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TRUCKEE RIVER

ROCK TO MCCARRAN REACH FLOOD PROJECT

[DRAFT] 30% DESIGN REPORT

WASHOE COUNTY, NEVADA

MAY 2026

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This document and its contents have been prepared and are intended solely as information for the Truckee River Flood Management Authority for support of the Rock to McCarran Reach Project.

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30% Draft Design Submittal

This 30% design submittal represents the preliminary stage of Project development at approximately 30% complete. It is provided for review, comment, and coordination. The design, quantities, and details are subject to revision and refinement in subsequent phases and are not intended for construction or bidding purposes.

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30% Design Plans – Under Separate Cover

List of Acronyms & Abbreviations

Acronym	Definition/Name
2D	Two-dimensional
Blvd	Boulevard
CAD	Computed-Aid Design
cfs	Cubic Feet per Second
CY	Cubic Yard
DEM	Digital Elevation Model
EM	Engineer Manual
EP	Engineer Pamphlet
ESA	Endangered Species Act
ETL	Engineer Technical Letter
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
ft	Feet
ft/s	Feet per second
GIS	Geographic Information Systems
GPS	Global Positioning System
GRR	General Re-evaluation Report
ARD	Aquatic Resource Delineation

Acronym	Definition/Name
H	Horizontal
HEC-RAS	Hydrologic Engineering Center's River Analysis System
HEC-SSP	Hydrologic Engineering Center's Statistical Software Package
LCT	Lahontan Cutthroat Trout
LCTCC	Lahontan Cutthroat Trout Coordinating Committee
LiDAR	Light Detection and Ranging
LOMR	Letter of Map Revision
LPP	Locally Preferred Plan
LWM	Large Woody Material
NDEP	Nevada Division of Environmental Protection
NDOW	Nevada Division of Wildlife
NDSL	Nevada Division of State Lands
NEPA	National Environmental Policy Act
NFWF	National Fish and Wildlife Foundation
NHC	Northwest Hydraulic Consultants
OHWM	Ordinary High-Water Mark
OPC	Opinion of Probable Cost
PLPT	Pyramid Lake Paiute Tribe
PMR	Physical Map Revision
ROB	Right Overbank
ROW	Right of Way
RSIC	Reno-Sparks Indian Colony
SA	Storage Area
SFHA	Special Flood Hazard Area
Sq ft	Square Feet
SWPPP	Stormwater Pollution Prevention Plan
TIFF	Tagged Image File Format
TIN	Triangulated Irregular Network
TMWA	Truckee Meadows Water Authority
TRFMA	Truckee River Flood Management Authority
TU	Trout Unlimited

Acronym	Definition/Name
UNR	University of Nevada, Reno
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Survey
USACE	United States Army Corps of Engineers
V	Vertical
WOTS	Waters of the State
WOTUS	Waters of the United States
WSE	Water Surface Elevation
WNTI	Western Native Trout Initiative

1.0 Executive Summary

The Rock to McCarran 30% design is based on the preferred alternative that was selected through the alternatives analysis process, which included significant study and public outreach. The Alternatives Analysis Report is included as Appendix A.

The Rock to McCarran Project (Project) is located along the Truckee River between Rock Boulevard on the west and McCarran Boulevard on the east, and generally within parcels owned by the City of Sparks and TRFMA.

Major components advanced during the 30% design phase include geotechnical investigation and design, geomorphological design, habitat creation, internal berm design to protect recreational areas and provide flood attenuation, park access grading, park transportation and parking layout, levee refinement, and recreation area design. The design was prepared by J-U-B Engineers, Inc. (J-U-B), with support from subconsultants Northwest Hydraulic Consultants (NHC), Crawford & Associates (Crawford), and Wood Rodgers.

The proposed design provides flood mitigation for the 100-year (100-yr) and 117-year (117-yr) flood events, enhances habitat and geomorphic function, and incorporates recreational opportunities that are protected to approximately the 75-yr flood event on the south side of the internal berm.

The design assumes future completion of other flood management projects within the broader Truckee River Flood Management Project (Flood Project), which are intended to provide containment of high flows within the river corridor. These include projects in the Meadows Reach, extending from the Interstate 580 bridges on the east side of the City of Reno to the Vista Narrows east of the City of Sparks.

Below are summaries of major tasks completed as part of this design:

Data Gathering (Section 3.0): A significant data collection and review effort was performed for the 30% design effort. The design builds on previously performed studies and work to the extent practical, however a significant amount of new data was collected and/or generated in the course of the work such as geotechnical drilling, hydraulic models, new survey and bathometry, utility mapping, and environmental studies. A data summary index is included in Appendix B.

Design Criteria (Section 4.0): The design objectives and criteria for the Rock to McCarran Reach Project were refined during the 30% design phase in coordination with TRFMA and are aligned with the broader Truckee River Flood Management Project. The Project prioritizes flood risk mitigation, followed by ecosystem restoration and enhancement, and flood-compatible recreation improvements. The primary focus is to reduce local and regional flooding while maintaining consistency with systemwide objectives, downstream flow limitations, and agency accreditation requirements. Key criteria include safely containing the 117-yr flood within the river corridor, providing three feet of freeboard for flood protection

infrastructure, evaluating 100-yr flood performance at bridges and downstream reaches, limiting peak flow increases at Vista Narrows to 2,400 cfs, and minimizing overall peak flow increases through coordinated channel, floodplain, and berm design. A Design Criteria Memo is also included in Appendix C.

Geomorphic Assessment (Section 5.0): NHC conducted a geomorphic assessment to support channel design and restoration for the Rock to McCarran Reach, providing critical insight into existing conditions, sediment dynamics, and historical channel behavior. The assessment included field investigations, sediment grain size and transport analyses, and evaluation of channel morphology, revealing a largely single-threaded reach with limited recent geomorphic change but a strong historical tendency toward deposition and channel migration. These findings informed the 30% design by establishing appropriate alluvial channel slopes, geometry, and planform ranges, and by emphasizing levee setbacks, minimized hard armoring, and allowance for controlled channel movement to improve habitat and natural river function. The assessment also guided erosion mitigation and revetment design, including bridge protection, habitat benches, vegetated and biotechnical bank treatments, and integration of large woody material. The Geomorphic Assessment is included in Appendix D.

Environmental (Section 6.0): The Project is focused on enhancing riparian and aquatic habitat while preserving existing high-value environmental features to improve overall stream health. The 30% design incorporates recommendations from environmental and aquatic resource studies, including the use of large woody material and root wads, enhancement of side channels and backwater channels, maintenance of riffle-pool sequences, and preservation of mature cottonwood gallery stands. These features are intended to increase habitat complexity, improve water temperature regulation and shading, support biodiversity, and provide ecological benefits for Lahontan cutthroat trout and other species, while remaining compatible with flood risk management objectives.

The design also establishes a terraced revegetation framework based on hydrologic inundation frequency to support diverse, resilient plant communities across the floodplain. Environmental review of the geomorphic design resulted in refinements that improve floodplain connectivity, reduce velocities, and expand vegetated areas where feasible. Measures addressing ESA-listed species, avian resources, bats at McCarran Bridge, and invasive species control are integrated into the Project approach. A long-term monitoring and success-criteria framework has been developed to track vegetation establishment, fish habitat function, and overall ecological performance as the Project advances beyond 30% design. Supporting studies including the Environmental Scan, Aquatic Resource Delineation, and Success Criteria can be found in Appendix E.

Nature Park and Recreation Design (Section 8.0): The recreation design was originally presented to the public as two general concepts: a nature park and a nature park with recreation complex. These concepts were shared through public outreach and generated significant public comment. Based on public input, TRFMA selected the Nature Park and Recreation Complex alternative to advance to 30% design.

The 30% Design of the Nature Park and Recreation Complex integrate flood-compatible recreation with ecosystem restoration and flood risk management, establishing a cohesive park framework that celebrates the Truckee River's natural processes, history, and community value. The 30% design defines a preliminary park theme and concept layout that includes trails, river access, playgrounds, a sports complex, wayfinding, public art, and supporting circulation and parking, while maintaining flexibility to accommodate flooding. The recreation design was developed by Wood Rodgers in conjunction with J-U-B and TRFMA. A Recreation Design Vision Memo is included in Appendix F.

Geotechnical Analysis (Section 9.0): The Geotechnical Analysis identified no overriding geologic hazards, such as faulting, landslides, severe erosion, or subsidence, based on site investigations that included drilling, test pits, laboratory soils testing, and review of published geologic mapping. Key geotechnical considerations for the Project include seepage mitigation, sourcing of suitable borrow materials, and integration of new levees with existing roadway embankments. Additionally, the Geotechnical Report identifies 70,000 CY of material for use in levee construction. The Geotechnical Report is provided in Appendix G.

Permitting Considerations (Section 10.0): The primary permit anticipated is the United States Army Corps of Engineers (USACE) 404/408 Permit, and the accompanying National Environmental Policy Act (NEPA) documentation and approvals. FEMA mapping efforts are also anticipated. Local and state level permitting will be required including building permits, traffic related studies and approvals, NDOT encroachment permits, NV Energy encroachment permits, and water quality permitting.

Hydrology & Hydraulics (Section 11.0): Hydraulic modeling represented a substantial component of the design effort and directly informed key design decisions. The Project was evaluated using two-dimensional (2D) Hydrologic Engineering Center's River Analysis System (HEC-RAS) version 6.6 simulations, with multiple design iterations based on model results. The resulting river configuration, terracing, levee heights, and revetment extents are all data-driven and derived from modeling outputs. The final design contains the 117-yr flood event and satisfies the Project requirement to limit increases in flow at Vista Narrows during the 100-yr flood to no more than 2,400 cfs. Revetted and riprapped areas were minimized by strategically reducing velocities through channel and floodplain geometry where practical.

30% Opinion of Probable Cost (Section 14.0): The team has created a 30% opinion of probable cost for the 30% design as summarized in Table 1. The "Base" Project cost includes a less expensive option for construction of the recreation elements in the Project, while the "Base + Supplemental" Project cost includes additional optional recreation items that complete the full recreation vision. The 30% Opinion of Probable Cost represents a preliminary planning-level estimate based on the current 30% design. The estimate reflects conceptual quantities, assumed construction methods, and preliminary design assumptions, and includes a 15% allowance for uncertainty consistent with this stage of design. Actual Project costs may vary as the design is refined, market conditions change, and additional information

becomes available during future design phases. The 30% Opinion of Probable Cost is included in Appendix H.

Value Engineering: As the Rock to McCarran Project advanced through the 30% design phase, targeted value engineering efforts were incorporated to reduce overall Project costs while maintaining performance objectives. These efforts included refining river and terrace geometry to reduce cut and fill quantities, minimizing revetment and riprap through velocity-based design refinements, optimizing levee alignments and heights based on updated hydraulic results, optimizing the internal berm to meet flow equalization objectives to reduce velocity, improving earthwork balance to reduce material hauling, and creating optional elements of the nature park and recreation design. Collectively, these refinements position the Project to advance into subsequent design phases with improved constructability and lower projected costs.

At full scope and scale, the complete recreation segment of the park showcases a multi-faceted civic landmark intended to meet several ambitious goals for the regional community: a sports complex able to host expansive field tournaments acting as a local revenue generator, intensive play opportunities in the form of naturalized and structured playgrounds that incorporate educational enrichment, and an elaborate trail network that connects users to the environmental restoration of this critical riparian ecosystem and provide safe and engaging access to the Truckee River. These different goals are represented within the plans as spatial zones and are referred to, in brief, as the soccer complex, the Linear Adventure Park, the Iconic Park, and trail network & river access.

Understanding the critical need of thoughtful construction phasing, this project ensures that the above-stated goals are met with the recreational base while the supplemental recreation portion of this project can “complete the picture” without sacrificing what makes this regional park a unique and exciting destination.

The supplemental costs identified for this Project primarily consist of aesthetic enhancements and non-essential amenities that do not impact core functionality. These elements are considered optional and may be deferred to a future phase as additional funding becomes available. They generally include landscape improvements, recreational field upgrades, playground enhancements, site furnishings, and signage features. For example, the base cost includes eight championship sized fields located at the Sports Complex, while two championship fields, one junior size field, and the entirety of the field lighting infrastructure supporting night-time games are within the supplemental recreation category. Other significant features categorized as supplemental recreation include the highly visible recreation amenity of the Iconic Park, aesthetic improvements along the Mill Street Berm and signage elements that include wayfinding, educational and iconic branding for the park. While these items contribute to the overall user experience and visual quality of the site, they are not required for initial Project delivery and can be implemented incrementally over time.

Table 1: Opinion of Probable Costs Summary

30% Opinion of Probable Cost Summary			
Project Cost	**Cost Category**	**Totals**	
Base	Mobilization/Demobilization (4%)	$	3,097,000
	Civil Site Work	$	57,029,000
	Transportation	$	7,810,000
	Recreation - Base	$	12,582,000
	Subtotal	**$**	**80,518,000**
	15% Contingency	$	12,078,000
	Total	$	92,596,000
Base + Supplemental	Mobilization/Demobilization – Supplemental (4%)	$	389,000
	Recreation - Supplemental	$	9,709,000
	Subtotal	**$**	**90,616,000**
	15% Contingency	$	13,593,000
	Total	$	104,209,000

Additional detail on the base vs supplemental elements can be found in Section 14.1 - Cost Opinion Description and the costs are detailed by line item in Appendix H – Opinion of Probable Cost.

2.0 Introduction

The Truckee River Flood Management Project (Flood Project) will include flood mitigation projects in strategic locations throughout the Truckee Meadows on the Truckee River. Improvements to the Rock to McCarran Reach will be essential for flood management included in the greater Flood Project. The Rock to McCarran Reach Project (Project) is located along the Truckee River between Rock Boulevard (Blvd) and McCarran Blvd, generally within parcels owned by the City of Sparks and the Truckee River Flood Management Authority (TRFMA), extending just north of the Tahoe-Pyramid Trail on the north side of the river and to Mill Street on the south.

The Rock to McCarran Reach Project Alternatives Analysis report, completed April 2025, revealed that a version of the preferred alternative that incorporates successful elements of the highest-ranking alternatives would be developed and further refined in the 30% design phase, discussed herein. The Alternative Analysis document can be found in Appendix A.

The Rock to McCarran Reach Project is a multi-beneficial flood control project to restore and enhance the river corridor in multiple disciplines, including meticulous design of a recreation/flood storage area, detailed terracing and habitat enhancement, river realignment and existing river channel repurposing, and levee and internal berm design. The Project will mitigate flooding, improve flood attenuation, reinforce public safety, and provide economic, environmental, and recreational benefits when integrated with the greater Flood Project.

2.1 Purpose and Need

The Rock to McCarran Reach Project is multi-beneficial, with three primary goals driving its implementation. First, it aims to reduce flood risks, addressing the recurring impact of flood events in the Truckee Meadows region. Second, it seeks to restore the natural ecosystem functions and geomorphology of the river, focusing on habitat improvement and floodplain reconnection. Lastly, the Project intends to enhance recreational opportunities in the area, including enhanced access to the river, additional areas for passive and active recreation, and the development of additional trails throughout the Project area.

This project is critical for flood risk mitigation in the Truckee Meadows. Historically, the area has experienced severe flooding from the Truckee River, with major flood events recorded in 1950, 1955, 1986, 1997, 2006, and 2017. The 1997 flood remains the largest event on record, highlighting the vulnerability of this region. The Rock to McCarran reach is a critical piece of the overall flood mitigation efforts by TRFMA, which consists of approximately 7 distinct required projects that must be completed to fulfill their flood mitigation goals.

Currently, substantial floodwaters escape the channel during periods of high flow, increasing the risk of flooding. This flooding extends beyond the Truckee River's banks, affecting both urban and rural areas. In particular, the Rock to McCarran Reach Project area experiences inundation that reaches industrial, commercial, and agricultural properties on both the north and south sides of the Meadows Reach,

including the Reno-Tahoe International Airport property, and the Reno and West Sparks industrial area. The Meadows Reach is a portion of the greater Flood Project and extends from the bridges at I-580 on the east side of the City of Reno, to the Vista Narrows on the east side of the City of Sparks. The impacts of this flooding are widespread, threatening human health and safety, property, and infrastructure in an area critical to the economy and daily life of the region.

Beyond flood control, there are significant environmental needs that the Project addresses. Habitat fragmentation is a concern, as it disrupts ecosystems and wildlife corridors. Additionally, the Project will take into consideration the needs of aquatic species, particularly shading, temperature regulation, and providing suitable habitats for spawning and refuge for Lahontan cutthroat trout (*Oncorhynchus clarkii henshawi*) (LCT).

The Project also responds to the growing demand for recreational space. In the Truckee Meadows area, flat fields are in short supply, and improved public accessibility to the Truckee River is desired. The creation of trails and improved river access will offer greater opportunities for outdoor recreation. Currently, the site already supports a portion of the Tahoe-Pyramid Trail, as well as a regional multi-use path at Glendale Park on the north side of the Project area, and plans to add further path connectivity to the south recreation area. Expanding upon these features will enhance and connect recreational opportunities, benefiting both residents and visitors to the region.

This Project is essential to address the risks and impacts of flooding, improve environmental habitat and restore natural river geomorphology, and enhance recreational opportunities in the Truckee River Meadows region. By focusing on flood control, ecosystem restoration, and recreation, the Project aims to create a safer, healthier, and more accessible environment for the community.

2.2 Background and Project Location

TRFMA is a joint effort among the cities of Reno and Sparks, Washoe County, and numerous other stakeholders with the purpose of reducing the devastating impacts of flooding along the Truckee River in Washoe County, Nevada. TRFMA accomplishes this goal by "planning, designing, and constructing flood impact reduction projects, maintaining existing flood infrastructure, providing information about flooding for planning and development, and providing logistical support to first responders during real-time flood events" (Truckee River Flood Management Authority, 2023).

TRFMA's primary focus, the Flood Project, is designed to "provide a variety of public safety, economic, recreational, and environmental benefits to the Truckee Meadows region." The primary goal of the Flood Project is to "develop a more resilient community by reducing flooding damage and secondarily incorporating recreational and environmental features" (Truckee River Flood Management Authority, 2024).

The Rock to McCarran Reach Project area is in Washoe County, Nevada, within the corporate limits of both the cities of Reno and Sparks. The Project extends from Rock Blvd to McCarran Blvd. The Project is

bordered by private industrial properties on the north and bounded by Mill Street on the south. Most parcels within the Project area are owned by TRFMA. The Mill & McCarran property was once owned by UNR and was purchased by TRFMA in 2006. There are currently several ongoing property and facility use agreements with several businesses including two agricultural properties and a non-profit entity. Figure 1 and Figure 2 show the Project vicinity map and the general Project limits, respectively

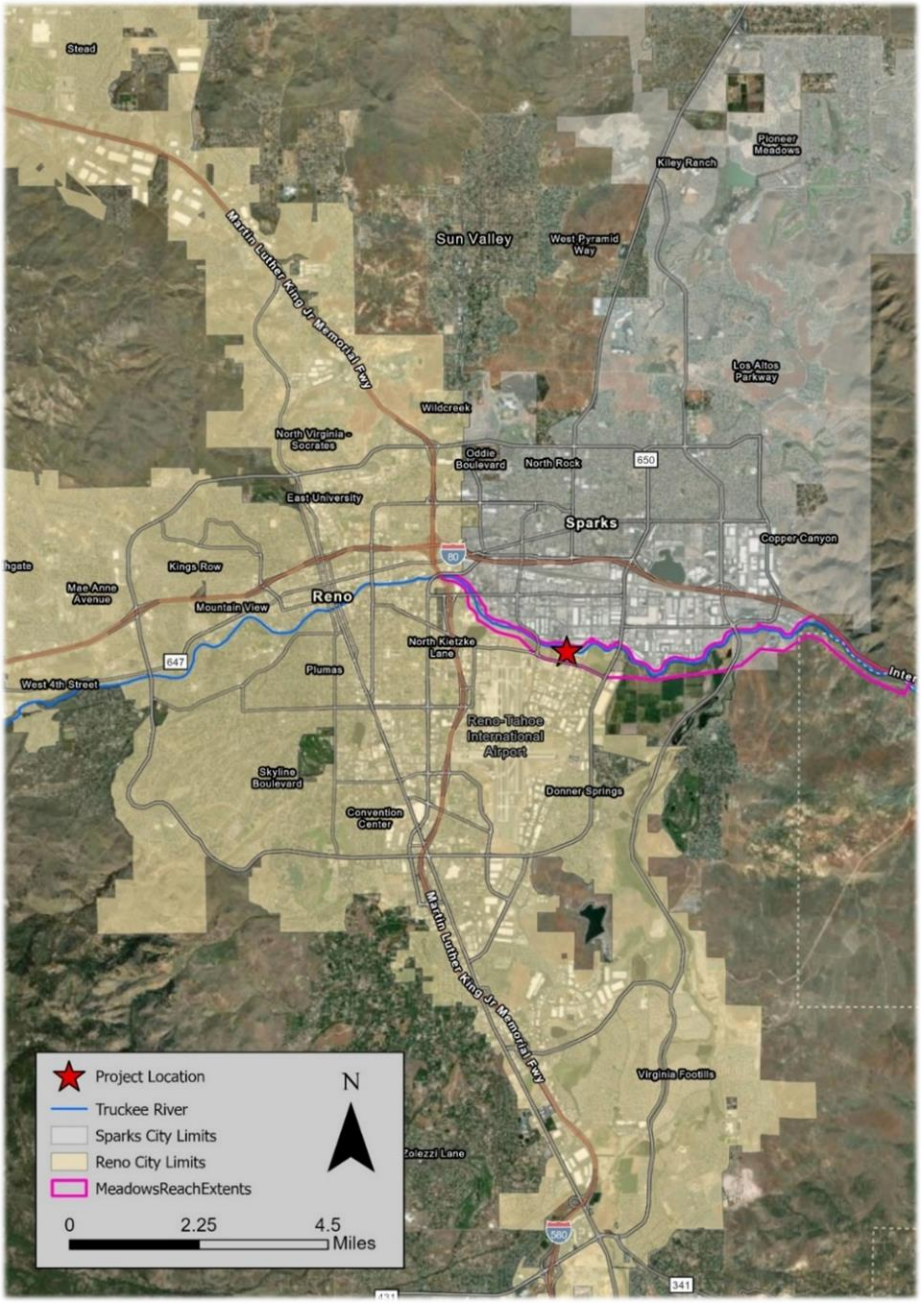

Figure 1: Project Vicinity

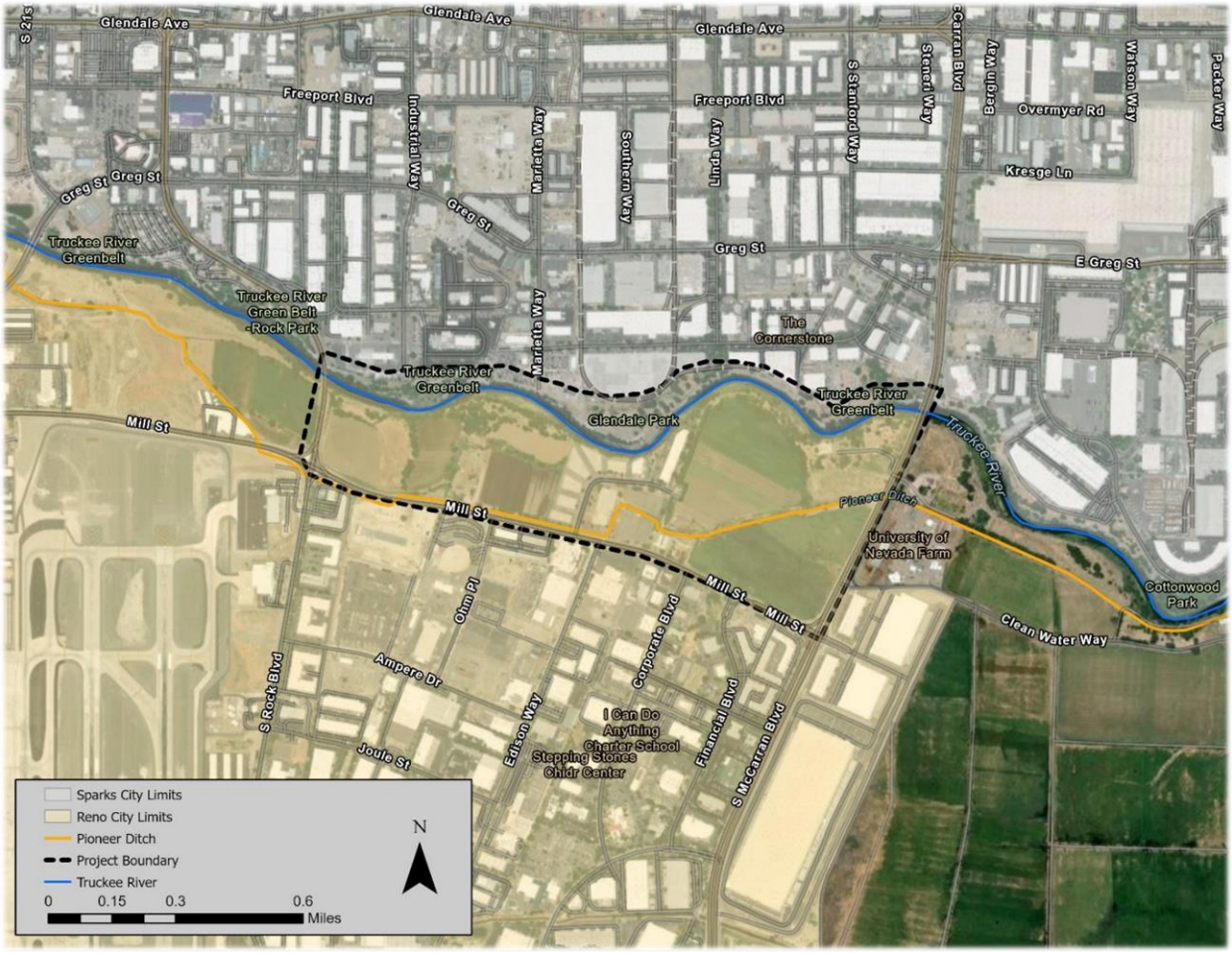

Figure 2: Project Area Boundary

3.0 Data

Data for the 30% design was collected in four main categories, including previous studies and reports, utility data, field data, and topographic surveys.

3.1 Report Data

The data provided by TRFMA included background information on the Rock to McCarran Reach Project site as follows:

- TRFMA Truckee River Conceptual Recreation Master Plan (2011)
- Locally Preferred Plan (LPP), Amendment to Draft General Reevaluation Report (2013), prepared by TRFMA and submitted to USACE Sacramento District
- United States Army Corps of Engineers (USACE) General Re-evaluation Report (2014)
- McCarran Boulevard Terracing Geotechnical Report CME (2019)
- Vista Narrows Design Documents (2020)
- Grand Sierra Resort Project CME (Construction Materials and Engineering) geotechnical reports (2021), and McGinley & Associates Hydrogeologic report (2022)
- Miscellaneous Presentations and Reports – TRFMA meeting notes and presentations and the One Truckee River Plan (2022)
- TRFMA Map Book (2023)
- HDR Truckee River Physical Map Revision (2023)

TRFMA also provided environmental resources that included environmental studies from restoration work on the Lower Truckee River reaches such as Lockwood and Mustang Ranch as well as LCT reports. Some of the documentation provided is listed below:

- Environmental Assessment for Restoration of the Lockwood, Mustang Ranch, and 102 Ranch Sites on the Lower Truckee River (2008)
- Multiple LCT reports such as the Recovery Plan for the LCT (USFWS, 1995) and LCT Action Plan (USFWS, 2009)
- Truckee River Below Derby Dam Environmental Assessment (2009)
- Vista Narrows Project Integrated Weed Management Plan, TRFMA, and Redhorse (2021)
- Vista Narrows Project Revegetation Plan, TRFMA, Redhorse, and Jacobs (2021)

Other reports and data regarding information on life history and habitat characteristics for LCT were collected from various environmental agencies. These reports came from the following agencies:

- LCT Coordinating Committee (LCTCC)
- Nevada Division of Environmental Protection (NDEP)
- National Fish and Wildlife Foundation (NFWF)
- Trout Unlimited (TU)
- United States Fish and Wildlife Service (USFWS)
- Western Native Trout Initiative (WNTI)

A summary of this data is provided in Appendix B.

3.2 Utility Data

Utility data was requested from various local and regional utilities as summarized in Table 2 below.

Table 2: Existing Utilities on Project Site

Utility Owner	Data Provided
City of Reno	Parcels, storm drain lines and structures, sewer lines and structures
City of Sparks	Storm drain lines and structures, sewer line and structures, open channels, and subbasins
Washoe County	Water main, water valve and water well locations
Truckee Meadows Water Authority (TMWA)	Potable, raw, and abandoned water lines
AT&T	Underground and overhead fiber lines
Charter Communications	Underground fiber lines
Jet Infrastructure	Aircraft fuel lines
MCI WorldCom	Verizon fiber lines
NV Energy	Electric, gas, overhead power and underground power lines
Zayo Group	Communication fiber lines

Relevant utilities were mapped for the 30% design, however the title reports and easements will need additional analysis during final design and may require potential relinquishment and/or realignment as needed.

The approximate parcel boundary for the Project based on publicly available Washoe County parcel information is shown in Figure 3.

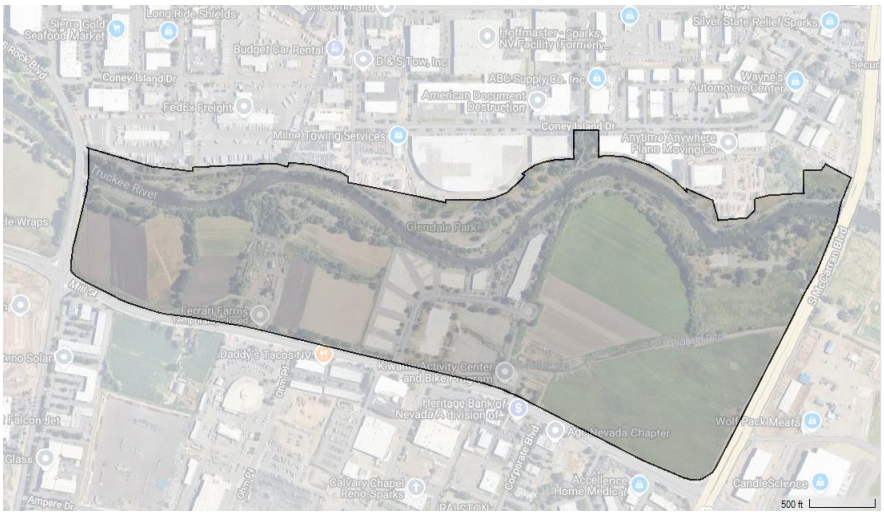

Figure 3: Project Parcel Exterior Boundary

The Pioneer Ditch is a major utility feature and a potential historic resource on the Project site whose geometry is apparent in existing conditions model terrain data used in hydraulic modeling and preliminary design. It is assumed that the ditch will be abandoned and not replaced as part of this Project. The ditch alignment is shown in Figure 2 above.

Potential utility conflicts that have been identified in the 30% design include sanitary sewer manholes, water valves, raw water wells and well houses, raw and potable water lines, fiber optics, underground fiber lines, underground and overhead electric lines, storm drain lines, and storm drain manholes. Further an NV Energy high voltage overhead power line tower and an underground jet fuel petroleum pipeline were identified on/through the north bank just downstream of the Rock Blvd bridge, expected to limit design options in this location, which resulted in the design of a 400-ft floodwall section prior to beginning the north levee.

3.2.1.1 Power Lines

The NV Energy power lines on the south side of the Project area were considered while designing the south levee alignment to avoid relocation due to their relatively recent installation. The approximate overhead power line alignments are shown in Figure 4.

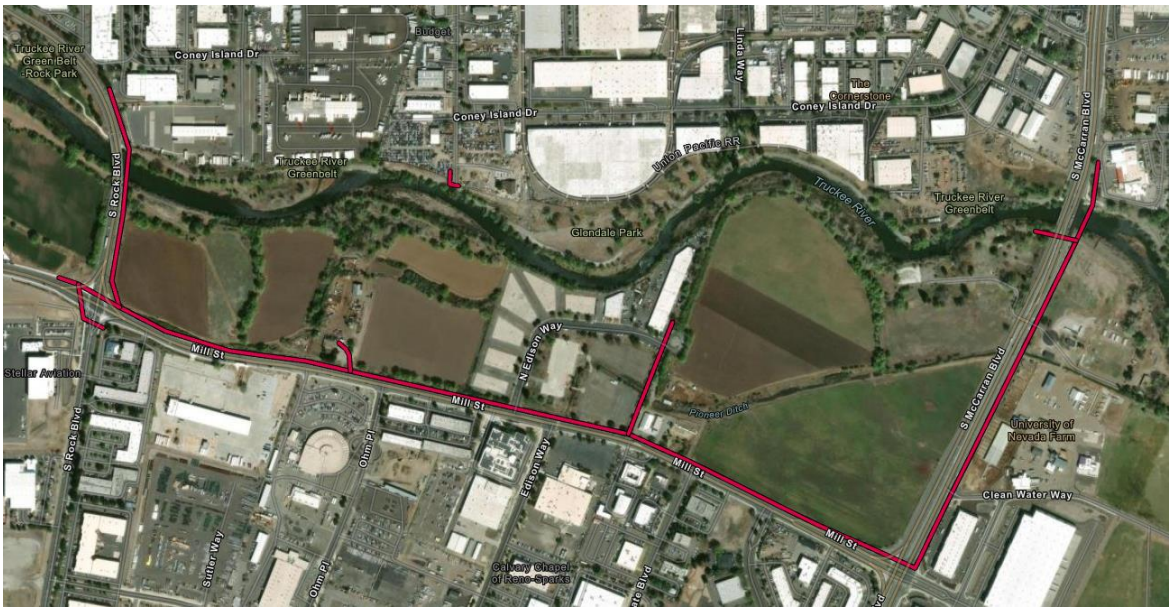

Figure 4: Power Line Map (red)

3.2.1.2 Jet Fuel Petroleum Line

An underground jet fuel petroleum pipeline was identified through the north bank just downstream of the Rock Blvd bridge, running from north south. The approximate location of the fuel line is shown in Figure 5.

Figure 5: Underground Jet Fuel Petroleum Pipeline (yellow)

3.3 Field Visits and Data Collection

Representatives of the team collected data from the site starting in July of 2024, with various site visits and investigations including geotechnical and survey continuing throughout the Project during the year of 2025. It is anticipated that additional field visits will be required as the Project progresses.

The team conducted an environmental inventory of the Project site which included recording observations of the presence of vegetation and wildlife, an informal large woody material (LWM) survey, and an aquatic resource delineation (ARD). On-site biologists documented dominant vegetation in the upper and midstory habitat, presence and size of LWM, stream shade quality, evidence of low flow side channels and backwater channels, and any erosion control features. The ARD sitework consisted of identifying and delineating the presence of wetlands and natural drainages in accordance with routine USACE methods.

3.4 Geomorphology

Northwest Hydraulic Consultants (NHC) performed a significant geomorphic analysis that included a geomorphic survey of most of the Truckee River in the Truckee Meadows. The geomorphic assessment included field studies with Wolman Pebble Counts and bulk samples for sediment grain size distribution, analysis of the existing channel characteristics, analysis of the sediment transport characteristics, and proposed channel design characteristics.

The geomorphology report is included in Section 5.0 and explains the on-site geomorphic assessment, the hydro-geomorphic analysis, and preliminary design recommendations. The geomorphological analysis is further summarized in Section 5.0 and can be referenced in Appendix D.

3.5 Survey

A survey was conducted by J-U-B based on the Nevada State Planes Coordinate System of 1983, West Zone, US Foot. Light Detecting and Ranging (LiDAR) bridge, bathymetric, and Global Positioning System (GPS) tree survey were performed at the site. The LiDAR was collected at Rock Blvd and McCarran Blvd bridges. The bathymetric survey was collected by boat where flows permitted, and by wading in areas where accessible and safe. Approximately 1,150 trees were surveyed and categorized by diameter and species.

Existing LiDAR-derived model terrain and bathymetry (collected in 2017 and 2013, respectively) was reviewed for conformance with newly acquired survey data and was determined to be adequate for the 30% design hydraulic modeling. However, new survey data was integrated at Rock Blvd and McCarran Blvd bridge openings to improve upon the previous interpolated bridge opening representation. Survey data on bridge structure geometry was checked for conformance and found to be adequate for 30% design. Implementation of survey data at the bridge openings was completed uniformly for both existing and proposed condition hydraulic models for consistency in comparisons. Further refinement of bridge representation is anticipated in 60% design.

3.6 Geotechnical Drilling

Crawford & Associates, Inc. (Crawford) reviewed previous geotechnical reports from the Project site including:

- Published soils, geologic, and seismic mapping of the site;
- Historical reports and subsurface data pertaining to the Project area; and
- Available groundwater data.

Additionally, Crawford performed a significant drilling and test pit program. The geotechnical efforts are summarized in Section 9.0 and documented in the geotechnical report attached in Appendix G.

4.0 Design Criteria

This section establishes the design objectives and criteria for the Rock to McCarran Reach Project. The criteria are consistent with those of the Truckee River Flood Management Project and were refined during the 30% design phase in coordination with TRFMA and the Project team.

Project Priorities in order of importance:

1. Flood Risk Mitigation
2. Ecosystem Restoration and Enhancement
3. Recreation Improvements

The purpose of flood risk mitigation is to reduce local and regional flooding while maintaining consistency with system-wide Flood Project objectives and downstream flow limitations. The design will follow FEMA and USACE criteria for accreditation. A short list of key design criterion is included below:

Key Design Criteria

- Contain the 117-yr flood event within the river corridor.
- Provide 3 feet of freeboard during 117-yr flood for flood protection infrastructure.
- Evaluate 100-yr flood performance for downstream impacts and bridge hydraulics.
- Limit the 100-yr peak flow increase at Vista Narrows to 2,400 cfs, per agreement with the Pyramid Lake Paiute Tribe.
- Minimize peak flow increases to the extent practicable through channel, floodplain, and internal berm design.

A memorandum with the full 30% design criteria is attached in Appendix C.

5.0 Geomorphology

As part of the design, NHC conducted a geomorphic assessment to inform the channel design and restoration efforts. This assessment provided critical insight for the existing conditions, sediment dynamics, and historical changes within the study reach. The full report is included in Appendix D for reference.

The geomorphic assessment included field studies with Wolman Pebble Counts and bulk samples for sediment grain size distribution, analysis of the existing channel characteristics, analysis of the sediment transport characteristics, and proposed channel design characteristics.

This study was critical to the design development and general understanding of the Project reach characteristics.

The existing Rock to McCarran reach is primarily single-threaded, with minimal aggradation or degradation observed. The river has engineered confinement for portions of the reach mainly in the forms of riprap and concrete. Riparian vegetation is sparse above the current flowline, underscoring the need to design riparian zones closer to typical flow elevations.

The report provides key design recommendations which are partially summarized below:

- In the existing conditions and any proposed conditions, it should be anticipated that there will be periods of little geomorphic activity punctuated with greater change during extreme floods.
- Levee setbacks as a nature-based solution provide a host of benefits, such as increased flood protection, water quality, and biodiversity.
- The morphology of the Rock to McCarran reach is susceptible to changes in downstream conditions, including the severe channel incision that is occurring downstream of the study reach.
- Restoration efforts will need to balance acceptable degrees of freedom while aiming to allow sufficient room for the river to move and adjust to changes in water, sediment, and woody material over time. The design should provide for a range of geomorphic variability, where the river is allowed to erode its banks and grow its point bars through deposition. Providing enough floodplain width and an initial channel that is set away from the levees is therefore critical.
- The proposed solutions include allowing the channel to move, thereby improving the natural function and habitat of the river and keeping riprap and other bank protection measures set back away from the channel.
- Where the channel is setback from infrastructure (i.e., levees) but migration is undesirable, use biotechnical means for resisting bank erosion. Examples include buried wood and strategic vegetation plantings.
- Where design elements overlap existing large boulders, those boulders could be repurposed as grade control and bank protection where lateral migration or vertical incision is undesirable.

- Historically this reach is believed to have been a depositional zone that would have experienced frequent channel migration and potentially multiple flow paths. Proposed designs should therefore anticipate deposition as a probable characteristic of the reach.
- Provide a range of habitat diversity such as split channels, secondary channels, overflow side channels, slack or backwater areas, ponds, deep pools, undercut banks with natural wood recruitment, shading, bank and mid-channel habitat refuge provided by vegetation roughness, floodplains with riparian vegetation, and uplands or terraces.
- If placement of levees at the bridges encroaches significantly on the river, such that passing floodwaters is a challenge, consider floodwalls instead of levees.
- Leaving portions of the existing cottonwood galleries allows for terracing of sections and potential recruitment for instream wood.
- Hard points are needed to force localized habitat diversity; the use of large woody material is suggested for these sorts of features. Large, isolated boulders can help induce pools as well, however, they do not provide the same level of habitat benefit.
- During excavation of new channels, the sediment should be separated and used accordingly to provide appropriate sediment sizing in different areas of the Project.
- Interpretive signs along walking paths that provide information about how rivers are dynamic, and that movement is critical for quality habitat are suggested.

Based on the geomorphic analysis, it is proposed that appropriate channel slopes could range between approximately 0.20-0.25%. As an example of reach averages, a constant design slope of 0.22% corresponds to the following suggested range of channel and planform geometry:

- Channel gradient: 0.22%
- Bottom width: 65-80 ft
- Depth: 4-6 ft
- Top width (using 3H:1V): 90-115 ft
- Meander wavelength: 1,000-1,350 ft
- Meander belt width: 600-800 ft
- Radius of curvature: 200-300 ft

The recommendations provided are based on an alluvial channel design under typical conditions.

Additionally, NHC assisted with erosion mitigation and revetment design up to the 117-yr flood event, resulting in the revetment design shown in the 30% design plans. A summary of design considerations are included as follows:

- Rock revetment for erosion mitigation in critical areas exceeding 3 ft/s up to the 117-yr flood event.
- Preliminary design for protection of Rock Blvd and McCarran Blvd bridge piers and abutments
- Upstream weir and bank protection with vegetated articulated concrete blocks.

- Downstream weir rootwad and riprap protection.
- Buried riprap windrow for mitigation of future channel migration on east end of site.
- General berm protection using geocell containment systems for locations exceeding 3 ft/s
- Targeted floodplain terracing for flows associated with recurrence intervals of 0-1 yr, 1-3 yr, 3-5 yr, and 5-10 yr
- Habitat benches and wood toe protection for erosion mitigation
- Isolated wood habitat features including apex jams and bank jams

Figure 6 below is displaying in red velocities that exceed 3 ft/s.

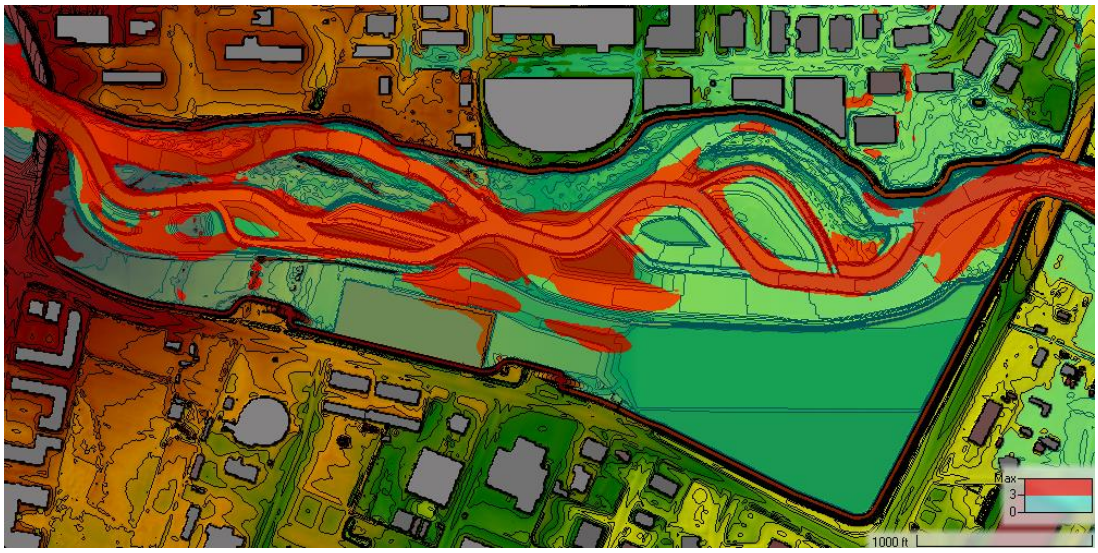

Figure 6: Project area map showing velocities greater than 3 ft/s (red)

The geomorphic assessment provided essential input to the design by guiding channel design parameters and informing ecological and flood management considerations. The geomorphic assessment will continue to guide the subsequent design phases beyond the 30% design. It should be noted that the meander belt at the 30% design generally meets or exceeds the suggested geomorphological width criteria for the entire project reach with the exception being near the bridges as the flow must constrict to pass through.

6.0 Environmental

One of the primary goals of this Project is to enhance riparian and aquatic habitat features, while also preserving existing beneficial habitat features to the extent practical, to benefit the natural environment of the reach. The riparian and aquatic habitat features improve overall stream health for the Rock to McCarran Reach by increasing shade and regulating water temperature, creating and maintaining in-stream habitats such as side channels, backwater channels, riffles and pools, and increasing biodiversity within plant community types. These improvements are anticipated to restore and enhance riparian and aquatic habitat function within the Project area and provide ecosystem benefits for LCT and other aquatic species.

6.1 Incorporation of Environmental Preliminary Recommendations in the 30% Design

An environmental scan and Aquatic Resource Delineation (ARD) were performed during the alternatives analysis and are provided in Appendix E. This section contains key preliminary design recommendations from those efforts (in italics), along with a brief description of how the 30% design incorporates or addresses those design recommendations.

Large Woody Material

Incorporate LWM where feasible. LWM is beneficial for aquatic species and stream health and can allow refuge for fish during flood events, provide food sources, shade, lower predation and help reduce erosional forces and stabilize banks. It is recognized that stakeholder agencies may have concerns with LWM incorporation given the flood risk management focus for this area, however, we recommend that LWM be considered in the design specifications to improve riparian habitat function whenever congruent with flood management features.

LWM has been preliminarily incorporated into the design for erosion protection and in stream habitat enhancement, however further design stages will refine the exact placement and specifications of LWM based on hydraulic evaluation, including velocity and shear stresses at the proposed locations.

Root Wad Revetment

Utilize root wads at every return location, especially at low to moderate flows, to stabilize the toe of streambanks and slow erosion. These features also provide refuge for adult and juvenile fish by creating shade and structure to escape predation.

Root wad revetments are preferred over stone in the 30% design.

Root wads are generally not readily available in the Truckee Meadows area. This is an important consideration which may result in higher costs due to shipping. Value engineering with log jams and other revetment types will be considered for the 60% design.

Side Channels

Design low flow side channels as well as backwater habitat, prioritizing side channels over backwater if selection is necessary. Side channels that connect flow back to the main channel, even at lower flows, would

have numerous ecological benefits for fish; these include having greater success for spawning habitat, providing low flow/low velocity channels that support rearing habitat, refuge and foraging habitat.

There are two distinct side channels in the northern section of the reach that will experience backwatering during low flows.

Riffles and Pools

Include areas with pools (deep areas with low velocity) to allow refuge for fish and riffles (shallow with high velocity) that increase oxygenation of the water. It is recommended to maintain as many riffle-pool sections as are currently present, and to add additional riffle-pool sequences into the new design, if feasible.

Riffle-pool sequencing will be prepared by NHC at the 60% design level and reviewed by the environmental team.

Pool Tail-Outs

Maintain and/or create pool tail-outs. Pool tail-outs are beneficial for spawning in rivers because they provide ideal conditions for fish to lay and incubate their eggs.

Pool tail-outs to be discussed at the 60% design level.

ESA Listed Species Habitat

Creating habitat for ESA listed species.

Habitat improvements include the terraced plant communities, which were mapped out at the 30% design level and are further discussed in Section 6.2. A preliminary vegetation species list and associated cost estimate were developed at the 30% design level and will be refined during subsequent design phases. A planting plan has not been prepared at this stage and will be completed during a subsequent design phase. In-stream habitat improvements and Endangered Species Act (ESA) species specific habitats will be addressed during subsequent design phases.

Maintenance and Preservation of Existing Cottonwoods

Maintain mature cottonwood gallery stands wherever feasible. While some mature cottonwoods are potentially declining, they still have high habitat value within the existing site. These include providing seedbank replenishment, and most importantly, breeding, nesting, rearing, and forage habitat for an array of wildlife guilds, including diverse avian and waterfowl species, small mammals, ungulates (mule deer), and insects, as well as providing a source of macroinvertebrates for fish feeding in this reach of the Truckee River. Cottonwoods and willows are both flood dependent species and help to stabilize the riverbank and reduce both the stream and air temperatures along the riparian area by providing shade. Furthermore, this site is a refuge habitat for migratory birds in the urban interface and therefore preservation of existing mature

vegetation, and establishment of structured riparian vegetation should be prioritized whenever possible in design and planning.

There are four distinct preserved areas of vegetation of which contain mature cottonwood galleries, two on the west side of the Project area and two on the east side of the Project area.

Planting Plan Phasing and Objectives

Developing vegetation that is large and mature enough to overhang and provide shade takes years and therefore maintaining existing vegetation along bank sections whenever feasible (specifically willows and cottonwoods) is recommended. Planting willow trees within riprap and allowing for natural cottonwood recruitment would help to reduce erosion along steeper slopes and provide shade to cool water temperatures and cover for fish species. Revegetation should focus on restoring the multi-story structure; overstory, midstory, and herb layer.

The planting plan, which will be completed during a subsequent design phase, will specify revegetation locations and prioritize overhanging vegetation that provides shade. The existing preserved vegetated areas were strategically chosen in the middle of the channel, separating the main channels from secondary channels, and expected to provide some shade at the start of the Project prior to the establishment of the revegetated areas.

Avian Survey

An avian survey will be required prior to construction. Multiple bird species and an active nest were identified by J-U-B biologists on site.

The avian survey will be conducted prior to construction and incorporated into the Project specifications.

Best Management Practices

Project specific BMPs like vehicle and equipment cleaning station to remove invasives prior to leaving the Project site.

During construction, it will be required to have a vehicle and equipment cleaning station to remove invasive species prior to entering and leaving the Project site to avoid the spread of invasive species. Other Project-specific BMPs, such as sediment fence and straw wattles to reduce the transport of sediment into the river, should be further analyzed with the progression of the Project. It is also recommended to stockpile and utilize on site soils during construction, avoiding imported material unless its certified weed-free. This assists in maintaining the existing seed bank, where desired.

Reducing Riprap

Minimize riprap as much as feasible and instead utilize LWM wherever practicable. If riprap must be used, the team recommends strong consideration for vegetated riprap, i.e., willow shoots installed in riprap.

Riprap placement in the design is anticipated to include vegetated riprap where flow velocities are low and it is feasible to allow for bioengineered bank stabilization methods rather than traditional rock riprap.

6.2 Revegetation Terracing

6.2.1 Terracing/Zone Description

Engineered terraces are used to connect rivers to their floodplains based on hydrologic inundation frequency. In natural alluvial systems, terraces develop through fluvial processes, including deposition and channel migration. Developing terraced zones adjacent to the active channel will allow for specific vegetative treatments to be planted by inundation regime and for functional habitat types to develop and support riparian diversity. For this Project, six zones, along with their corresponding representative plant communities, have been determined and are shown in Table 3 below. The return interval that corresponds to each zone level is indicated in parentheses under the terrace level column. The environmental terracing plan is shown in Figure 7.

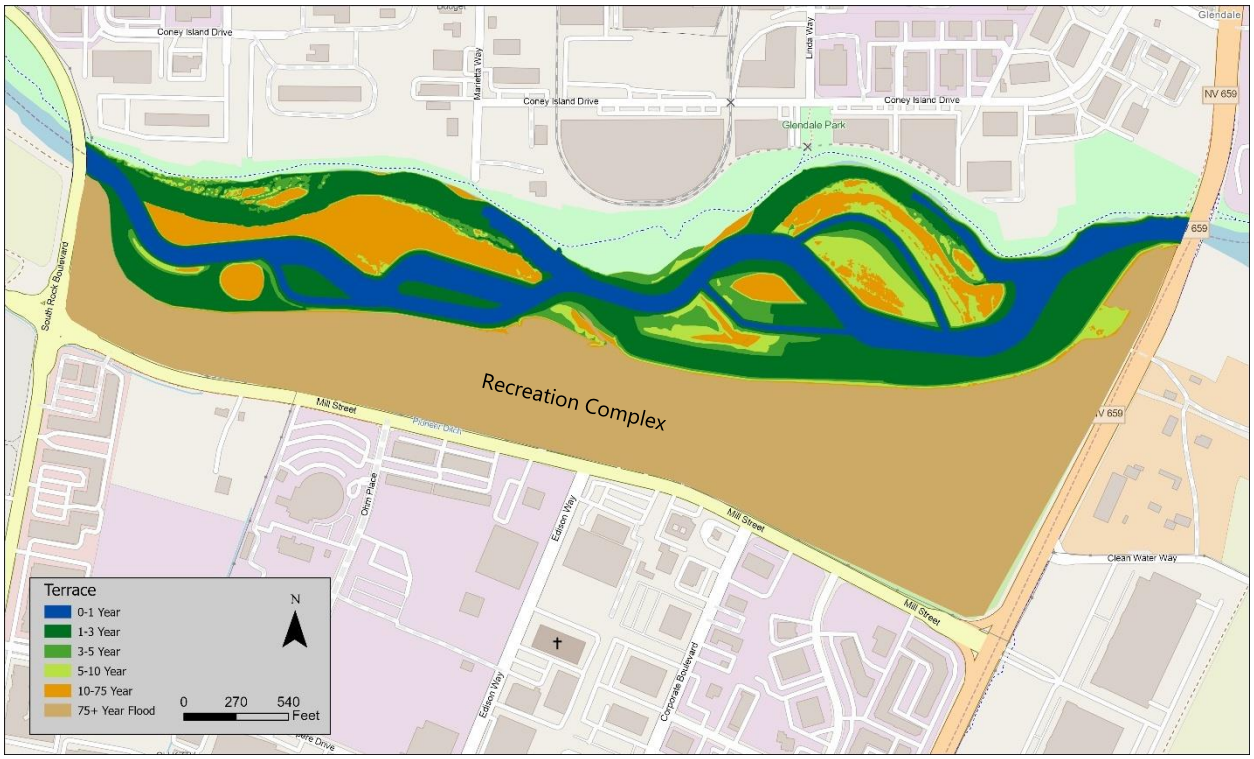

Figure 7: Environmental Terracing Plan

The terrace inundation zones are defined below:

- **Active Channel, Backwaters & Wetlands (0–1 year):**
  Includes permanently or seasonally flooded low-flow channels, backwater areas, side channels, low benches, and wetlands inundated multiple times per year.
- **Frequently Inundated Riparian Zone (1–3 year):**
  The active floodplain inundated during frequent floods; supports riparian vegetation communities that respond to regular flooding.
- **Occasionally Inundated Riparian Zone (3–5 year):**
  Benches, vegetated islands, and secondary floodplain surfaces inundated by moderate floods; vegetation communities reflect less frequent inundation and increased drought tolerance.
- **Rarely Inundated Zone (5–10 year):**
  High terraces and upland transition areas inundated only during large floods; vegetation communities represent transitional upland or relic riparian conditions.
- **Very Rarely Inundated Zone (10-75 year):** Upper benches, upper terrace surfaces and high islands located between active river channels that are inundated only during large flood events; vegetation communities are primarily upland dominated, with limited riparian influence restricted to channel margins and localized swales.
- **Extreme Event Inundation Zone (75+ year event, Retention/Recreation Area):**
  Includes the entire recreation area and detention basin located upland of the first four terraces and in areas south of the intermediate berm. This upper terrace is rarely inundated and functions as a managed upland zone that captures, filters, and infiltrates runoff from recreation areas, parking lots, and adjacent development to reduce pollutant loading.

Table 3: Revegetation Planting Zone Communities

Terrace Level	Functional Habitat Type	Plant Community
Active Channel, Backwater, Wetlands (0-1 yr)	Active channel and backwaters	Aquatic bed
	Low flow channel margins and side channels	Emergent marsh
	Unvegetated and sparsely vegetated gravel bars	
Floodplain Inundated Riparian Zone (1-3 yr)	Active floodplain	Emergent marsh
	Frequently inundated riparian habitat	Wet meadow
	Floodplain wetlands and backwaters	Riparian shrubland
Occasionally Inundated Riparian Zone (3-5 yr)	Lower floodplain bench	Riparian woodland
	Riparian corridor habitat	Riparian shrubland
	Mesic floodplain bench	Mesic grassland
Rarely Inundated Upland Zone (5-10 yr)	Upper floodplain bench	Transitional riparian woodland
	Riparian upland transition zone	Transitional riparian shrubland
		Transitional grassland
Very Rarely Inundated Upland Zone (10-75 yr)	Upland terrace	Upland woodland
	Upland riparian relict habitat	Upland shrubland
		Upland grassland
		Shrub steppe
Extreme Event Inundation Zone (75+ Year Event)	Extreme flood overflow	Upland woodland
		Upland grassland
		Shrub steppe
		Ornamental and maintained turf areas

6.2.2 Methodology

The process of displaying the terraced zones in the plan set involved using HEC-RAS, Geographical Information Systems (GIS), and Civil 3D. First, the 1-yr, 3-yr, 5-yr, 10-yr, 75-yr, and 117-yr inundation boundaries were extracted from HEC-RAS as shapefiles. Next, GIS was used to clip the shapefiles to the Project area boundary, buffer the inundation boundaries to eliminate breaks associated with raster stitching in HEC-RAS, and merge the buffered extents to create the return interval ranges used to define each zone. Lastly, the shapefiles were exported to CAD and hatched to display each zone with a unique shade of color.

These terraced zones are shown in the environmental terracing plan in Figure 7 above and on sheet C-400 in the 30% design plan set.

6.3 Environmental Review of 30% Geomorphology

The environmental team reviewed the initial 30% geomorphology design and provided suggestions for revisions to better align the design with environmental goals and objectives for the Project. NHC and the environmental team met to discuss these revisions and several key changes were incorporated into the design based on that discussion.

Key environmental features that were discussed and are incorporated in the 30% design include:

- There are six distinct vegetation zones, five of which are terraces that are dependent on hydrologic inundation, and a sixth zone that includes the recreation area.
- A portion of the west cottonwood gallery, where the corner meets the bifurcation point of the river, was slightly modified to accommodate for additional flow to enter this channel.
- Planting zones are anticipated to include both moisture-dependent species suited to their modeled return interval, as well as drought-tolerant species to accommodate both potential variability in flow timing and frequency as well as temporal variability in annual climate.
- Large woody material has been preliminarily placed in the Project area as a proposed feature, yet the specific locations and amount of large woody material have not yet been determined and will require further analysis at the 60% design level based upon modeled velocities and shear stresses. Currently large woody material details are included in the 30% design plans, and once designed, will need to be approved by permitting agencies.
- An oxbow feature is located on the southwest side of the channel. The oxbow was lowered two feet and shifted slightly downstream to allow for greater connection to the groundwater table and for natural water cycling to occur. The water depth is to be monitored with a piezometer in this location to ensure stagnant water is not occurring for long intervals of time. Coordination with Northern Nevada Public Health will occur as design progresses to confirm that this oxbow is not a concern for mosquitoes. Fish habitat stranding potential will also need to be further evaluated for this feature.

- Vegetated riprap will be used in areas where velocities and shear stress are low and it is feasible to allow for bioengineered bank stabilization methods rather than traditional rock riprap.
- Benched areas were widened to allow for greater inundation and proper drainage back into the river to occur.
- To reduce high velocities against the north levee, the secondary channel was slightly widened and slopes were laid back from 3:1 to 5:1.

These updated features are represented in the current 30% design.

6.4 Brazilian/Mexican Free-Tailed Bat Mitigation

- A colony of the Brazilian/Mexican Free-tailed Bat *(Tadarida brasiliensis),* a priority species and state protected bat, is known to be living under the McCarran Bridge. The Environmental Scan document was prepared under the assumption that the bridges would not be disturbed in the Project, however over the course of the Alternatives Analysis, modifications to the McCarran Bridge were explored. Modifications to the bridge include a walkway under the bridge and the removal of a retaining wall on the south side of the existing river, which would allow for additional flow to pass the bridge. These modifications are anticipated to be discussed with the Nevada Department of Transportation (NDOT). Mitigation for the bat colony was discussed with the Nevada Department of Wildlife (NDOW) on December 16th, 2025. Improvements to the McCarran Bridge are feasible with certain timing restrictions for construction. The Brazilian/Mexican Free-tailed bats are naturally desensitized to a certain level of activity from living under the McCarran Bridge and are therefore accustomed to vehicle noise.
- The bats are present from May-October, arriving in Reno in May and generally flying south for the winter in October. Birthing occurs from June to July. This is a critical time and should be avoided completely if possible.
- J-U-B noted it would be feasible to avoid sensitive time periods and periods when bats are present during construction of the bridge modifications, and that a buffer with a 100-foot radius of the colony, suggested by NDOW, is to be maintained during the majority of the construction at the Project site.
- Additional discussion topics included predation from beavers, reducing the spread of non-native vegetation, the timing of LCT spawning and avoiding this time period during in-river work (February to July), and performing a pre-construction bird survey.

J-U-B has provided NDOW with a formal Project description package with a request for written comments on construction timing restrictions and habitat restoration recommendations and considerations.

After the initial meeting additional recommendations were provided via email March 6th, 2026. A summary of the key recommendations is provided below:

- Avoid construction of a pedestrian trail beneath the south side of the bridge where the primary bat flight corridor occurs.
- Where feasible, route southern pedestrian connectivity above the bridge rather than beneath it (e.g., pedestrian overpass over McCarran).
- Avoid trail connections directly beneath the southern bridge abutment where bats regularly emerge, and where pups may land during the maternity season.
- If a southern trail beneath the bridge cannot be avoided, consider installing seasonal gates or closures during the period when bats occupy the bridge (generally May–October). Similar gate designs are commonly used at abandoned mine features to protect both wildlife and public safety.
- Avoid installation of lighting beneath the south side of the bridge where the primary flight corridor occurs.
- Any lighting installed near the structure should be fully shielded and directed downward in accordance with dark-sky principles.
- Lighting along the existing paved bike and pedestrian path on the north side of the bridge is less likely to affect the colony, provided fixtures remain shielded and downward-directed.
- Avoid locating trails or gathering areas directly beneath the southern portion of the bridge where guano or grounded pups may occur during the maternity period. If pedestrian access beneath the bridge cannot be avoided, consider design features that reduce exposure, such as overhead barriers or shielding structures above the trail.
- Where appropriate, consider interpretive signage advising the public not to handle bats and providing contact information for wildlife response.

The emailed set of recommendations sets a higher mitigation standard and will require additional guidance and conversations with NDOW as the design progresses. Coordination and collaboration with NDOW will be ongoing and will continue through the NEPA process for the proposed Project.

6.5 Environmental Monitoring Layout

An environmental monitoring layout and success criteria were developed to set milestones and track progress of the long-term ecological success of the Project. This document is included in Appendix E. A brief summary of this document is provided here:

- Includes an overview of terrace zone classifications as shown in Table 3 above.
- Provides techniques for long-term monitoring of the site that includes permanent radial plot sizes, as well as a list of data to be collected, including species lists, natural recruitment, percentages of cover, aerial surveys, and additional field measurements that could be considered, such as using shallow piezometers to monitor groundwater levels, and collecting wildlife data from local agencies like NDOW and USFWS to understand what species are present and use the site over time.
- Success criteria were broken down into three categories; vegetation, fish habitat, and retention/recreation area success.
    - Vegetation survival success would be determined based on the percentage of native cover, invasive cover, planted stock survival, and structural complexity per zone.

Vegetated riprap that maintains live vegetative cover and the use of photo and aerial documentation can be used to measure success.

- Fish habitat success is measured by the maintenance of the riffle-pool sequencing, side channel and backwater channel connections to the main channel, stabilization of LWM, shading for fish, and connectivity of in-stream habitat features to prevent fish stranding.

7.0 Public Involvement

TRFMA performs regular public outreach and involvement efforts through Working Group, Technical Advisory Committee, and Board of Directors meetings. In addition, TRFMA has completed substantial public outreach and involvement efforts in connection with specific projects. For the Rock to McCarran Reach Project, TRFMA informed the public and solicited public input through a combination of social media, website posts, press releases, online meetings, and an in-person meeting. Much of the outreach process was completed during the Alternatives Analysis and through early stages of the 30% design. The list below represents most of the official outreach and input solicitation meetings for the Project:

- **Alternatives analysis was performed in 2024**
    - Stakeholder and TAC outreach during creation of alternatives
    - 8 alternatives studied for overall configuration.
    - The preferred alternative was selected with proposed modifications.
    - TRFMA Board directed the team to proceed to 30% design.

- 3/12/2025 **In-Person Community Public Meeting** (Alternatives presented to public, call for comments)
- 4/25/2025 **Technical Advisory Committee** (Project update on the alternative analysis)
- 5/28/2025 **Working Group (**Focus on flood and environmental of modified preferred alternative)
- 5/30/2025 **Technical Advisory Committee** (Project status and debrief of meetings)
- 7/25/2025 **Technical Advisory Committee** (Layout of recreational alternatives)
- 7/30/2025 **Working Group (**Introduce two park concepts to the public)
- 8/27/2025 **Working Group (**Compared the two recreational park concepts in detail)
- 8/29/2025 **Technical Advisory Committee** (Project status update general Project discussion)
- 9/24/2025 **Working Group** (Recreation Vision & Cost memo)
- 9/26/2025 **Technical Advisory Committee** (Decision meeting on selected park)
- 1/30/2026 **Technical Advisory Committee** (Update on Project progress)

- **TRFMA Board of Director Meetings**
    - The Project was discussed at many TRFMA board meetings, various public comment received.

- **Supplemental Design Coordination Meetings with City of Reno staff**
    - Six formal supplemental meetings were held with the City of Reno along with other coordination and various phone calls.

Additionally, TRFMA Executive Director George Robison presented on the Rock to McCarran Project in a "Face the State" news segment on August 23, 2025, discussing the benefits the Project will provide to the community (KTVN, 2025).

Public comments received regarding this Project and other TRFMA efforts are available through TRFMA.

7.1 Alternatives Analysis Public Outreach Meeting Summary

A public outreach meeting was held by the Truckee River Flood Management Authority (TRFMA) from 6:00 pm-7:00 pm on March 12, 2025 at the McKinley Arts Center at 925 Riverside Drive in Reno, NV. Approximately 45 people attended, including reporters, City of Reno staff members, City of Sparks staff members, TRFMA staff and consultants, and otherwise unaffiliated members of the public. Public comments were summarized for the Alternatives Analysis. Additional information on public comments can be found at this TRFMA website:

https://trfma.org/rock-mccarran-project-public-comment/

Posters were presented at the public meeting by the Project team. There were two posters that described an overview of the main goals of the Rock-McCarran Project, how the Project ties into the Meadows Flood Project, and a visual of the location of the projects. There were three posters that described the alternatives analysis: one that showed the process with each contributing discipline, one with a comparison of all the alternatives, and one comparing the two highest ranked alternatives. Key features in the alternatives include the presence or absence of an intermediate levee/storage area, north and south levees, terracing with different channel alignment configurations that aimed to address the three goals of the Project: flood mitigation, ecosystem restoration, and enhancement of recreational opportunities. A poster specific to ecosystem restoration was presented showing both the existing degraded reach and the goal to restore the ecosystem to a healthy river system. Another poster discussed the future design phases and schedule.

The public comments on the preliminarily designed flood mitigation Project reflect a mix of support and concern, with many commenters expressing strong support for wildlife conservation and nature-based recreational opportunities. The feedback highlights the importance of balancing flood mitigation with environmental preservation, recreational opportunities, and existing community programs.

8.0 Recreation Design

TRFMA has conducted substantial public outreach regarding the recreation elements of this Project, particularly in 2011, through the *Truckee River Conceptual Recreation Master Plan* prepared by Stantec (Stantec Consulting Services, Inc., 2011). The Master Plan and subsequent coordination with Project stakeholders provided several potential recreational opportunities congruent with flood mitigation and habitat restoration needs.

An early stakeholder meeting was held with City of Reno Parks and Recreation staff. During this meeting, it was indicated there is a general lack of organized sports fields for youth and adults in the Truckee Meadows. City of Reno Parks and Recreation staff clarified that 'flat fields' (those used for football, soccer,

lacrosse, and similar sports) are lacking in the Truckee Meadows relative to its population and demographics.

Two conceptual recreation visions were developed based on the *Truckee River Conceptual Master Plan* and were presented during public outreach efforts. Based on public commentary and direction from the TRFMA Board, the Nature Park and Recreation Complex alternative was selected for development in the 30% design effort.

To accommodate the vehicle traffic that coincides with athletic activities, the number of parking stalls was also discussed, as well as having a maintenance building within the proposed recreation area. It would be required that any structures that have the potential to be impacted during the 100yr flooding event acquire building elevation certificates as well as flood insurance, and this is anticipated to be considered throughout the design.

8.1 Nature Park and Recreation Complex

The site is divided into three general recreation areas: north of the river, between the river and the internal berm, and south of the internal berm. The portions north of the internal berm (between the river and the internal berm and north of the river) are envisioned as parts of a nature park, with extensive natural areas, multi-use paths, and river access points. The southern portion of the Project (south of the internal berm) is envisioned to include:

- Wayfinding, Signage, Precedent Imagery, and Local Art
- Playgrounds and Play Areas
- A Sports Complex
- Trails, Trailheads
- Vehicle Circulation and Parking

The Rock to McCarran Reach Project envisions a Nature Park and Recreation Complex that celebrates the Truckee River's ecological, cultural, and recreational significance. The 30% design concept integrates natural landscapes with thoughtfully planned amenities to create a unified experience rooted in the river's history, wildlife, and seasonal rhythms - including its natural flood cycles. This theme drives the park's identity, with a focus on education, environmental stewardship, and creating a destination that serves families, outdoor enthusiasts, and visitors attending major sporting events. A network of wayfinding signage, interpretive displays, and public art will bring the park's theme to life. Monument signs at major entrances and well-marked internal trail signs will help guide visitors, while educational elements highlight native plants, wildlife, and river processes. Public art installations placed along trails, levees, and gathering areas will enrich the visual character of the park and offer opportunities for future collaboration with schools and community groups.

The park's recreational offerings will be diverse and thoughtfully integrated. Two playgrounds are—one within a floodable linear park designed to mimic the aesthetics of a braided river, and another located on higher ground featuring a signature iconic play structure visible from major roadways.

A major sports complex addresses the region's growing demand for youth athletic facilities, with championship-level fields, ample parking, a tournament hub, and amenities such as restrooms, shaded seating, and food-truck accommodations.

A comprehensive trail system ties the park together, offering natural-surface trails near the river for recreation and habitat exploration, and paved multi-use loops on berms and levees for walking, running, and cycling. Key connections, including a possible link under the McCarran Bridge to the Tahoe Pyramid Bike Trail, strengthen regional mobility and integrate the park into the broader Truckee Meadows trail network. Parking and vehicle circulation are carefully planned to balance capacity for large events with the need to maintain open space and a natural park atmosphere, a tournament hub, and amenities such as restrooms, shaded seating, and food-truck accommodations. The complex is designed to support both large events and everyday community use. The Recreation Design Vision Memorandum is included in Appendix F. Key figures from the document are shown in Figure 8 and Figure 9.

Figure 8: Recreation Vision

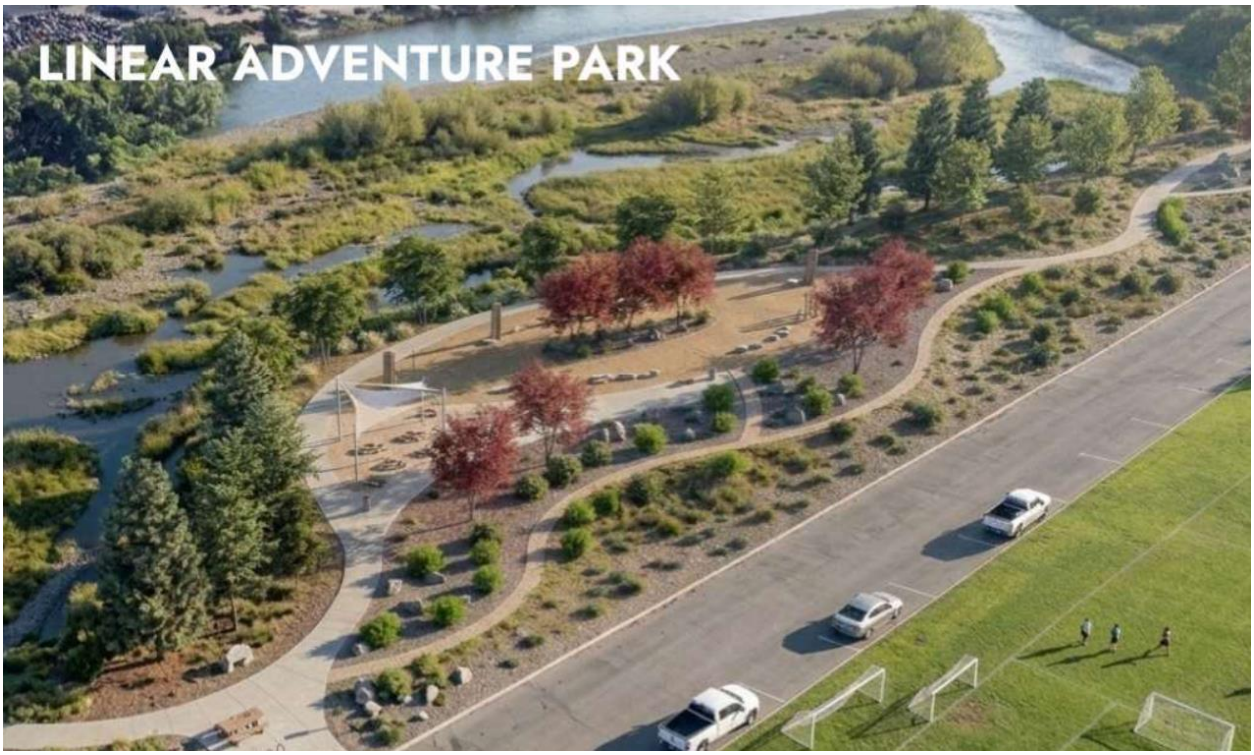

Figure 9: Recreation Linear Adventure Park

9.0 Geotechnical Studies

A preliminary geotechnical assessment was prepared by Crawford & Associates, Inc. to support the 30% design of the proposed levee system for this Project. The report provides engineering design guidance for the proposed levees and internal berm and is summarized below. The draft Geotechnical Design Recommendations Report is included in Appendix G.

The geotechnical investigation included drilling and logging of borings and test pits, laboratory testing of subsurface materials, and development of soil parameters for design. Subsurface conditions generally consist of Holocene-age floodplain and fluvial deposits, including silty clayey sand, clayey silt, and silt, underlain by older alluvial deposits comprised of granular materials ranging from sand to cobbles and boulders.

Based on evaluation, no overriding geologic hazards, such as faulting, landslides, severe erosion, or subsidence, were identified. However, subsurface conditions vary across the site, including non-uniform blanket layers and underlying permeable materials that influence seepage behavior.

Geotechnical analyses were performed to evaluate seepage, slope stability and seismic performance of the proposed levees under various loading conditions. Results indicate that, with the incorporation of recommended design measures, the levee system is generally feasible; however, localized areas may require additional refinement during subsequent design phases.

Key geotechnical considerations for advancement to the final design are expected to consist of the following:

- Seepage mitigation measures
- Suitability and sourcing of borrow materials for levee construction
- Variability of foundation soils and groundwater conditions
- Disposal and management of excess excavated material
- Integration of proposed levees with existing features, including roadway embankments
- Encroachments such as utilities, storm drain outlets, and other existing infrastructure within the levee footprint
- Construction considerations including staging and dewatering requirements

9.1 Preliminary Levee Design Guidance

The external levees will be designed in general accordance with applicable USACE and FEMA engineering guidance for levee systems. These standards establish criteria for levee geometry, seepage control, slope stability, seismic performance, and appurtenant features. The primary guidance documents applicable to this phase of design include:

- EM (Engineer Manual)1110-2-1913: *Design and Construction of Levees*
- EM 1110-2-2902: *Conduits, Pipes, and Culverts Associated with Dams and Levee Systems*
- Sacramento District Geotechnical Levee Practice
- EP (Engineer Pamphlet) 1110-2-18: *Guidelines for Landscaping, Planting, and Vegetation Management*
- ETL (Engineer Technical Letter) 1110-2-569: *Design Guidance for Levee Under Seepage*
- EM 1110-2-1902: *Slope Stability*
- ETL 1110-2-1806: *Earthquake Analysis, Evaluation, and Design for Civil Works Projects*
- FEMA - 44 CFR §65.10 — Mapping of Areas Protected by Levee Systems
- FEMA - Guidance for Flood Risk Analysis and Mapping – Levees (Nov 2023)

These guidance documents will be used in conjunction with the Project-specific geotechnical recommendations to develop levee sections that address seepage, stability, constructability, and long-term performance under both static and seismic load conditions.

The internal berm located between the two external levees is intended to function as a storage feature rather than a primary flood protection structure. As such, it is not currently anticipated to be subject to USACE levee design criteria. However, its configuration and materials will be evaluated during subsequent design phases to ensure compatibility with the adjacent levee system and overall Project performance.

9.2 Levee Geometry and Easement Requirements

At the 30% design phase, preliminary levee geometry has been developed using the USACE EM-1110-2-1913 recommendations and is subject to refinement as additional geotechnical and hydraulic analyses are completed. The current design assumptions include the following:

- Crest width:
  - 20 ft minimum.
- Slopes:
  - 3:1 (3H:1V) side slope or flatter for both waterside and landside slopes.
- Easements:
  - North Levee: 8 ft on the landside from the toe of the levee (space permitting based on property constraints).
  - South Levee: 20 ft on landside from the toe of the levee
  - 15 ft on the waterside (varies based on presence of river channel and water level)
- Inspection trenches:
  - Depths of at least 6 ft or equal to the levee height for levees under 6 ft.
  - Trenches may be omitted if a landside pervious toe drain is installed to a similar depth.
- Anticipated reusable fill for levees:
  - ~70,000 CY.
- Ditches:
  - Fill in the Pioneer ditch and compact to match existing adjacent grade.

9.3 Penetrations, Encroachments, and Vegetation

Various encroachments, penetrations, and vegetation within the levee footprint will need to be addressed:

- Pipes:
  - Non-pressurized pipes (e.g., storm drains) require backwater prevention structures on the waterside of the levee.
  - Pressurized pipes should include positive shutoff valves above the design water surface elevation within the crown limits.
- Encroachments:
  - Utility poles should be relocated outside of the levee footprint and easements.
- Vegetation:
  - All trees and vegetation within the levee footprint and easements should be removed prior to construction. Guidelines for landscape plantings and vegetation management for levees should be followed from the USACE EP 1110-2-18 for design efforts of landscaping on the levee itself.

9.4 Existing Embankments and Tie-Ins

The proposed levees will tie into existing roadway embankments at Rock Blvd and McCarran Blvd. The roadway embankments will be utilized, with potential treatments applied to meet levee compliance requirements. These tie-in locations will be coordinated closely with roadway owners to ensure compatibility and minimize impacts. Geotechnical design for these interfaces will follow applicable standards, including those outlined in the Orange Book and by the Nevada Department of Transportation (NDOT).

At McCarran Blvd, the current design includes a proposed pathway located adjacent to the existing abutment. The geotechnical design for this area will also conform to applicable standards, including the Orange Book and NDOT specifications.

At Rock Blvd, the proposed southern levee ties into the existing embankment near the intersection of Mill Street and Rock Blvd and serves as the primary line of flood protection between this location and the Truckee River. In this section, the Rock Blvd embankment should be assessed as a flood protection feature and additional improvements may be needed (i.e. waterside berm) to meet USACE design criteria.

10.0 Permitting

The design will likely involve significant permitting, though the level of permitting required is not yet determined. At the 60% design level, the team intends to approach the regulatory agencies formally with the design plans.

Two of the goals of this Project include providing flood attenuation and significantly improving the riparian area and overall habitat for aquatic and riparian species. This Project will be an improvement from a degraded channel system to a healthy riparian ecosystem, and therefore TRFMA views a full realignment of the river as a restoration effort.

The design involves the realignment of the Truckee River (both a Waters of the United States [WOTUS] and Waters of the State [WOTS]), extensive grading, and overall significant disturbance both above and below the ordinary high water mark (OHWM). It is anticipated that a USACE 404/408 permit would be required. Coordination with the USACE will occur later in design to determine the level of effort for permitting.

Due to active construction in WOTUS, a 401 Water Quality Certification and Construction Stormwater permit, that includes a diversion bypass plan, would be needed in coordination with the Nevada Division of Environmental Protection (NDEP). The team met with NDEP's Bureau of Water Quality Planning and the Bureau of Water Pollution Control branches to discuss the 401 permit requirements, and an individual groundwater discharge permit and a working in waterways permit, respectfully.

FEMA will require a Letter of Map Revision (LOMR) due to the development within the Special Flood Hazard Area (SFHA). TRFMA is actively coordinating with the Pyramid Paiute Lake Tribe (PLPT) and other downstream stakeholders regarding the proposed Project. The realignment of the river requires a land transfer agreement through the Nevada Division of State Lands (NDSL). Prior to construction, a cultural resources survey will need to be performed by a professional archeologist to identify if any cultural or historical resources are found on site and a Stormwater Pollution Prevention Plan (SWPPP) will need to be prepared.

Coordination with a Nevada Division of Wildlife (NDOW) fisheries biologist is recommended prior to construction to account for fish recovery during construction. Some early coordination with NDOW has already completed as discussed in Section 6.4.

During the Alternatives Analysis, an informal consultation was made with the team and members of the USFWS to discuss the proposed Project, the possibility of LCT in the Project area, and any specific habitat features to be considered. Positive feedback was received from USFWS regarding the concept of the proposed Project. Meeting notes from this discussion can be found in Attachment I of the environmental scan in Appendix E. Further formal consultation with the USFWS will be required as the Project progresses. It is anticipated that USACE will be the lead agency, with USFWS contributing to the review process.

The J-U-B team reached out to NDOT to discuss the sidewalk that is currently proposed to go under the McCarran Bridge on the south back and connect to existing trail systems. NDOT elected to have the team prepare an encroachment application after the 30% design is complete to review the encroachment. It is anticipated that an encroachment permit with NDOT will be required for the sidewalk under McCarran Bridge

Future coordination with City of Reno, City of Sparks, and Northern Nevada Public Health for permitting and review of the Project is expected.

11.0 Hydrology and Hydraulics Methodology

The hydraulic model utilized for the Project originates from the Truckee River Physical Map Revision (PMR) dated March 2023 and subsequently revised in April 2024, and incorporates the conceptual level full-buildout conditions of the known Flood Projects. Enhancements and refinements to the model were completed by the Team in HEC-RAS version 6.4.1, specifically for the Rock to McCarran Reach Project site to improve accuracy and understanding of the area. Final Alternative Analysis models for this Project were developed in HEC-RAS version 6.6 and are documented in detail in the Alternatives Analysis Report. The 30% design models for this Project were progressed from the Alternative Analysis models and finalized in version 6.6.

11.1 Hydrology

Hydrology was progressed from the Alternatives Analysis, which was generally derived from the as-received PMR model and supporting documentation including the General Re-evaluation Report (GRR). Additional low flow storms, including 200 cfs, 350 cfs, 1-yr, and 2-yr events, were added primarily to support geomorphological and environmental design.

11.1.1 Peak Flows

Peak flow rates for storm events in the 30% design were derived from various sources as indicated in Table 4.

Table 4: Peak Flow Rates Used in 30% Design

Return Interval (years)	Annual Exceedance Probability (percent)	Peak Flow Rate Used in 30% Design (cfs)	Source
N/A	N/A	200	Gage Analysis
N/A	N/A	350	Gage Analysis
1	100%	650	HEC-SSP*
2	50%	2,972	HEC-SSP
3	33%	4,684	Interpolated
5	20%	5,949	GRR
10	10%	7,593	PMR ER
20	5%	9,150	GRR
50	2%	13,721	GRR
75	1.33%	17,288	PMR ER
100	1%	20,734	GRR
117	0.85%	23,680	PMR ER

**50 cfs less than 1.05-yr peak flow equal to 700cfs*

For analysis of more frequently occurring peak flow rates, a statistical hydrology analysis was performed on USGS Station 10348200 'TRUCKEE R NR SPARKS' in Hydrologic Engineering Center Statistical Software Package (HEC-SSP) version 2.2. This analysis estimated the peak flows for smaller magnitude storms based on the gaging station on the downstream end of the Project area. Additionally, gage data was used to estimate an average daily flow of 350 cfs and an average lower summer flow of 200 cfs for channel and terrace design. More information on river geomorphology and design flows are included in the NHC Geomorphology Report in Appendix D. The 1-yr peak flow was estimated as 50 cfs lower than the 1.05-yr peak flow from HEC-SSP in conjunction with review of annual peak flow gage data. The 2-yr peak flow was estimated as 2,972 cfs from HEC-SSP. The 3-yr peak flow was interpolated between the 2-yr and 5-yr peak flows.

11.1.2 Hydrograph Creation

During development of the 30% design, Truckee River inflow hydrographs for storms greater than the 5-yr event up to the 117-yr event were scaled uniformly from the 100-yr hydrograph to each respective peak flow value. For these simulations, each of the three tributaries (Dry Creek, Steamboat, and North Truckee Drain) retained the 100-yr inflow hydrographs. The 5-yr flow hydrographs for both the Truckee River and the three tributaries were scaled from the 10-yr as-received DSS (Digital Speech Standard) file included with the PMR Emergency Response model. Truckee River hydrographs for storms smaller than the 5-yr event to the 1-yr event were scaled uniformly using the 10-yr hydrograph. The 3-yr event used 5-yr tributary hydrographs, while the 1-yr and 2-yr events used 1.25-yr tributary hydrographs. The 200 cfs and 350 cfs flows were set as a uniform hydrograph with a constant flow rate.

11.1.3 Hydrograph Truncation

Early 30% model development relied on spatial model truncation, similar to the methodology followed for the Alternatives Analysis. The team quickly realized the need to utilize the full model with the intricacies associated with the design. To accomplish this, most simulations were shortened to encompass the peak and ensure full routing of the flood wave through the Project area. The 117-yr, 100-yr, and 75-yr events were run through the full simulation time, as they were critical for designing the major containment and routing components of the 30% design.

11.2 Hydraulic Modeling Methodology

Hydraulic model development resumed from the final models created for the Alternatives Analysis study. Detailed documentation of that effort can be found in the Alternatives Analysis Report. The 30% design effort began with NHC performing the next iteration of geomorphological design on the truncated model, including refined river alignment, terracing, and habitat accommodation.

11.2.1 Truncated Model Utilization

The use of the truncated model facilitated rapid development of the next geomorphology design iteration prior to integrating design components into the full model. The truncated model boundary, identical to the one used in preliminary Alternatives Analysis modeling, is shown in Figure 10.

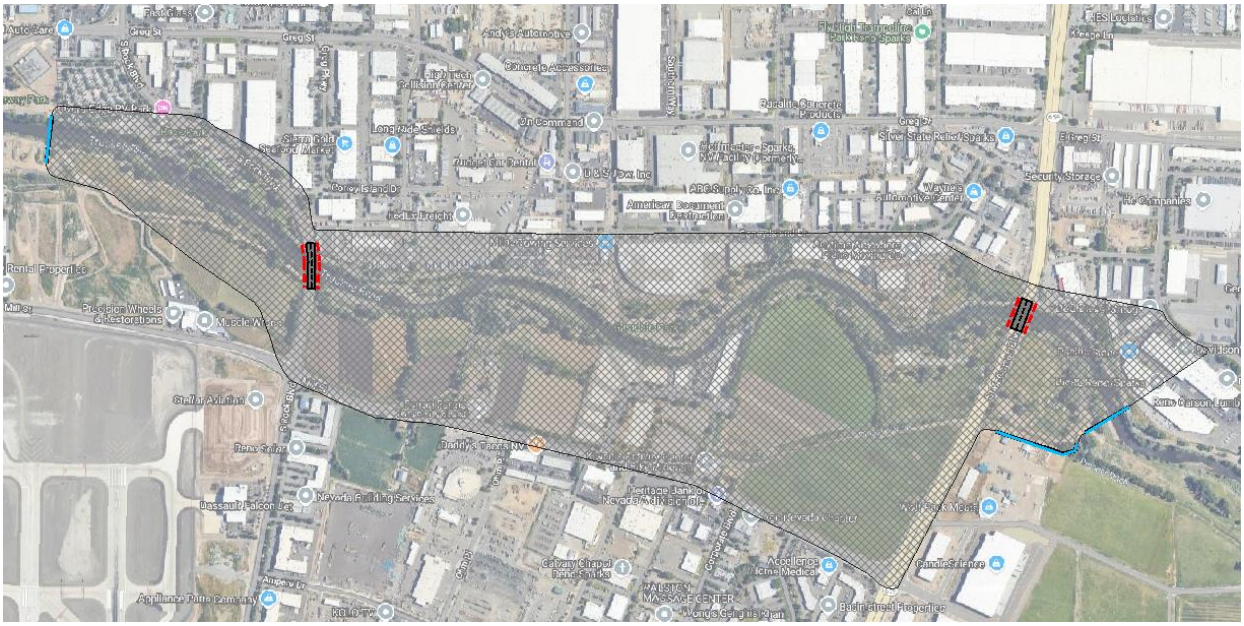

Figure 10: Truncated Model Extents

J-U-B used this model to preliminarily design and evaluate various internal berm configurations, which aimed to balance required fill with increased protection of the future recreation area. Four initial berm designs were modeled which shared the same alignment, but underwent variation of the profile height and total extent of the berm to accommodate different levels of protection. For example, a shorter berm would protect the recreation area for a smaller storm, but would require less fill to construct. The smaller berm may not have needed to be continuous along the full alignment and instead only protect the recreation area in flow breakout areas. The four berm configurations were successful in containing the following flows within the river corridor:

- Berm-1 = 9,150 cfs (20-yr)
- Berm-2 = 13,721 cfs (50-yr)
- Berm-3 = 15,000 cfs (59-yr, interpolated)
- Berm-4 = 17,288 cfs (75-yr)

Due to the relatively small amount of fill required to construct "Berm-4" and provide protection of the fields for the 75-yr event, "Berm-4" was selected for further development.

11.2.2 Full Model Design Methodology

11.2.2.1 Terrain Modifications

The terrain was further modified in both Autodesk Civil 3D Software (Civil 3D) and HEC-RAS to accommodate the specific requirements and details of the designed features. In Civil 3D, existing surfaces from the modeled Project area were modified to incorporate grading designs, while ensuring appropriate tie in of Project elements. Surfaces created in Civil 3D were then integrated into HEC-RAS model terrain for subsequent terrain modifications directly in RAS Mapper with terrain modification layers. This iterative process allowed for efficient and effective creation of terrain to meet Project goals including flood risk mitigation, ecosystem restoration and enhancement, and recreation.

The non-truncated model terrain was first rebuilt and new terrain modifications were copied in from the NHC model. Priority/order of terrain elements was carefully specified based on the as-received model. Major design elements were developed and refined as described in the following sections.

11.2.2.1.1 Bridge Opening Refinement

The Rock Blvd and McCarran Blvd bridge openings were updated from the original interpolated terrain to a combination of survey data and terrain modifications to improve their representation in the model. This was completed first in the existing conditions model and then subsequently in the proposed condition model to ensure comparable hydraulic results and an appropriate base surface for proposed modifications in the McCarran bridge opening. Images of the original and refined bridge openings for Rock Blvd and McCarran Blvd bridges are shown in Figure 11 and Figure 12 respectively.

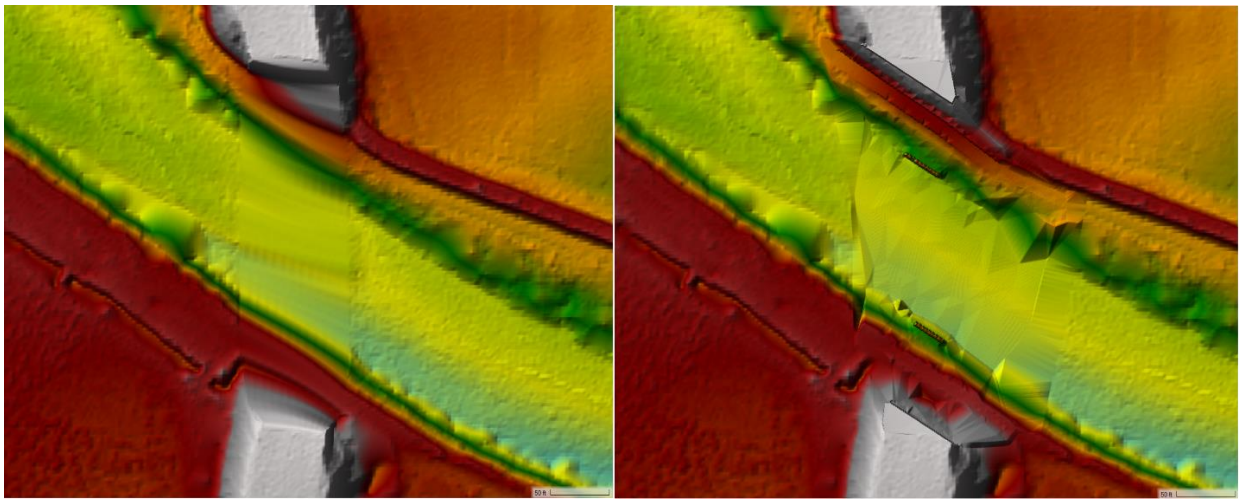

Figure 11: Rock Blvd Bridge Opening Original (Left) vs. Updated (Right)

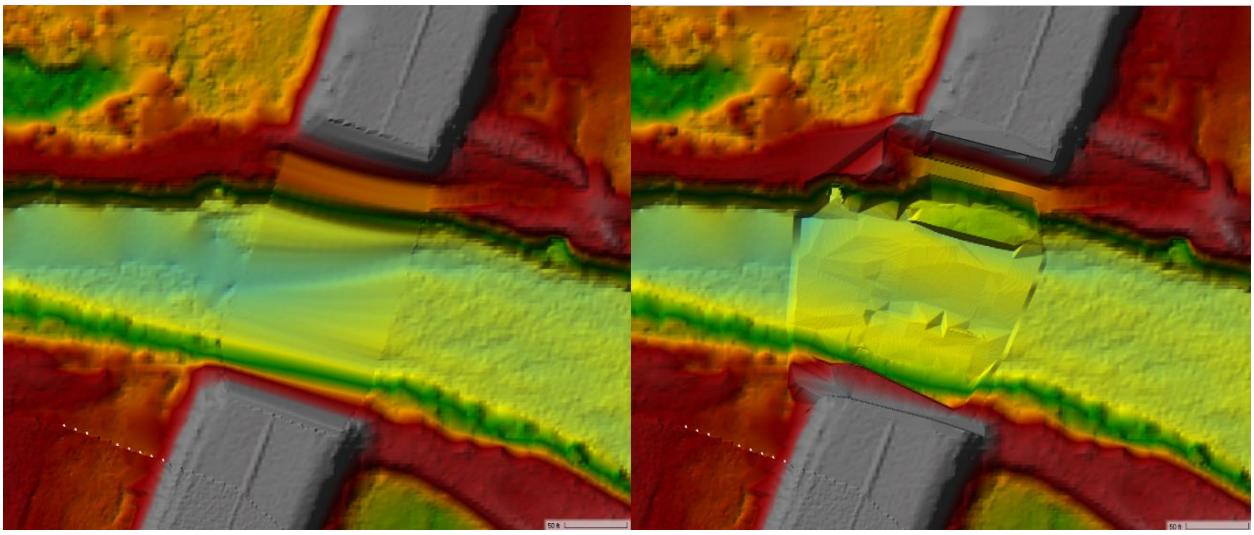

Figure 12: McCarran Blvd Bridge Opening Original (Left) vs. Updated (Right)

11.2.2.1.2 Proposed Preliminary McCarran Blvd Bridge Opening Modification

Various potential bridge openings were evaluated for the McCarran Blvd Bridge opening to increase hydraulic capacity and accommodate a pedestrian path along the south bank. Configurations tested included a full 2:1 slope, a benched 2:1 slope approximately matching the north side, and a 15-ft tall concrete wall intended to maximize capacity. The benched 2:1 slope provided a balance of increased capacity, recreation accommodation, and anticipated geotechnical and structural criteria compliance for the existing bridge structure. The existing and proposed McCarran Blvd bridge openings are shown in Figure 13 and Figure 14 respectively. Further bridge opening modification design will be performed during subsequent phases of the Project.

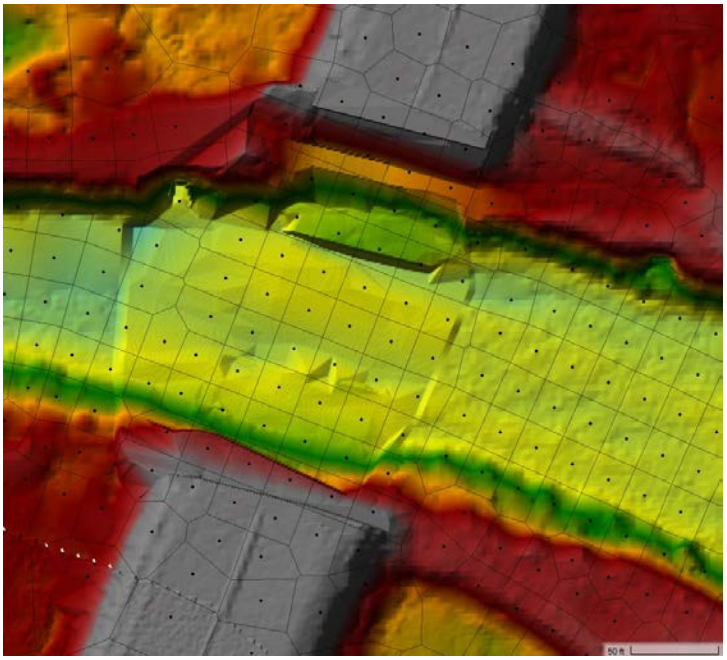

Figure 13: Updated Existing Bridge Terrain with Existing Concrete Wall (South Bank)

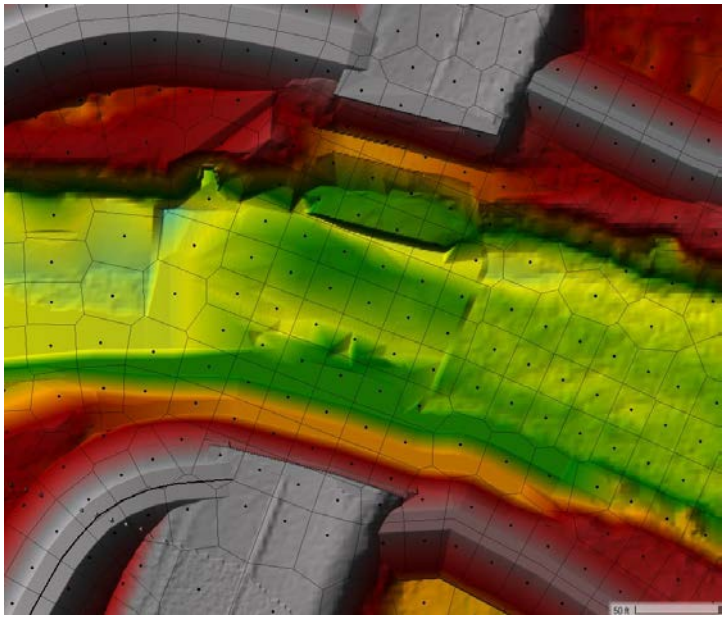

Figure 14: Preliminary Proposed Bridge Configuration, 2:1 Benched South Slope with Pedestrian Path, Wall Removed (South Bank)

11.2.2.1.3 Geomorphology

The river realignment, secondary channels, and proposed backwater features of the Truckee River were considered key geomorphological design features. Subsequent design iterations incorporated NHC's next version of detailed design elements including terracing, cottonwood islands, and backwater channels. Efforts were made to increase preservation of the existing mature cottonwood galleries adjacent to the river alignments where feasible, ensuring they remained intact as natural islands. The design included backwater channels to provide floodwater routing and increase attenuation, which ultimately allowed the preservation of the existing channel in some form throughout the Project area.

NHC relied on statistically based flow data, using HEC-SSP for determination of flows for geomorphological design, which varied slightly from the peak flow basis for early 30% design iterations. Generally the HEC-SSP flows were higher, resulting in reduced inundation of terraces, side channels, backwater channels, etc. relative to the original design intent. To correct for the difference in flows, geomorphological design features were iteratively adjusted to match the original intended flow depths for floods up to the 5-yr event. Model runs were shortened by simulating the majority of the peak and ensuring full flood wave routing through the Project area for each storm.

Final geomorphological design from NHC was completed and integrated into the final 30% hydraulic models. This included final refinements within the proposed river corridor and improved precision of wetting frequency using the full model. More detailed documentation of the final geomorphological design is included in the 30% Design Geomorphology Report in Appendix D.

11.2.2.1.4 Internal Berm Design

The 75-yr internal berm selected for further development using the truncated model was copied into the full model domain. Various notch locations to let flood waters into the recreation area at flows in excess of the 75-yr event were first evaluated during the 117-yr flood event. A notch at the upstream, middle, and downstream area of the berm were evaluated with profiles approximately equal to the 75-yr flood water-surface elevation (WSE) at each respective location. Combinations of notches were also evaluated to allow flow to enter the recreation area faster and potentially use it more effectively to reduce the peak flow at Vista Narrows. Findings from these initial model runs indicated that a single notch at the most upstream side was most effective for utilizing the recreation area for 117-yr flood attenuation. The berm profile was then iterated with the goal to only allow overtopping of the berm when the WSE was equalized on both sides of the berm. This design strategy aimed to minimize head cutting and reduce required scour/erosion measures.

Approximately 14 iterations of adjustments and subsequent model runs were performed for the berm profile to precisely time overtopping coincident with WSE equalization during the 117-yr and 100-yr events. Ultimately a single upstream notch that contained the 75-yr flood did not, by itself, let flood water into the recreation area fast enough to meet the WSE equalization criteria prior to overtopping. This could either be achieved by reducing the notch profile, therefore reducing the protection level from the 75-yr

event, or by adding additional inflow capacity for the internal berm with an additional notch. Both options were further studied and refined through multiple additional iterations. While both options were determined to be feasible and have similar hydraulic performance, the configuration with two notches was progressed primarily due to decreased fill requirements and protection of the recreation area to the 75-yr flood event.

Further refinement of the two-notch internal berm design was completed to ensure containment of the 75-yr flood event, control precise overtopping at WSE equalization conditions to the extent practical, and mitigate premature overtopping at the downstream end of the middle notch.

11.2.2.1.5 Exterior Levee Refinement

Through most of the model development, the model relied on alternative analysis version north and south levees, which provided adequate freeboard for the schedule of alternative models. This meant the levee profiles were left intentionally high, and with refinements described herein, there was room to optimize the levee profiles. First the north levee alignment was smoothed to replace sharp angle points with gradual curves. The south levee alignment was first adjusted to accommodate access ramps. This required bumping out the levee alignment to make space for preliminary access ramp geometry. Initial levee alignment "bump outs" were set conservatively for hydraulics, with ample room for transportation access and grading on the exterior side of the levee. Generally, the refined levee profiles were lowered to provide three feet of freeboard, resulting in decreased fill requirements. In the vicinity of access ramp crossings, an additional one foot of freeboard was added to the south levee profile to account for roadway material not expected to impound water effectively. As the design progressed, access ramps and the south levee alignment in their vicinity were optimized to maximize the available recreation area while maintaining requirements for access. The profile was then again refined to provide three feet of freeboard during the 117-yr flood event. Further discussion of access ramp design is included in Section 13.1.1.

11.2.2.1.6 Representation of Floodwall Section

Following identification of a constricted section of the north levee alignment just downstream of the Rock Blvd bridge, the decision was made to include a 400-ft floodwall alignment to reduce utility conflicts and the requirement of private property easements through this section, although both criteria still may not be completely avoidable. The floodwall alignment and profile, as well as floodwall pad grading below, were represented with terrain modifications in HEC-RAS. The 2D mesh was modified with breaklines to ensure cell faces were aligned with the full extent of the floodwall. Manual cell edits were completed at affected cells along the Rock Blvd bridge centerline.

11.2.2.1.7 Recreation Area Fill

Initial recreation area fill utilized approximately 65,000 CY to regrade the southeast corner of the site bordered by the south levee. This grading promoted positive drainage, while leaving a preferential flow path adjacent to the internal berm. When the exterior levee profiles were refined, fill requirements were

reduced, resulting in an increase in estimated excess material for the Project. Recreation area fill was reworked to use approximately 220,000 CY.

Throughout the 30% design, two conceptual level recreation designs were in progress. With uncertainty regarding which alternative may be selected, the regional park concept with ball fields was assumed solely for hydraulic design consideration. The two east-west oriented championship size fields near the middle of the site were elevated. North-south oriented championship size fields in the southeast corner of the site were elevated in three tiers:

- Two fields to fit in highest area in most southeast corner
- Approximately five fields to be elevated in the middle tier primarily adjacent to the internal berm
- Lowest tier to serve as treatment swale in far east portion of site between south levee and berm

The parking area specified between the fields was elevated slightly. An access road adjacent to the upper fields and parking area was graded to function as a flow conveyance channel through the recreation area. Finally, the area between the conveyance channel and internal berm middle notched section was filled with the intent to reduce scour/erosion protection measures in a hydraulically complicated portion of the internal berm notch. These features were graded at a preliminary level primarily to conservatively represent available flood storage in the recreation area for 30% design. Parking areas are envisioned to function as sediment basins that could be cleaned out after large storm events. Utilization of excess fill in the recreation area was graded with preferential flow routing in mind. It should be noted that recreation area grading was only complete for the purpose of hydraulic modeling for the 30% design; No recreation area grading was completed in the 30% design plans.

11.2.2.1.8 Access Ramps

Two conceptual level recreation designs were being developed during the 30% design. For hydraulic consideration, the regional park access concept was partially represented to allow for conservative progression of hydraulic design. The initial access plan included two ramps crossing the south levee centered approximately at Edison Way. This required a larger single "bump out" on the levee alignment, while not necessarily increasing traffic capacity. This concept was improved with inclusion of a single access ramp crossing at two separate locations along the south levee.

11.2.2.2 Model Geometry

A copy of Alternative C1 model geometry was created for progression of the Rock to McCarran Project 30% design. An important consideration in creation of the full-sized models was to not regenerate the 2D mesh, as is typically done in model development, in order to retain the integrity of the model outside the Project limits. For this reason, a refinement region was retained and modified, generally following the alignment of the south levee and the new internal berm centerline. The refinement region allowed for organization of 2D mesh in the area, while concurrently acting as a breakline for critical high ground features. Other breaklines were added and modified in the Project area. This methodology required

detailed manual cell edits to ensure appropriate cell face arrangement in locations with intersecting breakline areas and for appropriate cell orientation, size, transition, etc. within the Project area. In the Project area, the approximate smallest cell size was 25 ft x 25 ft and the largest cell size was 60 ft x 60 ft. Examples of the model geometry mesh are shown in Figure 15 and Figure 16.

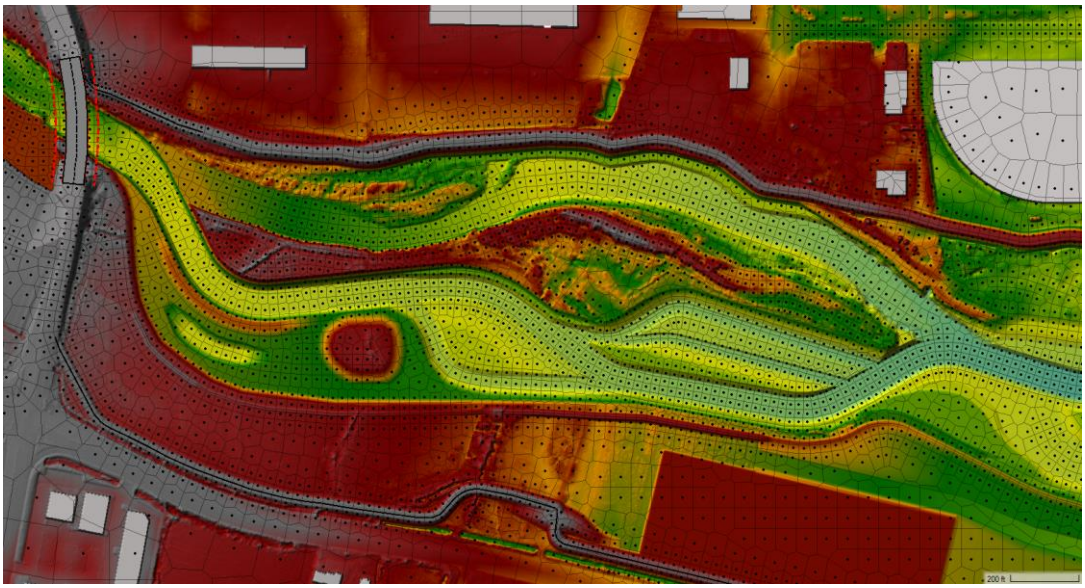

Figure 15: Model Geometry Downstream of Rock Blvd Bridge

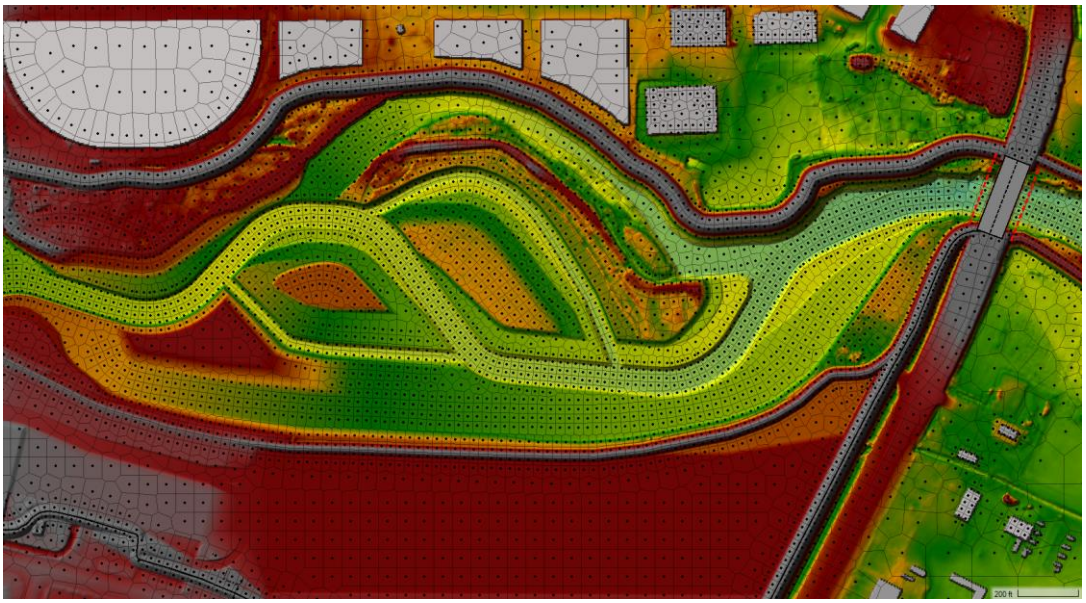

Figure 16: Model Geometry Upstream of McCarran Blvd Bridge

11.2.2.2.1 Roughness Regions

Manning's n-value regions were used to override the as-received proposed land cover data ("Land Cover Proposed") for the 30% design in the Rock to McCarran Project area. Override regions from the Alternatives Analysis were completely overhauled and refined for 30% design. N-value regions representative of key Project features such as protected existing and proposed cottonwood galleries were specified when practical. N-values delineated in the Project area are summarized in Table 5 and Figure 17.

Due to the amount of override regions required, general features and areas are summarized with typical values used. Two geometry versions were created to accommodate n-values for large woody material during low flows (3-yr event and below) and high flows (5-yr event and above). Refined representation of large woody material and other revetment is expected during 60% design.

Table 5: Manning's N-value Override Regions

Project Alternative Design Element	n-value
Main Channel	0.033
Side Channels	0.040
Upper Backwater Channel	0.048
Lower Backwater Channel	0.048
Backwater Channel Inlet Riprap	0.060
Riparian Area	0.045
Cottonwood Galleries (Existing and Proposed)	0.080
North and South Levees	0.055
Internal Berm Revetment	0.050
General Riprap	0.055
General Recreation Area	0.030
Paved Access Ramps	0.015
Large Woody Material (low flow/high flow)	0.7/0.4

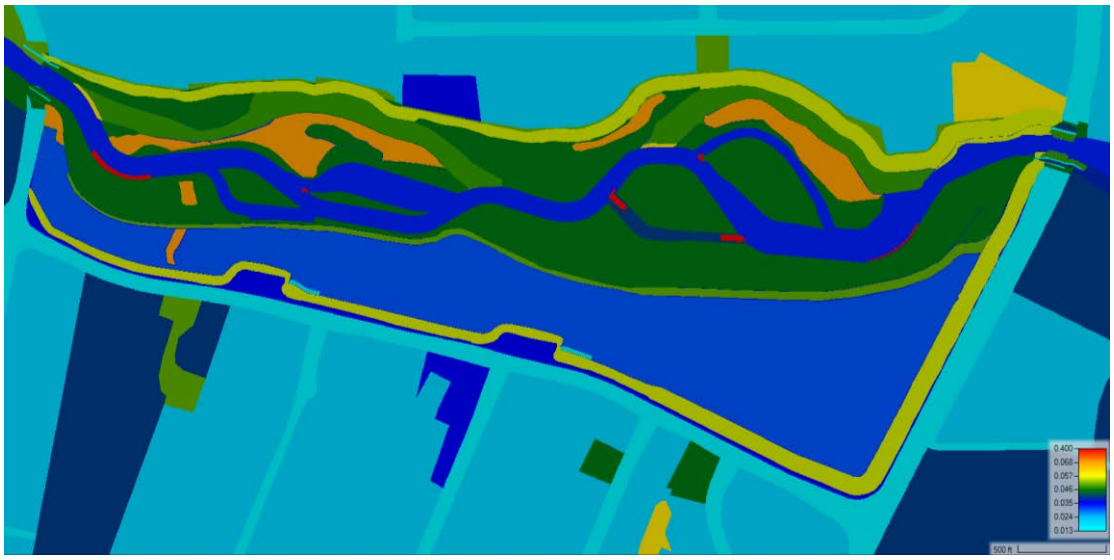

Figure 17: N-value Override Regions Used in Project Area

Generally, main channel and recreation areas are light blue, riparian areas and backwater channel are dark blue and blue grey, riprap areas are yellow and green, cottonwood areas are orange, and engineered log jams are red.

11.2.2.3 Computation Options and Tolerances

Generally, model computation options and tolerances were retained from the as-received PMR model. Computation interval was increased for smaller storm simulations. Model simulation times were adjusted for smaller storms to balance peak flow routing through the Project area with reduced model runtime.

11.2.2.4 Model Scrubbing

All model components not used in the final models were removed, except for the existing conditions model for comparison. The total model file size is approximately 43 GB, which includes existing conditions and 30% design geometry for the schedule of flood events analyzed.

12.0 Hydraulic Analysis and Results

12.1 Peak Flow at Vista Narrows

The peak flow during the 100-yr flood event was reviewed at a profile line at Vista Narrows, just downstream of the proposed terracing for that project. Peak flow at this location was compared to the allowed 2,400 cfs peak flow increase relative to existing conditions. It should be noted that the existing conditions model was updated with refined Rock Blvd and McCarran Blvd bridge geometry, consistent with updates applied to the proposed condition model. Results at Vista Narrows during the 100-yr flood event are summarized in Table 6.

Table 6: 100-yr Peak Flow Summary at Vista Narrows

Modeled Scenario	100-yr Peak Flow at Vista Narrows (cfs)	Total Increase from Existing Conditions (cfs)	Amount Under 2,400 cfs Allowed Increase (cfs)
Existing Conditions	20,273	0	N/A
30% Design (version 6.6)	22,300	2,027	373

12.2 Rock Blvd and McCarran Bridge Hydraulics

The Project does not decrease the capacity of the bridges, rather containment of the flood through the combination of projects in the greater Flood Project passes significantly more water under the bridges, thus reducing the available freeboard. The proposed Rock–McCarran Project confines flow within the proposed exterior levees between the Rock Blvd and McCarran Blvd bridges, resulting in increased flow conveyance through the McCarran Blvd bridge. However, the bridge itself does have a reduction in hydraulic capacity. The proposed modifications to the McCarran Blvd bridge opening attempt to partially mitigate the reduced freeboard and results in a minor increase in its hydraulic capacity. Increased flow routing through the bridges brings water surface elevations closer to the bridge low chord, which is why the available freeboard is reduced under the proposed conditions. Table 7 illustrates this condition by comparing existing and proposed flow conditions through the Rock Blvd Bridge, along with the corresponding freeboard values presented in Table 8.

Table 7: 100-yr Peak Flow Summary at Rock Blvd Bridge

Modeled Scenario	100-yr Peak Flow Through Rock Blvd Bridge (cfs)	Total Increase from Existing Conditions (cfs)
Existing Conditions	16,779	0
30% Design (version 6.6)	21,032	4,253

Hydraulic results through Rock Blvd and McCarran Blvd bridges were analyzed for the design. Freeboard was assessed by extracting the maximum water-surface elevation in a single central location in the channel just upstream of each bridge and comparing this value to the minimum low-chord elevation. Table 8 demonstrates the results of this analysis.

Table 8: Rock Blvd and McCarran Bridge Freeboard During 100-Yr Event

	Rock Blvd Bridge			McCarran Bridge		
Modeled Scenario	**Min Low Chord (ft)**	**Max WSE (ft)**	**Freeboard (ft)**	**Min Low Chord (ft)**	**Max WSE (ft)**	**Freeboard (ft)**
Existing Conditions	4423.85	4416.52	7.33	4404.79	4401.03	3.76
30% Design (version 6.6)		4417.30	6.55		4404.70	0.09

Additional model results will be analyzed and shown for 60% design. HEC-RAS version 6.7 is expected to release early this year, capable of updated bridge representation. The team expects an improved understanding of hydraulics in the Project area with the new software, most notably at Rock Blvd and McCarran Blvd bridges.

12.3 Performance of Proposed Project

A selection of results during various storm events are included to show the performance of the Project during various flow rates. Note water shown on the north side of the north levee during the 117-yr event is a result of a known model limitation of the as-received model where flow currently breaks out of the channel upstream at the Glendale Avenue bridge.

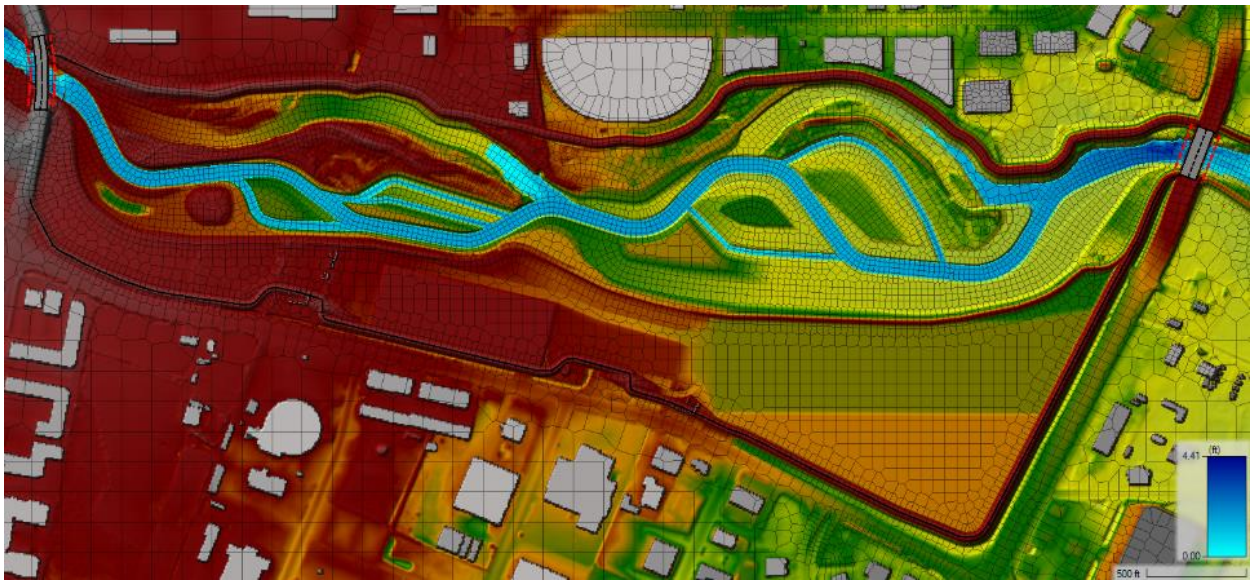

Figure 18: 350 cfs Maximum Depth

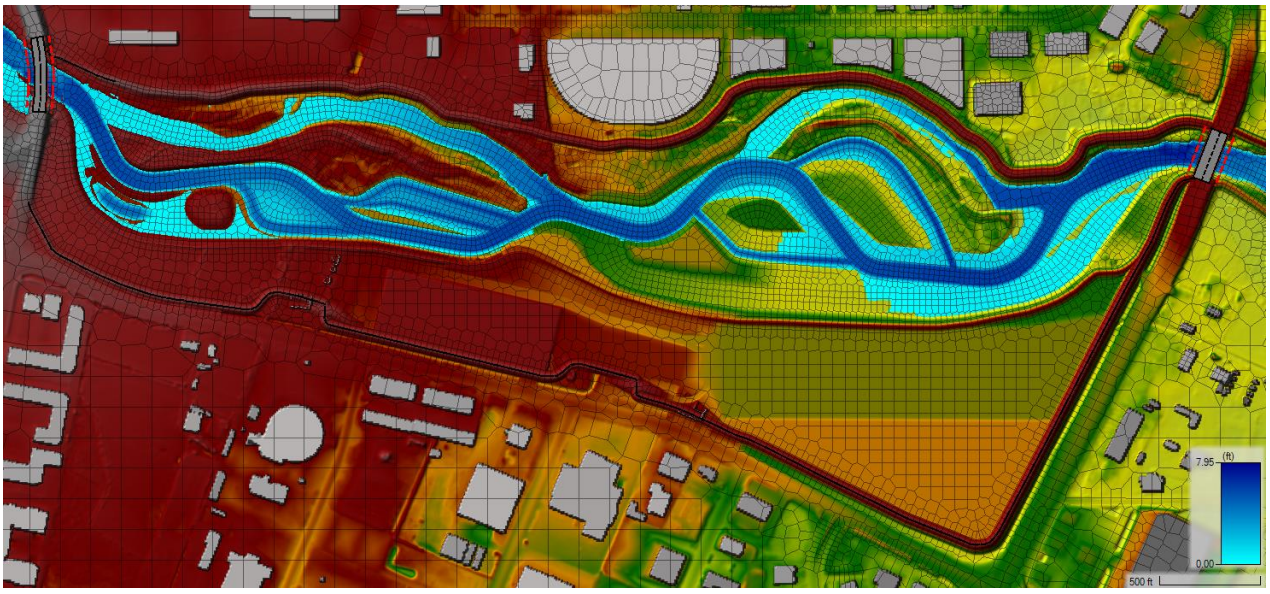

Figure 19: 2-yr Flood Event Maximum Depth

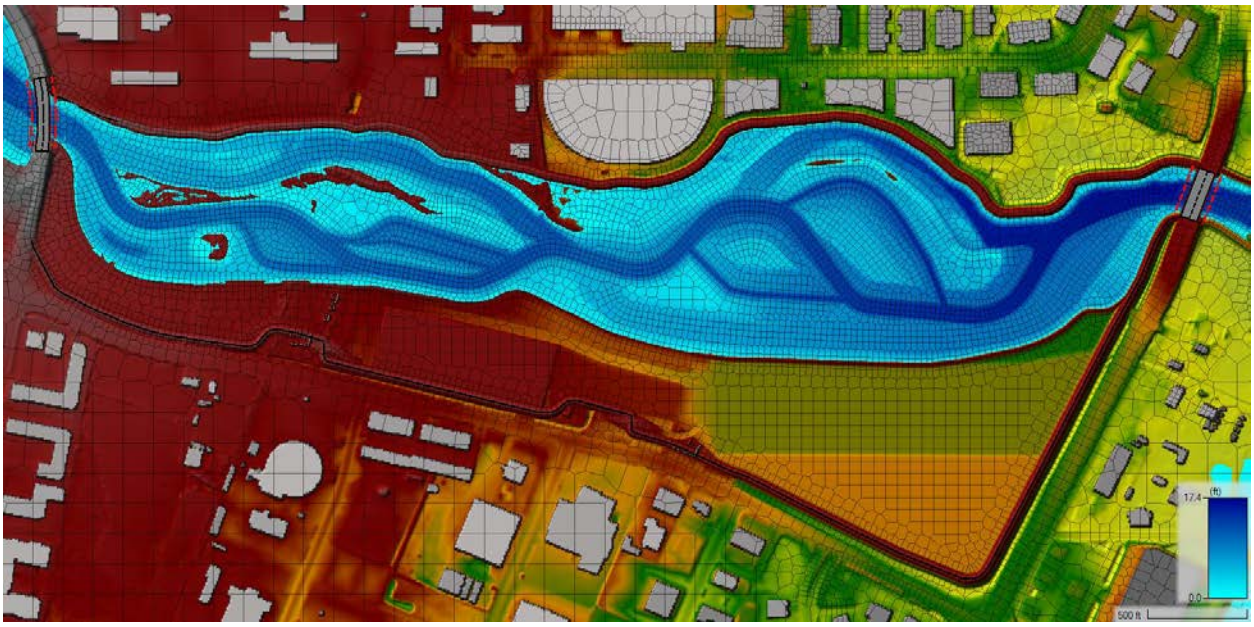

Figure 20: 75-yr Flood Event Maximum Depth

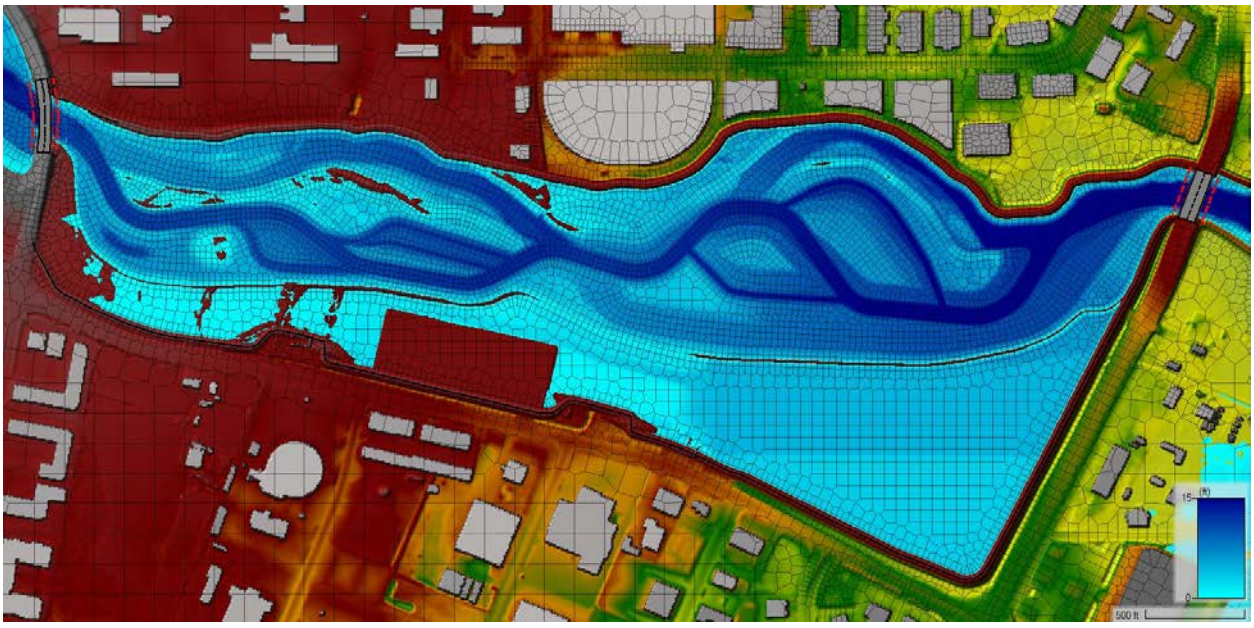

Figure 21: 100-yr Flood Event Maximum Depth

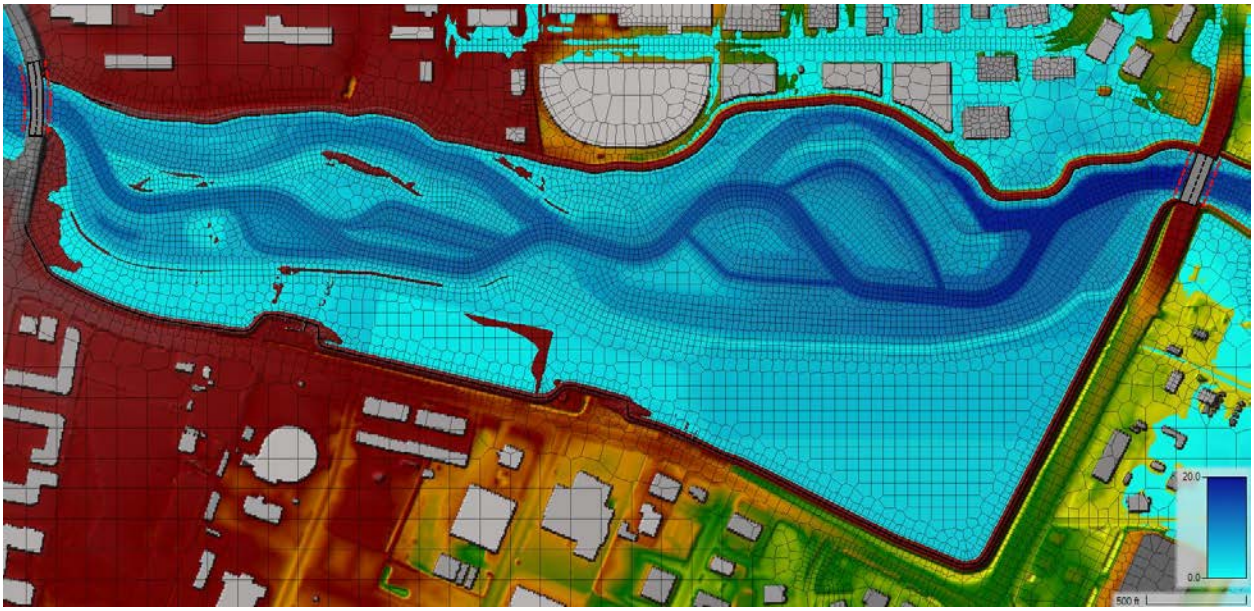

Figure 22: 117-yr Flood Event Maximum Depth

12.4 Internal Berm WSE Equalization During 100yr and 117yr Events

As discussed in Section 11.2.2.1.4 Internal Berm Design, the berm was iteratively designed to target equal WSE on either side of the berm prior to overtopping to reduce erosion and scour mitigation measures. Further, flood water on the south side of the berm at the east end of the berm alignment was intended to

flow from the recreation area side to the river to minimize debris accumulation in the recreation area during design floods. An example of WSE equalization performance is shown in Figure 23.

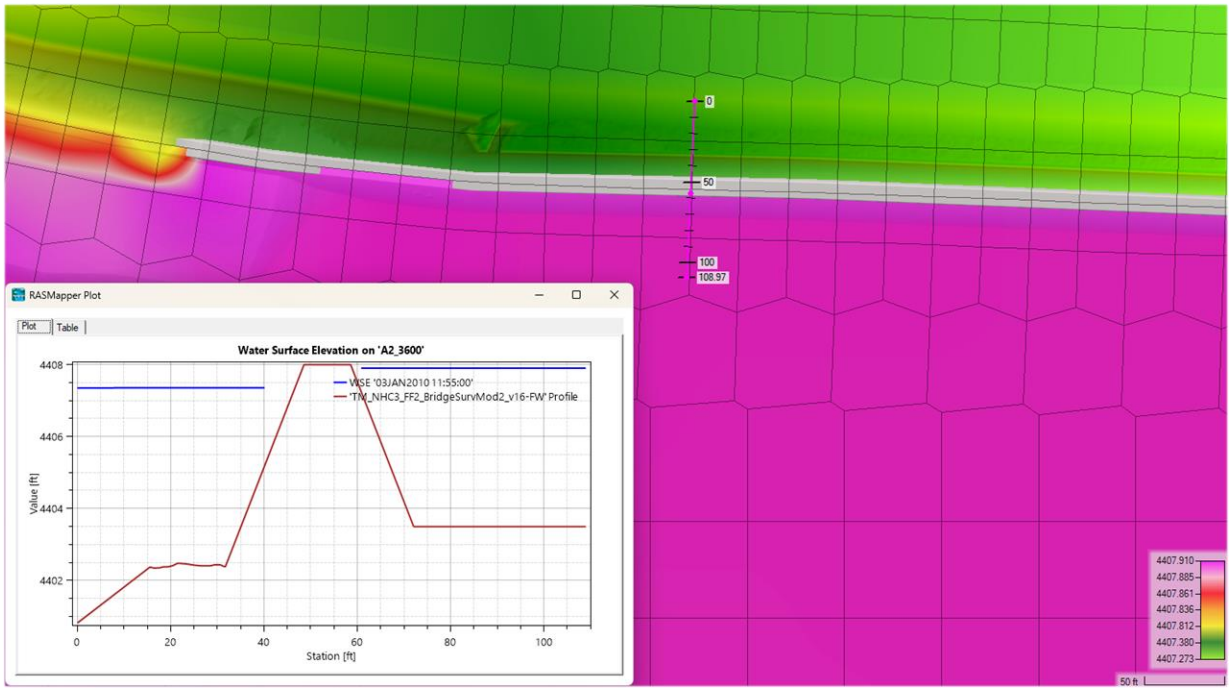

Figure 23: Internal Berm Water Equalization

12.5 Evaluation of Proposed Project with No Internal Berm

An additional model run was executed to assess Project performance assuming a potential failure of the internal berm feature. This was performed to ensure flow containment within the north and south levee limits independent of the internal berm. Results showed that adequate freeboard was available with the absence of the internal berm.

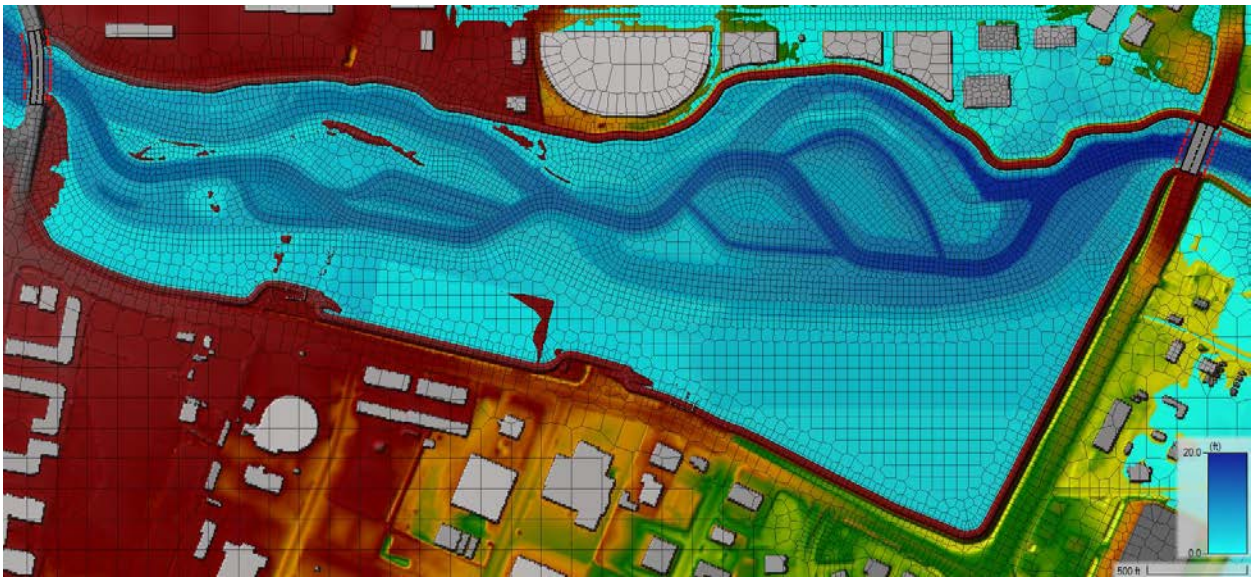

Figure 24: 117-yr Flood Event Maximum Depth with No Internal Berm

13.0 Additional Design Considerations

The following are additional considerations regarding the design.

13.1 Transportation & Access Evaluation

The transportation design for the Project includes a preliminary layout of internal park roads, access points, parking capacity and delineation, and circulation routes to support recreational use, maintenance access, and emergency vehicles. The preliminary design was developed to integrate with adjacent roadways and planned park features while maintaining compatibility with flood protection elements. As the Project advances beyond the 30% design phase, it is anticipated that additional transportation requirements may be identified, including the potential need for traffic studies and further coordination with applicable agencies to support final design and permitting.

13.1.1 Access Road Design

Access to the Project area is provided via two roads constructed over the south levee. To maintain flood protection, the road elevations were set to match or exceed the levee crest and preserve three feet of freeboard for the 117-yr flood event. This constraint created challenges for approach-road geometry, requiring multiple design iterations to maintain vehicle accessibility and provide ADA-compliant pedestrian access. The 30% design includes four potential ingress/egress locations: two designated for emergency access only and two intended for public access.

13.2 NDOT Encroachment application

During communications with NDOT regarding the potential modifications to the McCarran bridge, NDOT has requested that the 30% design be submitted as an encroachment application. The team attempted earlier coordination with NDOT, but was required to wait until the 30% design was complete to begin the encroachment application process. This could result in some changes to the design based on their evaluation of the design elements surrounding the McCarran Bridge.

13.3 Easement Restrictions

The parcel boundary was offset eight feet south to meet the minimum preliminary required easement on the north side of the north levee. On the south side of the north levee, the 15-foot easement is maintained upstream but cannot be met downstream near the McCarran Bridge due to flow constriction in that area. The upstream segment satisfies easement requirements up to the 117-yr storm event. The south levee meets the easement requirements on both sides. These easements are necessary to ensure adequate access for levee maintenance.

14.0 Opinion of Probable Cost

14.1 Cost Opinion Description

The intent of the Opinion of Probable Costs (OPC) is to provide a preliminary means of design based on anticipated major cost items which generally include demolition, earthwork, revetment, transportation, and recreation. Generally, costs for specific features were developed on a unit cost basis, with quantities estimated using Civil 3D, cross sections details, survey data, aerial imagery, and vegetation surveys. TRFMA has stated that a 117-yr flood, such as the one documented in 1997, today could potentially cause $2 billion in damages. The $2 billion in damages would include clean-up costs as well as lost revenues due to airport closures, decreased tourism, business closures, inventory losses, property damage, and a variety of other contributing factors. The "Base" Project cost includes a less expensive option for construction of the recreation elements in the Project, while the "Base + Supplemental" Project cost includes additional optional recreation items that complete the full recreation vision.

As stated in the executive summary, the base recreation of this park project includes key components of each of the recreational zones: the sports complex, the Linear Adventure Park, the Iconic Park, and trail network & river access. The following is a summary detailing the differences between each of these recreational zones. Figure 25 is an exhibit of the Project that identifies the park recreation components, both base and supplemental features, and the park infrastructure components. Figure 26 highlights the base amenities and Figure 27 highlights the supplemental amenities.

Sports Complex: At the core sports complex, the first phase of construction of the recreational base will include 8 of the 10 championship sized fields and the infrastructural soccer complex required to support them. The soccer complex includes a 60'x40' keystone structure that includes an appropriately sized restroom building for tournament level intensity and a separated structure for concessions and storage. These two structures, critical to successful tournament operations, are connected by a gabled roof to create a "breezeway plaza" between them, providing a covered area for gathering, announcements, and dining.

For value engineering purposes, supplemental recreation at the sports complex includes the field lighting for all ten championship fields and one junior size field, an estimated savings of approximately $3.5 million.

Linear Adventure Park: The Linear Adventure Park is sited centrally within the TRFMA – Rock to McCarran Park, settled a short walk from the soccer complex and allowing easy access to the trails atop the intermediate berm and the extensive trail system within the river corridor. With regard to its integral location, most major components of the Linear Adventure Park are included in the recreational base. The park's location also requires that it be floodable and flexible: meaning that the form of play takes on a more naturalized feel utilizing materials such as treated wood, stone, and integrated landscaping that blurs the lines between play and wilderness. Thoughtfully placed play structures nestled into the landscape provide immersive and adventurous play opportunities: multiple ziplines to and from "nests"

mimic native avian wildlife, precast concrete climbing walls are installed next to equally climbable rockery outcroppings, slope slides are incorporated into the adjacent berm, while children (and adults) can hop from log to log through meadowland rain-gardens that activate in a light downpour. Supplemental components of this playground include monkey bars, log jam climbers, and climbable structures mimicking local wildlife formed of Glass Fiber Reinforced Concrete (GFRC). While the 6-post shade structure is also included in the supplemental category, a 20'x20' restroom to support this park is included in the recreational base.

Iconic Park: The iconic park sits at the southwest corner of the park, bounded by Mill St. and Rock Blvd. With the intensity of the berms surrounding the perimeter of the park, this zone provides a rare view into the heart of the regional park itself. This area is also the only portion of the TRFMA – Rock to McCarran Park that would not be inundated by floodwater, even in the most severe of projections. As such, these plans make use of this "high and dry" area to bring in play structures that cannot be used within the floodable areas of the regional park.

With all of these site factors, the Iconic Park is so named because it presents a unique opportunity to showcase the recreational zeal of the TRFMA – Rock to McCarran Park and is represented by a prominent, high elevation play structure featuring a 20' tall slide which mirrors the water cycle within the mountains of Lake Tahoe: the source of the Truckee River. To complement this towering slide structure are two additional play structures for the 2-5 and 5-12 age ranges with colors and theming paying homage to the Sierra Nevadas. Two shade structures designed to simulate clouds further immerse users into the rich theming of the alpine water cycle. Additionally, a 20'x20' restroom is included in this design as well as an iconic monument at the corner of Mill St. and Rock Blvd. further branding this area as a destination park of Northern Nevada. With the inclusion of the Linear Adventure Park within the recreational base, the entirety of the Iconic Park has been categorized as supplemental recreation.

Trail Network & River Access: A key goal of this park is to allow users intimate access to the Truckee River. As such, the trail network atop the berms and within the river corridor are critical to the successful operations of the park and, with consideration to the relatively affordable cost of trail building, are entirely included within the recreational base. Additional amenities such as the 3 River Access nodes and several seating nodes along the trail are also included within the recreational base.

The OPC can be found in Appendix H. The Engineer's OPC is shown below in Table 9 for the Rock to McCarran Reach Project design.

Table 9: Engineer's Opinion of Probable Cost

30% Opinion of Probable Cost Summary			
Project Cost	**Cost Category**	**Totals**	
Base	Mobilization/Demobilization (4%)	$	3,097,000
	Civil Site Work	$	57,029,000
	Transportation	$	7,810,000
	Recreation - Base	$	12,582,000
	Subtotal	**$**	**80,518,000**
	15% Contingency	$	12,078,000
	Total	$	92,596,000
Base + Supplemental	Mobilization/Demobilization – Supplemental (4%)	$	389,000
	Recreation - Supplemental	$	9,709,000
	Subtotal	**$**	**90,616,000**
	15% Contingency	$	13,593,000
	Total	$	104,209,000

Figure 25: 30% Design Cost Phasing Exhibit

Figure 26: 30% Design Recreational Base Amenities

Figure 27: 30% Design Recreational Supplemental Amenities

14.2 Quantity Methodology

14.2.1 Earthwork Volumes

Quantities for 30% design were calculated by replicating proposed Project terrain from HEC-RAS within Civil 3D, resulting in design surfaces shown in the 30% design plans. The centerlines of key features, such as levees, the internal berm, and access ramps, were exported as shapefiles from HEC-RAS and were imported into Civil 3D for replication. The complicated river grading completed in HEC-RAS was exported for processing in Civil 3D. Ultimately design surfaces needed to be tied to the existing survey surface, differing from the existing surface utilized in the HEC-RAS models. The Civil 3D drawings were set up in Ground coordinates based on survey data. Data from HEC-RAS was then converted from Grid to Ground basis.

The quantities were recorded and broken down per design feature, allowing for detailed analysis of each bid item. Based on geotechnical findings, it was assumed that approximately 70,000 CY of native material could be reused for levee construction. An estimated 220,000 CY was assumed to be repurposed as fill in the recreation area, with an additional ~69,400 CY of unsuitable material needing to be hauled offsite. Detailed bid items for civil site work are included in Appendix H.

14.2.2 Other Quantities

Nearly all other quantities were estimated using a combination of Civil 3D, GIS, and HEC-RAS supplemented with topography, aerial imagery, and survey data. Bank stabilization quantities were estimated based on revetment design using length, area, and depth of features in Civil 3D. Similarly, quantities for the demolition of buildings, structures, pavement, and utilities were estimated in Civil 3D based on recent aerial imagery and survey linework.

Utility removal and replacement quantities were estimated by interpreting the data received by utility owners in combination with survey data. The quality of the data received varied, so in some cases estimation for removal consisted only of tabulating pipe material, size, length, and appurtenant structures. Other utility data with less detail was used as practical. Generally, storm drain infrastructure was assumed to be removed and replaced, while other utilities were assumed to be removed only. The storm drain system discharging on the north side of the Project area contains an approximate 72" diameter pipe with a surge tank/standpipe upstream of the discharge location. In future design phases, more detailed utility costs will be estimated according to the features present in the Project area.

15.0 Limitations

- These evaluations and cost estimates are based on preliminary and conceptual designs and are subject to change following improved understanding of site conditions and flood management strategy, advancement of designs, and regional construction costs.
- The as-received PMR model results in a breakout at the Glendale Avenue bridge during the 117-yr flood event in the proposed condition. Project design elements may need to be adjusted when this is resolved.
- The design often includes options and alternate details allowing flexibility in future phases of design.
- In this study, minor encroachment of levees on private property was assumed, but limited to the extent possible. Costs were not estimated for the acquisition of the private property. The Project layout generally relies on publicly available Washoe County parcel information.
- Mitigation of reduced freeboard conditions at McCarran bridge was not considered in this study beyond the minor proposed channel modifications through the McCarran bridge opening.
- The OPC for the 30% design is a preliminary level estimate. Many of the details will be developed as the Project progresses. Of note, the following items were omitted:
    - Land purchase and right-of-way acquisition. Nearly all parcels within the Project area are owned by TRFMA or the City of Sparks. Acquisition of parcels that are privately owned, both in the Project area and surrounding the Project area, were not included in this study.
    - Selected utility and infrastructure removal and relocation. Costs for raw water well decommissioning, salvage, and relocation were not considered.
    - Highly specific levee details. Costs for pressure relief wells, detailed levee-adjacent drainage, and utility penetrations through levees were omitted at this stage of evaluation.
    - Costs for material sourcing and import to site. Costs for sourcing material such as required import for levee fill, trees and rootwads for habitat structures, and other select materials used in the 30% design are not represented in the opinion of probable cost.
    - Locations and type of revetment. Location and type of revetment features shown in the 30% design are approximate only and subject to change.
- Estimates of habitat/terraced areas, main channel, recreation area, and backwater channels are approximate, and are likely to change in future design phases.
- Final models omitted outflow structures that allowed storage areas to drain, as this was not considered important for the goals of this study.
- Final models were upgraded to HEC-RAS version 6.6. There may be potential changes in results between model versions, however based on limited review, any changes are not expected to be appreciable. Further as-received existing and proposed condition models were not rerun in version 6.6.
- Limited easement and right-of way research was conducted using record data found within the Washoe County Recorders website. Title Reports were not supplied to conduct a full assessment.

16.0 References

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