Federal Funding	All Funding Sources
LOCKWOOD (~28 acres) Ecosystem Restoration + Trailhead	$392,000	$0	$2,116,000	$0	$2,510,000	$1,725,000	$0			$0	$1,725,000	$4,236,000
102 RANCH (~ 128 acres) Ecosystem Restoration	$0	$3,100,000	$0	$306,000	$3,406,000	$2,500,000	$500,000	$30,000	$0	$0	$3,030,000	$6,436,000
LOWER MUSTANG RANCH (~ 280 Acres) Ecosystem Restoration	$0	$1,675,000	$1,302,000	$776,000	$3,753,000	$4,217,000	$0	$0	$0	$0	$4,217,000	$7,970,000
TOTAL CONTRIBUTION BY SOURCE:	$392,000	$4,775,000	$3,420,000	$1,082,000	$9,669,000	$8,445,000	$500,000	$30,000	$0	$0	$8,975,000	$18,644,000

Costs include land acquisition; planning, design, and permitting; construction; and short-term monitoring and maintenance
Estimates are approximate and intended only for planning purposes
See chapter 6 for further discussion of Section 113 crediting
Source: D. Henderson, TRFMA 2011

CHAPTER 3
PROBLEMS AND OPPORTUNITIES

This chapter identifies the problems and opportunities in the study area based on the existing and expected future without-project conditions. The main areas of concern include continued flooding in the Truckee Meadows and resulting flood damages, river channel instability, degradation of riparian habitat, restricted fish passage, and the lack of recreation opportunities on the Truckee River.

3.1 Flood Problems

Problem: Flooding poses a life and safety hazard to downtown Reno and Truckee Meadows.

The Truckee Meadows has a long history of flooding from the Truckee River. Five significant floods were recorded in the area in the nineteenth century and at least nine in the twentieth century. Early accounts indicate that flooding took place in the study area in 1861, 1862, 1867, 1886, and 1890. In the Twentieth Century, major floods occurred in 1907, 1909, 1928, 1937, 1950, 1955, 1963, 1986, and 1997. Implementation of flood control measures, beginning about 1960, reduced the magnitude and frequency of flood events. The 1950, 1955, and 1963 events were all similar in magnitude. They were also some of the most damaging of the historical events due to the development of Reno to the south and southwest of the downtown area.

The November 1950 flood was the greatest recorded up to that time, resulting from warm storms that produced more than 5 inches of rain in one day at some locations. A maximum flow of 19,900 cfs was recorded at Reno. Floodwaters extended from West Second Street on the north to Mill Street on the south. All bridges in downtown were closed; the Rock Street Bridge was destroyed; and damage was estimated at $2.5 million (unadjusted 1950 dollars). Flood depths in downtown reached 4 feet and approximately 3,800 acres of agricultural lands were damaged in Truckee Meadows.

A large flood event on the Truckee River occurred on December 23, 1955. A peak flow of 20,800 cfs was measured at Reno where floodwaters reached depths of 5 feet in some downtown locations. In Truckee Meadows, 6,000 acres of farmland sat beneath 6 feet of water for 6 to 10 days. Cannon International Airport (aka Reno/Tahoe International Airport) was flooded, and flights were canceled for several days.

The February 1986 flood event resulted from heavy precipitation upwards of 200% of normal in parts of northwest Nevada. Aided by aggressive flood fighting and the upstream reservoirs at Martis, Stampede, Prosser, and Boca, downtown Reno experienced only minor flooding compared to the 1950 and 1955 floods. The peak flow was 14,400 cfs. Downstream of Vista, overbank flooding damaged property in scattered locations until Pyramid Lake.

The January 1997 event was a significant rain flood event due to a combination of heavy, unseasonably warm rain and snowmelt runoff in the higher elevations. A subtropical storm system originating in the central Pacific Ocean near the Hawaiian Islands brought rains from December 30, 1996 through January 3, 1997. Snowstorms in December 1996 built up the snowpack in the higher elevations of the Sierra Nevada to more than 180 percent of normal. The warm rains falling below the 10,000 ft elevation depleted some of the higher elevation snowpack and melted almost all of the snowpack below 7,000 feet. The peak flow observed at Reno approximately equaled the previous record of December 1955. However, Martis Creek Lake Prosser Creek and Stampede Reservoirs served to reduce the peak considerably in comparison to the 1955 flood. During the peak flow periods, releases from these projects into the Truckee River were near zero. Lake Tahoe releases contributed approximately 2,500 cfs to the peak flows on the Truckee River. The official USGS records for the 1997 flood give a peak flow of 18,200 cfs and 18,400 cfs at the Reno and Vista gages respectively. Personnel at the Hydrologic Engineering Center in Davis, California, calibrated an unsteady state HEC-RAS model to high water marks and determined that the peak values were actually 23,000 cfs and 20,700 cfs, respectively. The USGS has not revised their values. This analysis uses the peak values developed by the Corps. Historic peak values are shown in Table 3-1.

See Appendix A for representative photographs of the major floods described in this section.

The threat to public safety from flooding includes exposure to floodwaters, accidents during evacuation, and accidents during flood fighting. Life safety concerns in the study area are limited due to increased warning times and limited residential areas within the floodplain. However, while limited, life safety remains a concern. Loss of life has occurred during the last several flood events, including the 1997 flood event when one life was lost.

Early in the plan formulation process (prior to 2012), USACE determined that the Downtown Reno reach and the Truckee Meadows/Lower Truckee combined reaches were "separable elements." They are physically separate and hydrologically independent based upon the floodplains developed for the study area, and have separable costs and benefits.

Table 3-1. Peak Flows of Selected Historic Floods since 1900

Date	Historical Rainfloods - Truckee River at Reno					
	Regulated			Unregulated		
	Peak Flow (cfs)	Max 1-Day Mean Flow (cfs)	Max 3-Day Volume (ac-ft)	Peak Flow (cfs)	Max 1-Day Mean Flow (cfs)	Max 3-Day Volume (ac-ft)
18 Mar 1907	18,500	14,600	68,400	18,500	14,600	68,400
16 Jan 1909	10,100	8,540	43,600	10,100	8,540	43,600
26 Mar 1928	18,800 (1)	-	66,900 (1)	-	-	-
11 Dec 1937	17,000 (1)	-	53,100 (1)	-	-	-
21 Nov 1950	19,900	14,100	55,300	20,500	15,660	62,837
04 Dec 1950	11,700	6,580	30,600	-	-	-
23 Dec 1955	20,800	16,200	67,400	27,800	25,670	86,937
02 Feb 1963	18,400	11,500	47,700	33,400	24,480	79,380
23 Dec 1964	11,300	9,400	44,600	24,300	14,560	76,999
17 Feb 1986	14,400	10,000	55,000	-	20,100	93,660
02 Jan 1997	23,000(2)	18,900(2)	-	47,600	37,600	-

(1) Estimated from records at other stations
(2) Estimated by Corps; calibrated HEC-RAS to high water marks (differs from USGS record). USGS record for regulated flow is peak=18,200 cfs and 1-day=17,870 cfs for 1997 flood.

Problem: Flooding incurs damages to structures and their contents in the Downtown Reno and Truckee Meadows reaches.

The 1997 flood is the event of record for the Truckee River and caused over $700 million in flood-related damages, $450 million of which was in the Truckee Meadows area. Much of the damage occurred in the industrial areas of the cities of Sparks and Reno, and at the Reno-Tahoe International Airport. Damages in Rainbow Bend and Wadsworth were relatively modest in comparison, but still exceeded several million dollars. The Verdi Reach did not sustain any substantial flood damages during the 1997 event. Flooding in downtown Reno in 1997 caused roughly $200 million in damages and inundated the Arlington Avenue Bridge, Sierra Street Bridge, Virginia Street Bridge, and Center Street Bridge.

3.1.1 Context of Flooding in the Study Area

The problems caused by flooding in the study area have existed for more than a century. This section provides information on the historic flooding in the study area and information on the floodplain, related flood control projects, the frequency of flooding, and the discharge

frequency of flooding. Potential damages caused by flooding have been documented and analyzed by reach and category in order to quantify the needs a project could meet.

3.1.2. Floodplains

Verdi Reach

Nature of the floodplain within this reach is such that there is no substantial flood risk to structures.

Downtown Reno Reach

The downtown section of Reno is partially in a steep-banked reach of the river. The reach through downtown Reno consists of dense urban development with residential, commercial, and public uses, including casinos and hotels. The City of Reno is currently in the process of redeveloping several blocks of riverfront property in the downtown Reno reach. This redevelopment takes into consideration the current flooding problem and would address it through garage first floors or flood proofing. During times of high flow, structures within the first two blocks of the river can be inundated up to 6 feet or more when the river flows through this part of the city. This flow pattern has been documented more than once in recent times. Since the flooding stems generally from the restrictions of the downtown bridges, flooding is slow with adequate warning time so that life safety is not large concern. Figure 3-1 shows the 5%, 2%, and 1% ACE floodplains for the Downtown Reno Reach.

Truckee Meadows Reach

East of Highway 395 the river emerges from the more channelized upstream reach onto a broader expansion of the plain historically known as the Truckee Meadows. It is this area that receives the greatest inundation of flood flows. The Truckee Meadows area effectively acts to attenuate large flood volumes for Truckee River flows. Flooding in this area is characterized as volume-generated, with ponding due to hydraulic backwater effects backing up Steamboat Creek at its confluence with the Truckee River. Three tributaries contribute to this flooding: Steamboat Creek, Boynton Slough, and the North Truckee Drain. In a 1% Annual Chance Exceedence (ACE) (also referred to as 1:100, 1/100, or "100-year event"), these tributaries contribute approximately one-fourth of the flow. The remaining three-fourths comes from the Truckee River. The reach ends at the Vista Reefs, which constricts outflows from the Truckee River, backing up flood flows throughout the Meadows. Thhe Truckee Meadows Reach has several distinct land uses including commercial, light industrial, and residential. Included in this reach is the Reno/Tahoe International Airport to the south. Flooding around the airport consists of sheet flow up to McCarran Boulevard. Also included in this reach are the industrial areas for the cities of Reno and Sparks. This is one of the most rapidly growing industrial areas that also include commercial and public uses. Flooding in the industrial area consists of both ponding and sheet flow. The existing Truckee River and Tributaries project constructed by USACE in the 1960s provides a minimum capacity of 6,000 cfs in this reach, which is approximately equal to the 20% ACE (also referred to as 1:5, 1/5, or "5-year event") under current hydrology.

Farther southeast, the land use is predominantly rural cropland and includes the land owned and operated by the University of Nevada, Reno, the majority of which is used as pasture. South of the University Farms land, the area has grown rapidly over the past few years to include residential subdivisions. There is additional pressure to further develop the remaining lands along the fringes of the floodplain, with the exception of the existing wetlands, into residential subdivisions and associated commercial areas. Residential subdivisions in this area include Hidden Valley, Rosewood Lakes, Donner Springs, and Double Diamond. Flood-related problems in this area are aggravated by flood flows from the tributary streams of Steamboat Creek, Boynton Slough, and Dry Creek.

Figure 3-2 shows the 5%, 2%, and 1% ACE floodplains for the Truckee Meadows Reach. Each of these floodplains are shown separately in Figures 3-3, 3-4, and 3-5.

Lower Truckee River Reach

Downstream of Vista, the topography confines the floodplains. Long Valley Creek is a major tributary that enters the Truckee River at the community of Rainbow Bend. This creek has a watershed of 107 square miles and has experienced flooding in 1955, 1969, and 1995, with the greatest recorded flow of 5,400 cfs in 1986.

The 1997 flood also affected areas downstream of Vista. The bridge at Painted Rock was overtopped preventing residents from leaving their homes for a short time and threatened the integrity of the bridge foundations. Several homes were flooded when the river went out of bank at Wadsworth.

Figure 3-6 shows the 1% ACE floodplain for Vista to Wadsworth and Figure 3-7 shows the 1% ACE floodplain for Wadsworth to Pyramid Lake.

3.2 Flood Damages

Concentrating on the areas with the greatest potential for economic damages due to flooding, the study focused the economic data collection on the Downtown Reno and Truckee Meadows reaches. For economic evaluation and project performance purposes, the two reaches were divided into 15 economic impact areas. These areas were established to address changes in hydrology, hydraulics, and economic conditions. The delineation also took into account potential flooding locations. Figure 3-8 depicts the Economic Impact Areas (EIAs.) For analysis purposes, these reaches were grouped into the two separable reaches: Downtown Reno (EIA 1) and The Meadows Area (EIAs 2-15) which lies east of I-395 along the Truckee River to Vista.

Damageable property in the Truckee Meadows floodplain consists of commercial, industrial, residential, and public buildings valued at about $5 billion (structures only). Additional effects on the day-to-day business of the Reno-Sparks Metropolitan area would be significant.

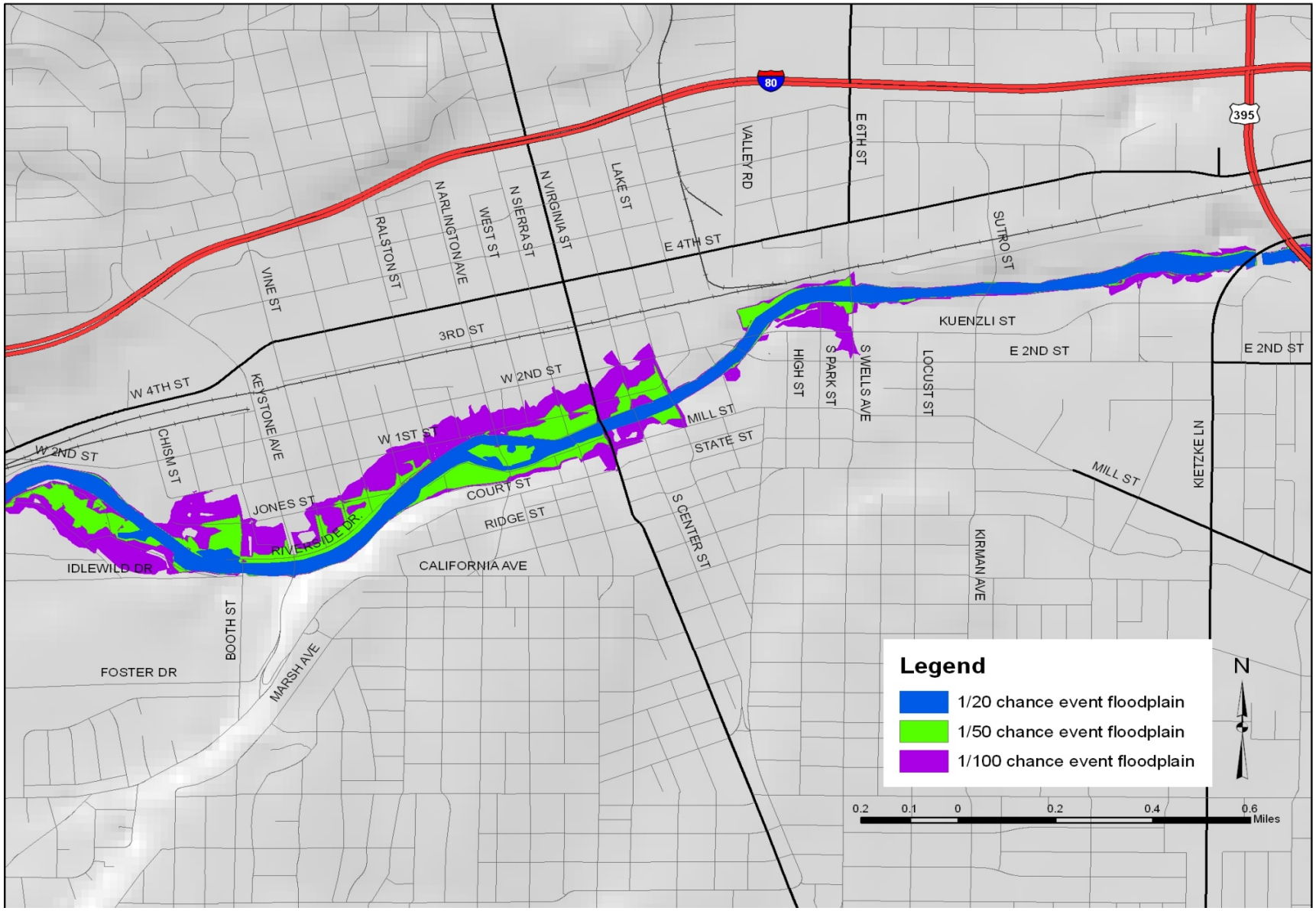

Figure 3-1. Existing Floodplains - Downtown Reno Reach (5%, 2%, and 1% ACE floodplains)

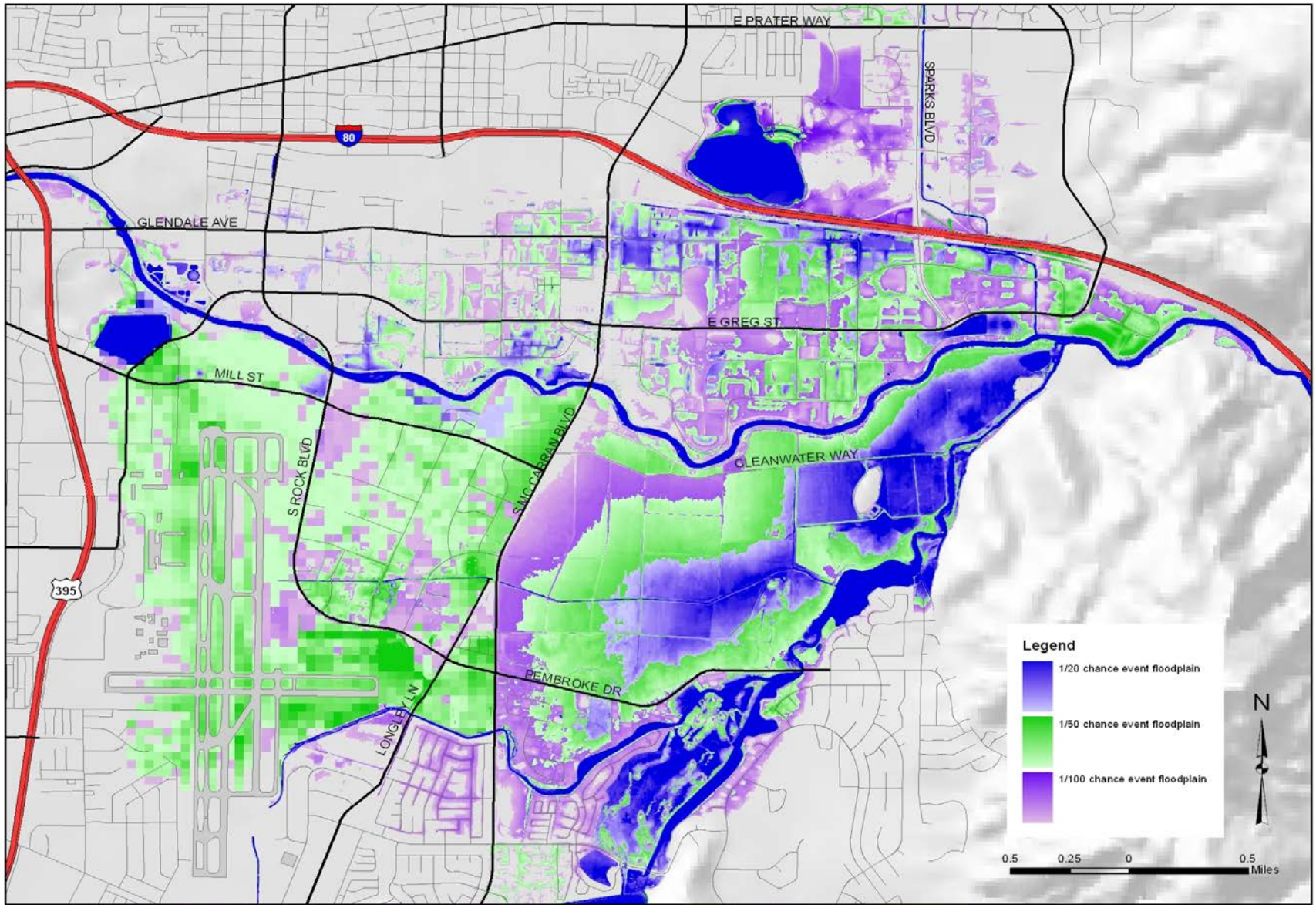

Figure 3-2. Existing Floodplain - Truckee Meadows Reach (5%, 2%, and 1% ACE floodplains)

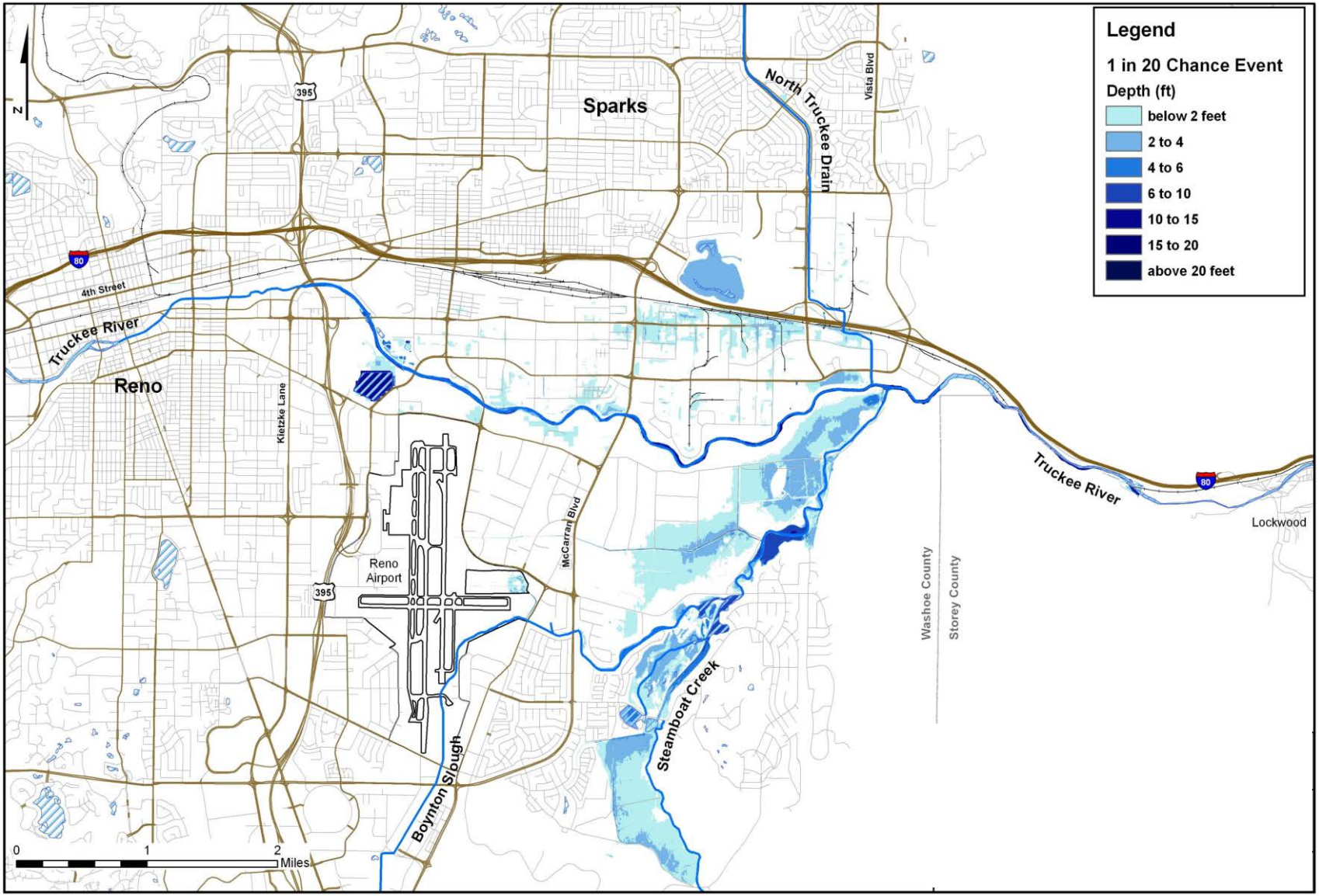

Figure 3-3. Existing Floodplain - Truckee Meadows Reach (5% ACE floodplain)

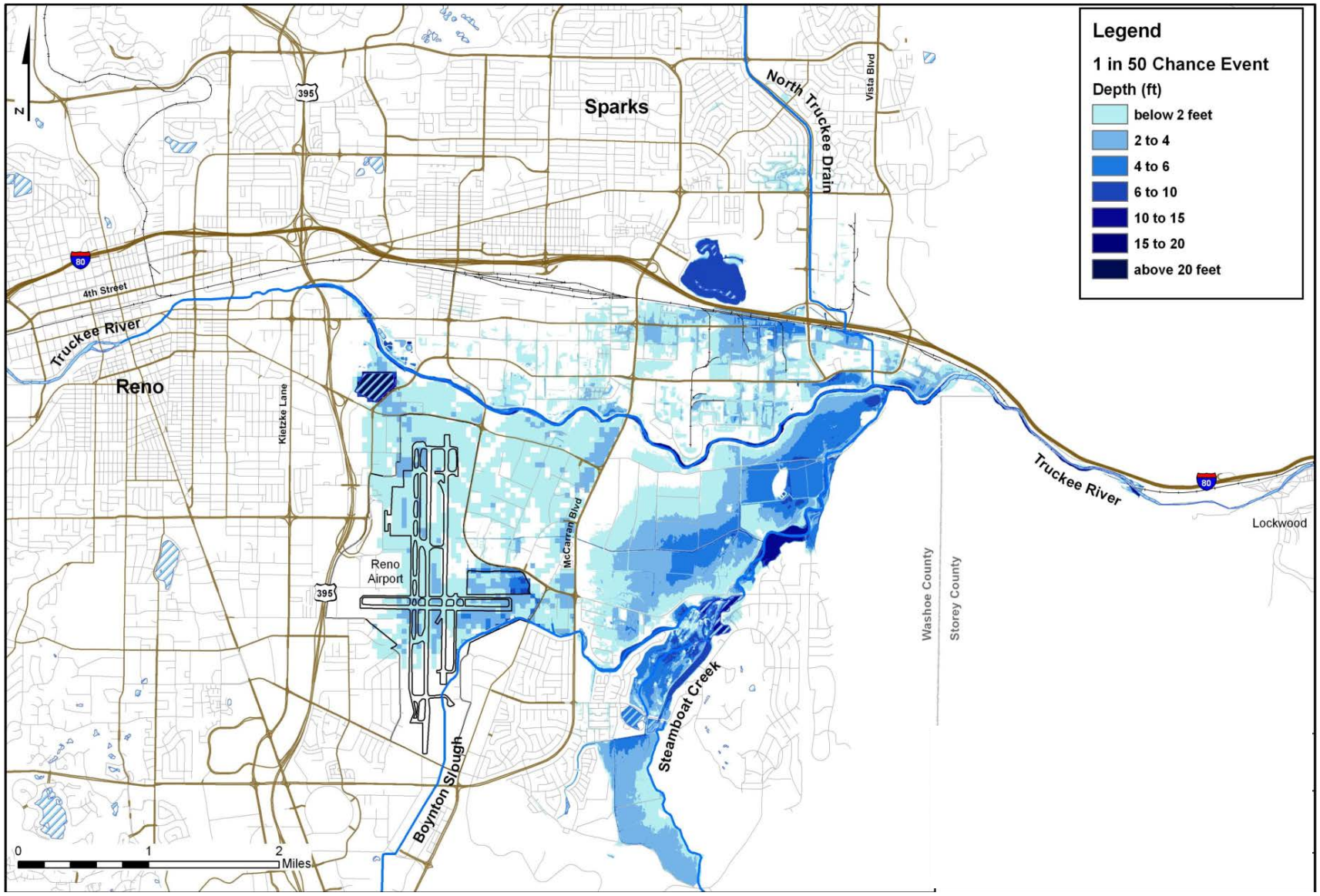

Figure 3-4. Existing Floodplain - Truckee Meadows Reach (2% ACE floodplain)

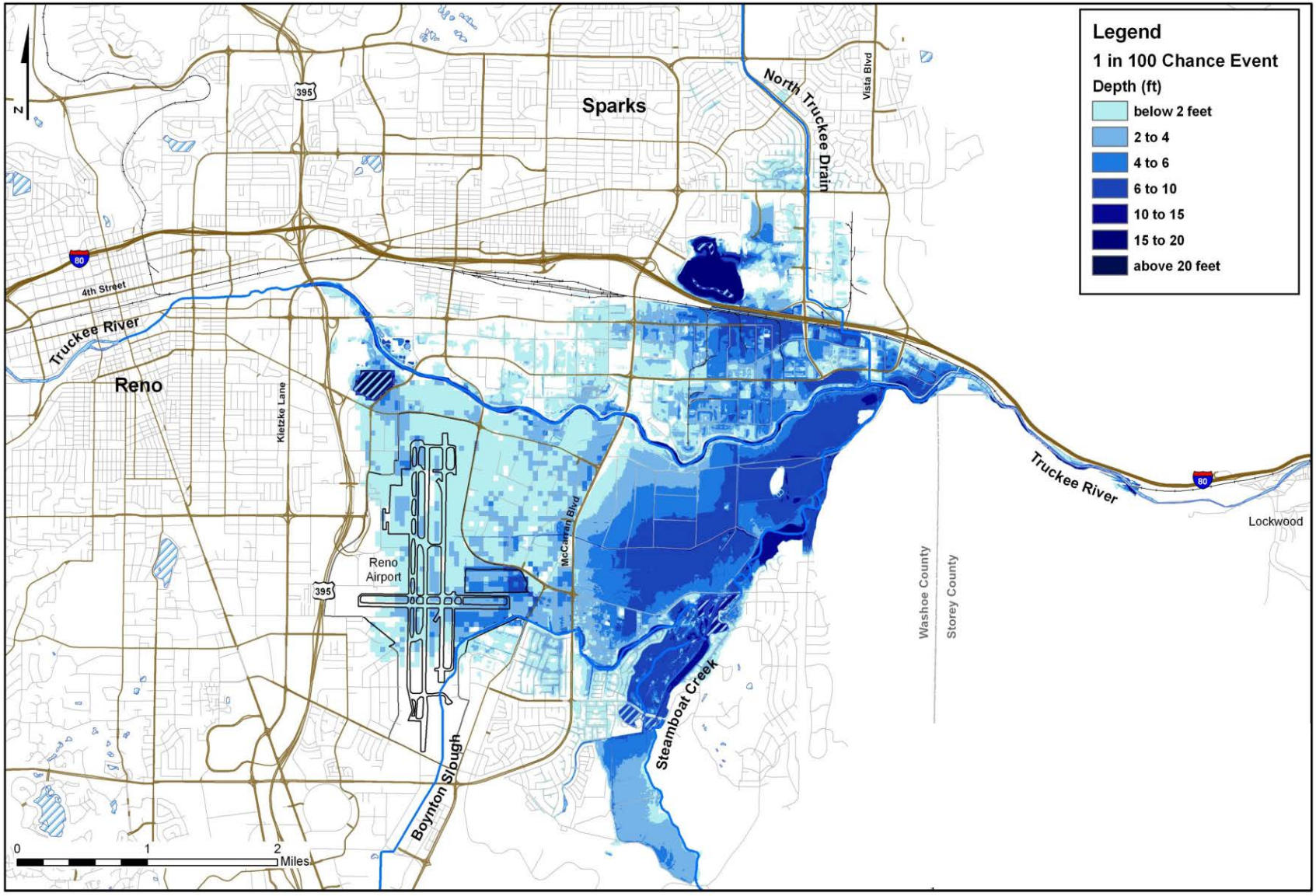

Figure 3-5. Existing Floodplain - Truckee Meadows Reach (1% ACE floodplain)

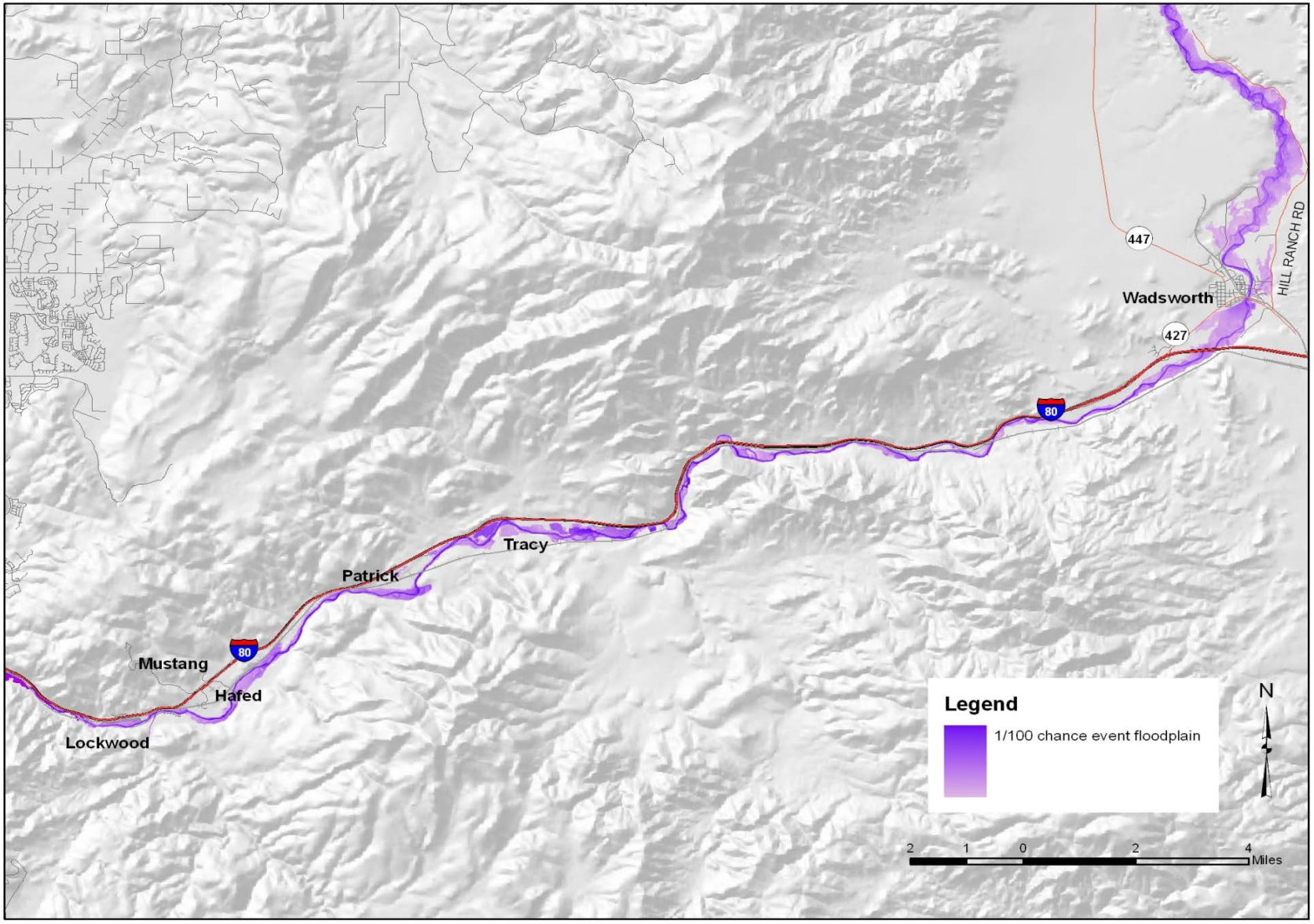

Figure 3-6. Existing Floodplains - Vista to Wadsworth (1% ACE floodplain)

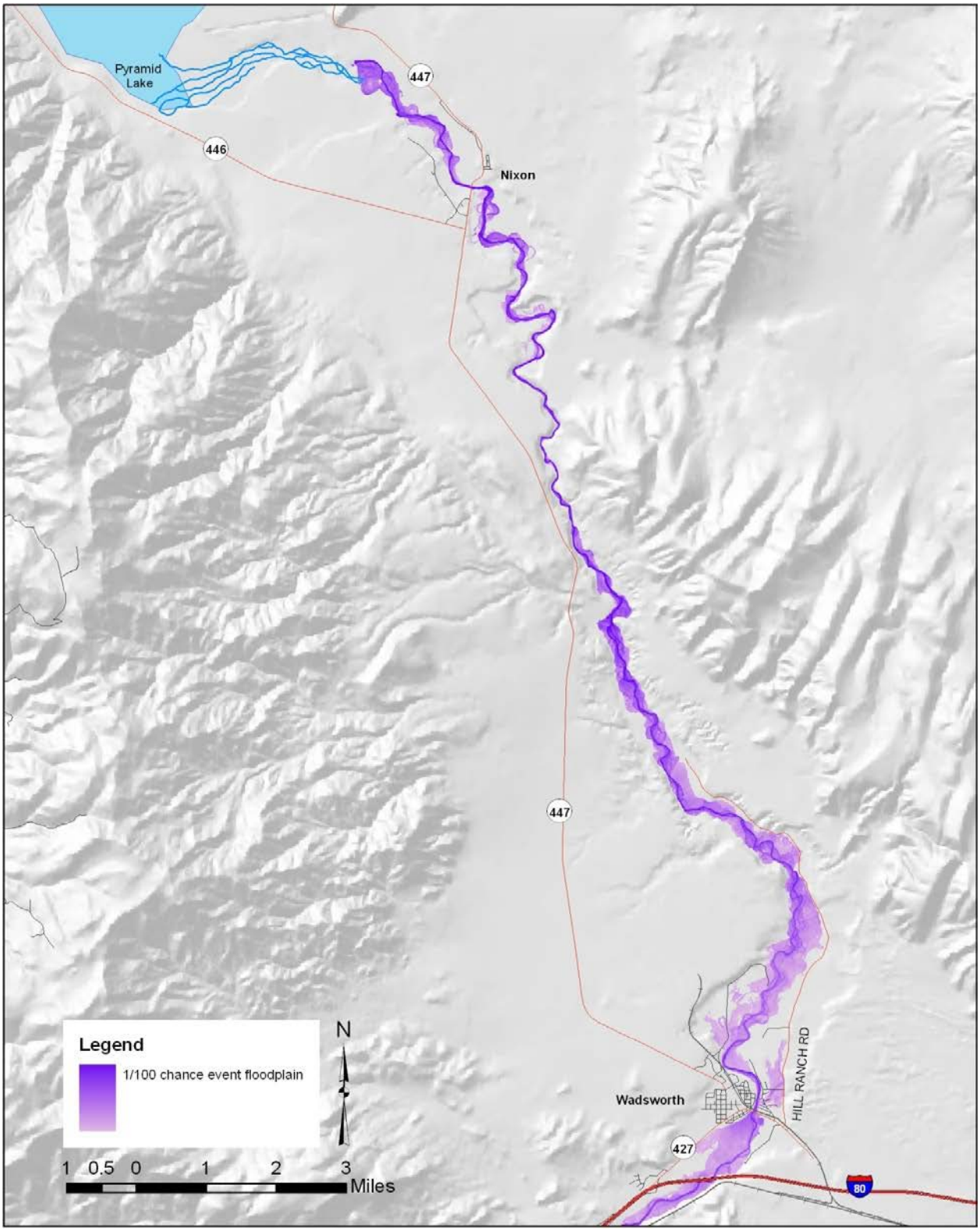

Figure 3-7. Existing Floodplains - Wadsworth to Pyramid Lake (1% ACE floodplain)

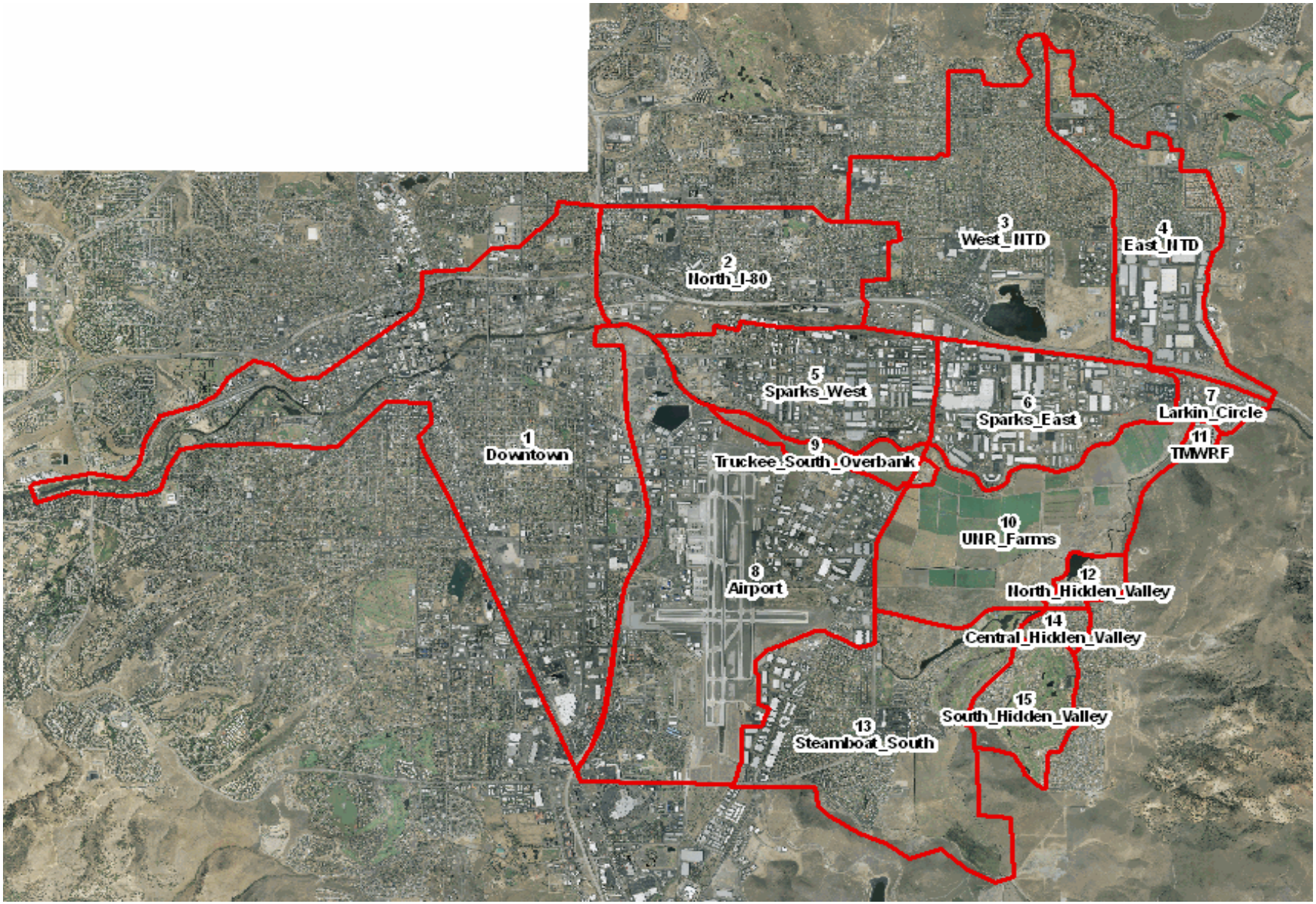

Figure 3-8. Economic Impact Areas - Truckee Meadows Reach

Physical damages caused by inundation losses or flood fighting preparation costs are the main types of flood damages within the floodplain. Physical damages include damages to, or loss of, buildings and their contents, raw materials, goods in process, and finished products awaiting distribution. Other physical damages include damages to lot improvements such as damages to roads, utilities and bridges, and cleanup costs. Additional costs are incurred during flood emergencies for evacuation and reoccupation, flood fighting, and disaster relief. Loss of life or impairment of health and living conditions are intangible damages that cannot be evaluated in monetary terms and have not been included in this analysis. Discussion of these potential effects can be found under Other Social Effects in Chapter 6.

3.2.1 Inventory

Land uses within the floodplains were determined based on parcel data characteristics, aerial photographs and visual inspections. GIS parcel data were provided by Washoe County which includes detailed information regarding land use, building type, square footage and other structural characteristics such as number of stories. Additional data on foundation heights and other structure qualities were noted in the inventory during field data collection. General land/building uses identified include: residential, commercial, casinos, public, and industrial.

- Residential. One- and two-story single family homes, duplexes, apartments, condominiums and mobile homes. Losses include structures and contents.

- Commercial. Shopping centers, offices, retail outlets, motels, hotels, and restaurants. Losses include structures, fixtures, and inventory.

- Casinos. Gaming facilities and casino hotels were separated from the standard commercial uses. Losses include structures, fixtures, and inventory.

- Public. Schools, hospitals, public organizations, offices, police and fire stations, utilities, and churches. Losses include structures and contents.

- Industrial. Warehouses, distribution centers, processing and packaging plants. Losses include structures and contents.

3.2.2 Value of Damageable Property - Structure Value

Depreciated structure values were calculated by obtaining improvement values from Washoe County assessor's data. With over 12,000 structures, valuation using direct depreciated cost valuation of each individual structure was not possible. These values were revised using Marshall and Swift valuation to represent current price levels in the inventory database used in the economic analysis. Table 3-2 depicts the number of structures, by damage category and flood event, within the study area.

Table 3-2. Total Number of Structures within the Study Area

Damage Category	Annual Chance Exceedance Flood Event						
	20% (1/5)	10% (1/10)	5% (1/20)	2% (1/50)	1% (1/100)	0.5% (1/200)	0.2% (1/500)
RES	0	3	21	318	1,237	5,938	10,086
COM	0	4	12	111	200	789	1,121
CASINOS	0	0	0	0	9	49	79
PUB	0	7	15	67	106	286	325
IND	0	9	55	269	436	682	825
TOTAL	**0**	**23**	**103**	**765**	**1,988**	**7,744**	**12,436**

Damage Category Definitions: RES – Residential, COM – Commercial, PUB – Public facilities, IND – Industrial buildings

3.2.3 Value of Damageable Property - Content Value

In addition to structures, building contents can also be at risk of flood damages. For this study, content values were estimated as a percentage of depreciated structure value based on land use. Content surveys were made to determine content percentages specific to the Sparks Industrial Area. For this reevaluation study, additional content surveys were completed to confirm or adjust values used in the original study.

Total value of damageable property includes the structural and content values described for the parcels within the 0.2% ACE (also referred to as 1/500, 1:500, or "500-year" event) floodplain. The breakdown of the value of structures and contents within the study area by event is located in Table 3-3. The breakdown of the damageable property by reaches is located in Appendix C – Economics.

3.2.4 Expected Annual Damages - Without Project Condition

Expected Annual Damages (EAD) were estimated using the risk-based Monte Carlo simulation program called HEC-FDA (version 1.2.4). The HEC-FDA program integrates hydrology, hydraulic, geotechnical, and economic relationships to determine damages, flooding risk, and project performance. Uncertainty is included for each relationship. The model samples form a distribution for each observation to estimate damage and flood risk and have the following relationships built in for each economic damage reach:

- Probability-Discharge - with uncertainty determined by the period of record
- Stage-Discharge - stage in the channel with estimated error in feet
- Interior-Exterior Stage - stage in the floodplain vs. stage in the channel
- Stage-Damage - for each damage category

In the HEC-FDA model, the stage-damage functions listed above were integrated with the discharge-exceedance probability functions and the stage-discharge functions utilizing a Monte Carlo simulation process. The derived probability-damage function was then integrated in the model to determine expected annual damages under without-project conditions. Detailed EAD by probability distribution can be found in Appendix B.

EAD under the without-project condition for the Downtown Reno and Truckee Meadows reaches was estimated for each damage category for all damage reaches. Table 3-4 summarizes the results. In total, there are $69.8 million in expected annual damages, with 12 percent of those damages occurring in the Downtown Reno Reach. Over 68% of all damages in the study area are from losses to industrial structures and contents.

The Lower Truckee River Reach was evaluated for flood risk, and it was determined that no substantive problem exists under the without-project condition. Since the reach is highly rural with limited population the flood risk to life and structures is very low.

Table 3-3. Value of Structures and Contents[1, 2] at Risk within Study Area by Event

Damage Category	Annual Chance Exceedance Flood Event						
	20% (1/5)	10% (1/10)	5% (1/20)	2% (1/50)	1% (1/100)	0.5% (1/200)	0.2% (1/500)
	Structure Value						
RES	0	104	1,731	61,760	255,353	796,015	1,284,139
COM	0	3,745	5,976	281,445	405,633	931,829	1,111,524
CASINOS	0	0	0	0	75,651	306,509	661,129
PUB	0	702	1,066	28,912	93,168	181,587	229,925
IND	0	14,095	100,118	522,933	891,191	1,267,637	1,546,199
TOTAL STRUCTURE	***$0***	***$18,646***	***$108,891***	***$895,050***	***$1,720,995***	***$3,483,577***	***$4,832,916***
	Content Value						
RES	0	52	865	30,880	127,677	398,008	642,070
COM	0	3,745	5,976	281,445	405,633	931,829	1,111,524
CASINOS	0	0	0	0	117,258	475,089	1,024,750
PUB	0	351	533	14,456	46,584	90,794	114,962
IND	0	70,347	495,356	2,339,589	4,010,424	5,598,708	6,739,329
TOTAL CONTENT	***$0***	***$74,495***	***$502,730***	***$2,666,370***	***$4,707,576***	***$7,494,427***	***$9,632,636***
TOTAL VALUE	**$0**	**$93,142**	**$611,621**	**$3,561,420**	**$6,428,571**	**$10,978,004**	**$14,465,552**

1. Damage Category Definitions: RES – Residential, COM – Commercial, PUB – Public facilities, IND – Industrial buildings
2. See Economic and Engineering Appendices regarding uncertainty.

The data in the damageable property tables above provide the basis for the following summary statistics:

- Total depreciated value of structures at risk of flooding (within the 0.2% ACE floodplain): $4.8 Billion.

- Total Value of Contents within at-risk structures: $9.6 Billion (Content-to-Structure value percentages used: Residential, 50%; Commercial, 100%; Casinos, 155%, Public, 50%, Industrial-light manufacturing, 160%, Industrial-Distribution Centers and Storage Warehouses, 558% (from fieldwork)).

- Total Value of Property at Risk (within the 0.2% ACE floodplain): $14.4 Billion.

Table 3-4. Expected Annual Damages Without Project[1] – by Category[2]

Economic Impact Area	AUTO	CAS	COM	IND	PUB	RES	PUB-INFR	TOTAL
Downtown Reno								
1-Downtown	401	3,657	1,864	298	1,116	1,058	0	**$8,394**
The Meadows Area (east of I 395 to Vista)								
2-North I-80	99	318	115	119	56	156	41	**$904**
3-West NTD	438	96	418	755	51	1,648	161	**$3,567**
4-East NTD	45	0	139	5,477	34	323	231	**$6,249**
5-Sparks West	2	11	183	2,933	7	9	43	**$3,188**
6-Sparks East	0	0	300	27,828	31	3	35	**$28,197**
7-Larkin Circle	0	0	37	1,078	1	0	2	**$1,118**
8-Airport	53	49	2,819	8,295	7	129	2,866	**$14,218**
9-Truckee South Overbank	0	0	1	296	6	1	0	**$304**
10-UNR Farms	1	0	5	0	1	3	0	**$10**
11-TMWRF	0	0	0	59	0	0	0	**$59**
12-North Hidden Valley	6	0	0	0	0	110	0	**$116**
13-Steamboat South	314	0	214	1,258	42	1,554	4	**$3,386**
14-Central Hidden Valley	7	0	0	0	1	47	0	**$55**
15-South Hidden Valley	7	0	0	0	0	103	0	**$110**
Sub-Total (2-15)	***$972***	***$474***	***$4,231***	***$48,098***	***$237***	***$4,086***	***$3,383***	***$61,481***
TOTAL	**$1,373**	**$4,131**	**$6,095**	**$48,396**	**$1,353**	**$5,144**	**$3,383**	**$69,875**

[1](October 2013 Prices, $1,000s);See Economic Appendix for economic uncertainty.
[2] Damage Category Definitions: AUTO – Automobile, CAS – Casino, COM – Commercial, IND – Industrial buildings, PUB – Public facilities, RES – Residential, PUB-INFR – Emergency/Public infrastructure.

3.2.5 Project Performance

In accordance with ER 1105-2-101, three statistical measures are provided to describe performance risk in probabilistic terms. These include annual exceedance probability (AEP), long-term risk, and assurance by events. AEP measures the chance

of having a damaging flood in any given year. Long-term risk provides the probability of having one or more damaging floods over a period of time (10, 30, or 50 years). Assurance indicates the chance of not having a damaging flood given a specific event. Existing condition performance statistics for each impact area are displayed in Table 3-5.

Table 3-5. Project Performance – Without-Project Condition[1]

EIA	AEP	LONG-TERM RISK			ASSURANCE BY ANNUAL CHANCE EVENT					
		10	30	50	10%	4%	2%	1%	0.40%	0.20%
1	2.7%	24%	50%	75%	99%	85%	32%	5%	0%	0%
2	0.9%	9%	20%	36%	99%	99%	96%	67%	16%	3%
3	3.0%	27%	54%	79%	99%	72%	30%	10%	0%	0%
4	3.3%	28%	57%	81%	98%	76%	40%	17%	1%	0%
5	5.3%	42%	74%	93%	96%	33%	4%	0%	0%	0%
6	3.9%	33%	63%	86%	99%	58%	21%	1%	0%	0%
7	2.1%	19%	42%	66%	99%	91%	60%	8%	0%	0%
8	10.1%	65%	93%	99%	54%	5%	0%	0%	0%	0%
9	4.1%	34%	64%	87%	97%	59%	17%	2%	0%	0%
10	19.4%	89%	99%	99%	26%	5%	1%	0%	0%	0%
11	1.1%	11%	25%	44%	99%	99%	96%	47%	2%	0%
12	6.1%	47%	79%	96%	85%	47%	18%	1%	0%	0%
13	2.6%	23%	49%	74%	99%	84%	56%	11%	0%	0%
14	3.9%	33%	63%	86%	95%	69%	37%	5%	0%	0%
15	2.8%	25%	51%	76%	98%	83%	55%	10%	0%	0%

1. See Engineering and Economic Appendices for information about project performance uncertainty.

Risk and Uncertainty

For this study, USACE risk assessment procedures, incorporating uncertainty analysis, were followed. These procedures incorporate the best-available hydrologic, hydraulic, geotechnical, and economic information to compute expected annual damage (EAD), accounting explicitly for uncertainty in the information.

Each aspect of the flood risk assessment must account for uncertainty. For hydrologic and hydraulic analysis, the principle variables are discharge and water surface elevation. Uncertainty in discharge exists because record lengths are often short or do not exist where needed, precipitation-runoff computation methods are inaccurate, and the effectiveness of flood flow regulation measures is not known precisely. Uncertainty factors that affect water surface elevation include conveyance roughness, cross-section geometry, debris accumulation, ice effects, sediment transport, flow regime, and bed form. For geotechnical and structural analyses, the principle source of uncertainty is the structural performance of an existing levee due to its physical characteristics and construction quality. Uncertainty also arises from a lack of information about the relationship between depth and inundation damage, lack of accuracy in estimating

structure and content values and locations, and the lack of ability to predict how the public will respond to a flood. These specific variables were explicitly accounted for in this risk assessment and via a sensitivity analysis. The uncertainty in the hydrology most influences the damage and engineering performance outputs and thus the alternative selection. However, variables not explicitly evaluated that could influence future performance include climate change, or unforeseen changes in the watershed conditions such as unplanned growth or dramatic changes in agricultural practices.

Details pertaining to how uncertainties were accounted for can be found in the report appendices. This applies to the existing and future without-project conditions, development and evaluation of alternative plans, and selection of a plan.

3.3 Ecosystem Problems and Opportunities

Problem: The quality and quantity of riparian and related floodplain habitats have diminished along the Truckee River.

The Truckee River was an integral part of a healthy riparian forest dominated by a cottonwood forest, willows, and alders. Historical accounts supported by geomorphic and photographic evidence indicate that the river channel was once well connected to its floodplain, its banks abundant with willow growth supporting a continuous, multi-canopied riparian forest.

Habitat supported by the Truckee River began to decline with the settlement of the area by European emigrants in the early 1850's. Degradation continued through the turn of the century with the completion of the Newlands Project that diverted flows of the Truckee River into the adjacent Carson River watershed for irrigation.

In 1954, USACE was authorized to construct the Truckee River and Tributaries Project to protect the cities of Reno and Sparks from frequent flooding by straightening, widening, and deepening large expanses and reaches of the river channel from Lake Tahoe to Pyramid Lake. This project caused excessive erosion and entrenchment of the river channel because of the altered hydrologic and geomorphologic conditions. This combined with other urban and agricultural encroachments into the floodplain caused substantial destruction and fragmentation of the riparian forest.

Associated floodplain habitats have also decreased significantly, especially wetlands habitat. These habitats were generally associated with riparian corridors and as those corridors diminished, so did the associated floodplain habitats.

Disturbed land areas that have a lack of vegetative cover allow for the introduction and dispersal of nonnative plant species. Among these species are tall whitetop, musk thistle, common ragweed, Canada thistle, bull thistle, poison hemlock,

prickly lettuce, whitetop, purple loosestrife, Russian thistle, Russian knapweed, yellow starthistle, cocklebur, and tamarisk. All of these invasive plant species have very low wildlife habitat value.

Whitetop, a nonnative invasive plant species, is prevalent in the upper reaches of the Truckee River below Vista. This plant species is most commonly associated with agricultural fields, river scoured areas, and other disturbed areas all characteristic of the Truckee River within the study area.

Tamarisk is another well-documented invasive plant species in the West and is found in the lower portion of the study area along the Truckee River between Wadsworth and Pyramid Lake. Tamarisk plants evapotranspire large amounts of water into the atmosphere. The amount of water consumed by tamarisk reduces the amount of water available for wildlife and for native riparian and wetland plant communities. Tamarisk tends to form dense, monotypic stands, outcompeting native vegetation.

Problem: The Truckee River is no longer a stable river system.

River damming, diminished flows, riparian forest destruction, and channel alterations all have contributed to channel instability throughout the study area. The banks in some areas have been stabilized with rock to protect the land from erosion. The Truckee River suffers in some reaches from considerable erosion that undercuts streamside habitat and results in barren streambanks with no habitat value.

Work done for the Truckee Meadows, Reno-Sparks Metropolitan Area, Nevada, Hydrology Report, 1980, documented that historic peak flows attenuated as they moved downstream. However, under regulated conditions, flows actually get larger as they move downstream. This hydrological occurrence can be related to the channelization work done in the lower river by USACE in the 1960's. This work likely induced geomorphic instability in the river.

Between Vista and Wadsworth, significant quantities of sediment have historically been delivered to the river by tributary alluvial fans. Due to the construction of Truckee Canal and Interstate 80 through the canyon, sediment delivery to this reach of the river has been significantly reduced. This lack of balance in the erosion/deposition characteristics normally seen in a healthy river system prevents the Truckee River from recovering on its own.

The channel in some locations has become incised, stranding cottonwood riparian forests on benches. Cottonwoods that depend on a wet substrate for seed germination and development are now isolated from all but the more extreme flood flows. Eventually these isolated forests will die without regenerating new growth.

Problem: The quality and quantity of aquatic habitat have diminished, causing adverse effects on the aquatic ecosystem, including special status fish species.

The Truckee River suffers from persistent water quality problems. Flows entering the study area have a high nutrient content largely from treated sewage effluent, agricultural runoff, and urban stormwater runoff. High nutrient levels accelerate algae growth and other indicators of water pollution, including physical and biological changes such as elevated aquatic temperatures and total dissolved solids, lowered dissolved oxygen levels, and modified existing biota towards pollution-tolerant species. Tertiary treated sewage enters the Truckee River from many treatment facilities throughout the system.

High instream temperatures are another significant water quality problem. Many factors influence instream temperature within the downstream reach of the Truckee River: loss of overstory shading through direct and indirect removal of riparian vegetation, lower than normal water flow levels due to diversions, naturally occurring thermal springs (upstream on Steamboat Creek), natural and human-induced surface runoff including agricultural flows, and decomposition of organic materials. High water temperatures result in less than optimum habitat conditions for cold water fish species including the Federally listed cui-ui lake sucker (*Chasmistes cujus*) and the Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) (LCT), and allow for the introduction of warm water species (native and nonnative) in their place.

The water quality of the Truckee River affects Pyramid Lake. Poor water quality has led to large blue-green algae "blooms" within Pyramid Lake that then further decrease water quality for the species present.

Problem: Passage of spawning fish species from Pyramid Lake is obstructed by various artificial barriers.

Construction of dams and water diversions has severely affected the movement of aquatic species throughout the Truckee River system. In particular, these structures act as complete or partial barriers to the upstream migration of the Federally listed LCT and cui-ui fish species to their historic spawning and rearing habitat. As a result, these native fish species are often forced to use sub-optimal habitats, reducing fish productivity and annual survivorship. Barriers are located starting at Marble Bluff Dam just upstream of Pyramid Lake up through the Verdi Reach into California. A list is included in Table 3-6.

Opportunity: **Incorporate environmentally sustainable design into features and restore fish passage**

There is an opportunity to incorporate environmentally sustainable design into flood risk reduction features and restore fish passage on the Truckee River.

Table 3-6. Primary Fish Passage Barriers on the Truckee River

Barrier Name	Function	Ownership
Marble Bluff	Grade Control	USBOR/FWS
Numana	Irrigation	USBIA/PLPT
Olinghouse #3	Irrigation	PLPT
S-S	Irrigation	UNR
Fellnagle	Irrigation	PLPT
Olinghouse #1	Irrigation	PLPT
Proctor	Irrigation	PLPT
Pierson	Irrigation	PLPT
Herman Ditch	Irrigation	PLPT
Gregory Ditch	Irrigation	Private
Washburn Ditch	Irrigation	Private
Derby	Irrigation	USBOR

3.4 Recreation Problem and Opportunity

Problem: Recreation opportunities have not kept pace with the increased demand stemming from increased population in the Reno/Sparks area.

The increase in population within the Reno-Sparks metropolitan area has caused an increase in demand for recreation. Existing facilities are unable to meet the current and projected future demand.

In particular, an insufficient number of outdoor recreation opportunities are located close to the population centers, where many lower-income and least formally educated citizens live. The 2010 Nevada Statewide Outdoor Recreation Plan indicates that lower income and lesser educated residents participate in outdoor recreation at lower rates than other groups. The America's Great Outdoors Initiative encourages recreation facilities to be located near populated areas to help serve these communities.

Opportunity: Incorporate recreation features associated with flood risk reduction and ecosystem restoration features.

There is an opportunity to incorporate outdoor recreation features, such as trails and kayak access, into flood risk management and ecosystem restoration features.

3.5 Summary of Problems and Opportunities

Reduction of flood damages, restoration of riparian areas and fish passage, and provision of recreation amenities were identified as opportunities addressing the problems and potentially having Federal interest.

Problems

- Flooding poses a threat to life and safety in downtown Reno and Truckee Meadows.
- Flooding incurs substantial damages to development in the Downtown Reno and Truckee Meadows.
- The quality and quantity of riparian and related floodplain habitats have diminished along the Truckee River.
- The Truckee River is no longer a stable river system.
- Passage of spawning fish species from Pyramid Lake is obstructed by various artificial barriers.
- Recreation opportunities have not kept pace with the increased demand stemming from increased population in the Reno/Sparks area.

Opportunities

- Incorporate environmentally sustainable design into flood risk reduction features and restore fish passage on the Truckee River downstream to Pyramid Lake.
- Incorporate recreation features associated with flood risk reduction and ecosystem restoration features.

(This page is intentionally blank)

CHAPTER 4
DEVELOPMENT OF ALTERNATIVE PLANS

This chapter discusses the development of alternative plans to help address the flood risk management, ecosystem restoration, and recreation problems in the study area. This formulation process focused on the primary purpose of flood risk management.

The development of alternative plans discussed in this chapter includes the evaluation of preliminary alternatives, including preliminary flood risk management alternatives for both the Downtown Reno and Truckee Meadows reaches. Alternatives that were carried forward for more detailed evaluation are discussed in Chapter 5.

4.1 Plan Formulation Process

Plan formulation is the multi-step process used to develop and evaluate alternative plans that meet national goals and planning objectives, and avoid planning constraints. After problems and opportunities are identified, the next step in this process is to identify the goals, objectives, and constraints that apply to this project. Once this is done, potential management measures can be proposed to achieve the project's objectives.

Next, the management measures are screened, and the most feasible ones are combined into preliminary alternative plans that focus on the project's potential purposes. After the screening of these preliminary alternative plans, the final array of alternative plans is selected for further evaluation based on planning criteria, including economic feasibility.

4.2 National Planning Goals

The Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G) require that Federal water and related land resources projects contribute to National Economic Development (NED) in a manner consistent with protecting the Nation's environment. Contributions to NED are achieved by increasing the net value of the Nation's output of goods and services, expressed in monetary units.

USACE projects for ecosystem restoration must contribute to National Ecosystem Restoration (NER) outputs by restoring degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. Contributions to NER are increases in ecosystem value and productivity, and are measured in non-monetary units such as average annual habitat units or acres.

4.3 Planning Objectives

Planning objectives are based on an analysis of existing and future conditions in the study area. Objectives are developed to address the problems and opportunities that were identified in this analysis and represent desired beneficial changes in future conditions.

The planning objectives for this study address three project purposes: flood risk management, ecosystem restoration, and recreation. The objectives for each of these project purposes are listed below. Each of these objectives applies to the 50-year period of analysis for this study. For each project purpose, the USACE objective is to maximize benefits relative to costs, consistent with the National planning goals. The sponsor also has a local objective of being able to accommodate flows from the 1% Annual Chance of Exceedance (ACE) (also referred to as 1:100, 1/100, or "100-year" event). This is consistent with National Flood Insurance Program (NFIP) criteria. USACE could not meet this local objective when selecting a plan because the economic analysis indicated that this was not economically justified.

Restoration of vegetation and aquatic habitat in and along the Truckee River was initially identified as an objective for this study. However, after preliminary alternatives were formulated and evaluated, it was determined that habitat restoration would not be considered further in this GRR.

4.3.1 Flood Risk Management

- Reduce flood damages in the Downtown Reno and Truckee Meadows reaches along the Truckee River and tributaries from overbank flows to the fullest extent consistent with Federal participation and community financial capabilities.

- Reduce the potential for loss of life from flooding from the Truckee River.

4.3.2 Ecosystem Restoration

- Improve fish passage at the dams and water diversion structures along the Truckee River between Lake Tahoe and Pyramid Lake.

4.3.4 Recreation

- Increase recreational opportunities along the Truckee River between Highway 395 and Vista.

4.4 Planning Constraints

A constraint is a restriction that limits the extent of the planning process. Constraints are designed to avoid undesirable changes in future conditions. A universal constraint for all project purposes is that the study will comply with all applicable Federal laws, regulations, and policies. The following constraints were identified to direct plan formulation efforts so that unacceptable adverse effects would be avoided.

4.4.1 Flood Risk Management

- Avoid adverse effects to threatened and endangered species, including the cui-ui and Lahontan cutthroat trout.

4.4.2 Ecosystem Restoration

- Avoid adversely affecting adjudicated water allocation in the Truckee River.

4.4.3 Recreation

- Limit recreation features within the runway clear zone or runway protection zone at the Reno/Tahoe International Airport.

4.5 Description and Screening of Management Measures

A management measure is a feature or an activity that can be implemented to address one or more of the planning objectives. After numerous collaborative meetings with the sponsor, other agencies, and the Community Coalition, a comprehensive list of flood risk management, ecosystem restoration, and recreation measures was compiled and then screened to determine which measures appeared to be feasible in the development of alternative plans.

This screening involved evaluating the potential effectiveness and efficiency of each measure. In this context, effectiveness was determined by how well a measure met the planning objectives. A simple scale of low, medium, or high was used. Measures that did not meet any planning objectives or scored low were dropped from further consideration. Efficiency was determined by the potential benefits and costs of the measure. Professional judgment and existing economic data were used to estimate the benefits and costs of each measure. Measures were determined to be efficient if benefits were at least equal to the estimated costs. Those measures for which the estimated costs far exceeded the benefits were dropped from further consideration.

A Value Engineering (VE) study was conducted in 2004 prior to the Alternative Review Conference (South Pacific Division Milestone F4) in accordance with SPD guidance. The purpose of the VE study was to ensure that the widest range of feasible and cost-efficient measures were considered and that alternatives formulated from those measures are not limited to those that first came to mind at the initiation of the GRR. Documentation of the VE study is available in the District's files.

This section describes the measures and discusses the reasons why the measures were either retained or dropped from further consideration. The results of the screening are summarized in Tables 4-1, 4-2, and 4-3.

4.5.1 Flood Risk Management: Nonstructural Measures

Nonstructural measures attempt to avoid flood damages by changing the use of the floodplains, accommodating existing land uses to the flood hazard, or excluding or removing damageable properties from flood-prone areas. These measures do not affect the frequency or level of flooding within the floodplain; rather, they affect floodplain activities.

The following flood risk management measures (both nonstructural and structural) were considered for the Downtown Reno and Truckee Meadows Reaches.

Flood Insurance

Under the authority of the National Flood Insurance Program42 U.S.C. § 4001, *et. seq.*, the Federal Emergency Management Agency (FEMA) has directed the Federal Insurance Administration to provide emergency assistance and Federally subsidized flood insurance for those residences and businesses projected to be affected by flooding. This measure has been implemented in the project area and is part of the future without- project condition. Therefore, this measure was dropped from consideration.

Early Flood Warning System

In previous investigations, this measure was considered as a potential solution for flood risk management. Subsequently, an early flood warning system was evaluated as part of the USACE Continuing Authorities Program and found to be justified. The Reno Early Flood Warning System is currently in place and is considered as a future without-project condition. Therefore, this measure was dropped from consideration.

Flood-proofing

Flood proofing of all structures within the floodplain would have a very high cost due to the large size of the floodplain; large numbers of residential, commercial, and industrial structures in the floodplain; and deep flood depths. However, as a selectively used measure, it could have high effectiveness. As a result, this measure was retained for further consideration.

Large Scale Floodplain Evacuation

Floodplain evacuation would include evacuating all buildings located within the floodplain and/or relocating structures to higher ground, raising materials above floodwaters, or removing materials to higher ground. Permanent evacuation of developed areas subject to inundation during high flows involves the acquisition of lands by purchase (through the local power of eminent domain, if necessary), removal of structural improvements, and relocation of the population. Lands acquired in this manner would be devoted to agriculture, parks, or permanent open space that would not impede flood flows.

To assess the potential accomplishments of this measure, two near stream areas were considered. These sites included the Sparks Auto Wrecking facility located on Larkin Circle and the East Sparks Industrial building located on Spice Island Drive. Both locations are considered representative of damageable property in the study area. The land acquisition costs to relocate these structures alone, without considering other associated relocation costs, are estimated to far exceed the benefits from the value of the new land use, reduction in emergency cost, or reduction in participation in NFIP. As a result, this measure was determined to be inefficient and was dropped from further consideration.

Small Scale Floodplain Evacuation

Although evacuation of structures from the floodplain on a large scale would likely not be feasible, evacuation of specific structures located within the floodway could be feasible if removal of the structure from the floodway would increase the channel carrying capacity. In addition, Washoe County and the cities of Reno and Sparks currently participate in the NFIP administered by the FEMA; therefore, any future development proposed within the jurisdictional boundaries of these local agencies is required to be constructed above FEMA's 100-year base flood elevation (1% ACE). This measure was retained.

Floodplain Management Plan

A comprehensive floodplain management plan would address issues with public outreach, preparedness, and emergency response for both pre- and post-disaster scenarios. A floodplain management plan would also address other issues within the floodplain, including controlling or limiting development, ordinances to ensure flood storage within the floodway, and other concerns. Any Federal project involving flood risk management requires a floodplain management plan. As a result, this measure was retained for further consideration.

Dedication of Floodplain to Storage

Dedication of Developed Floodplain to Natural Storage. Two developed floodplain areas were considered for reversion to natural floodplain for storage of flood flows. One location was the Sparks Auto Wrecking facility, located at Larkin Circle, and the second location was the East Sparks Industrial building, located on Spice Island Drive. Both locations are considered representative of damageable property within the floodplain of the study area. The costs to relocate existing structures including land acquisition costs and other costs associated with relocation would far exceed the benefits derived from the reduction in flood damages. Floodplain evacuation of structures to restore the river's connection to its floodplain would not be economically feasible for developed areas and was eliminated.

Dedication of Undeveloped Floodplain to Natural Storage. Dedication of specific property in the floodplain may be appropriate in undeveloped areas. Dedication of undeveloped areas to the natural floodplain such as UNR Farms is desired by the local community and provides opportunity for development of complementary ecosystem restoration and/or river parkway features. Thus, this measure has been retained for further consideration.

4.5.2 Flood Risk Management: Structural Measures

Structural measures are designed to control, divert, or exclude the flow of water from the flood prone areas to the extent necessary to reduce damages to property, any hazard to life or public safety, and general economic losses. The structural measures considered most appropriate in dealing with the character of the flood problems encountered typically include small detention basins, flood flow diversions, channel modification, and levees.

Storage/Detention

New Upstream Reservoirs. Several relatively large capacity upstream storage facilities along the Truckee River were considered, plus a combination of smaller sites and facilities. Most of the sites are located upstream of the City of Reno, within the state of California. These facilities would be on-stream reservoirs created by placing a dam on the river. By constructing an upstream storage dam and reservoir, excess peak flood flows could be temporarily stored so that downstream flood peaks would remain essentially unchanged from existing conditions. Preliminary cost-benefit analyses of each of the upstream storage facilities indicated that the total costs to construct the necessary infrastructure would significantly exceed the potential flood risk management benefits in the downstream urbanized area. For this reason, all upstream storage facilities that were evaluated were determined to be inefficient and were dropped from further consideration.

Upstream Detention with Weirs. Six potential sites for either on-stream or off-channel detention were considered. Potential storage capacity at any one of the six sites was up to 1,500 acre-feet. Target volume of over 4,000 acre-feet was determined necessary to provide sufficient flood protection for Reno and downstream areas. Due to the relatively small storage capacity of each facility, these options were determined to have low effectiveness and were dropped from further consideration.

On-stream Storage. The concept of using a series of several small on-stream storage areas from Lawton to the California-Nevada border was also considered. Permanent in-channel structures would visually affect the river channel and could interfere with recreational uses of the river. These structures could also pose a barrier to the movement of terrestrial wildlife. This measure was dropped from further consideration due to low expected efficiency.

Upstream, Off-Channel Detention. Four smaller sites for off-channel storage were evaluated: East Truckee, Union Bend, North Flat and Fleisch. At two of these sites (East Truckee and North Flat), variations were also considered, raising the total number of options considered to six. Potential water storage ranged from 900 acre-feet to nearly 12,000 acre-feet. Based primarily on the relatively high diversion structure costs, real estate costs, and/or only a slight reduction in the flood risk to Reno, this measure was determined to be inefficient and was dropped from further consideration.

Increasing Flood Control Storage at Upstream Reservoirs. Reoperating and raising the spillways of Stampede and Prosser Creek Dams, as well as increasing the allowable flood control storage in Martis Creek Reservoir, were evaluated and determined to only provide benefits during low probability events. No increase in flood benefits during higher probability events (e.g., 1% ACE) would be realized. This was evidenced during the January 1997 flood event in which no releases were being made into the Truckee River from Prosser, Boca, and Stampede Dams. During the 1997 event, additional flood control capacity at those reservoirs would not have reduced the magnitude of flooding in the Reno-Sparks-Truckee Meadows area.

Flood control space at Martis Creek Reservoir is limited to less than half of gross capacity due to geotechnical concerns regarding seepage and piping. Thus, there is uncertainty

regarding the technical feasibility of expanding available flood control storage at this reservoir.

Preliminary costs to enlarge the reservoirs at Stampede and Prosser Creeks with 5- and 10-foot spillway raises were reviewed. It was determined that the costs far exceeded the potential benefits. Therefore, this measure was determined to be inefficient and was eliminated from further consideration.

Tahoe Reoperation (precautionary release). The 1997 flood was the only recorded event where maximum releases from Lake Tahoe contributed to peak flood flows in the Truckee River during a large rain flood event in the Truckee River watershed. For all other significant rain flood events in the Tahoe Basin, there was sufficient space in the lake to accommodate inflows. In addition, 1997 was 1 of only 5 years of record since the completion of the existing Tahoe Dam in which discharge from Lake Tahoe into the Truckee River exceeded 2,000 cfs for 1 day or more.

Because in most flood situations one would not expect this circumstance to recur, this measure would be unlikely to consistently contribute to flood risk management. In addition, the rearrangement of operating rules for Lake Tahoe releases would probably be an institutionally complex and challenging task. There is a high degree of uncertainty regarding the feasibility and institutional acceptability of implementing this measure. This measure is consequently eliminated as it is expected to have low effectiveness.

Enclosed Detention Facility at University Farms. An enclosed detention facility at University Farms was included as part of the project that was authorized in 1988. The idea is to store some of the Truckee River flood flows in order to reduce the peak discharge of water carried downstream. This detention facility would result in a lower volume of backwater accumulating upstream of the Truckee's constriction at the Vista reefs, thereby reducing the floodwater surface elevations in the Truckee Meadows area and the downstream peak discharge during a flood. Therefore, this measure has been retained for further consideration and potential incorporation into a flood risk management plan alternative.

Mustang Ranch Detention Facility. The detention basin would be located off stream along the Truckee River on Mustang Ranch. The detention basin was included in the project to attenuate the impact of the increased downstream flood flows from the project improvements along the Truckee River. This measure was retained for further consideration.

Huffaker Hills Detention Facility. The detention basin would be located on stream along Steamboat Creek at Huffaker Hills (approximately 5 miles upstream of the main stem of the Truckee River). The detention basin was included in the project to attenuate the impact of the increased downstream flood flows from the project improvements along the Truckee River and Steamboat Creek. Preliminary indications were that this facility could reduce peak discharge from the Steamboat Creek watershed and was therefore retained for further consideration.

Bypass Tunnel to Huffaker Hills Reservoir. This measure consists of a small dam constructed on the Truckee River to divert flood flows south of Reno through a tunnel system extending to a reservoir constructed at Huffaker Hills on upper Steamboat Creek. Four earthquake faults are known to occur along the proposed alignment of the diversion tunnel. The

geologic investigations revealed that the tunnel would require a more substantial structural support system than normal because of the shallowness of the cover and unknown variables, such as weathering, fracturing, and other physical properties. The serious concerns regarding technical feasibility and extremely high cost vs. benefits derived give this measure low expected effectiveness and acceptability. Therefore, it was dropped from further consideration.

Increase Channel Flow Capacity

Channelization between Keystone and Arlington Avenues. Hydraulic modeling of this measure indicated that it was effective in reducing water surface elevations between Keystone and Arlington Avenues. Thus, this measure has localized hydraulic benefit that would not extend to the Reno redevelopment area or the Truckee Meadows area. This measure would therefore be expected to have limited (low) effectiveness. This measure is consequently eliminated from further consideration.

Channelization between Arlington Avenue and Virginia Street. This measure consists of temporarily removing the existing white water park located upstream of the Arlington Avenue Bridge, lowering the invert elevation by regrading the channel bottom to create a more uniform channel slope from Virginia Street upstream to a point approximately 1,500 feet above Arlington Avenue. The white water park would then be reconstructed. This measure would reduce velocity variances, prevent localized scour, reduce water surface elevations upstream of Arlington Avenue, and decrease the likelihood of additional sediment deposition between Virginia Street and Arlington Avenue. This measure is retained for further consideration.

Channel Widening from Sierra Street to Lake Street. This measure involves widening the river channel on the north bank from approximately Sierra Street to Lake Street in order to provide additional flow area. The widening would begin two vertical feet above the existing channel bottom and extend horizontally 12.5 feet into the riverfront lane. Channel widening would be implemented through the majority of this reach with the exception of the city block containing the AT&T building. Through this block the channel is widened by only 6 feet on the west and east sides of the AT&T building. There would be no widening along the front of the AT&T building. In conjunction with this measure, any replacement bridges at Sierra or Virginia Streets would need to be extended to span the wider channel. Similarly, a mini span at Center Street Bridge would be required. A culvert at Lake Street Bridge would also be necessary so that the additional flow area made possible by the widening could continue through the bridge location. This measure was retained for further consideration.

Culvert Around Replaced Lake Street Bridge. This measure provides for the installation of a culvert around Lake Street Bridge on the north side of the river. The culvert would direct excess flow around the bridge abutments, thereby increasing flow capacity. This measure would be implemented in conjunction with the widening measure (channel widening from Sierra to Lake Streets). A culvert would be required to accommodate the additional flow area created by channel widening because physical constraints (AT&T building) make lengthening of Lake Street Bridge infeasible. This measure was retained for further consideration.

Plazas. Plazas are a constructed open space using concrete with minimal appurtenances to ensure that flood flows would enter and leave the open space without constrictions. Plazas would be constructed on the north bank of the river and increase channel flow capacity. Plazas would begin at the north edge of the river, two feet above the bottom of the river channel, and extend perpendicularly from the river to First Street. One plaza would be placed between Sierra and Virginia Streets, using the entire block now occupied by the Masonic building, and the second plaza would be placed on the block formerly occupied by the Mapes casino and hotel. This measure would be consistent with downtown Reno redevelopment as an area of public access for river viewing. This measure was retained for further consideration.

Containment at First Street. This measure would set floodwalls north of the river back to First Street between Arlington Avenue and Center Street. This measure is intended to provide additional channel flow capacity beyond that of the river channel. The concept was based on an observation of the 1997 flood event during which a large amount of water broke overbank and flowed down First Street before reentering the channel further downstream. Further investigation determined that this measure would not provide protection to several structures. Therefore, this measure was determined to have low effectiveness and was not retained for further consideration.

Widening on the South Bank. Similar to the widening measure on the north bank of the river, this measure consists of widening the channel on the south bank. The south bank widening measure would begin just upstream of Sierra Street and end at Center Street. This measure was eliminated because of its significant cost relative to the benefits gained.

Downtown Buyout. This measure involves purchasing all buildings and parcels on the north bank from Sierra Street through Lake Street. The buildings would be removed and the vacant lots would become part of the channel. Starting from the existing bottom of the channel and extending to First Street, this measure would resemble the plaza concept, but would not be limited to the Mapes and mid-block sites. The intent of this measure was to create an increase in flow area without removing the historic bridges. The cost associated with land acquisition and excavation would be prohibitive. Therefore, the measure was dropped from consideration as inefficient.

Channelization at Glendale Park Area. This measure would reduce water surface elevations only in a localized area between Glendale Park and Rock Boulevard relative to a scenario with containment structures only. Since excavation in general is a costly undertaking, this measure would have low effectiveness for the Truckee Meadows area as a whole and would be inefficient in terms of the hydraulic benefit relative to the cost. In addition, local acceptability is questionable due to aesthetic concerns. This measure has consequently been eliminated.

Terracing Upstream of Steamboat Confluence. This measure would create an earthen terrace upstream of the confluence with Steamboat Creek. The purpose would be to reduce water surface elevation by 3 feet for a flow of 26,000 cfs. This measure has been retained for further consideration.

Terracing Downstream of Steamboat Confluence. Because this measure would result in a terrace above the existing low flow river channel, it does not pose the same environmental concerns as excavation down to or beyond the existing channel bottom. A terracing measure in the Vista area could reduce floodwater surface elevations at several points along the Truckee River relative to a scenario with containment structures only. The potential to provide hydraulic benefit makes this measure suitable for further consideration.

Extension of Airport Culvert on Boynton Slough. Due to backwater effects, containment of flows by levees and floodwalls in the Truckee Meadows area can increase water surface elevations, relative to existing conditions, in some reaches. Moderate increases in water surface elevations along Boynton Slough near the Reno International Airport cannot be contained by the existing natural topography of the area. Levees cannot be utilized near the Reno International Airport because levees must maintain a 10:1 side slope to meet airport regulations and space is limited in this area. An existing culvert conveys Boynton Slough flows beneath portions of the runways at the airport. In lieu of levees, extension of this culvert will be required under at least one of the alternatives. This measure would extend the existing triple-barrel box culvert approximately 1,795 feet. The internal dimension of each barrel is approximately 8 feet high by 12 feet wide. As the box culvert would be aligned along the existing channel alignment, minimal excavation would be required. This measure was retained.

Channel Widening (excavation to channel bottom). Excavation of the riverbanks down to the level of the channel bottom over an extended reach of the river would seriously affect the low-flow channel in that reach. This measure is considered inefficient due to significant environmental effects and associated high costs and has been eliminated from further consideration.

Channel Deepening at Vista Reefs. There have been efforts in the past to improve the flow past Vista by lowering the elevation of the rock outcropping. Recent studies have indicated that these actions in the past may have resulted in downcutting of the Truckee River up to 15 feet at McCarran Boulevard. This measure would also drastically affect the existing channel in the immediate area over which it is implemented. Channel deepening may increase the consequences to downstream locations since it allows more flow downstream as compared to the existing condition. Consequently, the measure is considered environmentally unacceptable and inefficient, and has been eliminated.

North Truckee Drain Realignment. The existing confluence of the North Truckee Drain with the Truckee River is located immediately upstream of the Steamboat Creek confluence. Relocating the confluence of the North Truckee Drain downstream from Steamboat Creek would reduce the extent of the backwater experienced along North Truckee Drain. The realignment would relocate the confluence approximately 4,500 feet downstream from its existing outlet and requires the construction of new conveyance facilities, including concrete lined channel and box culverts. This measure was retained for further consideration.

Reduce Flow Constrictions at Bridges in Downtown Reno

Bridge Rehabilitation. This measure would rehabilitate the historic bridges at Sierra, Virginia, and Lake Streets while maintaining their historic integrity. This rehabilitation would reinforce the bridges' structures, increasing their lifespan by approximately 25 years. In addition, it is assumed that the rehabilitation would be completed in a way that does not destroy the historic character of the bridges. The rehabilitation of Virginia Street Bridge would be conducted according to plans being developed by the Nevada Department of Transportation in consultation with the Nevada State Historic Preservation Office. No detailed plans have been developed for the Lake and Sierra Street Bridges. This measure has been retained for further consideration.

Bridge Preservation. This measure consists of preservation with only minor improvements to the historic bridges at Sierra, Virginia, and Lake Streets. Without major structural improvements, the Virginia Street Bridge would need to be closed to vehicular traffic within a few years, due to deterioration of structural conditions. The Nevada State Historic Preservation Office (SHPO) and Nevada Department of Transportation (NDOT) have indicated that major structural improvements can be made to Virginia Street Bridge without jeopardizing its historic character. Since this measure was not deemed effective, it was dropped from further consideration.

Replacement of Downtown Reno Bridges. Replacement of Sierra, Virginia, and Lake Street bridges has been retained as new structures could be designed to safely pass the mean 1% ACE flow thereby eliminating the flow constrictions caused by the structural characteristics of the existing bridges. There are two variations of this measure: replacement with Center Street type bridges and/or replacement with clear span bridges. This measure was retained.

Mini Spans at Center and Sierra Street Bridges. In conjunction with the channel widening measure is the addition of a partial or "mini" span to the existing Center and/or Sierra Street Bridges. Architecturally, each new "mini" span would resemble the current bridge spans. Where widening is implemented but a bridge is not replaced, the mini spans would be necessary to connect the existing bridges with the new channel bank. This span would provide an increase in the flow area at the bridge without requiring replacement of the entire bridge. This measure has been retained for further consideration.

New Span at Virginia Street Bridge. This measure would add a third span or archway to the north side of the Virginia Street Bridge. The new span would be implemented in conjunction with the plazas measure. Adding the new span would provide a direct hydraulic connection between the plazas and allow additional flow to pass through the bridge openings. The new span would be designed to have a similar appearance as the existing archway spans. Therefore, this measure was retained for further consideration.

Wells Avenue Lower Bridge Removal. This measure involves removing Wells Avenue's lower bridge to prevent backwater effects upstream of the bridge. Additional hydraulic modeling revealed that removal of the Wells Avenue lower bridge could reduce flood water elevations in the downtown reach. Therefore, this measure was retained for further consideration.

Arlington Avenue Bridge Replacement. This measure would replace the Arlington Avenue Bridge, which is actually composed of two separate bridges connecting Wingfield Park to the north and south banks of the river. A small section of roadway joins the two bridges. The bridge carries four lanes of through traffic, plus a turning lane. Due to the island located between the two portions of the bridge and the existing bridge's significant width, a large causeway would have to be constructed to create a bridge whose deck was elevated above flood flows, which would make it a costly measure. In addition, hydraulic modeling indicates that this measure would not significantly lower water surface elevations. The high cost relative to the hydraulic benefit caused the measure to be eliminated from further consideration due to low effectiveness and inefficiency.

Center Street Bridge Replacement. This measure would replace the Center Street Bridge with a bridge that was capable of passing the design event. This bridge was replaced in 1995 by the City of Reno based on pre-1997 hydrology. The current bridge does not have sufficient capacity to safely pass the mean 1% ACE on current hydrology. Due to the low effectiveness, this measure was dropped from further consideration.

Culverts around existing downtown Reno bridges. This measure combined with the cross-sectional flow areas of the existing bridges would not be effective. The culverts would also be costly and difficult to design at the existing bridges. Consequently, this measure is considered to have low effectiveness and efficiency and was not carried forward into an alternative plan.

Virginia Street Bridge Bypass. This measure consists of construction of two bypass channels along the north and south ends of the Virginia Street Bridge. This measure was not retained due to low effectiveness and uncertainty associated with hydraulic performance.

Culverts around new bridges (Sierra, Virginia, Lake, Center Streets). Modeling of this measure indicated that it could reduce water surface elevations relative to existing conditions. However, because debris accumulation could reduce the culverts' flow capacity, there is uncertainty regarding its reliability (an aspect of effectiveness), and it poses potential O&M burdens that are not desired by sponsoring agencies. Some uncertainty is also associated with the hydraulic design of these structures. Therefore, this measure was dropped from further consideration due to low effectiveness.

Bridge Lengthening at Rock and McCarran Boulevards. These lengthening measures are required as a consequence of any alternative that consists of the use of levees for flood flow containment. This measure has been retained for further consideration.

Bypass Channel at McCarran Boulevard. This measure consists of a bypass channel to split flows of the Truckee River around the historic property immediately west of McCarran Boulevard. This property is of historic interest and the sponsor had requested that a measure be evaluated to determine if the property could remain instead of being relocated. Therefore, this measure has been retained.

Build Floodwalls or Levees

Floodwalls. Floodwalls are physical barriers, typically reinforced concrete structures, designed to prevent waters from floods of a specified magnitude from inundating developed areas where residents, businesses, and/or high value property are located. These floodwalls could be in-channel floodwalls or on-bank floodwalls. This measure has been retained for further consideration.

Setback Floodwalls. Where undeveloped land immediately adjacent to the river's edge is available, setback of a floodwall would be feasible, provide hydraulic benefit, and not be cost prohibitive, then setback floodwalls would be used in preference to floodwalls that immediately border the river channel. This measure has been retained for further consideration.

Movable Barrier Floodwall System (MBFS). The MBFS is an automatic levee/floodwall system that theoretically operates solely by the buoyant forces of water. The system consists of a series of gasketed composite walls weighing approximately 20 pounds per cubic foot that are fitted inside a double-sided concrete channel trough. The moving walls are constructed of composite fiberglass and polyester materials. The MBFS is designed to keep at least 50 percent of its height inside the concrete channel when fully extended to provide support. There is a significant degree of uncertainty related to the technical feasibility of this measure because MBFS have never been installed and have no performance history. The measure is considered to have low efficiency and acceptability. As a result, this inefficient measure was dropped from further study due primarily to the estimated high cost and relatively short expected life.

Modular Floodwalls. Modular floodwalls consist of interlocking panels assembled on a ground surface level base system. The system typically consists of a concrete base with a guide and gasketed lock mechanism. Before flood events, lightweight wall panels are manually installed into the existing base system and locked into place. The wall panels are removed when the flood danger has passed. This measure was eliminated from further consideration due to the inefficiency of high labor requirements.

Tilt-up Floodwalls. Tilt-up floodwalls consist of concrete footings and/or base with hinged walls. The hinged walls, typically steel, lay flat against the ground surface when not in use. During flood events, these structures are raised to an angle near 90° with the ground surface, raising the effective height of the flood control structure. This measure determined to have low effectiveness and was eliminated from further consideration due to the physical limitations of erecting the floodwalls in time to handle flood events.

Levees/Berms. Levees are earthen flood control structures built high enough to prevent a specific flood event (e.g. the 1% ACE) from overtopping it, plus an additional height to allow a margin of safety. The allowable slope of the levee is determined by the strength of the soil comprising and underlying the levee, and the width of the levee at its base is determined in turn by both the required height and slopes. A layer of aggregate is often placed at the crest of the levee to provide firmer support for maintenance and inspection vehicles. For the flows for which they are designed to contain, levees can provide reliable flood protection if sited, designed, and constructed properly. This measure was retained for further consideration.

Setback Levees. Setback levees are simply levees which are set back a significant distance from the river's edge. Relative to levees that sit at the river's edge, setback levees increase somewhat the capacity of the high flow channel that is bounded by the levees. Where feasible and cost effective, setback levees would be used in preference to levees located immediately above stream banks. This measure was retained for further consideration.

Modify Other Infrastructure

Enlarge North Truckee Drain Capacity. This measure would place the existing North Truckee Drain into box culverts for a distance of approximately 3,200 lf, increasing its carrying capacity. This measure was retained.

Remove/Relocate Diversion Structures. This measure would address obstructions at specific diversion structures along the Truckee River. Consultation with local interests determined that the Glendale Ditch Diversion and the Pioneer Ditch Diversion were the two most problematic structures. However, both diversion structures are currently under study by other agencies for modification or removal. Therefore this measure was not carried forward for further evaluation.

Reduce Width of Riverside Drive. Marginally increasing the area allowed to flood by scaling back Riverside Drive would not be expected to significantly reduce flooding in the downtown Reno portion of the study area and would probably have no effect on flooding in the Truckee Meadows area. It is unclear how effective this measure would be, but it is expected that it would have high cost relative to benefit (i.e., low efficiency). Therefore this measure was eliminated from consideration.

Road Closure Bladders. Road closure bladders would be expected to have high effectiveness, as they tie off lines of physical defense from flood waters where floodwalls could not be erected and installation of levees would require redesign of a roadway. This measure was retained.

Replace culverts at Peckham Lane on Boynton Slough. This measure would extend the existing culvert on Boytnon Slough through the embankment at Peckham Lane and additional 1,800 lf. This measure was retained.

Screening results for FRM measures are summarized in Table 4-1.

4.5.3 Ecosystem Restoration (Fish Passage)

Eliminate Diversion Structure. This measure would include the removal of diversion structures within the project area to restore or improve fish passage in the Truckee River. This measure was retained.

Alter Diversion Structure. This measure would involve altering existing diversion structures to improve or restore fish passage. Structure alterations could include installing

secondary structures downstream of the main structure to reduce the hydraulic jump presented to fish migrating upstream, notching the existing structure, or lowering the structure's profile. This measure was retained for further study.

Combine Diversion Structures. This measure would involve combining diversion canals to reduce the number of diversion structures in the river. Preliminary investigations determined that this measure would not achieve project objectives and was dropped from further consideration.

Modify Existing Fish Ladders. This measure would involve modification to existing fish ladders at several diversion structures, as well as at Marble Bluff Dam, to improve their functional capacity for passage of a wider array of native fish species. This measure was retained.

Install a Bypass Channel. This measure would involve construction of a channel adjacent to the diversion structure at a gradient sufficient to accommodate upstream passage of targeted fish species from downstream of the diversion structure to upstream of the structure. Bypass channels provide fair to good upstream passage potential of targeted species and age classes, as well as the associated aquatic and riparian community, at a low to moderate cost. This measure was retained.

Install a Fish Ladder. Similar to the bypass channel, this measure would involve construction of a fish ladder either adjacent to or on the diversion structure that would accommodate upstream passage of targeted fish species from downstream of the diversion structure to upstream of the structure. Although fish ladders provide fair upstream passage potential of targeted species and age classes, passage of associated aquatic and riparian communities is generally poor, and costs are generally high. However, this measure was retained for further consideration.

Replace Diversion Structure with a Pump Diversion. This measure would involve replacement of the existing diversion structure with a screened pump intake. This would typically be associated with removal of the original structure and would provide good upstream passage potential. However, capital and operation and maintenance costs can be very high, depending on flow intake requirements, and physical constraints associated with the diversion site. This measure may be effective for those diversions in the system that have low diversion rates. This measure was retained for further consideration.

Install a Fish Screen. This measure would address downstream passage by reducing entrainment of fish in diversion canals. Installation of a screen at the inlet of a diversion canal or within the canal would either prevent fish from entering the canal or return fish to the river via a return canal. A variety of screen configurations exist, each with varying levels of fish exclusion capabilities, maintenance requirements, and cost. However, fish passage effectiveness is generally good. This measure was retained for further consideration.

Screening results for ecosystem restoration (fish passage) measures are summarized in Tables 4-2.

4.5.4 Recreation

Trail-Based Amenities

Create a Paved Maintenance Road/Bikeway. Construct a paved bikeway that could be used as a maintenance road. Consider possible linkage of all trails with the Tahoe-Pyramid Bikeway. This measure was retained.

Create Unpaved Trails. Develop unpaved nature trails and limited picnic or resting amenities in the ecosystem restoration areas. Create access to the river – nature trail system and gravel/sand beach terminal points. This measure was retained.

Provide Trailhead Access and Amenities. Develop new trailheads with parking and restrooms, small picnic area with a single shelter and 3-5 tables, waste receptacles, water fountains, kiosks, directional signage, nature trails and/or trail connection. Rural trailheads would need parking for 10 cars, as well, as other amenities described above. Trailheads shall be located along major exchanges of Interstate 80 and approximately 3-5 miles apart in rural reaches. This measure was retained.

Construct Pedestrian Bridges. Construct wooden pedestrian bridges to cross the Truckee River and provide linkage to existing and new trails. This measure was retained.

Provide (Americans with Disabilities Act) (ADA) compatible pathways. Provide ADA (universal accessibility) compatible pathways that, at a minimum, link parking and all permanent features. Preserve existing park amenities within the Project Lands and where possible assist with redevelopment plans. This measure was retained.

Truckee Meadows Recreation Features

Sports Courts. Design basketball courts in association with picnic areas and sport complex. This measure was dropped from consideration due to inconsistency with USACE policy regarding cost-shared recreation features.

Small and Large Open Fields. Practice fields would be the predominant use. Flat-fields would be designed such that they do not require fencing where practical, particularly on land neighboring the river, to reduce concerns that fencing could cause flood damages. Use design and landscaping with native "non-berry- and non-nut-producing" trees and shrubs to make area less attractive to geese and flocking birds and mammals near the airport. This measure was retained.

League-Size Soccer Complex. This measure consists of regulation-sized soccer fields with a central complex for scoring, refreshments, and restrooms. The scale of this measure would be dependent on available lands not in conflict with other project purposes. Fields would be turf and require permanent irrigation and lighting. This measure was dropped from further consideration due to inconsistency with USACE policy regarding cost-shared recreation features.

Diamond Sports Facility. A facility with sports diamonds would be designed to withstand or avoid the most common flood events. The electrical supply source would be kept out of the floodplain and would feed into buildings, sport complex lighting, amphitheatre lighting, concession and restrooms. This measure was dropped from consideration due to inconsistency with USACE policy regarding cost-shared recreation features.

Small and Medium Soccer Fields. Soccer fields with a permanent irrigation system for sport and practice fields and temporary irrigation to all other landscaped and ecosystem restoration areas to facilitate vegetation establishment would be constructed. Return/reuse water from the City of Reno will be used for irrigation. This measure was dropped from further consideration due to inconsistency with USACE policy regarding cost-shared recreation features.

Playground. A playground would be designed in association with picnic areas and sport complex. This measure was retained.

Picnic Sites and Shelters. Several sizes of picnic facilities would be provided to accommodate individuals and couples, small groups, and at least one large group facility. This would include a 500 person shelter near the current location of the Excel Building. This measure was retained.

Fishing Access. Trails or sites for fishing access would be provided. A flow-through pond site in the lower terrace of ecosystem restoration sites would be created for enhanced fishing opportunities. This could include pier and/or boardwalk or pedestrian bridges for trail linkage. This measure was retained.

Non-Motorized Water Craft—Kayak and Canoe Access. Access points on both sides of the river for put-in of recreational kayaks and canoes would be provided. This measure was retained.

Natural Amphitheatre. During excavation for floodplain terracing, a semi-circular area could be contoured and the slopes planted with native grasses so that the area could be used as an amphitheatre for public events. This measure was dropped from further consideration due to inconsistency with USACE policy regarding cost-shared recreation features.

Screening results for recreation measures are summarized in Tables 4-3.

Table 4-1. Summary of Flood Risk Management Measures Considered

Measures	Effectiveness[1]	Efficiency[2]	Dropped	Retained
Non-Structural Measures				
Flood Insurance		In place	✓	
Early Flood Warning System		In place	✓	
Flood-proofing	Medium			✓
Large Scale Floodplain Evacuation	Low	Inefficient	✓	
Small Scale Floodplain Evacuation	Medium			✓
Dedication of Developed Floodplain to Natural Storage	Low	Inefficient	✓	
Dedication of Undeveloped Floodplain to Natural Storage	High			✓
Floodplain Management Plan	Medium			✓
Structural Measures				
Storage/Detention				
New Upstream Reservoirs	Low	Inefficient	✓	
Upstream Detention with Weirs	Low	Inefficient	✓	
On-stream Storage	Low		✓	
Upstream, Off-Channel Detention		Inefficient	✓	
Increase Storage at Upstream Reservoirs	Low		✓	
Tahoe Reoperation (precautionary release)	Low		✓	
Enclosed Detention Facility at University Farms	Medium			✓
Mustang Ranch Detention facility	Medium			✓
Huffaker Hills Detention facility	Medium			✓
Bypass Tunnel to Huffaker Hills Reservoir		Inefficient	✓	
Increase Channel Flow Capacity				
Channelization Keystone Ave to Arlington Ave	Low		✓	
Channelization Arlington Ave to Virginia St	Medium			✓
Channel Widening Sierra St to Lake St	Medium			✓
Culvert Around Replaced Lake Street Bridge	Medium			✓
Plazas	Medium			✓
Containment at First Street	Low		✓	
Widening on the South Bank	Medium	Inefficient	✓	
Downtown Buyout	Medium	Inefficient	✓	
Channelization at Glendale Park Area	Low	Inefficient	✓	
Terracing Upstream of Steamboat Confluence	High			✓
Terracing Downstream of Steamboat Confl.	High			✓
Extension of Airport Culvert on Boynton Slough	Medium			✓
Channel Widening (to channel bottom)	Low	Inefficient	✓	
Channel Deepening at Vista Reefs	Low	Inefficient	✓	
North Truckee Drain Realignment	High			✓
Reduce Flow Constrictions at Bridges				
Bridge Rehabilitation	Medium			✓
Bridge Preservation	Low		✓	
Replacement of Downtown Reno Bridges	Medium			✓
Mini Spans at Center and Sierra Street Bridges	Medium			✓
New Span at Virginia Street Bridge	Medium			✓
Wells Avenue Lower Bridge Removal	Medium			✓
Arlington Avenue Bridge Replacement	Low	Inefficient	✓	
Center Street Bridge Replacement		Inefficient	✓	

Measures	Effectiveness[1]	Efficiency[2]	Dropped	Retained
Culverts Around Existing Downtown Bridges	Low	Inefficient	✓	
Virginia Street Bridge Bypass	Low	Inefficient	✓	
Culverts Around New Bridges (Sierra, Virginia, Lake, Center Streets)	Low		✓	
Bridge Lengthening at Rock and McCarran Boulevards	Medium			✓
Bypass Channel at McCarran Boulevard	Medium			✓
Floodwalls/Levees				
Floodwalls	High			✓
Setback Floodwalls	High			✓
Movable Barrier Floodwall System (MBFS)	Low		✓	
Modular Floodwalls	High	Inefficient	✓	
Tilt-up Floodwalls	Medium	Inefficient	✓	
Levees/Berms	High			✓
Setback Levees	High			✓
Modify Other Infrastructure				
Enlarge North Truckee Drain Capacity	Medium			✓
Remove/Relocate Diversion Structures	Low		✓	
Reduce Width of Riverside Drive	Low		✓	
Road Closure Bladders	Medium			✓
Extend culverts at Peckham Lane on Boynton Slough	Medium			✓

[1] Effectiveness is determined by how well a measure meets the planning objectives.
[2] Efficiency is determined by the potential benefits and costs of the measure.

Table 4-2. Summary of Ecosystem Restoration (Fish Passage) Measures Considered

Measures	Effectiveness[1]	Efficiency[2]	Dropped	Retained
Eliminate Irrigation Diversions	High			✓
Alter Irrigation Diversions	Medium			✓
Combine Diversion Structures	Low		✓	
Modify Existing Fish Ladders	Medium			✓
Install Bypass Channel	High			✓
Install Fish Ladder	Medium			✓
Replace Diversion Structure with Pump Diversion	Medium			✓
Install Fish Screen				✓

[1] Effectiveness is determined by how well a measure meets the planning objectives.
[2] Efficiency is determined by the potential benefits and costs of the measure.

Table 4-3. Summary of Recreation Measures Considered

Measures	Effectiveness[1]	Efficiency[2]	Dropped	Retained
Trail-Based Amenities				
Create a Paved Maintenance Road/Bikeway	High			✓
Create Unpaved Trails	High			✓
Provide Trailhead Access and Amenities	Medium			✓
Construct Pedestrian Bridges	Medium			✓
Provide ADA compatible pathways	Medium			✓
Truckee Meadows Features				
Sports Courts	Low	Not policy compliant	✓	
Small and Large Open Fields	Medium			✓
League-Size Soccer Complex	Low	Not policy compliant	✓	
Diamond Sports Facility	Low	Not policy compliant	✓	
Small and Medium Soccer Fields	Low	Not policy compliant	✓	
Playground	High			✓
Picnic Sites & Shelters	High			✓
Fishing Access	High			✓
Non-Motorized Water Craft--Kayak & Canoe Access	High			✓
Natural Amphitheatre	Low	Not policy compliant	✓	

[1] Effectiveness is determined by how well a measure meets the planning objectives.
[2] Efficiency is determined by the potential benefits and costs of the measure.

4.6 Formulation of Preliminary Alternative Plans

Preliminary alternative plans were formulated from the screened management measures previously discussed. These alternatives were developed to encompass a broad range of potential alternatives to address flood risk management and associated recreation opportunities in Downtown Reno and the Truckee Meadows, and fish passage restoration. Each of these preliminary alternative plans is configured to address the planning objectives defined by the study (see Section 4.3).

4.6.1 Formulation and Screening of Preliminary Alternatives for Flood Risk Management

Formulation Strategy

Preliminary flood risk management alternatives were formulated for the Downtown Reno reach and the Truckee Meadows reach, which have hydrologically separate floodplains. Flood risk management can be implemented in the Truckee Meadows Reach without affecting the Downtown Reno reach. However, improvements to conveyance in the Downtown Reno reach would increase flows in the Truckee Meadows Reach.

Each preliminary alternative consists of a combination of the retained flood risk management measures that are described in Section 4.6. Measures for the Truckee Meadows

Reach were scaled at the 1% ACE event and each alternative in the Truckee Meadows was scaled for the 1% ACE event to facilitate comparison of the alternatives. Most of these measures can be combined with other measures in the plan formulation process for either of the two reaches (Downtown Reno or Truckee Meadows) with some exceptions. Measures that are more general in application and not tied to a specific location can be considered in the plan formulation process for either or both reaches.

Once these alternatives were formulated, preliminary designs were developed for the purpose of developing cost estimates. These preliminary cost estimates were used to screen for cost effectiveness. Cost estimates for the purposes of screening alternatives were developed using historical bid histories and professional experience in recent construction market trends. Assumptions made during the development of these cost estimates included standard methods of construction, a five year construction period, and a 28.6 percent contingency.

Downtown Reno Reach

Substantial analysis was undertaken to address uncertainties about many measures and several of the more costly measures such as channelization, culverts around existing bridges, or channel widening were dropped prior to the formulation of alternatives.

Based on hydraulic modeling, the measures retained focused on addressing the insufficient passage at Virginia, Sierra, and Lake Street bridges and associated containment measures. Treatment of the bridges included rehabilitation, expansion, and replacement with designs matching the current Center Street Bridge design or incorporating the landmark design elements of the Virginia Street Bridge for all bridges.

Because this reach has an existing flow capacity estimated to safely convey the 1.6% AEP (also referred to as 1:60, 1/60, or "60-year event"), the formulation of alternatives focused on the 1% ACE event since an increment below that event would still incur the high costs of modifying the bridges without a substantial decrease in damages. Annual Exceedence Probability (AEP) is the chance of a flood of a given size (or larger) occurring in any one year. Table 4-4 displays the measures matrix for the preliminary alternatives formulated for Downtown Reno.

Truckee Meadows Reach

Alternatives formulated for the Truckee Meadows reach considered various ways to contain and control flooding from overbank flows and backwater floodwaters due to the narrows at Vista. Approaches to either retain floodwaters in the Truckee Meadows or to confine flows in the channel and move it more quickly downstream were considered. Table 4-5 displays the measures matrix for the preliminary alternatives formulated for the Truckee Meadows Reach.

Table 4-4. Management Measures Matrix - Preliminary Alternatives - Downtown Reno

Measure		DOWNTOWN RENO					
	Alt A Rehab	Alt B Matching	Alt C Landmark	Alt D Widening	Alt E New Span	Alt F Bridge Replacement	Alt G Non-structural
Increase Channel Flow Capacity							
Channelization between Arlington and Virginia St.	✓	✓	✓	✓	✓		
Channel widening from Sierra to Lake				✓	✓		
Culvert around Replaced Lake St. Bridge				✓	✓		
Plazas					✓		
Reduce Flow Constrictions At Bridges							
Replacement of Sierra St., Virginia St., Lake St. Bridges		✓	✓	✓		✓	
Rehabilitate Bridges at Sierra, Virginia, and Lake St.	✓				✓		
Mini spans at Center & Sierra St. Bridges				✓	✓		
Replace Bridges with Clear Span Bridges					✓		
New Span at Virginia Street Bridge					✓		
Wells Avenue Lower Bridge Removal	✓	✓	✓	✓			
Floodwalls, Levees							
Floodwalls	✓	✓	✓	✓	✓		
Levees/berms	✓	✓	✓	✓	✓		
Modify Other Infrastructure							
Road closure bladders	✓	✓	✓	✓	✓		
Non-structural Measures							
Non-structural Commercial & Residential Flood-proofing	✓	✓	✓	✓	✓	✓	✓
Small Scale Floodplain Evacuation							✓
Floodplain Management Plan	✓	✓	✓	✓	✓	✓	✓

Table 4-5. Management Measures Matrix - Preliminary Alternatives - Truckee Meadows

Measure	Alt 1	Alt 2	Alt 3
Storage/Detention			
Enclosed detention facility at University Farms		✓	
Dedication of undeveloped floodplain for natural storage	✓	✓	✓
Huffaker Hills detention facility		✓	✓[1]
Mustang Ranch detention facility		✓	✓[1]
Increase Channel Flow Capacity			
Terracing upstream of Steamboat confluence			✓
Terracing downstream of Steamboat confluence			✓
Extension of Airport Culvert on Boynton Slough	✓		
North Truckee Drain Realignment	✓	✓	
Reduce Constrictions At Bridges			
Bypass Channel at McCarran Blvd.	✓	✓	✓
Bridge lengthening at Rock and McCarrran Blvds.	✓	✓	✓
Extend culverts at Peckham Lane on Boynton Slough	✓		
Levees and Floodwalls			
Floodwalls	✓	✓	✓
Setback floodwalls	✓	✓	✓
Levees	✓	✓	✓
Setback levees			✓
Modify Other Infrastructure			
Enlarge North Truckee Drain Capacity			✓
Non-structural Measures			
Nonstructural Commercial and Residential Flood-proofing			✓
Floodplain Management Plan	✓	✓	✓

1. Detention was initially part of plans but subsequently dropped due to high costs and failing to meet the objectives.

4.6.2 Alternatives Descriptions, Downtown Reno Reach

Alternatives were formulated to address the project purpose of flood risk management for each reach. All alternatives would include development of a floodplain management plan to address residual risks.

Alternative A - Rehabilitation of Bridges with Floodwalls Alternative

Floodwalls. Left bank consists of a total of 3,615 feet, of which 1,095 feet are in-channel floodwalls, 1,970 feet are benched floodwalls and 550 feet are on-bank containment floodwalls (there are also 3,635 lineal feet of recreational facility floodwalls and 1,600 feet of on-bank containment floodwalls on the right bank). The walls vary in height from 4 to 21 feet. The floodwalls begin at Booth Street and end at Wells Avenue.

Channelization between Arlington and Virginia Streets. This measure consists of 40,500 cubic yards of excavation for 2,600 feet between Arlington and Virginia Streets.

Road Closures Bladders. There are several bridges where road crossings interrupt the continuity of proposed floodwall containment lines. With this measure, inflatable bladders would be installed at those bridges where a temporary barrier would be needed to provide a continuous barrier to adequately contain flood waters.

Nonstructural Commercial and Residential Flood Proofing. Four structures would require nonstructural flood proofing with this alternative. Three are located on the south bank, two are residential condominiums near Barbara Bennett Park and one is a single family residence. There is also a commercial building near Brick Park on the north bank.

Berm. Fill would be used to create a berm immediately downstream of Lake Street. The berm would measure 200 lineal feet by 2 feet high.

Rehabilitate Bridges at Sierra, Virginia and Lake Streets. Under this measure, the bridges at Sierra, Virginia, and Lake Streets would be rehabilitated while maintaining their historic integrity. This rehabilitation would reinforce the bridges' structures, increasing their lifespan by approximately 25 years. In addition, it is assumed that the rehabilitation would be completed in a way that does not destroy the historic character of any of the bridges. The rehabilitation of Virginia Street Bridge would be done according to plans being developed by NDOT in consultation with the Nevada State Historic Preservation Office (SHPO). Plans for the rehabilitation of Lake and Sierra Street Bridges would be done by USACE.

Wells Avenue Lower Bridge Removal. The Lower Wells Bridge, located beneath its replacement, is currently an obstruction to flows in the Truckee River. This measure would remove the bridge and its associated abutments.

Alternative B - Matching Bridges with Floodwalls Alternative

Floodwalls. The components of this feature are the same as Alternative A described above except for the wall heights, which vary from 3 to 19 feet.

Replace Bridges at Sierra, Virginia and Lake Streets. This plan component increases channel conveyance through the Downtown Reach principally by replacing the existing bridges at Sierra, Virginia, and Lake Streets with new bridges whose design and architecture would be similar to that of the Center Street Bridge. The Center Street Bridge was built in 1996, is capable of passing the design flow of 20,700 cfs, and blends architecturally with the post office and nearby floodwall railings on the river side of the building. Use of a design similar to the Center Street Bridge would provide a consistent and coherent architectural theme. This component is estimated to cost 8.7 million dollars.

Channelization, bridge closures, nonstructural commercial and residential flood proofing, and berm features are all the same as described for Alternative A above.

Alternative C- Landmark Bridges with Floodwalls Alternative

This alternative is identical to the Alternative B except that a bridge without any supporting structures located in the river (i.e., a clear span) would be constructed instead of a Center Street type bridge. The clear spans would provide even greater flow area and no bridge piers, further decreasing the potential for debris to accumulate at the bridges.

This alternative's relatively low floodwall heights would most enhance the visual experience along the river and be most consistent with the objectives and designated land uses of the redevelopment esplanade as stated in the River Corridor Action Plan.

The components of the floodwall feature are the same as Alternative A above except for the wall heights, which vary from 1 to 15 feet. Channelization, bridge closures, nonstructural commercial and residential flood proofing, and berm features are all the same as the Alternative A.

Alternative D - Widening of Bridges with Floodwalls Alternative

Floodwalls. The components of this feature are the same as Alternative A above except for the wall heights, which vary from 1 to 18 feet.

Replace Bridges at Sierra, Virginia, and Lake Streets. This component is identical to the Alternative B, but because of the channel widening associated with this alternative, more materials would be required to construct the replacement bridges. Therefore, the construction costs are greater than the other alternatives that do not include the channel widening.

Mini-Span at Center Street Bridge. In conjunction with the channel widening measure is the addition of a partial or mini span to the existing Center Street Bridge. Architecturally, the new mini-span would resemble the current bridge spans. Where widening is implemented but a bridge is not replaced, the mini-spans would be necessary to connect the existing bridges with the new channel bank. This would provide an increase in the flow area at the bridge without requiring replacement of the entire bridge. For the this alternative, a mini-span would be added only at the Center Street Bridge.

Channel Widening From Sierra to Lake Streets: This measure involves widening the river channel on the north bank from approximately Sierra Street to Lake Street to provide additional flow area. The widening would begin 2 vertical feet above the existing channel bottom and extend horizontally 12½ feet into the planned riverwalk. This flood risk management measure would be implemented through the majority of the Sierra-to-Lake-Street reach, with the exception of the city block that contains the AT&T building. Through this block, the channel would be widened by only 6 feet on the west and east sides of the AT&T building. There would be no widening along the front of the AT&T building.

Culvert at Lake Street. This measure provides for the installation of a culvert around Lake Street Bridge on the north side of the river. The culvert would direct excess flow around the bridge abutments, thereby increasing flow capacity. This measure would be implemented

only in conjunction with the widening measure. A culvert would be required to accommodate the additional flow made possible by widening, because physical constraints (AT&T building) make lengthening of Lake Street Bridge infeasible.

Channelization, bridge closures, nonstructural commercial and residential flood proofing, and berm features are all the same as Alternative A above.

Alternative E – Rehabilitation of Bridges with New Span and Floodwalls Alternative

Floodwalls. The components of this feature are the same as Alternative A above except for the wall heights, which vary from 3 to 18 feet.

Mini-Spans at Center and Sierra Street Bridges. Because of the channel widening associated with this alternative, a partial or mini-span would be constructed to lengthen the existing Center and Sierra Street bridges. Architecturally, each new mini-span would resemble the current bridge spans. Where widening is implemented but a bridge is not replaced, the mini-spans would be necessary to connect the existing bridges with the new channel bank. This would provide an increase in the flow area at the bridge without requiring replacement of the entire bridge.

Plazas. Plazas provide open areas on the north bank of the river to increase flow conveyance capacity. Plazas would begin at the north edge of the river, 2 feet above the bottom of the river channel, and extend perpendicularly from the river as far as the south side or closest public right-of-way line of First Street as measured from the river's edge. One plaza would be placed between Sierra and Virginia streets, using the entire block now occupied by the Masonic building, and the second plaza would be placed at the former Mapes block.

Channel widening and the culvert at Lake Street components of this alternative are the same as for Alternative D above. The Bridge Rehabilitation feature for this alternative is the same as Alternative A, above.

Channelization, bridge closures, nonstructural commercial and residential flood proofing, and berm features are all the same as Alternative A, above.

Alternative F - Bridges Replacement Only Alternative

This alternative consists of replacing Sierra, Virginia, and Lake Street bridges with bridges capable of passing 1% AEP event. No other confinement measures would be included. This alternative would provide only limited flood risk management beyond the current 2% AEP (also referred to as 1:50, 1/50, or "50-year event") non-damaging event. Both clear-span and double-span replacement bridges were considered with double-span bridges being selected due to lower costs.

Alternative G - Non-structural Alternative

A comprehensive non-structural solution for downtown Reno was determined to be infeasible due to high costs. During formulation, an average cost per structure to flood proof using recent project data was compared to preliminary property values. This comparison determined that it was not feasible to flood proof all structures. However, an alternative was formulated targeting the structures providing the greatest reduction in flood damages. A total of 10 structures were identified for flood proofing under this alternative.

4.6.3 Alternatives Screening, Downtown Reno Reach

The preliminary flood risk management alternatives were screened against the four P&G formulation criteria. Standards were established to determine if the alternative plans met each criterion. For a plan to be carried forward, minimum standards had to be met. The No-Action alternative was not included in this screening process because it must be carried forward in the process in order to serve as the baseline against which all retained alternatives are compared.

Standards established for the screening criteria are:

- Completeness. Completeness is a determination of whether or not the plan includes all elements necessary to achieve the objectives of the plan. It is an indication of the degree that the outputs of the plan are dependent upon the actions of others. Plans that depend upon the actions of others to achieve the desired output were dropped from consideration. Each alternative is considered complete.

- Effectiveness. Effectiveness is the extent to which a measure or alternative plan achieves the planning objectives. Measures or alternative plans that clearly make little or no contribution to the planning objectives were dropped from consideration. Since each alternative contributes to at least one planning objective, each is retained.

- Efficiency. Efficiency is a measure of the cost effectiveness of the plan expressed in net benefits. Benefits can be both monetary and non-monetary. Measures or alternative plans that provided little benefit relative to cost were dropped from consideration. Table 4-4 shows the results of the comparison of net benefits analysis.

- Acceptability. Acceptability is a measure of the ability to implement a measure or alternative plan. In other words, acceptability means a measure or plan is technically, environmentally, economically, and socially feasible. Unpopular plans are not necessarily infeasible, just unpopular. Measures or plans that were clearly not feasible were dropped from consideration. The measures developed for all of the alternative plans are generally considered satisfactory methods of addressing flooding problems and lack of habitat. While some measures are more preferable than others to the public, all were deemed acceptable. Therefore, all the alternatives were determined to be acceptable.

Benefits and costs computations were evaluated based on October 2012 prices. However, because of the length of analysis, price levels varied throughout the study phases. Nevertheless, values in previous price levels (2007 and 2011) that were critical to the evaluation and comparison of alternatives were brought to the current price level (October 2012). The remainder of the cost and benefits that were deemed un-influential remained at their respective levels.

Table 4-6. Economic Evaluation of Preliminary Flood Risk Management Alternatives in Downtown Reno at the 1% ACE. [1]

Preliminary Alternative	Total First Cost	Annualized First Costs	Annualized Benefits	Net Benefits	Economically Justified?
Alternative A	45,975	3,225	2508	-717	No
Alternative B	69,340	4,650	2508	-2142	No
Alternative C	56,560	3,925	2508	-1417	No
Alternative D	57,350	3,975	2508	-1467	No
Alternative E	63,290	4,385	2508	-1877	No
Alternative F	23,509	1,494	1,583	89	Yes
Alternative G	7,200	400	52	-348	No

[1] (October 2007 Prices, $1,000's, 4.125% Interest Rate)

As shown in Table 4-6, the only alternative with net benefits for the Downtown Reno reach was Alternative F - Bridge Replacement Only alternative. This alternative was retained for further NED analysis, including a detailed cost estimate. A comparison of the new cost estimate with updated economic benefits showed that removing and replacing the Sierra, Virginia, and Lake Street bridges was not cost-effective. Therefore, the project delivery team formulated a revised Bridge Replacement Only alternative in which the Sierra and Virginia Street bridges would be removed and replaced and the Lake Street Bridge would be removed, but not replaced. Benefits for this alternative are primarily from advanced bridge replacement cost savings. Each of the three bridges has some remaining life and currently serves transportation purposes. This plan extents the life of the bridges for the period of analysis. The replaced bridges would have extended life and would provide benefits beyond flood damage reduction. In Table 4-7, the advanced bridge replacement benefits for each bridge are shown.

Table 4-7. Advanced Bridge Replacement Benefits, Downtown Reno[1]

Bridge Crossing	First Cost of Bridge	Remaining Life in Years	Extension of Transportation Life	Average Annual Benefit
Sierra	12,047	25	25	$153
Virginia	14,587	1	49	$649
Total- Advanced Bridge Replacement Benefits				$802
Flood Damage Reduction Benefits				$772
Total Benefits – Bridge Replacement Only Alternative				$1,574

[1] (October 2011 Prices, $1,000's, 4% Interest Rate); See Economic Appendices regarding economic uncertainty.

As shown in Table 4-8, the revised Bridge Replacement Only alternative would not provide net benefits in excess of the costs. In addition, most of the benefits are for advanced bridge replacement and are incidental to the project purpose of flood risk management. Since a lower scale of project would provide fewer benefits but still require costly bridge modifications, no other scales were evaluated. Consequently, there is no Federal interest in the revised Bridge Replacement Only alternative. Despite iterative efforts, no measure or plan with a Federal interest has been identified for the Downtown Reno reach.

Table 4-8. Comparison of Alternative Plans in Downtown Reno[1]

Project Conditions	First Costs	Annual Benefits	Annual Costs	Net Benefit
Bridge Replacement Only (FRM & ABR)	$60,334	$1,574	$2,702	-$1,128
Bridge Replacement and Floodwalls (FRM & ABR)	$172,793	$3,353	$7,911	-$4,558

[1] 2011 Price Levels ($1000), 4% Interest Rate; See Economic Appendices regarding economic uncertainty.

4.6.4 Truckee Meadows Reach

Initial plan formulation efforts in the Truckee Meadows Reach focused on three preliminary alternatives for dealing with flood damage reduction. During public scoping meetings, it became clear that the induced flows of the first three preliminary alternatives were not acceptable to downstream interests. USACE conducted workshops and formulated 8 additional alternatives in an attempt to retain as much floodwaters in the Truckee Meadows as possible. These additional alternatives focused on increasing storage opportunities at Huffaker Hills and the UNR Farms locations.

Each of the preliminary alternatives was initially designed to address the 1% ACE event within the Truckee Meadows Reach to facilitate direct comparison of the alternatives. Optimization of the level of performance was deferred until after a cost effectiveness analysis could reduce the array of alternatives to a more manageable number. Since options for additional detention in the Meadows are limited, the team looked at expanding detention basins at UNR Farms, Huffaker Hills, and a new detention site at Upper Lockwood. Since downstream

hydraulic models were not completed at that time, the team used induced flows at Vista as a measure of the success of these 8 preliminary alternatives.

The evaluation showed that while induced flows could be reduced they could not be eliminated. In addition, the costs of including expanded detention were substantially higher than the three initial alternatives without any apparent increase in economic benefits. These costs were due to the high real estate costs in the Meadows that would be generated by increased detention sites and the larger levees required containing the additional flows.

Since additional detention measures did not increase the alternatives' ability to meet the planning objectives, the team determined that the five alternatives formulated with expanded detention facilities would not be carried further in the planning process. The evaluation also showed that a detention basin at Mustang Ranch was ineffective for mitigating downstream flows and this feature was dropped from the existing Alternatives 2 and 3.

Alternatives 1, 2, and 3 were retained for further evaluation as the final array of alternatives for flood risk management in the Truckee Meadows Reach. The following descriptions of the alternatives are based on designs that would address the 1% ACE flood event.

Downstream Induced Flows

Under each of the three alternatives, additional flows would be transferred from the Truckee Meadows Reach to the Lower Truckee River Reach under the with-project condition. An analysis was conducted to determine the potential for increased bank erosion and scour over the without project condition to assist in the determination of whether mitigation would be needed.

Specifically, this effort consisted of the following: 1) identify locations where the project would induce noticeable impacts on the velocity and shear on the channel, and 2) develop hydraulic-based designs which would provide protection. Channel shear stress and channel velocity were tabulated for both with- and without-project conditions design flow rates for each cross section in the model. In addition, a corresponding shear category and velocity category were assigned to each value. The categories were numbered from 1 to 10 and range upward with increasing hydraulic energy in the channel. Shear and velocity categories were delineated based on typical permissible shear and permissible velocity ranges for soil or sediment materials, vegetation, and rock sizes.

In comparing shear and velocity differences between without- and with-project conditions, if no increase or a decrease occurred under with-project conditions, or if the values increased but stayed within a single shear or velocity category, an impact number of 0 was assigned. If the shear or velocity increase caused a step up in one category level, an impact number of 1 or 2 was assigned, depending on whether one or both of the shear and velocity categories increased. Similarly, impact numbers of 3 and higher were assigned using the same logic.

The project delivery team subsequently identified locations where velocity and shear exceeded 0; the team assessed the potential for impacts to critical infrastructure, bridge piers, and proposed restoration sites. Based on that assessment, sites were identified and both structural and biotechnical bank protection measures were formulated and added to each alternative and costs for each were estimated.

Chapters 5 and 6 include additional information about induced flooding.

Description of Final Array of Flood Risk Management Alternatives

No Action Alternative

Under the No Action alternative, there would be no Federal action to reduce flood damages within the Truckee Meadows area. The population, structures and property within the floodplain would remain at risk from flooding during events greater than the 5% (also referred to as the 1:20, 1/20, or 20-year) ACE event.

Alternative 1 - Levees and Floodwalls Plan

This alternative accomplishes flood risk management in the Truckee Meadows Reach primarily by containing the flows with levees and floodwalls. Alternative 1 would not include any detention facilities or channel terracing. Because flows are contained, Alternative 1 has the highest design water surface elevations relative to the other alternatives, and downstream flows are increased in comparison to existing conditions. The major features of this alternative are listed in Table 4-9 and shown in Figure 4-1.

At the design flow event (1% ACE), Alternative 1 would induce an additional 2,400 cfs of flow above existing conditions in the Lower Truckee River Reach downstream of Vista. These additional flows could potentially increase flooding of residences in Lockwood/Rainbow Bend and Wadsworth, as well as increase inundation of agricultural lands in various locations in the Lower Truckee River Reach. Additional flows could also increase scour at the Painted Rock Bridge. Mitigation features proposed for these hydraulic effects include terracing at Rainbow Bend, constructing floodwalls at Wadsworth, and replacing the Painted Rock Bridge.

Bank Protection. A combination of bioengineered and rock bank protection is proposed to stabilize the streambank at locations where erosion could endanger critical infrastructure, such as the Union Pacific Railroad and I-80.

Table 4-9. Summary of Flood Risk Management Structures for Alternative 1

Water Course	Reach Description	Total Structure Length (feet)	Average Structure Height[1] (feet)	Structure Type(s)	Seepage Mitigation
Truckee River	North (left) Bank Glendale Avenue to Greg Street	1,000 2,000	8	Floodwall Levee	Drainage Blanket
	North (left) Bank Greg Street to 5,000 feet upstream of North Truckee Drain	7,800 (2,300 lf of in-channel floodwall) 8,700	7	Floodwall Levee	Relief Wells and Seepage Berms
	North (left) Bank 5,000 feet upstream of North Truckee Drain to North Truckee Drain	700 5,100	9	In-Channel Floodwall Levee	Relief Wells
	North (left) Bank North Truckee Drain to Vista	4,300	7	Levees	Relief Wells
	South (right) Bank Highway 395 to Greg Street	3,100 2,400	7	Floodwall Levee	Drainage Blanket
	South (right) Bank Greg Street to McCarran Boulevard	300 9,800	6	Floodwall Levee	Seepage Berm
	Levee east of McCarran Blvd	9,100	10	Levee	Seepage Berm
Steamboat Creek	West (left) Bank Upstream of Boynton Slough	5,700 1,500	8	Floodwall Levee	Cutoff Wall
	East (right) Bank	9,500	9	Floodwall	Cutoff Wall
Boynton Slough	North (left) Bank	1,900 6,500	6	Floodwall Levee	Cutoff Wall
	South (right) Bank	5,700 4,500	6	Floodwall Levee	Cutoff Wall
	Extend culvert on Boynton Slough near Reno-Tahoe International Airport	1,800		Culvert	
North Truckee Drain	West (right) Bank	9,400	8	Floodwalls	Relief Wells
	East (left)Bank	9,400	7	Floodwalls	Relief Wells
	Along both banks, all reaches	54,500 53,900 1,800		Floodwall Levee Culvert	

[1]Preliminary estimate of average levee and floodwall structure height are based on design water-surface elevation, 1% ACE, plus estimated 3 feet for risk and uncertainty on main stem of Truckee River and 2 feet for risk and uncertainty on Steamboat Creek, Boynton Slough, and North Truckee Drain.

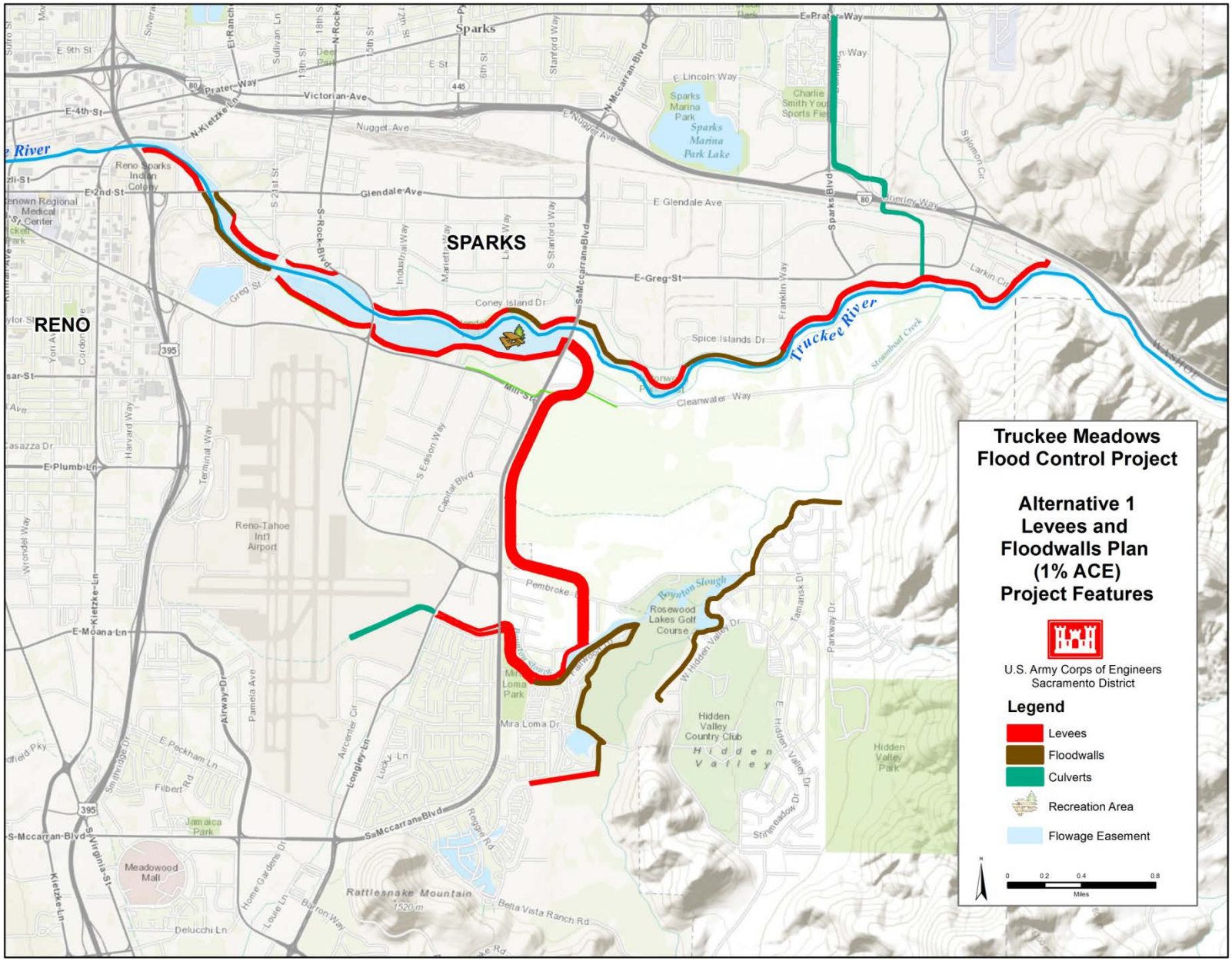

Figure 4-1. Alternative 1 - Levees and Floodwalls Plan

Lockwood/Rainbow Bend Terracing. Terracing of the banks at three locations downstream of the Lockwood Drive Bridge would lower water surface elevations from anticipated design flows such that water does not overtop the banks in the Rainbow Bend area. Excavation of terraces is proposed at two locations on the north bank and at one location on the south bank, approximately 500 feet downstream from the wastewater treatment facility. Depending on the underlying material, excavation could require some blasting of rock material to construct the channel terraces.

Replace Painted Rock Bridge. Painted Rock bridge would be replaced with a two-lane concrete girder bridge structure aligned immediately upstream of the existing bridge. The new bridge would be designed to handle anticipated debris loading from river flows and be constructed at an elevation sufficient to pass with-project design flows.

Construct a Floodwall at Wadsworth. Approximately 1,500 feet of floodwall is proposed along the east bank of the Truckee River to protect portions of a mobile home park.

Alternative 2 - Detention Plan

Alternative 2 accomplishes flood risk management in the Truckee Meadows area by capturing peak flows in detention facilities and by containing flows with levees and floodwalls. The detention basins were sited on stream along Steamboat Creek at Huffaker Hills (approximately 5 miles upstream of the main stem of the Truckee River), off stream at UNR Farms and off stream at Mustang Ranch. The detention basins were included in the project to attenuate the impact of the increased downstream flood flows from the project improvements along the Truckee River, Steamboat Creek and Boynton Slough. Due to construction of containment features along the Truckee River, peak flood flows downstream of Vista would be increased under project conditions. At the design flow event (1% ACE), Alternative 2 would induce an additional 1,800 cfs of flow above existing conditions in the Truckee River in the Lower Truckee River reach. Dimensions of the UNR detention basin are included in Table 4-10. The major features of this alternative are listed in Table 4-11 and shown in Figure 4-2. This alternative is similar to what was previously authorized.

Table 4-10. Summary of Levee Structures for UNR Farms Detention Facility

Reach Description	Total Structure Length (feet)	Average Structure Height (feet)	Structure Type(s)	Seepage Mitigation
West Levee	8,569	11.4	Levees	Seepage Berm
North Levee	6,667	12.2	Levees	Impervious Berm
East/South Levee	9,596	12.5	Levees	Cutoff Wall

Table 4-11. Summary of Flood Risk Management Structures for Alternative 2

Water Course	Reach Description	Total Structure Length	Average Structure Height[1] (feet)	Structure Type(s)	Seepage Mitigation
Truckee River	North (left) Bank Glendale Avenue to Greg Street	1,000 2,000	7.5	Floodwall Levees	Drainage Blanket
	North (left) Bank Greg Street to 5,000 feet upstream of North Truckee Drain	7,800 (2300 lf of in-channel floodwall) 8,700	6.5	Floodwalls Levees	Relief Well and Seepage Berm
	North (left) Bank 5,000 feet upstream of North Truckee Drain to North Truckee Drain	700 5,100	8.5	In-Channel Floodwall Levee	Relief Well
	North (left) Bank North Truckee Drain to Vista	4,300	6	Levee	Relief Well
	South (right) Bank Highway 395 to Greg Street	3,100 2,400	7	Floodwall Levee	Drainage Blanket
	South (right) Bank Greg Street to McCarran Boulevard	300 9,800	5.5	Floodwall Levees	Drainage Blanket and Seepage Berm
UNR Farms	UNR Detention Basin - West Levee	9,100	7.5	Levee	Seepage Berm
	UNR Detention Basin - North Levee	6,700	9.5	Levee	Seepage Berm
	UNR Detention Basin - East (South) Bank	9,600	10.5	Levee	Cutoff wall
Steamboat Creek	West (left) Bank Upstream of Boynton Slough	5,700 1,500	7.0	Floodwalls Levee	Cutoff Wall
	East (right) Bank	9,500	8	Floodwalls	Cutoff Wall
Boynton Slough	North (left) Bank	1,900 6,500	5.0	Floodwalls Levee	Cutoff Wall
	South (right) Bank	5,700 4,500	5.0	Floodwalls Levee	Cutoff Wall
North Truckee Drain	West (right) Bank	6,300		Floodwalls	Relief Wells
	East (left)Bank	6,300		Floodwalls	Relief Wells
	North Truckee Drain Box Culvert	5,300	10' by 20'	Concrete Box Culvert	NA
	North Truckee Drain Concrete Lined Channel	130		Concrete Lined Channel	NA
Total		48,300 70,200		Floodwall Levee	

[1]Average structure heights are based on design water-surface elevation, 1% ACE, plus 3 feet risk and uncertainty on main stem of Truckee River and 2-foot risk and uncertainty on Steamboat Creek, Boynton Slough, and North Truckee Drain.

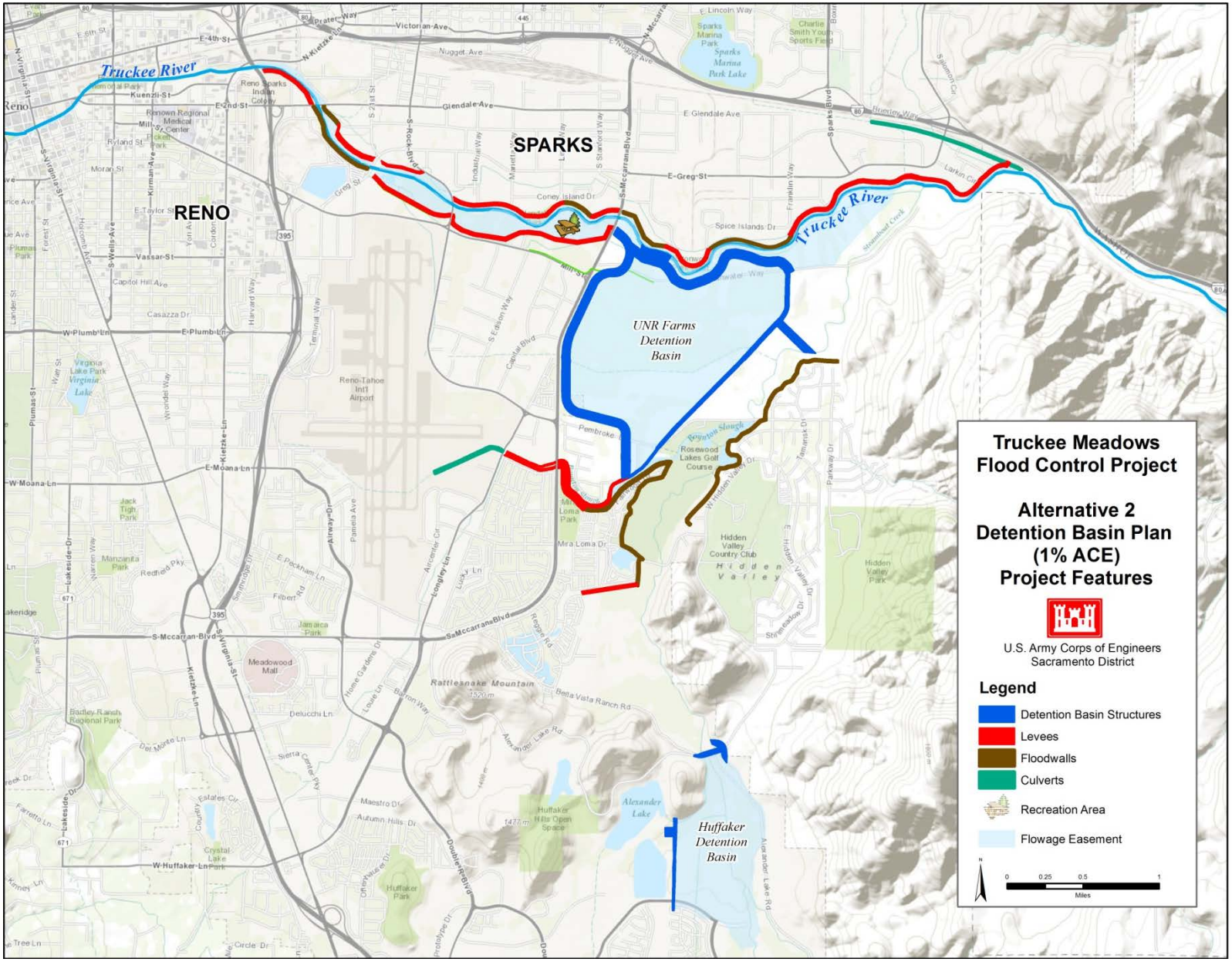

Figure 4-2. Alternative 2 - Detention Plan

At the design flow event (1% ACE), Alternative 2 would induce an additional 1,800 cfs of flow above existing conditions in the Truckee River in the Lower Truckee River reach. While less than the additional flows induced by Alternative 1, hydraulic mitigation would still be required at the same locations downstream. The hydraulic mitigation features for Alternative 2 would be the same as discussed for Alternative 1.

Alternative 3 – Floodplain Terrace Plan

Alternative 3 accomplishes flood risk management in the Truckee Meadows area by containing flood flows with levees and floodwalls, enlarging the flow area of the existing channel by terracing and by capturing peak flows in a designated overflow area. As a result of the channel terracing, Alternative 3 has the lowest water surface elevations in most areas relative to the other alternatives. Due to construction of containment features along the Truckee River, peak flood flows downstream of Vista would increase under project conditions. At the design flow event (1% ACE), Alternative 3 would induce an additional 3,100 cfs of flow above existing conditions in the Lower Truckee River reach. The major features of this alternative are displayed in Table 4-12 and shown in Figure 4-3. The hydraulic mitigation features for Alternative 3 would be the same as discussed for Alternative 1. Other features such as flood-proofing of existing structures and levees along Steamboat Creek and Boynton Slough were considered at this point in the planning process but were later dropped from consideration because they were found to not be incrementally justified.

Table 4-12. Summary of Flood Risk Management Structures for Alternative 3

Water Course	Reach Description	Total Structure Length (feet)	Average Structure Height[1] (feet)	Structure Type (s)	Seepage Mitigation
Truckee River	North (left) Bank Glendale Avenue to Greg Street	1,000 2,000	8	Floodwall Levee	Drainage Blanket
	North (left) Bank Greg Street to 5,000 feet upstream of North Truckee Drain	7,800 (2,300 lf of in-channel floodwall) 8,700	7.5	Floodwall Levee	Relief Wells and Seepage Berms
	North (left) Bank 5,000 feet upstream of North Truckee Drain to North Truckee Drain	700 5,100	8	In-Channel Floodwall Levee	Relief Wells
	North (left) Bank North Truckee Drain to Vista	4,300	5.5	Levee	Relief Wells
	South (right) Bank Highway 395 to Glendale	2,500	7	Levee	Drainage Blanket
	South (right) Bank Glendale to Greg Street	3.000	6	Floodwall	Drainage Blanket
	South (right) Bank Greg Street to McCarran Boulevard	300 9,800	4	Floodwall Levee	Drainage Blanket
	Terracing Downstream of Steamboat Confluence	4,300	-10	Floodplain Terrace	N/A
	Terracing Upstream of Steamboat Confluence	10,100	-10	Floodplain Terrace	N/A
	Ring Levee east of McCarran Blvd (UNR facilities)	2,600	5	Levee	Seepage Berm
Steamboat Creek	Steamboat Creek - East (right) Bank	2,800	6	Floodwall	Cutoff Wall
North Truckee Drain	North Truckee Drain - West (right) Bank (entrance to box culverts)	6,300	4	Floodwall	Relief Wells
	North Truckee Drain - East (left)Bank	6,300	4	Floodwall	Relief Wells
	North Truckee Drain Box Culvert	5,300	10’ by 20’	Concrete Box Culvert	NA
	North Truckee Drain Concrete Lined Channel	130		Concrete Lined Channel	NA
	Total	28,200 25,200		Floodwall Levee	

[1]Average structure heights are based on design water-surface elevation, 1% ACE, plus 3 feet risk and uncertainty on main stem of Truckee River and 2-foot risk and uncertainty on Steamboat Creek, Boynton Slough, and North Truckee Drain.

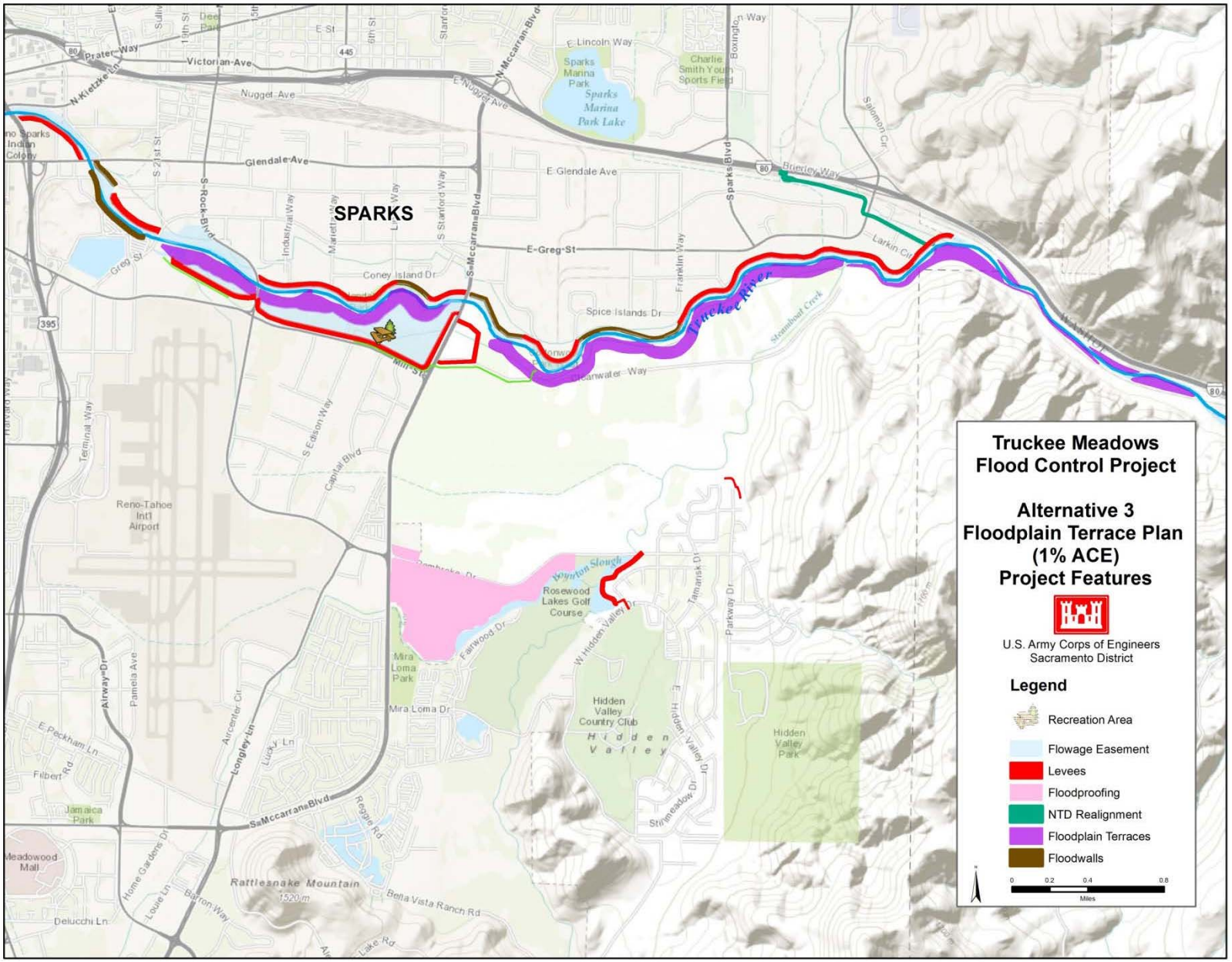

Figure 4-3. Alternative 3 - Floodplain Terrace Plan

4.7 Restoration of Fish Passage on the Truckee River

Restoration of fish passage on the Truckee River was evaluated in detail pursuant to the 1990 Tribes Water Rights Settlement Act, § 207. Measures and alternatives were developed by the USACE Engineer Research and Development Center (ERDC) to address fish passage problems at each barrier. The array of measures consisted of installing a bypass channel, installing a fish ladder, retrofitting existing fish ladders, diversion structure removal, replacing a diversion structure with a pump diversion, installation of a smaller secondary structure, installing a fish screen, and diversion structure modification.

Table 4-13 presents the measures considered for seventeen priority structures on the Truckee River. Many more exist in the system, but passage issues are being addressed at diversions that were deemed critical. Due to the prolific reproduction of cui-ui and some implementation issues, upstream passage received priority over downstream passage issues.

During the study, the United States Bureau of Reclamation (BOR) received funds for the removal of Numana Dam. That diversion was subsequently dropped from this analysis, reducing the number of priority structures to 16.

Table 4-13. Measures Considered at Diversions[1] on the Truckee River

Diversion	Measures Considered							
	Bypass Channel	Fish Ladder	Retrofit Fish Ladder	Diversion Removal	Pump Diversion	Secondary Structure	Fish Screens	Modify Structure
Marble Bluff	✓							
S-S				✓	✓		✓	✓
Fellnagle	✓			✓	✓	✓	✓	
Herman				✓	✓		✓	
Tracy PP					✓		✓	
Cochran							✓	
Idlewild Ponds							✓	
Chalk Bluff								
Orr				✓	✓		✓	
South Side				✓				
Lake							✓	
Last Chance							✓	
Washoe/High	✓		✓				✓	✓
Verdi	✓	✓					✓	
Steamboat	✓	✓				✓	✓	
Fleisch	✓		✓				✓	

1. Numana Dam diversion removal was originally identified but removed from analysis.

A diversion by diversion evaluation of measures and the likelihood of their success was undertaken, and a recommended action and secondary option were identified at each diversion. Also, further evaluation of the defunct South Side diversion indicated that its current condition did not represent a barrier to fish passage, and so it was not considered further in the study. Similarly, the Truckee Meadows Water Authority had recently modified the Chalk Bluff diversion and intake by installing a fish screen. Therefore, other than evaluating the performance of the fish screen's functionality, no further action was recommended by ERDC at Chalk Bluff. Tables 4-14 and 4-15 summarize the final array of upstream and downstream alternatives considered, respectively. Figure 4-4 shows the locations of each of the diversions evaluated.

There are two main components to successful fish passage around obstructions in the river. This includes improving or replacing existing facilities, or creating new facilities, to enable the efficient passage through or around the delta at the mouth of the Truckee River (herein referred to as downstream) and to upstream reaches above Derby Dam, to obtain access to upstream spawning habitat (herein referred to as upstream). Because upstream and downstream plans were developed independently of one another, a method was developed to assess combinations of these upstream and downstream plans into "system-wide" or "master" plans with all potential combinations of up- and downstream plans considered. This generated a total of 54 different master fish passage improvement alternatives to be assessed for environmental benefits and cost effectiveness.

The cost effectiveness and incremental cost analysis of the fish passage alternatives is displayed in Chapter 5.

Table 4-14. Summary of Upstream Alternatives Considered[1]

Structure-Alternative	Structure Alternative Measures
Marble Bluff-1	Bypass channel
Marble Bluff-2	Retrofit of existing fish ladder
Marble Bluff-3	New bypass channel + retrofit of existing fish ladder
S-S-1	Pump diversion
S-S-2	Modify existing diversion
Fellnagle-1	Partial dam removal + secondary structure
Herman-1	Construct new diversion upstream
Washoe/Highlands-1	Bypass channel
Verdi-1	Bypass channel
Steamboat-1	Constructed riffle-run (secondary structure)
Fleisch-2	Bypass channel

1. South Side diversion and Chalk Bluff diversions were considered but removed from analysis

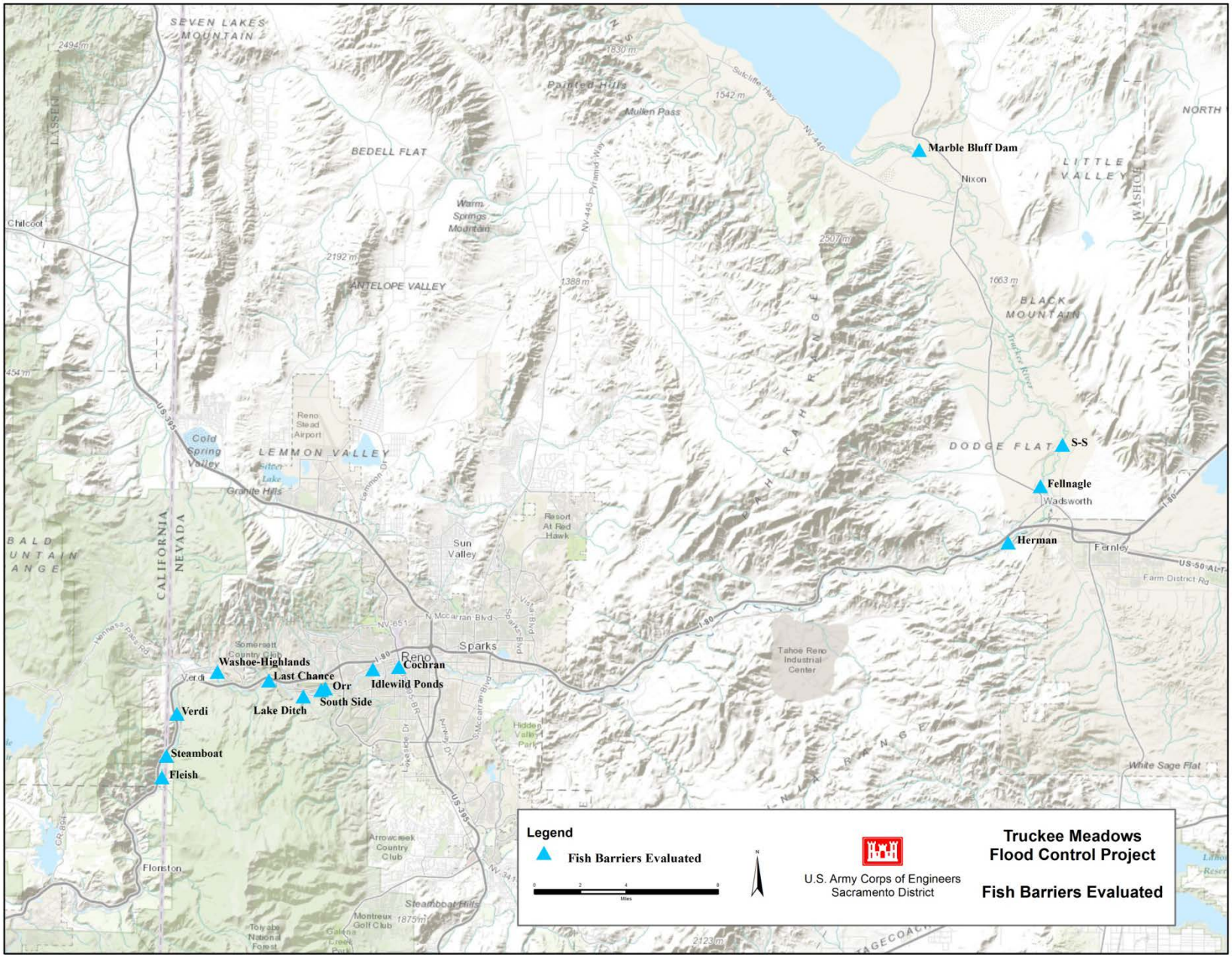

Figure 4-4. Fish Passage Improvement Locations

Table 4-15. Summary of Downstream Alternatives Considered[1]

Structure-Alternative	Structure Alternative Description
S-S-1	Fish screen on new diversion pump
S-S-2	Fish screen on modified diversion
Fellnagle-1	Fish screen
Herman-1	Fish screen
Tracy PP-1	Utilize diversion pump at off-stream pond for alternate cooling water source during critical river migration periods and install fish screen on existing river diversion pump
Cochran-1	Fish Screen
Idlewild Ponds-1	Fish Screen
Orr-1	Fish Screen
Lake-1	Fish Screen
Last Chance-1	Fish Screen
Washoe/Highlands-1	Fish Screen
Verdi-1	Fish Screen
Steamboat-1	Fish Screen
Fleisch-2	Fish Screen

1. South Side diversion was removed from analysis

4.8 Recreation Plan Formulation

An efficient means of formulating recreation plans was to wait until the array of alternatives was narrowed to a manageable level. For the following discussion, recreation features were formulated to be consistent with Alternative 3 in the Truckee Meadows. This section describes the formulation of preliminary recreation alternatives. Subsequent iterations were required to identify a plan that could be recommended. Descriptions of those iterations and subsequent evaluation and comparison can be found in Chapters 5 and 6.

4.8.1 Truckee Meadows Reach

USACE recreation specialists formulated and evaluated recreation plans. Meetings were held between local interests prior to the recreation planners and recreation economists planning activities. From these meetings, conceptual plans were developed by the project proponent's contractor, Stantec Consulting Inc. Stantec and the project proponents held charettes to capture local recreation demand and to provide concurrence with designs at the local level. This effort was not sufficient to meet the USACE criteria for identifying recreation demand due to lack of detail. However, it was determined the conceptual plans developed by Stantec could be used as a basis for plan formulation.

4.8.2 Recreation Demand and Benefit Methodology

To assess the community's recreational demand and willingness to pay, USACE hired Responsive Management of Harrisonburg, VA in 2008 to conduct a comprehensive recreation needs survey covering all planning regions throughout the eight-county area. The contractor used accepted statistical methods to determine the number of households needed in the sample and formulate an accurate, randomized survey.

A telephone survey of 1,218 residents over the eight-county area was completed. The results were weighted by city/county and gender so that the proportions of the male and female sample among the city and counties matched the distribution of the male and female population in the region as a whole. In other words, the results were weighted so that 5.4% of the sample was made up of males from Carson City, which matches its population proportion for the region as a whole, 5.4% of which are males from Carson City. Results of the survey were reported with a 95% level of confidence.

Survey responses showed that county residents, regardless of income or ethnic background, chose walking as the single most popular recreational activity;. of the top 18 recreation activities identified in the survey, based upon actual and desired participation, 50% involved walking, running or biking on roads, sidewalks and trails. Of the top 7 activities, three were walking on either roads/sidewalks, paved trails, and unpaved trails. The second most desired recreation activity was picnicking. The number 8 desired recreation activity was fishing. Respondents cited the Truckee Meadows area as particularly attractive for boating (kayaking) and wildlife viewing. This category also had the number 6 highest willingness to pay response from respondents. Sports court activities, field sports, and picnic/playground activities make up another 23% of expressed demand. The remaining 1% is for a BMX park. Since some of this demand is already being met, the alternatives analysis focused on the unfilled demand.

Existing recreation facilities were inventoried and assessed for usage using existing information provided by local recreation agencies. In addition, the 2008 survey asked if they did not participate in an activity because there were no places nearby to go or they did not know of any nearby places to go. For walking, running or biking on unpaved trails, 43% said there was no place to go and 36 % did not know of a nearly place. For paved trails the percentages were 50% and 29%. For the running/jogging and walking categories, no place to go nearby was the number one reason given by respondents for not participating in the activities.

As far as the specific features of the proposed trails that would make them especially attractive to recreation users, the survey asked all users of paved and unpaved trails what could be done to make them more inviting and interesting. Top responses include providing better signs/maps, extending/connecting the trails, better maintaining/improving the trails, providing educational signs/materials regarding vegetation and animals in the area, and adding plantings/vegetation to enhance them aesthetically.

For fishing, 21% of respondents cited the unavailability of facilities nearby as the reason they did not participate. For picnicking, 15% of respondents did not participate due to lack of nearby facilities.

The above statistics indicate that, especially for trails, there is a strong desire to participate in these activities, and many potential users are not engaging in these activities due to lack of available recreation resources.

Recreation benefits can be calculated in a number of ways. The unit day value (UDV) method, the travel cost method (TCM), and the contingent valuation methods (CVM) are all acceptable methods of calculating recreation benefits. In all cases, the number of visitors must be assumed or determined for each center of recreation such that it does NOT take benefits from another similar set of recreation opportunities. Double counting the same set of visitors would result in the over counting of demand and benefits.

The Unit Day Value (UDV) method was used to determine the benefits of recreation activities. Values for marginal increments were not quantified. The survey results identified the current recreation demand and the amount of unfilled demand for general recreation activities. The amount of expected participants was estimated based on survey results. A unit day value was developed for each recreation facility using the point system and dollar values from Economic Guidance Memorandum 13-03, Unit Day Values for Recreation for Fiscal Year 2013.

Facility use capacities were taken from the Texas Outdoor Recreation Planner, 1995 since no standard exists for Nevada. To account for seasonal use variations, final demand values were reduced by 20-25%. For each alternative, usage capacity for each facility was fixed and apportioned among all the possible types of activities within that facility. Usage figures were based on the number of stated visits per activity as a percent of the total possible visits for all activities.

4.8.3 Preliminary Recreation Alternatives

Two preliminary alternatives were formulated addressing those recreation activities with high demand. A USACE recreation alternative was formulated, using only those facilities eligible for federal cost-sharing, to be combined with the NED Plan for flood risk management. The second alternative, a locally-developed recreation plan, was provided by the project sponsor.

The USACE recreation plan included open fields, paved and unpaved nature trails, and picnic facilities, as well as river access points for fishing and non-motorized boating.

The locally-developed recreation plan included the same types of features as the USACE recreation plan. However, it decreased the amount of land available for environmental restoration use and increased open fields and water features. Table 4-16 provides a comparison of the two plans.

Table 4-16. Comparison of Preliminary Recreation Plans

Activity	Quantity		Units
	USACE Plan	Locally-Developed Plan	
Open fields (multi use reserved on large fields)	3	10	Acres
Open fields (multi use reserved on small fields)	3	10	Acres
Open fields (multi use reserved)	10	10	Acres
Unpaved Nature Trails (new)	10,032	10,032	LF
Playground	2	2	Site
Paved Trail (new)	9,389	9,389	LF
Picnic Site	32	30	Table
Small Picnic Shelter	4	4	Table
Medium Group Shelter	3	4	Table
Large Group Shelter	1	1	Site
Fishing Ramps and Pedestrian Bridges	6	6	Site
Non Motorized Water Craft Ramps	4	4	Site

CHAPTER 5
EVALUATION AND COMPARISON OF ALTERNATIVE PLANS

5.1 Evaluation Methodology

The alternatives formulated for the Truckee Meadows Flood Control Project were evaluated utilizing a plan evaluation framework with the following structure:

- NED analysis for flood risk management
- Cost Effectiveness and Incremental Cost Analysis for fish passage

The combined results of these analyses will result in a recommended plan with Federal interest. The evaluation of alternatives to the authorized project was conducted in accordance with Federal water resources planning procedures, regulations and laws, including the requirements of NEPA. Alternative modifications to the authorized project were considered to better meet the current project objectives for flood risk management, ecosystem restoration, and recreation while avoiding and mitigating adverse effects to the maximum extent practicable. These alternatives were developed and evaluated specifically to meet the planning objectives identified in Section 4.2.

5.2 Downtown Reno Reach

No alternative with Federal interest was identified for the Downtown Reno reach.

5.3 Truckee Meadows Reach

5.3.1 Preliminary Economic Analysis for the Truckee Meadows Reach

The three alternatives in the final array were evaluated at three levels of performance to economically optimize flood risk management. Preliminary benefits and costs for each level of performance were developed to identify the plan with the maximum net benefits. The cost estimates were preliminary in nature using conceptual designs, historic bid information, and professional judgment. These estimates were only used for screening. Ranking of the alternatives based on preliminary net benefits is shown in Table 5-1 (1 = highest rank). Only the relative ranking of alternatives is shown here, because significant inaccuracies were later found in the preliminary benefits (see explanation in next section).

Table 5-1. Comparison of Flood Risk Management Plans

Alternative (nominal level of performance[1])	First Costs[2] ($1000)	Rank Based on Preliminary Net Benefits
No-Action	0	8
Alternative 1a (50)	$ 321.3	4
Alternative 1b (100)	$ 513.3	7
Alternative 1c (117)	$ 555.0	6
Alternative 2a (50)	$ 315.9	5
Alternative 2b (100)	$ 598.1	10
Alternative 2c (117)	$ 614.1	9
Alternative 3a (50)	$ 325.4	2
Alternative 3c (100)	$ 482.8	3
Alternative 3d (117)	$ 488.3	1

[1] Nominal level of performance = 90% assurance of safely containing indicated event water surface elevation behind the lines of protection. For example, alternative 1a would safely contain the 2% (1/50) ACE water surface elevation 90% of the time.
[2] October 2007 prices

Based on the relative ranking of alternatives displayed above, Alternative 3 dominated Alternatives 1 and 2. The lowest net benefit produced by Alternative 3 at any level of performance exceeded the highest net benefit produced by either Alternative 1 or 2. Therefore, Alternative 3 was identified as the most cost effective plan, with Alternative 3d tentatively identified as the optimal plan for the Truckee Meadows Reach. Alternative 1 consistently outranked Alternative 2 at equivalent levels of performance and was therefore ranked second highest based on net NED benefits.

5.4 System of Accounts

The final array of alternatives was also evaluated and compared using the four accounts in the Principles and Guidelines, as displayed in Table 5-2. Evaluation of the Environmental Quality (EQ) account allowed consideration of the non-monetary effects the alternative plans may have on significant environmental resources. Also presented in the following table are the possible effects that the proposed plans may have on regional economic activity, specifically income and regional employment (compared under the Regional Economic Development (RED) account). Lastly, a comparison of the effects the alternatives may have on public facilities and services, recreational opportunities, transportation and traffic and man-made and natural resources (included under the Other Social Effects (OSE) account) are also presented.

Table 5-2. Comparison of System of Accounts

Criteria	No-Action	Alternative 1	Alternative 2	Alternative 3
National Economic Development Account				
Net NED Benefits (relative ranking)	n/a	Intermediate	Lowest	Highest
Environmental Quality Account				
Air Quality	Existing sources of air pollution would be expected to remain the same in the project area in the near-term future. Therefore, Hydrographic Area 87 would continue in the near-term future to be designated by the USEPA as being in serious non-attainment for PM.	The project construction emissions from this alternative would be less than the General Conformity de minimis thresholds and would have a less-than significant effect on air quality.	Same as Alternative 1.	Same as Alternative 1.
Water Resources and Quality	There would be a continued high risk of flooding and water quality could be adversely affected due to increases in total suspended solids and turbidity. Flooding in the study area would likely be considerable and could include bacterial and chemical (e.g., pesticides, petroleum products, heavy metals) contamination.	Increased flows could result in increased turbidity during peak flow events, but could also have positive effects such as reducing water temperatures and increasing dissolved oxygen levels. Loss of riparian vegetation shading the river could increase water temperature.	Increased flows in the Lower Truckee River would be less than modeled for Alternative 1, presenting a minor increase in turbidity during peak flow events. Loss of riparian vegetation shading would present similar increases to water temperature as Alternative 1.	Increased flows would be similar to Alternative 1. Revegetation of floodplain terraces in the Truckee Meadows would increase river shading, contributing to lower water temperatures.
Biological Resources		Vegetation and wildlife impacts include loss of riparian habitat in Truckee Meadows and Lower Truckee due to in-channel features such as floodwalls and hydraulic mitigation.	Vegetation and wildlife effects would be similar to Alternative 1 in the Truckee Meadows and slightly less than Alternative 1 in the Lower Truckee reach because of less hydraulic mitigation needed.	Vegetation and wildlife effects would be less than Alternative 1 and Alternative 2 in the Truckee Meadows because of setback levees and revegetation of floodplain terraces.
Special Status Species	A continued decline in special-status species' habitat value with associated decline in population numbers is likely.	Alternative expected to have adverse effects on special-status species. In-channel construction could directly affect fish species and changes in water quality (turbidity, temperature) could indirectly affect fish species.	Similar to Alternative 1 in the Truckee Meadows but slightly less than Alternative 1 in the Lower Truckee reach because of less hydraulic mitigation needs.	Similar to Alternative 1, but with a reduced affect to water temperature as a result of revegetation of floodplain terraces in the Truckee Meadows.
Cultural Resources	Existing sites would remain at risk from human activities.	Potential effects to historic and prehistoric sites located within levee footprint.	Same as Alternative 1.	Same as Alternative 1.

Criteria	No-Action	Alternative 1	Alternative 2	Alternative 3
Noise		Increased noise levels during construction. Noise generated by construction equipment, haul trucks, and worker vehicles. Noise levels exceed local objectives.	Same as Alternative 1.	Same as Alternative 1.
Aesthetics		Visual character of Truckee River would change to include high levees and floodwalls near the Truckee River, along Steamboat Creek, and on Boynton Slough.	Visual character of Truckee River would change to a greater degree than Alternative 1 due to the detention basin on UNR Farms.	Visual character of Truckee River would change but to a much smaller degree than Alternative 1 due to the reduction in levee and floodwall heights as a result of setback levees and floodplain terraces. Also, revegetation of floodplain terraces would provide beneficial effect.
Regional Economic Development Account				
Employment		Temporary increase in construction-related employment. The increased construction-related employment would have a corresponding short-term beneficial effect on the local economy. Increase would tend to be focused in lower specialization sector.	Employment effects anticipated to be similar to Alternative 1.	Employment effects anticipated to be similar to Alternative 1.
Housing Supply and Business		Implementation of Alternative 1 would not require removal of residences or displacement of businesses.	Implementation of Alternative 2 would require relocation of less than 10 residences and relocation of 23 businesses.	Same as Alternative 2.
Growth Inducing Impacts		Limited potential growth due to local restrictions for building in designated floodway.	Same as Alternative 1.	Same as Alternative 1.
Other Social Effects Account				
Public Health and Safety		Reduced flood losses for existing properties within the floodplain.	Same as Alternative 1.	Same as Alternative 1.

Criteria	No-Action	Alternative 1	Alternative 2	Alternative 3
Recreation		Informal public access to the Truckee River disrupted during construction; proposed maintenance roads would facilitate local plans for trails.	Same as Alternative 1.	Same as Alternative 1.
Transportation		Temporary increase in traffic on local roadways due to haul trucks and worker vehicles. Delays or disruption in traffic flow due to partial/full closure of roads. Change in circulation	Same as Alternative 1.	Same as Alternative 1.

5.5 Adjustments to Hydraulic and Economic Models

After a relatively optimal plan had been tentatively identified, concerns with the hydraulic and economic models were discovered during Agency Technical Review. A data-transfer error was discovered for Alternative 3d which had caused an underestimation of residual damages for that plan. This invalidated the previous tentative identification of Alternative 3d as the optimal plan. After consultation with the vertical team and project proponents, it was decided to reconstruct the hydraulic model rather than attempt to fix the flawed model. This would ensure a greater level of confidence in the resulting floodplains. The hydraulic model was reconstructed and has been used for the evaluations that follow.

Adjustments to the hydraulic and economic models affected all alternatives in a relatively consistent manner so that the previous ranking of alternatives beginning with the 2nd ranked plan would not change (see Table 5-1); therefore, Alternative 3a became the optimal plan. Alternatives 1 and 2 were not re-evaluated as a result of the model adjustments.

5.6 Reformulation Strategy for Truckee Meadows Reach

After adjustments were made to the hydraulic and economic models, a revised economic analysis was completed. The results indicated that none of the scales of Alternative 3 were economically justified and that an NED plan had not yet been identified. A reformulation workshop was held with the project delivery team, sponsor and vertical team members in November 2011 with the express purpose of identifying a Federally-supportable flood risk management plan for the Truckee Meadows Reach. The workshop analysis was based on existing information and informed professional judgment with the understanding that, if a plan was identified that appeared to be economically justified, more detailed evaluations on that plan would be conducted. The costs used in this workshop analysis were extracted from the preliminary cost estimate submitted with the submittal package that had undergone Agency Technical Review when the model problems were identified.

At this point in the iterative plan formulation process, an additional constraint was identified that due to budgetary considerations, the habitat restoration component of the ecosystem restoration would not be pursued any further in the process.

An additional measure was considered during this reformulation that had not been previously identified. Capping outlets of the People's Drain at the North Truckee Drain appeared to offer the potential for addressing flooding and was added to the array of measures considered.

The team began the reformulation process at the workshop by identifying the economic damage areas in the Truckee Meadows reach that provided the greatest potential for benefits. The East Sparks area and the Airport area were identified as having the greatest potential benefits, and the reformulation efforts focused on those areas. Downtown Reno was not evaluated further due to the lack of sufficient economic benefits to justify flood risk management measures.

The team first assessed the various elements of Alternative 3 for increments that could be implemented that would have a beneficial effect on the two highest priority economic damage areas. Terracing downstream of Steamboat Creek confluence was identified as the feature that incurred the greatest additional cost for downstream hydraulic mitigation and was identified as the likely break point for a cost effective plan. Formulation would focus on increments that would not require this terracing.

Terracing upstream of Steamboat confluence appeared to be an effective increment compatible with all other measures and was identified as Increment 1. This increment was not particularly effective in addressing the overall flooding problem, so additional increments were considered.

The next increment identified (Increment 2) was levees and floodwalls along the north bank of the Truckee River from McCarran Blvd. to Vista to reduce damages to the East Sparks Industrial area. This increment was estimated to have net benefits, but could be flanked from just upstream of McCarran Blvd. without additional features.

Levees and floodwalls along the north bank of the Truckee River from Highway 395 to McCarran Blvd. were the next added increment (Increment 3) to provide flanking protection to the East Sparks area. This increment would also reduce damages in the West Sparks area. The levee/floodwall on the north bank would induce flood flows over the south bank, so levees and floodwalls were added to the south bank from Highway 395 to McCarran Blvd. to reduce damages in the Airport area.

Increments 1, 2, and 3 would reduce existing flood storage within the floodplain and move the flows south into the UNR Farms area and up Steamboat Creek and the North Truckee Drain (NTD). Two alternative increments were identified for the NTD that would result in net benefits: Capping outlets from People's Drain at NTD, and realignment of NTD. Since capping the outlets maximized the net benefits, that measure was retained as Increment 4. Table 5-3 displays the results of the incremental analysis completed during the reformulation workshop. A gross estimate of benefits and costs were used in this analysis.

Table 5-3. Incremental Analysis for Flood Risk Management, Truckee Meadows Reach

Increment	First Cost	Annual Cost[1]	Annual Benefits	Net Benefits
1) Benching from Greg St. to 1,000 feet east of McCarran	9,900	461	6,055	5,594
Subtotal:	**9,900**	**461**	**6,055**	**5,594**
2) Levees and Floodwalls along north bank from McCarran to Vista, improvements along existing NTD alignment	46,800	2,131	10,092	7,961
Subtotal:	**56,700**	**2,592**	**16,147**	**13,555**
3) Levees and Floodwalls on both banks from I-395 to McCarran	32,500	1,500	4,037	2,537
Subtotal:	**89,200**	**4,092**	**20,184**	**16,092**
4) People's Drain caps (at NTD)	7,000	326	5,000	4,674
Subtotal:	**96,200**	**4,418**	**25,184**	**20,766**
Other Costs [2]	155,003	7,215	--	--
Rounded Totals:	**251,200**	**11,600**	**25,200**	**13,500**
Optional Modification to Increment 2): NTD realignment	*45,000*	*2,095*	*1,372*	*-723*

[1] 4% discount rate, $1000s.

[2] Other costs include bridge scour protection, environmental mitigation, construction management, and real estate.

Preliminary hydraulic modeling estimated that an added increment of benching the Vista reefs would likely cause sufficiently greater induced flows to require substantial hydraulic mitigation and cost between 2% and 1.3% ACE. Because a 2% ACE would be a relatively limited improvement over the without-project condition, with substantial damages beginning at approximately 5% ACE, it is unlikely that a level of performance below 2% ACE would provide increased net benefits to offset the additional costs benching of the Vista Reefs and associated hydraulic mitigation. Therefore, a 2% ACE was selected as the reasonably optimized scale for the reformulated flood risk management plan.

The reformulated plan for the Truckee Meadows reach is hereafter identified as Alternative 3 - Floodplain Terrace Plan as shown in Figure 5-1. This alternative has been carried forward for detailed evaluation.

During refinement of the preliminary hydraulic design, adjustments to the design were made where the project performance could be substantially improved at minimum additional cost. This resulted in an AEP near 1% for the main economic impact areas of concern. The estimated project performance varies by Economic Impact Area (EIA) as shown in Table 5-5.

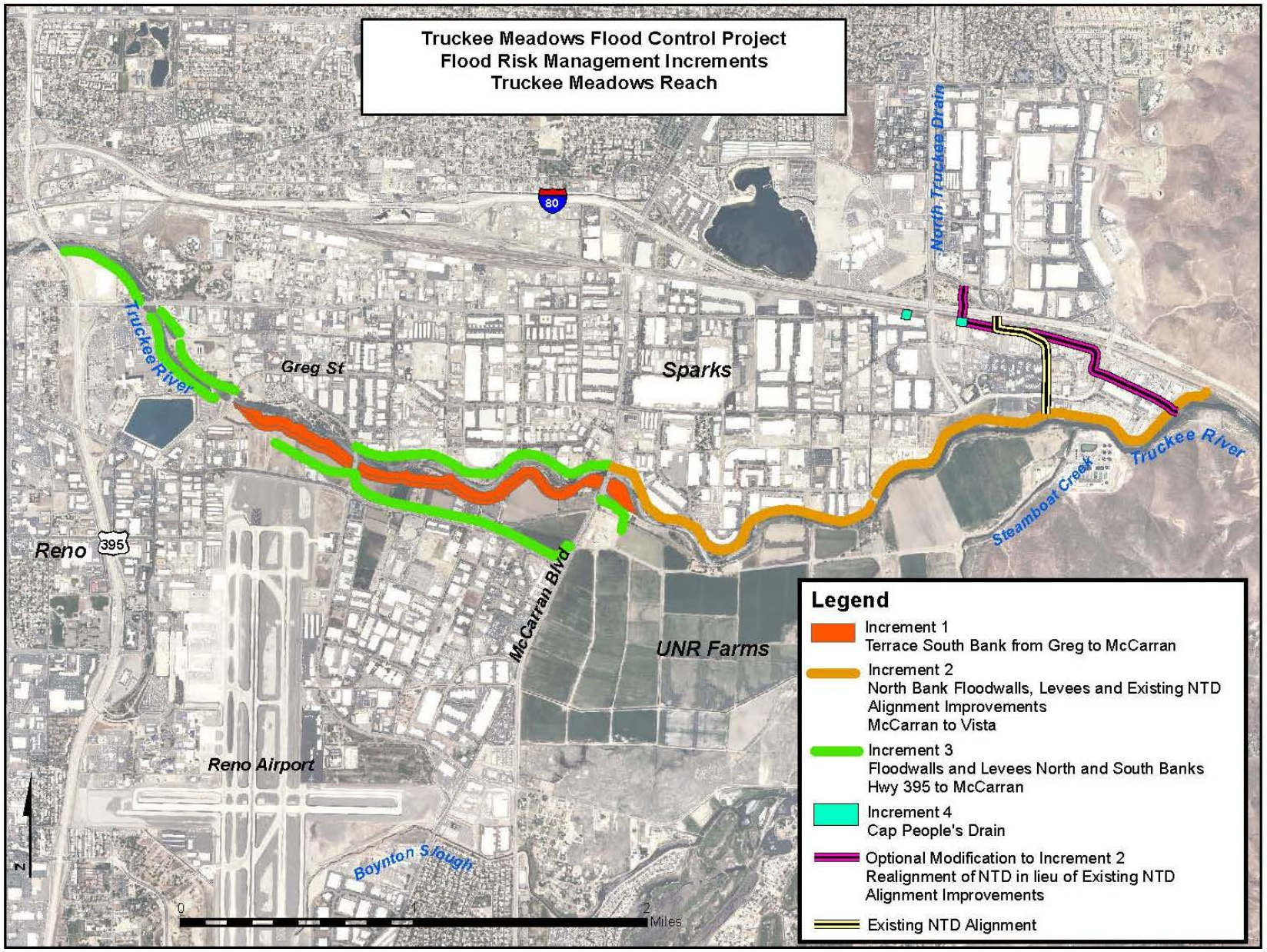

Figure 5-1. Alternative 3, Floodplain Terrace Plan Flood Risk Management Increments

5.7 Identification of NED Plan for Flood Risk Management, Truckee Meadows Reach

The preliminary flood risk management benefits, costs, net benefits, and benefit-to-cost ratio estimated for Alternative 3 - Floodplain Terrace Plan during the November 2011 workshop are summarized in Table 5-4 below. Because Alternative 3 - Floodplain Terrace was the highest ranked alternative in the final array and was formulated incrementally to provide a level of performance that reasonably maximizes net economic benefits, it has been identified as the NED Plan for FRM.

Table 5-4. Preliminary FRM Benefit-Cost Analysis for Truckee Meadows Reach ($1000) [1]

Alternative	First Cost	Annual Costs	Annual Benefits	Benefit-to-Cost Ratio	Net Benefits
Alternative 3 - Floodplain Terrace (1/50)	$251,200	$11,600	$25,200	2.1 to 1	$13,500

[1] October 2011 price levels; 50 years @ 4% interest; see Economic Appendix regarding economic uncertainty.

Feasibility-level designs and cost estimates were completed after the November 2011 workshop. Costs presented later in this report are based on those post-workshop products.

5.8 Residual Risk for NED Plan and Identification of Recommended Plan

5.8.1 Residual Risk

Not all Economic Impact Areas (EIAs) within the study area will have the same residual risk because some areas will get flooded by other tributaries/streams that are not part of the NED Plan (i.e., North Truckee Drain, Steamboat Slough, and Long Valley Creek) and/or are not directly behind the intended line of protection. While some of these areas may receive a slight benefit from the NED Plan, they will still have flooding from other sources at roughly the same frequency as they do under existing conditions. The EIAs that get flooded from other sources and/or are not directly behind an intended line of protection include EIAs 1, 2, 3, 4, 9, 10, 11, 12, 13, 14, and 15 (see Figure 5-2 and Table 5-5).

The project will increase the water surface elevations within the Truckee Meadows area as well as the downstream reaches of Steamboat Creek, Boynton Slough, and the North Truckee Drain. This increase in water surface elevation is due to the loss of storage in the floodplain. That is, construction of the proposed line of protection along the north side of the Truckee River results in the loss of storage in the commercial Sparks area which is removed from the Truckee River floodplain. This will result in an increase in water surface elevations of 4-8 inches for events between 2% and 1% ACE in EIAs 10-15. These increases were incorporated into the project performance and the impact to Annual Exceedance Probability and Assurance appear to be minimal as indicated in Table 5-5.

Figure 5-3 compares the residual floodplain for the NED Plan to the without-project floodplain for a 2% ACE event. The crosshatch area shows the without-project 2% ACE floodplain while the blue areas show the with-project 2% ACE floodplain.

Table 5-5. Project Performance[1] – With Project – Entire Study Area

EIA	Plan	AEP	LONG-TERM RISK			ASSURANCE BY ANNUAL CHANCE EVENT					
			10	30	50	10%	4%	2%	1%	0.40%	0.20%
1	*WO*	2.7%	24%	50%	75%	99%	85%	32%	5%	0%	0%
	Alt 3	2.7%	24%	50%	75%	99%	85%	32%	5%	0%	0%
2	*WO*	0.9%	9%	20%	36%	99%	99%	96%	67%	16%	3%
	Alt 3	0.8%	8%	18%	33%	99%	99%	97%	73%	21%	4%
3	*WO*	3.0%	27%	54%	79%	99%	72%	30%	10%	0%	0%
	Alt 3	2.6%	23%	49%	73%	99%	81%	41%	10%	1%	0%
4	*WO*	3.3%	28%	57%	81%	98%	76%	40%	17%	1%	0%
	Alt 3	2.6%	23%	48%	73%	99%	84%	50%	16%	3%	0%
5	*WO*	5.3%	42%	74%	93%	96%	33%	4%	0%	0%	0%
	Alt 3	0.7%	7%	16%	30%	99%	99%	98%	79%	29%	8%
6	*WO*	3.9%	33%	63%	86%	99%	58%	21%	1%	0%	0%
	Alt 3	0.9%	9%	20%	36%	99%	99%	99%	69%	3%	0%
7	*WO*	2.1%	19%	42%	66%	99%	91%	60%	8%	0%	0%
	Alt 3	1.0%	9%	21%	37%	99%	99%	98%	66%	3%	0%
8	*WO*	10.1%	65%	93%	99%	54%	5%	0%	0%	0%	0%
	Alt 3	0.9%	8%	20%	35%	99%	99%	95%	68%	19%	4%
9	*WO*	4.1%	34%	64%	87%	97%	59%	17%	2%	0%	0%
	Alt 3	--	--	--	--	--	--	--	--	--	--
10	*WO*	19.4%	89%	99%	99%	26%	5%	1%	0%	0%	0%
	Alt 3	20.4%	90%	99%	99%	24%	5%	1%	0%	0%	0%
11	*WO*	1.1%	11%	25%	44%	99%	99%	96%	47%	2%	0%
	Alt 3	1.2%	11%	25%	44%	99%	99%	95%	49%	2%	0%
12	*WO*	6.1%	47%	79%	96%	85%	47%	18%	1%	0%	0%
	Alt 3	6.4%	49%	81%	96%	83%	46%	16%	1%	0%	0%
13	*WO*	2.6%	23%	49%	74%	99%	84%	56%	11%	0%	0%
	Alt 3	2.7%	24%	50%	75%	98%	83%	54%	11%	0%	0%
14	*WO*	3.9%	33%	63%	86%	95%	69%	37%	5%	0%	0%
	Alt 3	4.0%	33%	64%	87%	94%	68%	35%	5%	0%	0%
15	*WO*	2.8%	25%	51%	76%	98%	83%	55%	10%	0%	0%
	Alt 3	2.8%	25%	51%	76%	98%	82%	52%	11%	0%	0%

1. See Engineering Appendix for uncertainty regarding project performance.

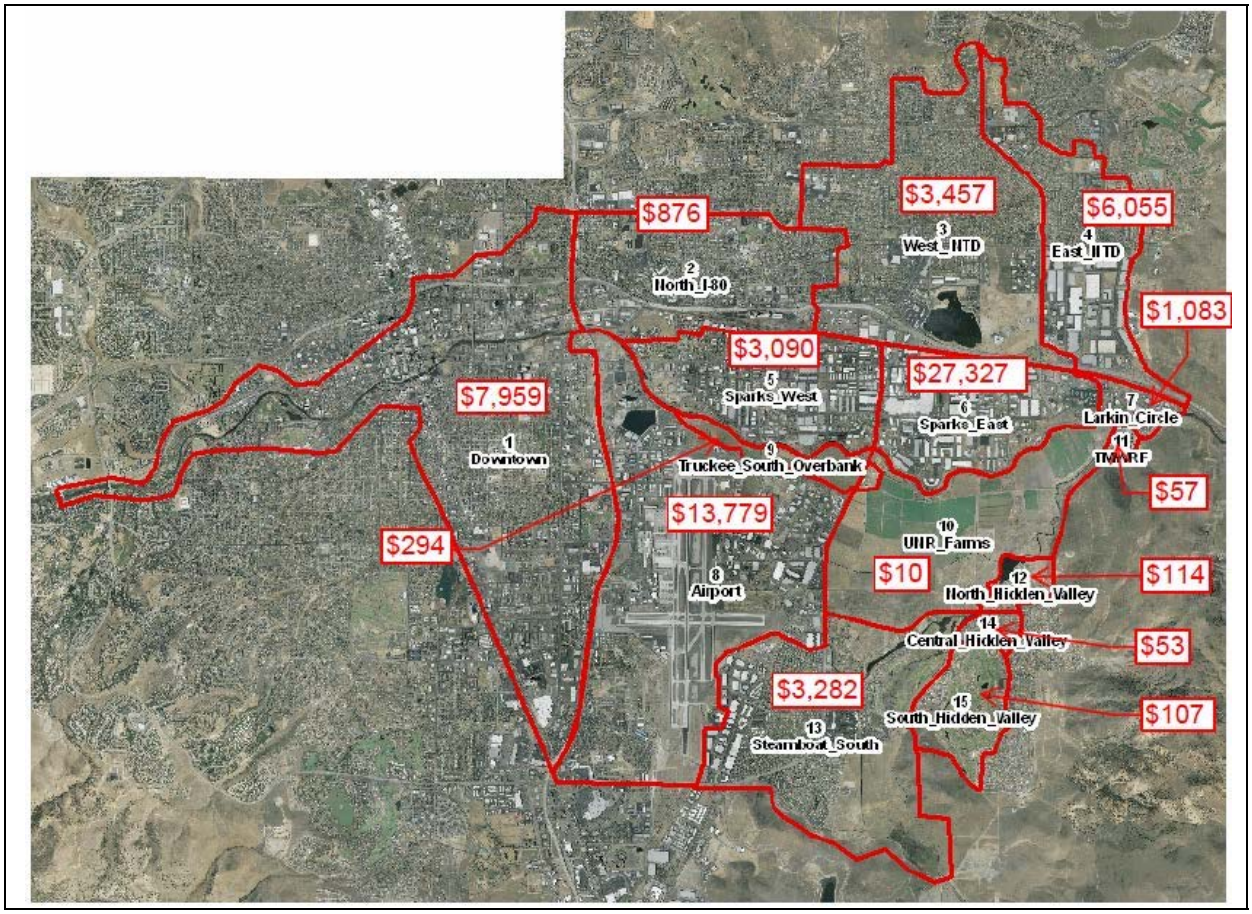

Figure 5-2. Expected Annual Damages by Impact Area
Oct 2011 Prices, $1,000's

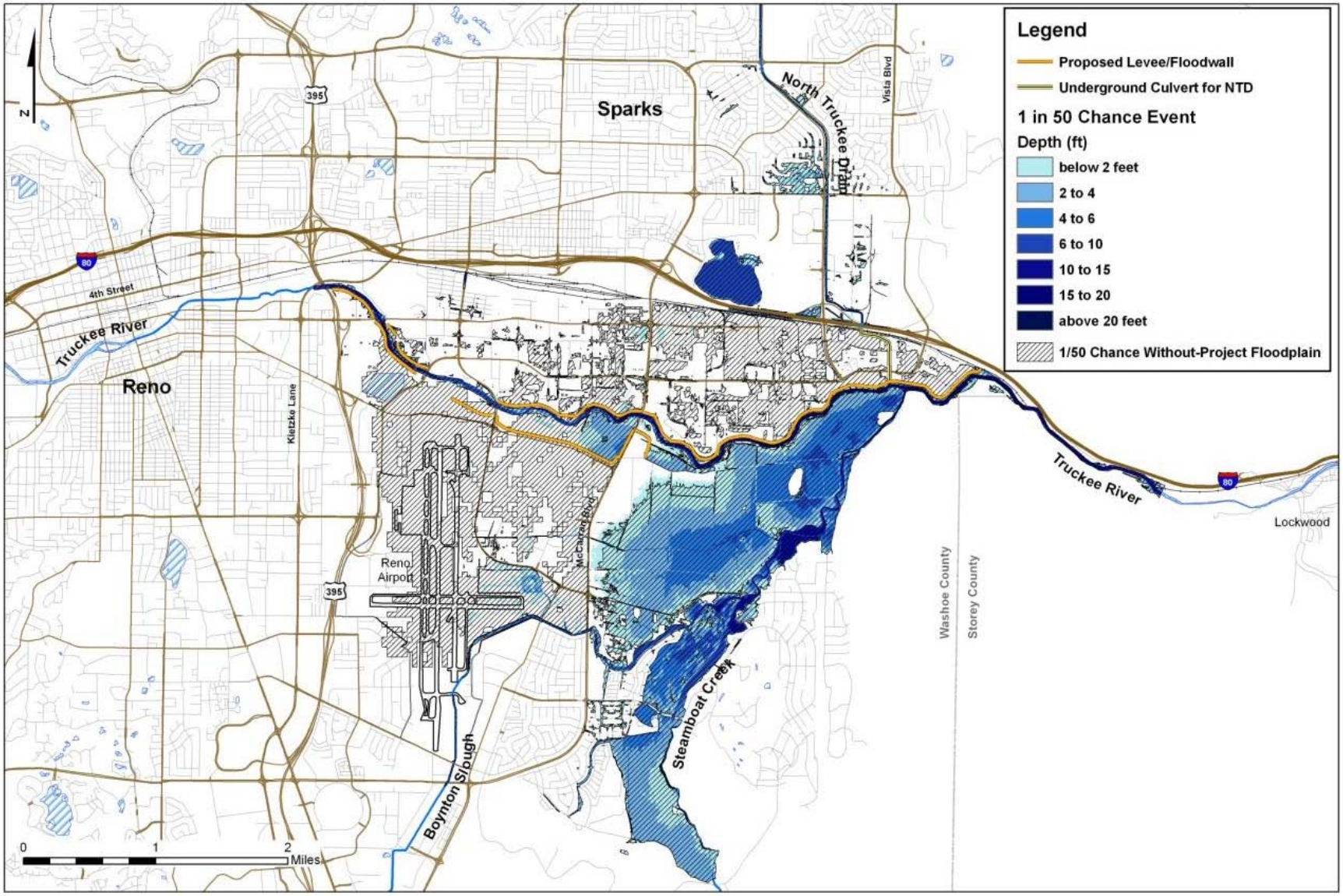

Figure 5-3. Without-project and residual floodplains for NED Plan for a 2% ACE

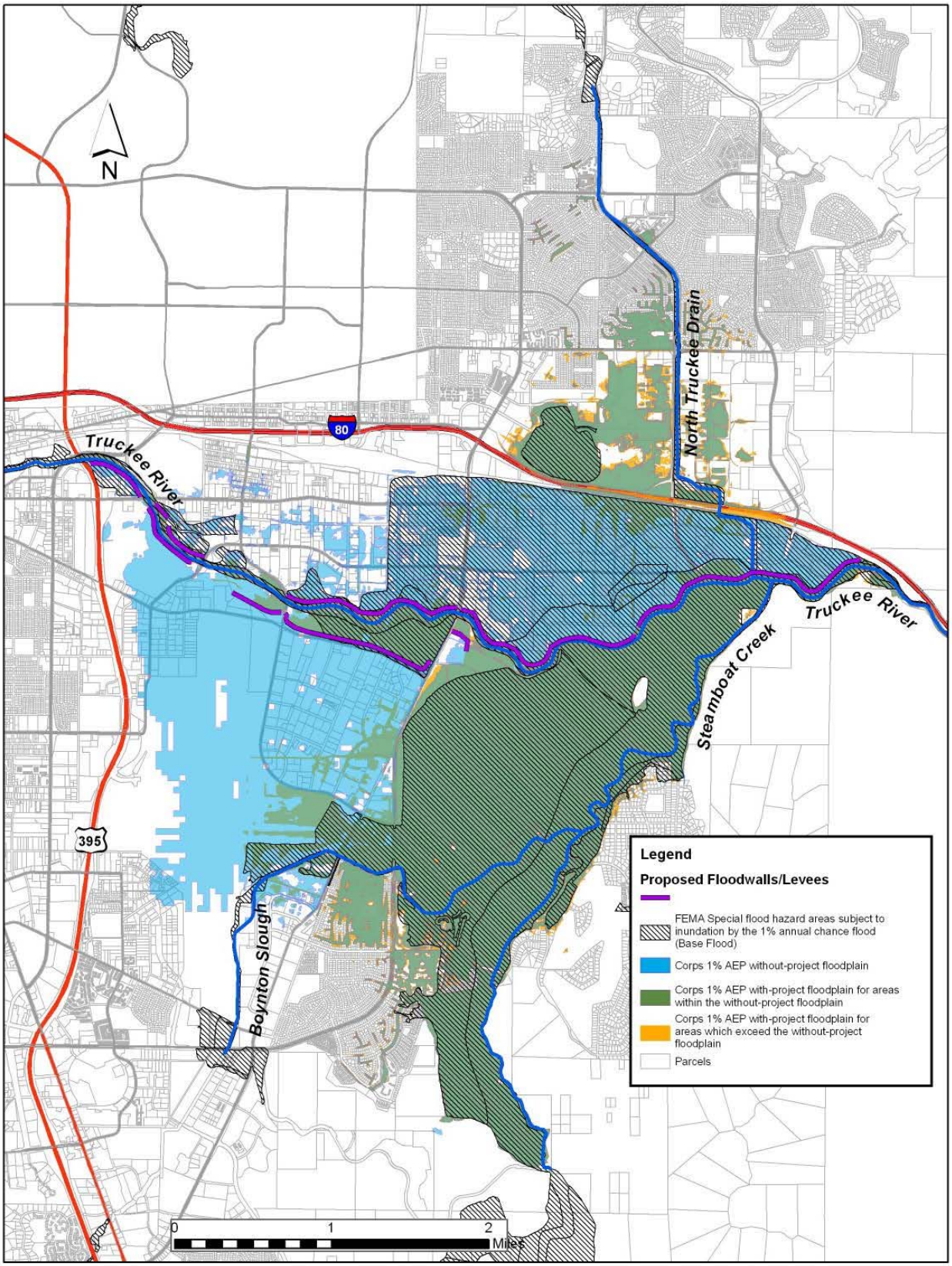

Figure 5-4. Without-project and residual floodplains for NED Plan for a 1% ACE

5.8.2 Induced Flooding Resulting From NED Plan in Two Areas

Hydraulic modeling of the NED Plan found that 1% ACE flood elevations would increase between 0.0 and 0.6 foot in several areas near the downstream end of the project compared to the without-project condition. (There is some level of uncertainty in any hydraulic model. In this case the actual without-and with-project water surface elevations could be 0.5 foot lower or higher than estimated.)

- UNR Farms and southern periphery (Steamboat South and Hidden Valley EIA's): The flood elevation increase in the UNR Farms area is up to 0.6 foot. USACE-estimated with-project 1% ACE flood elevations would exceed the first floor elevations of an estimated 900 existing structures (mostly single-family residences and multiplex apartment buildings) on the southern periphery of the UNR Farms area that are also within the USACE without-project 1% ACE floodplain. An estimated additional 175 residences that are outside of the USACE without-project 1% ACE floodplain would be within the limits of the with-project floodplain, but it is estimated that their first floors would still be above the with-project flood elevation. The estimated increase in the 2% ACE flood elevations would affect about 22 existing structures south of UNR Farms (Steamboat South and Hidden Valley EIA's), most of which would have an estimated increase of 0.2 to 0.4 foot.

- North Truckee Drain (NTD): The 1% ACE flood elevation on both sides of the North Truckee Drain (NTD) immediately north of I-80 would be increased by approximately 0.5 to 1 foot due to backwater effects in the NTD.

The average annual induced damages are estimated to be $90,000. Figure 5-4 shows the areas in the estimated without- and with-project 1% ACE floodplains based on USACE hydrology. The area shown in blue is the without-project 1% ACE floodplain and the area in green is the with-project 1% ACE floodplain. The areas shown in yellow are areas that are now in the 1% ACE (with-project) floodplain that were not in the without-project floodplain – these are areas that now are anticipated to flood from the 1% ACE event (see Figure 5-6 for additional view of these areas). The crosshatched area is the existing Federal Emergency Management Agency (FEMA) base flood area. The FEMA map is included here to illustrate the difference between the FEMA and USACE floodplains, as it is expected that FEMA will adopt USACE hydrology when the FEMA maps are updated.

Additional information regarding the increased flood elevation is included in the Economic Appendix and Attachment B to the Engineering Appendix.

5.8.3 Consideration of Mitigation for Induced Flooding From NED Plan

USACE policy allows mitigation for induced flooding to be recommended as a project feature when it is economically justified or there are overriding reasons of safety, economic or social concerns, or a determination of a real estate taking has been made (ER 1105-2-100, para.3-3.b.(5)). Potential mitigation measures for induced flooding were considered by the District, but none were found to be economically justified. The structural and non-structural measures considered for the south side of the Truckee River were: raising or wet floodproofing existing residential and commercial structures, levees and floodwalls to protect existing structures, a detention basin with perimeter levees in the UNR Farms area, excavation of the hydraulic constriction downstream of Truckee Meadows including downstream hydraulic and environmental mitigation, or purchase/ removal of the affected structures. The structural and non-structural measures considered for the north side of the Truckee River were a pump station, ring levees, or raising/wet flood-proofing existing residential and commercial structures. Raising/flood-proofing structures on the south side and a pump station on the north side were found to be the least costly options based on rough cost estimates for each measure by District civil and cost engineering staff using their professional experience. The average annual flood risk management benefits for those measures were found to be far less than required to justify their costs. Any increase in flooding will be an important concern for adversely affected property owners. However, because of the small increase in flood elevations and the low recurrence frequency of induced flooding, those concerns are not considered to be overriding safety, economic, or social concerns under USACE policy, and no real estate taking would occur specifically due to the increase in water surface elevations. Therefore, mitigation for induced flooding is not proposed as a project feature of the Federally-funded NED Plan.

5.8.4 National Flood Insurance Program Compliance

The increased 1% ACE flood elevations caused by the NED Plan (based on feasibility level hydraulic modeling) would trigger a National Flood Insurance Program (NFIP) regulatory requirement (44 CFR 60.3(d)) that communities must seek conditional approval from FEMA before allowing certain encroachments upon a floodplain. Applications for such conditional approvals must certify, among other things, that no structures are located in areas that would be impacted by increased base flood elevations (44 CFR 65.12(a)(5)). Under USACE policy (ER 1105-2-100, para.3-3.b.(5) and (10)), compliance with the NFIP is a non-Federal responsibility and compliance costs would be borne by non-Federal interests.

The cost for NFIP compliance is the estimated minimum cost for the non-Federal interests to comply with the NFIP if the NED plan is implemented. Participation in and compliance with applicable Federal floodplain management and flood insurance programs is a requirement of non-Federal sponsor participation in Federal flood control projects under Section 402 of WRDA 1986, as amended. The NFIP compliance costs are not based on specific features proposed by the sponsor. The estimated NFIP compliance costs are based on the least-cost

features that could be added to the NED Plan by local interests to achieve NFIP compliance, without modifying the NED Plan. NFIP compliance costs have been identified pursuant to the joint FEMA-USACE memorandum, subject: FEMA/USACE Joint Actions on Planning for Flood Risk Management Projects, signed in June 2012.

USACE considered several options for NFIP compliance and determined that non-structural methods including house raising would likely be the least-cost option on the south side of the Truckee River. Through coordination with regional FEMA staff, it was verified that raising the first floors of affected residences above the new base flood elevation would comply with the NFIP regulation. Approximately 764 homes and 128 multiplex apartment buildings would need to be raised in the area south of the river. Additionally, four commercial structures and three public buildings would also need to be raised or "wet flood-proofed" with closures and sealing. Figure 5-7 identifies the land parcels with structures that are estimated to require raising or flood-proofing. The preliminary cost estimate to raise and flood-proof structures for NFIP compliance on the south side of the Truckee River is $172 million. For the north side of the Truckee River, a 400-cfs capacity pump station on the North Truckee Drain with an outfall to the Truckee River would be the least-cost option. The estimated first cost for the pump station is $23 million. Therefore, the total estimated minimum non-Federal costs cost for NFIP compliance is $195 million.

Because compliance with the NFIP is a non-Federal responsibility, the affected NFIP communities could develop their own plan for compliance with the NFIP and would not be required to implement the specific assumed least-cost features. The estimated NFIP compliance costs are subject to change based on more detailed hydraulic analysis during final design of the project, including the results of NFIP hydraulic modeling assumptions and methods, and more detailed surveys of the elevations of existing structures.

5.8.5. Sensitivity Analysis of Potential Additional Effects of SouthEast Connector

Washoe County Regional Transportation Commission (RTC) plans to construct a 5.5 mile north to south roadway, SouthEast Connector, in the USACE study area (Figure 5-5). Although it is considered likely that a roadway project will be built, there is significant uncertainty about the final design and effects of the roadway. This uncertainty is due to changes that may be required in order to obtain a USACE permit and any changes resulting from the public opposition. However, a sensitivity analysis was conducted based on the current roadway design to determine whether it would significantly change the results of the economic analysis of the NED Plan or the recommendations in this GRR.

USACE reviewed the 50% design of the roadway and using professional hydraulic engineering judgment has estimated that the water surface elevation for the 1% ACE flood event under the NED Plan would increase up to an additional 1 foot (plus or minus 0.5 foot) primarily in the area on the west side of the roadway. An estimated 153 additional structures would have a 1% base flood elevation increased above their first floor. It is estimated that 152 of those

structures would need to be elevated for NFIP compliance and one commercial structure would be floodproofed. The 899 structures identified in Section 5.8.4 would also need to be raised (or floodproofed if appropriate) an additional foot. Based on preliminary estimates, the additional minimum non-Federal cost for NFIP compliance, if the SouthEast Connector is constructed as currently designed, would be $29 million, which is approximately $1.3 million in annual costs. A sensitivity analysis of the effect of that potential additional economic cost on the project justification is included in Section 6.7.

The hydraulic effects of the final design of the SouthEast Connector will be considered during PED for the Truckee Meadows Flood Control Project and adjustments will be made as appropriate.

5.9 Restoration of Fish Passage in the Truckee River

The Lahontan cutthroat trout (LCT) and cui-ui lake sucker occur only in the Truckee River and Pyramid Lake. The LCT is a Federally listed threatened species. The cui-ui is listed as endangered by both the Federal government and the State of Nevada. Both fish species are institutionally recognized as significant based on the criteria in ER 1105-2-100, Appendix E. The cui-ui is also publicly recognized as significant by the Pyramid Lake Paiute Tribe as a sacred resource. The LCT can be found throughout the entire Truckee River, although self-sustaining populations are only found in a few tributaries of the upper watershed. The cui-ui are not currently able to access the river above Derby Dam.

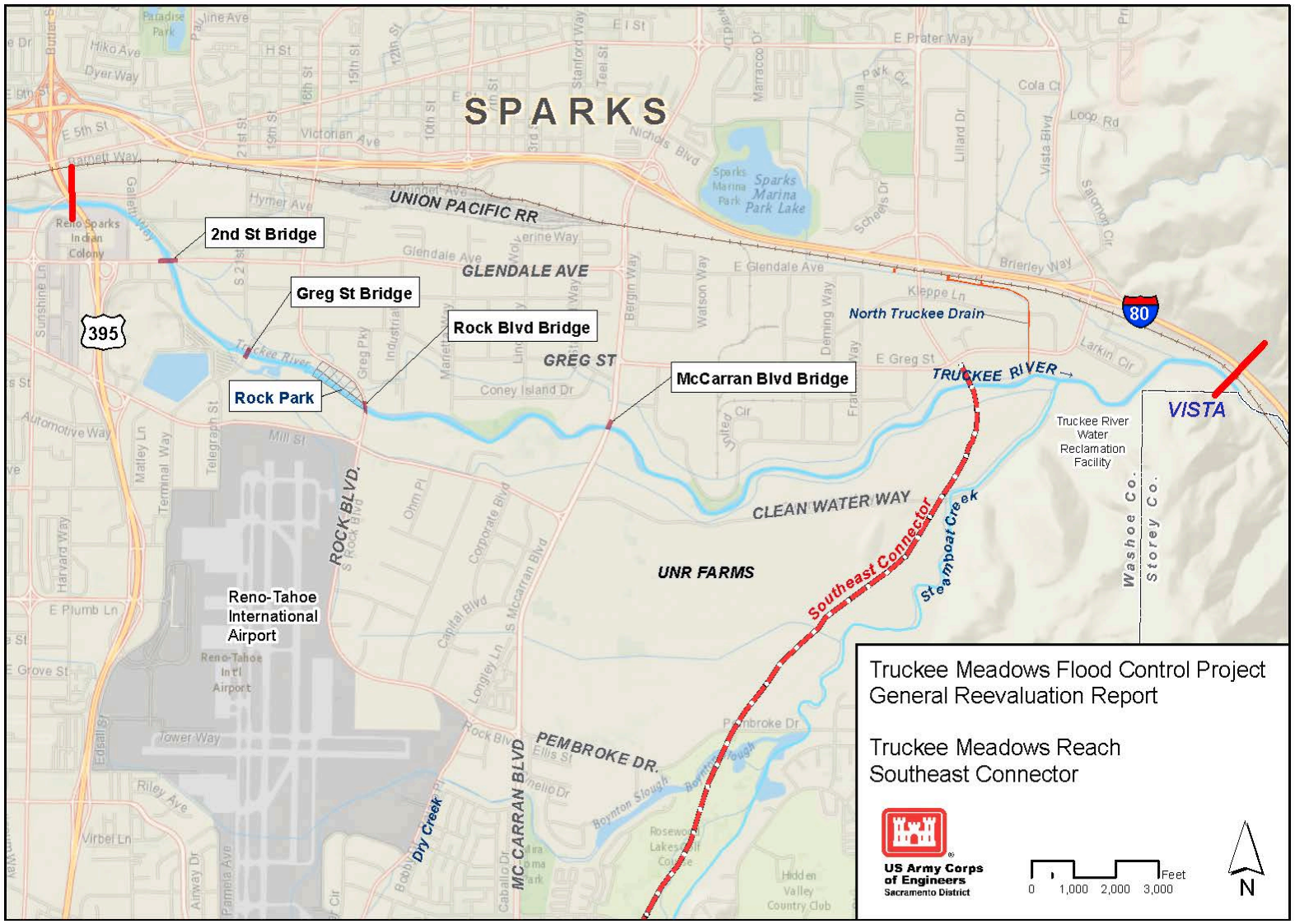

Figure 5-5. Proposed Location of SouthEast Connector

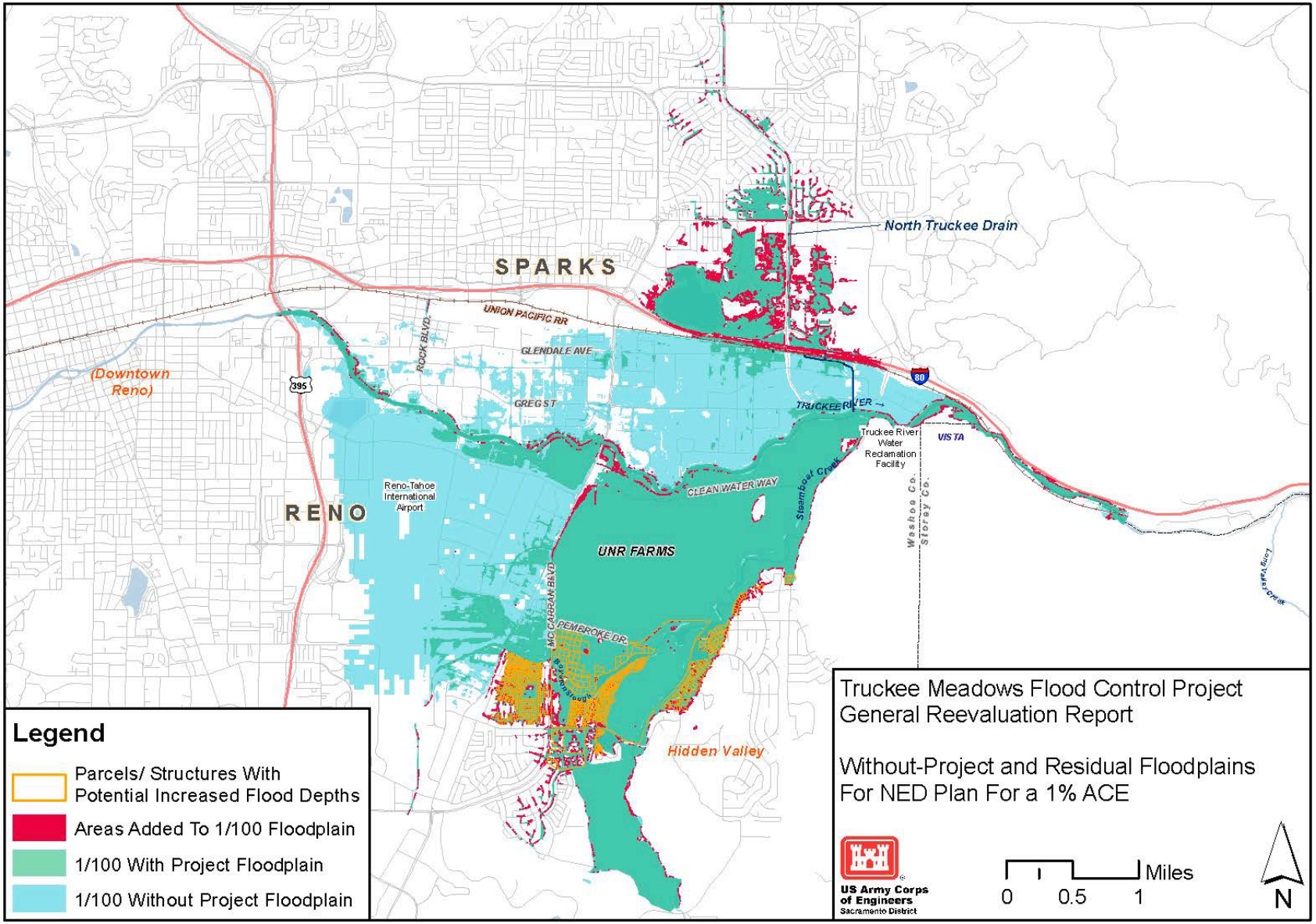

Figure 5-6. Areas added to 1/100 Floodplain and Parcels Potentially Requiring Raising/Flood-proofing for NFIP Compliance

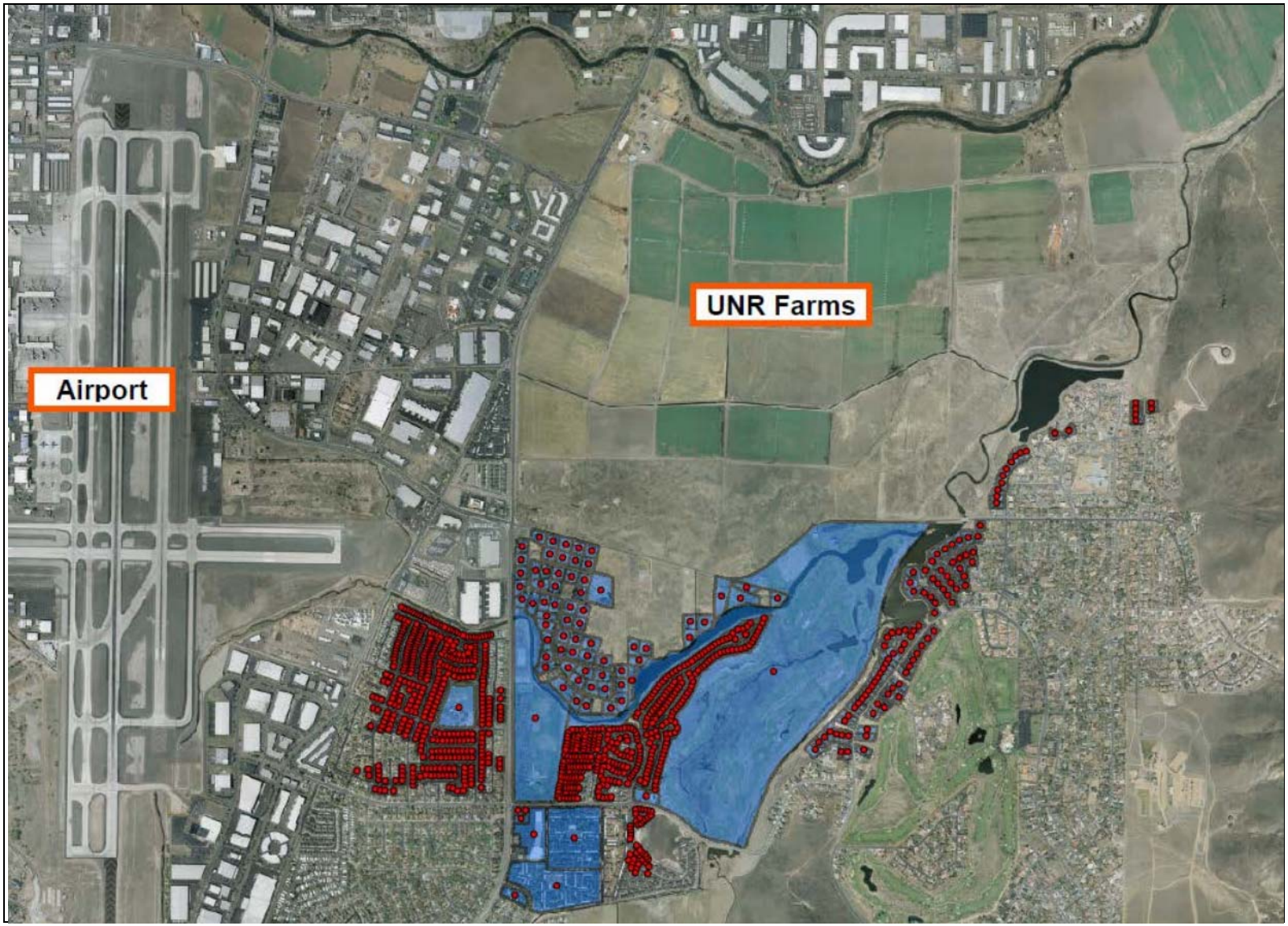

Figure 5-7. Parcels with Structures Potentially Requiring Raising/Flood-proofing for NFIP Compliance

5.9.1 Fish Passage Benefits

Crucial to the evaluation process for the fish passage alternatives is establishing the metric for the output or benefit of each alternative. Since there is no commonly accepted metric for fish passage, a specific method of quantifying benefits was established for the Truckee River. The development of benefits for the fish passage alternatives has been a cooperative venture between the USACE, Engineer Research and Development Center (ERDC), the Pyramid Paiute Tribe, and local resource agencies. The quantification of benefits for fish passage proved to be quite subjective, with the lack of basic species data forcing the team to make a number of assumptions that could potentially be challenged. It was determined that an expert elicitation would be the best route to determining the benefits of the various fish passage alternative plans.

Based on the number of assumptions and the species-specific knowledge, ERDC developed a simplified version of a recognized prioritization and benefits scoring system for northwestern anadromous salmonids for upstream benefits. The scoring system takes a number of variables to measure quality (such as population potential, habitat range, mobility potential) multiplied by river miles. Since the variables differ widely from species to species, there is not ideal score per mile. In general, the higher the output score, the better the alternative performs. A discussion of the benefit methodology, including formulas and algorithms used is in the Truckee River Fish Passage Report available in the Sacramento District's project files.

There are two main components to successful fish passage around obstructions in the river: upstream and downstream. The upstream and downstream components each required different solutions and, consequently, different benefit evaluations. As described in Chapter 4, a total of 54 different combinations of alternatives at all diversions were evaluated for fish passage.

5.9.2 Cost Effectiveness Analysis

The results of cost effectiveness analysis using the average output estimate are shown in Figure 5-8. There are 16 cost effective plans including No Action. The outputs are units of river miles; however, the equations scale river miles as a function of the ecosystem processes with significance to restoration. They are equivalent to the more conventional "habitat units," and can be scaled accordingly.

5.9.3 Incremental Cost Analysis

Incremental Cost Analysis was performed on all cost effective plans. The results of ICA using the average or expected value of environmental outputs are shown in Table 5-6 and Figure 5-8. ICA displays the increase in cost to obtain an increase in outputs for successively larger cost effective plans. The Best Buy plans are the most efficient in production of

successively larger (i.e., greater output) plans. The three Best Buy plans (in addition to No Action) are:

- Plan 37, which consists of Marble Bluff (bypass channel) + S-S (pump) (upstream only) + Fellnagle (upstream only) + Herman (upstream only)

- Plan 12, which consists of all upstream actions + Washoe downstream + Verdi downstream + Fleisch downstream

- Plan 11, which is the maximum plan consisting of all sites and all measures (upstream and downstream)

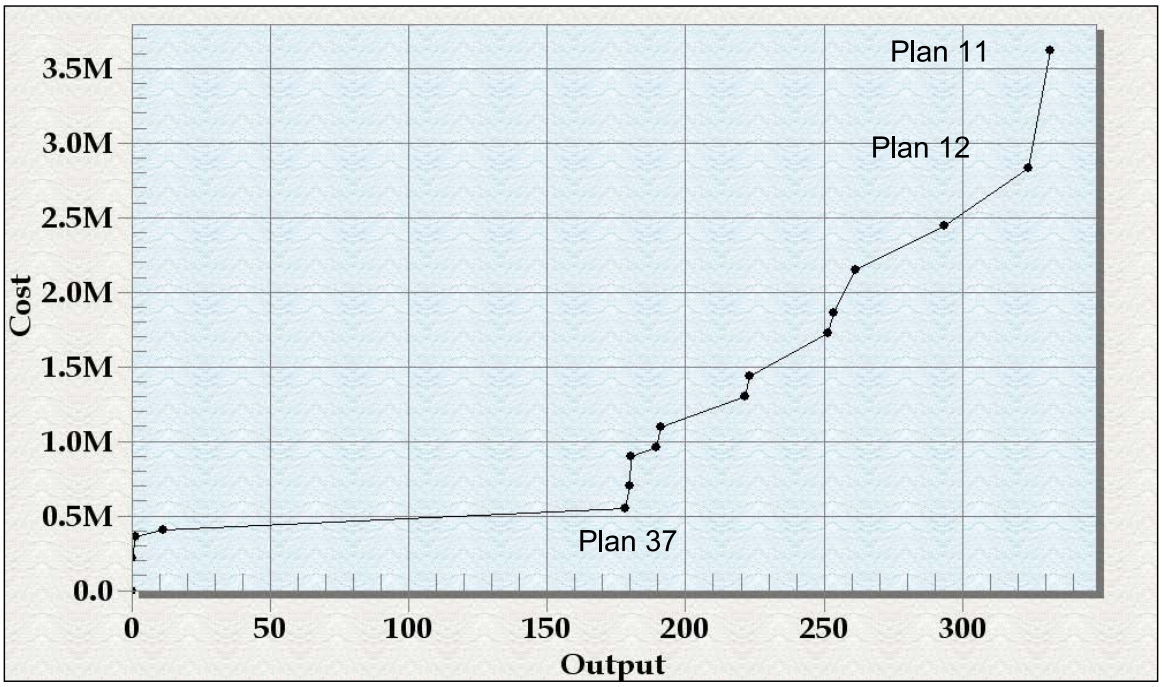

Figure 5-8. Cost Effective Plans – Average Output

Table 5-6. Incremental Cost Analysis: Best Buy Plans – Average Output

Alternative	Incremental Cost ($)	Incremental Output (miles)	Incremental Cost / Incremental Output
No Action Plan	0	0	0
Plan 37	553,373	178.0	3,109
Plan 12	2,280,725	145.6	15,659
Plan 11	783,342	7.9	99,567

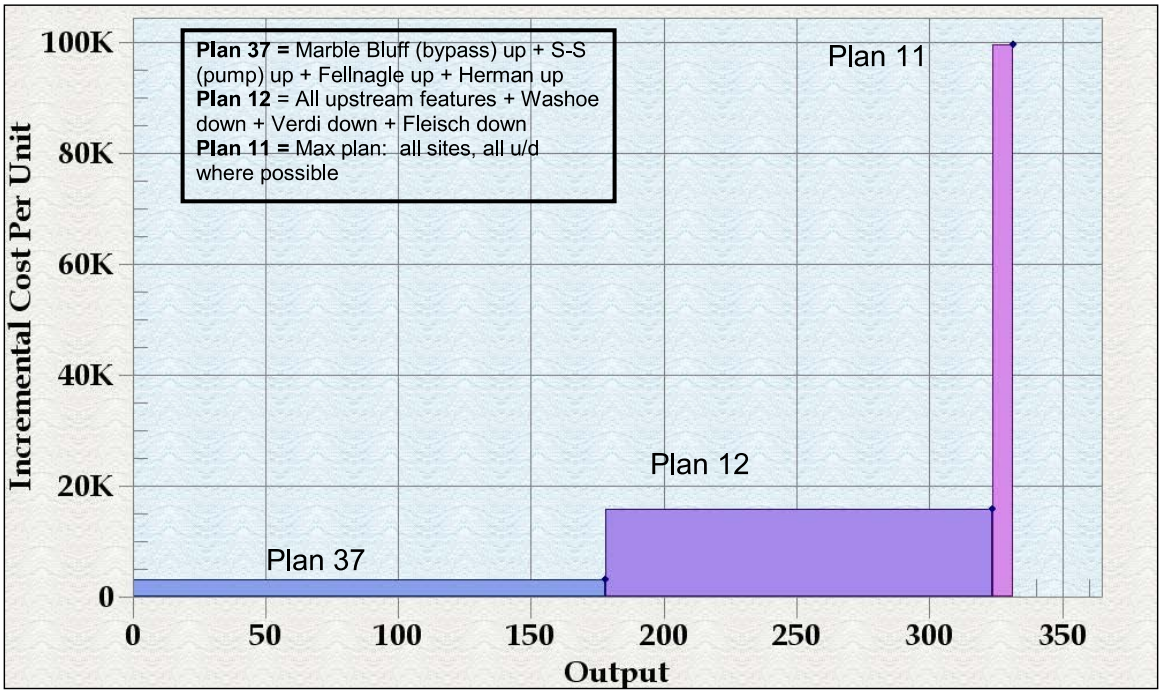

Figure 5-8. Best Buy Plans – Average Output

A sensitivity analysis was performed using minimum and maximum output forecasts. Plans 37, 12, and 11 were consistently identified as Best Buy plans. This gives the project delivery team confidence that, regardless of some residual uncertainties associated with estimation of subjective parameters in the benefits methodology, these plans are the most economically efficient.

5.9.4 Identification of Most Cost Effective Plan for Fish Passage

Table 5-7 provides a summary of the composition, benefit, and cost of each of the Best Buy Plans. Important considerations to note are:

- Plan 37 is an upstream passage plan that addresses only the lower river, which was not recommended by ERDC due to the importance of coldwater habitats in the upper system to Lahontan cutthroat trout and other species.
- Plans 11 and 12 include the most expensive and highest benefit upstream passage restoration plans.

Based on the results of the Cost Effectiveness/Incremental Cost Analyses, Plan 12 is the most cost effective plan for fish passage.

In summary, the features of Plan 12 are:

- Fleish Diversion: Construct new fish bypass channel and install a fish screen at ditch inlet.
- Steamboat Diversion: Modify existing rock weir/dam to improve fish passage.
- Verdi Diversion Dam: Construct new fish bypass channel and install a fish screen at ditch inlet.
- Washoe/Highlands Diversion: Construct new fish bypass channel and install a fish screen at ditch inlet.
- Herman Ditch Diversion: Reconstruct fish-friendly dam structure and ditch inlet.
- Fellnagle Diversion: Modify dam structure and ditch inlet.
- S-Bar-S Ranch: Install an irrigation pump with fish screen.
- Marble Bluff Dam: Construct new fish bypass and retrofit existing fishway for low lake level conditions.

The total first cost of Plan 12 is $47,224,000 (Oct 2012 price level). The plan restores upstream passage at all 9 diversions and downstream passage at 3 diversions. This restores fish access to approximately 90 miles of the Truckee River.

Through a series of meetings between 2008 and 2010, the Best Buy plans were presented to project partners, regulating agencies, and stakeholders to discuss the benefits and drawbacks of each plan and to solicit a preference for a specific plan. Based on feedback from the PLPT, USFWS, USBOR, NDOW, USGS, Washoe County, TMWA (TMWA was later replaced by TRFMA), and the University of Nevada, Reno, Plan 12 was also the stakeholders' preferred fish passage plan.

Table 5-7. Summary of Best Buy Plans for Fish Passage

Diversion	Plan 37	Plan 12	Plan 11
Marble Bluff	bypass channel	bypass and retrofit of fish ladder	bypass and retrofit of fish ladder
S-S	pump (with fish screen)	pump (with fish screen)	pump (with fish screen)
Fellnagle	modify existing dam and inlet structure	modify existing dam and inlet structure	modify existing dam and inlet structure with fish screen
Herman	modify existing dam and inlet structure	modify existing dam and inlet structure	modify existing dam and inlet structure with fish screen
Tracy PP			fish screen
Cochran			fish screen
Idlewild Ponds			fish screen
Orr			fish screen
Lake			fish screen
Last Chance			fish screen
Washoe/ Highlands		bypass channel and fish screen	bypass channel and fish screen
Verdi		bypass channel and fish screen	bypass channel and fish screen
Steamboat		modify existing rock weir	modify existing rock weir
Fleisch		bypass channel and fish screen	bypass channel and fish screen
Total Output (avg)	432.8	578.5	586.3
Net Output (miles)	178.0	323.6	331.5
Avg Annual Cost[1]	553,373	2,834,098	3,617,440
Total First Cost	8,662,860	44,425,460	56,824,100

[1]Average Annual Costs include OMRRR and IDC.

The Truckee Meadows project was authorized by Congress in 1988 for flood control and fish and wildlife enhancement. Since the 1990's, there has been a strong local interest in reestablishing a "living river" corridor to convey flood flows, reestablish native habitat and restore fish passage along the Truckee River. All of these project purposes were considered during USACE's general reevaluation of the project. Restoration of fish passage on the Truckee River was evaluated in detail pursuant to the 1990 Tribes Water Rights Settlement Act, § 207. In 2012, the USACE and the Administration, in coordination with the sponsor, decided to refocus plan selection on the primary project purpose of flood risk management to expedite completion of the study consistent with Administration and sponsor priorities (Reference: Commander, USACE South Pacific Division memorandum dated 6 July 2012, subject: Truckee Meadows Project General Reevaluation Report, NV). Federal interest in a plan for the restoration of fish passage has been established, but that plan is not being recommended for implementation by the USACE at this time.

5.10 Recreation Component

5.10.1 Recreation Plan Evaluation

Cost estimates for two preliminary recreation plans were completed in 2008. The sponsor's contractor, Stantec, prepared a preliminary cost estimate for the Locally-Developed Recreation Plan that totaled $74 million dollars. Because the costs exceeded the available recreation benefits, the sponsor and USACE downsized the plan. The revised preliminary estimate totaled $39.1 million, which still was not economically justified. The Locally-Developed Recreation Plan was therefore eliminated from further consideration.

The USACE recreation plan was formulated based on policy-compliant recreation features. The strategy used to formulate recreation alternatives was to start with a relatively few basic recreation measures and add more optional features (playground and group picnic shelters) as additional increments. The measures were evaluated against their ability to meet the planning objective and the four P&G screening criteria, particularly effectiveness. Three scales of recreation features were evaluated to complement the NED plan for flood risk management:

Alternative A includes:

- 50 Individual picnic areas
- 4 Kayak and canoe input areas
- 13 Fishing areas
- 9,700 lf paved trails
- 8,900 lf unpaved trails

Trailheads were included in the paved and unpaved trail features. Fishing access, non-motorized boat access and kayaking access costs were combined with the cost of trails leading to them because benefits cannot be derived from these activities unless access is provided by trails.

Alternative B adds the following measures to Plan A:

- 1 Playground
- Small group picnic shelter

Alternative C adds the following measure to Plan B:

- Medium group picnic shelter

Costs and benefits were developed for each of the three alternatives. Preliminary costs were used based on conceptual designs, previous bid results and professional judgment. Basic access, health, and safety features including parking and restrooms were included in all alternatives. The unit day benefit value was developed for each recreation alternative using professional judgment and the guidelines provided in Economic Guidance Memorandum 13-03, Unit Day Values for Recreation for Fiscal Year 2013. The unit day values are presented in Table 5-8. Point values were assigned based on an evaluation of existing recreation features within the project area using the point scale provided in EGM 12-03. Criteria measured included recreation experience, availability of opportunity, carrying capacity, accessibility, and environmental condition. Scoring was the result of informed opinion and professional judgment. Potential point values range from 0 to 100.

Table 5-8 Unit Day Value Worksheet for Alternative A

Alternative A - Recreation Unit Day Value Worksheet		
Evaluation Criteria	**Assigned Points**	**Notes on Judgment Factors**
Recreation Experience	without project: 11	Several general activities; one high quality value activity (rafting)
	with project: 13	Increase in general activities over w/o project
Availability of Opportunity	without project: 3	Recreation opportunities exist w/i both 1 hour and 30 min.
	with project: 6	Increases opportunities for some activities to w/i 30 min
Carrying Capacity	without project: 6	Basic + facilities (could be a 5)
	with project: 8	Provides adequate facilities at site.
Accessibility	without project: 10	Fair access to existing recreation
	with project: 13	Improved access to site
Environmental Condition	without project: 5	Average quality; viewshed limited or impaired
	with project: 13	New recreation would have high esthetic quality and improved viewshed
Total Assigned Points	without project: 35	
	with project: 53	

Table 5-9. Unit Day Value Worksheet for Alternative B

Recreation Unit Day Value Worksheet		
Evaluation Criteria	**Assigned Points**	**Notes on Judgment Factors**
Recreation Experience	without project: 11	Several general activities; one high quality value activity (rafting)
	with project: 15	Increase in general activities over w/o project and Alt A.
Availability of Opportunity	without project: 3	Recreation opportunities exist w/i both 1 hour and 30 min.
	with project: 6	Increases opportunities for some activities to w/i 30 min
Carrying Capacity	without project: 6	Basic + facilities (could be a 5)
	with project: 8	Provides adequate facilities at site.
Accessibility	without project: 10	Fair access to existing recreation
	with project: 13	Improved access to site
Environmental Condition	without project: 5	Average quality; viewshed limited or impaired
	with project: 13	New recreation would have high esthetic quality and improved viewshed
Total Assigned Points	without project: 35	
	with project: 55	

Table 5-10. Unit Day Value Worksheet for Alternative C

Recreation Unit Day Value Worksheet		
Evaluation Criteria	**Assigned Points**	**Notes on Judgment Factors**
Recreation Experience	without project: 11	Several general activities; one high quality value activity (rafting)
	with project: 16	Increase in general activities over w/o proj and Alts A & B
Availability of Opportunity	without project: 3	Recreation opportunities exist w/i both 1 hour and 30 min.
	with project: 6	Increases opportunities for some activities to w/i 30 min
Carrying Capacity	without project: 6	Basic + facilities (could be a 5)
	with project: 11	Provides optimum facilities at site.
Accessibility	without project: 10	Fair access to existing recreation
	with project: 14	Improved access to site and on site
Environmental Condition	without project: 5	Average quality; viewshed limited or impaired
	with project: 13	New recreation would have high esthetic quality and improved viewshed
Total Assigned Points	without project: 35	
	with project: 60	

Table 5-11. Unit Day Values and Recreation Value

Recreation Alternative	Assigned Point Value	Gen. Recreation Value
Project Without Project	35	$5.70
Alternative A	53	$8.07
Alternative B	55	$8.07
Alternative C	60	$8.78

Recreation demand was determined based on a 2008 recreation demand survey conducted by Responsive Management of Harrisonburg, VA. Table 5-12 displays the results by recreation feature. The methodology involves multiplying carrying capacity times turnover rate times weeks in the season divided by the percentage of day use. That total is then divided by the percentage of season use. Recreation demand for unpaved trails was calculated on the activities of running, walking, and jogging. The survey identified mountain biking as another activity that could make use of unpaved trails, however, for an urban setting this demand is considered to remain unmet by the project.

The general recreation value for each alternative was multiplied by the average annual users to determine a total annual recreation value for each alternative. The results are displayed in Table 5-13.

Each recreation alternative had a preliminary cost estimate developed. A preliminary estimate of the interest during construction and the routine OMRRR costs was developed to calculate the average annual cost for each alternative. The summary is displayed in Table 5-14.

Table 5-15 shows the preliminary recreation evaluation results. Alternative C has the greatest net recreation benefits at $333,006, as well as a benefit-to-cost ratio of 2.1:1 Therefore; Alternative C is identified as the NED recreation plan. A more detailed cost estimate for the recreation plan was subsequently prepared after a considerable length of time had elapsed. Consequently the final costs for recreation are considerably higher than those included in this benefit analysis. However, the increases in cost affected all the alternatives in a commensurate manner and Alternative C remains the NED recreation plan.

Table 5-12. Recreation Demand by Feature

Recreation Feature	Total Expected Participants[1]	Carrying Capacity	Turnover rate	Weeks in Season	Weekend Day Use[2]	Recreation Season Use	Annual Users per Feature (x number of features)
Medium Picnic Shelter - Large* 40' x 40' w/16 tables	363,853	64	1	30	35%	75%	7,314
Small - 20' x 20' w/4 tables	683,698	16	1	30	35%	75%	1,829
Picnic Areas	1,388,114	5	2	30	35%	75%	57,143
Kayaking	563,825	1	4	20	25%	65%	9,600[4]
Non Motorized Boats	812,744	0.5	4	20	20%	65%	NA
Fishing	998,330	0.2	4	20	20%	65%	1,600
Playgrounds	4,421,642	1	8	30	25%	65%	1,477
Trails							
Unpaved	9,950,885	12	4	30	30%	70%	24,080
Paved	5,015,074	12	4	30	30%	70%	12,597
Total							**115,640**

[1]Represents total demand for each recreation feature throughout survey area.
[2] Percentage of weekends facility is in use.
[3] Percentage of recreation season that facility is in use.
[4] Combined users for kayaking and non motorized boats.

Table 5-13. Total Annual Recreation Value

Recreation Alternative	Gen. Recreation Value	Avg. Annual Visitors	Total Annual Value	Net Annual Value
Without Project	$5.70	70,122	$399,695	0
Alternative A	$8.07	106,497	$859,433	$459,738
Alternative B	$8.07	108,326	$874,191	$474,495
Alternative C	$8.78	115,640	$1,015,320	$615,625

Table 5-14. Summary of Recreation Costs (Preliminary Costs, Oct 2011 Prices)

Recreation Alternative	First Costs	IDC	Total Investment Cost	Annualized Investment Cost	Annual O&M	Average Annual Costs
Alternative A	$3,959,230	$240,720	$4,199,950	$195,509	$54,890	$250,399
Alternative B	$4,148,760	$252,240	$4,401,000	$204,867	$57,400	$262,267
Alternative C	$4,476,250	$272,160	$4,748,410	$221,039	$61,580	$282,619

Based on October 2011 price levels, 4 percent rate of interest, and a 50-year period of analysis.

Table 5-15. Comparison of Alternative Recreation Plans (Prelim Costs, Oct 2011 Prices)

Recreation Alternative	Average Annual Benefits	Average Annual Costs	B/C Ratio	Net Benefits
Alternative A	$459,738	$250,399	1.84	$209,339
Alternative B	$474,495	$262,267	1.81	$212,228
Alternative C	$615,625	$282,619	2.18	$333,006

5.10.2 Recreation Plan Description and Detailed Benefit/Cost Evaluation

The NED recreation plan Alternative C consists of the following features in the Truckee Meadows Reach:

- 50 Individual picnic areas
- 4 Kayak and canoe input areas
- 13 Fishing areas
- 9,700 lf paved trails
- 8,900 lf unpaved trails
- 1 Playground
- Small group picnic shelter
- Medium group picnic shelter
- Access road, parking, restrooms, and signage

The table below provides the benefit/cost evaluation of the NED recreation plan (Alternative C) using more detailed cost estimates at October 2013 price levels and a 3.5% interest rate. Benefits were also updated to October 2013 prices.

Table 5-16. Revised BCR and Net Benefits for Alternative C (Oct 2013 Prices)

Recreation Alternative	Average Annual Benefits	Average Annual Costs	B/C Ratio	Net Benefits
Alternative C	$625,000	$612,000	1.0	$13,000

5.11 Identification of the Recommended Plan

The Recommended Plan for the Truckee Meadows GRR consists of:

- No action in the Downtown Reno Reach
- Flood risk management in the Truckee Meadows Reach, consisting of the NED Plan (FRM Alternative 3 - Floodplain Terrace Plan)
- NED Plan for recreation in the Truckee Meadows Reach (Recreation Alternative C)

CHAPTER 6
DETAILS OF THE RECOMMENDED PLAN

As identified in Chapter 5, the Recommended Plan consists of no action in the Downtown Reno Reach, flood risk management in the Truckee Meadows Reach (Alternative 3 - Floodplain Terrace Plan) and recreation in the Truckee Meadows Reach (Alternative C).

6.1 Features and Accomplishments

The principal features of the Recommended Plan are (1) construction of floodwalls, levees, and floodplain terracing in the Truckee Meadows Reach, and (2) basic recreation features in the Truckee Meadows Reach. A summary description follows and is also shown in Table 6-1.

6.1.1 Levees and Floodwalls

The Recommended Plan includes approximately 9,650 lineal feet of on-bank (6,500 feet) and in-channel (3,150 feet) floodwalls along the north bank and 31,000 lineal feet of levees along the north and south banks of the Truckee Meadows Reach (see Figure 6-2). A gravel maintenance road is included on the crown of the levee. The road will be 12 feet wide with 2-foot aggregate base shoulders.

6.1.2 Floodplain Terracing

This feature involves excavating a benched area along portions of the south (right) bank of the Truckee River between Greg Street to McCarran Boulevard. Vertically, the excavation would extend down to just above the two-year water surface elevation (WSE). Excavation would create a low bench above the low-flow channel bed, which would be inundated during higher winter and spring flow events. This low bench would extend approximately 150 to 250 feet to the landside of the south bank of the Truckee River from Greg Street to Vista. A second bench, approximately 2 feet higher in elevation, would be extended approximately 50-70 feet to the landside of most of the length of the low bench. Floodplain terracing would increase the flood flow channel capacity and thereby reduce water surface elevations in the Truckee Meadows area during a flood. Figure 6-1 shows a typical cross-section of the channel with terracing in place.

Erosion will be controlled on the excavated surfaces of the terraces through establishment of permanent vegetative cover. Native trees grasses and shrubs such as meadow barley, slender wheatgrass, cottonwoods, willows, golden currant, and buffaloberry will be utilized as they will provide a self sustaining cover of vegetation to serve both the purpose of stabilization and exclusion of noxious weeds. At the end of the Reno International Airport runways, between Greg Street and Rock Blvd., no cottonwood and red willow trees will be planted on the excavated terraces due to clearance zone restrictions. During the time that it takes to establish a permanent vegetative cover, erosion control best management practices will be utilized as needed. Hydraulic design of the Recommended Plan assumed that the terraces will be covered by mature vegetation, so the vegetation will not need to be managed to maintain the design hydraulic capacity of the terraces.

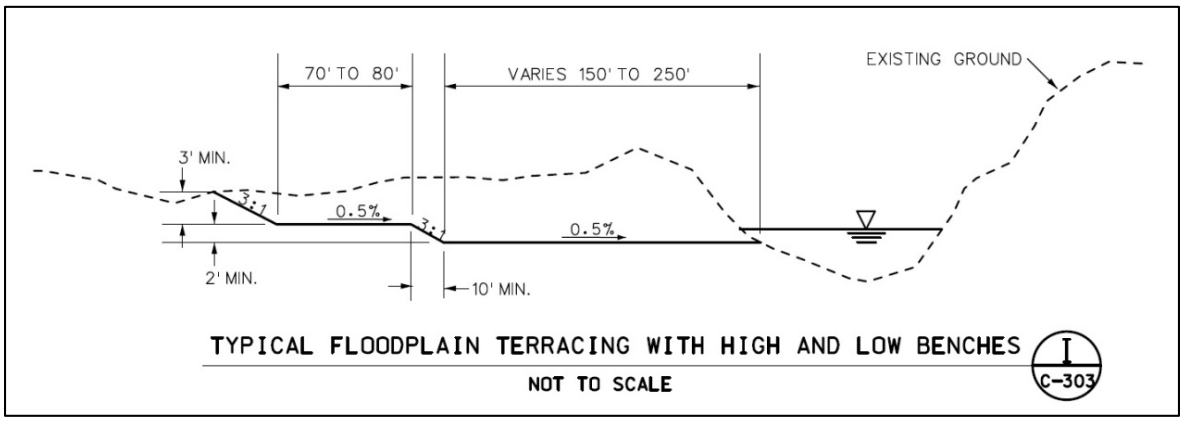

Figure 6-1. Typical cross-section of floodplain terrace

Table 6-1. Project Features – Truckee Meadows Reach

Features	Description
Levees	31,000 lf on north/south banks of Truckee River
Floodwalls (on-bank)	6,500 lf on north and south banks of Truckee River
Floodwalls (in-channel)	3,150 lf on north and south banks of Truckee River
Floodplain terrace	150 to 250 feet to the landside of the south bank of the Truckee River from Greg Street to just upstream of McCarran Boulevard. A higher bench, approximately 2 feet higher in elevation, would be extended approximately 50-70 feet to the landside of the low bench.
Box culverts on North Truckee Drain (NTD)	NTD placed in 2 box culverts for approximately 3,100 lf. The new drainage structure includes an approximately 200-lineal-foot extension to the existing People's Drain. Cap 2 junction structures of People's Drain.
Interior drainage	14 cfs pumping station just upstream of Glendale and new flap gates and vertical sluice gates for all existing storm drains.
Seepage prevention	Seepage berms, drainage blankets, impervious berms, and relief wells
Bridge pier/Scour protection	11,600 lf rock scour protection. Pier protection at 3 bridges between US Hwy 395 and Vista.

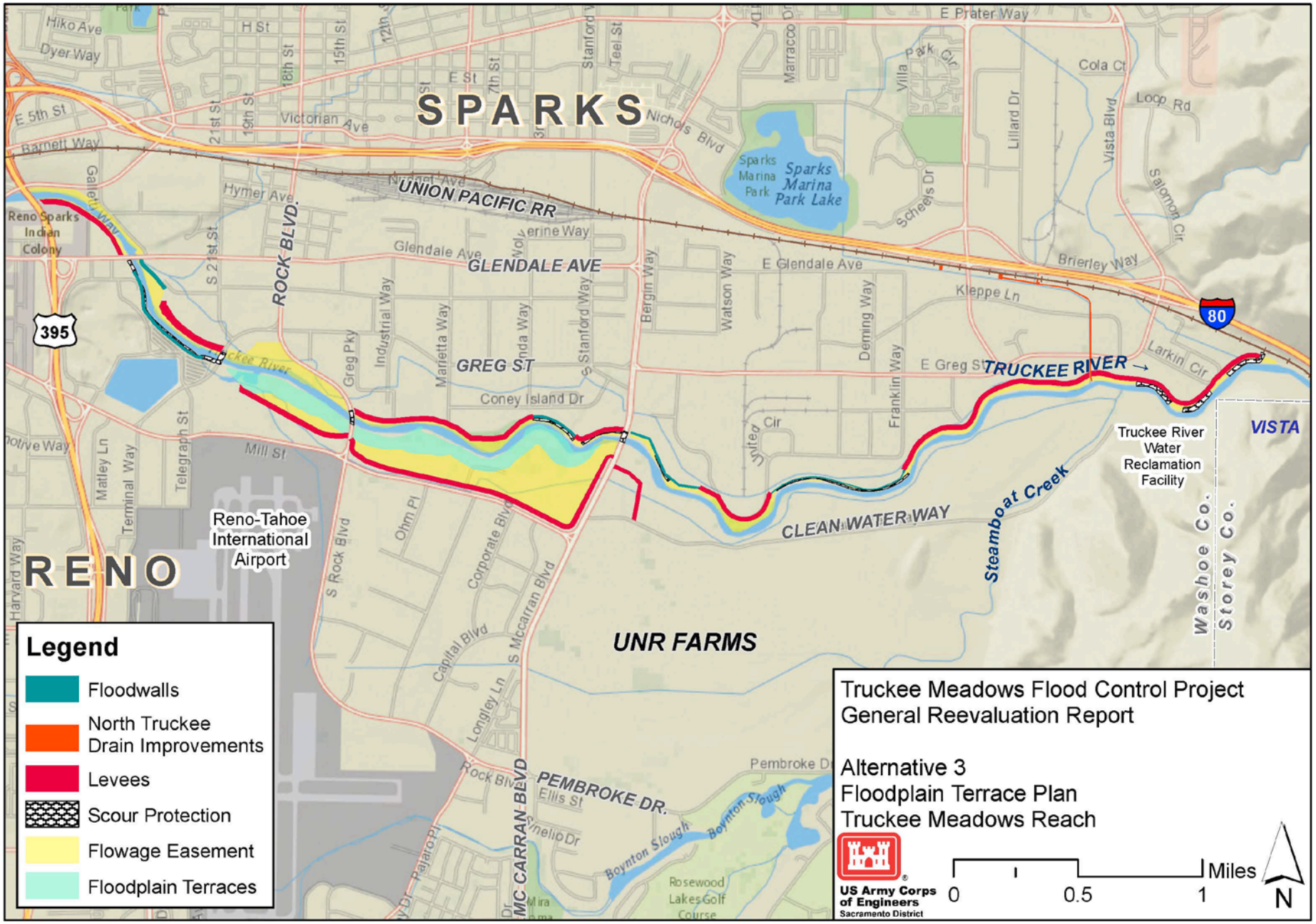

Figure 6-2. Alternative 3 - Floodplain Terrace Plan Truckee Meadows Reach

6.1.3 North Truckee Drain and People's Drain

To prevent overbank flooding upstream of the confluence with the Truckee River, the North Truckee Drain (NTD), downstream of I-80 and the UPRR, would be placed in two buried box culverts, about 11.5 feet wide by 10 feet high, for a length of approximately 3,100 lineal feet. The new drainage structure includes an approximately 200-lineal-foot extension to the existing People's Drain. At the transition at the existing NTD crossing under the railroad, a 20-foot-wide by 10-foot-high reinforced concrete box culvert would be installed. Two junction boxes along the existing People's Drain would be enclosed by sidewalls and precast lids to prevent overflows into the developed area south of I-80.

6.1.4 Bank and Bridge Pier/Abutment Scour Protection

Bank and pier scour protection is included in the Recommended Plan within the Truckee Meadows Reach. The bank protection is required to provide scour protection for the proposed levee and floodwall features consistent with standard design guidance. Bank protection is proposed for 13 sites and consists of two bio-engineered segments and 11 rip rapped segments having a total extent of approximately 11,600 linear feet or 2.5 miles. Additionally, scour countermeasures are proposed at 3 bridges to prevent increased erosion caused by increased in-channel flows which occur when the flows are limited to the channel by construction of the floodwalls and levees. Hydraulic analysis indicates that the flow concentration will significantly increase pier and/or abutment scour to the point where bridge failure may occur under the with-project condition. The cost of bridge repair or replacement is more costly than scour protection. A detailed scour analysis will be conducted in Pre-construction Engineering and Design (PED) to confirm the bank and bridge pier scour analysis.

6.1.5 Interior Drainage Facilities

Interior drainage facilities were designed in accordance with USACE guidance requiring minimum interior facilities to avoid induced interior flooding behind the line-of-protection for a levee/floodwall (EM 1110-2-1413). The potential for additional interior drainage facilities was considered, but no additional economically-justified facilities were identified. The formulation of interior drainage facilities, including residual floodplains, is discussed in detail in Hydraulics Attachment to the Engineering Appendix.

The proposed interior drainage facilities include a 14 cfs pumping station just upstream of Glendale Avenue and new flap gates and vertical sluice gates would be provided for all existing storm drains.

6.1.6 Seepage Remediation

Seepage remediation measures proposed include seepage berms, drainage blankets, impervious berms, and relief wells. Remediation measures were selected based on geotechnical seepage analysis. Relief wells were substituted in a limited area to minimize impact to adjacent

structures. A detailed list of locations and specific measures can be found in Appendix D, Engineering Appendix.

6.1.7 Relocations

No significant utility relocations are proposed for the Truckee Meadows Reach other than utilities that are through or under existing berms that will be replaced by levees/floodwalls. Compensable utilities that are disturbed will be replaced in kind. For feasibility-level design, utility relocations information provided by the sponsor and developed by an A/E firm was used as a basis for estimating required relocations.

6.1.8 Recreation Features

The Recommended Plan for recreation consists of one small group picnic shelter, one medium group picnic shelter, 50 individual picnic areas, one playground, an access road, parking and restrooms located north of Mill Street between Greg Street and McCarran Boulevard (Figure 6-3). In addition, 9,700 linear feet of paved trails and 8,900 linear feet of unpaved trails will be constructed linking the picnic areas with four kayak and canoe input areas and 13 fishing areas along the river (see Appendix E). All recreation features would be located on lands required for flood risk management purposes.

6.1.9 Habitat Mitigation

Impacts to fish and wildlife habitat in the Truckee Meadows Reach will be avoided and minimized by the environmentally sustainable design approach to flood risk management features in the Truckee Meadows Reach, particularly in regards to revegetation of floodplain terraces with native riparian vegetation and implementation of bioengineering techniques in the scour protection features, to the extent possible. No compensatory fish and wildlife habitat mitigation is proposed because there will be no net loss of significant habitat due to the flood risk management and recreation features of the Recommended Plan.

While construction activities, including in-channel construction, present the possibility of increased erosion and sedimentation in the river until disturbed areas are restored and stabilized, best management practices will be implemented to avoid or minimize erosion and sedimentation during construction and until revegetation efforts have been fully established. Best management practices and other requirements from NDEP's water quality certification will be included in a Storm Water Pollution Prevention Plan that will be developed and implemented during construction. Revegetation efforts will be implemented after each year of construction. Monitoring and adaptive management will take place for up to 3 years following completion of all construction activities to ensure successful plant establishment.

In-channel construction activities would occur the first 3 years of construction. In order to avoid or minimize effects to sediment load, in-channel construction will take place during the period of lowest river flows, July through September. In addition, the river will be temporarily

diverted around the area of in-channel construction. Water quality monitoring will be carried out on a daily basis both upstream and downstream of the construction area to ensure water quality thresholds are not exceeded.

Best management practices for this area will also be implemented for weed and pest control. This includes practices such as: revegetating banks at the end of each construction season, using certified weed-free hay/straw bales if needed for sediment control, updating and implementing the Comprehensive Wildlife Sensitive Weed Control Plan, minimizing use of herbicides within 30 feet of the river of any wetlands, and developing an integrated pest management plan. These and other best management practices to be implemented are further described in the EIS.

Costs for implementation of the best management practices have been accounted for in both the project and OMRR&R cost estimates. Additional information regarding these costs can be found in the Engineering Appendix.

As an indirect effect to flood risk management features in the Truckee Meadows Reach, during the modeled 1% annual chance event the Recommended Plan would induce an additional 1,520 cfs of flow in the Truckee River downstream of Vista relative to current conditions. In the long-term, shifts in sediment aggradation and degradation in the Lower Truckee River Reach would occur as an indirect result of this plan; however, sediment budget analyses carried out on larger plans that would induce flows in the Lower Truckee River Reach up to 3,300 cfs greater than the No Action condition in a 1% ACE event, indicated only minor changes to the average annual volume of sediment transport (or yield) along the Lower Truckee River (Corps, 2008b). These minor changes in transport volume translate to a less than significant change to sediment distribution in the river. For the Recommended Plan, induced flows are half of what was indicated for the larger plans and its changes to the average annual volume of sediment transport are expected to be substantially less.

It is important to note that estimates of the effective discharge were made during the sediment budget analysis. The effective discharge is defined as the mean of the discharge increment that transports the largest fraction of the annual sediment load over a period of years. The effective discharge is one estimator of the channel-forming discharge. The channel-forming discharge is a theoretical discharge that if maintained over a long period of time would produce a stable channel geometry in a fully alluvial stream. Other estimators commonly used are the bankfull discharge and the discharge for a specific recurrence interval. The advantage of the effective discharge is that it is a calculated value not subject to the problems associated with determining field indicators inherent in bankfull and recurrence interval methods.

In general, for both the No Action conditions and conditions for the larger plans evaluated in 2008, the effective discharge between Vista and Marble Bluff Dam was estimated at around 3,000 cfs which roughly translates to approximately a 33% ACE event (i.e., about a "3-year" event). Hydraulic modeling of the No Action and the Recommended Plan indicates no increases in flood discharges out of the Truckee Meadows for the 20% ACE event. Thus, significant long-term impacts in sedimentation due to the Recommended Plan are considered

unlikely since the effective discharge is not impacted by the project. With no changes to the effective discharge, vegetation and wildlife resources in the Lower Truckee River Reach would not experience substantial shifts in sediment dynamics and should not experience a significant shift in their ecological patterns. Therefore, no mitigation is proposed.

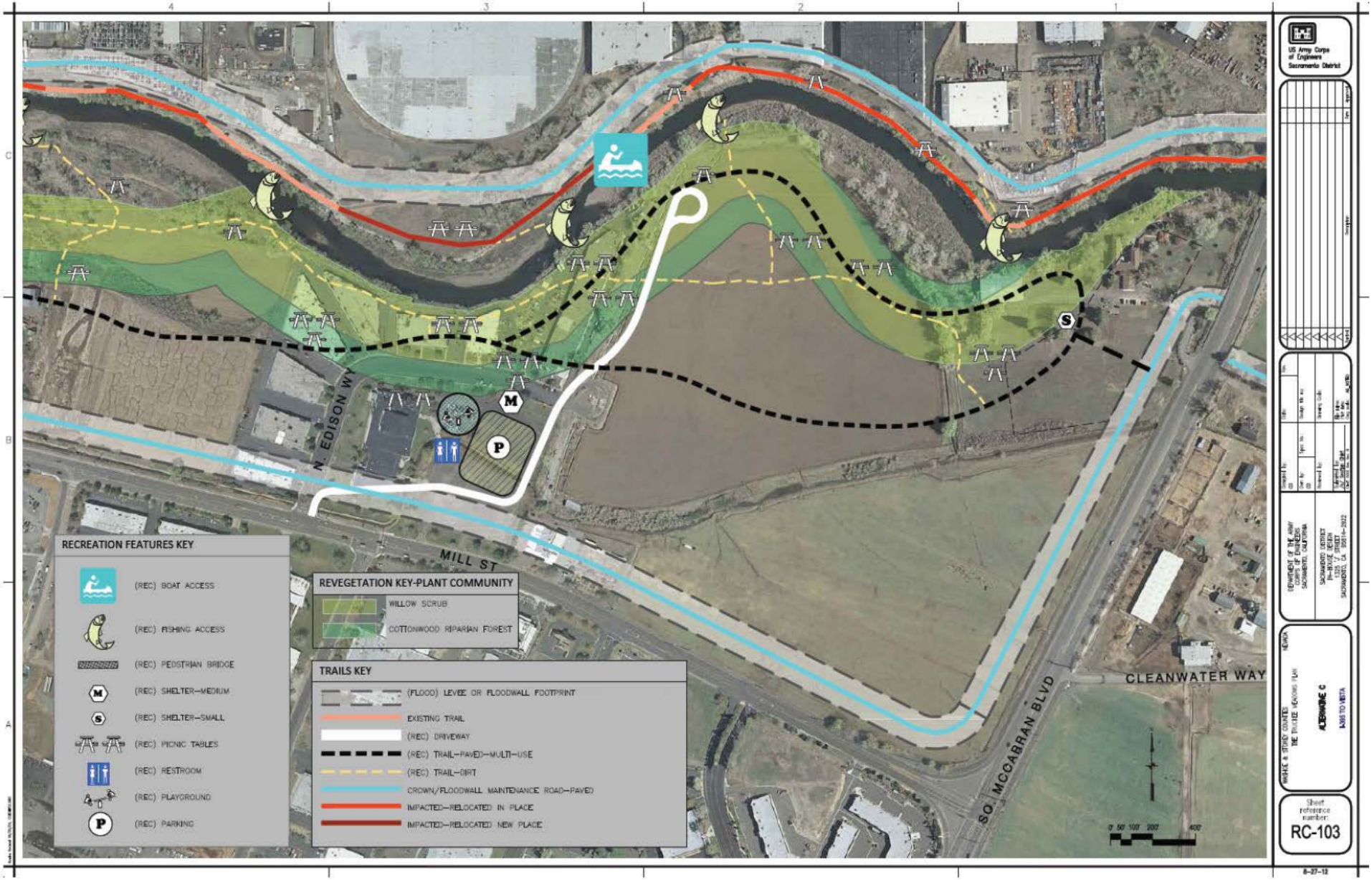

Figure 6-3. Conceptual Plan of Primary Recreation Access/Facilities in Truckee Meadows Reach

6.1.10 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Once project construction is complete, the project would be transferred to the sponsor. The sponsor would then be responsible for the operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) of the project in accordance with the OMRR&R manual. Subsequent to the completion of the design of the project features and prior to construction, a draft OMRR&R manual would be prepared in coordination with the sponsor and affected agencies. A final OMRR&R manual would be prepared after the completion of construction.

Flood Risk Management Features

Structural Features

Operation and maintenance is required for floodwalls, levees, interior drainage, relief wells, seepage remediation, and scour/bank protection proposed in the Recommended Plan. The requirements include inspecting and maintaining all features regularly and keeping project features free from vegetation growth per USACE standards. During floods, the levees and floodwalls would be patrolled continuously to locate possible boils or unusual wetness that signals a problem in the structure.

At a minimum, annual inspection and monitoring reports will be provided by the sponsor to USACE. Reports will contain the inspection checklist and photographs from monitoring points. Additional monitoring at the discretion of the State, sponsor, and stakeholders will be encouraged.

The following practices currently used on California levees related to pesticide (rodenticide) were included for cost estimating purposes:

- Rodent control will include baiting and burrow repair.
- A combination of bait stations and broadcast spreading for rodents, mainly ground squirrels will be used
- Cost estimates were based on the use of anti-coagulant rodenticide applied to rolled oats.

All best management practices for both weeds and burrowing animals will be revisited during PED to ensure that the most up to date practices are used to minimize effects to non-target wildlife. An integrated pest management plan would be developed using a variety of control methods to provide safe and effective control.

Floodplain Terrace Revegetation

The vegetation on the floodplain terraces will require a 3 to 5 year establishment period consisting of weed control and irrigation. This maintenance would be required through contract award for three to five years following completion of construction. At the end of the three to five year term, the areas would be turned over to the local sponsor. The

local sponsor would need to perform periodic weed control to prevent noxious weeds from taking hold. The local sponsor would also need to remove garbage on a periodic basis for the purpose of maintaining public health and safety. Gates, locks and signs would need to be kept in functional order.

Control of noxious weeds will be a major focus of the maintenance of the floodplain terraces. Prior to turnover of the floodplain terraces to the Non-federal sponsor, during the installation and establishment period aggressive control of weeds will be performed through timed mowing, broad application of selective and nonselective herbicides, spot spraying and hand pulling of weeds. After the establishment period when native vegetation has become established and can significantly suppress noxious weeds the same weed control methods will be used but on a more infrequent basis. The vegetation targeted for the floodplain terraces should provide a cover of woody vegetation that shades out the main weed of concern, tall white top. Annual broadcast treatment of trouble spots, spot spraying and hand pulling of individual weeds would be required.

Recreation Features

Upon transfer at completion of construction, the operation and maintenance of the recreation features of the project becomes the responsibility of the sponsor. The picnic shelter, picnic sites, playground, new trails, trailheads, fishing access, kayak and boat launch sites will require maintenance. At a minimum, annual inspections will be performed and maintenance activities such as trash and litter removal, cleaning, weeding, painting, and replacement of broken parts would be performed on a regular basis.

OMRR&R Costs

For the Recommended Plan, the estimated average annual OMRR&R costs are $862,000. This includes $691,000 for flood risk management features and $171,000 for recreation features.

Deauthorization of a Portion of the Truckee River and Tributaries Project

The Operation and Maintenance Manual for the existing Truckee River and Tributaries Project would be modified to be compatible with the new project. Because the Recommended Plan would completely replace the existing Truckee River and Tributaries Project between Glendale Avenue and Vista, the sponsor for the Truckee Meadows Flood Control Project would be responsible for OMRR&R of all project features in that reach. In Chapter 9, this GRR recommends deauthorization of the Glendale Avenue to Vista Reach of Truckee River and Tributaries Project to ensure that the sponsor for the Truckee Meadows Flood Control Project has full and clear responsibility, as between USACE and the sponsor, for OMRR&R of all USACE flood risk management elements between Glendale Avenue and Vista. The State of Nevada would no longer be required by USACE to maintain that portion of the existing Truckee River and Tributaries Project. OMRR&R responsibilities for the parts of the Truckee

River and Tributaries Project upstream of Glendale Avenue or downstream of Vista would not be changed by the Recommended Plan.

Between U.S. Highway 395 and Glendale Avenue, the river channel is currently maintained by the Carson-Truckee Water Conservation District (CTWCD) under the Martis Creek Lake Operation and Maintenance Manual for Truckee River and would not be modified by the Recommended Plan. The only Recommended Plan feature in that approximately 2,700-foot segment is the Reno-Sparks Indian Colony floodwall/levee that has already been constructed and is proposed for Section 104 credit. The new floodwall/levee did not significantly modify the river channel or left (north) bank. Therefore, CTWCD will continue to maintain the river channel and banks riverward of the permanent levee easement for the Reno-Sparks Indian Colony floodwall/levee.

6.2 Real Estate Requirements

The real estate interests include the estates, number of ownerships, and estimated land values. The baseline cost estimates include a gross appraisal and the Federal and non-Federal costs associated with acquiring the lands for the project. The total gross appraisal estimate for real estate requirements for the Recommended Plan is shown in Table 6-5 and 6-6. More detailed information on the real estate interests is presented in the Real Estate Plan (Appendix B).

The sponsor will not receive credit for lands, easements, or rights-of-way that were provided for a previous Federal project, including the Truckee River and Tributaries (TRT) project. Within the Truckee Meadows Reach, the TRT project consists of approximately 29,500 feet of excavated channel, beginning at Glendale Avenue, with an 80-foot invert width. The as-built construction plans for TRT identify a permanent right-of-way of varying width.

Within the footprint of the current Recommended Plan, approximately 32 parcels, totaling 15 acres (outside of the State-owned riverbed) were previously required to be provided for the Truckee River and Tributaries project. The sponsor for the current project will not receive credit for those parcels.

Table 6-2. Real Estate Requirements-Recommended Plan, Total LERRDs

Recommended Plan	Acres	Costs	Incremental Real Estate Costs (Contingencies)	Total Costs Rounded
MCACES 01 ACCOUNT - LANDS AND DAMAGES (Non-Fed)				
Lands and Damages / Non Federal Admin (Gross Appraised Value)	320	$48,279,000	$16,096,000	$64,375,000
*Additional Section 113 FRM lands costs Expended		$1,912,000	N/A	$1,912,000
**Recreation		$115,000	$43,000	$158,000
			Sub Total:	$66,445,000
MCACES 01 ACCOUNT - LANDS AND DAMAGES (Fed)				
Federal Admin		$1,455,000	$73,000	$1,528,000
MCACES 01 ACCOUNT - LANDS AND DAMAGES: TOTALS (Fed & Non Fed)		**$71,849,000**	**$16,212,000**	**$67,973,000**
MCACES 02 ACCOUNT - RELOCATIONS (Non-Fed)				
Relocations (Construction)		$6,790,000	$1,835,000	$8,625,000
PED Relocations		$1,018,000	$283,000	$1,301,000
Construction Management		$679,000	$184,000	$863,000
TOTAL RELOCATIONS				**$10,789,000**
TOTAL LERRDS COSTS			**(Rounded)**	**$78,762,000**

[1] Financial cost for LER acquired in advance of the Project Partnership Agreement is $44,500,000. Corps estimated current fair market value for the same parcels is $42,588,000. Per Section 113, the sponsor must be credited based on expenditures. This is estimated to include an additional $1,912,000 above the current fair market value.

6.2.1 Section 113 Crediting

According to the provisions of Section 113 of the Energy and Water Development Appropriations Act (EWDAA) of 2006 (Pub. L. 109-103, § 113, 119 Stat. 2247, 2254) (Section 113), the crediting of the sponsor for lands, easements and rights-of-way (LER) is based on expenditures required for the Recommended Plan. Table 6-2 contains the accounting for future Section 113 crediting. To date, the sponsor has acquired some LER in the amount of $45,250,000 that is expected to be necessary for the Recommended Plan. There is no significant difference between these expenditures and the gross appraisal estimate of the Corps ($43,338,000 for nearly equivalent acquisition). The Recommended Plan estimate for the LER is based on a Corps' gross appraisal and the sponsor's additional expenditures for LER they have acquired. The gross appraisal is used for planning purposes and not for crediting of LERs. Crediting occurs after the PPA is executed, and absent the provisions of Section 113, normally involves the Corps review of a site specific acquisition appraisal that sets out the fair market value of the real property interests, plus certain incidental costs of acquiring those interests. Therefore the funds expended by the Sponsor under Section 113 could be more or less than what would normally be credited under the Corps regulations. The total result of implementing

Section 113 credit for LERs will not be known until the sponsor has completed all LER acquisitions and their expenditures are evaluated. Crediting of LER under Section 113 would have no effect on the economic analysis for the project because economic costs are determined by current fair market values, rather than expenditures. The effect of Section 113 on cost apportionment is discussed in Section 6.5.1.

Neither the preliminary project costs nor the preliminary cost allocation for the Recommended Plan include crediting for sponsor construction of water quality improvement features (including the provision of 6700 acre-feet of water rights) or ecosystem restoration features pursuant to Section 113 of Energy and Water Development Appropriations Act of 2006 (P.L. 109-103). A credit may only be given toward the non-Federal share of the project cost when a sponsor implements part of an authorized project. Because the Recommended Plan does not include water quality improvement features or ecosystem restoration features, the total project cost does not include costs for water quality improvement features or ecosystem restoration features and no credit for such costs can be given. The sponsor has not constructed or implemented any of the recreation features that are included in the Recommended Plan.

6.3 Cost Estimate

The first cost was estimated on the basis of October 2013 price levels and amounts to $280,820,000. Estimated average annual costs were based on a 3.5 percent interest rate, a period of analysis of 50 years, and construction ending in 2018. Table 6-3 shows the project first costs. Project first costs do not include associated economic costs. Project first costs include the sunk PED costs, which are estimated to be $42,200,000 at the time this GRR is completed. The sunk cost is included in first costs in Tables 6-3, 6-4, 6-5, and 6-6.

Table 6-3. Estimated First Costs of Recommended Plan[1]

Cost Account[2]	Description	Total First Costs ($1,000)
01	Lands and Damages[3]	$67,973
02	Relocations	$10,789
09	Channels	$46,765
11	Levees	$60,495
14	Recreation	$8,030
16	Bank Stabilization	$12,594
18	Cultural Resources	$1,817
30	Planning, Engineering, Design[4]	$61,487
31	Construction Management	$10,870
	Total Project First Cost	**$280,820**

[1] October 2013 price levels.
[2] Detailed cost estimates are presented in Appendix E.
[3] Lands and Damages include $1,912,000 additional non-Federal credit for expenditures to date in excess of current fair market value in accordance with Sec 113 of EWDAA 2006.
[4] PED includes $42,200,000 sunk costs.

6.4 Section 104 Credit for Reno-Sparks Indian Colony Levee

The Recommended Plan includes completed local work that is eligible for credit under Section 104 of WRDA 1986. Eligibility for Section 104 credit for levee and floodwall construction between U.S. 395 and Glendale Bridge was approved by the ASA(CW) on February 8, 2008. The completed work, locally identified as the Reno-Sparks Indian Colony (RSIC) project, consists of approximately 2,241 linear feet of floodwall/levee on the south bank of the Truckee River. The RSIC flood control work was designed to provide a 0.9% AEP (also referred to as 1:117 or "117-year") level of performance. The design of the work was reviewed by USACE prior to construction for consistency with USACE standards.

The Recommended Plan includes a levee that would provide an approximately 2% AEP (also referred to as 1:50 or "50-year") level of performance along the same alignment as the RSIC floodwall/levee. The amount credited under Section 104 will not exceed the amount that is a reasonable estimate of the reduction in Federal project expenditures resulting from substitution of the local work for authorized project elements. The maximum amount creditable will be the actual expenditures made by non-Federal entities. The estimated Section 104 credit for construction work, based on the current feasibility-level cost estimate for the Recommended Plan, is $2,406,000. This is substantially less than the approximately $3.6 million that was actually expended by non-Federal interests for construction of the RSIC floodwall/levee. Because the Section 104 work was constructed on the same alignment as the levee in the Recommended Plan, this GRR assumes that the credit for LERRD associated with the Section 104 work will be the same as the estimated LERRD cost for the corresponding Recommended Plan levee feature. Under that assumption, the sponsor would receive credit for providing the same LERRD with or without performing the Section 104 construction work, so the LERRD portion of the Section 104 credit has no effect on the preliminary cost apportionment in this GRR.

6.5 Preliminary Cost Allocation and Apportionment

The apportionment of costs between the Federal Government and the sponsor is presented in Tables 6-4 and 6-5. Table 6-4 shows the apportionment of costs prior to the consideration of credit under Section 104 for RSIC floodwall/levee completed by non-Federal interests. Table 6-5 shows the effect of the estimated Section 104 credit on cost apportionment. In both instances, the non-Federal cost is estimated at $99,168,000. Cost apportionment based on the fully funded cost estimate is presented in Table 6-6 using the current project schedule and projected future rates of price escalation.

6.5.1 Effect of Section 113 Crediting on Cost Apportionment

Crediting the sponsor for expenditures to date for lands, easements, and rights-of-way (LER) pursuant to Section 113, in lieu of crediting based on current fair market values, would increase the estimated sponsor credit and total project financial costs by approximately $1,912,000. The sponsor's estimated cost-share for FRM (based on a 35%

minimum cost-share) would increase by $669,200. The net increase in Federal costs would be $1,242,800 compared to costs without Section 113 crediting, based on current cost estimates.

Table 6-4. Preliminary Cost Allocation and Cost Apportionment for Recommended Plan Without Section 104 Credit

Without Sec 104 Credit	Federal ($1,000)	Non-Federal ($1,000)	Total ($1,000)
Flood Risk Management			
Construction	$119,854		$119,854
LERRD[1]	$1,496	$77,076	$78,572
PED (includes sunk costs)	$60,276		$60,276
Construction Management	$10,188		$10,188
Subtotal	$191,814	$77,076	$268,890
Minimum 5 percent cash contribution	($13,445)	$13,445	
Additional cash contribution[2]	($3,591)	$3,591	
Total FRM First Cost	$174,779	$94,112	$268,890
Percent of Total FRM	**65%**	**35%**	
Recreation			
Construction	$8,030		$8,030
LERRD[1]	$32	$158	$190
PED	$1,211		$1,211
Construction Management	$682		$682
Subtotal	$9,955	$158	$10,113
Cash contribution	($4,899)	$4,899	
Total Recreation First Cost	$5,057	$5,057	$10,113
Percent of Total Recreation	**50%**	**50%**	
Cultural Resources Data Recovery	$1,817		$1,817
TOTAL FIRST COSTS	**$181,652**	**$99,168**	**$280,820**

Oct 2013 price levels

[1] Federal costs on this line are administrative costs only. Non-Federal costs include Section 113 credit for expenditures to date.

[2] Cash contribution will include credit for $1.4M non-Federal cash contribution during PED pursuant to Memorandum of Agreement dated 22 Aug 2012.

Table 6-5. Preliminary Cost Allocation and Cost Apportionment for Recommended Plan With Section 104 Credit

With Section 104 Credit	Federal ($1,000)	Non-Federal ($1,000)	Total ($1,000)
Flood Risk Management			
Construction without Section 104	*$119,854*		
Section 104 Construction	*($1,948)*	*$1,948*	
Construction with Sec 104	$117,906	$1,948	$119,854
LERRD[1]	$1,496	$77,076	$78,572
PED without Section 104	*$60,276*		
Section 104 PED	*($292)*	*$292*	
PED with Sec 104 (incl sunk costs)	$59,984	$292	$60,276
Const Mngmt without Section 104	*$10,188*		
Section 104 Const Mngmt	*($166)*	*$166*	
Construction Mngmt with Sec 104	$10,022	$166	$10,188
Subtotal	$189,408	$79,482	$268,890
Minimum 5 percent cash contribution	($13,445)	$13,445	
Additional cash contribution[2]	($1,185)	$1,185	
Total FRM First Cost	$174,779	$94,112	$268,890
Percent of Total FRM	**65%**	**35%**	
Recreation			
Construction	$8,030		$8,030
LERRD[1]	$32	$158	$190
PED	$1,211		$1,211
Construction Management	$682		$682
Subtotal	$9,955	$158	$10,113
Cash contribution[2]	($4,899)	$4,899	
Total Recreation First Cost	$5,057	$5,057	$10,113
Percent of Total Recreation	**50%**	**50%**	
Cultural Resources Data Recovery	$1,817		$1,817
TOTAL FIRST COSTS	**$181,652**	**$99,168**	**$280,820**

Oct 2013 price levels

[1] Federal costs on this line are administrative costs only Non-Federal costs include Section 113 credit for expenditures to date.

[2] Cash contribution will include credit for $1.4M non-Federal cash contribution during PED pursuant to Memorandum of Agreement dated 22 Aug 2012.

Table 6-6. Summary of Cost Sharing for Recommended Plan (Fully Funded)[1]

Item	Federal ($1,000)	Non-Federal ($1,000)	Total ($1,000)
Flood Risk Management			
Construction[2,5]	$207,607	$2,758	$210,365
LERRD[3]	1,645	81,208	82,853
Minimum Cash Contribution (5%)	-14,661	14,661	
Additional Cash Contribution	3,999	3,999	
Sub-total Flood Risk Management	190,592	102,626	293,218
Recreation			
Construction[2]	11,696		11,696
LERRD[3,4]	35	166	201
Cash Contribution	-5,783	5,783	
Sub-total Recreation	5,949	5,949	11,897
Cultural Resources Data Recovery	1,985		1,985
Total	**$198,525**	**$108,575**	**$307,100**

[1] Total Project Cost (Fully Funded); Includes estimated Section 104 credit for RSIC levee at fully funded cost.
[2] Construction costs include PED and Construction Management costs.
[3] LERRD (Lands, Easements, Rights-of-Way, Relocations and Disposal areas) include Federal administrative costs ($1,680,000); and, per Sec 113, non-Federal credit for expenditures to date.
[4] Recreation LERRD limited to upgrade of FRM easements to fee title.
[5] Non-Federal Construction includes estimated creditable cost for completed Sec 104 work ($2,758,000).

6.6 Economic Costs and Benefits

Table 6-7 displays the economic costs and benefits of the Recommended Plan. The evaluation of economic benefits is described in detail in Appendix C, Economics. Benefit-cost ratios are shown for both the current water resources planning discount rate of 3.5% and the Office of Management and Budget (OMB) budgetary interest rate of 7%. The total economic costs, including the associated cost for NFIP compliance, were allocated to the purposes of flood risk management (FRM) and recreation. A separate benefit-cost analysis was completed for each purpose. Costs for cultural resource data recovery are excluded from the allocation of costs (up to 1% of the Federal project cost) in accordance with USACE guidance (ER 1105-2-100, Appendix E, paragraph E-63). Sunk costs expended prior to the completion of this GRR were also excluded from the economic analysis, although they are subject to cost-sharing during construction.

The estimated NFIP compliance costs included in the economic costs are based on the least-cost features that could be added to the NED Plan by local interests to achieve NFIP compliance, without modifying the NED Plan. Based on feasibility level hydraulic modeling, approximately 764 homes and 128 multiplex apartment buildings would need to be raised in the area south of the river. Additionally, four commercial structures and three public buildings would also need to be raised or "wet flood-proofed" with closures and sealing. The estimated cost to raise and flood-proof structures for NFIP compliance on the south side of the Truckee River is $172 million. For the north side of the Truckee River, a 400-cfs capacity pump station on the North Truckee Drain with an outfall to the Truckee River has been estimated to cost $23 million. These estimated economic costs are subject to change based on more detailed hydraulic analysis during final design of the project, including the results of NFIP hydraulic modeling assumptions and methods, and more detailed surveys of the elevations of existing structures.

The Recommended Plan provides $25.9 million of annual benefits from flood risk management, resulting in $6.2 million in annual net benefits and a benefit-to-cost ratio of 2.2 to 1 for flood risk management. The Recommended Plan also provides basic recreation features with an annual benefit of $625,000, resulting in $13,000 in net annual benefits and a benefit-to-cost ratio of 1.0 to 1 for recreation. The overall benefit-to-cost ratio for the Recommended Plan is 2.2 to 1.

In accordance with ER 1105-2-101, flood damages reduced were determined as mean values and by probability exceeded. Table 6-8 shows the benefits for the Recommended Plan for the 75%, 50%, and 25% probability that benefits exceed the indicated values. The damage reduced column represents the mean benefits for each increment and the 75%, 50%, and 25% represent the probability that the flood damage reduction benefits exceed the number in that column for that increment. The Recommended Plan has an average (mean) benefit of $25.9 million, but only a 50% chance that benefits will be greater than $25.1 million, 75% confidence that benefits will be greater than $16.4 million and a 25% confidence that benefits will exceed $36.1 million.

Table 6-7. Economic Costs and Benefits of Recommended Plan[1]

Item	Project Purpose	
	FRM ($1,000)	**Recreation ($1,000)**
Investment Cost		
NED First Cost[2]	$266,978	$10,113
Less Sunk PED costs	($42,200)	
Interest During Construction[3]	$21,978	$227
Total Investment Cost	$246,756	$10,340
Annual Cost		
Interest and Amortization	$10,520	$441
OMRR&R[4]	$691	$171
Total Annual Costs	$11,211	$612
Annual Benefits (NED Plan)	$24,880	$625
Net Annual Benefits	$13,669	$13
Benefit-Cost Ratio **Water Resources Planning Rate: 3.5%**	**2.2**	**1.0**
Benefit-Cost Ratio OMB Circular No. A-94 Rate: 7%	1.2	0.7

[1] Based on October 2013 price levels, 3.5 percent rate of interest, and a 50-year period of analysis. See Economic Appendix regarding economic uncertainty.
[2] Cultural resources data recovery costs ($1,817,000) and Section 113 financial costs ($1,912,000) are not included in economic costs per USACE policy.
[3] Includes IDC for least-cost NFIP compliance measures.
[4] Operation, Maintenance, Repair, Replacement, and Rehabilitation.

Table 6-8: Probability Distribution of Equivalent Annual Damages Reduced[1]

Expected Annual Damages			Probability Damage Reduced Indicated Values		
Without Project	**With Project**	**Damages Reduced**	**0.75**	**0.50**	**.025**
61,481	35,582	25,899	16,416	25,130	36,106

[1] $1,000, October 2013 Prices, 3.5% Interest Rate. See Economic Appendix for additional information.

6.7 Risk and Uncertainty

As noted in Chapter 3, each aspect of flood risk assessment must account for uncertainty. This includes hydrology, hydraulic, geotechnical, and economic analyses. USACE risk assessment procedures were followed in this study that account for uncertainty in the information to the extent practicable. However, there is some project performance uncertainty in all studies, even with the risk assessment procedures.

Chapter 2 identified a regional transit project that is planned in the project area, the SouthEast Connector. A sensitivity analysis, described in Section 5.8.5, showed that the NFIP compliance costs for the Recommended Plan could increase by $29 million ($1.2 million annual cost) if the SouthEast Connector is permitted and constructed as currently designed. This could reduce the benefit-to-cost ratio for the Recommended Plan. The Recommended Plan would still be economically justified and the recommendations of this GRR would not change. If the SouthEast Connector receives required permits, USACE will conduct a more detailed hydraulic analysis during final design of the Truckee Meadows Flood Control Project. USACE will continue to coordinate with the sponsor, Washoe County, and the Regional Transportation Commission regarding potential design of the SouthEast Connector. Local jurisdictions will need to continue to address NFIP requirements for any projects they plan or approve within the FEMA Special Flood Hazard Area.

CHAPTER 7
PUBLIC INVOLVEMENT

7.1 Overview

The public and concerned resource agencies have been invited to participate in all phases of the Truckee Meadows Flood Control Project since the initiation of the General Reevaluation Study in 1996. This has included opportunities to comment on the 1997 Reconnaissance Report (GRR), the Notice of Intent to prepare an Environmental Impact Statement (EIS), the Public Scoping Meeting conducted in 1999, and public workshops in 2000, 2003, and 2005. Additional efforts were made to solicit public input and feedback on the Truckee Meadows Flood Control Project planning efforts, including:

- Disseminating information through a project web site - www.truckeeflood.us.
- Creating and publishing a monthly newsletter on progress of the project.
- Creating opportunities for comment and discussion through public meetings and workshops at which USACE, local proponents, and other involved agencies have actively participated.
- The opportunity to review and provide comments on the draft GRR and EIS.

7.2 Scoping

A Public Scoping Meeting was held in 1999 to provide background information, discuss the purpose of the study, and discuss conceptual alternatives used in flood protection projects. Concerns identified during public scoping focused on four categories: flood protection, schedule, recreation, and environment.

Public concerns about flood protection included: the reduction of existing and potential flood damage to private and public properties and facilities, potential high maintenance costs for a flood control project, the length of time required to complete the project; noise impacts on adjacent landowners during construction, and removing properties from the "100-year" floodplain. All pertinent scoping concerns have been considered in the preparation of this document.

Environmental issues included public concerns about the biological effects of the project on vegetation, wildlife, and fish. Tribal concerns were raised concerning induced flood impacts, barriers to fish passage, and environmental impacts.

7.3 Public Meetings

USACE held several meetings with stakeholders of the Truckee River downstream of Vista. Informational meetings were held in 2002, 2004, 2005, 2007,

2010, and 2011 with representatives for the Pyramid Paiute Tribe, and residents of Rainbow Bend and Painted Rock.

In November 2003, a meeting was held in Rainbow Bend to update residents and other interested parties on project progress. Preliminary without project floodplains were presented, along with ecosystem restoration conceptual alternatives and a detailed description of the study process. In October 2004, after initial with-project floodplains were completed, another meeting was held at Rainbow Bend. That meeting was a workshop to solicit public input on potential solutions for both induced flooding impacts and effects of flooding from Long Valley Creek. A follow-up session was held in December 2004 to brief interested parties on the progress of the economic evaluation of potential damages at Rainbow Bend. Subsequent meetings between residents and the local sponsors resulted in a proposed solution for induced flooding impacts that was included in the alternatives array for evaluation.

Informational meetings were held with members of the Pyramid Lake Paiute Tribe throughout the study. USACE has also attended several tribal meetings to brief the tribal council on study progress. Tribal members were also included in an inter-agency resource group that helped to evaluate fish passage solutions on the Truckee River. Tribal concerns over water quality and induced flooding impacts were taken into consideration during the study.

A project website was established in coordination with the local proponents at www.truckeeflood.us. The website has grown steadily since its establishment and now serves as a prime portal for project information to the local community. USACE developed and distributed a project newsletter, which was later prepared and distributed by the local sponsor.

7.4 Local and Regional Interests

Throughout the General Reevaluation (GRR) study, USACE and local proponents have coordinated planning activities with other Federal, State, and local regulatory and planning agencies. USACE and local proponents have engaged these agencies throughout the development and refinement of a range of alternatives that would meet the flood risk reduction, recreational, and environmental objectives of the project. The primary conduit for technical feedback from other agencies and environmental groups included USACE interagency meetings and public outreach meetings, with members representing the following organizations:

- U.S. Army Corps of Engineers
- Truckee River Flood Project
- City of Reno
- City of Sparks
- Washoe County
- Storey County
- U.S. Fish and Wildlife Service

- U.S. Environmental Protection Agency
- Pyramid Lake Paiute Tribe
- Nevada Department of Transportation
- Federal Highways Administration
- Federal Aviation Administration

7.4.1 Community Coalition Process

A community-based planning process was initiated by the local project sponsors in response to the high level of expressed interest in public involvement in finding the most acceptable solution to the regional flooding problem. The Truckee Meadows Community Coalition was formed in 2000, and the local sponsors agreed to work with the Coalition in developing a preliminary alternative that would have broad community support and would be included in GRR. A facilitated community-based planning process began, and a diverse array of community members representing environmental, business, and neighborhood groups spent many hours establishing their goals and design objectives.

The Coalition pursued a preliminary alternative that would protect property from the 1% Annual Chance of Exceedance (ACE) (also referred to as 1:100, 1/100, and "100-year") event while minimizing or eliminating floodwalls in existing residential neighborhoods, and providing open floodplain area adjacent to the river for floodplain management, ecosystem restoration, and parkway purposes. Some of the Coalition members formed the Working Group and Hydrologic and Hydraulic (H&H) Modeling Group to assist in developing the Coalition preliminary alternative. The Truckee River hydrology was reevaluated and received concurrence from the H&H Modeling Group as well as USACE.

In March 2002, the Community Coalition provided their alternative for USACE to consider in the GRR. The alternative provided flood protection in downtown Reno with the Landmark Bridges alternative described in Chapter 3, flood protection combined with ecosystem restoration in the Truckee Meadows, and ecosystem restoration downstream.

A successor to the Community Coalition was the Truckee River Flood Project Working Group, consisting of members of the Community Coalition process who desired to remain involved in the process. They meet regularly with the local sponsors and provide input into the local planning efforts.

7.4.2 Flood Project Coordinating Committee

The Flood Project Coordinating Committee (FPCC) was formed in April 2005 consisting of representatives from Washoe County, City of Reno, City of Sparks, and University of Nevada, Reno. This group was formed under a cooperative agreement to establish a local voice in the implementation of the project. More than a dozen non-voting members from the public are also members of the FPCC. This committee met on

a monthly basis to conduct business related to the local efforts to support the project. USACE participated in these meetings, providing project briefings, and answering inquires from the committee.

The FPCC coordinated numerous public outreach meetings, seminars and public events during the study, as well as directed their technical staff regarding interaction with the project delivery team. The FPCC operated between 2005 and 2011.

7.4.3 Truckee River Flood Management Authority

In 2009 the Cities of Reno and Sparks and Washoe County determined that a cooperative agreement between the governing bodies would be necessary to meet the responsibilities of a non-Federal sponsor. The Nevada Legislature passed SB 175 authorizing cities and counties to collect fees for the purpose of a flood project. Truckee River Flood Management Authority (TRFMA) held its first meeting and formally approved the Interlocal Cooperative Agreement in 2011.

7.5 Views of the Local Project Proponent

Until 2012, this GRR was conducted at 100% Federal cost, so USACE did not have a cost-sharing agreement with a non-Federal sponsor. A Memorandum of Agreement was signed with TRFMA (sponsor) in 2012 that provided non-Federal funds for completion of the GRR. Additionally, TRFMA technical staff continues to interact with USACE on technical issues.

TRFMA is fully aware of its cost-sharing responsibilities, including the responsibility to furnish all project lands, easements, rights-of-way, and relocations. They are also aware of its responsibility to comply with the provisions of the NFIP. Washoe County voters approved a 1/8 cent sales tax to pay for their portions of the non-Federal cost-share prior to the initiation of the GRR. This funding is controlled by TRFMA. When it became clear that this would be insufficient to fund the non-Federal share of the project, a joint powers authority was created and additional funds will be raised through an assessment.

TRFMA has the objectives of achieving flood risk reduction for the 1% ACE event in downtown Reno and the Truckee Meadows areas and ecosystem restoration along the Truckee River downstream of Vista. Although the Recommended Plan does not meet these local objectives, TRFMA supports the GRR and has provided a letter of intent to serve as the non-Federal sponsor for the project as it proceeds into the Preconstruction Engineering and Design and Construction phases.

During the public review period TRFMA provided a letter in support of the Recommended Plan.

7.6 Views of Resource Agencies

The USFWS's primary concern is the loss of riparian and wetland habitat and the potential for induced flows to increase the risk of scour downstream of Vista along the river's bed and banks. Increased scouring could result in the loss of riverbank and aquatic habitats, which would adversely affect the Federally listed Lahontan cutthroat trout and cui-ui. The USFWS also participated in local working groups and assisted in the formulation of alternative plans for fish passage.

7.7 Views of Tribes

The Pyramid Lake Paiute Tribe's (PLPT) fundamental concerns are induced flows from a project in the Truckee Meadows and changes to water quality conditions that could affect native fisheries. Loss of riparian habitat and disturbance to the river channel during construction, as well as induced flows in the Lower Truckee River reach can increase sediment loading and degrade water quality, which can threaten aquatic habitat and native fisheries. The Tribe cultivates a successful Lahontan cutthroat trout fishery that provides income from sport fishing, so any negative effects from induced flows carry the potential to jeopardize an important part of the Tribe's livelihood. The Tribe is also concerned with the overall environmental effects of the project.

The PLPT is a proponent for fish passage improvements and has expressed concern that fish passage is not included in the Recommended Plan and concern that not enough coordination was conducted with the Tribe during the development of the Recommended Plan. The Corps has collaborated, coordinated and consulted with the Pyramid Lake Paiute Tribe on the Truckee Meadows Flood Control Project over the years. This communication was established prior to 2005. Government to Government consultation was initiated in 2005. Throughout the years, Corps staff identified, shared, and discussed potential effects and benefits for the array of alternatives under consideration and sought comments and views from the Pyramid Lake Paiute Tribe for consideration. After a brief pause on the project to review overall direction and scope/schedule, a tentatively selected plan (TSP) was established. As part of this pause, USACE, the Army, and TRFMA made a decision to remove the ecosystem restoration from the alternatives being considered. After the project pause, Corps staff re-engaged consultation with the Pyramid Lake Paiute Tribe. In April and May 2013, consultation opportunities included supplying information on the TSP, reviewing technical data and modeling, providing feedback for consideration and presenting information to the tribal governance. Additional information on Government to Government consultation is provided in the Final Environmental Impact Statement (EIS).

The PLPT is also concerned about adverse impacts to their lands. The hydraulic modeling of this study has shown that, although there would be a slight increase in the stage of the 1% ACE event along the river, it would not be great enough to affect existing structures in the Lower Truckee River reach, including on Tribal lands.

The PLPT's comments and USACE responses are included the Final EIS.

Another tribe in the study area is the Reno-Sparks Indian Colony (RSIC). The original RSIC land holding is adjacent to flood risk management features, and their stated concern was the flood risk reduction offered by the project. A Wal-Mart store was recently constructed on the RSIC land that included a floodwall along the proposed alignment of the flood project levee. This floodwall provides stand-alone flood risk reduction benefits for the RSIC property up to the 0.9% ACE flood event. TRFMA contributed funding for construction of the floodwall and has requested consideration of credit for this contribution towards their non-Federal cost-share obligations.

Additionally, the RSIC is concerned with the overall environmental effects of the project on traditional and cultural resources along the Truckee River.

CHAPTER 8
PLAN IMPLEMENTATION AND SCHEDULE

8.1 Public Review of Document

The GRR and EIS were circulated for agency and public review for 45 days. During the review period, two public meetings were held to obtain comments from the public, agencies, and other interested parties. After completion of the public review period, comments were considered and incorporated into the final GRR and EIS were appropriate. Responses to comments are included in the final EIS.

8.2 Report Review and Approval

The South Pacific Division Engineer will transmit copies of the final GRR and EIS to USACE Headquarters for review.

A Civil Works Review Board (CWRB) will be convened within 21 calendar days of receipt by USACE Headquarters of the Division Engineer's Transmittal Letter. During the CWRB briefing, the District Engineer and Division Engineer will provide briefings on the project and review process to date, including Independent External Peer Review. The Office of Water Project Review (OWPR) will also provide its assessment of the materials for policy and legal concerns that could delay the State and Agency (S&A) review.

Upon receipt of the CWRB decision to proceed with S&A review, USACE Headquarters will administer the S&A Review with assistance from the District. OWPR will provide transmittal letters, mailing list, and the proposed Report of the Chief of Engineers to the District for distribution. The final EIS will be circulated for a 30-day public review. The Division Engineer will issue responses to comments received from interested parties, as needed.

After S&A and NEPA reviews have been completed, the OWPR will complete its final policy compliance review of the package and issue the Documentation of Review Findings and certify policy compliance. Once these reviews have been completed, USACE Headquarters will prepare a recommendation package for the Chief of Engineers that includes documentation of the review to date, as well as the Chief of Engineers Report and Record of Decision for the FEIS for signature by the Chief of Engineers.

Once the Chief's Report has been signed, letters of notification are sent to Congress and a copy is sent to the Assistant Secretary of the Army (Civil Works) (ASA (CW)).

The ASA(CW) will review the documents to determine the level of Administration support for the Chief of Engineers recommendation. The ASA(CW) will submit a copy of the report to the Office of Management and Budget (OMB). OMB will review the documents to determine their relationship to the program of the President.

OMB will then provide a letter to ASA(CW) either clearing the release of the report to Congress or objecting to the release.

After receiving OMB views on the relation of the recommended project to the programs of the President, the ASA(CW) will sign the Record of Decision (ROD) and forward the Chief's Report, final GRR and EIS, state and agency review letters, and the ROD to Congress for authorization of the project.

8.3 Federal and Non-Federal Implementation Responsibilities

8.3.1 Federal Responsibilities

Following completion of the final GRR and EIS, USACE will enter into a Design Agreement with the sponsor and then prepare detailed designs, including plans and specifications. After Congressional authorization of the project, appropriation of construction funds, completion of a project partnership agreement, completion of the plans and specifications, and provision of LERRD by the sponsor, USACE will award and manage contracts to construct the project.

8.3.2 Non-Federal Responsibilities

Federal law requires non-Federal participation in the financing of projects. In accordance with the Water Resources Development Acts of 1986 and 1996 and other requirements, the non-Federal sponsor would, prior to implementation, agree to perform the responsibilities detailed in the Project Partnership Agreement, which briefly stated include the following:

a. Provide a minimum of 35 percent, but not to exceed 50 percent of total flood risk management costs as further specified below:

1. Provide 35 percent of design costs allocated by the Government to flood risk management in accordance with the terms of a design agreement entered into prior to commencement of design work for the flood risk management features;

2. Provide, during the first year of construction, a contribution equal to 35 percent of the costs related to performance of the reevaluation report for the project;

3. Provide, during construction, a contribution of funds equal to 5 percent of total flood risk management costs;

4. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the flood risk management features;

5. Provide, during construction, any additional funds necessary to make its total contribution for flood risk management equal to at least 35 percent of total flood risk management costs;

b. Provide 50 percent of total recreation costs as further specified below:

1. Provide 50 percent of design costs allocated by the Government to recreation in accordance with the terms of a design agreement entered into prior to commencement of design work for the recreation features;

2. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the recreation features;

3. Provide, during construction, any additional funds necessary to make its total contribution for recreation equal to at least 50 percent of total recreation costs;

c. Provide, during construction, 100 percent of the total recreation costs that exceed an amount equal to 10 percent of the Federal share of total flood risk management costs;

d. Shall not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefore, to meet any of the non-Federal obligations for the project unless the Federal agency providing the Federal portion of such funds verifies in writing that expenditure of such funds for such purpose is authorized;

e. Not less than once each year, inform affected interests of the extent of protection afforded by the flood risk management features;

f. Agree to participate in and comply with applicable Federal floodplain management and flood insurance programs;

g. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires a non-Federal interest to prepare a floodplain management plan within one year after the date of signing a project cooperation agreement, and to implement such plan not later than one year after completion of construction of the flood risk management features;

h. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with protection levels provided by the flood risk management features;

i. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the level of protection the flood risk management features afford, hinder operation and maintenance of the project, or interfere with the project's proper function;

j. Keep the recreation features, and access roads, parking areas, and other associated public use facilities, open and available to all on equal terms;

k. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

l. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

m. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

n. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;

o. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

p. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable

Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c *et seq.*);

q. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

r. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project;

s. Agree, as between the Federal Government and the non-Federal sponsor, that the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA; and

t. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103(j) of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213(j)), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project or separable element. (www.usace.army.mil/Portals/2/docs/civilworks/Project%20Planning/ppa/ioc/11498v7.pdf + HQ changes Feb13)

8.4 Project Partnership Agreement

Federal and non-Federal obligations for construction and OMRR&R will be defined in a PPA that will be signed after Congress authorizes the project and appropriates construction funds.

8.5 Project Schedule

Division Commander's Transmittal	August 2013
Chief of Engineers Report	April 2014
Potential Authorization	2014
Design Agreement	2014
Pre-construction Engineering and Design	2015-2016
Initiate Construction	2017
Complete Physical Construction	2020
Complete Plant Establishment Period	2023

8.6 Further Studies

During Pre-construction Engineering and Design (PED), some additional studies would be undertaken as part of developing detailed designs for the project. Upon initiation of PED, any new information that has been collected by others would be considered before undertaking these additional studies. These studies include:

- Interior drainage evaluation
- Topographic surveys
- Foundation explorations for levee design
- Soil borings
- Cultural resource surveys
- Detailed hydraulic modeling
- Detailed sedimentation study
- Site-specific appraisals and takings analysis
- Develop OMRR&R manual

CHAPTER 9
CONCLUSIONS AND RECOMMENDATION

9.1 Conclusions

Major conclusions of the study are:

- A plan to provide flood risk management (FRM) and recreation in the Truckee Meadows Reach of the Truckee River is physically, economically, and environmentally feasible.

- The primary features of the NED Plan include (1) floodwalls, levees, and floodplain terracing in the Truckee Meadows Reach (FRM Alternative 3 - Floodplain Terrace), and (2) paved and unpaved trails, picnic sites, fishing access points, kayak access sites, restrooms and a playground on lands acquired for flood risk management in the Truckee Meadows Reach (Recreation Alternative C).

- The Recommended Plan is the National Economic Development (NED) Plan.

- The estimated first cost for the Recommended Plan is $280,820,000 (October 2013 price level). An additional $195,000,000 is estimated as the minimum associated cost for non-Federal interests to comply with National Flood Insurance Program requirements by avoiding induced flooding of existing structures.

- The estimated fully funded project cost is $307,100,000.

- The FRM features of the Recommended Plan would be cost shared at a minimum of 35 percent non-Federal cost and the recreation features would be cost shared 50 percent non-Federal in accordance with WRDA 1986 as amended by WRDA 1996. The estimated cost-sharing for the Recommended Plan would be $176,596,000 Federal (including cultural resources data recovery) and $94,112,000 non-Federal for FRM, and $5,057,000 Federal and $5,057,000 non-Federal for recreation. The overall benefit-to-cost ratio is 2.2 to 1.

- Based on hydraulic and economic analyses, the Recommended Plan would provide improved flood risk management and increased recreation opportunities in the Truckee Meadows area.

- The Recommended Plan will not induce additional floodplain development.

- The environmental analysis indicates that the various project alternatives would result in potentially significant adverse effects on socioeconomics, traffic, public health, air quality, noise, and cultural resources. Most of these effects are temporary in nature and would be avoided by implementing appropriate best management practices.

- The Recommended Plan includes completed flood control work at the Reno-Sparks Indian Colony that is creditable under the provisions of Section 104 of WRDA 1986. The estimated credit for the completed work is $2,406,000 based on the current USACE cost estimate for the portion of the Recommended Plan that will not be constructed because of the completed work.

- The cost of the Recommended Plan would exceed the Section 902 limit for the Truckee Meadows Flood Control Project authorized by Congress in 1988 (preliminary estimate of the current Section 902 limit is $184,249,000), so additional project authorization will be required.

- USACE and the Administration, in coordination with the sponsor, have decided to give priority to flood risk reduction. Federal interest in a plan for the restoration of fish passage has been established, but that plan is not being recommended for implementation by USACE at this time.

9.2 Environmental Operating Principles

The Recommended Plan supports each of the seven USACE Environmental Operating Principles (EOPs). The EOPs are:

1. Foster sustainability as a way of life throughout the organization.

2. Proactively consider environmental consequences of all USACE activities and act accordingly.

3. Create mutually supporting economic and environmentally sustainable solutions.

4. Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the USACE, which may impact human and natural environments.

5. Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs.

6. Leverage scientific, economic, and social knowledge to understand the environmental context and effects of USACE actions in a collaborative manner.

7. Employ an open, transparent process that respects views of individuals and groups interested in USACE activities.

The EOPs are being addressed in the following ways:

Environmental balance and sustainability (EOPs 1, 2, 3, and 4)

- Recommended Plan avoids or minimizes environmental impacts while maximizing future safety and economic benefits to the community.

- Recommended Plan uses environmentally sustainable design of the flood risk management features, including revegetation of floodplain terraces with native species, to avoid or minimize significant adverse effects.

Planning with the environment (EOP 1, 2, 4, 5, and 7)

- Worked with local resource agencies during planning to minimize impacts to the environment.

- Potential for ecosystem restoration was evaluated and coordinated with local stakeholders and local resource agencies.

Leverage scientific, economic, and social knowledge base (EOP 6)

- Available scientific, economic, and social information was used whenever possible in the planning process.

- Environmental experts were consulted during the planning process, including the Engineer Research and Development Center, US Fish and Wildlife Service, Community Coalition, Desert Research Institute, Bureau of Reclamation, Nevada State Historic Preservation Officer, TRFMA, consultants, Pyramid Lake Paiute Tribe, and others.

Seeks public input and comment (win-win solutions) (EOP 7)

- Held stakeholder meetings and public workshops throughout the planning process.

- Worked with local Community Coalition to integrate project goals and public concerns during the planning process. Local public meetings were held during review of the draft GRR and EIS.

9.3 USACE Campaign Plan

The USACE Campaign Plan guides our policy decisions on how we organize, train, and equip our personnel; how we plan, prioritize, and allocate resources; and how we respond to emerging requirements and challenges. The Recommended Plan supports USACE Campaign Plan Goals 2a, 2b, 4a, and 4b as follows:

- **2a. Deliver integrated, sustainable, water resource solutions.** The project delivery team used a holistic approach to identify the Recommended Plan by considering a complete range of economic, social, and environmental goals and constraints within the Truckee River watershed during the planning process. The Recommended Plan incorporates a large natural overflow area to minimize adverse effects caused by increases in downstream flows. An environmentally sustainable design was developed for the Recommended Plan, including revegetation of excavated floodplain terraces with native species that will avoid and minimize impacts on significant resources so that compensatory mitigation is not required. The Recommended Plan also accounts for additional non-Federal associated costs that will be required to continue to comply with the National Flood Insurance Program as a result of the project.

- **2b. Implement collaborative approaches to effectively solve water resource problems.** During the study process, external agencies and stakeholders were engaged to identify and blend multiple approaches for planning and for management and delivery of the study. The sponsor and stakeholders engaged in a community coalition process to identify preferred solutions and provide the project delivery team with information regarding local problems, opportunities and constraints.

- **4a. Identify, develop, maintain, and strengthen technical competencies**. Project delivery team members have worked closely with appropriate communities of practice, such as the plan formulation and hydraulics sub-COPs, to address some of the complexities of the project. USACE team members presented papers at the Planning COP annual conference on the project to inform the broader community on insights and lessons learned.

- **4b. Communicate strategically and transparently.** USACE has an open, two-way communication strategy with the sponsor, stakeholders, the public, and within the project delivery team that is vertically synchronized.

9.4 Recommendation

After giving careful consideration to the environmental, social, and economic effects and engineering feasibility of the alternative plans, I recommend that the Recommended Plan for the Truckee Meadows Flood Control Project, with such modifications thereof as in the discretion of the Commander, HQUSACE, may be advisable, be authorized for implementation as a Federal project, subject to cost sharing, financing, and other requirements of the Water Resources Development Act of 1986, as amended.

Per Section 6.5, implementation of Section 113 of the Energy and Water Development Appropriations Act of 2006 (Pub. L. 109-103, § 113, 119 Stat. 2247, 2254) conflicts with standard USACE policies and practices for crediting non-Federal costs.

I further recommend that this report be approved as the basis for preparation of plans and specifications for construction of this project.

I also recommend that the part of the existing Truckee River and Tributaries Project between Glendale Avenue and Vista be deauthorized upon completion and transfer to the sponsor of all elements of the Recommended Plan for the Truckee Meadows Flood Control Project within that same reach. Deauthorization of the obsolete part of the Truckee River and Tributaries Project (which is currently maintained by the State of Nevada) will ensure that the non-Federal sponsor for the Truckee Meadows Flood Control Project has full and clear responsibility, as between the Department of the Army and the sponsor, for operation, maintenance, repair, replacement and rehabilitation (OMRR&R) of all Federal flood risk management elements between Glendale Avenue and Vista. OMRR&R responsibilities for the parts of the Truckee River and Tributaries Project upstream of Glendale Avenue or downstream of Vista would not be changed by the Recommended Plan.

I also recommend additional studies to investigate further reduction of the residual flood risk to the Reno-Sparks area and/or ecosystem restoration opportunities along the Truckee River, which may be undertaken as part of or coordinated with any future comprehensive investigation of the Truckee River watershed, or a portion thereof. The previously authorized purpose of fish and wildlife enhancement (i.e., ecosystem restoration) should be retained for the Truckee Meadows Flood Control Project for potential future implementation.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Michael J. Farrell
Colonel, U.S. Army
District Commander